# ATTACHMENTS TO

# Environmental Assessment
# Determinations and Compliance Findings for HUD-assisted Projects
# 24 CFR Part 58

# Arcata Wastewater Treatment Facility Upgrades Project
# City of Arcata, California

**ATTACHMENTS**
*These documents are also available for review at the City of Arcata Community Development Department, 736 F Street, Arcata, CA 95521.*

**Attachment 1:** State Historic Preservation Officer Clearance. July 28, 2020.

**Attachment 2:** Bear River Band of Rohnerville Rancheria, Blue Lake Rancheria, and Wiyot Tribe. 2020. *E-mails from Wiyot Area Tribal Historic Preservation Officers (THPO) Erika Cooper of the Bear River Band of Rohnerville Rancheria, Jacob Pounds of the Blue Lake Rancheria, and Ted Hernandez of the Wiyot Tribe stating that the inadvertent discovery protocol for Native American archaeological deposits recommended in the Cultural Resources Study performed by DZC Archeology and Cultural Resource Management is sufficient.* July 9, 15 and 16.

**Attachment 3:** United State Environmental Protection Agency (EPA). 2020*. Sole Source Aquifers.* Available at: https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=9ebb047ba3ec41ada1877155fe31356b. Accessed on: 9/21/20

**Attachment 4:** Carollo Engineers. 2020. *Project Figures*.

**Attachment 5:** DZC Archeology and Cultural Resource Management. 2019. *Cultural Resource Assessment Report for the City of Arcata Wastewater Treatment Facilities Improvement Project*. November 2019.

**Attachment 6:** U.S. Census Bureau Website. 2019. *City of Arcata: Quick Facts*. Available at: www.factfinder.census.gov. Accessed on: 12/17/18.

**Attachment 7:** LACO Associates. August 28, 2018. *Geotechnical Exploration and Geologic Hazards Report Part One.*

**Attachment 8:** U.S. Environmental Protection Agency (EPA) Website. 2019. Environmental Justice Screening and Mapping Tool (EJSCREEN) – City of Arcata, CA. Available at: https://ejscreen.epa.gov/mapper/. Accessed on: 9/25/20

**Attachment 9:** Stillwater Sciences. April and August 2020. *Final Delineation of Waters and*

*Wetlands for the City of Arcata Wastewater Treatment Plant Improvement Project, California.*

**Attachment 10:** LACO Associates. 2017. *Engineering Geologic and Hydrogeologic Exploration Arcata Waste Water Treatment Plant, Arcata, Humboldt County, California.*

**Attachment 11:** Stillwater Sciences. August 2020. *Wetlands Impacts Assessment.*

**Attachment 12:** Humboldt County. 2020 *Humboldt County Web GIS – Airport Compatibility Zones. Available at: http://www.humboldtgov.org/1357/Web-GIS.* Accessed on: August 2020.

**Attachment 13:** National Wild and Scenic Rivers System Website. 2020. *California Designated Wild & Scenic Rivers.* Available at: www.rivers.gov/california.php. Accessed September 2020. Accessed 08/31/20.

**Attachment 14:** City of Arcata. 2000. *Excerpts from Air Quality Element of the Arcata General Plan.*

**Attachment 15:** Redwood Empire Municipal Insurance Fund. 2020. *Program Year 2020-2021 Memorandum of Coverage-Property.*

**Attachment 16:** Alliant Insurance Services. 2020. *Alliant Property Insurance Program Binder of Insurance.*

**Attachment 17:** City of Arcata. 2002. *Report of Findings for City of Arcata Corporation Yard Phase II Over Excavation and Stockpiling of Contaminated Soils and Proposed Groundwater Monitoring Well Installation.*

**Attachment 18:** City of Arcata. 2016. *Adopted Floodplain Ordinance.* Adopted 11/02/2016.

**Attachment 19:** Carollo Engineers. 2016. *City of Arcata Facility Plan.* Revised July 2017.

**Attachment 20:** City of Arcata. 2000. *Noise Element of the Arcata General Plan.*

**Attachment 21:** City of Arcata. 2000. *Land Use Element of the Arcata General Plan.*

**Attachment 22:** City of Arcata. 2010. Hazardous Materials Business Plan Modules for Use with CERS Electronic Reporting. Revised 12/14/10.

**Attachment 23:** City of Arcata. 2016. *City of Arcata Risk Management Plan.* Adopted January 11, 2016.

**Attachment 24:** Carollo Engineers. 2019. *City of Arcata Predesign Report.*

**Attachment 25:** City of Arcata. 2020. *Early Notice and Public Review of Proposed Activities in 100-Year Floodplain and Mapped Wetland Area.* Published 07/08/2020.

**Attachment 26:** North Coast Regional Water Quality Control Board. 2019. *Order No. R1-2019-0006. Waste Discharge Requirements for the City of Arcata Wastewater Treatment Facility, Humboldt County.* Signed 11/06/2019.

**Attachment 27:** City of Arcata. 2020. *Letter to California Coastal Commission Federal Consistency Division.* Sent 08/12/20.

**Attachment 28:** California Coastal Commission Federal Consistency Brach. 2020. *Federal Consistency Letter.*

**Attachment 29:** SHN Engineers. May 2020. *Soil and Groundwater Management Contingency Plan. Arcata Corp Yard, Arcata California, Case No. 1NHU767.*

**Attachment 30:** Federal Emergency Management Agency. 2017. *Flood Insurance Rate Maps.* Updated June 21, 2017.

**Attachment 31:** City of Arcata. September 2020. *Biological Assessment September 2020. City of Arcata-Wastewater Treatment Facility Upgrades Project.*

**Attachment 32:** City of Arcata. September 2020. *US Department of Housing and Urban Development: 8-Step Process. Arcata Wastewater Treatment Facility Upgrades Project-Arcata, CA.*

**Attachment 33:** North Coast Unified Air Quality Management District. 2015. Rule 110 – New Source Review (NSR) and Prevention of Significant Deterioration (PSD). Adopted 07/09/20.

**Attachment 34:** CAPCOA. 2017. *California Emission Estimator Model (CalEEMod). Version 2016.3.2*. Model for project used on: 8/7/20 and 9/15/20.

**Attachment 35:** North Coast Unified Air Quality Management District (NCUAQMD). 2020. *Website– Air Quality Planning & CEQA.* Available at:www.ncuaqmd.org/index.php?page=aqplanning.ceqa#T1. Accessed on: 9/15/20.

**Attachment 36:** U.S. Environmental Protection Agency (EPA) Website. 2020. *Current Nonattainment Counties for All Criteria Pollutants*. Available at: www.epa.gov/airquality/greenbook/ancl.html. Accessed on: 10/9/20.

**Attachment 37:** U.S. Environmental Protection Agency (EPA) Website. 2020. *General Conformity- De Minimis Tables*. Available at: https://www.epa.gov/general-conformity/deminimis-tables. Accessed on: 9/30/20.

**Attachment 38:** North Coast Regional Water Quality Control Board. *Email Correspondence regarding Site Closure*. October 19, 2020.

**Attachment 39:** City of Arcata. September 2020. *Final Notice and Public Explanation of a Proposed Activity in a Wetland*. Published 09/16/20.

# ATTACHMENT 1

*State Historic Preservation Officer*
*Clearance. July 28, 2020.*

State of California • Natural Resources Agency
Gavin Newsom, *Governor*

**DEPARTMENT OF PARKS AND RECREATION**
**OFFICE OF HISTORIC PRESERVATION**
Lisa Ann L. Mangat, *Director*

**Julianne Polanco, State Historic Preservation Officer**
**1725 23rd Street, Suite 100, Sacramento, CA 95816-7100**
**Telephone: (916) 445-7000 FAX: (916) 445-7053**
**calshpo.ohp@parks.ca.gov www.ohp.parks.ca.gov**

July 28, 2020
[VIA EMAIL]

Refer to HUD_2020_0723_001

Mr. David Loya
Community Development Director
City of Arcata
736 F Street
Arcata, CA 95521

Re: City of Arcata Wastewater Treatment Facility Improvements Project, Arcata, CA

Dear Mr. Loya:

The California State Historic Preservation Officer received the consultation submittal for the above referenced undertaking for our review and comment pursuant to Section 106 of the National Historic Preservation Act and its implementing regulations found at 36 CFR Part 800. The regulations and advisory materials are located at www.achp.gov.

Pursuant to 36 CFR §800.4(d) we do not object to the City of Arcata's finding that no historic properties will be affected by the proposed wastewater treatment facility improvements project. However, the City may have additional Section 106 responsibilities under certain circumstances set forth at 36 CFR Part 800. For example, in the event that historic properties are discovered during implementation of the undertaking, your agency is required to consult further pursuant to §800.13(b).

We appreciate the City of Arcata's consideration of historic properties in the project planning process. If you have questions please contact Shannon Lauchner Pries, Historian II, with the Local Government & Environmental Compliance Unit at (916)445-7013 or by email at shannon.pries@parks.ca.gov .

Note that we are only sending this letter in electronic format. Please confirm receipt of this letter. If you would like a hard copy mailed to you, respond to this email to request a hard copy be mailed.

Sincerely,

Julianne Polanco
State Historic Preservation Officer

# ATTACHMENT 2

*Formal Consultation with Bear River Band of Rohnerville Rancheria, Blue Lake Rancheria, and Wiyot Tribe. July 2020.*

| | |
|---|---|
| **From:** | Erika Cooper |
| **To:** | Delo Freitas |
| **Cc:** | Ted Hernandez; Janet Eidsness; Janet Eidsness; Jacob Pounds; Emily Benvie; Mark Andre; Hazel James; Jesse Lopez; Dimitra Zalarvis-Chase |
| **Subject:** | [EXTERNAL] Re: [EXTERNAL] Re: AB 52 Consultation for Arcata Wastewater Treatment Plant Upgrades - Blue Lake |
| **Date:** | Thursday, July 16, 2020 12:12:23 PM |

**CAUTION:** This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hello Delo,

I do not have any specific concerns about the project and agree with both Janet and Ted that inadvertent discovery protocols are sufficient moving forward.

Thanks.

Erika Cooper, M.A.
Tribal Historic Preservation Officer

Bear River Band of the Rohnerville Rancheria
266 Keisner Road
Loleta, CA 95551
707-733-1900 x233 Office
707-502-5233 Cell
707-733-1727 Fax
erikacooper@brb-nsn.gov

CONFIDENTIALITY STATEMENT: This message, together with any attachments is intended only for the use of the individual or entity to which it is addressed. It may contain information that is confidential and prohibited from disclosure. If you are not the intended recipient, you are hereby notified that any review, dissemination or copying of this message or any attachment is strictly prohibited. If you have received this item in error, please notify the original sender and destroy this item, along with any attachments. Thank you.

On Thu, Jul 16, 2020 at 8:15 AM Delo Freitas <dfreitas@cityofarcata.org> wrote:

> Thank you for your response, Ted!
>
> Hope everyone has a good Thursday.
>
> Delo
>
> ---
>
> **From:** Ted Hernandez <ted@wiyot.us>

**Sent:** Thursday, July 16, 2020 2:14:00 AM
**To:** Janet Eidsness; Janet Eidsness; Jacob Pounds; Emily Benvie
**Cc:** Erika Cooper; Mark Andre; Delo Freitas; Hazel James; Jesse Lopez; Dimitra Zalarvis-Chase
**Subject:** [EXTERNAL] Re: AB 52 Consultation for Arcata Wastewater Treatment Plant Upgrades - Blue Lake

**CAUTION:** This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hello everyone
I have had a chance to review this project. I to agree and concur with Janet on inadvertent discovery protocol for said project.

Ted Hernandez
Wiyot Chairman/Cultural Director
1000 Wiyot Drive
Loleta, CA., 95551
(707)733-5055

This communication, including any attachments, may contain privileged or confidential information intended for a specific individual and purpose, and is protected by law. If you are not the intended recipient, you should delete this communication and/or shred the materials and any attachments and are hereby notified that any disclosure, copying, or distribution of this communication, or the taking of any action based on it, is strictly prohibited. Hu' (thank you).

---

**From:** Janet Eidsness <jpeidsness@yahoo.com>
**Sent:** Wednesday, July 15, 2020 10:52:11 AM
**To:** Janet Eidsness <jeidsness@bluelakerancheria-nsn.gov>; Jacob Pounds <jpounds@bluelakerancheria-nsn.gov>; Emily Benvie <ebenvie@cityofarcata.org>
**Cc:** Erika Cooper <erikacooper@brb-nsn.gov>; Ted Hernandez <ted@wiyot.us>; Mark Andre <mandre@cityofarcata.org>; Delo Freitas <dfreitas@cityofarcata.org>; Hazel James <hazel@wiyot.us>; Jesse Lopez <jesselopez@brb-nsn.gov>; Dimitra Zalarvis-Chase <dimitrazc@gmail.com>
**Subject:** Re: AB 52 Consultation for Arcata Wastewater Treatment Plant Upgrades - Blue Lake

Emily, Mark and Delo,

I have reviewed the Nov. 2019 cultural resources study for the subject project prepared by DZC and find it very thorough. I have no knowledge of cultural resources in the project APE.

I concur with the recommendation that the Inadvertent Archaeological Discovery Protocol be made a project condition. As there are no Tribal Cultural Resources that will be affected by this project, the Blue Lake Rancheria decline the invitation for government consultation with the City of Arcata.

Regards,

JANET P. EIDSNESS, M.A. Tribal Historic Preservation Officer (THPO) for Blue Lake Rancheria HOME: 2488 Sonnenfelt Road, Bayside, CA 95524 (707) 825-0460 (VOICE), (530) 623-0663 (CELL) jpeidsness@yahoo.com

On Thursday, July 9, 2020, 03:09:05 PM PDT, Emily Benvie <ebenvie@cityofarcata.org> wrote:

Hi Janet & Jacob,

On behalf of Mark Andre, I have attached the AB52 consultation letter for the proposed Arcata Wastewater Treatment Plant Upgrades. The packet is quite large, so we will send the letter and maps by mail as hard copies. If you would like hard copies of any of the other technical reports, we are happy to send upon request. Also, the PDF of the complete packet is too large to attach all three packets in one email, so I apologize that you all will receive three emails regarding the same project. Please let us know if there is any other information on the project. Best,

Emily Benvie

Environmental Programs Manager

City of Arcata - Environmental Services

736 F Street  Arcata, CA 95521

(707) 825-2102

ebenvie@cityofarcata.org

City of ARCATA

736 F Street Arcata, California 95521

City Council 822-5953 | City Manager 822-5953 | Public Works 822-5957 | Police 822-2428
Community Development 822-5955 | Environmental Services 822-8184 | A&MRTS 822-3775
Finance 822-5951 | Recreation Division 822-7091 | FAX 822-8018

July 9, 2020

The Wiyot Tribe
Wiyot Drive
Loleta, CA 955551
Attn: Chairman Hernandez

FROM: Mark Andre, City of Arcata

RE: Tribal Cultural Resources under the California Environmental Quality Act, AB 52 (Gatto, 2014). Formal Notification of determination that a Project Application is Complete or Decision to Undertake a Project, and Notification of Consultation Opportunity, pursuant to Public Resources Code § 21080.3.1 (hereafter PRC).

Dear Chairman Hernandez:

The City of Arcata has decided to undertake the following project: Wastewater Treatment Facilities Improvement Project

Pursuant to PRC § 21080.3.1 (d), please find a description of the proposed project below; two maps showing the project location and Area of Potential Effect are enclosed; and the project point of contact is Mark Andre.

Also included with this consultation are the following documents:

1. A Cultural Resources Report for the project, prepared by DZC Archaeology and Cultural Resource Management, in November 2019
2. Part 1 of Geotechnical Exploration and Geologic Hazards Report, prepared by LACO Associates, which includes geologic cross sections
3. An Engineering Geologic and Hydrogeologic Exploration, prepared by LACO Associates, which includes information related to the soils and boring locations

Hard copies of the above documents (1-3) may be sent upon request.

Description of Proposed Project

The City of Arcata proposes to construct upgrades to the existing Arcata Wastewater Treatment Facility (Treatment Facility, or Facility) to update aging infrastructure and comply with the requirements of Regional Water Quality Control Board (RWQCB) Order No. 1-2019-0006. Ongoing preventative maintenance has kept the original treatment plant in operation but there has been little replacement of equipment or structures since original construction.

The Treatment Facility provides secondary treatment using natural processes including two oxidation ponds and six constructed wetland treatment marshes. Enhancement to the secondary treated water is provided by three enhancement marshes located in the Arcata Marsh Wildlife Sanctuary (Wildlife Sanctuary). The Treatment Facility currently includes headworks, primary clarifiers, oxidation ponds, treatment wetlands, enhancement wetlands, and chlorine disinfection. Treated effluent is discharged into the Humboldt Bay (Outfall 001) or is circulated into Enhancement Wetlands (Outfall 002) in the Wildlife Sanctuary for further treatment. Solids removed in the primary clarifier are treated in anaerobic digesters and solids drying beds.

Proposed upgrades include oxidation pond and wetland treatment system improvements, construction of a parallel oxidation ditch treatment system/secondary clarification, construction of an Ultraviolet (UV) disinfection system upstream of discharge to the Enhancement Marshes, and an updated Facility configuration allowing for discharges below 6 MGD to enter the newly created Brackish Marsh following treatment through the enhancement marshes to provide overall improvements to effluent quality discharged to Humboldt Bay/McDaniel slough.

The upgraded disinfection system will include a new UV System equipment which will be purchased with Community Development Block Grant (CDBG) funds, which requires this environmental assessment. The installation of the 9.8 MGD capacity UV disinfection system will replace the existing break point chlorination disinfection system utilizing chlorine gas (CL2) and sulfur dioxide (SO2). This will reduce the number of violations for dichlorobromomethane, a chlorine disinfection by-product. This byproduct has historically been one of the major environmental concerns with Arcata's treated effluent. The UV will also allow the City to dramatically reduce Cl2 and SO2 storage and usage and hopefully will be able to be entirely removed in phase 2.

The full scope of the upgrades will be undertaken in two separate phases, and will include the following elements:

*Phase 1* will focus on rehabilitation of the current system and reconfiguring the effluent flow to a single path. Rehabilitation will be done to the natural system facilities (i.e. ponds and the wetlands) and to the aging infrastructure. It will include replacing and installing new equipment (i.e. pumps, aerators and monitoring equipment), and increasing resilience of facilities for treatment and hydraulic capacities. Many of the activities associated with Phases 1 and 2 would be considered routine maintenance of the plant if evaluated as stand-alone activities.

Phase 1 includes:

- Excavation and contouring for improved water quality and maintenance at the outlet of the Hauser Enhancement Marsh.
- Laying new discharge pipe to the new Outfall 003 in the brackish marsh from the existing Hauser pump station.
- Replacing aged equipment (screw pumps, bar screen and grit chamber reconstruction/rehabilitation) in the existing headworks structure foot print.

- Installation of a 9.8 MGD ultra-violet UV disinfection system into one half of the existing chlorine contact basin (CCB), eliminating the use of chlorine gas and sulfur dioxide for disinfection except in an emergency disinfection scenarios (flows > 9.8 MGD) or if emergency electrical power was interrupted.
- Replacement of existing clarifier no.2 rotating center armature/skimmer, various flow configuration improvements throughout the system for automation and creating a higher quality effluent.
- Placement of up to 24 new 12.5 Hp mixer aerators to improve treatment within the oxidation pond 2.
- Replacement/upgrading of aboveground vertical pumping stations within the plant and at Hauser Marsh pump station with submersible variable speed pumping systems.
- Installation of new SCADA and plant control and monitoring system for all AWTF operations to be constructed within the existing centralized control room.
- Construction of new building for the placement of new electrical services, PGE connection and switch gear including a diesel powered emergency generator rated at 0.75 MW and removal of an existing natural gas powered 150 KW generator.
- Placement of structural fill up to 1.5' deep to elevate the existing 16' wide roadway between The Hauser Treatment Marsh and Gearheart Treatment Marsh to minimum height of 8.0'.
- Adding additional photovoltaic panels to existing facility roofs.
- Raise levees to meet minimum FEMA and City requirements for construction of new/rehabilitated facilities.

*Phase 2* will focus on constructing the additional secondary treatment system, as well additional site improvements within the AWTF and the City of Arcata Corp Yard. In general Phase 2 builds on the performance of Phase 1 improvements.

Phase 2 includes construction of all the additional facilities needed for the parallel secondary treatment facility, including:

- Construction of the new oxidation ditch.
- Construction of two new secondary clarifiers and pumping for the return activated sludge (RAS) and the waste activated sludge (WAS).
- If determined necessary, following ongoing Phase 1 performance, an alkalinity feed system may be constructed within the existing developed AWTF.
- The large footprint of the preferred design will require relocation of some of the AWTF facilities ties within the project area.

Excavation depths of various project elements vary but are limited to eight (8) feet, with the exception of the piles necessary to secure the headworks improvements, clarifier center mount and electrical building Maximum depth 85' with 3' diameter drilled piers.

The majority of ground-disturbing activity will involve laying new discharge pipe and electrical conduit; both activities will only require ground disturbance of up to four (4) feet. All ground-disturbing activity in the APE will occur south of Samoa Boulevard, which loosely demarcates

the historic perimeter of Humboldt Bay. **Refer to the LACO Geohazards Report for more information on soils in the project area.**

Additionally, the following table may be helpful in evaluating different elements of the project, though construction depths will be draft until the final design of the project is complete:

## 1.1 Project Description

A list of improvement components, along with anticipated dimension, foundation elevations, loads, and occupancy categories is presented in Table 1. The location of these improvements are shown on Site Plan, Figure 2.

*Table 1. Improvement Component Locations*

| Improvement Component | Anticipated Plan Dimensions (feet) | Anticipated Foundation Depth (feet) | Anticipated Foundation Loads (ksf) | Occupancy Category |
|---|---|---|---|---|
| Headworks | 22 x 52 | 3.3 | 2.5 | 3 |
| Headworks | 17 x 15 | -1.9 | 2 | 3 |
| Oxidation ditch | 65 x 266 | 1.5 | 2 | 3 |
| Secondary Clarifier (2) | 75 (diameter) | -3.8 | 2 | 3 |
| UV Disinfection channels and canopy | 14 x 58 | 6 | 2 | 3 |
| Thickener – at grade portion | 20 x 25 | 8 | 1.5 | 3 |
| Thickener – below grade portion | 22 x 15 | 5 | 1.5 | 3 |
| Chemical storage facility | 20 x 50 | 8 | 1.5 | 3 |
| New Electrical Building | 24 x 37 | 8 | 1.5 | 3 |
| New Generator | 5 x 12 | 8 | 1.5 | 3 |
| New Transformer | 5 x 5 | 8 | 1.5 | 3 |
| New ML Flow Split Structure | 29 x 22 | 6.3 | 2 | 3 |
| New RAS Pump Station | 26 x 40 | -3.8 | 1.5 | 3 |
| New WAS Pump Station | 18 x 18 | 8 | 1.5 | 3 |

DRAFT

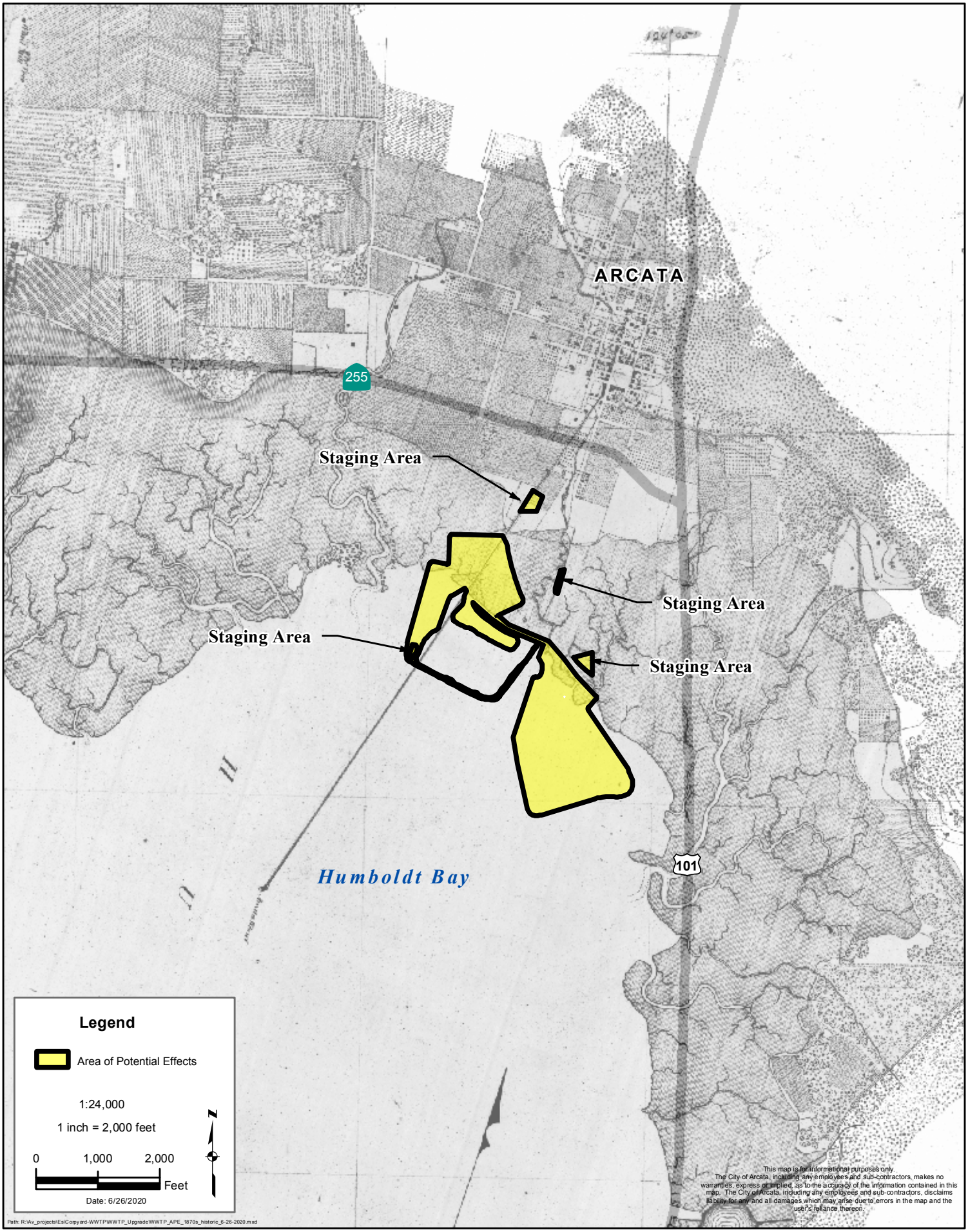
Pursuant to PRC § 21080.3.1 (b), you have 30 days from the receipt of this letter to request consultation, in writing, with the City of Arcata.

Very Respectfully,

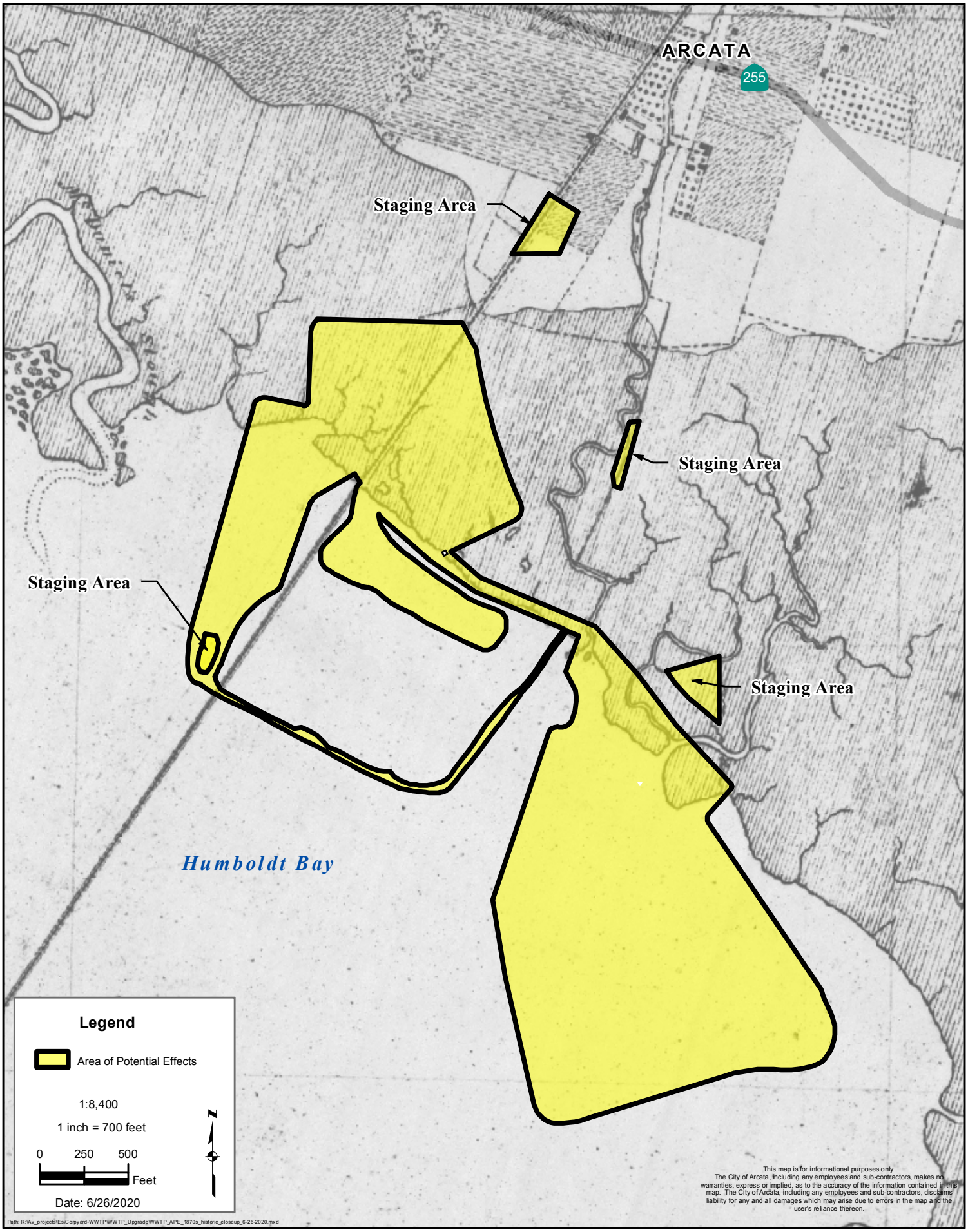
Mark Andre, Director Environmental Services
City of Arcata
707-822-8184
mandre@cityofarcata.org

# Area of Potential Effects & 1870 US Coast Survey

# Area of Potential Effects & 1870 US Coast Survey
# Arcata Wastewater Treatment Upgrade



# Area of Potential Effects & 1870 US Coast Survey
# Arcata Wastewater Treatment Upgrade



# Cultural Resource Assessment Report for the City of Arcata Wastewater Treatment Facilities Improvement Project

# CULTURAL RESOURCE ASSESSMENT REPORT FOR THE CITY OF ARCATA WASTEWATER TREATMENT FACILITIES IMPROVEMENT PROJECT,

## ARCATA, HUMBOLDT COUNTY, CALIFORNIA



**Submitted to:**

**City of Arcata**
**Arcata City Hall**
**736 F Street**
**Arcata, CA 95521**

**Prepared for:**

City of Arcata
Arcata City Hall
736 F Street
Arcata, CA 95521

**Prepared by** :

Dimitra Zalarvis-Chase, M.A., RPA
Sydney Kerkhove-Peltier, B.A.
Jaques Kerkhove-Peltier, M.A.
Kelly Hollreiser, B.A. Author

DZC Archaeology & Cultural Resource Management

455 I Street, Suite 204 Arcata, Ca 95521

November 2019

# CULTURAL RESOURCE ASSESSMENT REPORT FOR THE CITY OF ARCATA WASTEWATER TREATMENT FACILITIES IMPROVEMENT PROJECT, ARCATA, HUMBOLDT COUNTY, CALIFORNIA

---

**SUBMITTED TO:**

City of Arcata
Arcata City Hall
736 F Street
Arcata, CA 95521

**PREPARED FOR:**

City of Arcata
Arcata City Hall
736 F Street
Arcata, CA 95521

**PREPARED BY:**

Dimitra Zalarvis-Chase, M.A., RPA
Sydney Kerkhove-Peltier, B.A.
Jaques Kerkhove-Peltier, M.A.
Kelly Hollreiser, B.A.

November 2019

USGS 7.5-Minute Series Arcata South Quadrangle;
Township 6 North, Range 1 West, Section 32; Township 5 North, Range 1 East, Unsectioned; 123-acre study area

**Keywords:**
City of Arcata, Arcata Wastewater Treatment Facilities Improvements, Arcata Marsh Wildlife Sanctuary, State Water Resources Control Board, North Coast Regional Water Quality Control Board, National Pollutant Discharge Elimination System permit, Arcata and Mad River Railroad/Union Wharf and Plank Walk Company

*STATEMENT OF CONFIDENTIALITY*

***This document is not for public distribution.*** ***This report identifies the locations of cultural resource sites. Disclosure of this information to the public may be in violation of both federal and state laws. Applicable United States laws include, but may not be limited to, Section 304 of the National Historic Preservation Act (NHPA) (16 U.S.C. 470w-3), the Archaeological Resources Protection Act (ARPA) [16 U.S.C. Section 9(a) and Section 470(hh)], and Executive Order 13007. In California, such laws include, but may not be limited to, Government Code Section 6254.10. Site location information is confidential and is not for public disclosure.***

***Additionally, records maintained or in the possession of the Native American Heritage Commission or state and local agencies that are exempt from public disclosure include those that contain information on Native American graves, cemeteries, and sacred places, and include records obtained during consultation with Native Americans (California Government Code §6254(r) and §6254.10).***

*LIMITATIONS STATEMENT*

***This report has been prepared based on certain key assumptions made by DZC Archaeology & Cultural Resource Consulting, LLC (DZC) that substantially affect the conclusions and recommendations of this report. These assumptions, although thought to be reasonable and appropriate, may not prove to be true in the future. The conclusions and recommendations of DZC are conditioned upon these assumptions.***

***These assumptions include confidential information provided by the Native American Heritage commission on September 10, 2019, by the Northwest Information Center on July 19, 2019, and by direct observation of site conditions and other information that is generally applicable as of October 9, 2019. The conclusions and recommendations herein are therefore applicable only to that timeframe. Information obtained from these sources in this timeframe is assumed to be correct and complete. DZC will not assume any liability for findings or lack of findings based upon misrepresentation of information presented to the project team or for items not visible, made available, accessible, or present at the site at the time of the Project site survey.***

# MANAGEMENT SUMMARY

This report details the results of a Phase I Cultural Resources Inventory conducted by DZC Archaeology & Cultural Resource Consulting, LLC (DZC) on portions of Humboldt County Accessor's Parcel Numbers (APN) 503-241-010, 503-232-013, 503-251-012, 503-211-026, 503-241-016, 503-251-009, 503-241-011, 503-241-013, 503-211-005, 503-241-012, and one unnumbered parcel. The parcels combined represent the City of Arcata Wastewater Treatment Facility (AWTF) and City Corporate Yard. The City of Arcata retained DZC to conduct the inventory in support of a National Pollutant Discharge Elimination System (NPDES) permit through the North Coast Regional Water Quality Control Board (NCRWQCB).

Approximately 123 acres comprise the Area of Potential Effects (APE), located in the City of Arcata, Humboldt County, California. The legal location of the APE is Township 6 North, Range 1 West, Section 32, and Township 5 North, Range 1 East Unsectioned, of the Arcata South 7.5-Minute USGS Quadrangle (Humboldt Baseline Meridian). The Environmental Study Limits (ESL) constitute a 0.5 mile radius around the APE.

The City of Arcata is the Lead Agency providing regulatory oversight for the permitting process. The purpose of this cultural resources inventory is to satisfy the requirements of the National Environmental Policy Act (NEPA) of 1969, Section 106 of the National Historic Preservation Act (NHPA) of 1966, and the California Environmental Quality Act (CEQA) of 1970 (all as amended), and the City of Arcata Historical Preservation Element.

In advance of a field survey of the APE, DZC completed historical research for the APE and ESL at the Northwest Information Center of the California Historic Resources Information System (NWIC). The review identified 16 previously conducted archaeological surveys of interest: 10 surveys within the APE, and six outside the APE but either partially or completely within the ESL. Five previously recorded resources were identified within the ESL and one within the APE. The geoarchaeological research indicated a low potential for buried and surface prehistoric resources, and a moderate potential for buried and surficial historical resources within the APE.

A field survey of the APE was undertaken on October 9th, 2019, and November 5th, 2019, by Dimitra Zalarvis-Chase, M.A., RPA a U.S. Secretary of the Interior qualified archaeologist and staff archaeologist Kelly Hollreiser (B.A.). Of the 123 acres, 75 acres were intensively surveyed in transects of 15 meters or less. Approximately 48 acres within the APE are unsurveyable ponds, wetlands, and marshes. Impediments to ground visibility included dense vegetation, imported gravels, and paved areas. The surface scrapes were utilized where visibility was poor.

One built environment complex, the AWTF, and a mapped alignment of a California Historical Landmark (CHL) No.842 (The Arcata and Mad River Railroad/Union Wharf and Plank Walk Company) are present within the APE. The AWTF was determined ineligible for the National Register of Historic Places in 2006. Portions of CHL No.842 within the APE are limited to a historically mapped alignment; the remaining physical elements are located outside of and immediately adjacent to the APE.

This report recommends a Finding of No Impacts to historical, archaeological, or tribal cultural resources, as defined by CEQA, and a Finding of No Effects, as defined by NEPA. It is best practice to avoid cultural resources whenever possible. Additional survey will be required if the project changes to include areas not previously surveyed.

# CONTENTS


STATEMENT OF CONFIDENTIALITY ..... ii

LIMITATIONS STATEMENT ..... ii

1.0 Introduction ..... 1

1.1 Project Description ..... 1

1.2 Project Location ..... 1

1.3 Delineation of the APE & ESL ..... 1

2.0 Regulatory Setting ..... 4

2.1 State ..... 4

2.1.1 California Environmental Quality Act (CEQA) ..... 5

2.1.2 Clean Water State Revolving Fund (CWSRF) Program ..... 5

2.1.3 Assembly Bill 52 (AB 52) Native American Consultation & CEQA ..... 6

2.2 Humboldt County ..... 6

2.2.1 Goals ..... 6

2.2.2 Policies ..... 6

2.3 City of Arcata Historical Preservation ..... 7

3.0 Setting ..... 8

3.1 Natural setting ..... 8

3.2 Cultural Setting ..... 8

3.3 Ethnographic Background ..... 10

3.4 Historical Background ..... 11

4.0 Methods ..... 13

4.1 NWIC Archival Record Search Results ..... 13

4.1.1 Previously Recorded Cultural Resources within the APE and ESL ..... 14

4.1.2 Prior Cultural Resource Studies within the APE and ESL ..... 14

4.2 Native American Coordination ..... 17

4.3 Parcel Specific History ..... 18

4.3.1 Initial Land Ownership and Development ..... 18

4.3.2 APE Parcel Specific Topographic Maps and Aerial Photographs ..... 19

4.3.3 The Arcata Marsh - Environmental Innovation ..... 21

4.4 Geoarchaeological Research ..... 21

4.4.1 Hydrology of the ESL ..... 22

4.5 Cultural Resource Survey Expectations ..... 23

5.0 Report of Findings ..... 23
5.1 Archaeological Survey Results ..... 23
6.0 Resource Discussion ..... 24
6.1 Resource Evaluation Criteria ..... 24
6.1.1 National Register of Historic Places ..... 24
6.1.2 California Register of Historical Resources ..... 24
6.2 Resource Evaluation ..... 25
6.2.1 AWTF Infrastucture ..... 25
6.2.2 Arcata and Mad River Railroad/union Wharf and Plank Walk Company – California Historic Landmark No. 842 (CHL 842) ..... 26
7.0 Recommendations and Conclusions ..... 27
7.1 CEQA - Finding of No Impacts ..... 27
7.2 NEPA – Finding of No Effects to Historic Properties ..... 27
7.3 Native American Consultation & Coordination ..... 27
7.4 Management Considerations ..... 28
8.0 References ..... 29

Appendix A – Project Maps
Appendix B – Northwest Information Center Correspondance
Appendix C – Native American Coordination
Appendix D – Historical Documents
Appendix E – Project Location Photos
Appendix F – CONFIDENTIAL Resource Location Map

## FIGURES

Figure 1 Project Vicnity ..... 2
Figure 2 Project Location ..... 3
Figure 3. Borax Wide Stem Type of the Borax Lake Pattern (Figure 13 from Justice 2002: 104). ..... 9
Figure 4. Tuluwat Pattern distribution (Map 53 from Justice 2002: 417). ..... 10
Figure 5. Aerial view of Union (Arcata) and the Union Wharf circa 1947 ..... 13
Figure 6. Northeastern shore of Humboldt Bay circa 1865 (Doolittle 1865) ..... 18
Figure 7. Northeastern shore of Humboldt Bay circa 1922 (Belcher Abstract Title Company). ..... 19

## TABLES

Table 1. Project location descriptions. ..... 4
Table 2. Previously recorded resources within the APE and ESL. ..... 14
Table 3. Previous reports within the ESL. ..... 15
Table 4. State volume patents and serial patents within the project APE and ESL. ..... 19

# TABLE OF ABBREVIATED TERMS

| | |
|---|---|
| AB 52 | Assembly Bill 52 |
| APE | Area of Potential Effects |
| ac | Acres |
| APN | Assessor's Parcel Number |
| ARPA | Archaeological Resources Protection Act |
| AWTF | Arcata Wastewater Treatment Facility |
| Caltrans | California Department of Transportations |
| CCR | California Code of Regulations |
| City | City of Arcata |
| CEQA | California Environmental Quality Act |
| CFR | Code of Federal Regulations |
| CHL | California Historic Landmark |
| CHRIS | California Historic Resources Information System |
| CRHC | California Register of Historical Resources |
| CWSRF | Clean Water State Revolving Fund |
| DZC | DZC Archaeology & Cultural Resource Consulting |
| DHPE | Design and Historical Preservation Element |
| ESL | Environmental Study Limits |
| FEMA | Federal Emergency Management Agency |
| HBWA | Humboldt Bay Wastewater Authority |
| NAHC | Native American Heritage Commission |
| NCA | Neighborhood Conservation Areas |
| NEPA | National Environmental Policy Act |
| NETR | National Environmental Title Research |
| NHPA | National Historic Preservation Act |
| NPDES | National Polluant Discharge Elimination System |
| NRHP | National Register of Historic Places |
| NWIC | Northwest Information System |
| PRC | Public Resource Code |
| NCRWQCB | North Coast Regional Water Quality Control Board |
| SWRCB | State Water Resources Control Board |
| TCP | Traditional Cultural Property |
| USEPA | United States Environmental Protection Agency |
| USGS | United States Geological Survey |

# 1.0 INTRODUCTION

## 1.1 PROJECT DESCRIPTION

The City of Arcata Wastewater Treatment Facilities (AWTF) Improvements Project aims to improve local water management facilities by addressing National Pollutant Discharge Elimination System (NPDES) requirements for wastewater treatment in Arcata, California (City of Arcata 2019). The goals of the project are to address sea level rise and long-term community requirements through improvements to current and future infrastructure at the AWTF. The project will be completed in two phases and will include improvements to oxidation ponds, treatment wetlands, and other infrastructure at their northern Humboldt Bay location (Appendix A, Figures A1-A4).

The city of Arcata retained DZC Archaeology & Cultural Resource Consulting, LLC (DZC) to conduct a cultural resource investigation of the AWTF Improvements Project to support compliance of State and Federal regulations regarding cultural resources, Native American resources, and historic properties. DZC is an environmental consulting firm with over 10 years of experience with projects throughout northern California. DZC conducts cultural resource studies in accordance with the Secretary of the Interior's standards and in compliance with all applicable federal, state, and local codes, acts, regulations, and orders relating to cultural resources, where applicable. This cultural resources inventory report was prepared by Dimitra Zalarvis-Chase, a Registered Professional Archaeologist, who meets the Department of the Interior's Professional Qualifications Standards in Prehistoric and Historic Archaeology, with contributions by Sydney Kerkhove-Peltier, B.A., Jaques Kerkhove-Peltier, M.A., and Kelly Hollreiser, B.A.

## 1.2 PROJECT LOCATION

The 123-acre (ac) project area is situated in Humboldt County, California, along the northern shoreline of Humboldt Bay and south of Humboldt State University (Figure 1). The legal location of the project area is Township 6 North, Range 1 East, Section 32; Township 5 North, Range 1 East, Unsectioned; Humboldt Base Meridian, of the United States Geological Survey (USGS) Arcata South 7.5-Minute Series (1959) Quadrangle (Figure 2).

## 1.3 DELINEATION OF THE APE & ESL

The physical location with the potential for impact to archaeological resources is designated as the Area of Potential Effects (APE). The Environmental Study Limits (ESL) for the project area constitutes an additional 0.5-mi background review radius around the APE.

An APE varies depending on the potential impacts of the project, the type of environmental clearance required, and the Lead Agency. The 123 ac area constitutes the APE for this project. The proposed project must meet National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) standards, as the project requires a permit from the North Coast Regional Water Quality Control Board (NCRWQCB), funded by the Clean Water State Revolving Fund (CWSRF), a federal financing program discussed further in Section 2.1.1 of this report.

Horizontal boundaries for the APE were provided to DZC by the City of Arcata. The APE is composed of four separate study units, including four staging areas (Figure 2, Table 1). Unit 1 (Staging Area 1) measures 388 ft (north-south) by 300 ft (east-west); Unit 2 (Staging Area 2) measures 466 ft (north-south) by 139 ft

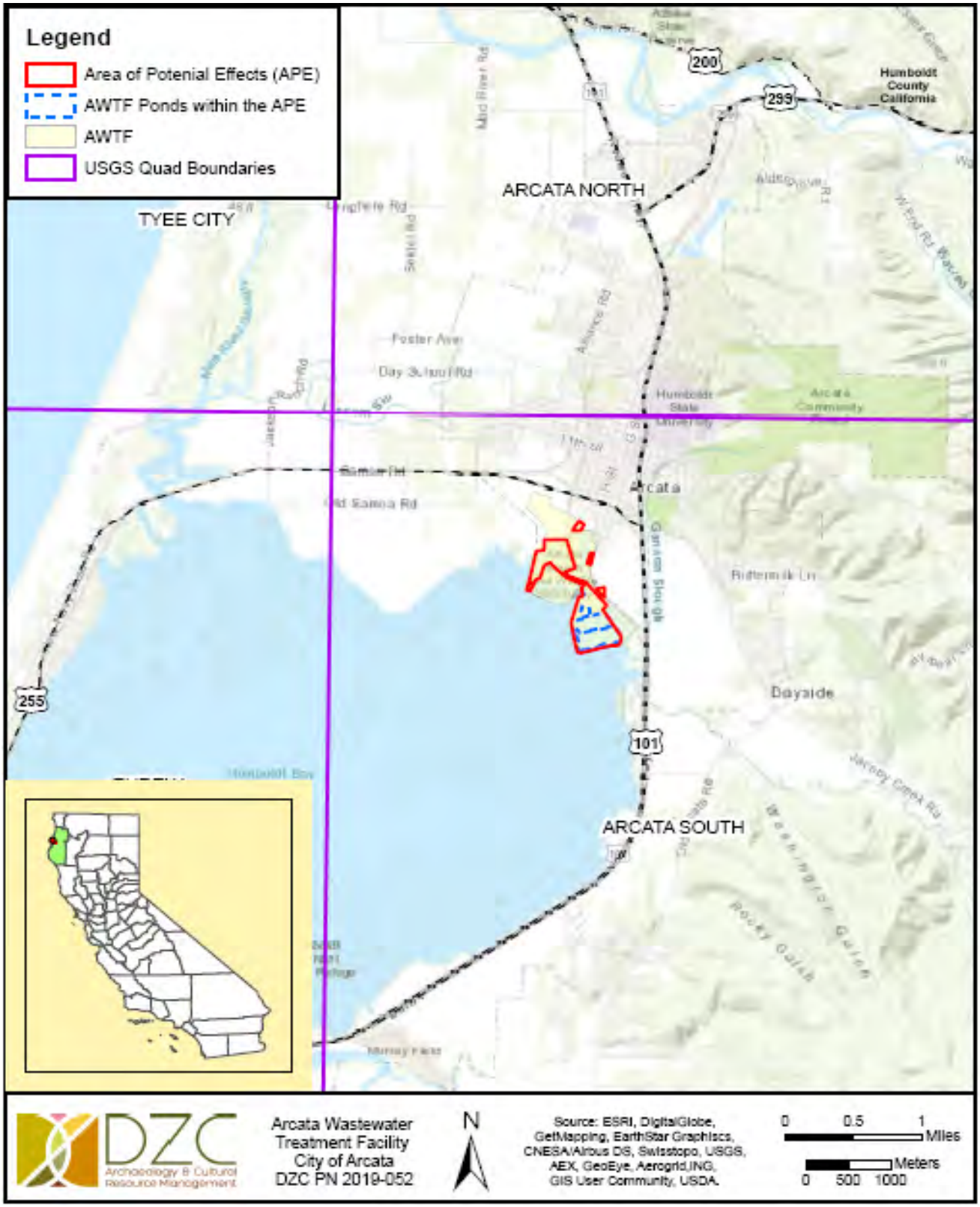



**Figure 1 Project Vicinity**

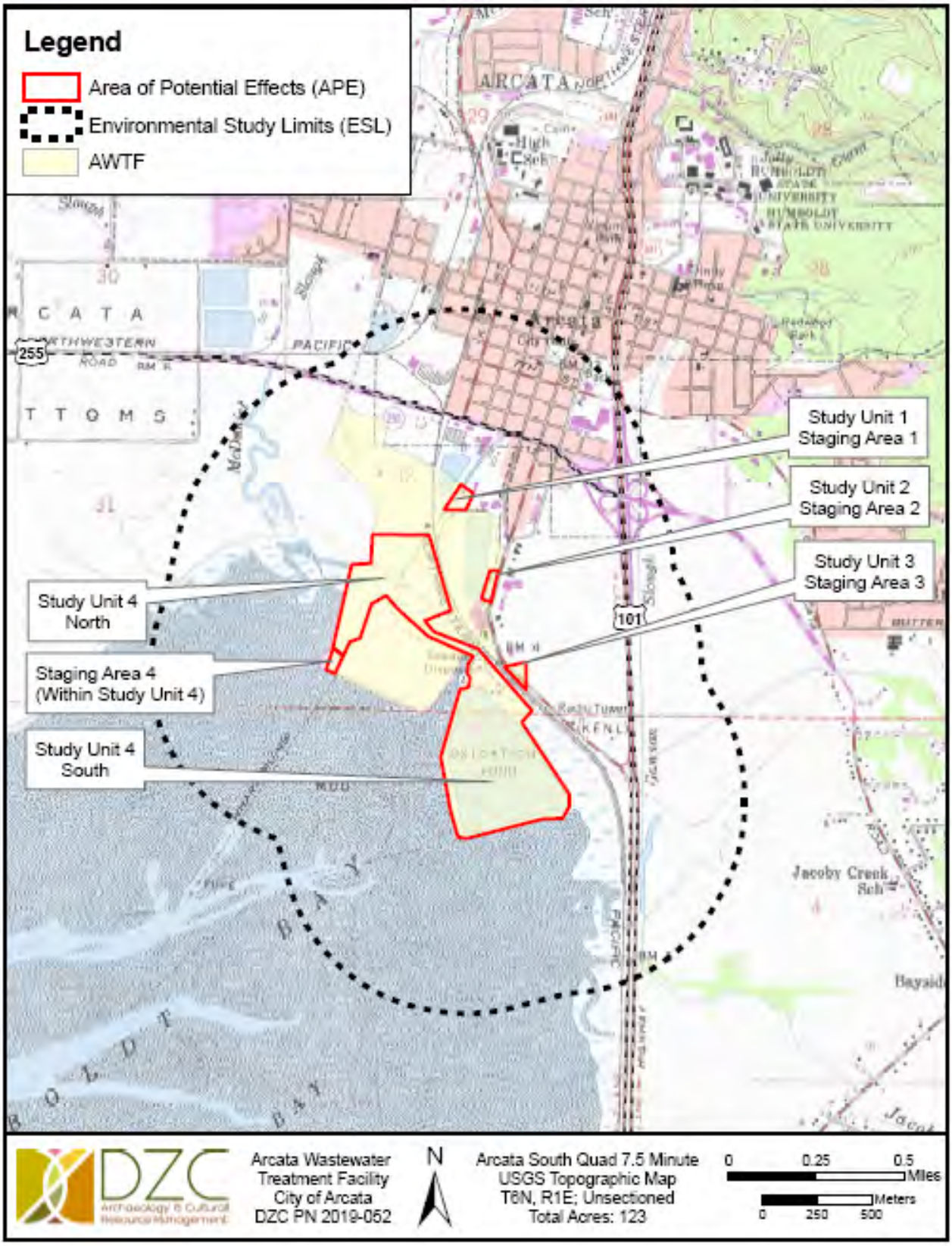



**Figure 2 Project Location**

(east-west); Unit 3 (Staging Area 3) measures 288 ft (north-south) by 302 ft (east west); and Unit 4 (Staging Area 4) measures 257 ft (north-south) by 168 ft (east-west). Staging Area 4 is completely encompassed in the northern section of the largest APE polygon. Unit 5 is the largest area, consisting of northern and southern sections. It also encompasses Staging Area 4. The horizontal boundaries of the northern section of APE Unit 5 measure approximately 2,173 ft (north-south) by 1,495 ft (east-west). The horizontal boundaries of the southern section measure approximately 2,520 ft (north-south) by 1,827-ft (east west).

**Table 1. Project location descriptions.**

| APE Study Unit | Legal Location | AWTF Association | Acreage |
|---|---|---|---|
| **1** | Arcata South Quad T6N, R1E, Section 32 | Staging Area 1 | 2.1 acres |
| **2** | Arcata South Quad T6N, R1E, Section 32 | Staging Area 2 | 1.5 acres |
| **3** | Arcata South Quad T6N, R1E, Section 32 | Staging Area 3 | 1.5 acres |
| **4** | Arcata South Quad T6N, R1E, Section 32 | Staging Area 4 | 1.1 acres |
| **4** | Arcata South Quad T6N, R1E, Section 32; T5N, R1E, Unsectioned | Arcata Marsh; Treatment Ponds; City Yard | 117 acres |

DZC did not have access to the structural engineering designs for the AWTF project, and therefore the vertical APE for this study is based limited information concerning the types and diameters of pipes that are proposed to be installed (Appendix A, Figures A-3 through A-6). The largest of these is 30 inches (in.) in diameter, and therefore the expected vertical excavation depth would be approximately 3-5 ft below the ground surface. The vertical APE is expected to range from -5 ft below to approximately +10 ft above the ground surface.

It is highly desirable to conduct all surveys prior to ground disturbance. However, ground disturbance in the form of grading, facilities and levee construction, and pond, marsh, and wetland excavations all occurred on site prior to the archaeological survey.

# 2.0 Regulatory Setting

## 2.1 State

The following sections discuss the regulatory guidelines for this Cultural Assessment Report.

### 2.1.1 California Environmental Quality Act (CEQA)

The lead agency for this project is the City of Arcata. CEQA requires a lead agency to determine whether a project may have a significant effect on historical resources (Section 21084.1). If it can be demonstrated that a project will cause damage to resources Eligible for or Listed in the California Register of Historical Resources (CRHR), Tribal Cultural Resources (TCRs), and other resources on county or local lists, or those determined by the lead agency to be significant, the lead agency may require reasonable efforts be made to permit any or all of the resources to be preserved in place or left in an undisturbed state. To the extent that they cannot be left undisturbed, mitigation measures are required (Section 21083.2[a], [b], and [c]).

A historical resource is a resource listed, or determined to be eligible for listing, in the CRHR (Section 21084.1); in a local register of historical resources (Section 15064.5[a][2]); or any object, building, structure, site, area, place, record, or manuscript that a lead agency determines to be historically significant (Section 15064.5[a][3]).

Public Resource Code (PRC) Section 5024.1, Section 15064.5 of the CEQA Guidelines, and PRC Sections 21083.2 and 21084.1 were used as the basic guidelines for this cultural resources study. PRC Section 5024.1 requires an evaluation of historical resources to determine their eligibility for listing in the CRHR. The purpose of the register is to maintain listings of the state's historical resources and to indicate which properties are to be protected from substantial adverse change. The criteria for listing resources on the CRHR were expressly developed to be in accordance with previously established criteria developed for listing in the National Register of Historic Places (NRHP), enumerated below.

According to PRC Section 5024.1(c) (1–4), a resource is considered historically significant if it (i) retains "substantial integrity," and (ii) meets at least one of the following criteria:

1. Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;
2. Is associated with the lives of persons important in our past;
3. Embodies the distinctive characteristics of a type, period, region or method of installation, or represents the work of an important creative individual, or possesses high artistic values; or
4. Has yielded, or may be likely to yield, information important in prehistory or history.

Impacts to significant cultural resources that affect the characteristics of any resource that qualify it for the NRHP or adversely alter the significance of a resource listed on or eligible for listing in the CRHR are considered a significant effect on the environment. These impacts could result from "physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of an historical resource would be materially impaired" (CEQA Guidelines, Section 15064.5 [b] [1], 2000). Material impairment is defined as demolition or alteration "in an adverse manner [of] those characteristics of an historical resource that convey its historical significance and that justify its inclusion in, or eligibility for inclusion in, the California Register…" (CEQA Guidelines Section 15064.5[b] [2] [A]).

### 2.1.2 Clean Water State Revolving Fund (CWSRF) Program

The CWSRF program is partially funded by the United States Environmental Protection Agency (USEPA) that provides low- interest financing and is administered by the Division under the California State Water Resources Control Board (SWRCB). The purpose of the CWSRF Program is to implement the Clean Water

Act and various state laws by providing low-interest financing for construction and improvement of wastewater treatment facilities.

Due to the federal nexus with USEPA, federal laws and regulations (e.g. federal cross-cutters) apply to all projects pursuing CWSRF financing. Under the CWSRF program, the Division under the State Water Board uses the CEQA document plus the federal cross-cutting documentation in place of a National Environmental Policy Act (NEPA) documents, which is defined "CEQA_Plus" documentation. The State Water Board does not complete a NEPA review process, but rather completes the "NEPA-like" process of CEQA-Plus.

#### 2.1.3 Assembly Bill 52 (AB 52) Native American Consultation & CEQA

In 2016, CEQA established a consultation process with all California Native American Tribes, including both federally and non-federally recognized tribes that are historically connected and culturally affiliated with the project location. This bill has established the TCR classification and requires consideration of Tribal Cultural Values in determination of project impacts and mitigation, requires tribal notice of the project, and requires meaningful consultation.

In accordance with PRC Section 21080.3.2(b), consultation ends when either both parties agree to mitigation measures, other agreements to avoid a significant effect on TCR's, or, when a party, acting in good faith and after reasonable effort concludes that mutual agreement cannot be reached.

### 2.2 Humboldt County

Approved by the County in May of 2012, Section 10.6 of the General Plan, Cultural Resources of the Humboldt County Conservation and Open Space Element Chapter, provides general guidance for the protection of cultural and paleontological resources within the County. Section 10.6.3 outlines the goals and policies of the County:

#### 2.2.1 Goals

CU-G1: Protection and Enhancement of Cultural Resources. Protected and enhanced significant cultural resources, providing heritage, historic, scientific, educational, social and economic values to benefit to present and future generations.

#### 2.2.2 Policies

CU-P1: Identification and Protection. The potential for significant impacts to cultural resources shall be identified during ministerial and discretionary permit review, assessed as to significance, and if found to be significant, protected from substantial adverse change.

CU-P2: Consultation. Native American Tribes (as defined), historical organizations, other interested parties, and applicable agencies shall be consulted during discretionary project review for the identification, and protection and mitigation of adverse impacts to cultural resources. Consultation on ministerial permits shall be initiated if it has been determined the project may create a substantial adverse change in the significance of a cultural resource. At their request, Tribes shall be afforded the opportunity to review and provide comments to the County early in project review and planning (screening) about known or potential significant Native American cultural resources located in project areas within their respective tribal geographical area of concern.

CU-P3: Avoid Loss or Degradation. Projects located in areas known to have historic or prehistoric ruins, burial grounds, or archeological sites shall be conditioned and designed to avoid loss or substantial degradation of these resources, including standard provisions for post-review inadvertent discoveries of archaeological or Native American remains.

CU-P4: Findings Necessary for Loss or Destruction. Cultural resources shall not be knowingly destroyed or lost through a ministerial or discretionary action unless:

1. The site or resource has been found not to be of significant value after consultation by representatives of the cultural resources community and relevant experts; or
2. There is an overriding public benefit from the project, and compensating mitigation to offset the loss is made part of the project.

CU-P5: Mitigation. Mitigation measures shall be required for any permitted project or County action that would adversely impact significant cultural resources

The General Plan also includes recommendations for implementation of these goals and policies:

- Adopt procedures for review and approval of all City-permitted projects involving ground disturbance and all building and/or demolition permits that will affect buildings, structures, or objects "identified as historically significant" (City of Eureka 1997b:5-8).
- Adopt preservation incentive programs, including the Mills Act, Historic Preservation Easement program, and Certified Local Government Program.
- "Preparation, adoption, and implementation of a cultural resources ordinance that provides definitions and standards for identification and protection of cultural resources and provides penalties for their disturbance" (City of Eureka 1997b:5-8).
- Preparation and updating of a citywide cultural resource database.

The General Plan also designates Neighborhood Conservation Areas (NCAs) within the city of Arcata as areas that are historically noteworthy where review is conducted to assure that new construction, modifications or alterations are harmonious with the existing character of the neighborhood.

## 2.3 City of Arcata Historical Preservation

The City of Arcata General Plan includes a Historical Preservation element. As the AWTF project requires a permit from the City, it is subject to compliance with this element.

The following is excerpted from the Design and Historical Preservation Element (DHPE) (City of Arcata 2010):

> "An inventory of Arcata's historical structures and sites in 1979 [Susie Van Kirk: Reflections of Arcata's History: eighty years of architecture, 1979] identified four early periods of residential building styles: settlement (1850-1885) Victorian (1885-1900), Transitional (1900-1910) and Craftsman (1910-1930), in addition to the modern period (1930-present).
>
> The City's first historic preservation ordinance [Ordinance No. 935] was adopted by the City Council in 1980. Since that time, 85 structures or sites have been formally designated by ordinance as local historic landmarks. The City retains a map of Historic Landmarks, Neighborhood Conservation Areas, and Specific

Plan Districts. [Throughout this element the name of the Historic Landmarks Commission has been changed to Historic and Design Review Commission, per Ordinance No. 1377, September 2008.]"

The Guiding Principles and Goals of the DHPE are the following:

A. Promote preservation of structures and sites that are representative of the various periods of the city's social and physical development.
B. Preserve the historical character of the Plaza and the surrounding commercial district.
C. Encourage owners of eligible structures to seek historic landmark status and to invest in restoration efforts.
D. Conserve the many examples of early residential building styles found in the city's older neighborhoods, from Bayside to Arcata Heights.
E. Assure that new construction and additions to existing historically-designated buildings maintain the character and livability of the historic neighborhoods.
F. Promote interest in and appreciation of the value of Arcata's history and its heritage of historic buildings.
G. Encourage tourism and economic development through historic resource preservation.
H. Prevent destruction of archaeological and cultural resources and assure that any artifacts receive proper disposition.

# 3.0 SETTING

The following sections provide the environmental and cultural context of the APE and ESL.

## 3.1 NATURAL SETTING

The APE is located in the Coast Range geomorphic province in northwestern California (Wagner 2002). A review of the bedrock and surficial geology of the APE and the ESL on the Redding Sheet of the Geologic Atlas of California (Strand 1962) reflects the APE & ESL as underlain entirely by Recent Alluvium deposit, which is composed of alluvium, old alluvium, and young stream terrace deposits (ibid.).

The climate of the Humboldt Bay region is classified as Mediterranean in the Köppen Climate System (Köppen 1936), with average annual rainfall and temperatures of 68 in. and 44-85 degrees Fahrenheit, respectively (WRCC 2016).

As defined by Mayer & Laudenslayer (1988), the habitat setting is Wet Meadow (WTM), Fresh Emergent Wetlands (FEW), and Saline Emergent Wetlands (SEW), hosting a diverse array of wetland plants and animals.

## 3.2 CULTURAL SETTING

Early studies of prehistoric chronological sequences on the California north coast include efforts by Loud (1918), Bickel (1979), Hayes et al. (1980), and Moratto (1984). A review of these studies by Hayes et al. (1985) cites difficulties in compiling an in-depth sequence for the coastal stretch of Mendocino County due in part to the paucity of comparative information available for the area. However, as a larger marine and intermountain region, a unified chronology is in use that spans southern coast of Oregon down to Cape Mendocino, and from the ocean east into the Klamath-Trinity Mountains.

Literature regarding prehistoric north coast settlement patterns is primarily focused on the entry of diverse groups (Fredrickson 1984). Although Whistler (1979) proposes a sequence based on language, the overall culture between diverse groups in the area is remarkably similar. There is some disagreement among archaeologists over the mode and tempo of cultural evolution on the coast. Some archaeologists are inclined to see all aspects of ethnographic culture as developing together at the same time, while others see cultural evolution on the coast as a mosaic, in which different aspects of the ethnographic pattern developed at different times and at different rates (Ames 1994). Numerous predictive models have emerged in anthropological literature over the years to analyze the validity of both arguments. Current anthropological literature strongly characterizes Northwestern Pacific California settlement patterns to be mosaic in nature.

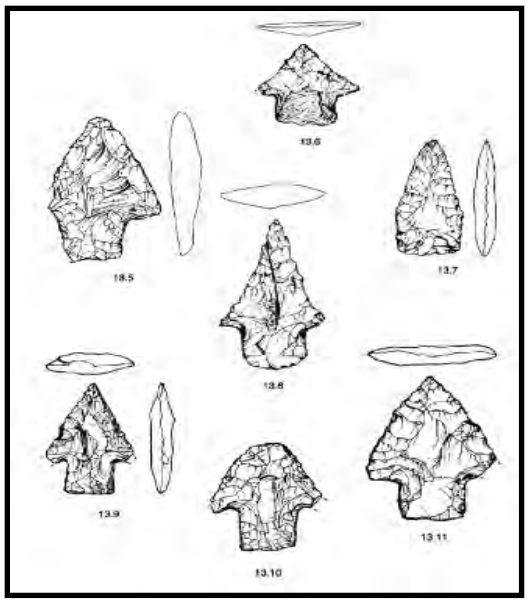


**Figure 3. Borax Wide Stem Type of the Borax Lake Pattern (Figure 13 from Justice 2002: 104).**

The major patterns noted for the region are Borax Lake (10,000 Years Before Present [BP] – 2,800 BP), Mendocino Pattern (2,800 PB – 1,100 BP), and Tuluwat (Gunther) Pattern (1,100 BP – ca. 150 BP).

Following a post-glacial warming trend, Whistler (1979) posits that the earliest migrations of human habitants to the area focused on inland riverine exploits. The earliest pattern, identified as the Borax Lake Pattern, is characterized as highly mobile family groups who utilized hunting and gathering strategies centered on migration and seasonal resources such as elk, acorns, and edible seeds (Eidsness 1988; Hayes et al. 1985). The Borax Lake Site (CA-LAK-36) is the first published archaeological work to identify the Borax Lake Pattern. It was conducted by M. R. Harrington, who claimed that the artifacts of the site were similar in age to the Clovis points found across North America, due to the fluted characteristics of the Borax Lake projectile points. This location is one of the earliest habitation sites in California; possibly as old as 12,000 BP. However, a re-examination of the site conducted by Meighan and Haynes (1968) concluded that the likely earliest dates lie between 10,000 and 8,000 BP (White 1999:9; Greenway 1988:59).

Regionally, the Borax Lake Pattern has been uncovered in the mountains of Humboldt and Mendocino Counties, Santa Rosa Plain, and most prominently in the Clear Lake Basin where assemblages are reflected by flaked stone only (i.e. wide-stemmed points [Figure 1], ovoid flake tools, and bladelet flakes) (Jones & Klar 2007:89). Artifact assemblages comprised hand-stones, milling slabs, and large wide-stemmed spear points made of locally sourced chert or obsidian. In Humboldt and Mendocino areas, obsidian is relatively rare in records from this period. Additional evidence indicates extensive use of high-elevation sites and mountain ridge systems for mobility (Wylie 1976).

Studies from Middle Period sites indicate an adaptation from mobile resource procurement to low elevation semi-permanent villages focused on salmon-bearing streams and acorn exploitation, referred to as the Mendocino Pattern. Storage practices indicate increased sedentism and a shift to bringing

resources back to a central location. This may have been influenced by a climatic shift, cooling the interior of California and resulting in declining food sources at higher elevations (Eidsness 1988; Hildebrandt & Hayes 1983, 1984). Artifact tool assemblages show enhanced diversity comprising spear and atlatl tips, increased use of slab mortars and pestles over hand-stones and milling slabs, and a diminutive refinement of point types (Eidsness 1988). Whistler (1979) suggests this is the period in which the Wiyot settled the coastal strip, indicating the Yurok arrival was nearly 200 years later.




**Figure 4. Tuluwat Pattern distribution (Map 53 from Justice 2002: 417).**

The Tuluwat (formerly known as Gunther) Pattern is set firmly in marine and estuarine practices, reflecting a similarity with greater northwest influences (Eidsness 1988). The pattern is distributed throughout the whole of Northern California and some locations in Southern Oregon (Figure 2). Artifact assemblages are characterized by enhanced woodworking skills (habitations, dugout canoes), steatite bowls and pipes, harpoon points of bone and antler, and the small, distinctive Tuluwat barbs (Eidsness 1988). Exchange networks and measures of religion and wealth are evidenced by dentalium money and large ceremonial obsidian blades, sourced from material nearly 400 kilometers distant (Eidsness 1988; Loud 1918; Hughes 1978). Baskets are a high art form, integrated for all manners of resource procurement, storage, and everyday use. Whistler (1979) credits the firm settlement of the Yurok and Wiyot with the emergence of the Tuluwat pattern and the ability to fully exploit the marine and riverine resources. Excavations show an increased complexity and options in funerary practices including pre-internment grave burning, cremation, and the destruction of personal property (Heizer and Elsasser 1964; Fenega 1968).

## 3.3 Ethnographic Background

Pre-European contact ethnographic information is presented for the Wiyot, the cultural group identified for the project location.

The Wiyot resided in and around the area encompassing the lower Mad and lower Eel rivers, and the estuaries of Humboldt Bay. According to Kroeber (1976: 112), the designation as “Wiyot" actually refers to the lower Eel river area, with proper names for the Humboldt Bay and lower Mad River districts noted as Wiki and Batawat, respectively. Kroeber defines the Wiyot territory as:

> “…just south of Little River, at whose mouth stood the Yurok town of Metsko. On Mad River, near Blue Lake, near the forks, was still Wiyot. The north fork was without villages and is in doubt. The Wiyot owned at least half the lower portion…and the whole of the drainage has been assigned to them. From Mad River south to Eel River Wiyot territory extended to the first range inland. Jacoby, Freshwater, and Salmon Creeks, Elk River and Boynton Prairie were thus Wiyot…On Eel River the boundary came at Eagle Prairie near Rio Dell. Southwest of Eel River, the Bear River Mountains separated the Wiyot from another Athabascan division,

the Mattole. The spurs of this range reach the sea at Cape Fortunas, between Guthrie and oils Creek (1976; 113)".

The traditional territory encompasses approximately 525 square miles (mi), and comprises ocean dunes, riverine and estuarine lands, foot hills, open prairies, and wooded mountains. Loud (1918) estimated the pre-contact aboriginal population to be between 800-1,000 Wiyot between the three districts. Geographically, the location is restrictive and considered culturally insular.

The Wiyot language is a member of the Ritwan group, and linguistically related to the Algonquin language of the Algic family (Golla 2007), which has roots in central and eastern North America (Gruhne 1988). For a complete discussion of structural composition and comparison see Haas (1967), Sapir (1913), and Voegelin (1942); for taxonomy see Haas (1967), Teter (1964), and Michelson (1914); for sociolinguistics see Durbin (1967), Gruhn (1988), and Kinkade & Powell (1976); for dialects and language family see and Frachtenberg (1918), and Dixon & Kroeber (1913). The Wiyot language is currently undergoing a renewal with new research, documentation, and digital interactive language tools.

According to Loud (1918), there were no formal chiefdoms, but instead families of distinction, as designated by their wealth and standing in their districts. For further discussion on geography and migration in relationship to social structure and development see Rogers et al (1990), Milke et al (1949), and Kroeber (1909). For further discussion on cultural development, kinship structures, and burial practices, see Fenega (1968) and Loud (1918).

Like their neighbors, as different resources became available throughout the year, the Wiyot broke into small family bands and traveled to various locations within their territory to fish, hunt, and gather edible and medicinal plants. Subsistence patterns tended to follow both seasonal and socially conscripted routines (Loud 1918). These seasonal rounds took them to outlying areas where they established seasonal base camps and a series of radiating temporary camps and task-related activity stations.

The Wiyot today are represented by one band in each traditional Wiyot District including the Blue Lake Rancheria, Batawat District; the Wiyot Tribe of Table Bluff, Wiki District; and the Bear River Band of the Rohnerville Rancheria. Tribal members still use this area, continue to harvest plant resources, especially for basket resources, and are manifesting a cultural resurgence within their cultural territory (Seidner 1999).

## 3.4 HISTORICAL BACKGROUND

The project area is located along the northern shore of Humboldt Bay and south of the city of Arcata. Humboldt County is closely tied to important themes in California history including early settlement, westward expansion, the Gold Rush, development of the timber industry, and early environmental activism in the City of Arcata.

### 3.4.1 The Arcata Wharf

The following information regarding Arcata's Union Wharf was extracted from Susie Van Kirk's Arcata Marsh History (2015) unless cited otherwise. Van Kirk's (2015: 5) accounting of the recognized need for construction of a commercial wharf is as follows:

> *Union Wharf. The slough did yeoman service, but some Union men saw the limitations of slough freighting and proposed a facility to serve an ocean trade. The town was growing, its merchants*

*busily filing orders for the mines in response to a demand that exceeded any previous time (Humboldt Times 16 Sept. 1854). And another industry was showing its muscle. Within four years of settlement, twenty miles of logging "railroads" were operating around Humboldt Bay where two hundred men were engaged in the woods (Humboldt Times 9 Sept. 1854). It was clear that a shipping facility for goods coming in and lumber going out would stimulate both trades, benefit the town's economy and reward its developers.*

*On November 21, 1854, mill owners Thomas Titlow and Dunbar Averill entered into an agreement with Stillman Daby, Byron Deming and Henry W. Walker, whereby Daby and partners would, within ten months, construct a wharf "from the town of Union to ship channel on Humboldt Bay." Titlow and Averill would advance them $1,500 and provide the construction lumber, consisting of three-inch planks 16 feet long and four-by-four inch scantling. The amount of lumber needed was estimated at 250,000 feet (Recorder's Office, Miscellany A: 29; amended A:31).*

*The wharf company received a Certificate of Incorporation on December 15, 1854. The Union Plank Walk Rail Track and Wharf Company declared its intention to build a walk, track and wharf from the "southwest corner of the public square in the town of Union…and running in a southwesterly direction and in a straight line across the marsh and the flats in Humboldt Bay to the ship channel…for the purpose of transporting freight and passengers over the same and for such other purposes." Incorporated for twenty years, the company had a capital stock of $15,000 divided into 60 shares and there were five directors, including Daby, president and Deming, secretary with Walker, Walter Van Dyke and J.E. Wyman as the remaining directors (Misc. A:23). Before the end of December 1854, the wharf company leased a 30 x 50 foot lot at the northeast corner of Block 153 (present site of the Arcata Post Office) from M.M. Steinthal for the construction of a warehouse, along with a right-of-way over the south half of the block (Misc. A:25).*

*The east and south halves of this block (bounded by 7th, 8th, H and I streets) served as the warehouse and depot location, first for the wharf company, later for the Arcata and Mad River Railroad, and still later as the regional bus depot. Running the track in a "straight line" from the Plaza to the wharf was no exaggeration; the wharf company was definitely committed to the "shortest-distance-between-two-points" principle. From the back of the warehouse block, the track proceeded directly to a ship channel at a 45 degree angle.*

*Crossing the block between 6th and 5th and H and I streets, the line created a pie-shaped parcel that remains today (the Marsh House). An 1887 deed describes the property as bounded on the east by the "roadbed of the Arcata and Mad River Railroad" (Recorder's Office, Deeds 23:448). Never veering an iota, the line headed directly across the marsh and mud flats to its deep-water destination. A 1947 aerial photograph provides one of the best views of that "straight-as-an-arrow" railroad.*



**Figure 5. Aerial view of Union (Arcata) and the Union Wharf circa 1947 (photo by Mel Schuster 1947, reproduced in Van Kirk 2015).**

For further details see Susie Van Kirk's 2005 paper "Arcata Marsh History: Union Wharf, Mad River Canal, Reclamation, Lumber Mills, City Designs."

# 4.0 METHODS

To obtain historical background information, archival research included an examination of multiple sources concerning known archaeological sites, historic properties, and historical activities within and/or adjacent to the APE. Repositories and agencies consulted include the following:

- The California Historical Resources Information System (CHRIS) at Sonoma State University
- The Native American Heritage Commission (NAHC)

## 4.1 NWIC ARCHIVAL RECORD SEARCH RESULTS

A record search request was sent to the CHRIS at Sonoma State University on July 18, 2019. The search included a 0.5-mi radius around the APE for previously recorded archaeological sites and previous surveys (Appendix B).

The following resources were consulted at the Northwest Information Center (NWIC):

- National Register of Historic Places – Listed and Determined eligible Properties (2012)
- California Register of Historical Resources (2012)
- California Points of Historical Interest (2012)
- California Historical Landmarks (2012)

- Directory of Properties in the Historic Property Data Files for Humboldt County (2012)
- Caltrans Local and State Historic Bridge Inventory
- Handbook of North American Indians, Vol. 8, California (1970)
- The Handbook of California Indians (1975)
- City of Arcata Historical Landmarks (South of Samoa Blvd and west of Hwy 101 only)

### 4.1.1 Previously Recorded Cultural Resources within the APE and ESL

The record and literature search revealed no previously recorded cultural resources within the APE, but one resource (site Loud 42) was previously recorded within the ESL (Table 2).

**Table 2. Previously recorded resources within the APE and ESL.**

| Resource Identifier | Resource Description; Date Recorded and by Whom | Source | NRHP/CRHR Status | APE or ESL Location |
|---|---|---|---|---|
| P-12-000100; CA-HUM-00042; Loud 42 | Village site; not occupied in 1850 nor named; Site is believed to be obliterated due to construction of South G Street and Hwy 101 (Loud 1918) | NWIC/ CHRIS | 7 Unevaluated | ESL |
| HUM 101 | Gannon Slough Bridge 4-024L (Caltrans 1986) | SHPO | Ineligible | ESL |
| None | A segment of the Northwest Pacific Railroad (T. Keefe 2006) | Keefe 2006 | 6Z – Determined Not Eligible through field survey | ESL |
| California Historic Landmark #842 | Arcata and Mad River Railroad; Union Wharf and Plank Walk Company (Unknown) | Belcher 1922; Rich 2012 | CHL Listed Resource No. 842 | APE |
| None | H.N. Ry Railroad | Belcher 1922 | Unknown | ESl |
| CA-HUM-001156 | Arcata Bay Levy | HSU-CRF | Unknown | ESL |

Resource P-12-000100 was recorded as a result of Loud's ethnographic survey of the Wiyot. Other than location data, very few details are available from the original site recording.

### 4.1.2 Prior Cultural Resource Studies within the APE and ESL

The record and literature search revealed 10 previous cultural resource studies having been conducted within the APE, and 6 previous studies conducted outside the APE but within the ESL (Table 3).

**Table 3. Previous reports within the ESL.**

| Report Number | Report Title | Date Reported & By Whom | Within APE or ESL |
|---|---|---|---|
| **S-000132** | An Archaeological Survey of the Proposed McKinleyville Sewage Collection and Treatment Facility | David A Fredrickson, Sonia Tamez, and Pamela R. Roberts, 1975 | APE |
| **S-006403** | Archaeological Survey Report for a proposed sewage collection system for Bayside in Arcata, California | Barry Kevin Douglas, 1984 | ESL |
| **S-006669** | Archaeological Survey Report, Butcher's Slough Wetlands Restoration Project, Arcata, California | Barry K. Douglas, 1984 | APE |
| **S-014210** | An Archaeological Investigation of Assessor's Parcel Number 21-184-05, Located in Arcata, Humboldt County, California | James M. Roscoe, 1992 | APE |
| **S-015199** | A Cultural Resources Study of the Proposed Marsh Commons Project, Located in Arcata, California | James Roscoe, 1993 | APE |
| **S-017469** | Historical and Technological Significance of the Humboldt Bay Jetties, Humboldt Bay, California | Carroll W. Pursell, Jr., 1981 | APE |
| **S-022314** | Archaeological Survey for City of Arcata, Janes Creek culvert and Drainage Improvements, FEMA HMGP #1008-6283 (letter report) | David Fukutomi, 1999 | APE |
| **S-029030** | Archaeological Assessment of a 1.5-Acre Parcel (APN 367-180-010), Located at 915 Deer Creek Drive, Martinez, Contra Costa County, California (letter report) | Leigh Martin, 2004 | ESL |
| **S-037718** | A Cultural Resources Investigation of the Proposed McDaniel Slough Marsh Enhancement Project, Located near Arcata, Humboldt County, California | William Rich, James Roscoe, and Susan Van Kirk, 2003 | APE |
| **S-038304** | Historic Property Survey Report for the Proposed Eureka-Arcata Corridor Projects on California State Highway 101 at Post Mile 79.9/86.3 in Humboldt County, California | Timothy Keefe, 2006 | ESL |

| Report Number | Report Title | Date Reported & By Whom | Within APE or ESL |
|---|---|---|---|
| **S-038434** | Archaeological Inventory and Evaluation for the Wal-Mart Mitigation at the Old Lynch Canyon Homestead Project, Solano County, California | Charlane Gross and Jason Coleman, 2011 | APE |
| **S-040249** | Cultural Resources Survey Report for the South G Street (Christie) WRP Project, Humboldt County, California | Jason A. Coleman | ESL |
| **S-041725** | A Cultural Resources Investigation of the Daylighting of Jolly Giant Creek Project, located in Humboldt County, California | Nick Angeloff and James Roscoe, 2004 | ESL |
| **S-041786** | Historic Property Survey, Archaeological Survey, and Historical Resources Evaluation Reports, Highway 255 Gateway Improvements, CALTRANS District 1, Humboldt County, CA | Leslie S. Heald, 2002 | ESL |
| **S-048287** | A Cultural Resources Investigation of three Coastal Access Points for the Humboldt Bay Water Trails Implementation Program, Located in Humboldt County, California | James Roscoe and William Rich, 2012 | APE |
| **S-050908** | A Cultural Resources Investigation of the Arcata Wastewater Inflow and Infiltration Project, Arcata, Humboldt County, California | Nick Angeloff and Lynette Mullen, 2016 | APE |

The 1975 cultural resources study by Sonoma State's David Fredrickson, Sonia Tamez, and Pamela R. Roberts (Report number S-000132; Fredrickson et al., 1975) included work in the project APE. This study encompassed 3,660 acres and 25.5 linear miles and identified four cultural resources. However, none of these resources were identified within the ESL of this project.

Barry Kevin Douglas conducted two cultural resources studies in 1984, one within the APE (S-006669) and one within the ESL (S-006403). Report S-006403 describes a survey completed for installation of a sewage collection system for Bayside Arcata (Douglas 1984A), while report S-006669 details a 30 ac wetlands restoration project within the APE. One cultural resource was identified as a result of this investigation, site Loud 42 (P-12-000100), which is located within the project APE (Douglas 1984B).

James M. Roscoe and associates conducted five cultural investigations in the area during the 1990s and early 2000s. Report S-014210 details a cultural resources study that was completed for a 0.3 ac accessor's parcel, on which no cultural resources were identified (Roscoe 1992). Report S-015199 details a cultural resources study that was completed for a Marsh Commons project consisting of 1.5 ac, in which no cultural resources were identified as a result for this investigation (Roscoe 1993). Roscoe along with

William Rich and Susie Van Kirk conducted a cultural resources study for the proposed Slough Marsh Enhancement project in Arcata, in which three cultural resources were identified. Loud 42 (P-12-000100) was noted within the project APE (Roscoe et al 2003). Report S-041725 details a cultural resources study that was completed by Humboldt State University, in which no cultural resources were identified (Angeloff and Roscoe 2004). Report S-048287 details a cultural resources study that was completed for implementation of Humboldt Bay Water trails. No cultural resources were identified as a result of this investigation (Roscoe and Rich 2012).

Report S-017460 details a cultural resources study that was completed for determination of historical significance of the Humboldt Bay Jetties, in which no cultural resources were identified (Pursell 1981). Report S-022314 details a cultural resources study that was completed for drainage and Culvert Improvements for FEMA work in Arcata. No cultural resources were identified as a result of this investigation, neither of which are within the project's ESL (Fukutomi 1999). Report S-029030 details a cultural resources study that was completed for 1.0 ac accessor's parcel, in which no cultural resources were identified (Martin 2004). Report S-050908 details a cultural resources study that was completed for the Arcata Wastewater Inflow and Infiltration project, in which twenty-nine cultural resources were identified. Loud 42 (P-12-000100) is the only cultural resource identified within the APE (Angeloff and Mullen 2016).

Report S-038434 describes the cultural resources study completed for an inventory and evaluation of the Old Lynch Canyon Homestead. A single cultural resource was identified, which is located outside the project's ESL (Gross and Coleman, 2011). Coleman also conducted a cultural resources study for the South G Street WRP project, in which no cultural resources were identified (Coleman 2013).

Caltrans completed two cultural resources studies in the area during the early 2000s. Report S-038304 (Keefe 006) details a cultural resources study that was completed along 4.5 linear miles for the proposed Eureka-Arcata corridor along California State Highway 101. Eleven cultural resources were identified as a result of this investigation, but all are located outside of this project's ESL. However, this report also determined that the Arcata Wastewater Treatment plant was found Ineligible for inclusion in the National Register at that time. Report S-041786 (Heald 2002) describes the cultural resources study completed for Highway 255 Gateway improvements. Seventeen cultural resources were identified as a result of this investigation, but none within this project's ESL (Heald 2002).

## 4.2 Native American Coordination

In accordance with PRC § 5097.91-5097-94, the Native American Heritage Commission (NAHC) maintains a catalog pertaining to places of special religious or social significance to Native Americans. In order to identify if places of religious or social significance exist within the APE, DZC contacted the NAHC on August 30, 2019 to request a review of their Sacred Lands Files.

The NAHC responded by email on September 19, 2019, stating that the Sacred Lands File search was negative and provided a list of individuals to be contacted regarding the project.

PRC § 21080.3.1, subd. (b), declares that California Native American Tribes traditionally and culturally affiliated with a geographic area may have expertise concerning their tribal cultural resources. As such, DZC contacted persons on the designated contact list maintained by the NAHC, providing each with a

project description, location map, a request to respond to DZC with any relevant information, and a request to respond to the lead agency within 30 days, should the tribe wish to engage in formal government-to-government Consultation. Email or hard-copy notifications were sent to all parties on the NAHC list on October 10, 2019.

Janet Eidsness, THPO of Blue Lake Rancheria responded on October 11, 2019. THPO Eisdness acknowledged the proximity of P-12-000042 (CA-HUM-00042/Loud 42) within the ESL, concurred that the resource is outside of the APE, and offered that Blue Lake Rancheria had no knowledge of any additional sites in the APE.

As of October 31, 2019, no response was received from (1) Bear River Band of the Rohnerville Rancheria: Barry Brenard, Chairperson; Celeste Ruiz, Executive Secretary; and Erika Cooper, THPO; (2) Cher-Ae-Heights Indian Community of the Trinidad Rancheria: Claudia Brundin and Garth Sundberg, Sr., Chairpersons; and (3) Wiyot Tribe: Ted Hernandez, Chairperson.

Formal government-to-government Consultation, as defined by PRC § 21080.3.1 (a), is the purview of the lead agency, the City of Arcata. Records pertaining to formal consultation are on file with the City of Arcata. All correspondence regarding Native American coordination conducted by DZC is included in Appendix C.

## 4.3 Parcel Specific History

The following sections detail initial land ownership and development of the APE utilizing public records and historical maps, followed by an analysis of topographic maps, aerial photographs, and satellite imagery.

### 4.3.1 Initial Land Ownership and Development

The historic map review included analysis of the A. J. Doolittle Map (1865), the Stanley Forbes Company map (1886), the J.N. Lentell map (1914), and the Belcher Abstract & Title Company map (1922).

The A. J. Doolittle (1865) indicates that the APE and surrounding area had been moderately surveyed by 1865. The depiction of Northern Bay has several noted landmarks surrounding the APE, but not within the APE. The majority of the project area was historically a marsh. Along the immediate western boundary of the APE, a railroad extends into Humboldt Bay. Although it is unclear on Doolittle's map if it overlaps the APE, the landowner along the




**Figure 6. Northeastern shore of Humboldt Bay circa 1865 (Doolittle 1865).**

marsh boundary is “Phillips” (Doolittle 1865).

The Hickey and Standish (1895) map does not indicate a landowner for the APE in 1895. The J.N. Lentell (1914) map does not indicate a landowner for the APE in 1914. However, two railroad lines are depicted as extending through the APE and ESL including a segment of the Arcata and Mad River Railroad (Union Wharf and Plank Walk Company, California Historic Landmark No.842) and a segment of the Northwestern Pacific Railroad.

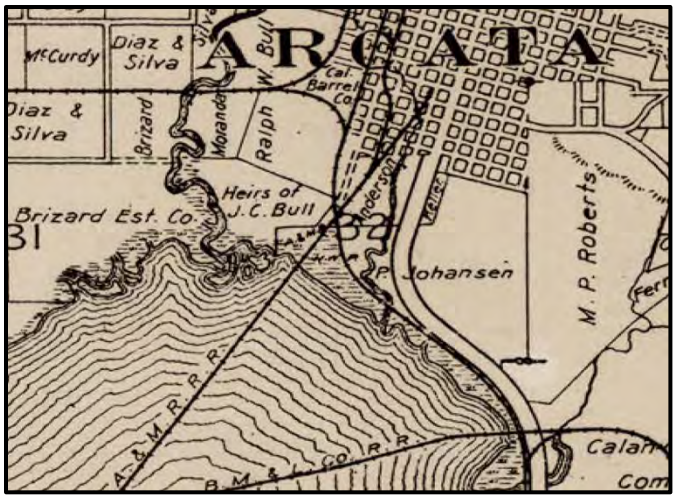



**Figure 7. Northeastern shore of Humboldt Bay circa 1922 (Belcher Abstract Title Company).**

The Belcher Abstract & Title Company map (1922) depicts several landowners along the northern shore of Humboldt Bay associated with the APE. The Annie and Mary Railroad owned property directly on the shore of Humboldt Bay and owned the railroad line that extended northeast-southwest into the Bay (Union Wharf and Plank Walk Company, California Historic Landmark No.842). A segment of the Northwestern Pacific Railroad is also depicted within the APE and ESL. Neighboring landowners in or near the APE included Heirs of J.C. Bull, Ralph W. Bull, and P. Johansen.

See Appendix D for the approximate location of the APE on these historical maps.

A state volume patent and a serial patent were issued for the APE the 19th and 20th century. Below is a table detailing state volume patents and serial patents within the project’s APE and ESL (Table 4). Historical documents regarding the development of the APE and ESL are included in Appendix D.

**Table 4. State volume patents and serial patents within the project APE and ESL.**

| Name | Date | Quadrant | Township/Range/Section | GLO Source | Project Segment overlap |
|---|---|---|---|---|---|
| State of California | January 12, 1903 | Arcata South | T6N/R1E/ Section 32 | Serial Patent; GLO 1903 | Study Unit 1, 2, 3, 4, and 5 |
| Marc Teremater | November 11, 1867 | Arcata South | T6N/R1E/ Section 32 | State Volume Patent; GLO 1867 | Study Unit 1 |

### 4.3.2 APE Parcel Specific Topographic Maps and Aerial Photographs

Utilizing the National Environmental Title Research (NETR) website, DZC reviewed the USGS topographic maps of the APE and ESL. The USGS maps are hereby referred to as NETR (1933, 1942, 1948, 1953, 1961,

1966, 1972B, 1974, 2012B, 2015) and encompasses Arcata South 7.5-minute quadrangle map Township 6 North, Range 1 East, Section 32 and Township 5 North, Range 1 East, Unsectioned and all four previously designated polygons pertaining to the APE (Table 1).

In 1933, two prominent linear landmarks are demarcated on the historical topographic map while the majority of the APE is designated as marshland. The Arcata and Mad River Railroad line or wharf runs in a northeast-southwest direction along the APE's northwestern boundary. The Redwood Northwestern Highway is adjacent to the APEs eastern boundary. A clearly delineated grid system is established in Arcata and is featured within the projects northern ESL (USGS 1933). Between 1948 and 1953, three buildings are constructed adjacent to Study Unit 1 and three ponds, designated as reservoir, are established near Study Unit 1 and 2, but within the ESL (USGS 1948, 1953). By 1961, the "Oxidation Pool", which encompasses the southern portion of the APEs Unit 5, is established. Two of the three ponds built between 1948 and 1953 are merged into one pond by 1961 (USGS 1961). Just five years later in 1966, several buildings are constructed on the eastern side of the Redwood Highway within the ESL as well as a Radio Tower. Within the APE, the Oxidation Pond, previously built facilities, and two smaller ponds are labeled Sewage Disposal (USGS 1966).

Between 1972 and 1974, the northern portion of Study Unit 5 is no longer labeled as marshland and has a clear boundary around what will eventually become Klopp Lake. The previously labeled Arcata and Mad River Railroad line is labeled Wharf (Ruins) by this time and part of the railroad along the APEs eastern boundary is labeled Northwestern Pacific Railroad (USGS 1972B, 1974). In 2012, the area encompassing the northern portion of Study Unit 5 is labeled Jolly Giant C and is situated between roads Marina W. and South G St, which are within the western and eastern portion of the ESL (USGS 2012). By 2015, no significant changes are demarcated except a large pond, which is located in the northern portion of Study Unit 5 (USGS 2015).

DZC also examined aerial photos of the APE from the NETR website (1956, 1972A, 1989, 1993, 2005, 2009, 2010, 2012A, 2014, 2016). The earliest aerial photographs of the area, from 1956, are poor quality. What can be demarcated on the landscape shows that Study Unit 5 is a combination of marshland, mud, and vegetation. A single structure is located between Study Units 2 and 5 within the ESL (USGS 1956). By 1972, all of the ponds within the APE, including the Oxidation Pond, are clearly demarcated on the landscape as well as some smaller buildings near Study Unit 2 and a few dirt roads, but none of which are well developed (USGS 1972A). By 1989, the APE and surrounding area are far more established as evidenced by clear pond designations and buildings, which are concentrated near Study Units 3 and 5. The Oxidation pond has also been internally divided into 13 rectangular polygons (USGS 1989). No significant changes occur within the APE or ESL until 2016, in which green vegetation becomes more prominent in the surrounding ESL (USGS 2010, 2012A, 2014, 2016).

Satellite imagery from Google (2016) indicates that several of the ponds have designated names. Within Study Unit 2 is east of the South G Street Storm Water Pond, Study Unit 3 is located adjacent to No-name Pond, and Study Unit 5's southern portion is designated as North Oxidation Pond and South Oxidation Pond. Study Unit 5's northern portion encompasses Hauser Marsh along South I St. and Gearheart Marsh. Several structures are located within the ESL east of South G St (Google 2016).

### 4.3.3 THE ARCATA MARSH - ENVIRONMENTAL INNOVATION

The following summary of the social justice aspects and physical processes of the AWTF is summarized from a manuscript written by Amanda Suutari, published in June 2006.

In 1972, Federal Water Pollution Control Act Amendments called for the improvement of the water quality in Humboldt Bay and at that time, Arcata's former wastewater treatment plant was not adequately treating the city's wastewater. Originally constructed in the 1940s, wastewater discharged into the bay from the treatment plant received only primary treatment. The facilities were expanded in 1958, which increased the level of treatment by adding chlorination. However, by 1974 these processes were not only deemed inadequate by the standards of the Water Pollution Control Act Amendments of 1972 but were also becoming socially unacceptable when considering sustainable fisheries and other aquatic life. By 1974, the City of Arcata and its community entered into the "Wastewater Wars" when the State and Regional Governments proposed a wastewater treatment plant that would serve Arcata as well as other areas on the bay, a project that would make the rural region vulnerable to strip development and increased sewage disposal costs.

In the spirit of local activism, community members had recently created the first Community owned forest in the country and prevented a new federal freeway from further bisecting their town. Riding that wave with the backing of local notables including Dr. George Allen, Dr. Robert Gearheart, Dan Hauser, and Franklin Klopp, the citizenry focused on creating the Arcata Marsh and Wildfire Sanctuary and proving to State and federal government agencies that the facility's wastewater would "enhance" the bay (Esther Scott et. al. 1989). The overall goal was to remove the remnants of the derelict lumber mill and associated ponds, compromised concrete foundations, and the unkempt landfill and replace it with the wastewater treatment plant that would remain independent while providing wildlife habitat and recreational opportunities. Primary processes included industrial remediation by the National Guard, installation of temporary dikes, sediment removal, terraforming, and native plant revegetation.

The resulting infrastructure currently supports primary treatment, which separates liquids from solids, and secondary treatment, which addresses harmful pathogens. Major components include the headworks, primary clarification retention facilities, digesters, oxidation ponds, treatment marshes, and disinfection prior to final discharge into enhancement marshes.

The initial AWTF was completed in 1986 with subsequent expansions of 3.51 ac funded by the California State Coastal Conservancy and the addition of the Arcara Marsh Interpretive Center in 1993. The marsh complex today is internationally renowned as a first-class example of an innovative, cost effective, environmentally integrated facility.

For further details regarding the historic, political and industrial processes surrounding the formation of the AWTF, the reader is referred to the full publication by Amanda Suuti, included in Appendix D.

## 4.4 GEOARCHAEOLOGICAL RESEARCH

To assess the potential for buried archaeological sites within the proposed project components, this assessment considers factors that either encourage or discourage human use or occupation of certain landforms (e.g., geomorphic setting and distance to water), combined with those that affected the subsequent preservation (i.e., erosion or burial) of those landforms. It is well-known, for instance, that

prehistoric archaeological sites in California are most often found on relatively level landforms near natural water sources (e.g., springs, streams, rivers, or estuaries), which is often where two or more environmental zones (ecotones) are present. Landforms with this combination of variables are frequently found at or near the contact between a floodplain and a higher and older geomorphic surface, such as an alluvial fan or stream terrace (Hanson 2004:5).

An attempt is given to forecast the burial sensitivity by looking at the intersection of existing geomorphic, stratigraphic, soils spatial variables, land use, and past impacts as well as any behavioral variables that may forecast human occupation. The following describes the project site in terms of these variables and generates an archaeological sensitivity forecast. This is not an analysis of whether a particular area was attractive for human activity, but whether the conditions are favorable for buried archaeological deposits.

Soil Composition

A review of the USDA Soil Survey Geographic Database Soil Series for Humboldt County, California (CA600) revealed that 92% of the APE consists predominantly of Miscellaneous Water and Water. The remainder includes Urban land-Anthraltic Xerorthents association (0-2% slopes), and Hydraquents (0-3% slopes) (USDA 2019). Together with water dominating the majority of the APE, these two soil families represent 8% of soils found in the APE.

The Urban land-Anthraltic Xerorthents soil type is found in the central part of the APE and is associated with Fluviomarine terraces and backslopes. The parent material consists of coarse-loamy fluviomarine deposits and/or coarse-loamy dredge spoils (USDA 2019). Depth to the water table is roughly 24 in. and this class is moderately well-drained. Water movement in the most restrictive layer is high (ibid.). A typical soil profile for this soil type reads 1.) 0-6 in.: gravely loam fine sand; 2.) 6-31 in.: sandy loam; 3.) 31-43 in.: gravelly sand; and 4.) 43-65 in.: sand (ibid.).

The Hydraquents-Wassents soil type is found the central and western portion of the APE and is associated with tidal flats. The parent material consists of mucky, silty, and clayey estuarine deposits (ibid.). Depth to restrictive layer is 0 in. to aslic and 20 to 79 in. to sulfuric and this class is very poorly drained. The depth to water table is about 0 inches (ibid.). A typical soil profile for this soil type reads 1.) 0-59 in.: mucky silty clay loam (ibid).

These two soil profiles together form approximately 100 percent of the recorded surface in the APE that is not water. Within the APE, Meyer's predictive model (Meyer et al. 2013:102) for surface deposit potential in the aquatic terrain is moderately high to high based on favorable distance to water, low elevations below 4,000 ft, 0- to 3-degree slopes, proximity to waterways confluences, and slightly convex or concave landforms. The age of the two soil types present, which are Urban land-Anthraltic Xerorthents and Hydraquents-Wassents, is recent (Meyer et al. 2013, Appendix B).

### 4.4.1 HYDROLOGY OF THE ESL

With reference to the USGS 7.5-minute Topographic Map, Arcata South (1959), the directional groundwater flow through the APE is westward towards the Pacific Ocean. The Federal Emergency Management Agency national flood hazard map does indicate the APE to be within the path of a 100-year flood event (FEMA 2016).

### 4.5 Cultural Resource Survey Expectations

The results of archival research, the Sacred Lands Search, previous surveys adjacent to and within the study area, and the environmental context all contribute to an assessment of the sensitivity level for a given project area. Based on the geomorphological and topographic characteristics of the project area, the results of the records and literature search, the age the soils mapped in the area, and the level of historic disturbance, the APE is considered to have a low potential for buried and surficial prehistoric resources, a moderate potential for buried historic resources, and a low potential for surficial historic resources.

## 5.0 Report of Findings

### 5.1 Archaeological Survey Results

DZC conducted the archaeological survey of the APE on October 9, 2019 and on November 5, 2019. Within the APE, designated project Study Units 1-5 were targeted for archaeological survey coverage, which includes Staging Areas 1-4 (Appendix A, Figure A-7). The City of Arcata identified 123 ac of land for Intensive survey.

The primary constraint to survey efforts was poor ground visibility. Generally, ground visibility was less than five percent since most surfaces were either paved, vegetated, or covered with imported gravel. To circumvent this, vegetation was scraped clear at select intervals to obtain a clear view of the mineral surface. This method was employed in other areas within the APE where low-lying and dense vegetation was present. Some soils were occasionally visible because of gopher holes and occasional bare patches of ground without vegetation cover. The soils observed varied greatly and included light sandy loam, dark loam aggregated rounded and subangular cobbles associated with commercial imported gravels. Fragmentary refuse, including crushed cement tailings and modern broken glass, were observed but not in sufficient quantities to obtain interpretive data aside from industrial use association.

In Staging Area 1 poor visibility was due to low-lying dense vegetation and surfaces covered with imported gravel. Staging Area 2 provided similar constraints to survey efforts with poor visibility due to paved asphalt and low dense vegetation surrounding the Arcata Marsh Parking lot on South G Street. Constraints of Staging Area 3 included the presence of low dense vegetation, briars, and imported gravels. Staging area 4 constraints were similar to those of Staging Area 2, with paved asphalt and low dense vegetation surrounding the Arcata Marsh Parking lot on South I Street.

Pedestrian survey efforts resulted in 100% coverage of the target acres excluding wetlands, ponds and marshes, and provided intensive coverage in transects of 15 m or less for all acres covered (Appendix A, Figure A-7 Survey Coverage and Results).

The survey was negative for precontact resources. Two built environment features were identified within the APE including the AWTF and a remnants of the Arcata Mad River Railroad/Union Wharf and Plank Walk Company.

# 6.0 RESOURCE DISCUSSION

## 6.1 RESOURCE EVALUATION CRITERIA

### 6.1.1 NATIONAL REGISTER OF HISTORIC PLACES

To be eligible for listing on the National Register, a resource must be significant in American history, architecture, archaeology, engineering, or culture. Districts, sites, buildings, structures, and objects of potential significance must meet one or more of the following four established criteria:

- Criterion A - Are associated with events that have made a significant contribution to the broad patterns of our history;
- Criterion B - Are associated with the lives of persons significant to our past;
- Criterion C - Embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master; or that possess high artistic values; or that represent a significant and distinguishable entity whose components may lack individual distinction;
- Criterion D - Have yielded, or may be likely to yield, information important in prehistory or history.

In addition to meeting one or more of the above criteria, a resource must retain integrity to be considered eligible for listing on the NRHP. Integrity is the authenticity of the physical identity that is evidenced by the survival of characteristics that existed during the resource's period of significance. The seven aspects of integrity are outlined in the National Register Bulletin No. 15 and consist of: location, design, setting, materials, workmanship, feeling, and association (Shrimpton 2002). Resources must retain enough of their character or appearance to be recognizable as resources and to convey the reasons for their significance. Further, unless the resource possesses exceptional significance, it generally must be at least 50 years old to be eligible for National Register listing.

Section 101(d)(6)(A) of the National Historic Preservation Act (NHPA) allows properties of traditional religious and cultural importance to a Native American tribe to be determined eligible for NRHP inclusion. In addition, a broader range of Traditional Cultural Properties (TCPs) is also considered and may be determined eligible for or listed in the NRHP. A TCP is a property associated with the cultural practices or beliefs of a living community; TCPs are rooted in that community's history and are important in maintaining the continuing cultural identity of the community. In the NRHP programs, "culture" is understood to mean the traditions, beliefs, practices, lifeways, arts, crafts, and social institutions of any community, be it a Native American tribe, a local ethnic group, or the nation as a whole.

### 6.1.2 CALIFORNIA REGISTER OF HISTORICAL RESOURCES

As provided in California Public Resources Code Section 5020.4, the California Legislature established the CRHR in 1992. The CRHR is used as a guide by state and local agencies, private groups, and citizens to identify the state historical resources and properties to be protected, to the extent prudent and feasible, from substantial adverse change. The CRHR automatically includes all California properties already listed in the NRHP and those formally determined to be eligible for listing in the NRHP. The CRHR may also include various other types of historical resources that meet the criteria for eligibility, including the following:

- Individual historic resources
- Resources that contribute to a historic district

- Resources identified as significant in historic resource surveys
- Resources with a significance rating of Category 3 through Category 5 in the State Inventory (Categories 3 and 4 refer to potential eligibility for the NRHP; Category 5 indicates a property with local significance)

The CRHR follows the lead of the NRHP in utilizing the 50-year threshold: a resource is usually considered for its historical significance only after it reaches the age of 50 years. This threshold is not absolute, but was selected as a reasonable span of time after which a professional evaluation of historical value/importance should be made. The criteria for listing resources in the CRHR were expressly developed to be in accordance with previously established criteria developed for listing on the NRHP.

Section 15064.5(a)(3) of the CEQA Guidelines states that "Generally, a resource shall be considered by the lead agency to be 'historically significant' if the resource meets the criteria for listing on the California Register of Historical Resources," which are as follow:

- Criterion 1 - Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;
- Criterion 2 - Is associated with lives of persons important in our past;
- Criterion 3 - Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values; or
- Criterion 4 - Has yielded, or may be likely to yield, information important in prehistory or history.

Using the information outlined above, the first level of evaluation is to determine whether a resource is considered eligible for the CRHR and is, therefore, significant. Significance, in part, is determined based on a historical resource's integrity. Integrity in the context of the CRHR means a resource is sufficiently intact to yield important information regarding the past. Integrity encompasses the following factors: location, setting, design, materials, workmanship, association, and feeling.

## 6.2 Resource Evaluation

### 6.2.1 AWTF Infrastructure

The AWTF was initially constructed in the 1940s with various parts of the system being replaced or improved multiples times since that time. With respect to the AWTF's cultural significance, wastewater treatment facilities are ubiquitous features found in most cities and towns. No evidence has been found to suggest that the initial construction and materials used in the AWTF are in any way unique. Further, ongoing repairs and maintenance continue to upgrade and improve the design, workmanship, and material qualities of the original construction. However the expansion of the AWTF in 1986 may represent both an innovative design, which may be considered a unique construction method, and social justice activism associated with the City of Arcata. As such, this discussion regarding the criteria for evaluation aims to identify persons and events relative to the AWTF.

NEPA and CEQA mandate that resources older than 50 years may qualify for eligibility on the National Register of Historic Places or the California Register of Historic Resources.

A/1: AWTF was originally constructed in in the 1940s in order to facilitate wastewater disposal for the City of Arcata. Since that time, it has undergone multiple modifications and improvements, however the processes remain true to the original idea. Wastewater treatment plants are ubiquitous facilities found throughout most towns and cities. However, research has shown that the AWTF is associated with significant local events of environmental activism. Projects occurring within the AWTF post-2036 should consider evaluation of the facility for the NRHP/CRHR.

B/2: Research has shown four figures of historical significance to be related to the construction of the AWTF or its operation. Dr. George Allen, professor and Fisheries Sciences at Humboldt State University; Dr. Robert Gearheart, professor of Environmental Engineering at Humboldt State University; Mr. Dan Hauser, City Council Member and Mayor of the City of Arcata from 1974-1982; and Mr. Frank Klopp, City Engineer since 1968 and Director of Public Works. These individuals were part of the seminal force for the formation of the water treatment plant and several ponds and marshes within the AWTF are named in their honor. Subsequent evaluation efforts warrant further investigation into the roles and responsibilities these individuals had into the formation of the AWTF.

C/3: The materials and construction of the AWTF is considered typical. The treatment plant does not embody a distinctive characteristic of a type, period, or method of construction, does not represent the work of a master; does not possess high artistic values. However, upon reaching the threshold for evaluation in 2036, the facility may represent a significant and distinguishable entity whose components may exhibit engineering distinction.

D/4: The AWTF is regularly maintained and is currently used for treating wastewater derived from within and near the city limits. This facility is unlikely to yield information important in prehistory or history.

NEPA and CEQA mandate that resources older than 50 years may qualify for eligibility on the National Register of Historic Places or the California Register of Historic Resources. Although the plant does not currently meet the age threshold for evaluation consideration, projects undertaken after 2036 may require formal evaluation of the AWTF.

In 2006, Tim Keefe (Senior Environmental Planner and Archaeologist/Caltrans, District 1) determined the AWTF as Ineligible for inclusion in the National Register. This assessment still stands and no additional information value is expected to be provided by facility at this time.

### 6.2.2 Arcata and Mad River Railroad/union Wharf and Plank Walk Company – California Historic Landmark No. 842 (CHL 842)

The background literature review and historic photo analysis revealed that the historic alignment of the Arcata Mad River Railroad - Union Plank Walk and Wharf Company, California's first organized railroad (formally designated CHL 842) built circa 1855, traverses Study Units 1 and 4. The review also indicated that Study Unit 1/Staging area 1 underwent major remediation to remove industrial contaminants and structures. The remediation efforts, along with the construction of the Arcata Marsh, resulted in the removal of all terrestrial features associated with CHL 842 formerly within the APE. The remnant pilings of CHL 842 are located in the waters of Humboldt Bay, outside of the APE.

As a California Historic Landmark Listed resource, no further evaluation is warranted at this time.

As Study Area 1/Staging Area retains no remnants of CHL 842, and Staging Area 4 is completely paved over, this study determines that current Project plans to use these areas for the temporary staging of equipment and materials has no potential to impair any aspect of the historic significance of CHL 842.

# 7.0 Recommendations and Conclusions

## 7.1 CEQA - Finding of No Impacts

CEQA aims to "develop and maintain a high-quality environment now and in the future, and take all action to protect, rehabilitate, and enhance the environmental quality of the state (PRC § 21001)". Historical and tribal cultural resources are part of the environment and as such, a project with an effect that may cause a substantial adverse change in the significance of an historical resource is a project that may have a significant effect on the environment.

One historical property alignment is mapped within the APE (CHL #842). The portion of the property within the APE is limited to a mapped alignment and as such retains no physical remnants within the APE. The remaining physical features associated with CHL #842 are located outside of the APE. Additionally, Project activities in the vicinity of the mapped alignment will not cause sub-surface disturbances. Therefore, this study concludes a **Finding of No Impacts** to historic resources as defined by PRC § 5024.1, Title 14 CCR, Section 482.

## 7.2 NEPA – Finding of No Effects to Historic Properties

This Project is funded in part by State Revolving Funds Program. As such, the project is considered a Federal undertaking and is subject to NEPA and NHPA (as amended, 16 United States Code [USC] 470f). Cultural resources are considered during federal undertakings under Section 106 of NHPA, through its implementing regulations at 36 CFR 800 (Protection of Historic Properties).

One significant historic property alignment is mapped within the APE (CHL #842). The portion of the property within the APE is limited to a mapped alignment and as such retains no physical remnants within the APE. The remaining physical features associated with CHL #842 are located outside of the APE. Additionally, Project activities in the vicinity of the mapped alignment will not cause sub-surface disturbances. Therefore, this study concludes a **Finding of No Effects** to Historic Properties as defined by 36 CFR 800.16 (i).

## 7.3 Native American Consultation & Coordination

As a result of initiating a Sacred Land File & Native American Contacts List Request with the NAHC, DZC has contacted the tribes identified with the APE requesting knowledge of, or concerns for, cultural resources within the APE and Project vicinity.

Communications with, and responses from, the Native American community are included in Appendix B.

The outreach conducted by DZC may be considered Native American coordination. Coordination seeks to solicit information, build partnerships, and identify if and when formal Consultation is needed. Coordination does not substitute for Native American Consultation as defined by Section 106 of the NHPA, which requires government-to-government communications between tribal entities and the Lead Agency.

As the Lead Agency, it is the responsibility of the City of Arcata to formally engage in Consultation with the APE affiliated cultural groups.

## 7.4 Management Considerations

DZC recommends the project proceed with the following stipulations, which should be included on all project plans:

1. It is best practice to avoid cultural resources whenever possible. In cases of inadvertent (unplanned) discovery of cultural resources or human remains, the following procedures are required:
    a. If buried cultural materials are encountered during construction, it is required that work stop in that area until a qualified archaeologist can evaluate the nature and significance of the find [CCR 15064.5(f)].
    b. Immediately notify a qualified archaeologist to evaluate the nature and significance of the find [36 CFR 800.13]. A local archaeologist may be contacted at:

DZC Archaeology and Cultural Resource Consulting, LLC
445 I Street, Suite 204
Arcata, CA. 95521
707-599-9842
dimitra@dzcarc.com

2. If human remains are encountered during future construction, it is required that work stop immediately in that area and notification be made to the Humboldt County Coroner (CCR 15064.5(e) (1) (A); HSC Sec.7050.5).
3. Contact information for the Chief Deputy Coroner office at the time of this report:

Ernest Stewart
Humboldt County Chief Deputy Coroner
3012 I Street, Eureka, CA. 95501
Phone: 707-445-7242

4. If the coroner determines the remains to Native American, the Coroner shall contact the NAHC within 24 hours and collaboratively determine the Most Likely Descendant (CCR 15064.5(e)(1)(B)

The information and results contained in this document are based on the existing information provided to the archaeological firm as of August 29, 2019. Additional survey will be required if the project changes to include areas not previously surveyed.

# 8.0 REFERENCES

Angeloff, Nick and Lynette Mullen. 2016. A Cultural Resources Investigation of the Arcata Wastewater Inflow and Infiltration Project, Arcata, Humboldt County, California (S-050908). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Angeloff, Nick and James Roscoe. 2004. A Cultural Resources Investigation of the Daylighting of Jolly Giant Creek Project, located in Humboldt County, California (S-041725). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Bailey, E. H., W. P. Irwin, and D. L. Jones. 1964. Franciscan and related rocks and their significance in the geology of western California. California Div. Mines and Geology Bull. 183: 177.

Belcher Abstract & Title Company. 1922. Historic Map of Humboldt County. Atlas of Humboldt County; Sheet No. 16. Eureka, CA.

Coleman, Jason A. 2011. Cultural Resources Survey Report for the South G Street (Christie) WRP Project, Humboldt County, California (S-040249). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Doolittle, A.J. 1865. Historic Map of Humboldt County. A.J. Doolittle, San Francisco, CA.

Douglas, Barry K. 1984. Archaeological Survey Report, Butcher's Slough Wetlands Restoration Project, Arcata, California (S-006669). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Douglas, Barry Kevin. 1984. Archaeological Survey Report for a proposed sewage collection system for Bayside in Arcata, California (S-000643). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Eidsness, Janet P. 1988. A Summary of Cultural Resources Projects, Redwood National Park. Purchase Order No.1PX8480-7-0217, PX8480-7-0689, PX8480-8-0316. On file with Redwood National Park, Orick, California.

Esther Scott and Leslie Brunetta. 1989. Wastewater Wars. Havard Kennedy School Case Program. Electronic article accessed November 18, 2019. https://case.hks.harvard.edu/wastewater-wars/

FEMA – Federal Emergency Management Agency. 2016. National Flood Hazard Layer. Map Number 0645C1800F. Online database. FEMA Flood Map Service Center. Accessed July 25, 2019. https://msc.fema.gov/portal.

Fenega, Franklin. 1968. Review of University of California Archaeological Survey, No. 62, University of California. Archaeological Research Facility, Department of Anthropology, University of California, Berkeley.

Forbes, Stanly. 1886. Forbes Official Map of Humboldt County. Stanly Forbes Company.

Fredrickson, David A. 1984. Geysers Cultural Resources Management Plan: Prehistoric Archaeology. Bureau of Land Management, Ukiah district office.

Fredrickson, David A., Sonia Tomez, and Pamela R. Roberts. 1975. An Archaeological Survey of the Proposed McKinleyville Sewage Collection and Treatment Facility (S-000132). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Fukutomi, David. 1999. Archaeological Survey for City of Arcata, Janes Creek culvert and Drainage Improvements, FEMA HMGP #1008-6283 (letter report) (S-022314). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

GLO – General Land Office Records

1867. Teremater, Marc, State Volume Patent CA0910_.419, November 20, 1867. Bureau of Land Management. Online database. Accessed November 4, 2019. GLORecords.blm.gov.

1903. State of California. Serial Patent CACAAA 140332, January 12, 1903. Bureau of Land Management. Online database. Accessed November 4, 2019. GLORecords.blm.gov.

Hanson, I. 2004. The Importance of Stratigraphy in Forensic Investigation. In Forensic Geoscience: Principles, Techniques and Applications. Pye, K., Croft, D.J. (eds.), Geological Society Specialty Publications, pp. 5.

Hayes, John F., David A. Fredrickson, Adrian Praetzelis, and Mary Praetzelis. 1980. Description and Analysis of Prehistoric and Historic Artifacts from Archaeological Sites Within Redwood National Park, California. On file with Redwood National Park, Orick, California.

Hayes, John F., David A. Fredrickson, and Thomas M. Origer. 1985. An Analysis of Redwood National Park Artifacts. Pursuant to Purchase Orders No. PX 8480-5-0169 & PX 8480-5-0302. On file with Redwood National Park, Orick, California.

Heald, Leslie S. 2002. Historic Property Survey, Archaeological Survey, and Historical Resources Evaluation Reports, Highway 255 Gateway Improvements, CALTRANS District 1, Humboldt County, CA (S-041786). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Heizer, R.F., and A.B. Elsasser. 1964. Archaeology of Hum-67, the Gunther Island Site in Humboldt Bay, California. University of California Archaeological Survey Reports 61:1-122. Berkeley.

Hildebrandt, William R. and John F. Hayes. 1983. Archaeological Investigations on Pilot Ridge, Six Rivers National Forest. Six Rivers National Forest, Eureka.

Hughes, Richard. 1978. Aspects of Prehistoric Wiyot Exchange and Rank. Journal of California Anthropology 5(1):53-66.

Jones, Terry L. and Kathryn A. Klar. 2007. California Prehistory: Colonization, Culture, and Complexity. Altamira Press. Plymouth, U.K.

Justice, Noel D. 2002. Stone Age Spear and Arrow Points. Indiana University Press, Bloomington, Indiana.

Keefe, Timothy. 2006. Historic Property Survey Report for the Proposed Eureka-Arcata Corridor Projects on California State Highway 101 at Post Mile 79.9/86.3 in Humboldt County, California (S-038304). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Köppen, Wladimir. 1936. A Geographic System of Climates. Rudolf Greiger, Berlin: Borntraegar.

Kroeber, A. 1909. Classification Systems of Relationships. The Journal of Royal Anthropological Institute of Great Britain and Ireland, Vol. 39 (Jan-Jun. 1909). pp 77-84

Kroeber, 1976, Handbook of the Indians of California (reprint of 1925 publication). Bulletin No. 78 of the Bureau of American Ethnology, Smithsonian Institution, Washington D.C.

Lentell, J. N. 1914. Historic Map of Humboldt County, California. Britton and Rey. San Francisco, CA.

Loud, L.L. 1918. Ethnography and Archaeology of the Wiyot Territory. University of California publication in American Archaeology and Ethnology, Vol. 14, No. 3, pp. 221-436, plates 1-21, 15 text-figs. Dec 23, 1918.

Mayer, Kenneth E. and William F. Laudenslayer, Jr. 1988. A Guide to Wildlife Habitats of California. State of California, Resources Agency, Department of Fish and Game, Sacramento, California.

Meighan, C. W. and C. V. Haynes, Jr. 1968. New Studies on the Age of the Borax Lake Site. Southwest Museum, Masterkey 42: 4-9.

Moratto, Michael J. 1984. California Archaeology. San Francisco: Academic Press, Inc.

Most, Stephen. 2006. River of Renewal. Oregon Historical Society in association with University of Washington Press, Seattle and London.

Martin, Leigh. 2004. Archaeological Assessment of a 1.5-Acre Parcel (APN 367-180-010), Located at 915 Deer Creek Drive, Martinez, Contra Costa County, California (letter report) (S-029030). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

NETR – National Environmental Title Research. United States Geological Survey Historic Topographic Map, Arcata South Quadrangle. Online database. Site accessed on November 4, 2019. http://www.historicaerials.com/.

NETR – National Environmental Title Research. Aerial Photo; Arcata, California. Online database. Site accessed on November 4, 2019. http://www.historicaerials.com/.

2015. United States Geological Survey Historic Topographic Map, Arcata South Quadrangle. Online database. Site accessed on November 4, 2019. http://www.historicaerials.com/.

2016. Aerial Photo; Arcata, California. Online database. Site accessed on November 4, 2019. http://www.historicaerials.com/.

Pursell Jr., Carroll W. 1981. Historical and Technological Significance of the Humboldt Bay Jetties, Humboldt Bay, California (S-017469). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Rich, William, James Roscoe, and Susan Van Kirk. 2003. A Cultural Resources Investigation of the Proposed McDaniel Slough Marsh Enhancement Project, Located near Arcata, Humboldt County, California (S-037718). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Roscoe, James M. 1992. An Archaeological Investigation of Assessor's Parcel Number 21-184-05, Located in Arcata, Humboldt County, California (S-014210). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Roscoe, J. 1993. A Cultural Resources Study of the Proposed Marsh Commons Project, Located in Arcata, California (S-015199). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Roscoe, James and William Rich. 2012. A Cultural Resources Investigation of three Coastal Access Points for the Humboldt Bay Water Trails Implementation Program, Located in Humboldt County, California (S-048287). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Strand, Rudolph. 1962. Geologic Atlas of California – Redding Sheet. Geologic Atlas of California. Map No. 011, 1:250,000 scale. California Geologic Survey.

Suutari, Amanda. 2006. USA – California (Arcata) – Constructed Wetland: A Cost-Effective Alternative for Wastewater Treatment. Online article. Accessed November 18, 2019. http://www.ecotippingpoints.org/our-stories/indepth/usa-california-arcata-constructed-wetland-wastewater.html

USDA – United States Department of Agriculture. 2019. Soil Survey Geographic database Soil Map; ESL boundary. Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Online database. Accessed July 24, 2019.https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx.

Van Kirk, Susie. 2015. Arcata Marsh History: Union Wharf, Mad River Canal, Reclamation, Lumber Mills, City Designs. On file, Humboldt State University Digital Commons: Susie Van Kirk Papers. Accessed November 4, 2019. https://digitalcommons.humboldt.edu/svk.

Wagner, D. L. 2002. California Geomorphic Provinces. Sacramento, California: California Department of Conservation, California Geological Survey.

Whistler, K.W. 1979. Linguistic Prehistory of the Northwestern California Coastal Area. In A Study of Cultural Resources in Redwood National Park, California, P. McW. Bickel, ed.

White, Greg. 1999. Research Design for Archaeological Investigations in the Cache Creek Primitive Area, Bureau of Land Management, Ukiah Office. CSU Chico Archaeological Research Program.

Wylie, Henry G. 1976. Pilot Ridge Survey; A Graphic Summary of Borax Lake Points and Other Materials from the Six Rivers National Forest, Humboldt County, California. Paper presented at the annual meeting of the Society for California Archaeology, San Diego, California.

# Appendix A

## Project Maps

Figure A-3 Treatment Wetlands Site Plan



Figure A-4 Enhancement Wetlands Site Plan

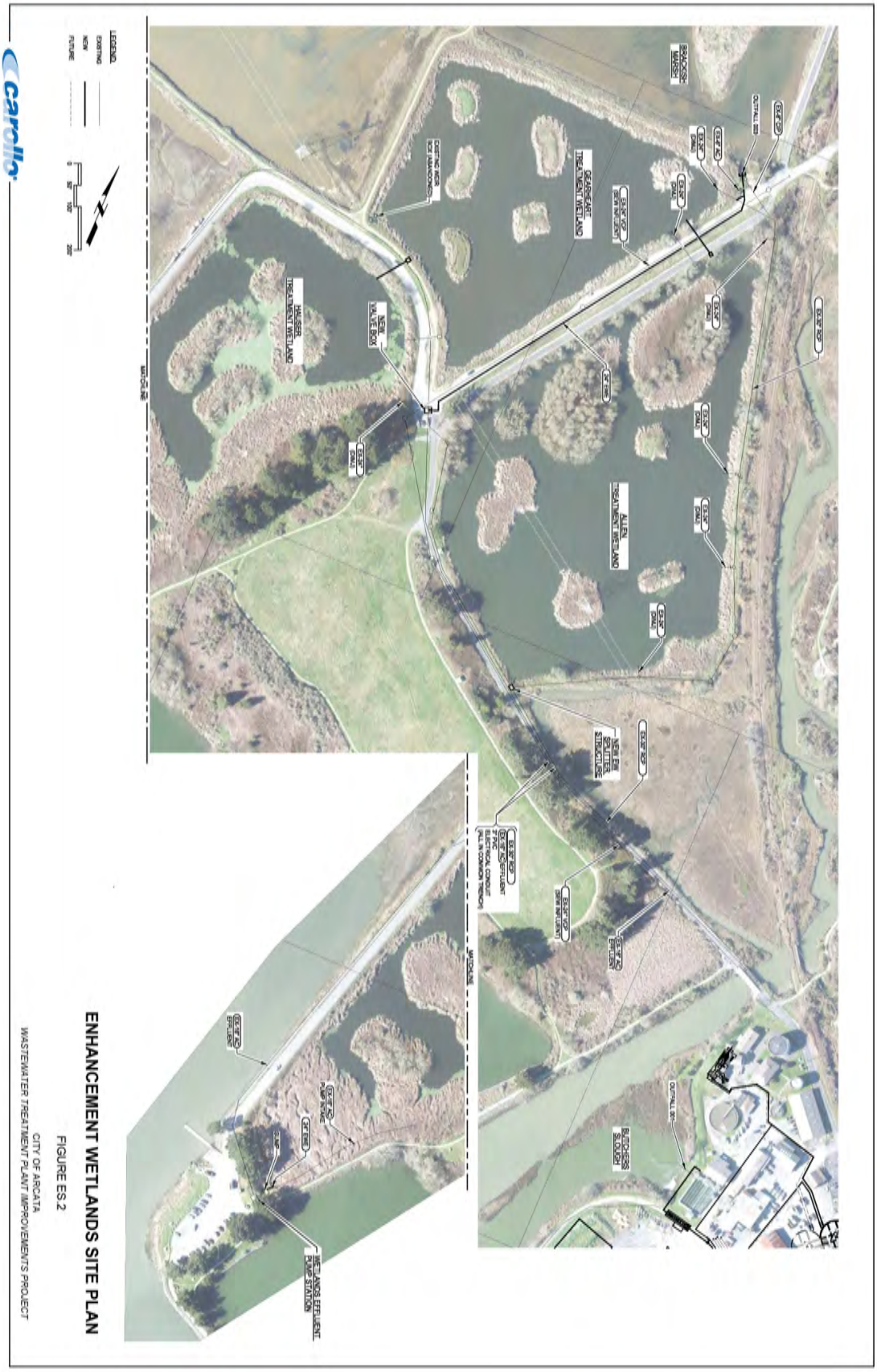

ENHANCEMENT WETLANDS SITE PLAN
FIGURE ES.2
CITY OF ARCATA
WASTEWATER TREATMENT PLANT IMPROVEMENTS PROJECT
carollo
LEGEND
EXISTING
NEW
FUTURE
GEARHEART TREATMENT WETLAND
ALLEN TREATMENT WETLAND
HAUSER TREATMENT WETLAND
EXISTING AGS OXIDATION DITCHES
BUTCHERS SLOUGH
MAD RIVER SLOUGH
OUTFALL 001
OUTFALL 002
WETLANDS EFFLUENT PUMP STATION
WETLANDS EFFLUENT FLOW METER
WETLANDS EFFLUENT PUMP STATION
WETLANDS EFFLUENT SPLITTER
WETLANDS EFFLUENT VALVE BOX
WETLANDS EFFLUENT SPLITTER
WETLANDS EFFLUENT SPLITTER
WETLANDS EFFLUENT SPLITTER

Figure A-5 Central Site Plan

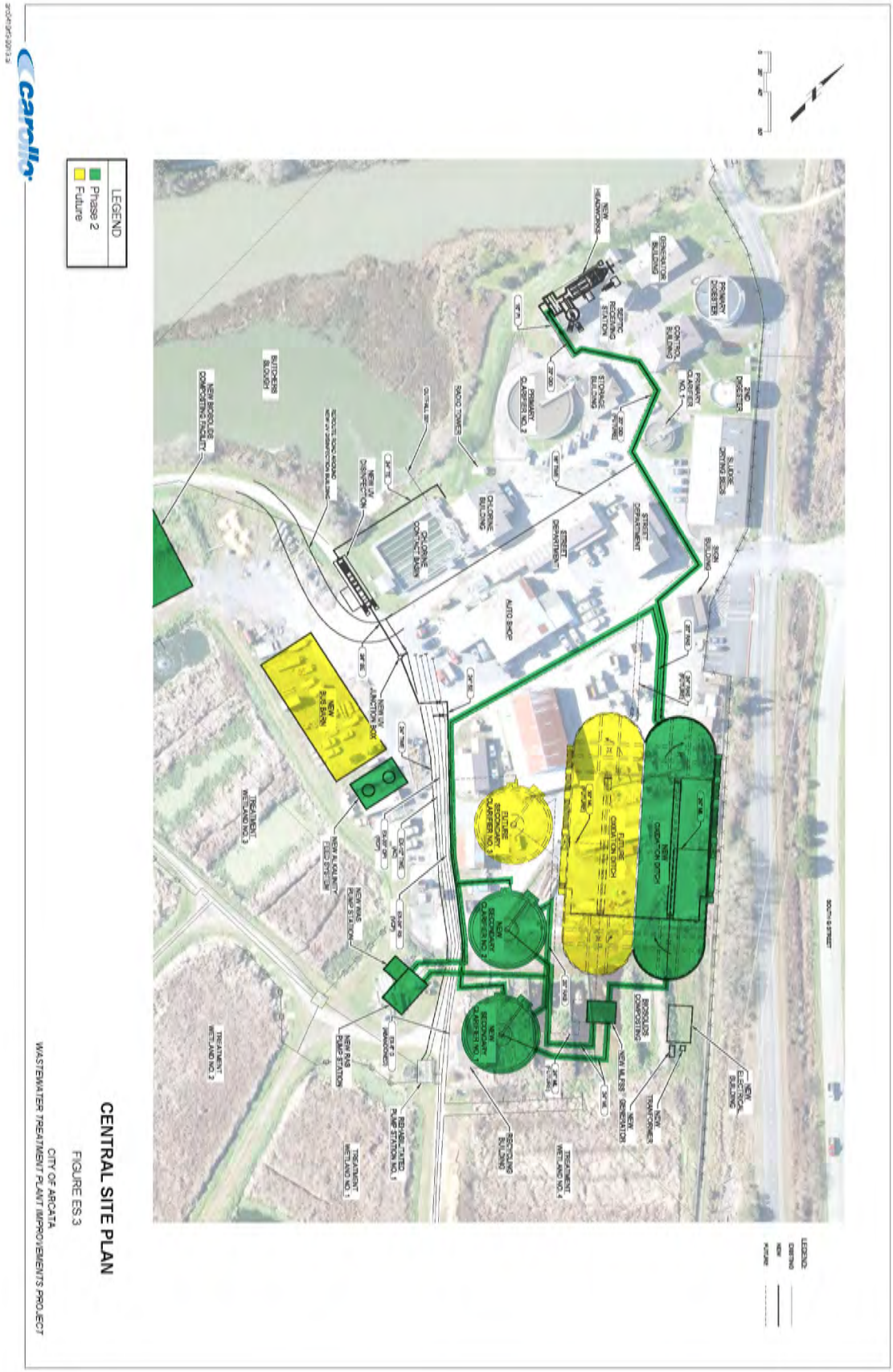


Figure A-6 Process Flow Diagram

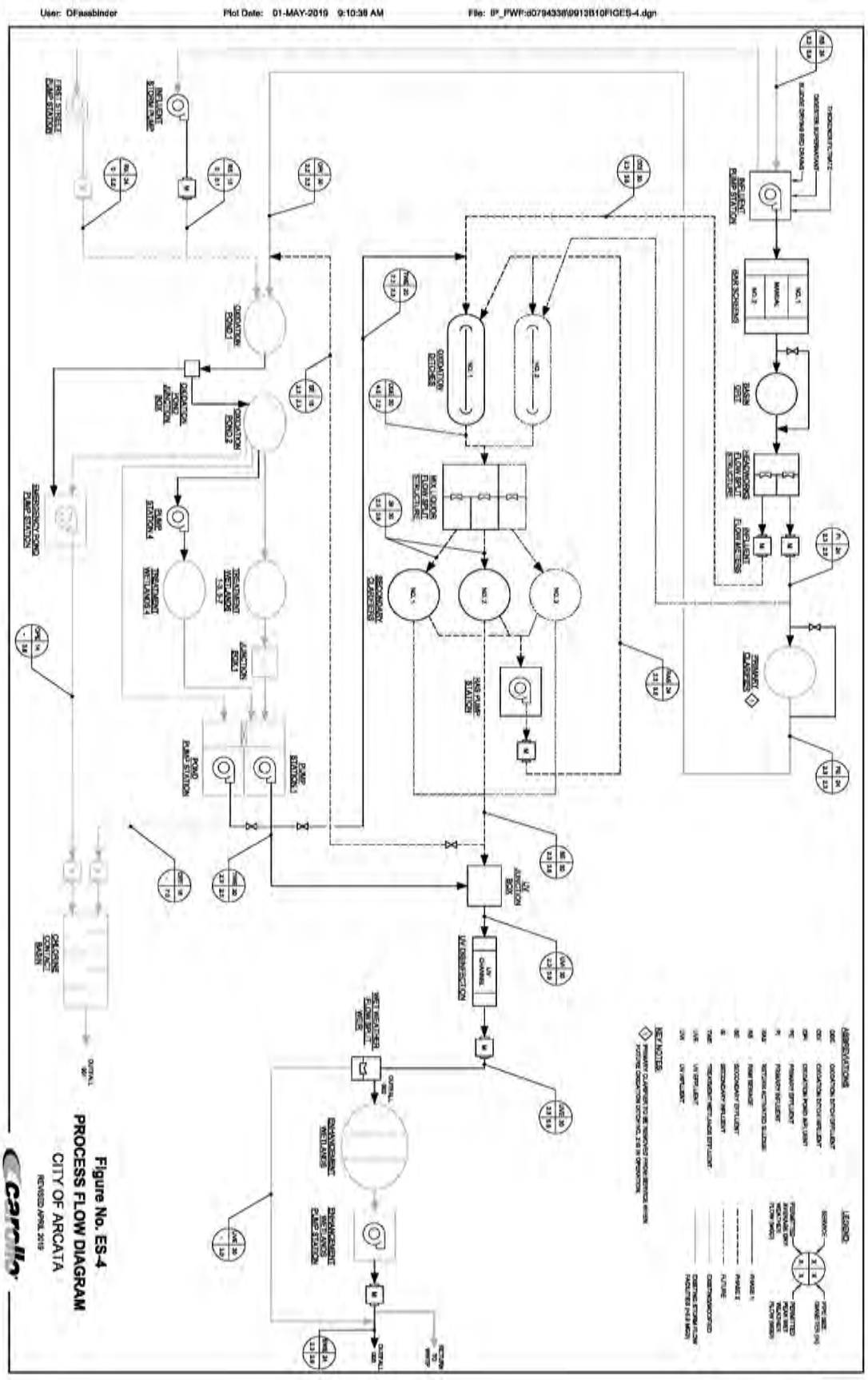
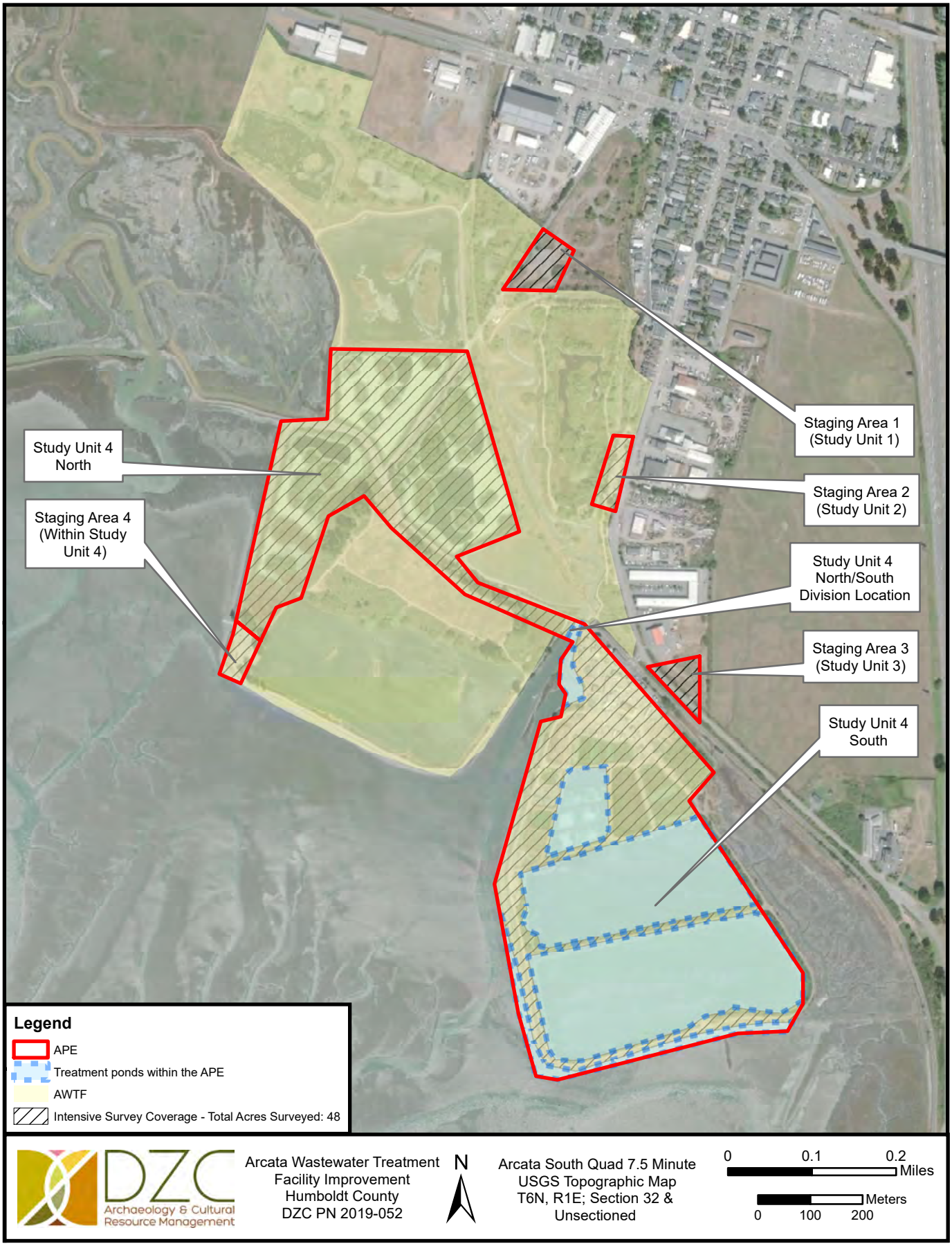


Figure A-7 Archaeological Survey Coverage



# Appendix B

## Native American Coordination

# Sacred Lands File & Native American Contacts List Request

**NATIVE AMERICAN HERITAGE COMMISSION**
1550 Harbor Blvd, Suite 100
West Sacramento, CA 95501
(916) 373-3710
(916) 373-5471 – Fax
nahc@nahc.ca.gov

*Information Below is Required for a Sacred Lands File Search*

Project: Arcata Wastewater Treatment Facility Improvements

County: Humboldt

USGS Quadrangle

Name: Arcata South

Township: 6 N Range: 1 E Section(s): Unsectioned

Company/Firm/Agency:

DZC Archaeology & Cultural Resource Consulting

Contact Person: Dimitra Zalarvis-Chase

Street Address: 455 I Street, Suite 204

City: Arcata, CA Zip: 95521

Phone: (707) 599-9842 Extension:

Fax:

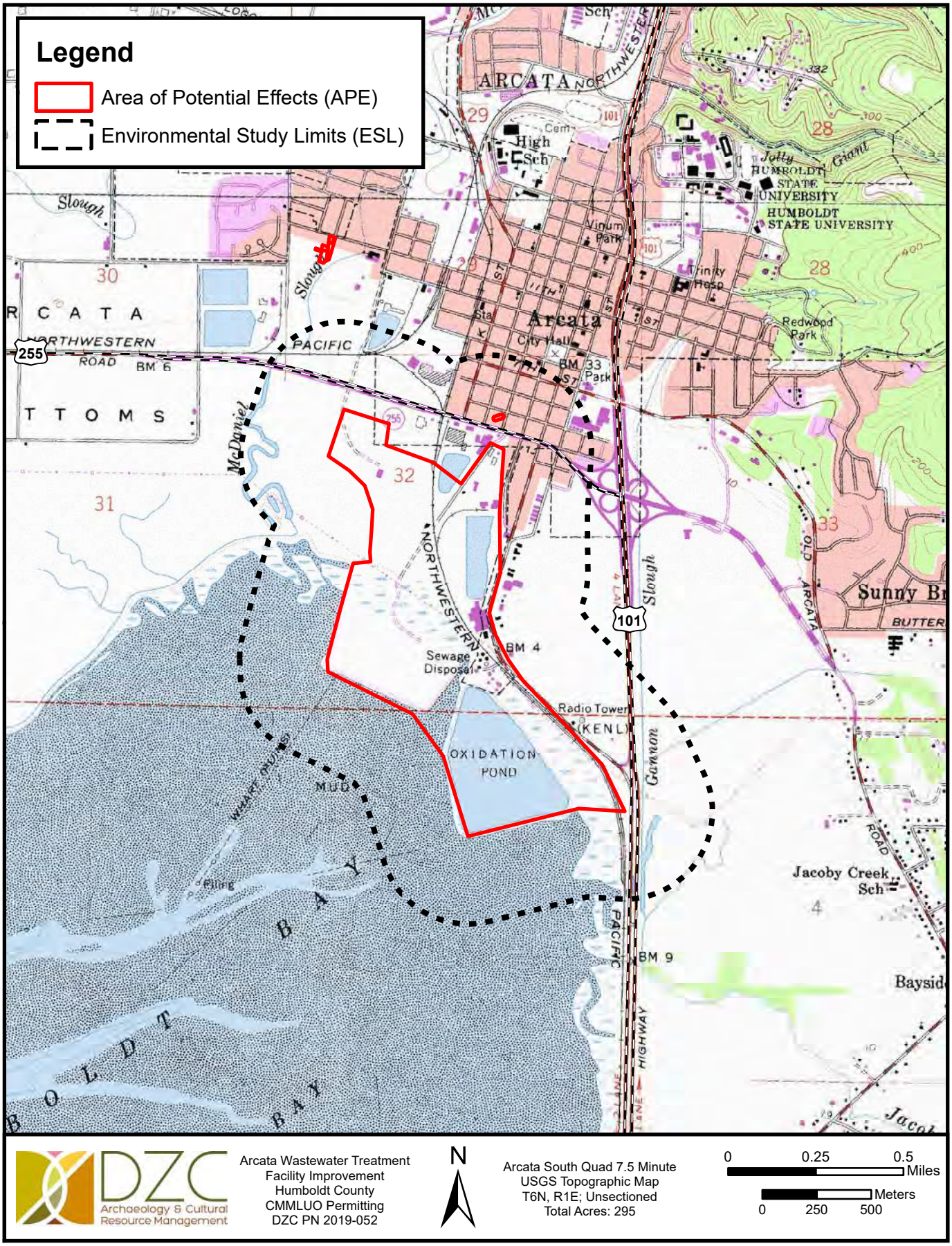
Email: Dimitrazc@gmail.com

Project Description:

DZC Archaeology & Cultural Resource Consulting has been retained by the City of Arcata in support of the proposed improvements at the Arcata Wasterwater Treatment Facility. The improvements are meant to increase the capacity and functioning capabilities of the facility. A map of the project location is attached.

☑ Project Location Map is attached

Figure A-2 Project Location & ESL




DZC Archaeology & Cultural Resource Management

Arcata Wastewater Treatment
Facility Improvement
Humboldt County
CMMLUO Permitting
DZC PN 2019-052

N

Arcata South Quad 7.5 Minute
USGS Topographic Map
T6N, R1E; Unsectioned
Total Acres: 295

0 0.25 0.5 Miles

0 250 500 Meters

**NATIVE AMERICAN HERITAGE COMMISSION**
**Cultural and Environmental Department**
**1550 Harbor Blvd., Suite 100**
**West Sacramento, CA 95691 Phone: (916) 373-3710**
**Email: nahc@nahc.ca.gov**
**Website: http://www.nahc.ca.gov**

September 19, 2019

Dimitra Zalaris-Chase
DZC Archaeology & Cultural Resource Consulting

VIA Email to: Dimitrazc@gmail.com

RE: Arcata Wastewater Treatment Facility Improvements, Humboldt County.

Dear Ms. Zalarvis-Chase:

A record search of the Native American Heritage Commission (NAHC) Sacred Lands File (SLF) was completed for the information you have submitted for the above referenced project. The results were negative. However, the absence of specific site information in the SLF does not indicate the absence of cultural resources in any project area. Other sources of cultural resources should also be contacted for information regarding known and recorded sites.

Attached is a list of Native American tribes who may also have knowledge of cultural resources in the project area. This list should provide a starting place in locating areas of potential adverse impact within the proposed project area. I suggest you contact all of those indicated; if they cannot supply information, they might recommend others with specific knowledge. By contacting all those listed, your organization will be better able to respond to claims of failure to consult with the appropriate tribe. If a response has not been received within two weeks of notification, the Commission requests that you follow-up with a telephone call or email to ensure that the project information has been received.

If you receive notification of change of addresses and phone numbers from tribes, please notify me. With your assistance, we can assure that our lists contain current information. If you have any questions or need additional information, please contact me at my email address: katy.sanchez@nahc.ca.gov.

Sincerely,

Katy Sanchez

KATY SANCHEZ
Associate Environmental Planner

Attachment

**Native American Heritage Commission**
**Native American Contacts List**
**9/20/2019**

Bear River Band of the Rohnerville Rancheria
Barry Brenard, Chairperson
266 Keisner Road
Loleta ,CA 95551
(707) 733-1900
(707) 733-1727 Fax
Wiyot
Mattole

Blue Lake Rancheria
Claudia Brundin, Chairperson
P.O. Box 428
Blue Lake ,CA 95525
lalbright@bluelakerancheria-nsn.gov
(707) 668-5101
(707) 668-4272 Fax
Wiyot
Yurok
Tolowa

Blue Lake Rancheria
Janet Eidsness, Historic Preservation Officer
P.O. Box 428
Blue Lake ,CA 95525-042
jeidsness@bluelakerancheria-nsn.gov
(707) 668-5101 ext. 1037
707-668-4272 - Fax
Wiyot
Yurok
Tolowa

Blue Lake Rancheria
Jacob Pounds, Assistant THPO
P.O. Box 428
Blue Lake ,CA 95525
jpounds@bluelakerancheria-nsn.gov
(707) 668-5101 ext 1038
Wiyot
Yurok
Tolowa

Cher-Ae Heights Indian Community of the Trinidad Rancheria
Garth Sundberg Sr., Chairperson
P.O. Box 630
Trinidad ,CA 95570-063
gsundberg@TrinidadRancheria.com
(707) 677-0211 Office
(707) 677-3921 Fax
Yurok
Karuk
Tolowa
Wiyot

Wiyot Tribe
Ted Hernandez, Chairperson
1000 Wiyot Drive
Loleta ,CA 95551
ted@wiyot.us
(707) 733-5055
(707) 733-5601 Fax
Wiyot

**This list is current as of the date of this document and is based on the information available to the Commission on the date it was produced.**

**Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code,Section 5097.94 of the Public Resources Code, or Section 5097.98 of the Public Resources Code.**

**This list is only applicable for contacting local Native Americans Tribes for the proposed: Arcata Wastewater Treatment Facility Improvements, Humboldt County.**

**NATIVE AMERICAN HERITAGE COMMISSION**
**Cultural and Environmental Department**
**1550 Harbor Blvd., Suite 100**
**West Sacramento, CA 95691 Phone: (916) 373-3710**
**Email: nahc@nahc.ca.gov**
**Website: http://www.nahc.ca.gov**

September 19, 2019

Dimitra Zalarvis-Chase
DZC Archaeology & Cultural Resource Consulting

VIA Email to: Dimitrazc@gmail.com

RE: Northern Realm, Humboldt County.

Dear Ms. Zalarvis-Chase:

A record search of the Native American Heritage Commission (NAHC) Sacred Lands File (SLF) was completed for the information you have submitted for the above referenced project. The results were negative. However, the absence of specific site information in the SLF does not indicate the absence of cultural resources in any project area. Other sources of cultural resources should also be contacted for information regarding known and recorded sites.

Attached is a list of Native American tribes who may also have knowledge of cultural resources in the project area. This list should provide a starting place in locating areas of potential adverse impact within the proposed project area. I suggest you contact all of those indicated; if they cannot supply information, they might recommend others with specific knowledge. By contacting all those listed, your organization will be better able to respond to claims of failure to consult with the appropriate tribe. If a response has not been received within two weeks of notification, the Commission requests that you follow-up with a telephone call or email to ensure that the project information has been received.

If you receive notification of change of addresses and phone numbers from tribes, please notify me. With your assistance, we can assure that our lists contain current information. If you have any questions or need additional information, please contact me at my email address: katy.sanchez@nahc.ca.gov.

Sincerely,

Katy Sanchez

KATY SANCHEZ
Associate Environmental Planner

Attachment

**Native American Heritage Commission**
**Native American Contacts List**
**9/20/2019**

Bear River Band of the Rohnerville Rancheria
Barry Brenard, Chairperson
266 Keisner Road
Loleta ,CA 95551
(707) 733-1900
(707) 733-1727 Fax

Wiyot
Mattole

Round Valley Reservation/ Covelo Indian Community
James Russ, President
77826 Covelo Road
Covelo ,CA 95428
tribalcouncil@rvit.org
(707) 983-6126
(707) 983-6128 Fax

Yuki ; Nomlaki
Pit River
Pomo
Concow
Wailaki; Wintun

**This list is current as of the date of this document and is based on the information available to the Commission on the date it was produced.**

**Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code,Section 5097.94 of the Public Resources Code, or Section 5097.98 of the Public Resources Code.**

**This list is only applicable for contacting local Native Americans Tribes for the proposed: Northern Realm, Humboldt County.**

Date
October 10, 2019

***REQUEST FOR COMMENT***

**TO:** Barry Brenard, Chairperson, Celeste Ruiz, Executive Secretary, and Erika Cooper, THPO, Bear River Band of the Rohnerville Rancheria
Claudia Brundin, Chairperson, Janet Eidsness, THPO, and Jacob Pounds, Assistant THPO, Blue Lake Rancheria,
Garth Sundberg, Sr., Chairperson, Cher-Ae-Heights Indian Community of the Trinidad Rancheria
Ted Hernandez, Chairperson, Wiyot Tribe

**FROM:** Dimitra Zalarvis-Chase, Archaeologist

**EMAIL:** dimitrazc@gmail.com

**PHONE:** (707) 599-9842

**PROPOSED PROJECT:** Arcata Wastewater Treatment Facilities Improvements

**SITE LOCATION:** Arcata South 7.5-Minute Quad; T6N, R1E, Section 32

**SITE SIZE:** 295 ± acres

DZC Archaeology and CRM Consulting is conducting the necessary records search and comment solicitation pursuant to the California Environmental Quality Act, and AB 52.

The proposed project is to improve the Arcata Wastewater Treatment Facilities infrastructure with the addition of a new secondary treatment system.

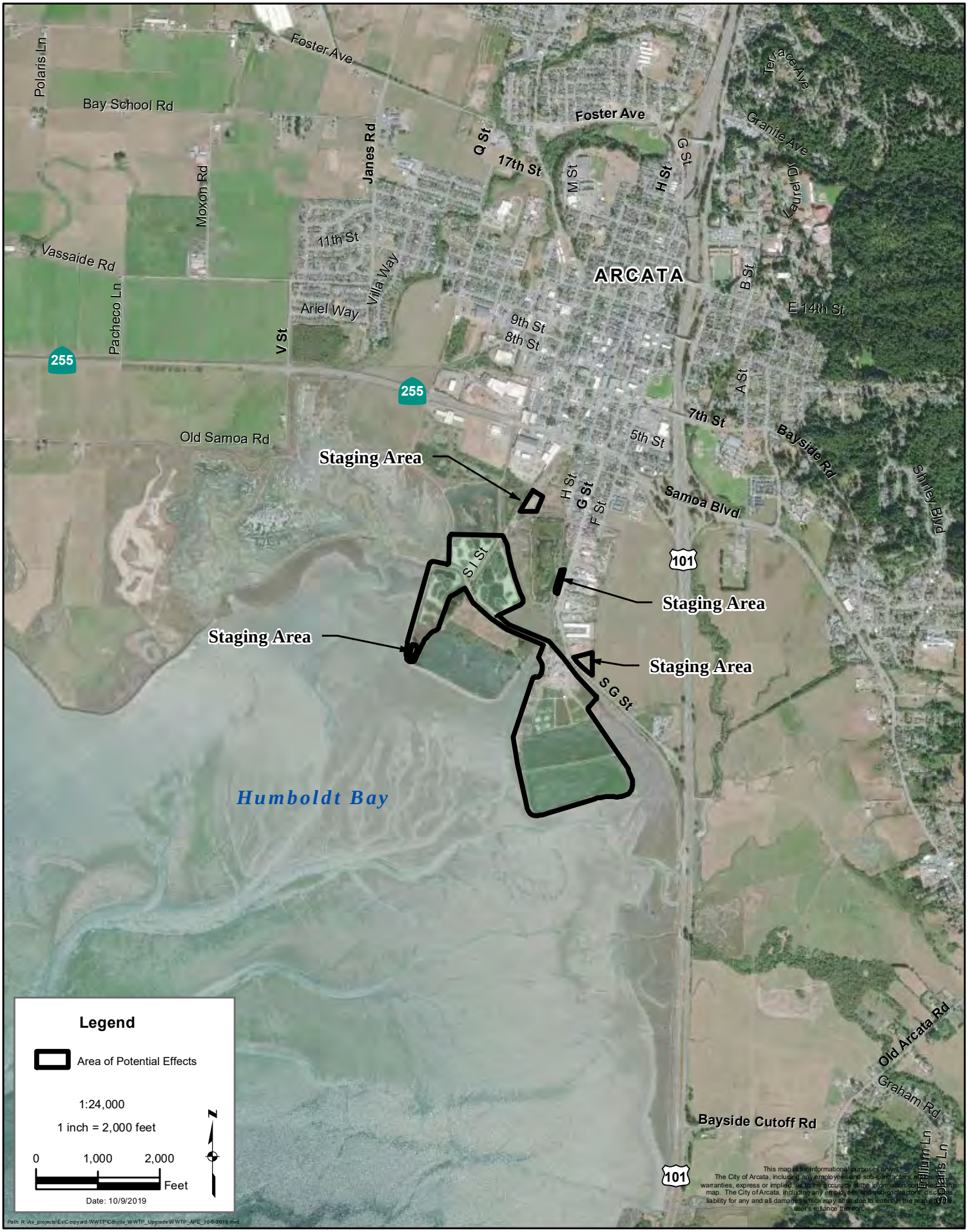
We would appreciate any information you could provide regarding known cultural resources in the project vicinity. If we have not received a response within 30 days from the date of this letter, we will assume you have no concerns or information to provide.

If this project is outside of your tribal area of sensitivity, please **also** contact the Native American Heritage Commission to refine your area of concern and avoid unwanted project notifications.

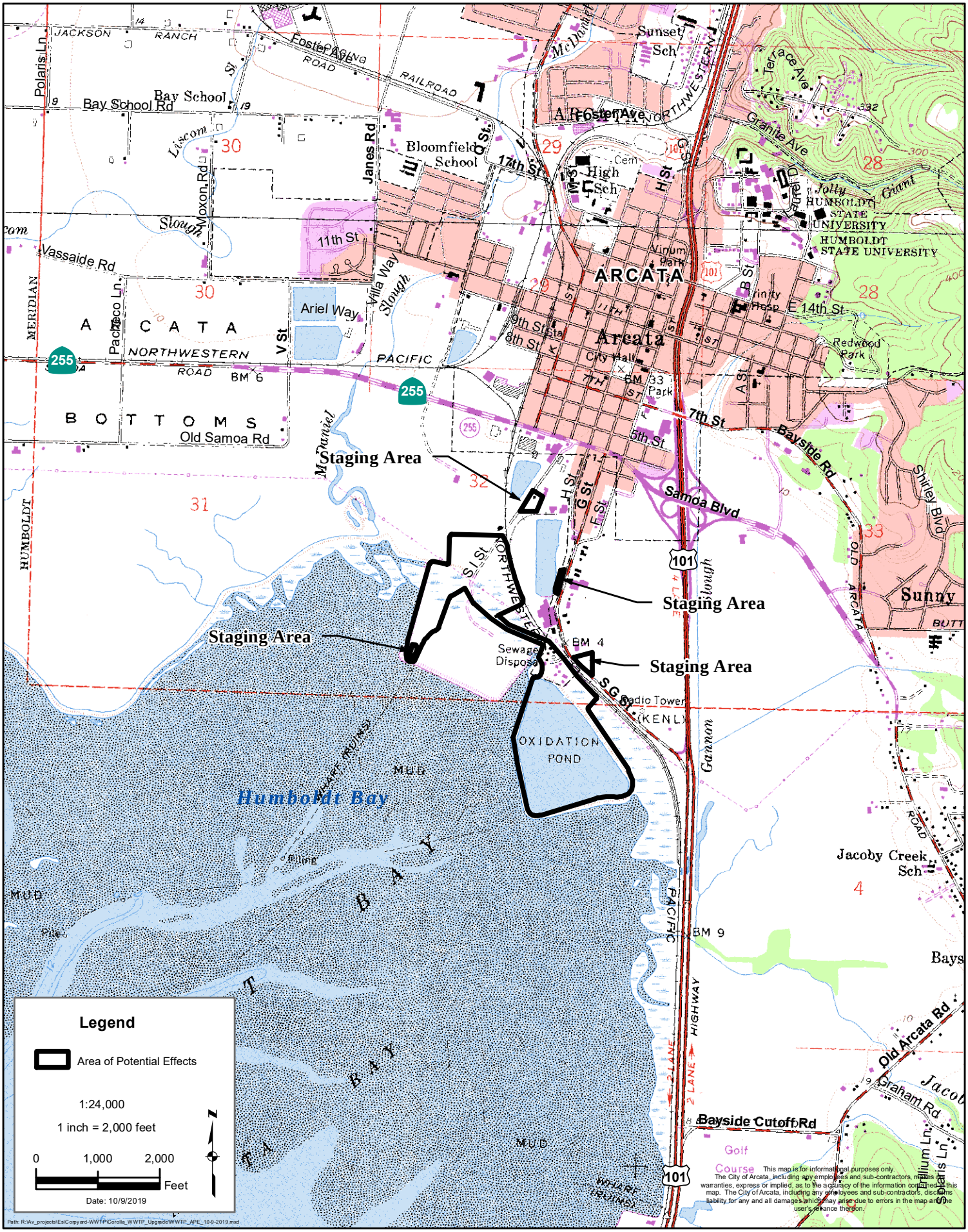
Thank you for your assistance.
Dimitra Zalarvis-Chase

Enclosed: Project Vicinity Map, Project Location Map

# Area of Potential Effects
# Arcata Wastewater Treatment Upgrade



# Area of Potential Effects
# Arcata Wastewater Treatment Upgrade



# Appendix C

## Northwest Information Center Correspondence

# Report Detail: S-000132

## Identifiers

*Report No.:* S-000132
*Other IDs:*
*Cross-refs:*

## Citation information

*Author(s):* David A. Fredrickson, Sonia Tamez, and Pamela R. Roberts
*Year:* 1975 (Mar)
*Title:* An Archaeological Survey of the Proposed McKinleyville Sewage Collection and Treatment Facility
*Affliliation:* The Anthropology Laboratory, California State College, Sonoma
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Field study
*Inventory size:* c 3660 ac + 25.50 li mi
*Disclosure:* Not for publication
*Collections:* No

## General notes

There was no surface evidence of a reported prehistoric site.

## Associated resources

| *Primary No.* | *Trinomial* | *Name* |
|---|---|---|
| P-12-000064 | CA-HUM-000006 | Loud 6, chumi' djome |
| P-12-000081 | CA-HUM-000023 | Loud 23, Digawethatkil - Tekewe |
| P-12-000083 | CA-HUM-000025 | Loud 25 |
| P-12-000097 | CA-HUM-000039 | Loud 39, mipa't |

*No. resources:* 4
*Has informals:* Yes

## Location information

*County(ies):* Humboldt
*USGS quad(s):* Arcata North, Arcata South, Eureka, Tyee City
*Address:*
*PLSS:*

## Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 4/7/2005 | nwic-main |
| *Last modified:* | 11/13/2017 | raelync |

*IC actions:*

| *Date* | *User* | *Action taken* |
|---|---|---|
| 4/7/2005 | jay | Appended records from NWICmain bibliographic database. |
| 1/13/2016 | hagell | edited notes |
| 11/13/2017 | raelync | Mapped in both Rep Poly and Approx to capture that access was not granted to portions of the northern area surveyed. |

*Record status:* Verified

# Report Detail: S-006403

### Identifiers

*Report No.:* S-006403
*Other IDs:*
*Cross-refs:*

### Citation information

*Author(s):* Barry Kevin Douglas
*Year:* 1984 (Feb)
*Title:* Archaeological Survey Report for a proposed sewage collection system for Bayside in Arcata, California
*Affliliation:*
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Field study
*Inventory size:*
*Disclosure:* Not for publication
*Collections:* No

### General notes

### Associated resources

*No. resources:* 0
*Has informals:* No

### Location information

*County(ies):* Humboldt
*USGS quad(s):* Arcata South
*Address:*
*PLSS:*

### Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 4/7/2005 | nwic-main |
| *Last modified:* | 5/30/2019 | hagell |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 4/7/2005 | jay | Appended records from NWICmain bibliographic database. |
| | 2/10/2015 | mikulikc | database incomplete: no affiliation submitted |

*Record status:* Verified

# Report Detail: S-006669

### Identifiers

*Report No.:* S-006669
*Other IDs:*
*Cross-refs:*

### Citation information

*Author(s):* Barry K. Douglas
*Year:* 1984 (Jun)
*Title:* Archaeological Survey Report, Butcher's Slough Wetlands Restoration Project, Arcata, California
*Affliliation:*
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Excavation, Field study
*Inventory size:* 30 ac.
*Disclosure:* Not for publication
*Collections:* No

### General notes

### Associated resources

| | *Primary No.* | *Trinomial* | *Name* |
|---|---|---|---|
| | P-12-000100 | CA-HUM-000042 | Loud 42 |

*No. resources:* 1
*Has informals:* No

### Location information

*County(ies):* Humboldt
*USGS quad(s):* Arcata South
*Address:*
*PLSS:* T6N R1E Sec. 32 MDBM

### Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 4/7/2005 | nwic-main |
| *Last modified:* | 11/15/2017 | moored |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 4/7/2005 | jay | Appended records from NWICmain bibliographic database. |
| | 11/13/2017 | raelync | no affiliation provided; added resource to list; |

*Record status:* Verified

# Report Detail: S-014210

### Identifiers

*Report No.:* S-014210
*Other IDs:*
*Cross-refs:*

### Citation information

*Author(s):* James M. Roscoe
*Year:* 1992 (Jun)
*Title:* An Archaeological Investigation of Assessor's Parcel Number 21-184-05, Located in Arcata, Humboldt County, California
*Affliliation:*
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Field study
*Inventory size:* c 0.3 ac
*Disclosure:* Not for publication
*Collections:* No

### General notes

### Associated resources

*No. resources:* 0
*Has informals:* No

### Location information

*County(ies):* Humboldt
*USGS quad(s):* Arcata South

| *Address:* | *Address* | *City* | *Assessor's parcel no.* | *Zip code* |
|---|---|---|---|---|
| | Samoa Boulevard | Arcata | 21-184-05 | |

*PLSS:*

### Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 4/7/2005 | nwic-main |
| *Last modified:* | 11/15/2017 | moored |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 4/7/2005 | jay | Appended records from NWICmain bibliographic database. |
| | 11/14/2017 | raelync | no affiliation provided |

*Record status:* Verified

# Report Detail: S-015199

## Identifiers

*Report No.:* S-015199
*Other IDs:*
*Cross-refs:*

## Citation information

*Author(s):* James Roscoe
*Year:* 1993 (Jun)
*Title:* A Cultural Resources Study of the Proposed Marsh Commons Project, Located in Arcata, California
*Affliliation:*
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Field study
*Inventory size:* c 1.5 ac
*Disclosure:* Not for publication
*Collections:* No

## General notes

The parcel APN's listed in the report have been subdivided into approx 14 parcels.

## Associated resources

*No. resources:* 0
*Has informals:* No

## Location information

*County(ies):* Humboldt
*USGS quad(s):* Arcata South

| *Address:* | *Address* | *City* | *Assessor's parcel no.* | *Zip code* |
|---|---|---|---|---|
| | | | 503-241-18 | |
| | | | 503-241-19 | |
| | | | 503-241-20 | |

*PLSS:*

## Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 4/7/2005 | nwic-main |
| *Last modified:* | 11/16/2017 | hagell |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 4/7/2005 | jay | Appended records from NWICmain bibliographic database. |
| | 4/2/2015 | mikulikc | database incomplete: no affiliation submitted |

*Record status:* Verified

# Report Detail: S-017469

## Identifiers

*Report No.:* S-017469

| *Other IDs:* | *Type* | *Name* |
|---|---|---|
| | Agency Nbr | DACW07-E-2f523 |

*Cross-refs:*

## Citation information

*Author(s):* Carroll W. Pursell, Jr.
*Year:* 1981 (Sep)
*Title:* Historical and Technological Significance of the Humboldt Bay Jetties, Humboldt Bay, California
*Affliliation:*
*No. pages:*
*No. maps:*
*Attributes:* Architectural/historical, Evaluation
*Inventory size:*
*Disclosure:* Not for publication
*Collections:* No

## General notes

## Associated resources

*No. resources:* 0
*Has informals:* No

## Location information

*County(ies):* Humboldt
*USGS quad(s):* Arcata South, Cannibal Island, Eureka, Fields Landing
*Address:*
*PLSS:*

## Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 4/7/2005 | nwic-main |
| *Last modified:* | 6/25/2019 | hagell |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 4/7/2005 | jay | Appended records from NWICmain bibliographic database. |
| | 4/2/2015 | mikulikc | database incomplete: affiliation not submitted |
| | 1/10/2017 | bentonb | added Cannibal Island as a quad |
| | 5/23/2019 | surgeonj | Added "Evaluation" ICDB report attribute, Changed GIS layer from "Other" to "Report Poly". |
| | 5/28/2019 | scannerwide | PDF Verified. Oversized pages have been scanned and added to PDF |

*Record status:* Verified

# Report Detail: S-022314

### Identifiers

*Report No.:* S-022314

*Other IDs:*

| *Type* | *Name* |
|---|---|
| Agency Nbr | FEMA HMGP #1008-6283 |

*Cross-refs:*

### Citation information

*Author(s):* David Fukutomi
*Year:* 1999 (Dec)
*Title:* Archaeological Survey for City of Arcata, Janes Creek Culvert and Drainage Improvements, FEMA HMGP #1008-6283 (letter report)
*Affliliation:* Federal Emergency Management Agency
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Field study
*Inventory size:*
*Disclosure:* Not for publication
*Collections:* No

### General notes

### Associated resources

*No. resources:* 0
*Has informals:* No

### Location information

*County(ies):* Humboldt
*USGS quad(s):* Arcata South
*Address:*
*PLSS:* T6N R1E Sec. 32

### Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 4/22/2005 | leigh |
| *Last modified:* | 3/24/2015 | paganob |

*IC actions:*
*Record status:* Verified

# Report Detail: S-029030

### Identifiers

*Report No.:* S-029030
*Other IDs:*
*Cross-refs:*

### Citation information

*Author(s):* Leigh Martin
*Year:* 2004 (Sep)
*Title:* Archaeological Assessment of a 1.5-Acre Parcel (APN 367-180-010), Located at 915 Deer Creek Drive, Martinez, Contra Costa County, California (letter report)
*Affliliation:* WSA
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Field study
*Inventory size:* c 1 ac
*Disclosure:* Not for publication
*Collections:* No

### General notes

### Associated resources

*No. resources:* 0
*Has informals:* No

### Location information

*County(ies):* Contra Costa
*USGS quad(s):* Briones Valley

| *Address:* Address | City | Assessor's parcel no. | Zip code |
|---|---|---|---|
| 915 Deer Creek Drive | Martinez | 367-180-010 | |

*PLSS:* T11N R3W Rancho El Pinole

### Database record metadata

| | Date | User |
|---|---|---|
| *Entered:* | 4/7/2005 | nwic-main |
| *Last modified:* | 11/15/2017 | moored |

| *IC actions:* Date | User | Action taken |
|---|---|---|
| 4/7/2005 | jay | Appended records from NWICmain bibliographic database. |

*Record status:* Verified

# Report Detail: S-037718

## Identifiers

*Report No.:* S-037718

| *Other IDs:* | *Type* | *Name* |
|---|---|---|
| | Voided | NCoIC S-24426 |

*Cross-refs:*

## Citation information

*Author(s):* William Rich, James Roscoe, and Susie Van Kirk

*Year:* 2003 (Apr)

*Title:* A Cultural Resources Investigation of the Proposed McDaniel Slough Marsh Enhancement Project, Located near Arcata, Humboldt County, California

*Affliliation:* Roscoe and Associates

*No. pages:*

*No. maps:*

*Attributes:* Archaeological, Architectural/historical, Field study

*Inventory size:*

*Disclosure:* Not for publication

*Collections:* No

## General notes

The historic Bull-Hunt Barn is within the project area. There was no evidence of CA-HUM-42. It may be located several hundred yards to the east of the property boundaries.

## Associated resources

| *Primary No.* | *Trinomial* | *Name* |
|---|---|---|
| P-12-000097 | CA-HUM-000039 | Loud 39, mipa't |
| P-12-000100 | CA-HUM-000042 | Loud 42 |
| P-12-002605 | CA-HUM-001156H | Arcata Land Improvement 1893 |

*No. resources:* 3

*Has informals:* Yes

## Location information

*County(ies):* Humboldt

*USGS quad(s):* Arcata South

*Address:*

*PLSS:*

## Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 2/24/2011 | guldenj |
| *Last modified:* | 3/4/2015 | mikulikc |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 2/26/2015 | rinerg | add CA-HUM-39 to resources |

*Record status:* Verified

# Report Detail: S-038304

## Identifiers

*Report No.:* S-038304

*Other IDs:*

| *Type* | *Name* |
|---|---|
| Voided | NCoIC S-25180 |
| Caltrans | EA 01-366000 |
| Caltrans | EA 01-363300 |

*Cross-refs:*

## Citation information

*Author(s):* Timothy Keefe

*Year:* 2006 (Sep)

*Title:* Historic Property Survey Report for the Proposed Eureka-Arcata Corridor Projects on California State Highway 101 at Post Mile 79.9/86.3 in Humboldt County, California

*Affliliation:* Caltrans; URS Corporation; JRP Historical Consulting Services

*No. pages:*

*No. maps:*

*Attributes:* Archaeological, Architectural/historical, Evaluation, Field study

*Inventory size:*

*Disclosure:* Not for publication

*Collections:* Unknown

---

*Sub-desig.:* a

*Author(s):* Sally Salzman Morgan, Sean David Dexter, and Brian Hatoff

*Year:* 2006 (Aug)

*Title:* Archaeological Survey Report: Eureka to Arcata Route 101 Corridor Improvement Project, Humboldt County, California

*Affiliation:* URS

*Report type(s):* Archaeological, Field study

*Inventory size:*

*No. pages:*

*Disclosure:* Not for publication

*Collections:* No

*PDF Pages:* 52-121

---

*Sub-desig.:* b

*Author(s):* Timothy Keefe

*Year:* 2006 (Sep)

*Title:* Supplemental Archaeological Survey Report for the Eureka-Arcata Corridor Projects, State Route 101, Humboldt County, California, 01-HUM-101, (PM 79.9/84.4)

*Affiliation:* Caltrans District 01

*Report type(s):* Archaeological, Field study

*Inventory size:*

*No. pages:*

*Disclosure:* Not for publication

*Collections:* No

*PDF Pages:* 122-164

## General notes

Site records and Attachments 5 - 8 (historic evaluation reports, Batini Dump Site action plan, & historic significance of bridges) were missing from this copy of the report. There was no conclusive surface evidence of CA-HUM-48, CA-HUM-49, or CA-HUM-50.

## Associated resources

| *Primary No.* | *Trinomial* | *Name* |
|---|---|---|
| P-12-000106 | CA-HUM-000048 | Loud 48 |
| P-12-000107 | CA-HUM-000049 | Loud 49 |
| P-12-000108 | CA-HUM-000050 | Loud 50 |

# Report Detail: S-038304

| | | | |
|---|---|---|---|
| | P-12-000717 | CA-HUM-000726H | Northwestern Pacific Railroad |
| | P-12-001397 | CA-HUM-001053H | Timber bridge ruins at Brainard |
| | P-12-001398 | | Void, see P-12-000717 |
| | P-12-001399 | | Isolate #1 - wood in water |
| | P-12-001400 | | Isolate #2 - Plank ditch |
| | P-12-001401 | | Isolate #3 - Chert Flake |
| | P-12-002662 | CA-HUM-001165H | Batini Dump |
| | P-12-003310 | | Murray Field Airport |
| *No. resources:* | 11 | | |
| *Has informals:* | No | | |

### Location information

| | |
|---|---|
| *County(ies):* | Humboldt |
| *USGS quad(s):* | Arcata South, Eureka |
| *Address:* | |
| *PLSS:* | |

### Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 11/9/2011 | blacke |
| *Last modified:* | 4/7/2015 | grahams |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 2/9/2015 | mikulikc | updated database; added additional citation information |

*Record status:* Verified

# Report Detail: S-038434

### Identifiers

*Report No.:* S-038434

*Other IDs:*

| *Type* | *Name* |
|---|---|
| OHP PRN | COE120426A |

*Cross-refs:*

### Citation information

*Author(s):* Charlane Gross and Jason Coleman
*Year:* 2011 (Dec)
*Title:* Archaeological Inventory and Evaluation for the Wal-Mart Mitigation at the Old Lynch Canyon Homestead Project, Solano County, California
*Affliliation:* Solano Archaeological Services
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Evaluation, Excavation, Field study
*Inventory size:*
*Disclosure:* Not for publication
*Collections:* Yes

---

*Sub-desig.:* a
*Author(s):* Charlane Gross and Jason A. coleman
*Year:* 2011 (Dec)
*Title:* (draft) Archaeological Inventory and Evaluation for the Wal-Mart Mitigation at the Old Lynch Canyon Homestead Project, Solano County, California
*Affiliation:* Solano Archaeological Services
*Report type(s):* Archaeological, Evaluation, Excavation, Field study
*Inventory size:*
*No. pages:*
*Disclosure:* Not for publication
*Collections:* Yes
*PDF Pages:* 111-218

---

*Sub-desig.:* b
*Author(s):* Jenan Saunders and Jane M. Hicks
*Year:* 2012 (May)
*Title:* Re: Wetlands restoration project at the Old Lynch Homstead (COE 120426A); File Number 2006-30352N
*Affiliation:* Office of Historic Preservation; US Army Corps of Engineers
*Report type(s):* OHP Correspondence
*Inventory size:*
*No. pages:*
*Disclosure:* Not for publication
*Collections:* No
*PDF Pages:* -

### General notes

### Associated resources

| *Primary No.* | *Trinomial* | *Name* |
|---|---|---|
| P-48-000388 | CA-SOL-000303/H | Williams and Morgan Homestea |

*No. resources:* 1
*Has informals:* No

### Location information

*County(ies):* Solano
*USGS quad(s):* Cordelia

# Report Detail: S-038434

| *Address:* | *Address* | *City* | *Assessor's parcel no.* | *Zip code* |
|---|---|---|---|---|
| | | Lynch Canyon | | |

*PLSS:* T4N R3W Sec. 16, 17 MDBM

**Database record metadata**

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 1/13/2012 | blacke |
| *Last modified:* | 9/24/2018 | carlosp |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 3/6/2018 | vickeryn | Assigned subdivision 'a' to additional citation 'a' |
| | 9/24/2018 | carlosp | fixed spelling for additional citation; added additional citation 'b' and 'c'; and OHP PRN |
| | 9/24/2018 | carlosp | |

*Record status:* Verified

# Report Detail: S-040249

### Identifiers

*Report No.:* S-040249
*Other IDs:*
*Cross-refs:*

### Citation information

*Author(s):* Jason A. Coleman
*Year:* 2013 (Jan)
*Title:* Cultural Resources Survey Report for the South G Street (Christie) WRP Project, Humboldt County, California
*Affliliation:* Solano Archaeological Services
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Field study
*Inventory size:*
*Disclosure:* Not for publication
*Collections:* No

### General notes

### Associated resources

*No. resources:* 0
*Has informals:* No

### Location information

*County(ies):* Humboldt
*USGS quad(s):* Arcata South
*Address:*
*PLSS:*

### Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 3/11/2013 | baileyl |
| *Last modified:* | 4/4/2013 | kloppl |

*IC actions:*
*Record status:* Verified

# Report Detail: S-041725

### Identifiers

*Report No.:* S-041725

| *Other IDs:* | *Type* | *Name* |
|---|---|---|
| | Voided | NCoIC S-23963 |

*Cross-refs:*

### Citation information

*Author(s):* Nick Angeloff and James Roscoe

*Year:* 2004 (Nov)

*Title:* A Cultural Resources Investigation of the Daylighting of Jolly Giant Creek Project, located in Humboldt County, California

*Affliliation:* Cultural Resources Facility, Center for Indian Community Development, Humboldt State University

*No. pages:*

*No. maps:*

*Attributes:* Archaeological, Field study

*Inventory size:*

*Disclosure:* Not for publication

*Collections:* No

### General notes

### Associated resources

*No. resources:* 0

*Has informals:* No

### Location information

*County(ies):* Humboldt

*USGS quad(s):* Arcata South

*Address:*

*PLSS:* T5N R1E Sec. 32 HBM

### Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 9/11/2013 | blacke |
| *Last modified:* | 11/16/2017 | hagell |

*IC actions:*

*Record status:* Verified

# Report Detail: S-041786

## Identifiers

*Report No.:* S-041786

*Other IDs:*

| *Type* | *Name* |
|---|---|
| Voided | NCoIC S-24030 |
| OHP PRN | FHWA 040302A |

*Cross-refs:*

## Citation information

*Author(s):* Leslie S. Heald
*Year:* 2002 (Dec)
*Title:* Historic Property Survey, Archaeological Survey, and Historical Resources Evaluation Reports, Highway 255 Gateway Improvements, CALTRANS District 1, Humboldt County, CA
*Affliliation:*
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Architectural/historical, Evaluation, Field study
*Inventory size:*
*Disclosure:* Not for publication
*Collections:* No

---

*Sub-desig.:* a
*Author(s):* James M. Roscoe
*Year:* 2002 (Oct)
*Title:* Archaeological Survey Report Arcata Highway 255 Improvement
*Affiliation:*
*Report type(s):* Archaeological, Field study
*Inventory size:*
*No. pages:*
*Disclosure:* Not for publication
*Collections:* No
*PDF Pages:* 21-23

---

*Sub-desig.:* b
*Author(s):* Leslie S. Heald
*Year:* 2002 (Nov)
*Title:* Historical Resources Evaluation Report Highway 255 Gateway Improvements
*Affiliation:*
*Report type(s):* Architectural/historical, Field study
*Inventory size:*
*No. pages:*
*Disclosure:* Unrestricted
*Collections:* No
*PDF Pages:* 24-155

## General notes

## Associated resources

| *Primary No.* | *Trinomial* | *Name* |
|---|---|---|
| P-12-002613 | | 524-540 3rd St. |
| P-12-002614 | | 513 4th St. |
| P-12-002615 | | 541 4th St |
| P-12-002616 | | 304-344 F Street & 566 3rd St. |
| P-12-002617 | | 309 F Street |
| P-12-002618 | | 345 F Street |
| P-12-002619 | | 347 F Street |
| P-12-002620 | | 407 F Street & 646 Samoa Blvd |

# Report Detail: S-041786

| | |
|---|---|
| P-12-002621 | 414 F Street |
| P-12-002622 | 389 H Street |
| P-12-002623 | 438 H Street |
| P-12-002624 | 460 I Street, 885 5th Street, 491 |
| P-12-002625 | 421 J Street |
| P-12-002626 | 901 Samoa Blvd |
| P-12-002627 | 940-960 Samoa Blvd |
| P-12-002628 | 1017-1117 Samoa Blvd |
| P-12-002629 | 1076 Samoa Blvd |

*No. resources:* 17

*Has informals:* No

## Location information

*County(ies):* Humboldt

*USGS quad(s):* Arcata South

*Address:*

*PLSS:*

## Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 9/12/2013 | HagelL |
| *Last modified:* | 11/16/2017 | hagell |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 2/25/2015 | rinerg | clean up identifiers, check resources; create additional citations for architechural survey report & archaeological survey report |
| | 3/4/2015 | mikulikc | database incomplete: no affiliation submitted |

*Record status:* Verified

# Report Detail: S-048287

### Identifiers

*Report No.:* S-048287
*Other IDs:*
*Cross-refs:*

### Citation information

*Author(s):* James Roscoe and William Rich
*Year:* 2012 (Jun)
*Title:* A Cultural Resources Investigation of three Coastal Access Points for the Humboldt Bay Water Trails Implementation Program, Located in Humboldt County, California
*Affliliation:* Roscoe and Associates - Cultural Resources Consultants
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Architectural/historical, Field study
*Inventory size:*
*Disclosure:* Not for publication
*Collections:* No

### General notes

### Associated resources

*No. resources:* 0
*Has informals:* No

### Location information

*County(ies):* Humboldt
*USGS quad(s):* Arcata South, Eureka
*Address:*
*PLSS:*

### Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 12/5/2016 | cabrala |
| *Last modified:* | 1/6/2017 | grahams |

*IC actions:*
*Record status:* Verified

# Report Detail: S-050908

## Identifiers

*Report No.:* S-050908

*Other IDs:*

| *Type* | *Name* |
|---|---|
| OTIS Report Number | EPA_2018_0110_001 |
| Other | CWSRF No 8127-110 |
| Other | NWIC 17-1254 |

*Cross-refs:*

## Citation information

*Author(s):* Nick Angeloff and Lynette Mullen
*Year:* 2016 (Jun)
*Title:* A Cultural Resources Investigation of the Arcata Wastewater Inflow and Infiltration Project, Arcata, Humboldt County, California
*Affliliation:* Archaeological Research and Supply Company
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Field study
*Inventory size:*
*Disclosure:* Not for publication
*Collections:* Yes

---

*Sub-desig.:* a
*Author(s):* Nick Angeloff
*Year:* 2017 (Nov)
*Title:* Addendum of: A Cultural Resources Investigation of the Arcata Wastewater Inflow And Infiltration Project, Arcata, Humboldt County, California, Addendum 1
*Affiliation:* Archaeological Research and Supply Company
*Report type(s):* Archaeological, Excavation, Field study, Management/planning
*Inventory size:*
*No. pages:*
*Disclosure:* Not for publication
*Collections:* Yes
*PDF Pages:* 140-174

---

*Sub-desig.:* b
*Author(s):* NICK ANGELOFF
*Year:* 2017 (Sep)
*Title:* Arcata Wastewater 1&1 Project Historic Resources Report, Amendment 2
*Affiliation:* Archaeological Research and Supply Company
*Report type(s):* Archaeological, Management/planning
*Inventory size:*
*No. pages:*
*Disclosure:* Not for publication
*Collections:* Yes
*PDF Pages:* -

# Report Detail: S-050908

*Sub-desig.:* c
*Author(s):* Julianne Polanco and Wendy Pierce
*Year:* 2018 (Mar)
*Title:* Section 106 Compliance for the City of Arcata's Inflow and Infiltration Reduction Project, Humboldt County, Clean Water State Revolving Fund Project No. 8127-110 (your letter of January 09, 2018) ( EPA_2018_0110_001 )
*Affiliation:* Office of Historic Preservation, CA State Water Resources Control Board
*Report type(s):* OHP Correspondence
*Inventory size:*
*No. pages:*
*Disclosure:* Unrestricted
*Collections:* No
*PDF Pages:* 185-192

*Sub-desig.:* d
*Author(s):* Nick Angeloff
*Year:* 2017 (Nov)
*Title:* Monitoring and Discovery Plan for The City Of Arcata CWSRF I&I Project, Humboldt County, California
*Affiliation:* Archaeological Research and Supply Company, City of Arcata
*Report type(s):* Archaeological, Management/planning
*Inventory size:*
*No. pages:*
*Disclosure:* Not for publication
*Collections:* Yes
*PDF Pages:* 193-382

*Sub-desig.:* e
*Author(s):* Nick Angeloff
*Year:* 2017 (Dec)
*Title:* Data Recovery Plan for the City Of Arcata CWSRF I&I Project, Humboldt County, California ( 8127-110 )
*Affiliation:* Archaeological Research and Supply Company, City of Arcata
*Report type(s):* Archaeological, Management/planning
*Inventory size:*
*No. pages:*
*Disclosure:* Not for publication
*Collections:* No
*PDF Pages:* 383-401

### General notes

### Associated resources

| *Primary No.* | *Trinomial* | *Name* |
|---|---|---|
| P-12-000100 | CA-HUM-000042 | Loud 42 |
| P-12-000101 | CA-HUM-000043 | Loud 43 |
| P-12-000102 | CA-HUM-000044 | Loud 44 |
| P-12-000363 | CA-HUM-000351/H | [none] |
| P-12-000364 | CA-HUM-000352 | Void, see P-12-000363 |
| P-12-001305 | | Campbell Creek Dam |
| P-12-001306 | | Campbell Creek corduroy road |
| P-12-001401 | | Isolate #3 - Chert Flake |
| P-12-002595 | | University Center, Humboldt Stat |
| P-12-002605 | CA-HUM-001156H | Arcata Land Improvement 1893 |
| P-12-002613 | | 524-540 3rd St. |
| P-12-002614 | | 513 4th St. |
| P-12-002615 | | 541 4th St |
| P-12-002616 | | 304-344 F Street & 566 3rd St. |
| P-12-002617 | | 309 F Street |

# Report Detail: S-050908

| | |
|---|---|
| P-12-002618 | 345 F Street |
| P-12-002619 | 347 F Street |
| P-12-002620 | 407 F Street & 646 Samoa Blvd |
| P-12-002621 | 414 F Street |
| P-12-002622 | 389 H Street |
| P-12-002623 | 438 H Street |
| P-12-002624 | 460 I Street, 885 5th Street, 491 |
| P-12-002625 | 421 J Street |
| P-12-002628 | 1017-1117 Samoa Blvd |
| P-12-003050 | Arcata Substation Control Buildi |
| P-12-003279 | 1825 11th St |
| P-12-003280 | Caldwel House / John Silva Resi |
| P-12-003281 | McKenzie House |
| P-12-003282 | Car Garage |

*No. resources:* 29

*Has informals:* No

## Location information

*County(ies):* Humboldt

*USGS quad(s):* Arcata North, Arcata South

| *Address:* | *Address* | *City* | *Assessor's parcel no.* | *Zip code* |
|---|---|---|---|---|
| | | Arcata | | |

*PLSS:*

## Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 8/9/2018 | mcgurlm |
| *Last modified:* | 5/16/2019 | surgeonj |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 8/9/2018 | mcgurlm | Citations "a, b, c, d, e" |
| | 1/9/2019 | lucientesK | Updated report attributes of main report and additional citations. |

*Record status:* Verified

# Appendix D

## Historical Documents



photos.com

# Eco Tipping Points

## How a vicious cycle can become virtuous

### by Amanda Suutari and Gerald Marten

The cicadas are in full voice on a sultry morning in May as we make our way along a rickety wooden boardwalk that snakes through a community mangrove forest near Thung Dase village in southern Thailand. The mangroves offer welcome shade near a dock where a small boat is moored. Handmade bamboo traps are set to catch mud crabs when the tides go out. In a flash of orange and turquoise, a kingfisher swoops to a low-hanging branch.

It's hard to imagine that three decades ago the area's lush abundance was collapsing into a wasteland. "At one time," recalls Nom Ham Yak, chair of the forest's management committee, "our economic base was crabs, fisheries, and rubber. Then areas were leased as concessions to private contractors to clear for charcoal, and the forest became badly degraded."

The prospects for the area's villages were so bleak that a revival would have seemed a fantasy. What brought them back from the brink was an Eco Tipping Point.

Eco Tipping Points offer a new paradigm for restoring our communities, both natural and human. Conventional approaches to ecological problems – from piecemeal micromanagement, to techno-fixes, to top-down regulation – often fail or generate new messes. But Eco Tipping Points show how the same forces that endanger environments and communities can be harnessed to heal them.

To demonstrate what Eco Tipping Points are and how they work, consider two very different stories from two continents: the mangrove forests of Trang Province and the marshes of Arcata, California.

## From charcoal to pink gold

Five hundred thirty-five miles south of Bangkok, Trang Province is located on Thailand's southwest coast at the western shore of the Andaman Sea. Thung Dase and its neighboring villages lie in the watershed of the Palian and Trang Rivers, which drain into the sea from the Bandthad mountain range. The villages cluster along the mangrove-lined coastal wetlands, providing a fertile buffer zone for marine and terrestrial life. Besides offering a rich variety of foods, mangrove forests supply medicinal plants and materials such as thatch for housing and fishing gear. They are also refuges and nurseries for juvenile fish, crabs, shrimp, and mollusks.

Big changes came in the 1960s, when the Thai government embraced the Western model of export-led development. Industrial trawlers freely violated the no-fishing zone two miles from shore. They ravaged the sea bed and coral reefs, swallowing fish stocks faster than they could regenerate. As their coastal fishery waned, fishers spent more time on their boats and went further from shore. Some used explosives or poisons to harvest the remaining fish, or invested in better fishing equipment – causing stocks to plummet even faster.

Meanwhile, the government had granted mangrove concessions to the private sector to make charcoal briquettes. As mangroves dwindled, so did the diverse and useful products they provided. "Plants and animals, especially crabs, became scarce," explains Nom Ham Yak.

Their options narrowing, fishers began accepting menial jobs cutting mangroves for charcoal, working on commercial trawlers, or migrating into nearby cities for work. "Fishing incomes went down," Ham Yak says. "The people in the village had to leave for towns to find work in fish-canning factories, rubber-tapping plantations, general day labor, or construction. When the men went out to work and the wives stayed in the village, family relations would suffer. People also started selling pieces of land because there was no work at that time."

Worse, development agencies and banks had begun promoting shrimp farming in the mangrove forests. Unfortunately, the 'pink gold' of shrimp aquaculture can be a classic boom-bust venture in which the production from a shrimp pond declines drastically after the first five years. Local people discovered that initial quick returns were supplanted by mounting debts and environmental ruin as abandoned shrimp ponds spread across the landscape.

In 1999, a team led by economist Suthawan Sathirathai did a cost-benefit analysis of shrimp farming on a ▶




Sukree Sukplang / Reuters

*Industrial trawlers sometimes violate the shoreline no-fishing zone, swallowing fish stocks faster than they can regenerate.*



Sukree Sukplang / Reuters

*Mangrove forests supply medicinal plants and thatch for housing and fishing gear. They are also refuges for juvenile fish, shrimp, mollusks, and crab.*

coastal village in Surathani Province, southern Thailand, to compare the monetary value of mangroves versus shrimp farms. When taking into account only marketable products, shrimp farms brought higher returns, with a net value of $9,335 US per acre compared to $1,665 for mangroves. But calculating in the indirect value of mangroves dramatically reversed these figures. When they assigned a monetary value to environmental services such as nurseries for fish and protection from erosion and storms, the value of the mangroves rose to $14,428, more than 50 percent higher than shrimp aquaculture.

## The positive tip

As university students, Pisit Charnsnoh and his wife, Ploenjai, were part of a generation of democracy activists. After graduating from Khon Khaen University, Charnsnoh got involved with rural development and urban labor rights. In 1985, the couple moved to Ploenjai's hometown in Trang Province, where they started a small organization called Yadfon Association (Yadfon means 'raindrop' in Thai), aimed at helping the coastal villages in the region. At that time, Trang Province residents were locked into a vicious cycle of increasing poverty, unraveling society, and a deteriorating ecosystem.

Yadfon members spent nearly a year in dialogue with the villagers of Ban Leam Makham, working hard to gain the community's trust. The approach was to support residents' own insights into their shared crisis. Charsnoh points out that this method was more powerful than giving the villagers lectures. "We couldn't go in as outsiders and tell them, 'This or that species is disappearing, you have to be careful,' or 'You have to protect these forests.'" Over time, and with some success with micro-credit, well-digging, and other rural development schemes, Yadfon began to earn the villagers' respect.

Through a series of meetings with Yadfon, villagers developed the idea of reviving the badly degraded mangrove forests around Ban Leam Markham and Ban Thung Dase. Because the land was under government control, Yadfon staff acted as a go-between to obtain consent from provincial authorities to create a community mangrove forest. The first of its kind in Thailand, the forest covered 95 acres of land. It later became part of a 235-acre area that combined the mangrove forest with a sea grass conservation zone.

An emerging inter-village network created a system to manage the forest. Allowing use of some areas of the forest helped to get buy-in from a community that would otherwise break rules if the whole forest were declared off-limits. They prohibited shrimp farms inside the forests, set up no-fishing areas, discouraged the use of cyanide and dyna-

mite, and banned push-nets altogether. They replanted some areas of the forest and designated others untouchable, to allow for natural regeneration. The network also began replanting the sea grass beds in the coastal waters of nearby Chao Mai village.

Their efforts paid off. There was an increase in the near-shore fish catch, and a species of fish thought to have disappeared returned. These early results boosted the villagers' commitment and motivated them to further action. An endangered dugong spotted in the waters near Chao Mai village helped win government support for their seagrass protections zones; the dugong became a living symbol for conservation progress in the area.

## Cycles and tipping points

Creating community mangrove forests was an Eco Tipping Point. It tipped the local community and environment from a vicious cycle to a *virtuous* cycle, and the momentum switched from destruction to recovery.

Vicious and virtuous cycles are 'feedback loops.' These mutually reinforcing cycles of cause and effect are the heart of Eco Tipping Points. In the negative tip, as mangroves were cleared, fisheries began to decline. As fish stocks fell, fishers worked harder to get them, causing stocks to fall ever faster. In this way, they were locked into a vicious cycle of declining resources and an accelerating race to get what little remained.

After the positive tip, the fishery began to restore itself. In a study of 500 families between 1991 and 1994, total catch rose by 40 percent. Fishers spent three to four fewer hours per week on the water, while their net incomes increased by 200 percent. They could return with full boats without using dynamite or pushnets. In this virtuous cycle, less pressure from fishers allowed fish stocks to recover faster, making the fishers' jobs even easier.

The revival of the fishery spawned other virtuous cycles. Better incomes meant there was less need to migrate from villages. Instead of being locked into depletion, villagers were now locked into conservation, as the financial incentive to preserve mangroves now outweighed the incentive to destroy them.

Most importantly, investing in their future motivated the people to fight for it. A sense of ownership gave them the grit and confidence to confront encroaching trawlers and to lobby the government to enforce the two-mile no-fishing zone. It also made them less likely to sell off their land, which often ended up being converted to resort development. Reviving the forests also helped to put zoning limits on shrimp ponds. Charnsnoh explains that while many of their villages have shrimp ponds, they have kept the ponds outside the boundaries of the forests.

While the community mangrove forests started small, the virtuous cycles rippled out over time. Today, these districts include 10 community forests and four sea grass and dugong conservation areas totaling 50 square miles. Meanwhile, Yadfon has extended its involvement to some 60 villages in the three districts. Through a growing network of grassroots organizations, Charnsoh is involved with influencing policy at the national and international levels, lobbying for stronger legal standing for the forests, and gathering support to stop the practice of intensive shrimp farming. Meanwhile, Ploenjai is connecting with villages further inland, discovering new links between inland and ▶



Gerald Marten

*Humboldt County, California decided to treat wastewater as a resource rather than a problem, and built the Arcata Marsh and Wildlife Sanctuary. The marsh relies on natural systems to filter the city's sewage.*

coastal regions. "I was working with the fisherfolk since the beginning," she explains, "and have moved up [the watershed]. Now we work with the whole ecosystem."

## Treating wastewater with wetlands

Across the Pacific Ocean, a small university town nestled in the northern California coastal redwoods may seem worlds away from a fishing village of southern Thailand. But Arcata's pioneering wetland and wildlife sanctuary reveals a similar underlying story: tipping a coastal ecosystem from a vicious cycle into a virtuous one.

Home to Humboldt State University, Arcata is a vibrant little community some 280 miles north of San Francisco. Historic charm is visible in the thriving downtown, and green space abounds with the community forest and wetland areas framing the vista of Humboldt Bay. Arcata's Eco Tipping Point arrived when the community faced a sewage treatment crisis. Until the early 1950s the city discharged unchlorinated primary effluent into Humboldt Bay. Secondary treatment and chlorination were not added until the early 1970s. In 1974, federal water quality standards were revised, and state and regional authorities began cracking down.

The community faced a thorny dilemma: Buy into a proposed $25-million regional sewage processing plant to discharge treated, up-to-standard wastewater into Humboldt Bay – or devise a more environmentally acceptable alternative. The former would be a costly undertaking for a community whose population at the time was just 12,600. Also, the sewer pipeline was a potential nightmare, since ruptures under the bay could make the pollution worse.

Most importantly, the regional plant would have unleashed a vicious cycle of runaway sprawl. By laying the pipeline along the undeveloped land between Arcata and its neighbors, Arcatans believed developers would soon follow with strip malls, big-box retail zones, and subdivisions. More development would have affected the thriving downtown and locked residents into car-dependency. The sewage plant itself, along with the roads and infrastructure needed to support the development, would have demanded an unprecedented outlay from municipal coffers and taxpayers' wallets.

## The problem is the solution

The idea to treat the wastewater as a resource rather than a problem first came from Humboldt State University fisheries professor George Allen. In 1969, he had begun testing whether Pacific salmon and cutthroat trout could be raised in ponds of seawater and partially treated wastewater. Bob Gearhart, another Humboldt State University professor, expanded on Allen's idea. Why not use a marsh to treat municipal sewage more easily, more sustainably, and more economically? "The whole issue is the ownership of the wastewater – what you have control over," explains Gearhart. "It's not about disposal – it's a resource issue."

After a protracted and divisive political and legal battle known locally as 'The Wastewater Wars,' regional authorities reluctantly allowed the city to create a small version as a pilot project. If it was successful, the community would be free to expand to a fully functioning system.

The chosen site was a derelict brownfield that included a sealed landfill, two defunct logging mills, and a log pond. Creating the marsh first meant breaking up concrete where the lumber had once been stacked and stored on the old lumberyard site. National Guard engineers blew it up and carted it off. Next, a bulldozer terra-formed the ground, creating a micro-terrain similar to that of a wetland. Volunteers from the community planted several kinds of native marsh plants in order to have alternating areas of open water and vegetation. They took care to plant more densely in the farther reaches of the marsh in order to fully remove any solids that remained in the water. In 1986, the treatment system was completed and became operational.

Today, the Arcata Marsh and Wildlife Sanctuary covers 154 acres of freshwater and saltwater marshes, tidal mudflats, and grasslands. Wastewater is piped from homes and buildings to the 'headworks,' where debris is removed and solids settle. The solids are sent to digesters for use as compost on the town's community forest. The sewage is sent to oxidation ponds before entering a series of treatment and enhancement marshes. Naturally occurring processes progressively purify the water, then two rounds of chlorination bring it up to state standards before its release into Humboldt Bay.

When Eco Tipping Points launch virtuous cycles, they employ nature's own processes to do most of the work. Instead of a multi-million dollar treatment plant, Arcata has used the "free" services of a wetland to purify its wastewater. Roots and stems of wetland plants form a dense, netlike filter that removes suspended solids. Plants and algae remove nutrients such as nitrogen and phosphorus, while bacteria and fungi decompose the solids and remove dissolved organic material. Bulrushes provide a canopy of shade, controlling the growth of algae, and helping to slow water flow so the microorganisms can do their job.

Plants and microorganisms pass organic material up the food web to small aquatic animals and insects, and ultimately to top predators such as hawks, foxes, and otters that have come to symbolize the wildness of Arcata's wetland. As plants, animals, and microorganisms break down organic material to extract energy, the residue passes out of the wetland ecosystem and into

the atmosphere as carbon dioxide and water. Meanwhile, larger animals, birds, and flying insects move out of the wetland, carrying organic material and nutrients and distributing them around the surrounding countryside. They also bring in seeds from other areas, promoting and supporting biodiversity. The end result is a wetland and wildlife sanctuary that supports 300 species of birds and mammals, 100 species of plants, and six species of fish.

As the wetland regenerated nature's systems, it spun off virtuous cycles for humans as well. Arcata's wastewater and derelict brownfield became economically and socially valuable. 'Recycling' gave Arcatans access to their formerly blocked-off waterfront. They gained a community space for leisure and recreation that draws as many as 150,000 visitors a year. Walking through a pathway surrounded by the songs of thrushes hidden in dense foliage, it is hard to imagine that the wetlands are actually working to break down household sewage. By creating a physical barrier to development, the wetland became a *de facto* 'zoning restriction' that was more effective than any government regulation. Students at Humboldt State University gained a research site. In the process, they provided a level of technical support, data collection, and monitoring that the town could not have afforded on its own.

More critically, choosing this unorthodox path set Arcata apart from its more conventional neighbors and fed the city's sense of pride. The marsh became a shared symbol that has helped to shape local identity. The community's motto today is "Flush With Pride."

"I think the marsh has become symbolic of [the idea] that we can do things our way," says Julie Fulkerson, a former Arcata mayor and councilor. "Thinking of this community without the marsh is very depressing. For one thing, if the massive [treatment] system had been built, it would have cost millions of dollars, and we'd be paying for it. And with a pipeline between Eureka and Arcata, I just can't imagine why there would not have been development in that entire strip. It would have looked like any other blended community in California."

## Common ground

In spite of their obvious differences, a deeper look at both Arcata and Trang Province reveals Eco Tipping Points at the source of each community's revival. Both communities had found leverage points in the vicious cycles where targeted actions could reverse them. Feedback loops that created and reinforced environmental degradation were replaced by feedback loops that rescued the ecosystems. By allowing mangroves to regenerate, and by designing a system that could treat waste with very little external manipulation, the communities let nature do the work of restoring their shared resources. The cohesion that emerged as a result gave them the impetus to rise to new challenges.

Despite their successes, these communities are not utopias. Both are on steep learning curves towards sustainability, and new challenges emerge as old ones are tackled. But they show how human and natural systems can tip together out of decline and towards greater health and sustainability. They show that local citizens can devise their own environmental solutions, without elaborate government regulations or high-cost technologies. Sharing the stories of these Eco Tipping Points can demonstrate that achievements often considered unrealistic, costly, or otherwise unfeasible are not just desirable alternatives. They are practical ones. ✹

*Amanda Suutari is an environmental journalist based in Vancouver, Canada. Gerald Marten is an ecologist at the East-West Center in Honolulu (www.eastwestcenter.org).* *Steve Brooks and Ann Marten provided editorial contributions. The Eco Tipping Points project has documented approximately 100 environmental success stories to discover and communicate ingredients for success. The stories, lessons learned from them, and further explanation of how Eco Tipping Points work can be seen at www.ecotippingpoints.org. More details about Thailand's community mangrove forests and Arcata's constructed wetland are presented at www.ecotippingpoints.org/indepth/thailandmangrove.html and www.ecotippingpoints.org/indepth/usaarcata.html. Thanks to members of Yadfon Association, Arcata City Hall, and Humboldt State University for their extensive assistance.*



Gerald Marten

*The Arcata Marsh and Wildlife Sanctuary is a community leisure and recreation space that attracts some 150,000 visitors a year.*

# USA - California (Arcata) - Constructed Wetland: A Cost-Effective Alternative for Wastewater Treatment

ETP Share


- **Author**: Amanda Suutari
- **Posted**: June 2006
- Introduction by Ann Marten
- **Site visit assistance and editorial contributions**: Gerry Marten, Ann Marten


- This story was published in Earth Island Journal

- This in-depth ETP story features a Photogallery

**The city of Arcata, California was faced with a dilemma: Buy into an expensive regional sewage processing plant to bring their wastewater discharge into Humboldt Bay up to water quality standards, or come up with an acceptable alternative. They embarked on a pioneering journey, using wastewater to create and nourish a wetland where a logging pond and city dump had once been. The wetland provides prime wildlife habitat and recreation for the community at the same time it purifies the water.**

## Introduction

The people of Arcata, California, did not think of their sewage as a resource. In fact, like most of us, they did not think about their sewage much at all. But in 1974 they entered a period referred to as the "Wastewater Wars" when the need to reassess that view and assert their community's control of this "valuable" resource became essential.

Arcata is a small city located on Humboldt Bay, in the coastal redwood country of Northern California. In 1972 new federal legislation required that the water quality of the Bay be improved. Eureka, a larger city 5 miles south was often dumping raw sewage in to the bay, and Arcata's wastewater treatment plant was not adequately treating their wastewater. The State and regional government proposed a new

wastewater treatment plant that would serve this small university town and the other areas on the bay. This would be a very expensive undertaking for Arcata, population 12,600. Also, the sewer pipeline that would follow Highway 101 from McKinleyville on the north, through Arcata to Eureka and then out into the bay itself was a potential nightmare. Ruptures under the bay could make the pollution worse. And it would provide the infrastructure to open up the surrounding area to development.

Arcatans valued the unique character of their university town and their semi-rural setting. They had no desire to be engulfed by strip malls and housing developments. The regional wastewater treatment facility proposal was an engineer's and developer's dream. Turning that dream into their own is a story about taking charge of a local resource and tipping it from planned unsustainability to a sustainable, productive force in their community. The outcome was the Arcata Marsh and Wildlife Sanctuary (AMWF), 154 acres of freshwater and saltwater marshes, tidal mudflats and grasslands. It treats and disposes of the city's sewage while providing a wonderful natural recreational area, and has become an inspiration for other communities throughout the world.

In 1974, before this began, the area where the Arcata Marsh Interpretive Center (AMIC) now stands was surrounded by a derelict lumber mill with a log-filled marsh, cracking concrete and an unkempt landfill, affectionately known as Mt. Trashmore.

Arcata had recently fought a battle to prevent a new federal freeway from bisecting their town and developing the surrounding agricultural lands. Earlier on they had stopped the clear cutting of an adjoining redwood forest, turning it into a community park with hiking trails. It was the first community managed and owned forest in the country. Arcata also boasted the first recycling program in the country.

Despite their history of local environmental activism, taking on the State of California and the Feds was daunting. But there were things about Arcata that made it possible—though it didn't always seem that way in the midst of the fray. Arcata is the home of Humboldt State University, a campus known for its strong environmental programs. The more conservative surrounding areas see it as home to "kooks, tree huggers and flakes." Even within Arcata the town-gown split has traditionally mirrored this difference. However, a change in the federal electoral law had recently allowed 18 year olds to vote and the students and young residents used their new found voice to elect a new city council, one that campaigned on protecting the environment and near-by agricultural land. The university also contributed a faculty with incredible expertise and a willingness to share it.

Ironically, the shoreline of Humboldt Bay had not been accessible to the town for many years as it was blocked by the old saw mill, the landfill and the existing sewage treatment plant. Now it is the crown jewel of Arcata, used daily for recreation, birding and gazing by locals and tourists alike.

Committed and courageous leadership is essential to carry a campaign like this through to the end. The Arcata story had many. A trip around the marsh sanctuary introduces some of these leaders.

There is the George Allen Marsh on what was once an abandoned concrete log deck. In 1969 Dr. Allen, a professor of fisheries science at the university, had begun an experimental project intended to find out if Pacific Salmon and cutthroat trout could be raised in ponds with a mixture of partially treated wastewater and seawater. This project was the first to question the conventional paradigm of waste, accustoming Arcatan's to more elastic thinking about wastewater. In fact, the initial alternative proposal to the regional treatment plant was to use aquaculture based on some of Dr. Allen's ideas. Though this changed, he remained an important part of the development of the marsh.

Then we come to the Robert Gearheart Marsh, formerly minimally used pastureland. Dr. Gearheart was a professor of environmental engineering at the university. He always saw himself as a biologist first, and an engineer second. Like many of the important leaders in this project, he was willing to take a calculated risk —some would say a huge gamble. What they tried to do had never been done. He knew there was no guarantee his idea of a marsh would work. However, he was a careful scientist and an excellent communicator. His dedication to the vision of the marsh as way for the community to maintain control of its resources and uniqueness kept the torch alive. He feels that one of Arcata's strongest arguments was that "they were putting back into service 30-40 acres of unused wetland—basically ugly, industrial brownfields that nobody wanted."

Further on is Dan Hauser Marsh, the first marsh to be treated with wastewater. Dan served on the city council and as mayor from 1974—1982, and then spent 5 years as city manager. He felt the marsh grew out of political and land use issues rather than wastewater treatment. "When Bob Gearheart started explaining what a marsh could do and we began reading stories about what the marsh used to be like," Dan says, "I fell in love with the idea of marshes."

"The regional wastewater project was a good idea in theory, but it just didn't fit Arcata," according to Hauser. The proposed pipeline would increase pressure to develop the adjacent agricultural land. In fact, in 1974 one of Dan and the new city

council's first acts had been to deny water for development of a newly annexed area pushed through by the old guard. This effectively stopped the project.

Hauser and the council estimated that "The wastewater treatment plant and pipeline would have been the largest energy consumer in the county, costing a bundle to run." Even the environmental community was not wholly behind the marsh idea. David Joseph, an environmentalist, was the head of the North Coast Regional Water Quality Control Board (RWQCB), the body that was in charge of the proposed regional treatment plant. He was concerned that the city was trying "to get out of something." Also, at that time Eureka, the larger city down the road, was discharging raw sewage into the bay. He was afraid if the project didn't go through this wouldn't stop.

Continuing around the Marsh, Franklin Klopp Lake comes into view. Frank had been a city engineer since 1968, graduating to Director of Public Works. He was an "old guard" engineer and says he didn't object to the new treatment plant until he got to the last 4 pages of the report and saw the cost. It would mean doubling the sewer rates just to get it going. He had just pushed through a doubling of the rates and had taken quite a bruising. He was not anxious to repeat that. He started listening much more carefully to Bob Gearheart. But he needed to see an actual working example. Words were not enough. They went on a visit to Mountain View, a town on the peninsula south of San Francisco. There they saw "a simulated marsh made up in part of beer cans filled with foam and wood chips processing sewage." He figured with Arcata's resources it could work even better. He also gambled that the costs of developing the marsh for sewage treatment would be less than the regional plant. He figured it would have cost Arcata $10 million for their share of the construction of the regional system as opposed to the $5 million they spent. And the annual maintenance cost is about $500,000 instead of $1.5 million.

Today the marsh not only treats all of Arcata City's municipal sewage and wastewater, it also supports approximately 100 species of plants, 6 species of fish, and a multitude of bird and mammal species that have populated it naturally from the surrounding region, including otters. The marsh lies on the Pacific Flyway, which is the permanent or temporary home to over 200 species of birds. The Aleutian Goose, for example, takes off from the tip of the Aleutian Islands, flies across the Gulf of Alaska, and makes landfall in Humboldt County.

And most important, more than 200,000 people a year get to enjoy the marsh for recreation, birding, or scientific study, and the whole area now has access to the bay. The community support organization, Friends of Arcata Marsh, hosts regular birding tours. Moreover, since 1996 Arcata has hosted the annual 3-day Godwit Days festival, a birding event held at the peak of the spring migration, which

features field trips, boating excursions, lectures and other community activities for birders.

The vicissitudes of the political battle that led to the marsh are complex. It came down to the pro-marsh forces being able to prove that the marsh would "enhance" the water quality of the bay, meeting a key legal requirement. We will leave most of the politics aside for now and focus on the marsh itself.

---

## The Setting and Its History

Arcata city, population 16,651, lies on the north-east shore of Humboldt Bay, 280 miles north of San Francisco. It was established in 1850 as a supply port during the gold rush era that precipitated the timber boom which was to follow. Arcata rests in the heart of Northern California's "redwood county" and is home to Humboldt State University. In 1970, the population was 8,985, and it has risen to 12,850 in 1980 and to 15,197 in 1990. Today it has about 16,381. About half of Arcata's residents are students at Humboldt State University, and the overwhelming majority of the population (81.3 %) is Caucasian. It is a progressive town in an otherwise conservative region. The decline of the logging and fishing industries has caused the regional economy to flounder economically over the past three decades. Where Arcatans see an unspoiled landscape, small cottage industries and extensive community involvement as ongoing goals, others in the region would like to see industries that bring jobs, convenient shopping and affordable housing so they can stay there.

People have inhabited the region of Humboldt Bay for thousands of years. The indigenous Yurok and Wiyot people settled here because of its abundant resources and easy access to transportation. In those days, the Bay was surrounded by salt marshes, freshwater swampy meadows, and forest. Despite the Wiyot peoples' presence, the landscape remained relatively unchanged over centuries.

From 1849, however, European explorers arrived and began to settle in the area. The settlers forcibly displaced and sometimes massacred the indigenous communities, so that by 1860 the native population was down to less than 5% of its pre-Europe population. From 1870 the settlers began draining the marshes for agriculture, and built a wharf and California's first railroad track. The railroad linked dry land and a shipping channel built further out into the Bay that remained functional until the 1920s.

In 1945, two lumber mills operated in the area (one where the Interpretive Center is now located and the other where Allen Marsh is located). There was a log deck for

storing lumber. Butcher's Slough was elongated to make a channel for the mills, and a nine-acre log pond was built. The mills closed down in the late 1960's as the region's logging economy began to implode. The mills' condition further deteriorated over the years as a result of fires and neglect.

In 1964, the area that is now nicknamed "Mount Trashmore" was drained and diked in order to create a 40-acre landfill. Within a decade of the landfill starting operation, the ecosystem deteriorated as the overpopulation of cats and gulls began unraveling the food web, and leachate from the landfill contaminated the Bay. In 1973 the landfill was condemned, shut down, and sealed using mud from the Bay. This raised the question of what to do with the closed landfill,. Suggestions floated included a marina, motor cross area, golf course, baseball field and nature center/marsh restoration area. The City of Arcata finally decided to restore the area to a wetland. This coincided with the time that the federal and State government began strictly regulating wastewater.

---

## The History of Wastewater Treatment in Arcata

Arcata's former wastewater treatment plant was constructed in the 1940s, when the town's first sewers were installed. There was only primary treatment of the wastewater, with no chlorination, before it was discharged into the bay. It did not reduce Biological Oxygen Demand (BOD) or remove suspended solids and possible pathogens. Biological Oxygen Demand, a key standard for measuring treated wastewater, is the measure of oxygen required to break down organic materials in water. With untreated (or improperly treated) sewage high organic loads may reduce the amount of oxygen available to sustain fish or other aquatic life.

Fifty-five acres of oxidation ponds were added to the facility in 1958, which raised the level of treatment to secondary standards, followed by chlorination facilities in 1968. De-chlorination facilities were added in 1975. At this time, the State of California was getting tougher on municipalities' wastewater management policies in response to the Federal Water Pollution Control Act Amendments of 1972, the predecessor of the Clean Water Act.

In April of 1974, the California State Water Resources Control Board (SWRCB) adopted a Comprehensive Basin Plan for the North Coast Region. In a nutshell, the policy regarding discharges into the Bay was that it be "phased out at the earliest practicable date." However, the Regional Water Quality Control Board could grant exceptions if the discharging municipality could prove that "the wastewater in question would consistently be treated and discharged in such a manner that it would enhance the quality of receiving waters above that which would occur in the

absence of the discharge." This meant that a municipality would somehow have to prove that the wastewater, if discharged into the Bay, would enhance the water quality in the Bay. It was assumed that this would only be feasible if all the municipalities along the bay pooled resources to build a regional treatment plant. No single municipality was large enough to afford a treatment system advanced enough to satisfy these federal regulations.

In response to this plan, a “Joint Powers Agency” was created in 1973 to resolve the issue. The Agency consisted of the municipalities of Eureka, Arcata and McKinleyville in Humboldt County. An engineering firm, Metcalf & Eddy, developed a design for a regional facility that would serve these communities. The facility would be located on the Samoa Peninsula and was estimated to cost $25 million. In 1974, the Humboldt Bay Wastewater Authority (HBWA) was formed. It included the Joint Powers Agency and the McKinleyville and Humboldt Community Services Districts, and was charged with the responsibility of constructing the regional wastewater treatment plant.

The proposed plant would have large interceptors around the perimeter of the bay, with a major line crossing under the water in the region of active navigation. Effluent from the plant would be released offshore into an area of shifting sea bottom and heavy seas during winter storms. The facility would have been capital- and energy-intensive, and no one agency could afford it, so sharing expenses was believed to be the only solution to solving the Bay communities’ collective wastewater problems. However, as plans progressed, the logistical challenges of incorporating all communities as well as the costs--economic, social and ecological--became increasingly apparent. The plan became a hot political issue. A major concern, especially in Arcata, was that the creation of a sewer interceptor line running from McKinleyville to Eureka along Highway 101 would open up agricultural areas to suburban-style sprawl. The resulting strip malls and subdivisions would render the communities indistinct from one another and eliminate the rural character of the area. Another concern was that some of Arcata’s investments, both in the aquaculture project, and in the existing treatment plant, would be lost. For two years, the City Council tried to convince the Regional Water Quality Control Board (RWQCB) and HBWA that there had to be other alternatives to the regional treatment plant.

From the time the Comprehensive Plan was created, Arcata descended into a politically volatile period sometimes referred to as the "wastewater wars." The main factions split along two lines. The supporters were the development and financial interests, the engineering community consisting of the RWQCB as well as State officials, the bulk of Arcata’s "old-timers," and environmentalists who feared that if

Arcata opted out of the plan, HBWA would collapse and neighboring Eureka would continue to discharge its partially untreated effluent into the Bay. Supporters of the marsh were led by City Councillor Dan Hauser, Humboldt State University environmental engineering professor Bob Gearheart, then-Public Works director Frank Klopp, and Humboldt State University fisheries professor George Allen. Arcata citizens against the project tended to be environmentalists, professors and students, and newcomers who were fleeing other built-up areas further south, all of whom valued Arcata's natural beauty and historic rural charm.

In 1975, critics of the regional plan formed a coalition called "Citizens for a Sewer Referendum." They launched a campaign to call for a vote on the project. Their persistence paid off in eventually helping to stall the project. However, it became increasingly clear that if Arcata were to opt out of the plan it would effectively block the regional treatment plant. Other communities in HBWA could not afford to go forward without Arcata. Part of the antagonism towards the Arcata critics of the plan was that as time went on, inflation was rapidly increasing the cost of the project.

At this point, Arcata had to come up with an alternative plan that would not only assure treatment of the sewage, but that would satisfy the "enhancement" requirement in the Comprehensive Basin Plan. The idea to build its own wastewater treatment plant came about in 1976 amidst this divisive controversy. The City began exploring the design of a decentralized system which made use of constructed wetlands. The idea had its origins in the aquaculture work of Dr. George Allen. In 1969, Dr. Allen had begun an experimental project intended to find out if Pacific Salmon and cutthroat trout could be raised in ponds with a mixture of seawater and partially treated wastewater. This type of project challenged the conventional paradigm of waste in two ways. First, it said waste was a valuable resource rather than a harmful, expensive nuisance that had to be disposed of. It also declared that communities themselves—rather than centralized bureaucratic regulatory bodies—could manage this resource if given the freedom to do so. The idea of creating and using a marsh began to grow in the mind of Robert Gearheart, another Humboldt State University professor. Using the fish aquaculture project and a treatment marsh as probable ways to prove "enhancement," a city task force proposed that the natural processes of a wetland could be harnessed to effectively and efficiently treat municipal wastewater. This was a huge departure from business as usual.

In 1977, the City of Arcata team, consisting of George Allen, Bob Gearheart, Public Works director Frank Klopp and City Councillor Dan Hauser put their proposal to the Regional Water Quality Control Board. They would have a wastewater treatment process that used the existing primary sedimentation facilities, a 22.3 hectare oxidation pond facility, and three new constructed marshes. The effluent from the

marsh system would then flow through a 6.9 hectare lake before being discharged into the Bay. The city insisted that this system would not only protect all of the existing beneficial uses of the Bay, but would enrich them and even create new ones such as greater bird habitat and extensive recreational space. They presented this plan at RWQCB meetings and before the SWRCB, as well as to the citizens of Arcata itself. There was much quibbling over whether or not this was the type of enhancement outlined in the regulations. They challenged the Chair of the SWRCB to define exactly what was meant by enhancement. When he could not do it, the marsh supporters were able to prove that 'enhancement' of the Bay' was a meaningless term and legislation was introduced to eliminate this requirement.

Meanwhile, the Coastal Conservancy, a California non-profit organization became involved. The Coastal Conservancy purchases critical coastal habitat and conservation easements and works with communities to restore coastal land. They had been observing the events in Arcata and offered to help fund the wetlands restoration that was part of the three original marshes.

The University and the city formed the Task Force on Wastewater Treatment that created the pilot project Arcata was finally granted permission to undertake. The State Water Resources Control Board funded the 3-year study which began in September of 1979. It experimented with partially treated wastewater and the natural processes of wetland ecosystems. The results of the pilot project promisingly showed that not only could the constructed wetlands effectively treat wastewater, but that it would also enhance the biological productivity of the wetland environment into which wastewater was discharged. At the end of the pilot project in 1983, the Board agreed that the marsh system would indeed "enhance" the beneficial uses of the Bay for scenic enjoyment and educational study, and that a full-scale marsh system would satisfy the requirements of the Basin Plan. As the Task Force's original leaders emphasized, the plan was a simple, cost-effective application of an appropriate technology.

With the help of the Arcata City Council and political representatives in Sacramento, in 1983 the city received the go-ahead to develop the marsh.

---

## Constructing the Marsh

Sections of Arcata's old industrial sites by the shore of the bay had concrete where the lumber had been stacked and stored. To create the marshes, they had to break up the concrete. This was done as an activity with the National Guard combat engineers. They came in one Sunday, blew the concrete up, and carried it off. A lot of other residue from the saw mills also had to be taken out.

The section that is now Gearheart Marsh was originally pasture land. Because the terrain was slightly lower than the surrounding area, it had relatively large areas of open water once the water was let in. Marsh plants were allowed to grow in naturally.

When the landfill was closed, a dike was set up around the Bay. Sediment was scooped out and put on top of the landfill to seal it. The current wetlands surround the landfill, but none are on top of it. The landfill has been monitored for seepages of any kind and so far no contaminants have been found to have leached out of it.

The last marsh was "terraformed" to be various depths, deeper in some places, shallower in others. Moving the dirt around to create this "micro-terrain" was done by bulldozer. Differing depths was necessary because if it was kept shallow, the tubers of the sago pondweed would spread everywhere uniformly and undermine the biodiversity needed for the marsh to do its work. Flow in the marsh is faster at the edges of groups of aquatic plants than in the middle.

Vegetation was added to about one third of the last marsh, Hauser Marsh, to provide denser vegetation towards the end of the system. This ensures that the marsh will strip out any remaining solids in the effluent. They used native Hardstem bulrush brought in from a near by fishing lake. This marsh has alternating areas of open water and vegetation. Everyone said they wanted islands but they didn't work as well as planned and were removed. This was one important lesson they learned about creating a constructed wetland.

Sago pondweed seeds were broadcast into all the deep areas of all the marshes. Ducks love to eat this seed, providing a natural harvest to keep it from taking over. The team learned a lot about planting, often by trial and error. Some of the unsuccessful methods they used included burying the whole plant by the roots and throwing sprigs of the plants into the water. Unfortunately the waterfowl would eat everything immediately. Their greatest success came when they trucked in plants, cut off their tops, but kept a substrate of some of the original soil around the tuber. Previous orders of plants had come with their original dirt stripped away and they were unable to make the transition to the marsh. It takes about two years for the soil encrusted plants to grow to maturity.

A floating plant, Hydrocotyl, can sometimes take over and excessively shade the marsh, so it is periodically harvested. It is then mixed with sludge settled out from the first stage of treatment and used as compost in the Arcata Community Forest.

In 1986, the treatment system was completed and became operational. In the same year, the Coastal Conservancy provided funds to restore Butcher's Slough which

expanded the Sanctuary to its current size. The slough was refigured into a more natural channel, thereby enlarging the saltwater wetlands, and creating another freshwater marsh in a former log pond.

In order to extend the area of the marsh further, 3.15 acres of land on the inland side of the wetland area has been acquired, and a pond has been created there. Aquaculture still continues in parts of the marsh, though the fish are not raised for commercial purposes. However, more than half of the oysters grown in California are produced in a subsection of Humboldt Bay known as Arcata Bay.

---

## The Wastewater Treatment System

All municipal sewage treatment, whether conventional or alternative, is broken down into two main phases. Primary treatment is largely a mechanical process which separates the solids from the liquids, while secondary treatment removes contaminants and pathogens harmful to humans. The AMWS's primary treatment occurs in the headworks and clarifiers, while the secondary treatment occurs at the oxidation ponds, chlorination basins, treatment marshes and enhancement marshes.

The flow between components occurs through underground tunnels. Water levels in the marsh are not intentionally changed, for example, by adjusting weir levels. Once they are set, they are left to function on their own.

1. The Headworks. This is the first phase in the treatment of raw sewage. Water is piped underground from Arcata households to the headworks. Here inorganic materials are removed from the water using two Archimedes screw pumps that lift the raw sewage fifteen feet up and pass it through bar screens and grit separators before it enters the clarifiers.
2. Primary Clarification. The water sits for about four hours in the clarifiers. Two clarifiers (26 feet and 60 feet in diameter) are used for settling out any remaining suspended material that makes it past the headworks. The liquid effluent from the clarification process is sent to the oxidation ponds. The solids that settle out from the clarification process are sent to digesters.
3. Digesters. The remaining sludge from the clarifiers is pumped to the primary and secondary digesters respectively. Anaerobic microorganisms in the digesters consume the nutrients in the sludge as their food, and produce carbon dioxide, methane and hydrogen sulphide as by-products. The digesters mix the sludge by recirculating

methane gas with compressors. The remaining sludge goes onto a sludge drying bed. It is then mixed with yard waste and hydrocotyl, the aquatic plant, and is used to fertilize the soil in the Community Forest.

4. Oxidation Ponds. These ponds cover an area of 55 acres. They were built in the late 1950's. They are approximately five feet deep, and are used for settling out smaller solids not removed by primary treatment. The effluent is channeled by underground tunnel into the oxidation ponds to treat it to secondary standards. "Secondary standards" means that at least half of the BOD (biochemical oxygen demand) and suspended solids that remain after primary treatment have been removed. Breakdown of the floating and settling organic matter in the sewage is facilitated by algae growth and microbial/bacteria activities in the ponds. Sunlight is key to this process, because algae produce oxygen through the process of photosynthesis,. Algae also consume nitrogen and phosphorus, two common nutrients found in municipal wastewater. Microbes and bacteria use oxygen produced by the algae to break down and use the nutrients in the waste for their own metabolism. The by-product of this is carbon dioxide, which is then used by the algae to produce more oxygen for the microbes. Mechanical aerators are used in the oxidation ponds as well, to aid the algae in oxygen production.

5. Treatment Marshes. The treatment marshes reduce the remaining BOD concentrations, dead algae, and other suspended solids that remain in the oxidation pond effluent. There are three treatment marshes, each of which is two acres in area. They are located north of the oxidation ponds. They were created by subdividing the original oxidation ponds. All the marshes were planted with hardstem bulrush. This helps settle out the suspended solids by slowing down the water flow and preventing growth of new algae. The wastewater circulates through a marsh system before it is combined at a pump station and flows into the disinfection facility.

6. Disinfection. There are two separate stages of disinfection. The first occurs after the effluent passes through the treatment marshes. The second takes place after passing through the enhancement marshes just before its release into Humboldt Bay. Disinfection is necessary to kill any viruses or pathogens present in the water. Technically the second chlorination is unnecessary given the effectiveness of the enhancement marshes, but is required by regulators in order to conform to fecal coliform standards. Ironically, the standards are 'violated' only because birds are discharging excrement into the enhancement marshes. Because of the double chlorination, two

chlorine contact basins are necessary. The basins are located immediately south of the headworks. Any free chlorine remaining in the final effluent after the 60 minute contact time is removed with sulphur dioxide. After the second chlorination, depending on how much water is coming into the marsh, it is either released into the Bay or sent to the enhancement marshes. Usually it is mixed with water from the enhancement marshes and released into the Bay.

7. Enhancement Marshes. After the first chlorination process, the effluent flows into the enhancement marshes located northwest of the oxidation ponds. The three marshes, each named after George Allen, Bob Gearheart, and Dan Hauser respectively, cover a total of 31 acres. The flow is controlled through the use of sluice gates and weirs, though the water flow is rarely interfered with. The natural processes occurring in the marshes simultaneously purify the wastewater by removing excess nutrients and 'feed' the marsh plants with water high in nitrogen-rich organic matter. Nutrients are taken up by the plants and thus removed from the wastewater. The roots and stems of the plants also clean the water by forming a dense netlike filter that removes large quantities of suspended solids. Algae, fungi, bacteria and micro-organisms attached to the roots of these plants feed on these solids. This nutrient-rich habitat attracts many birds to the sanctuary. It has become an exceptional and cherished place for birders, recreation, research and education. Before discharge into Humboldt Bay, the water returns to the disinfection facility for a second chlorination. In total, all wastewater that enters the system spends about fifty days there from its first contact with the headworks to its release into Humboldt Bay.

---

## Marsh Specifications

- Design Population: 19,056
- Average Annual Flow: 2.3 million gallons/day (mgd)
- Maximum Monthly Flow: 5.9 mgd
- Peak Flow: 16.5 mgd
- BOD's Load: 4100 lbs/day
- TSS Load: 3400 lbs/day

---

## The Arcata Marsh Interpretive Center

All the work and ingenuity that went into the marsh was rewarded in 1987 when Arcata received the Innovations in Government Award from the Ford Foundation/Harvard University Kennedy School of Government and $100,000 to begin building the Arcata Marsh Interpretive Center. Open to the public since 1993, the Interpretive Center has exhibits on the political, ecological and technical aspects of the marsh. It is staffed by city employees on weekdays and by community volunteers on weekends and holidays. The Friends of the Arcata Marsh offers free educational tours of the AMWS and treatment facility.

---

## Spin-Offs

Creation of the marsh allowed not only reuse of wastewater but also ecological restoration of industrial, agricultural, and public service land:

- "Zoning." An important aspect of the case was that it not only prevented development in the agricultural areas between the communities, but it also restored a degraded waterfront area. Before the marsh, the land consisted of an abandoned lumbermill pond, channelized sloughs, low-quality pasture land, and a sealed landfill.
- A window to Humboldt Bay. Before the marsh was created, Arcata citizens had no access to its waterfront. After the AMWS, the entire area was opened up. As the disused landfill, "Mount Trashmore," was on higher ground, it now allows people a broad view of the Bay.
- Habitat creation. Some 60,000 acres of wetland are lost annually, mainly to draining and reclamation for development and agriculture. Of the remaining 100 million acres, many are severely degraded. Creating the Arcata wetlands not only provided a cost-effective, low-energy, low-maintenance essential service, it also locally reversed the trend of wetland loss.
- Green city. Arcata City Hall is environmentally active and maintains various other programs including a greenhouse gas reduction plan, solid waste reduction, Open Spaces initiative, pesticide reduction plan, pedestrian/bicycle plan, and community forest.

---

## The Community Forest

Arcata's Community Forest is comprised of approximately 622 acres of 120+ year old redwood forest obtained in several purchases financed by bond measures over a

50 year period. This acquisition process culminated in the dedication of the Community Forest in 1955.

The forestland was used as a source for the municipal water supply until 1964. Since then it has served many functions including recreation, education, sustainable timber harvesting, and wildlife habitat. It is also an outdoor laboratory for students and 'citizen scientists'. The forest serves as the headwaters of many of Arcata's urban streams. The main tree species is California Redwood but Douglas Fir, Grand Fir, Western Hemlock and Sitka are also present.

In 1979, a "Forest Management and Parkland Initiative" ballot measure was passed by Arcatans. Its intent was to create a long-term management program governed by 'ecological principles' that would preserve its recreational uses as well as generate revenue for further forest acquisition by carefully harvesting the forest's timber. This was the nation's first forest to be certified by the Forest Stewardship Council (FSC) as eligible for the "Smartwood" designation which denotes sustainably harvested wood.

Annual revenue generated by the forest is $500,000-700,000 per year. Trees are generally harvested every other year. Revenues from the sale of timber go into acquisition of land through outright purchase or by granting conservation "easements," where land owners are paid a fee to sustainably manage a given parcel of land. The focus is on areas contiguous to the forest or otherwise ecologically sensitive habitat. Land acquisition is contingent upon funding, mostly from grants.

---

## Conditions Contributing to Arcata's Success

1. Public Works Director Frank Klopp was an "old paradigm engineer" who subscribed to the belief that wastewater had to be disposed of and not utilized, typically through command-and-control and technology. He initially supported the regional wastewater treatment pipeline plan until he saw the cost to Arcata. He realized Arcata would never be able to afford it. This led him to seriously consider the merits of the 'other side's' plans. Through discussions with the marsh's main proponents and after witnessing a similar project in the San Francisco Bay area, he 'converted'. He then became a key figure in enlisting buy-in from engineers in the HBWA, SWRCB, and RWQCB as well as the more conservative members of the community in a way that someone outside his profession could not.
2. There was a reduction in the national voting age in 1971 from 21 years of age to 18. This new political clout among younger people had

particular impact in a university town like Arcata.

3. The change in political climate helped facilitate the "changing of the old political guard," which brought in a new generation of politically progressive leadership in City Hall.
4. The city displayed a high level of creativity in finding alternatives to the 'bust' that characterized the region's extraction-based fishing-forestry economy (possibly due to #2 and #3) (see Julie Fulkerson's and Dan Hauser's comments below).
5. The Marsh and the Community Forest became de facto 'zoning' initiatives because development could not occur there. This was more effective than any regulation, as the community forest and wetland became physical barriers to development, impregnable to the power or political machinations of the development crowd.
6. While initial concern over the pipeline was that it would allow development between Arcata and neighboring Eureka and McKinleyville, this bled into other concerns such as the mounting costs and potential liability issues if the pipelines under the Bay were to malfunction or rupture.
7. The presence of Humboldt State University meant access to cost-effective, often free, technical support, data collection, monitoring and research that continues to this day. This level of scientific and technical knowledge would not have been otherwise affordable to Arcata. Humboldt State is unique in that it has the only program known as "environmental resources engineering," which integrates fields which have normally been fragmented. It integrates biology, chemistry, physics and ecology. Partly as a result of Bob Gearheart's involvement with the marsh this program was redesigned so that engineering students, in their formative undergraduate years, get a more comprehensive outlook on the world (see Bob Gearheart's comments).

---

## Environmental Tipping Point Elements

1. Positive feedback. The trend in North America towards development that opens up formerly agricultural or virgin land was partially halted by the marsh in two ways: **i)** The Regional plan with its pipeline following Highway 101 would have provided the infrastructure for easy development of the agricultural land between McKinleyville and Eureka. Creating the marsh prevented the "freeing up" of this land. **ii)**

Creating the marsh efficiently reused disused land which had fallen onto the City because no one wanted it, rather than using new land which would have set in motion the feedback loops in i).

2. "Nature Doing the Work." Wetlands are well-known biological filters and perform critical cycling, filtering, purifying, water storage and flood prevention services for free. Using a wetland to treat waste simply takes advantage of natural biological processes occurring in wetlands. The main function of wetlands in wastewater treatment is the uptake or removal of nitrate, ammonium, phosphate, and possibly heavy metals.

---

### A Few of Many Examples of Nature "Doing the Work" in the Marsh:

· The structure of a wetland itself, with its slow flow and shallow depths allow sediments to settle as water passes through it. Also, the slow flow allows long contact times between the water and the surfaces in the wetland, allowing for crucial exchanges to happen at the microbial level.

· Two processes are of particular importance for nitrogen cycling:

1) Dentrification: The conversion of nitrates found in wastewater by bacteria into nitrogen gas through removal of oxygen in the anoxic conditions found in the detrital layers of the wetland.

2) Nitrification: The conversion of ammonium to nitrates (which must happen in oxygen rich regions of the soil, usually near the clumps of vegetation) which can then be converted into nitrogen gas through dentrification.

· Plants, primarily bulrushes, provide a "canopy" of shade over the water which inhibits algae growth, cools the water, slows down its flow, blocks UV rays, reduces the level of evaporation and helps to oxygenate the water through the process of photosynthesis. It also provides the habitat for microorganisms such as beneficial bacteria, on the roots of these plants. These bacteria are beneficial because they consume the suspended solid particles. Floating plants that block light are generally harvested by aquatic birds (although, as stated earlier, periodically they must be harvested if excessive). These floating plants also reduce the level of evaporation.

· The layer of litter on the soil surface of a wetland is known as the "detrital layer." It is in a generally constant state of slow decomposition by bacteria and other organisms. Generally wetlands have ample detritus because the anaerobic conditions in the wetland slow down decomposition. It offers surface area for decomposers such as fungi and bacteria that nitrify and dentrify (see above).

Acinomycetes is one particularly active microorganism that helps to cycle nutrients. Sediments in the oxygen-poor detrital layer also provide conditions for breaking down complex organics (i.e. greases, fats, solvents, fuels). As well, they sequester metals and provide a source of carbon, nitrogen and phosphorus to drive microbial processes.

· Sunlight, through the process of photosynthesis, produces oxygen needed to facilitate the processing of nutrients in the wastewater by microorganisms.

· Single and multi-celled organisms reduce the carbon and organic material and "pass it up the food chain" in the form of insects and birds which then fly away and carry it out of the wetland. Birds also bring in seeds from other areas which foster biodiversity and ensure continued growth of flora.

· Insect larvae and other insects such as beetles consume the solids which settle out of the partially treated wastewater.

3. "Success Breeding Success." The success and popularity of the marsh gave those in City Hall the freedom to imagine more possibilities for the marsh and other projects. It also has created a stronger base for support of environmentally friendly projects in the town.

4. Replication: Arcata's story has become a landmark in alternative wastewater treatment. It has attracted interest and visitors nationally and internationally. Bob Gearheart and other key players have traveled to various parts of the world to promote and provide technical support to other communities interested in adopting similar models. They have visited Oaxaca in Mexico, the West Bank, Egypt, Thailand, Indonesia, Palo Alto and Petaluma in California, and some smaller towns in the San Francisco Bay Area. Neighboring McKinleyville and Eureka are creating similar systems, though they are loathe to admit it has anything to do with influence from Arcata. Replication is not always easy to trace. Multiple sources may be consulted. Sometimes communities try and fail, others adopt some aspects of the Arcata model, and still others may not yet have done so, but the 'seeds' are lying dormant, needing only a final impetus to start bearing fruit.

---

## References


- US EPA et al. "Design Manual: Constructed Wetlands and Aquatic Plant Systems for Municipal Wastewater Treatment." pp. 27-30.
- Davis, Luise. "A Handbook of Constructed Wetlands." USDA-Natural Conservation Service and US EPA, region II. Online link

- A site visit to Arcata City including a tour of the marsh and interviews with Dr. Robert Gearheart, former Councilor Julie Fulkerson, City Manager Dan Hauser, former Public Works Director Frank Klopp
- Maria Streshinsky. "From Blighted to Beautiful: Five fabulous makeovers for Mother Earth." Via Online: The AAA Travellers Companion, November 1999.
- Jordan, Fred. 1990. "The Wastewater Wars," in *Innovating America*, Chapter 8. A Ford Foundation report. Profiles of eight award-winning projects (1986-1988) in the Innovations in State and Local Government awards Program, which is sponsored by the Ford Foundation and administered by the John F. Kennedy School of Government at Harvard University. The awards honor exemplary programs and policies addressing important social and economic problems at the state and local levels.


## Acronyms

- **SWRCB**: The State Water Resources Control Board
- **RWQCB**: The Regional Water Quality Control Board
- **HBWA**: Humboldt Bay Wastewater Authority
- **AMIC**: Arcata Marsh Interpretive Center
- **AMWS**: Arcata Marsh and Wildlife Sanctuary

Back to top

Copyright © 2006-Now | The EcoTipping Point Project | ALL RIGHTS RESERVED
Website users are welcome to download and distribute any materials from this website. Please acknowledge ecotippingpoints.org as the source.

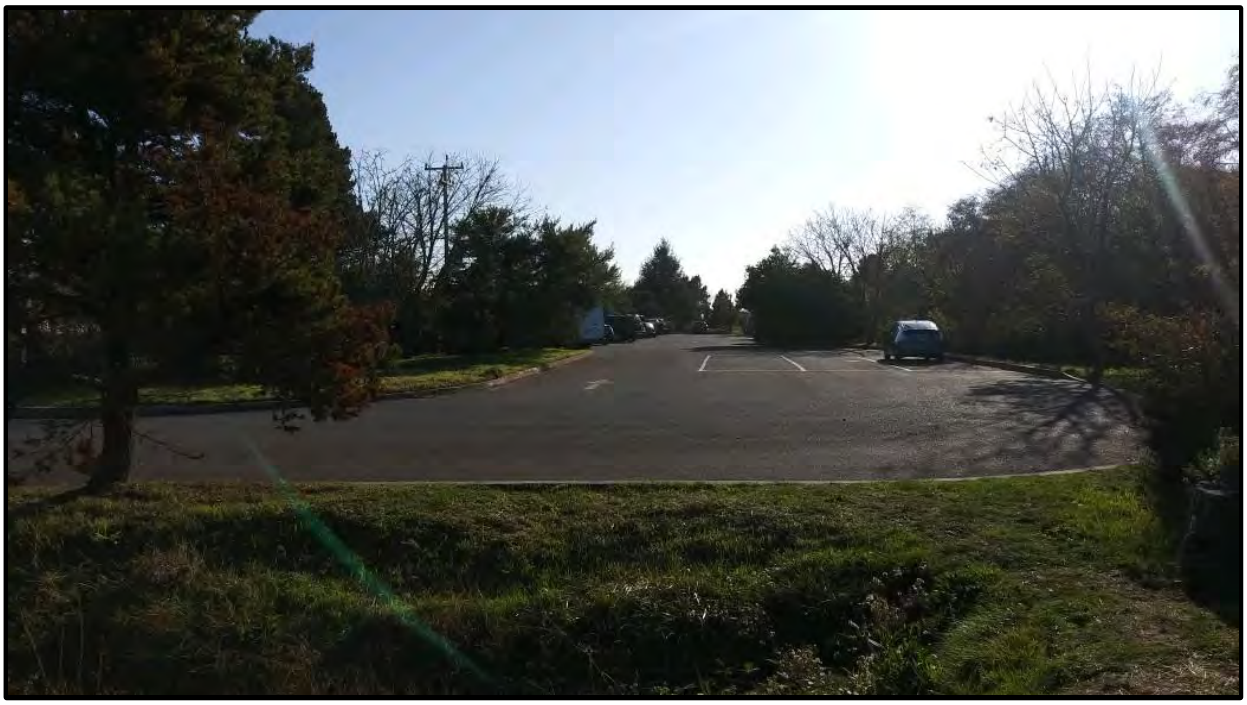
# Appendix E

## Project Location Photographs

**Appendix E - Project Photos**



**View (south) of Staging Area 1, the southwest corner of APN 503-232-013**



**View (south) of Staging Area 2, the south G st parking lot of the Arcata Wildlife Marsh and Sanctuary, adjacent to the Arcata Marsh Interpretive Center**



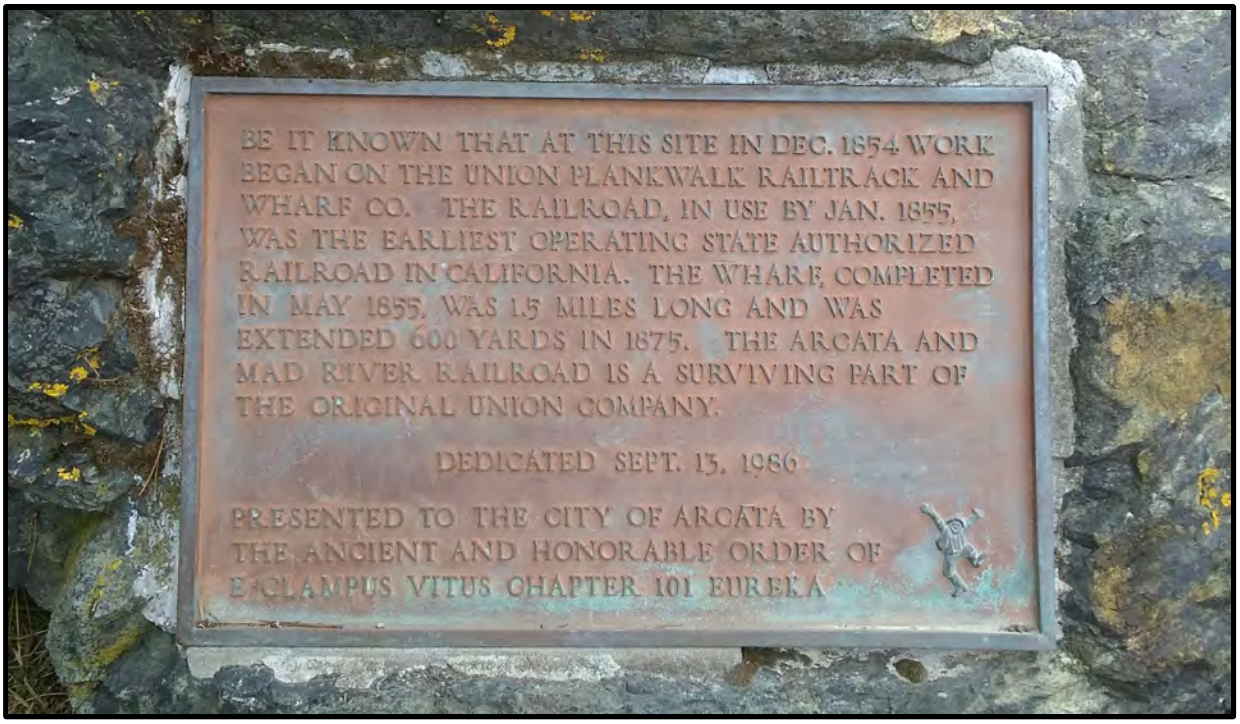
View (east) of Staging Area 3, the southern section of APN 503-211-026



View (south) of Staging Area 4, the south I st, parking lot of the Arcata Wildlife Marsh and Sanctuary



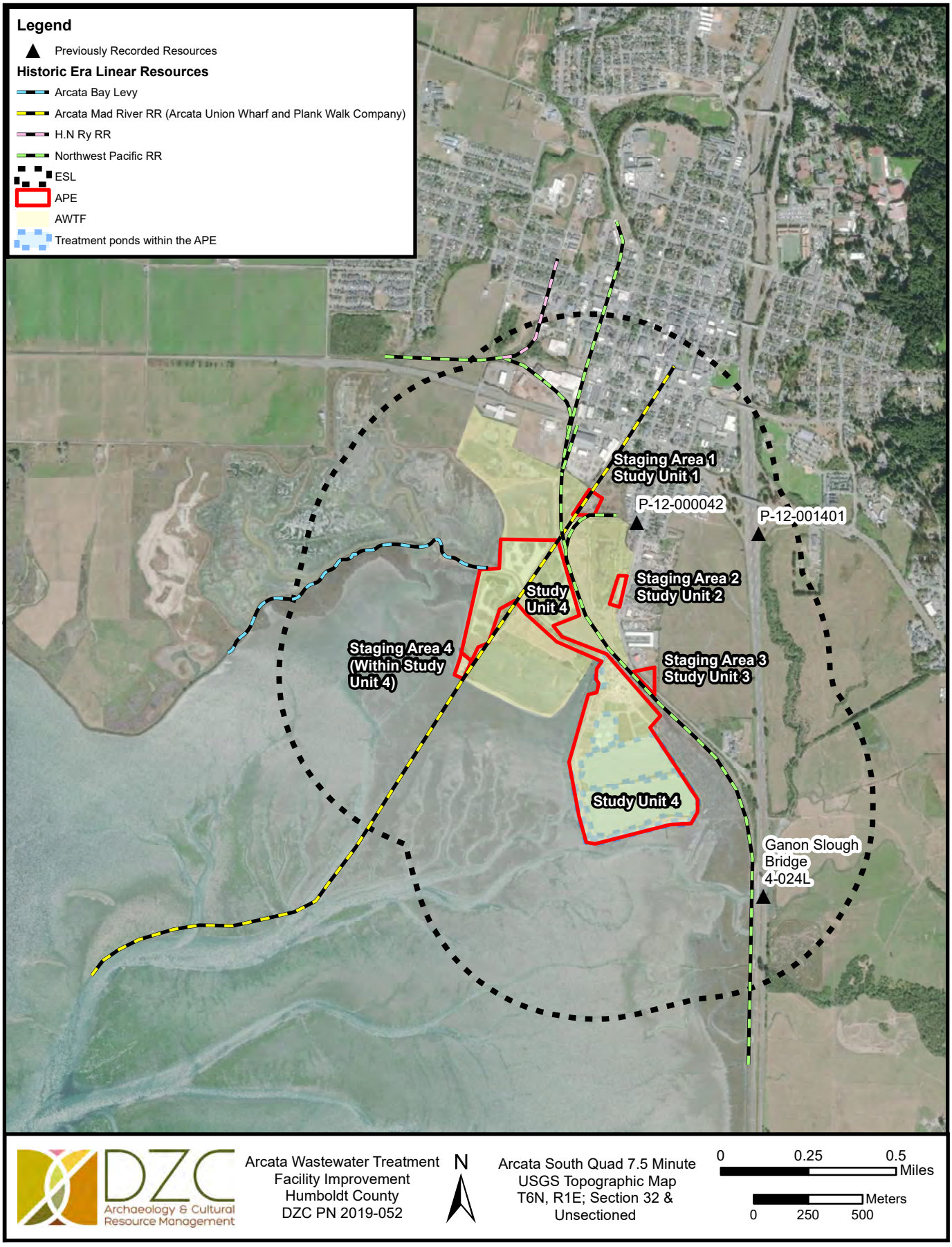
View (southwest) of the Arcata Wharf Ruins




Detail view of the commemorative plaque posted along the trail adjacent to the Arcata Wharf Ruins

# Resource Location Map

Figure F-1 CONFIDENTIAL Resource Location Map



# Geotechnical Exploration and Geologic Hazards Report – Part 1

# Geotechnical Exploration and Geologic Hazards Report Part 1

## Arcata Wastewater Treatment Facility Improvements Project
## 736 F Street, Arcata, California

August 28, 2018

Prepared for:
Carollo Engineers, Inc.

Prepared By:
LACO Associates, Inc
21 West 4th Street
Eureka, California 95501
707-443-5054

Project No. 7986.01

DRAFT

LACO

advancing the quality of life for generations to come

Design
Planning
Engineering
Geology and Geotechnical
Environmental Science
Materials Testing
Survey

800 515-5054
www.lacoassoicates.com
Eureka | Ukiah | Santa Rosa

J. Erich Rauber, P.E., G.E.
Senior Geotechnical Engineer

Christopher J. Watt, C.E.G., C.H.G.
Principal

TABLE OF CONTENTS

1.0 Introduction ..... 1
1.1 Project Description ..... 1
1.2 Scope of Services ..... 1
2.0 Exploration ..... 2
3.0 Site and Subsurface Conditions ..... 4
3.1 Site Conditions ..... 4
3.2 Geologic Setting ..... 4
3.3 Subsurface Conditions ..... 4
4.0 Geologic Hazards ..... 4
4.1 Seismic Ground Shaking ..... 4
4.2 Liquefaction ..... 5
4.3 Volcanism ..... 7
4.4 Slope Instability/Landsliding ..... 7
4.5 Flooding ..... 7
4.6 Tsunami Inundation ..... 7
4.7 High Groundwater ..... 7
4.8 Soil Corrosivity ..... 7
4.9 Soil Swelling or Shrinkage Potential ..... 8
5.0 References ..... 9
Figures 10
Appendix 1 ..... 11
Appendix 2 ..... 12
Appendix 3 ..... 13

DRAFT

Appendix 4 ..... 14

Appendix 5 ..... 15

## Figures

| | |
|---|---|
| Figure 1 | Vicinity Map |
| Figure 2A-B | Site Plans |
| Figure 3A-D | Geologic Cross Sections A-D |

## Appendices

| | |
|---|---|
| Appendix 1 | Boring Logs |
| Appendix 2 | Laboratory Test Results |
| Appendix 3 | Site-Specific Ground Motion Analysis |
| Appendix 4 | Liquefaction Assessment Results by use of SPT Data |
| Appendix 5 | Liquefaction Assessment Results by use of CPT Data |

DRAFT

# 1.0 INTRODUCTION

This report presents the results of a geotechnical exploration performed by LACO Associates (LACO) in connection with the City of Arcata's existing wastewater treatment facility improvements project (the project). The project location in relation to adjacent streets and landmarks is shown on the Vicinity Map, Figure 1. at 736 F Street, west of U.S. Highway 101 in Arcata, California (Site) as presented in Figure 1-Vicinity Map. This report is presented in two parts. Part 1 includes our findings, including subsurface data and improvements to potential geologic hazards and site specific seismic analysis results. Part 2 is primarily devoted to presenting interim design of foundation system.

## 1.1 Project Description

A list of improvement components, along with anticipated dimension, foundation elevations, loads, and occupancy categories is presented in Table 1. The location of these improvements are shown on Site Plan, Figure 2.

*Table 1. Improvement Component Locations*

| Improvement Component | Anticipated Plan Dimensions (feet) | Anticipated Foundation Depth (feet) | Anticipated Foundation Loads (ksf) | Occupancy Category |
|---|---|---|---|---|
| Headworks | 22 x 52 | 3.3 | 2.5 | 3 |
| Headworks | 17 x 15 | -1.9 | 2 | 3 |
| Oxidation ditch | 65 x 266 | 1.5 | 2 | 3 |
| Secondary Clarifier (2) | 75 (diameter) | -3.8 | 2 | 3 |
| UV Disinfection channels and canopy | 14 x 58 | 6 | 2 | 3 |
| Thickener – at grade portion | 20 x 25 | 8 | 1.5 | 3 |
| Thickener – below grade portion | 22 x 15 | 5 | 1.5 | 3 |
| Chemical storage facility | 20 x 50 | 8 | 1.5 | 3 |
| New Electrical Building | 24 x 37 | 8 | 1.5 | 3 |
| New Generator | 5 x 12 | 8 | 1.5 | 3 |
| New Transformer | 5 x 5 | 8 | 1.5 | 3 |
| New ML Flow Split Structure | 29 x 22 | 6.3 | 2 | 3 |
| New RAS Pump Station | 26 x 40 | -3.8 | 1.5 | 3 |
| New WAS Pump Station | 18 x 18 | 8 | 1.5 | 3 |
| New Bus Barn | 140 x 60 | 8 | 1.5 | 3 |

ksf–kips per square foot

DRAFT

## 1.2 Scope of Services

LACO's scope of services is outlined in the task order issued by Carollo Engineers, Inc. dated April 12, 2018.

# 2.0 EXPLORATION

On April 24-26, and May 7-10, 2018, LACO explored subsurface conditions at the Site by (1) advancing 11 cone penetration test (CPT) probes to a maximum depth of 60 feet below ground surface (bgs), and (2) drilling 7 test borings to a maximum depth of 51.5 feet bgs. Approximate CPT and test boring locations are shown in Figure 2. Under the direction of a LACO geologist, CPT probes were advanced by Gregg Drilling, Martinez, California using a 15 square centimeter ($cm^2$) standard cone; test borings were drilled by Clear Heart Drilling, Inc. using a DR7K track-mounted drill rig equipped with a 4-inch diameter hollow stem auger, both. Our geologist logged the test borings in general accordance with the American Society for Testing and Materials (ASTM) Test Procedure D2488, and obtained relatively undisturbed and disturbed soil samples for visual classification and laboratory testing. Boring logs are presented in Appendix 1.

Select soil samples collected during our field exploration were subjected to the following laboratory tests:

- Particle Size Finer than No. 200 sieve (ASTM C117);
- Atterberg Limits (ASTM D4318);
- Consolidation (ASTM D2435);
- Direct Shear (ASTM D3080);
- Uncontinued Compressive Strength Test (ASTM D2166);
- Moisture Content (ASTM D2216) and Unit Weight (ASTM D2937); and,
- Basic Corrosivity (pH, resistivity, electrical conductivity, sulfate, chloride)

Laboratory test results are summarized in Table 2 and presented in Boring Logs (Appendix 1). Detailed test results are presented in Appendix 2.

*Table 2. Laboratory Test Results*

| Boring | Depth (feet bgs) | USCS Soil Type | Finer Than #200 Sieve | Moisture / Density | | Atterberg Limits | | Direct Shear | | Unconfined Compressive Strength Test | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | FC | DD | MC | PI | LL | DS | | UC | US |
| | | | (%) | (pcf) | (%) | (%) | | C (psf) | Φ (degrees) | (psf) | (psf) |
| GBH-1 | 5 | CL | - | 59.01 | 68.8 | - | - | - | - | 514 | 257 |
| GBH-1 | 11 | CL | - | 97.2 | 28.4 | - | - | - | - | - | - |
| GBH-1 | 15.5 | SP-SC | - | 102.2 | 26.9 | - | - | - | - | - | - |
| GBH-2 | 2.5 | CL | 28.1 | - | - | - | - | - | - | - | - |
| GBH-2 | 5 | CL | - | 58.1 | 67.7 | - | - | - | - | 703 | 351 |
| GBH-2 | 10 | CL | 89.0 | - | - | - | - | - | - | - | - |
| GBH-2 | 20 | SM | 13.7 | 83.4 | 34.6 | NP | NP | 229 | 37.6 | - | - |
| GBH-2 | 35 | SM | 93.3 | - | - | 4.9 | 23.4 | 400 | 35 | - | - |
| GBH-2 | 45 | SM | - | 99.8 | 25.0 | - | - | - | - | 1479 | 739 |
| GBH-2 | 50 | SC | 18.2 | 103.3 | 23.0 | NP | NP | - | - | 196 | 98 |
| GBH-3 | 5 | CL | - | 50.7 | 64.5 | - | - | - | - | 809 | 405 |
| GBH-4 | 16 | CL | - | 121.1 | 17.1 | - | - | - | - | - | - |
| GBH-4 | 21 | CL | - | 111.3 | 23.7 | - | - | - | - | - | - |

DRAFT

| Boring | Depth (feet bgs) | USCS Soil Type | Finer Than #200 Sieve | Moisture / Density | | Atterberg Limits | | Direct Shear | | Unconfined Compressive Strength Test | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | FC | DD | MC | PI | LL | DS | | UC | US |
| | | | (%) | (pcf) | (%) | (%) | | C (psf) | Φ (degrees) | (psf) | (psf) |
| GBH-5 | 2.5 | SC | - | 131.3 | 7.6 | - | - | - | - | - | - |
| GBH-5 | 5 | SC | - | 92.7 | 22.2 | - | - | - | - | 493 | 246 |
| GBH-5 | 10.5 | CL | 94.9 | - | - | - | - | - | - | - | - |
| GBH-5 | 11 | CL | - | 75 | 44.2 | - | - | - | - | 358 | 179 |
| GBH-5 | 15.5 | CL | 97.5 | - | - | - | - | - | - | - | - |
| GBH-5 | 16 | CL | - | 92 | 30.2 | - | - | - | - | 871 | 436 |
| GBH-5 | 20 | SC | 7.1 | 93.8 | 29.0 | NP | NP | 794 | 28.9 | 922 | 461 |
| GBH-5 | 30 | MH | 59.4 | - | - | - | - | - | - | - | - |
| GBH-5 | 30.5 | MH | - | 67.5 | 54 | - | - | - | - | 1713 | 857 |
| GBH-5 | 31 | MH | 95.5 | - | - | - | - | - | - | - | - |
| GBH-5 | 35 | MH | 99.8 | 79.52 | 40.4 | 30.2 | 61.8 | 349 | 23.4 | 2888 | 1444 |
| GBH-5 | 37 | CL | - | 70.2 | 50.6 | - | - | - | - | - | - |
| GBH-5 | 40 | MH | 59.9 | - | - | - | - | - | - | - | - |
| GBH-5 | 40.5 | MH | 92.7 | - | - | - | - | - | - | - | - |
| GBH-5 | 41 | MH | - | 105.7 | 24.9 | - | - | - | - | 1800 | 90 |
| GBH-5 | 45.5 | SP-SC | 10.6 | - | - | NP | NP | - | - | - | - |
| GBH-5 | 51 | SP-SC | 49.1 | 105.4 | 22.8 | - | - | - | - | 643 | 322 |
| GBH-6 | 4.5 | SC | 31.6 | - | - | - | - | - | - | - | - |
| GBH-7 | 5 | CL | - | 59.0 | 72.7 | - | - | - | - | - | - |

USCS – Unified Soil Classification System
FC – Fines Content (Percent finer than No. 200 sieve)
DD – Dry Density (pounds per cubic foot)
MC – Moisture Content
PI – Plasticity Index
LL – Liquid Limit
DS – Direct Shear
C – Cohesion
Φ- Internal Friction Angle (degrees)
UC – Unconfined Compressive Strength
US – Undrained Shear Strength

DRAFT

# 3.0 SITE AND SUBSURFACE CONDITIONS

## 3.1 Site Conditions

The Site is located on the western side South G Street approximately 0.5 miles from its off-ramp from U.S. Highway 101. The planned building area is relatively flat, currently occupied by an existing wastewater treatment facility. The Site sits in the marsh of the north-eastern edge of the Arcata Bay at approximately 10 feet above sea level.

## 3.2 Geologic Setting

The Site is located in the Coast Ranges geomorphic province which is characteristic of northwest-trending ridges and valleys running subparallel to the San Andreas Fault Zone. Prior to development in the area the landscape was covered with delta marsh deposits that were saturated and tidally influenced. Published geologic maps (CDMG, 1984; McLaughlin et. al., 2000) indicate, the site is underlain by a layer of fill bay mud primarily consisting of alluvial fan and marine deposits that include clays, silts, and fine sands. Coarser deposits of sand and gravel are present in isolated areas as discontinuous lenses within the otherwise fine grain deposits. At unknown depth, the alluvial deposits unconformably overlie poorly cemented alluvial deposits of the early to middle-Pleistocene Falor Formation. Based on the morphology of the slopes in the vicinity, the contact between the unconsolidated bay margin sediments and underlying poorly unconformably overlies the Jurassic to Cretaceous age Franciscan Formation bedrock.

DRAFT

## 3.3 Subsurface Conditions

Our borings indicate the Site is blanketed by a layer of fill approximately 5 feet thick. The fill is underlain by marsh deposits approximately 40 to 60 feet thick. The marsh deposits are underlain by old terrace deposits. The fill consists of dense clayey sand with gravel. Marsh deposits consist of primarily soft fat/elastic silt, clay and fine sand. The terrace deposits consist of dense clayey sand that is comprised of fine to coarse sand with sub angular to rounded gravel. Geologic cross sections are provided in Figures 3. During drilling, free groundwater was encountered in our borings between 2 to 8 feet (bgs).

# 4.0 GEOLOGIC HAZARDS

## 4.1 Seismic Ground Shaking

Primary seismic hazards at the site include:

- Potential for ground rupture.
- Level of ground shaking anticipated to be experienced at the project site.

Regarding the former, the site is not located within an Alquist-Priolo earthquake fault zone (CDMG, 2000). Therefore, the potential for active surface fault rupture to adversely affect the project site is considered low.

The level of anticipated seismic ground shaking at the site is a function of the following factors:

- The closest distance from the seismic source (fault system) to the site.

- The magnitude of the postulated earthquake on the fault system.

A splay of the Fickle Hill fault is approximately 1.3 miles northeast of the Site (CDMG, 1983). The upper-bound earthquake considered likely to occur on the nearby Fickle Hill fault has an estimated moment magnitude (mw) of 6.9 (ICBO-CDMG, 1998). Peak ground accelerations of at least 0.635 g (63.5 percent of the force of gravity), and possibly more, may be expected to occur on this site as a result of this regional design basis earthquake (Petersen et al, 1999; CGS 2008;).

Recent and ongoing research into the seismicity of the Pacific Northwest has shown that the Cascadia subduction zone is capable of generating major earthquakes which will affect the site. The Cascadia subduction zone marks the boundary between the North American plate and the subduction Gorda and Juan De Fuca plates. It extends from offshore of Cape Mendocino, Humboldt County, to Victoria Island, British Columbia, and is considered capable of rupturing along its entire length and generating an upper-bound earthquake with a Mw of 9.0 (Satake et. al., 2003).

A site specific seismic response analysis, that provides response spectra and other seismic design parameters, is presented in Appendix 3.

## 4.2 Liquefaction

A state of soil liquefaction occurs when, as a result of cyclic fluctuations in pore fluid pressure, sediment grains lose contact with one another, causing a loss of effective stress and consequently of shear strength. Liquefaction is most commonly initiated by earthquake ground motions. A soil in a saturated, loose state and one which may generate significant pore water pressure when sheared, are the most likely to liquefy. Liquefaction is more likely to occur in sandy or non-plastic, silty soils, but may, in rare cases, occur in gravels and sensitive clays. Deposits most susceptible to liquefaction are young (Holocene-age, deposited within the last 10,000 years) sands and silts of similar grain size (poorly graded), in beds at least 1 meter thick, and saturated with water.

DRAFT

To evaluate the potential for induced liquefaction settlement to occur at the Site, we utilized the results of laboratory tests, Standard Penetration Test (SPT) data obtained in the field, input parameters presented in Table 3, and the computer program LiqSVs developed by GeoLogismiki.

*Table 3. Liquefaction Analysis Input Parameters*

| Calculation Method | Maximum Moment Magnitude | $PGA_M$ |
|---|---|---|
| NCEER 1998 | 7.3 | 0.81g |

In our analysis, we used the logs for test boring GBH-2, and GBH-5; a groundwater level during drilling of 6.5 and 4 feet bgs for GBH-5 and GBH-2, respectively; and assumed a groundwater level of 0 feet during a hypothetical seismic event. Fine-grained soils with a plasticity index of 7 or greater that have fine grained fractions exceeding 35 percent were input as not liquefiable because they tend to exhibit clay-like behavior (Boulanger and Idriss 2006). The results of our analyses are presented in Appendix 4 and settlement values are summarized in Table 4.

*Table 4. Liquefaction Induced Settlement Estimates Calculated from SPT Data and Laboratory Tests*

| Boring Number | Depth Range (feet bgs) | Potential for liquefaction induced settlement (inches) | Soil Description |
|---|---|---|---|
| GBH-5 | 0 - 5 | 0 | Clayey Sand |
| | 5 -10 | 4.97 | Clayey Sand |
| | 10 - 21 | 0 | Lean Clay* |
| | 21 - 30.5 | 6.61 | Clayey Sand |
| | 30.5 – 35.5 | 0 | Fat Clay with Sand* |
| | 35.5 – 45.5 | 0 | Fat Clay with Sand* |
| | 45.5 - 51.5 | 3.23 | Poorly Graded Sand with Clay |
| | **Total Settlement:** | **15 inches** | |
| GBH-2 | 0 - 5 | 1.68 | Sandy Lean Clay Fill |
| | 5 - 16 | 3.91 | Lean Clay with Sand |
| | 16 - 21.5 | 2.19 | Poorly Graded Sand with Clay |
| | 21.5 – 27.5 | 0 | Lean Clay with Sand* |
| | 27.5 - 35 | 0 | Lean Clay with Sand* |
| | 35 - 45 | 3.76 | Clayey Sand |
| | 45 – 52.5 | 3.43 | Clayey Sand |
| | 52.5 – 56.5 | 0 | Clayey Sand with Gravel |
| | **Total Settlement:** | **15 inches** | |

* Layers input as not liquefiable

As shown, results indicate the potential for liquefaction induced settlement generated from the LiqSVs program is approximately 15 inches in both GBH-2 and GBH-5.

To further evaluate the potential for liquefaction induced settlement we used CPT data and the computer software CLiq v.2.2.1.11 developed by GeoLogismiki. The results of our analyses are presented in Appendix 5, and settlement and lateral displacement values are summarized in Table 5.

*Table 5. Potential for Liquefaction Induced Settlement Calculated from CPT Data*

| Cone Penetration Test | Potential for liquefaction induced settlement (inches) | Lateral Displacement (Inches) |
|---|---|---|
| CPT-1 | 7.43 | 108.55 |
| CPT-2 | 4.50 | 84.91 |
| CPT-3 | 4.79 | 97.97 |
| CPT-6 | 4.35 | 92.89 |
| CPT-9 | 2.46 | 42.20 |

Although the LiqSVs software indicates that liquefaction would cause approximately 15 inches of settlement in GBH-2 and GBH-5, CPT data indicates that the potential for liquefaction induced settlement is 4.7 inches averaged across the Site. Lateral displacement ranged between 42 and 109 inches. Due to inherent variability, sensitivity to test procedure and uncertainty, SPT N-values may be affected by soil disturbance and heave within the boring which commonly occurs during drilling. Comparing the results of liquefaction induced settlements calculations from boring data (Table 4) and CPT data (Table 5) we note the following.

- Liquefaction assessment by use of the SPT data from test borings resulted in settlements of 15 inches; and
- Liquefaction assessment by use of the CPT data resulted in settlements of between 2.46 and 7.43 inches, or less than one half of the test boring results.

DRAFT

CPT based results tend to be more realistic for the following reasons, they provide an almost continuous penetration resistance profile for stratigraphic interpretation and the test's repeatability is very good (SCEC,1999).

## 4.3 Volcanism

According to the United States Geologic Survey (USGS) Volcano Hazards Program, the Site is not situated in a volcanically active area. The nearest volcano (Mt. Shasta) is located over 100 miles to the east. The likelihood of the Site experiencing active volcanism is low (USGS, 2017).

## 4.4 Slope Instability/Landsliding

Given the relatively flat site, we consider the potential for slope instability to adversely affect the Site to be negligible. Similarly, we consider the potential for liquefaction-induced lateral spreading to be low.

## 4.5 Flooding

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map, Map Number 06023C0852G, effective June 21, 2017, the Site is mapped as flood zone AE, which is inside of the special flood hazard area. A special flood hazard area is defined by the annual chance of a 100-year flood equaling or exceeding 1percent. Consequently, we conclude the likelihood of significant flooding occurring during the economic lifespan of the project is high (FEMA, 2017).

DRAFT

## 4.6 Tsunami Inundation

According to the CGS California Emergency Management Agency, Tsunami Inundation Map for Emergency Planning Arcata South Quadrangle, the potential for the Site to to experience flooding during a tsunami event is high.

## 4.7 High Groundwater

As noted in Section 3.3 of this report, groundwater was observed during our subsurface exploration between 2-8 feet bgs at the time drilling, with historically high groundwater levels judged to be approximately 1 foot bgs. Therefore, the risk of encountering groundwater in relatively shallow utility trenches or other required earthwork excavations for the project is considered high.

## 4.8 Soil Corrosivity

Corrosion is the deterioration of a metal through a chemical reaction with its environment. Factors that contribute to corrosion potential include the presence of soluble salts, soil and water resistivity, soil and water pH, and the presence of oxygen.

Corrosion potential of soils in the vicinity of the proposed school building was assessed by obtaining 12 soil samples across the site. The samples were analyzed for sulfate, chloride, and sulfide, resistivity, oxidation/reduction potential, and pH. The results of these tests are summarized in Table 6 with full lab results presented in Appendix 2

*Table 6. Corrosion Test Results*

| Sample | pH | Min. Resistivity (Ohm-cm) | Electrical Conductivity (µmhos/cm) | Sulfate (ppm) | Chloride (ppm) |
|---|---|---|---|---|---|
| GBH-1 at 3 feet | 7.16 | 643 | 1556 | 294 | 370 |
| GBH-2 at 10.5 feet | 7.92 | 163 | 6135 | 450 | 2,370 |
| GBH-2 at 51 feet | 8.27 | 614 | 1628 | 234 | 1,125 |
| GBH-3 at 4 feet | 6.44 | 225 | 444 | 750 | 870 |
| GBH-3 at 25 feet | 8.66 | 119 | 8403 | 1,725 | 2,550 |
| GBH-4 at 3 feet | 6.21 | 1,880 | 532 | 78 | 390 |
| GBH-4 at 4 feet | 6.07 | 1,285 | 778 | 450 | 330 |
| GBH-5 at 10 feet | 7.59 | 118 | 8446 | 825 | 7,650 |
| GBH-5 at 26 feet | 8.04 | 123 | 8130 | 525 | 6,600 |
| GBH-5 at 50.5 feet | 7.86 | 572 | 1748 | 138 | 840 |
| GBH-6 at 4 feet | 5.80 | 3,366 | 297 | 138 | 300 |
| GBH-7 at 10 feet | 6.48 | 558 | 1794 | 102 | 840 |

ppm – parts per million

For structural elements, CalTrans considers a site to be corrosive if one or more of the following conditions exist for the representative soil and/or water samples taken at the Site: chloride concentration is 500 ppm or greater, sulfate concentration is 2,000 ppm or greater, or the pH is 5.5 or less. A minimum resistivity value for soil and/or water less than 1,000 ohm-cm indicates the presence of high quantities of soluble salts and a higher propensity for corrosion (CDOT, 2012). As shown, the majority of the soil at the Site has a high propensity for corrosion. An engineer specializing in corrosion should be retained to evaluate whether or not a corrosion risk exists.

DRAFT

## 4.9 Soil Swelling or Shrinkage Potential

Expansive soils, generally consisting of cohesive, fine-grained clay soils, represent a significant structural hazard to buildings founded on them, especially where seasonal fluctuations in soil moisture occur at the foundation-bearing depth. Surface soils encountered during our field exploration consist of coarse and fine grained soils, with a low expansion potential. However, marsh deposits below the fill passes expansive soil characteristics.

# 5.0 REFERENCES

Branum, D., Harmsen, S., Kalkan, E., Wills, C., 2008. Earthquake Shaking Potential for California. California Geological Survey, Department of Conservation, State of California.

California Division of Mines and Geology (CDMG), 1983, State of California Special Studies Zones, Arcata South 7.5-Minute Quadrangle, Humboldt County, California.

California Division of Mines and Geology (CDMG), 2000, Digital Images of Official Maps of Alquist-Priolo Earthquake Fault Zones of California, Northern and Eastern Region.

California Geological Survey (CGS), 2008, Probabilistic Seismic Hazards Mapping (http://www.conservation.ca.gov/cgs/rghm/pshamap/pshamain.html), Ground Motion Page.

Federal Emergency Management Agency (FEMA) 2017, Flood Insurance Rate Map: Humboldt County, California. Map Number 06023C0852G, Panel 852of 1150, Department of Homeland Security.

Hart, E.W., compiler, 1999, Fault number 13, Mad River fault zone, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, https://earthquakes.usgs.gov/hazards/qfaults, accessed 05/30/2018 04:08 PM.

International Conference of Building Officials-California Division of Mines and Geology, 1998, Maps of Known Active Fault Near Source Zones in California and Adjacent Portions of Nevada.

McLaughlin, R.J., Ellen, S.D., Blake, M.C., Jayko, A.S., Irwin, W.P., Aalto, K.R., Carver, G.A., Clarke, S.H., Barnes, J.B., Cecil, J.D., and Cyr, K.A., 2000, Geology of the Cape Mendocino, Eureka, Garberville, and southwestern part of the Hayfork 30 X 60 minute quadrangles and adjacent offshore area, northern California, with digital database: U.S. Geological Survey, Miscellaneous Field Studies Map MF-2336, scale 1:100,000

Petersen, M.D., D. Beeby, W. Bryant, C. Cao, C. Cramer, J. Davis, M. Reichle, G. Saucedo, S. Tan, G. Taylor, T. Toppozada, J. Treiman, and C. Wills, (1999), Seismic Shaking Hazard Maps of California. Division of Mines and Geology, Map Sheet 48.

Satake, K., Wang, K., and Atwater, B.a., 2003, Fault Slip and Seismic Moment of the 1700 Cascadia Earthquake inferred from Japanese Tsunami Descriptions. Journal of Geophysical Research, Vol. 108, No. B11, 2535, doi;10.109/2003JB002521, 2003.

Seed, H.B. and Idriss, I.M., 1982 Ground Motions and Soil Liquefaction During Earthquakes Earthquake Engineering Research Institute.

United States Geological Survey Program, V. H. (n.d.). Mount Shasta California Volcano Observatory. https://volcanoes.usgs.gov/volcanoes/clear_lake/. Accessed on June 1, 2017.

DRAFT

# FIGURES

**Figure 1** **Vicinity Map**

**Figure 2A-B** **Site Plans**

**Figure 3A-D** **Geologic Cross Sections A-D**

DRAFT

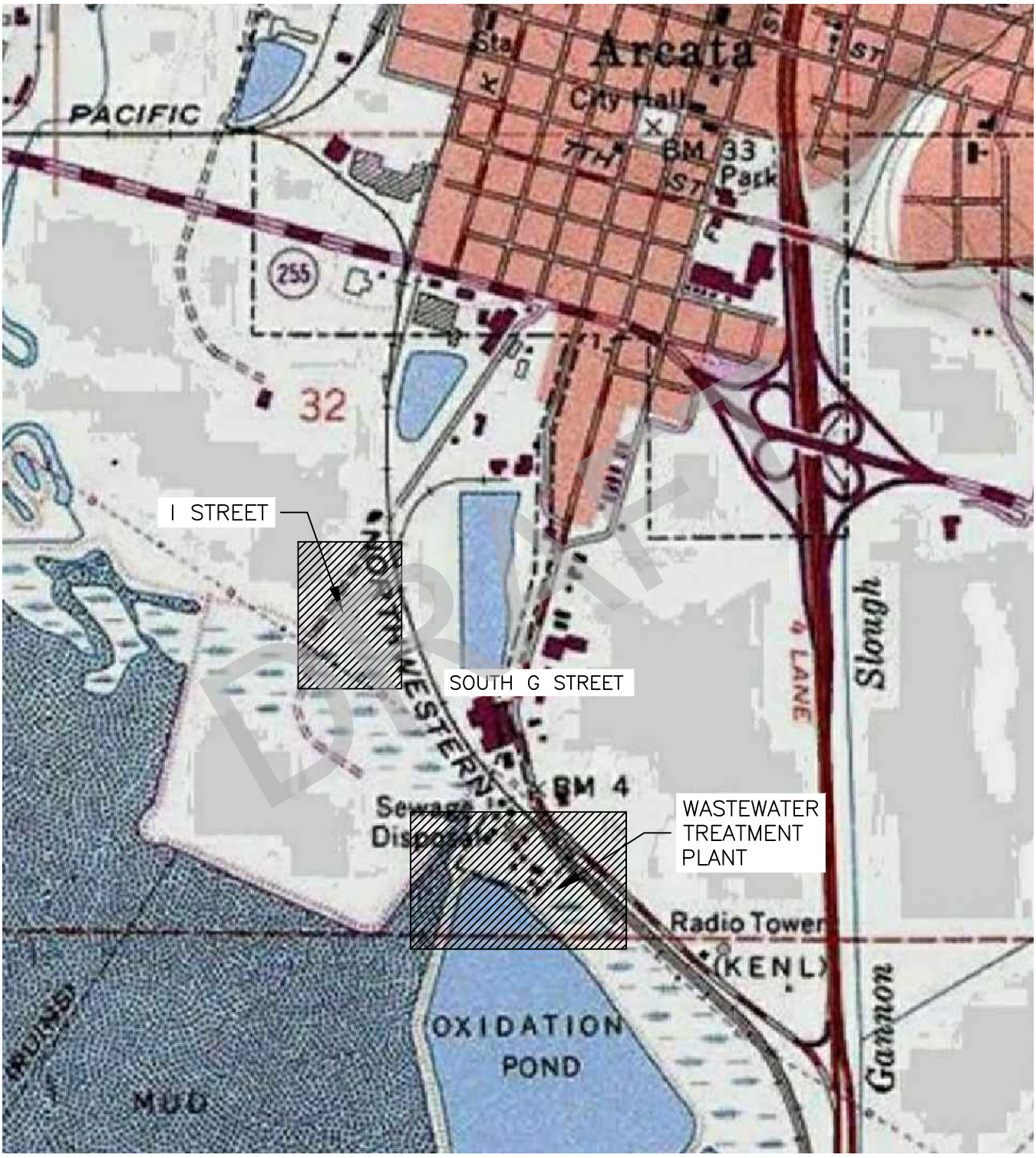
# LACO

EUREKA Å UKIAH Å SANTA ROSA

1-800-515-5054 WWW.LACOASSOCIATES.COM

| | | | |
|---|---|---|---|
| PROJECT | WASTEWATER TREATMENT PLANT IMPROVMENTS | BY CRGT | FIGURE 1 |
| CLIENT | CAROLLO ENGINEERS, INC. | DATE 6/30/18 | |
| LOCATION | 736 F STREET, ARCATA, CA | CHECK BAV | JOB NO. 7986.01 |
| | VICINITY MAP | SCALE AS SHOWN | |

REUSE OF DOCUMENTS: This document and the ideas and design incorporated herein, as an instrument of professional service, is the property of LACO Associates and shall not be reused in whole or part for any other project without Laco Associates express written authorization.




0 500' 1000' 2000' 3000'

SCALE: 1"=1000'

Aug 31,2018-10:02am T:\Cadfiles\7900\7986.01 ARCATA WASTEWATER TREATMENT FACILITY DESIGN\DWG\ 7986.01 EXPLORATION MAP_REV.dwg

REUSE OF DOCUMENTS: This document and the ideas and design incorporated herein, as an instrument of professional service, is the property of LACO Associates and shall not be reused in whole or part for any other project without Laco Associates express written authorization.

LEGEND

- GEOLOGIC PROFILE (SEE FIGURES 3A,3B,3C,3D)
- APPROXIMATE LOCATIONS OF AUGER BORING (LACO, 2018)
- APPROXIMATE LOCATIONS OF CPT SOUNDING (LACO, 2018)




0 40' 80' 160' 240'

SCALE: 1"=80'

LACO

EUREKA Â UKIAH Â SANTA ROSA

1-800-515-5054 www.lacoassociates.com

| NO. | HISTORY / REVISION | BY | CHK. | DATE |
|---|---|---|---|---|

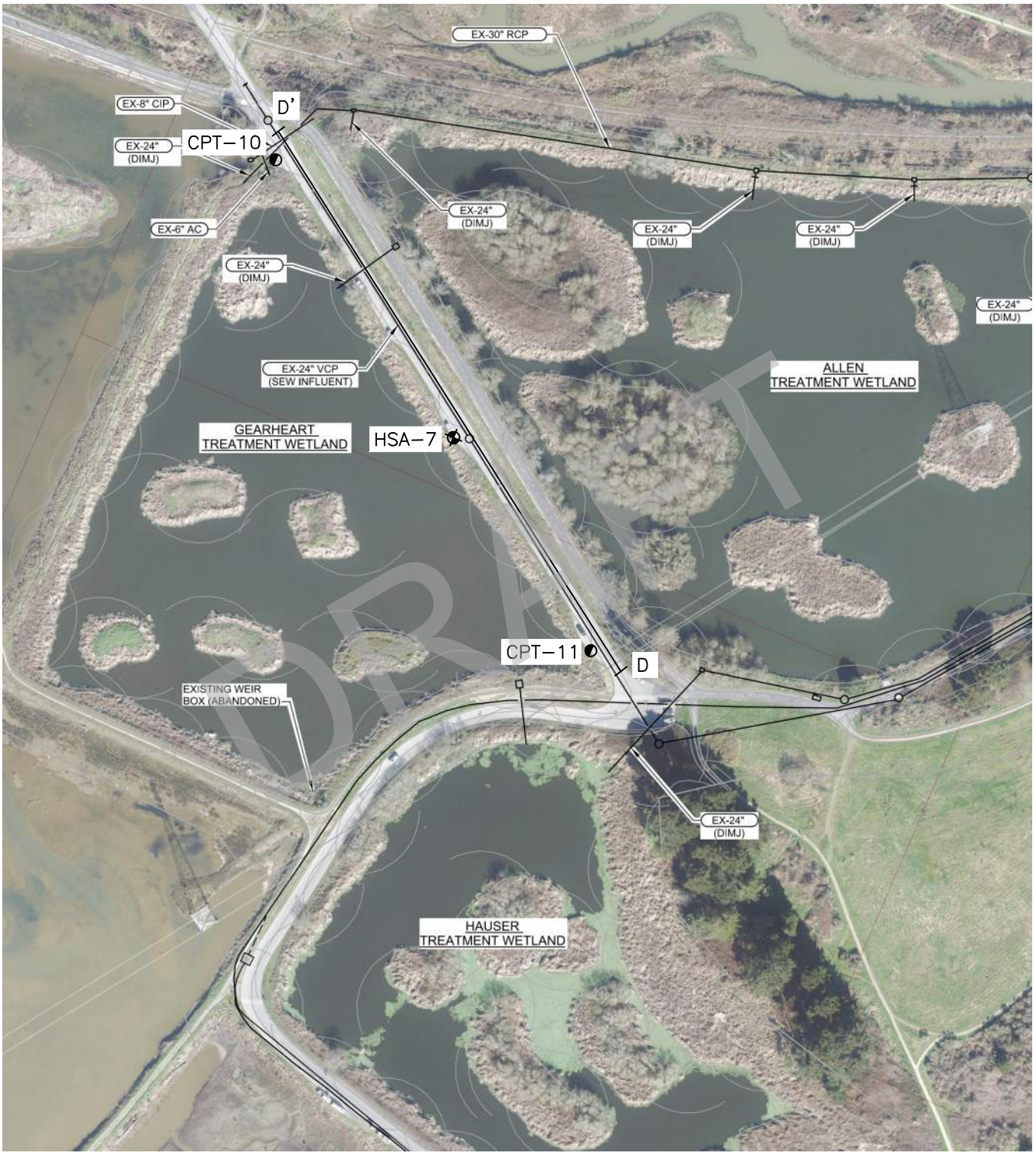
WASTEWATER TREATMENT PLANT IMPROVEMENTS
GEOTECHNICAL EXPLORATION
WASTEWATER TREATMENT PLANT SITE PLAN

CAROLLOW ENGINEERS INC.

| | |
|---|---|
| DRAWN | CRGT |
| CHECK | BAV |
| APPROVED | JER |
| DATE | 6/30/18 |
| JOB NUMBER | 7986.01 |
| FIGURE | 2A |

| LACO | | | | |
|---|---|---|---|---|
| EUREKA Å UKIAH Å SANTA ROSA<br>1-800-515-5054 WWW.LACOASSOCIATES.COM | PROJECT | WASTEWATER TREATMENT PLANT IMPROVMENTS | BY CRGT | FIGURE 2B |
| | CLIENT | CAROLLO ENGINEERS, INC. | DATE 6/30/18 | |
| | LOCATION | 736 F STREET, ARCATA, CA | CHECK JER | JOB NO. 7986.01 |
| | | I STREET SITE PLAN | SCALE AS SHOWN | |

REUSE OF DOCUMENTS: This document and the ideas and design incorporated herein, as an instrument of professional service, is the property of LACO Associates and shall not be reused in whole or part for any other project without Laco Associates express written authorization.

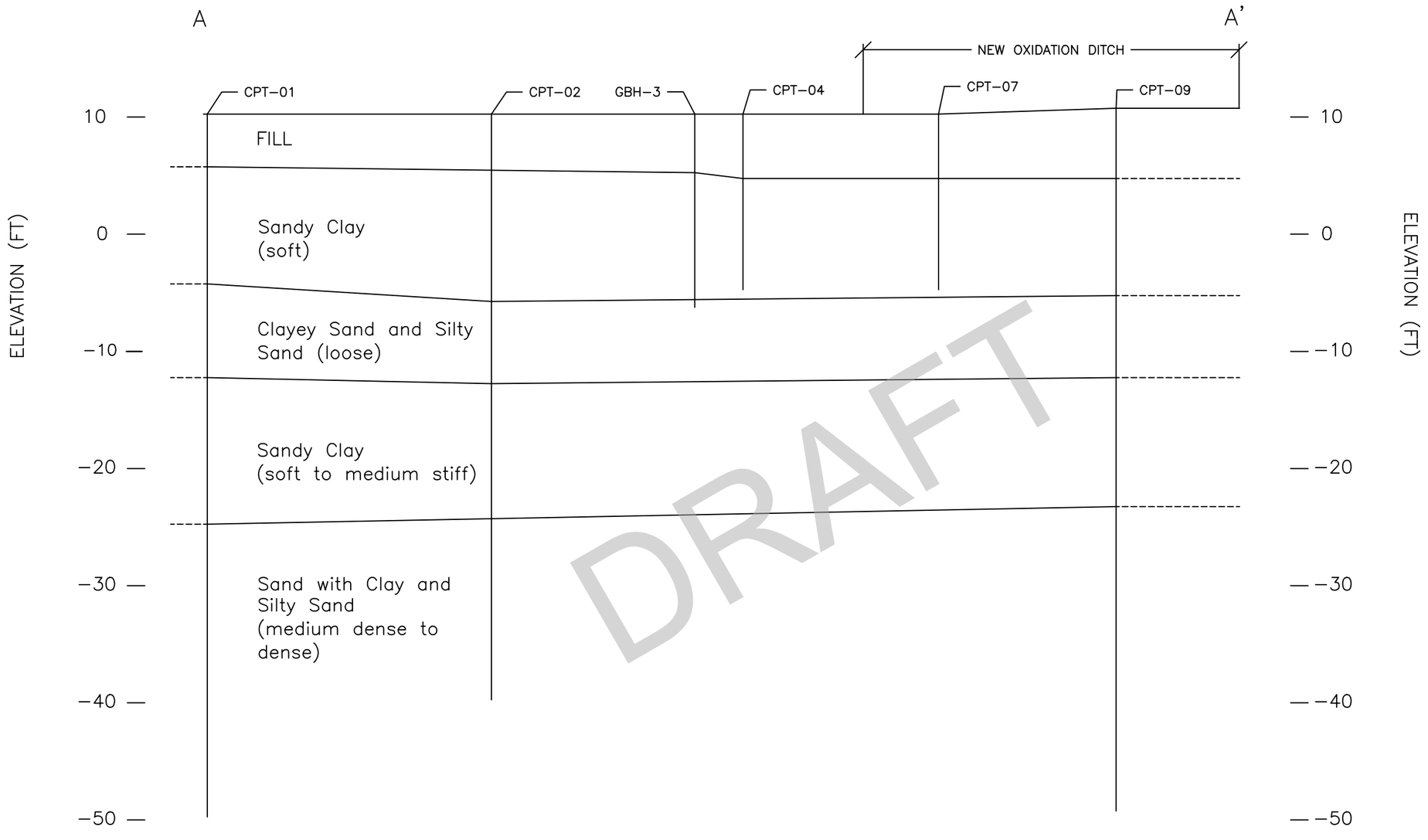



0 100' 200' 400' 600'

SCALE: 1"=200'

Aug 31,2018–10:00am T:\Cadfiles\7900\7986.01 ARCATA WASTEWATER TREATMENT FACILITY DESIGN\DWG\ 7986.01 EXPLORATION MAP_REV.dwg

REUSE OF DOCUMENTS: This document and the ideas and design incorporated herein, as an instrument of professional service, is the property of LACO Associates and shall not be reused in whole or part for any other project without Laco Associates express written authorization.




SCALE
H: 1"=80'
V: 1"=10'

LACO
EUREKA Â UKIAH Â SANTA ROSA
1-800-515-5054 www.lacoassociates.com

| NO. | HISTORY / REVISION | BY | CHK. | DATE |
|---|---|---|---|---|

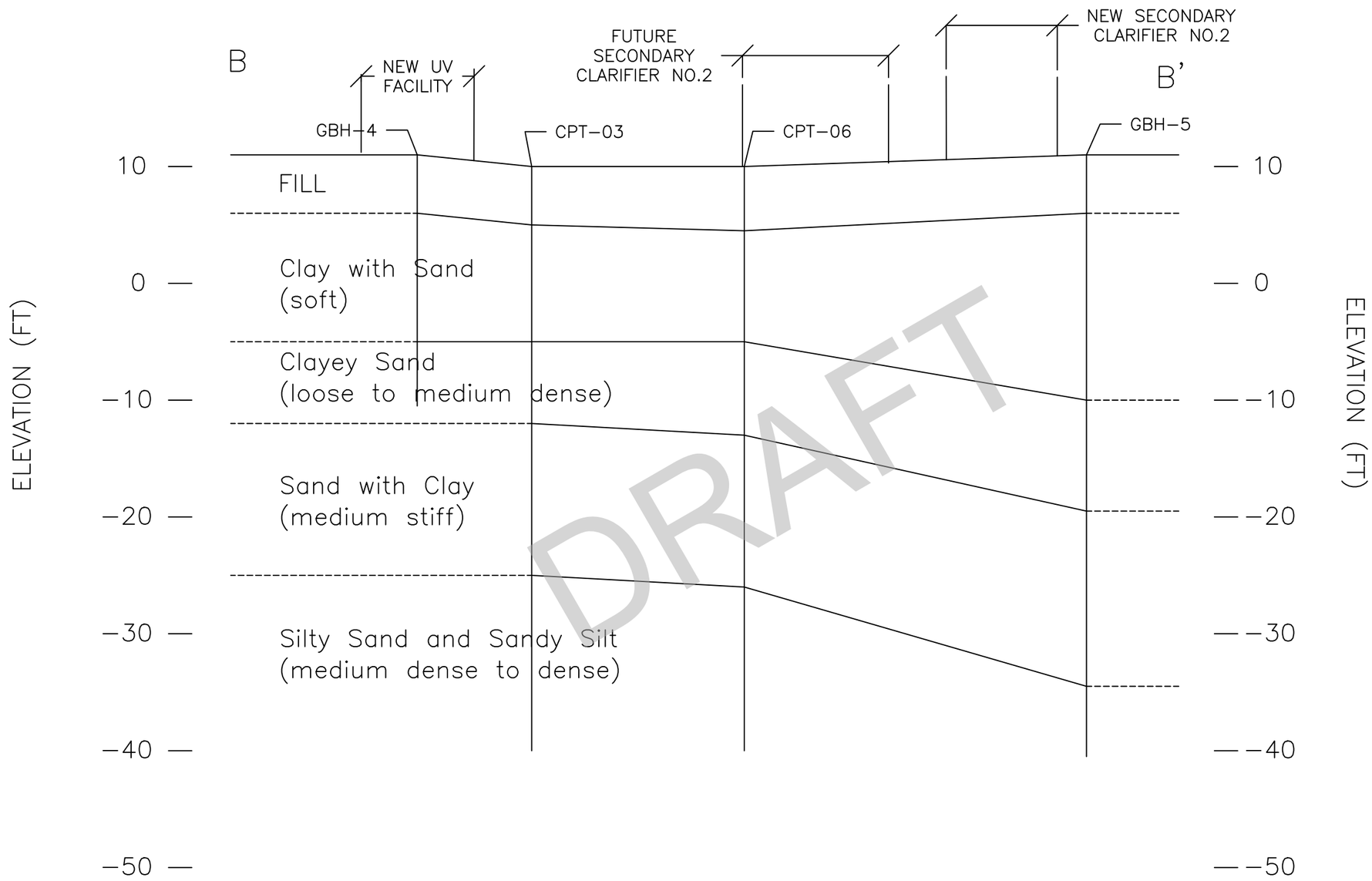
WASTEWATER TREATMENT PLANT IMPROVEMENTS
IDEALIZED CROSS SECTION A-A'

CAROLLO ENGINEERS INC.

| | |
|---|---|
| DRAWN | CRGT |
| CHECK | BAV |
| APPROVED | JER |
| DATE | 5/16/18 |
| JOB NUMBER | 7986.01 |
| FIGURE | 3A |

Aug 31,2018-3:10pm
T:\Cadfiles\7900\7986.01 ARCATA WASTEWATER TREATMENT FACILITY DESIGN\DWG\ 7986.01 EXPLORATION MAP_REV.dwg

REUSE OF DOCUMENTS: This document and the ideas and design incorporated herein, as an instrument of professional service, is the property of LACO Associates and shall not be reused in whole or part for any other project without Laco Associates express written authorization.




SCALE
H: 1"=60'
V: 1"=10'

LACO
EUREKA Â UKIAH Â SANTA ROSA
1-800-515-5054 www.lacoassociates.com

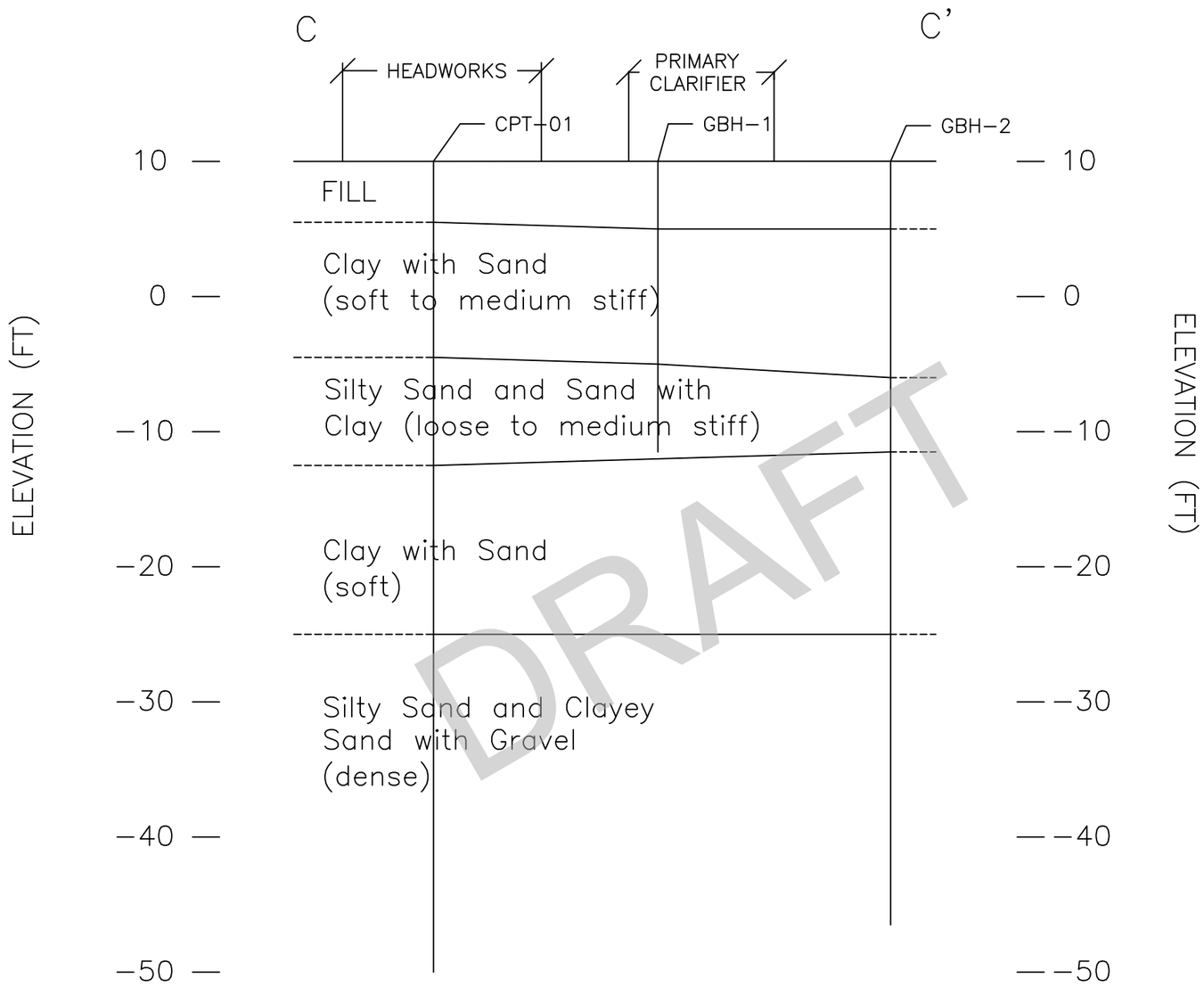
| NO. | HISTORY / REVISION | BY | CHK. | DATE |
|---|---|---|---|---|

WASTEWATER TREATMENT PLANT IMPROVEMENTS
IDEALIZED CROSS SECTION B-B'

CAROLLO ENGINEERS INC.

| | |
|---|---|
| DRAWN | CRGT |
| CHECK | BAV |
| APPROVED | JER |
| DATE | 5/16/18 |
| JOB NUMBER | 7986.01 |
| FIGURE | 3B |

REUSE OF DOCUMENTS: This document and the ideas and design incorporated herein, as an instrument of professional service, is the property of LACO Associates and shall not be reused in whole or part for any other project without Laco Associates express written authorization.




SCALE
H: 1"=60'
V: 1"=10'

LACO
EUREKA Â UKIAH Â SANTA ROSA
1-800-515-5054 www.lacoassociates.com

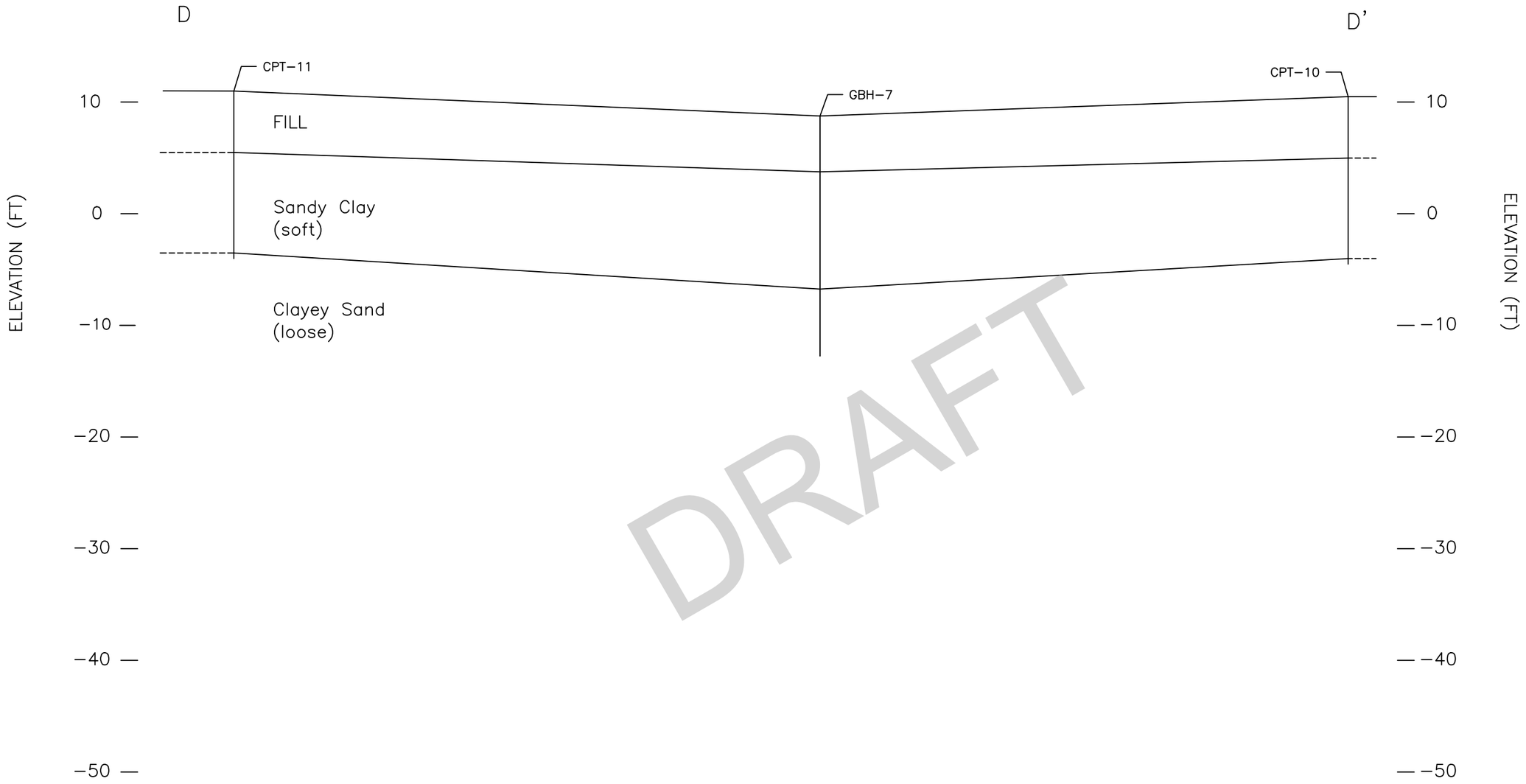
| NO. | HISTORY / REVISION | BY | CHK. | DATE |
|---|---|---|---|---|

WASTEWATER TREATMENT PLANT IMPROVEMENTS
IDEALIZED CROSS SECTION C-C'

CAROLLO ENGINEERS INC.

| | |
|---|---|
| DRAWN | CRGT |
| CHECK | BAV |
| APPROVED | JER |
| DATE | 5/16/18 |
| JOB NUMBER | 7986.01 |
| FIGURE | 3C |

REUSE OF DOCUMENTS: This document and the ideas and design incorporated herein, as an instrument of professional service, is the property of LACO Associates and shall not be reused in whole or part for any other project without Laco Associates express written authorization.




SCALE
H: 1"=80'
V: 1"=10'

LACO
EUREKA Â UKIAH Â SANTA ROSA
1-800-515-5054 www.lacoassociates.com

| NO. | HISTORY / REVISION | BY | CHK. | DATE |
|---|---|---|---|---|

WASTEWATER TREATMENT PLANT IMPROVEMENTS
IDEALIZED CROSS SECTION D-D'

CAROLLO ENGINEERS INC.

| | |
|---|---|
| DRAWN | CRGT |
| CHECK | BAV |
| APPROVED | JER |
| DATE | 5/16/18 |
| JOB NUMBER | 7986.01 |
| FIGURE | 3D |

Aug 31,2018-3:11pm
T:\Cadfiles\7900\7986.01 ARCATA WASTEWATER TREATMENT FACILITY DESIGN\DWG\ 7986.01 EXPLORATION MAP_REV.dwg

# Geologic and Hydrogeologic Exploration
# Arcata Wastewater Treatment Plant

LACO

# TECHNICAL MEMORANDUM

## Engineering Geologic and Hydrogeologic Exploration
## Arcata Waste Water Treatment Plant
## Arcata, Humboldt County, California

---

Date: February 24, 2017

Project No.: 6938.21

Prepared For: City of Arcata
736 F Street
Arcata, California, 95521

Prepared By: Christopher J. Watt, C.E.G., C.H.G.
Principal Engineering Geologist

Vanessa Davis, Staff Geologist

Steven Medina, Staff Geologist

Reviewed By: Eric Wilson, P.G., C.E.G.
Senior Engineering Geologist

Enclosures:

| | |
|---|---|
| Figure 1: | Site Map and Boring Locations |
| Figure 2: | Historical Channels |
| Appendix 1: | Boring Logs |
| Appendix 2: | Laboratory Analytical Results |
| Appendix 3 | Thermal Images of Possible Seeps |
| Appendix 4: | Tidal and Pressure Graphs Over Time |
| Appendix 5: | Slope Stability Analysis |

---

21 W. 4th Street, Eureka, California 95501 707 443-5054 Fax 707 443-0553
311 S. Main Street, Ukiah, California 95482 707 462-0222 Fax 707 462-0223
3450 Regional Parkway, Suite B2, Santa Rosa, California 95403 707 525-1222

Toll Free 800 515-5054 www.lacoassociates.com

# 1.0 INTRODUCTION

This report presents the results of the Engineering Geologic and Hydrogeologic investigation performed by LACO Associates (LACO) for the City of Arcata (Client). The purpose of the investigation was to evaluate effluent seepage from the oxidation ponds located at the Arcata Waste Water Treatment Plant (WWTP), hereafter referred to as the Site, with respect to the proposed development of Treatment Marsh Number 7. A Site Location and Boring Map is presented as Figure 1.

The Arcata WWTP uses several passive and natural processes to clean the City's effluent to water quality objectives (WQO) regulated by the NCWQCB. The existing oxidation ponds are under consideration for expansion by the potential lowering of pond bottom elevations and the possibility of increasing levee crest elevation. The proposed modifications are intended to increase the treatment capacity for long term functionality. This functionality is related to an increase capacity to meet future loads; to increase levee height to account for sea level rise; to assess potential impacts of the modifications, such as increased head, increased seepage, and slope instability.

# 2.0 SCOPE OF SERVICES

In accordance with LACO's Proposal dated December 16, 2016, data was collected at the WWTP to evaluate hydraulic and geotechnical properties of pond and levee soils from January 11, 2017 to January 19, 2017, under the direction of a LACO Certified Engineering Geologist. The collection of data consisted of the following:

- Review of operational records provided by the City of Arcata staff:
  - oxidation pond water levels;
  - flows in and out of various ponds;
  - personal observations;
- Review of historic photos and relevant reports;
- Conducting a field exploration that included:
  - water level monitoring in oxidation pond number 2 for 8 days;
  - site visit to directly observe bay side levee toe;
  - collection and testing of soil samples from the levee system;
- Conducting laboratory testing for selected soil samples to characterize soil properties; and
- Preparing this Engineering Geologic and Hydrogeologic Report as requested by the City of Arcata.

# 3.0 FIELD EXPLORATION AND LABORATORY TESTING

The subsurface investigation performed on January 12 to January 19, 2017, included hand auguring, soil sampling, and logging of four exploratory borings at the approximate locations shown on Figure 1 – Site Map and Boring Locations. The boring locations were selected because of access, location near proposed Treatment Marsh 7 and spatial representation. The four borings were advanced to discrete depths to collect levee soil samples using a Shelby Tube. One boring, B4, was collected east and below the levee material. Once the desired depth was reached, a 12-inch Shelby tube was attached to a push rod and

driven into the boring no more than 12 inches with a slide hammer, ensuring that the rod was plumb with the boring.

In order to separate the sample from the underlying soil, a duration of 10 – 15 minutes was allotted in order for the soil to expand within the Shelby tube, then the tube was slowly rotated to shear the material at the end of the tube and to alleviate water and/or suction pressures and improve recovery. To improve recovery of highly cohesive and compressible bay mud underlying the levee, sampling was conducted at the base of a test pit. The test pit was dug with a backhoe to a depth of 8 feet in the area of the boring. The Shelby tube was then pushed to approximately 9 feet at which point the sample was excavated using the backhoe bucket; extreme care was given to ensure that the backhoe bucket went well below the Shelby tube during excavation. Once samples were pulled, the Shelby tubes were kept upright and detached from the push rod. Afterwards, the sample was inspected to ensure the target soil was present and any voids on the top or bottom were filled with nonabsorbent material and capped to ensure moisture was not lost. A LACO geologist logged the borings and obtained relatively undisturbed samples for laboratory testing. Soils were logged and collected in general accordance with the American Society for Testing and Materials (ASTM) Test Procedure D2488 and D1587. Boring logs are presented in Appendix 1.

# 4.0 SITE CONDITIONS

Located at the north end of Humboldt Bay, the WWTP occupies 307 acres of the Arcata Marsh and Wildlife Sanctuary. The marsh and sanctuary includes freshwater marshes, saltwater marches, tidal sloughs, grassy uplands, mudflats, and brackish mash (Arcata Marsh & Wildlife Sanctuary, 2017). The facility contains a series of oxidation ponds, treatment wetlands, and enhancement marshes that are used to treat wastewater before discharging the effluent into Humboldt Bay.

## 4.1 Soils

Although the facility was developed on historic tidal flats consisting of 20 - 30 feet of bay mud deposits on the northern section of Humboldt Bay, there are historic channels, creeks, and sloughs which traverse the area, potentially associated with granular soils that have a significantly higher permeability than the bay mud deposits which may affect flux between the oxidation ponds and bay.

# 5.0 SEEPAGE INVESTIGATION

## 5.1 Document Review

The document review consisted of reviewing operational records provided by city staff. Records included original levee plans and personal observations. The review also included reviewing historic photos and relevant reports.

Prior to the construction of the WWTP in 1949, the area north Humboldt Bay was an undeveloped tidal flat which appears to have been crossed by a several potential channels including but not limited to the Jolly Giant Creek and portions of McDaniel Slough. These potential channels may represent areas of potentially high permeability sediments within the low permeability tidal muds. The potentially higher permeability

sediments were located using the original levee plans and historic aerial photographs from the Historic Atlas of Humboldt Bay and Eel River Delta between 1931 and 1969. Approximately five potential channels appear to have existed before the construction of the oxidation ponds and levees. These historic channels were mapped in GIS and labeled according to corresponding year as seen in Figure 2.

## 5.2 Permeability Sampling and Analysis

Relatively undisturbed samples collected during field exploration were submitted to a state certified laboratory. Laboratory testing was performed to estimate permeability of the levee soils.

Laboratory test results are included as Appendix 2 and are summarized in Table 1.

*Table 1: Laboratory Test Results*

| Boring | Sampling Method | Sampling Depth (bgs) | Side of Levee | Hydraulic Conductivity (cm/s) |
|---|---|---|---|---|
| B1 | Hand auger/Shelby tube | 4.7 – 5.7 | Pond side | 3.0E-07 |
| B2 | | 2.5 – 3.5 | Bay side | 2.0E-06 |
| B3 | | 3.25 – 4.25 | Pond side | 1.0E-06 |
| B4 | | 8.0 – 9.0 | Pond Side | 8.0E-08 |

## 5.3 Thermal and Visual Observations

The levee evaluation also included visual observation with the aid of Flir t420 thermal camera. The camera was used scan for flowing water near the levee toe during low tide. Several areas of flow were noted around the levee, from approximately Dr. Gearheart's office to approximately the old outwash, predominately near the southwest corner of Oxidation Pond Number 1 (Figure 2). Several thermal images (Appendix 3) record the observed flow and we estimated a maximum discharge rate of no more than 0.1 gallon per minute.

## 5.4 Water Level Monitoring

A pressure transducer (Hobo Logger) was installed to a depth of approximately 4 feet below the water surface in Oxidation Pond Number. The Hobo Logger collected pressure and temperature data every 15 minutes from January 11 to January 18, 2017. Upon retrieval of the pressure transducer, data was downloaded and pressure measurements were corrected for atmospheric noise; atmospheric pressure was subtracted from the pressure measurements thereby eliminating the low and high pressure weather system influence on the data. Both pressure and tide were graphed versus time to see if any correlation or tidal influence on the ponds exists. Each comparison consisted of a 24 hour period and for several days (Appendix 4).

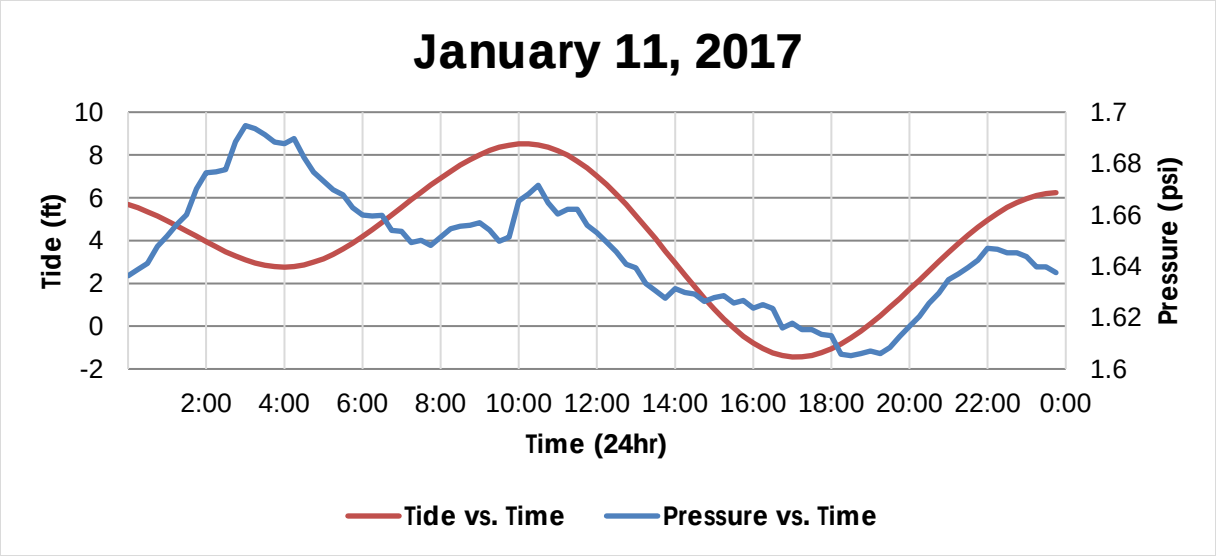



**Figure A: Daily tidal cycle and Oxidation Pond #2 pressure measurements**

The daily comparison of tide and pressure from January 11, 2017, to January 18, 2017, correlates, but further evaluation is needed to check the potential magnitude of flux between the oxidation ponds and bay. Figure A depicts the correlation between tide and pond pressure. However, given the flownet estimation and calculations with the measured hydraulic conductivity from B3, the theoretical likelihood is that seepage through the levee, using the highest hydraulic conductivity value from B3 is 267 gallons per day per hundred feet of levee. A complete daily tide and pressure versus time graphs are located in Appendix 3.

## 6.0 LEVEE SLOPE INSTABILITY ANALYSIS

The impact on levee stability of the proposed improvements was evaluated by constructing a series of quantitative slope instability analysis models. Existing levee geometry was taken from three representative cross-sections at stations 16+00, 31+00 and 39+00, chosen for their proximity to borings conducted as part of this and previous (LACO, 2009) exploration reports. The resulting geologic cross-sections were modified by the addition of 3 feet of fill to the crown and in-board pond slopes.

The pre-modification levee topography for the three sections was based on levee sections prepared as part of a civil design set, dated June 9, 2009, prepared, by LACO as part of the Arcata Levee Repair Project. Pond bathymetry and depth of sludge were incorporated from measurements made by Jeff Woodke, of Humboldt State University.

Soil engineering properties included in the model, such as density, cohesion, and friction angle were either measured directly by laboratory analysis (LACO, 2009), estimated based on a combination of Standard Penetration Test (SPT) data and grain-size analysis following procedures outlined in the 2013 Caltrans Geotechnical Manual (after Bowles 1977), or by engineering judgment and experience with local soils. The material divisions used broadly follow those used by the 2009 report with the addition of a unit representing unconsolidated bay mud. Material parameters used are presented in Table 2 below:

*Table 2. Instability Analysis Material Parameters*

| Material | Description | Unit Weight (lb/ft3) | Cohesion (psf) | Friction Angle (degrees) |
|---|---|---|---|---|
| 1 | Proposed Fill | 100 | 800 | 16 |
| 2 | Existing Revetment | 140 | 0 | 50 |
| 3 | Existing Granular Levee Fill | 132 | 0 | 35 |
| 4 | Existing Fine Grained Fill | 108 | 1000 | 25 |
| 5 | Unconsolidated Bay Mud | 100 | 400 | 0 |
| 6 | Partially Consolidated Bay Mud | 100 | 800 | 16 |

To provide an assessment of the full range of conditions that may occur during the design life of the levee, seismic slope stability analyses were run. The impacts of a design level earthquake on slope stability were estimated using the pseudo-static approach, where the earthquake load is simulated by "equivalent" static horizontal acceleration acting on the mass of the landslide. The pseudo-static seismic loading coefficient was calculated in accordance with guidelines presented in California Geologic Survey Special Publication 117A, and Note 48 using a 6.9 magnitude earthquake on the Fickle Hill Fault Zone.

The analyses were performed using the computer program Slide 7.0. The analyses utilized the Modified Bishop method to search for the critical failure surface and calculate the factor of safety against sliding. The critical failure surface is defined as the surface with the lowest calculated factor of safety. In general, factors of safety greater than 1.0 indicate stable conditions, while factors of safety less than 1.0 indicated an unstable condition.

The following worst case scenarios were considered in the slope instability models:

- A design level earthquake, at low tide with the ponds filled to 1 foot below the levee crown; and
- A design level earthquake, with the ponds empty, and high tide 1 foot below the levee crown.

The results of our analysis are presented in Appendix 5 The slope stability analysis for each of the sections, run for the high tide, empty pond scenario, generated critical failure surfaces (the surface with the lowest factor of safety) extending through the bay mud under the levee prism to a toe surfacing within the pond. The resulting failure surfaces had pseudo-static factors of safety ranging from 1.33 to 1.49. The slope stability analysis for each of the sections run for the low tide, full pond scenario, generated critical failure surfaces, initiating on the levee slope within the pond and surfacing in the tidal flat approximately 30 to 50 feet from the levee toe. The resulting failure surfaces had had pseudo-static factors of safety ranging from 1.45 to 1.71. Based on CGS Special Publication 117A guild-lines Pseudo-Static analysis with a factor of safety of greater than 1 is considered stable.

# 7.0 CONCLUSIONS AND RECOMMEDATIONS

- Construction of additional treatment facilities inside the levee system will not result in a measureable discharge of untreated effluent to the bay through or under the levee system. A project specific geotechnical report is recommended to develop earthwork recommendations.

- Construction of improvements to increase the height of the levee crest using bay mud deposits is feasible. A project specific geotechnical report is recommended to develop earthwork recommendations.

- Average theoretical seepage from the oxidation ponds to the bay through the levee materials is insignificant (0.01 gpm for the entire levee system) and the rate of movement (<1 foot/year) is such that any seepage would likely result in attenuation of wastewater constituents to below regulated levels.

- There is a potential for preferential seepage from the oxidation ponds to the bay through higher permeability sediments within and below the levee system. While flow on the order of 0.1 gallons per minute was observed at the levee toe during low tide at several locations, the source of flow was not confirmed. Several sources for the flow exist which are not mutually exclusive: 1) discharge of infiltrated rainwater; 2) discharge of bay water trapped behind the geotextile located under the rip-rap; 3) effluent seepage through the levee; and 4) effluent seepage under the levee. Chemical testing of the flow is recommended to aid in its characterization.

# 8.0 REFERENCES

Arcata Marsh & Wildlife Sanctuary | Arcata, CA." Arcata Marsh & Wildlife Sanctuary | Arcata, CA. N.p., n.d. Web. 08 Feb. 2017.

Bowles, J. E., 1977, Foundation Analysis and Design, McGraw-Hill, Inc., New York

LACO Associates, 2009, Geotechnical Soils Report, City of Arcata, Project # 6938.01/.02

# FIGURES

**Figure 1: Site Map and Boring Locations**

**Figure 2: Historical Channels**

| LACO<br>EUREKA • UKIAH • SANTA ROSA<br>1-800-515-5054 www.lacoassociates.com | PROJECT City of Arcata: WWTP Hydrogeo | BY VSD | FIGURE 1 |
|---|---|---|---|
| | CLIENT City of Arcata | DATE 2/23/2017 | |
| | LOCATION South G Street, Arcata, California | CHECK SJM | JOB NO. 6938.21 |
| | Site Map and Boring Locations | | |




LACO Associates and shall not be reused in whole or part for any other project without LACO Associates written authorization.

| LACO<br>EUREKA • UKIAH • SANTA ROSA<br>1-800-515-5054 www.lacoassociates.com | PROJECT City of Arcata: WWTP Hydrogeo | BY VSD | FIGURE 2 |
|---|---|---|---|
| | CLIENT City of Arcata | DATE 2/23/2017 | |
| | LOCATION South G Street, Arcata, California | CHECK SJM | JOB NO. 6938.21 |




LACO Associates and shall not be reused in whole or part for any other project without LACO Associates written authorization.

# APPENDIX 1

## Boring Logs

# BORING NUMBER B1



LACO
21 W. 4th Street, Eureka, California 95501 707 443-5054 Fax 707 443-0553
311 Main Street, Ukiah, California 95482 707 462-0222 Fax 707 462-0223
3450 Regional Parkway, Suite B2, Santa Rosa, California 95403 707 443-5054 Fax 707 443-0553
www.lacoassociates.com

**CLIENT** City of Arcata
**PROJECT NAME** Arcata Wastewaster Treatment Plant
**PROJECT NUMBER** 6938.21
**PROJECT LOCATION** 569 G Street, Arcata, CA
**DATE STARTED** 1/12/17 **COMPLETED** 1/12/17
**GROUND ELEVATION** 10 ft **HOLE SIZE** 2.5 inches
**DRILLING CONTRACTOR** LACO
**GROUND WATER LEVELS:**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 1.50 ft / Elev 8.50 ft
**LOGGED BY** VSD **CHECKED BY** VSD
**AT END OF DRILLING** ---
**NOTES**
**AFTER DRILLING** ---

| DEPTH (ft) | SAMPLE TYPE NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|
| 0.0 | | OL | | (OL) Organic Soil, dark brown, moist, firm, medium plasticity, ~ 10% fine sand |
| 0.8 | | | | 9.3 |
| | | CL | | (CL) Lean Clay, medium to dark brown, moist, soft, low to medium plasticity, ~10% fine sand |
| | | | | ▽ |
| 2.3 | | | | 7.8 |
| 2.5 | | SP-SC | | (SP-SC) Poorly Graded Sand with Silt, dark green and brown, wet, medium dense, low to medium plasticity, fine sand |
| 4.0 | | | | 6.0 |
| | | CL | | (CL) Lean Clay, medium gray, moist, firm, low to medium plasticity, fine sand |
| 5.0 | | | | |
| 6.5 | | | | 3.5 |

Bottom of borehole at 6.5 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/7/17 09:48 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\6938.21 AWWTP.GPJ

# BORING NUMBER B2



LACO
21 W. 4th Street, Eureka, California 95501 707 443-5054 Fax 707 443-0553
311 Main Street, Ukiah, California 95482 707 462-0222 Fax 707 462-0223
3450 Regional Parkway, Suite B2, Santa Rosa, California 95403 707 443-5054 Fax 707 443-0553
www.lacoassociates.com

**CLIENT** City of Arcata
**PROJECT NAME** Arcata Wastewater Treatment Plant
**PROJECT NUMBER** 6938.21
**PROJECT LOCATION** 569 G Street, Arcata, CA
**DATE STARTED** 1/12/17 **COMPLETED** 1/12/17
**GROUND ELEVATION** 11 ft **HOLE SIZE** 2.5 inches
**DRILLING CONTRACTOR** LACO
**GROUND WATER LEVELS:**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 2.00 ft / Elev 9.00 ft
**LOGGED BY** VSD **CHECKED BY** VSD
**AT END OF DRILLING** ---
**NOTES**
**AFTER DRILLING** ---

| DEPTH (ft) | SAMPLE TYPE NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|
| 0 | | OL | | (OL) Organic Soil, dark brown, moist, soft, medium plasticity, ~ 10% fine sand |
| | | | | 0.8 — 10.3 |
| 1 | | CL | | (CL) Lean Clay, light to medium brown, moist, soft, low to medium plasticity, ~10% fine sand: roots present |
| 2 | | | | 2.0 ▽ — 9.0 |
| | | CL | | (CL) Lean Clay with Sand, gray, wet, low to medium plasticity, ~15% fine sand |
| 3 | | | | 3.5 — 7.5 |
| | | | | Bottom of borehole at 3.5 feet. |

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/7/17 09:48 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\6938.21 AWWTP.GPJ

# BORING NUMBER B3



LACO
21 W. 4th Street, Eureka, California 95501 707 443-5054 Fax 707 443-0553
311 Main Street, Ukiah, California 95482 707 462-0222 Fax 707 462-0223
3450 Regional Parkway, Suite B2, Santa Rosa, California 95403 707 443-5054 Fax 707 443-0553
www.lacoassociates.com

**CLIENT** City of Arcata
**PROJECT NAME** Arcata Wastewaster Treatment Plant
**PROJECT NUMBER** 6938.21
**PROJECT LOCATION** 569 G Street, Arcata, CA
**DATE STARTED** 1/12/17 **COMPLETED** 1/12/17
**GROUND ELEVATION** 12 ft **HOLE SIZE** 2.5 inches
**DRILLING CONTRACTOR** LACO
**GROUND WATER LEVELS:**
**DRILLING METHOD** Hand Auger
**AT TIME OF DRILLING** --- Not Encountered
**LOGGED BY** VSD **CHECKED BY** VSD
**AT END OF DRILLING** ---
**NOTES**
**AFTER DRILLING** ---

| DEPTH (ft) | SAMPLE TYPE NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION | |
|---|---|---|---|---|---|
| 0 | | OL | | (OL) Organic Soil, dark brown, moist, medium stiff, plastic fines, fine sand | |
| | | | | | 0.5 |
| | | CL | | (CL) Lean Clay with Gravel, medium brown, moist, low to medium plasticity, fine sand | |
| 1 | | | | | |
| 2 | | | | | |
| | | | | | 2.3 |
| | | CL | | (CL) Lean Clay, dark brown, moist, soft, low to medium plasticity, fine sand | |
| 3 | | | | | 3.0 |
| | | CL-ML | | (CL-ML) Lean Clay, dark gray, moist, stiff, low to medium plasticity, fine sand | |
| 4 | | | | | |
| | | | | | 4.3 |
| | | | | Bottom of borehole at 4.3 feet. | |

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/7/17 09:49 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\6938.21 AWWTP.GPJ

# BORING NUMBER B4



LACO
21 W. 4th Street, Eureka, California 95501 707 443-5054 Fax 707 443-0553
311 Main Street, Ukiah, California 95482 707 462-0222 Fax 707 462-0223
3450 Regional Parkway, Suite B2, Santa Rosa, California 95403 707 443-5054 Fax 707 443-0553
www.lacoassociates.com

**CLIENT** City of Arcata
**PROJECT NAME** Arcata Wastewaster Treatment Plant
**PROJECT NUMBER** 6938.21
**PROJECT LOCATION** 569 G Street, Arcata, CA
**DATE STARTED** 1/19/17 **COMPLETED** 1/19/17
**GROUND ELEVATION** 14 ft **HOLE SIZE** 2.5 inches
**DRILLING CONTRACTOR** LACO
**GROUND WATER LEVELS:**
**DRILLING METHOD** Hand Auger
**AT TIME OF DRILLING** --- Not Encountered
**LOGGED BY** SJM **CHECKED BY** SJM
**AT END OF DRILLING** ---
**NOTES**
**AFTER DRILLING** ---

| DEPTH (ft) | SAMPLE TYPE NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|
| 0.0 | | OL | | (OL) Organic Soil, dark brown, moist, medium stiff, plastic fines, fine sand |
| 2.0 | | | | |
| 2.5 | | CL | | (CL) Lean Clay, dark brown, moist, soft, low to medium plasticity, fine sand |
| 5.0 | | | | |
| 6.0 | | | | |
| 7.5 | | CL | | (CL) Lean Clay, dark gray, moist, stiff, low to medium plasticity, fine sand |
| 7.5 | | CH | | (CH) Fat Clay, light gray, wet, stiff to hard, high plasticity; Bay Mud |
| 9.0 | | | | Bottom of borehole at 9.0 feet. |

12.0
8.0
6.5
5.0

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/7/17 09:49 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\6938.21 AWWTP.GPJ

# APPENDIX 2

## Laboratory Results

# Hydraulic Conductivity
**ASTM D 5084**
Method C: Falling Head Rising Tailwater

| | | | | | |
|---|---|---|---|---|---|
| **Job No:** | 592-045 | **Boring:** | B-1 | **Date:** | 02/06/17 |
| **Client:** | Laco Associates | **Sample:** | | **By:** | MD/PJ |
| **Project:** | 6938.21 | **Depth, ft.:** | 4.8 | **Remolded:** | |

**Visual Classification:** Greenish Gray Sandy CLAY

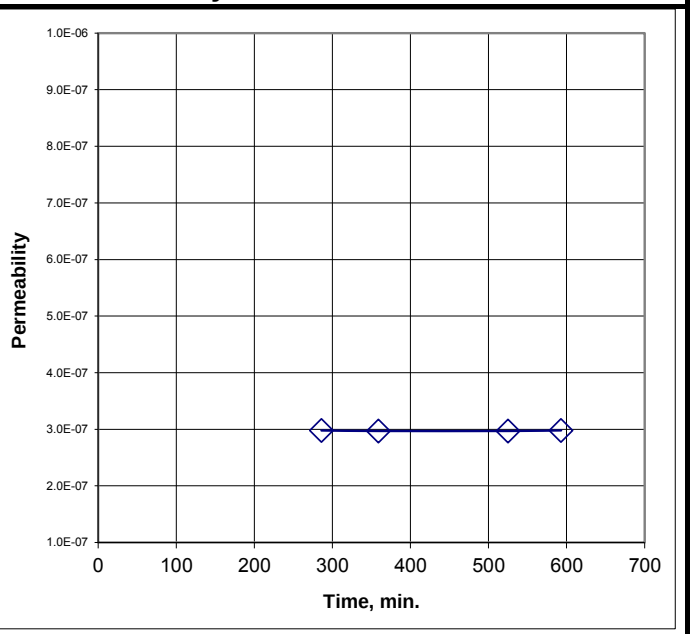
**Max Sample Pressures, psi:**

| Cell: | Bottom | Top | Avg. Sigma3 |
|---|---|---|---|
| 43.5 | 39 | 38 | 5 |

**B: =** >0.95 **("B" is an indication of saturation)**

**Max Hydraulic Gradient: =** 15

| Date | Minutes | Head, (in) | K,cm/sec |
|---|---|---|---|
| 1/31/2017 | 0.00 | 42.69 | Start of Test |
| 1/31/2017 | 286.00 | 38.99 | 3.0E-07 |
| 1/31/2017 | 359.00 | 38.09 | 3.0E-07 |
| 1/31/2017 | 525.00 | 36.09 | 3.0E-07 |
| 1/31/2017 | 593.00 | 35.29 | 3.0E-07 |




**Average Hydraulic Conductivity: 3.E-07 cm/sec**

| Sample Data: | Initial (As-Received) | | Final (At-Test) |
|---|---|---|---|
| Height, in | 2.98 | | 2.80 |
| Diameter, in | 2.97 | | 2.95 |
| Area, in2 | 6.93 | | 6.82 |
| Volume in3 | 20.61 | | 19.09 |
| Total Volume, cc | 337.7 | | 312.8 |
| Volume Solids, cc | 171.7 | | 171.7 |
| Volume Voids, cc | 166.1 | | 141.1 |
| Void Ratio | 1.0 | | 0.8 |
| Total Porosity, % | 49.2 | | 45.1 |
| Air-Filled Porosity (θa),% | 2.9 | | 1.3 |
| Water-Filled Porosity (θw),% | 46.3 | | 43.8 |
| Saturation, % | 94.1 | | 97.1 |
| Specific Gravity | 2.70 | Assumed | 2.70 |
| Wet Weight, gm | 619.7 | | 600.5 |
| Dry Weight, gm | 463.5 | | 463.5 |
| Tare, gm | 0.00 | | 0.00 |
| Moisture, % | 33.7 | | 29.6 |
| Wet Bulk Density, pcf | 114.5 | | 119.8 |
| Dry Bulk Density, pcf | 85.6 | | 92.5 |
| Wet Bulk Dens.ρb, (g/cm$^3$) | 1.83 | | 1.92 |
| Dry Bulk Dens.ρb, (g/cm$^3$) | 1.37 | | 1.48 |

Remarks:

# Hydraulic Conductivity
**ASTM D 5084**
Method C: Falling Head Rising Tailwater

| | | | | | |
|---|---|---|---|---|---|
| **Job No:** | 592-045 | **Boring:** | B-2 | **Date:** | 02/07/17 |
| **Client:** | Laco Associates | **Sample:** | | **By:** | MD/PJ |
| **Project:** | 6938.21 | **Depth, ft.:** | 2.5 | **Remolded:** | |

**Visual Classification:** Greenish Gray CLAY w/ organics

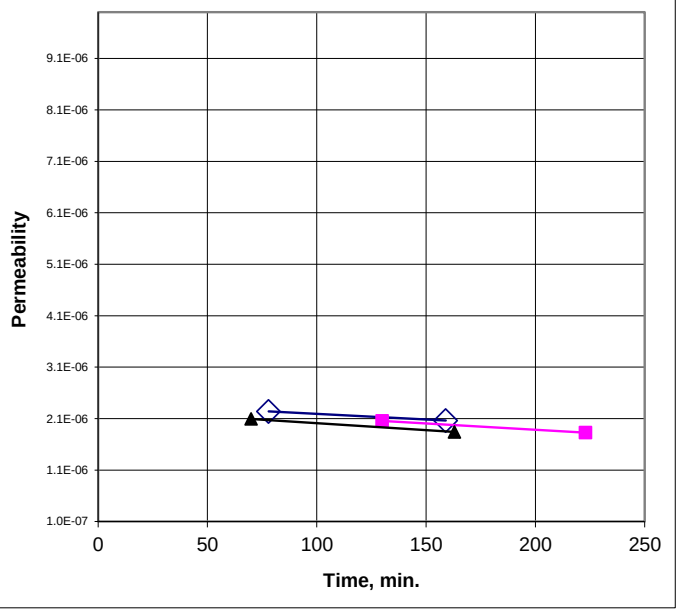
**Max Sample Pressures, psi:**

| Cell: | Bottom | Top | Avg. Sigma3 |
|---|---|---|---|
| 53.5 | 49 | 48 | 5 |

**B: =** >0.95 **("B" is an indication of saturation)**

**Max Hydraulic Gradient: =** 12

| Date | Minutes | Head, (in) | K,cm/sec |
|---|---|---|---|
| 2/1/2017 | 0.00 | 29.79 | Start of Test |
| 2/1/2017 | 78.00 | 25.29 | 2.2E-06 |
| 2/1/2017 | 159.00 | 21.89 | 2.1E-06 |
| 2/2/2017 | 130.00 | 27.89 | 2.1E-06 |
| 2/2/2017 | 223.00 | 24.29 | 1.8E-06 |
| 2/3/2017 | 70.00 | 29.69 | 2.1E-06 |
| 2/3/2017 | 163.00 | 25.49 | 1.8E-06 |




**Average Hydraulic Conductivity: 2.E-06 cm/sec**

| Sample Data: | Initial (As-Received) | | Final (At-Test) |
|---|---|---|---|
| **Height, in** | 2.96 | | 2.95 |
| **Diameter, in** | 2.88 | | 2.86 |
| **Area, in2** | 6.51 | | 6.42 |
| **Volume in3** | 19.28 | | 18.92 |
| **Total Volume, cc** | 316.0 | | 310.0 |
| **Volume Solids, cc** | 134.9 | | 134.9 |
| **Volume Voids, cc** | 181.1 | | 175.1 |
| **Void Ratio** | 1.3 | | 1.3 |
| **Total Porosity, %** | 57.3 | | 56.5 |
| **Air-Filled Porosity (θa),%** | 3.2 | | 0.0 |
| **Water-Filled Porosity (θw),%** | 54.1 | | 56.5 |
| **Saturation, %** | 94.4 | | 99.9 |
| **Specific Gravity** | 2.70 | Assumed | 2.70 |
| **Wet Weight, gm** | 535.2 | | 539.2 |
| **Dry Weight, gm** | 364.2 | | 364.2 |
| **Tare, gm** | 0.00 | | 0.00 |
| **Moisture, %** | 47.0 | | 48.1 |
| **Wet Bulk Density, pcf** | 105.7 | | 108.5 |
| **Dry Bulk Density, pcf** | 71.9 | | 73.3 |
| **Wet Bulk Dens.ρb, (g/cm$^3$)** | 1.69 | | 1.74 |
| **Dry Bulk Dens.ρb, (g/cm$^3$)** | 1.15 | | 1.17 |

Remarks:

# Hydraulic Conductivity
**ASTM D 5084**
Method C: Falling Head Rising Tailwater

| | | | | | |
|---|---|---|---|---|---|
| **Job No:** | 592-045 | **Boring:** | B-3 | **Date:** | 02/07/17 |
| **Client:** | Laco Associates | **Sample:** | | **By:** | MD/PJ |
| **Project:** | 6938.21 | **Depth, ft.:** | 5.3 | **Remolded:** | |

**Visual Classification:** Greenish Gray CLAY

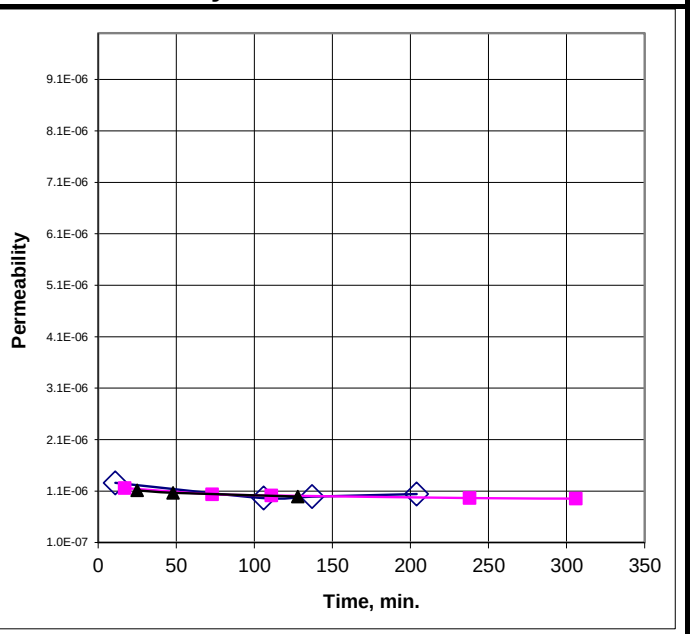
**Max Sample Pressures, psi:**

| Cell: | Bottom | Top | Avg. Sigma3 |
|---|---|---|---|
| 43.5 | 39 | 38 | 5 |

**B: =** >0.95 **("B" is an indication of saturation)**

**Max Hydraulic Gradient: =** 14

| Date | Minutes | Head, (in) | K,cm/sec |
|---|---|---|---|
| 1/31/2017 | 0.00 | 42.69 | Start of Test |
| 1/31/2017 | 11.00 | 42.14 | 1.3E-06 |
| 1/31/2017 | 106.00 | 38.74 | 9.6E-07 |
| 1/31/2017 | 137.00 | 37.49 | 9.9E-07 |
| 1/31/2017 | 204.00 | 34.84 | 1.0E-06 |
| 1/31/2017 | 17.00 | 41.89 | 1.2E-06 |
| 1/31/2017 | 73.00 | 39.69 | 1.0E-06 |
| 1/31/2017 | 111.00 | 38.29 | 1.0E-06 |
| 1/31/2017 | 238.00 | 34.19 | 9.6E-07 |
| 1/31/2017 | 306.00 | 32.19 | 9.5E-07 |
| 2/1/2017 | 25.00 | 41.59 | 1.1E-06 |
| 2/1/2017 | 48.00 | 40.69 | 1.1E-06 |
| 2/1/2017 | 128.00 | 37.89 | 9.9E-07 |




**Average Hydraulic Conductivity: 1.E-06 cm/sec**

| Sample Data: | Initial (As-Received) | | Final (At-Test) |
|---|---|---|---|
| **Height, in** | 2.97 | | 2.95 |
| **Diameter, in** | 2.87 | | 2.87 |
| **Area, in2** | 6.47 | | 6.45 |
| **Volume in3** | 19.21 | | 18.99 |
| **Total Volume, cc** | 314.9 | | 311.1 |
| **Volume Solids, cc** | 154.3 | | 154.3 |
| **Volume Voids, cc** | 160.5 | | 156.8 |
| **Void Ratio** | 1.0 | | 1.0 |
| **Total Porosity, %** | 51.0 | | 50.4 |
| **Air-Filled Porosity (θa),%** | 1.5 | | 2.0 |
| **Water-Filled Porosity (θw),%** | 49.5 | | 48.4 |
| **Saturation, %** | 97.0 | | 96.1 |
| **Specific Gravity** | 2.70 | Assumed | 2.70 |
| **Wet Weight, gm** | 572.4 | | 567.3 |
| **Dry Weight, gm** | 416.6 | | 416.6 |
| **Tare, gm** | 0.00 | | 0.00 |
| **Moisture, %** | 37.4 | | 36.2 |
| **Wet Bulk Density, pcf** | 113.4 | | 113.8 |
| **Dry Bulk Density, pcf** | 82.6 | | 83.6 |
| **Wet Bulk Dens.ρb, (g/cm$^3$)** | 1.82 | | 1.82 |
| **Dry Bulk Dens.ρb, (g/cm$^3$)** | 1.32 | | 1.34 |

Remarks:

# Hydraulic Conductivity
**ASTM D 5084**
Method C: Falling Head Rising Tailwater

| | | | | | |
|---|---|---|---|---|---|
| **Job No:** | 592-046 | **Boring:** | B-4 | **Date:** | 02/09/17 |
| **Client:** | Laco Associates | **Sample:** | | **By:** | MD/PJ |
| **Project:** | 6938.21 | **Depth, ft.:** | 8-9 | **Remolded:** | |

**Visual Classification:** Very Dark Greenish Gray CLAY (Bay Mud)

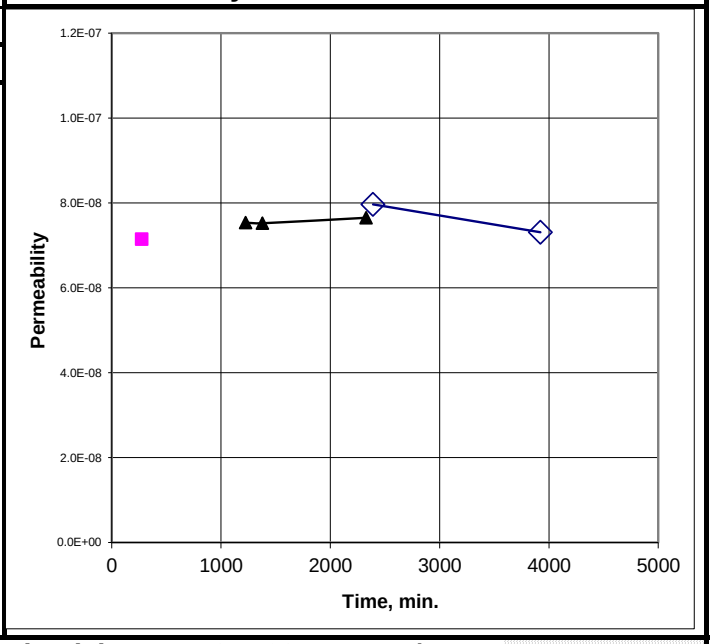
**Max Sample Pressures, psi:**

| Cell: | Bottom | Top | Avg. Sigma3 |
|---|---|---|---|
| 43.5 | 39.5 | 37.5 | 5 |

**B: =** >0.95 **("B" is an indication of saturation)**

**Max Hydraulic Gradient: =** 24

| Date | Minutes | Head, (in) | K,cm/sec |
|---|---|---|---|
| 2/3/2017 | 0.00 | 36.79 | Start of Test |
| 2/5/2017 | 2391.00 | 30.94 | 8.0E-08 |
| 2/6/2017 | 3922.00 | 27.89 | 7.3E-08 |
| 2/6/2017 | 274.00 | 41.59 | 7.1E-08 |
| 2/7/2017 | 1227.00 | 64.38 | 7.5E-08 |
| 2/7/2017 | 1380.00 | 63.68 | 7.5E-08 |
| 2/8/2017 | 2327.00 | 59.38 | 7.7E-08 |




**Average Hydraulic Conductivity: 8.E-08 cm/sec**

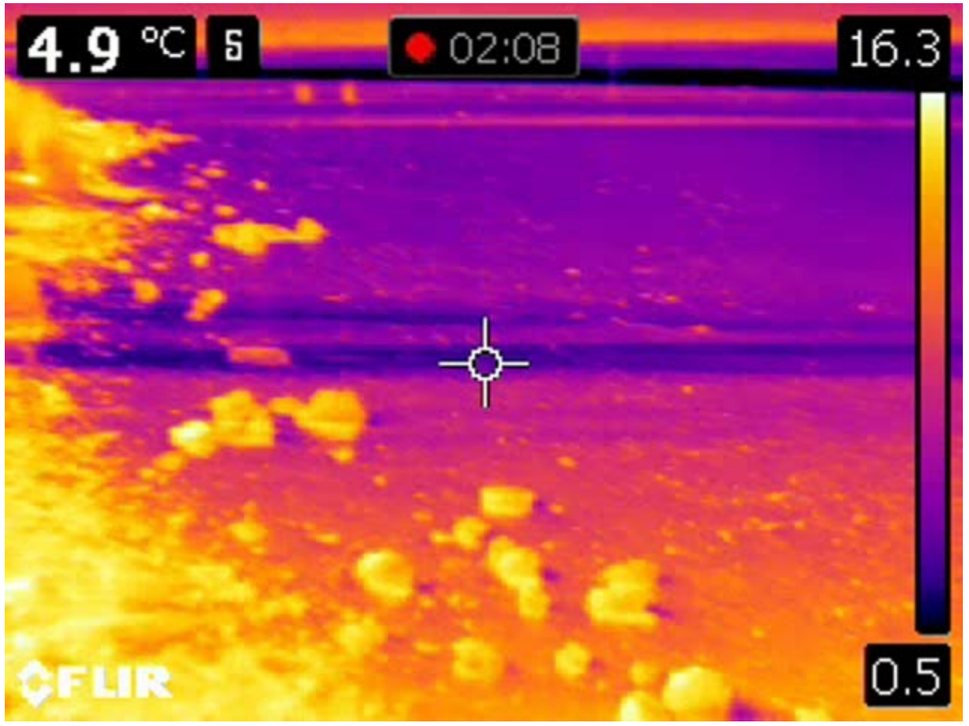
| Sample Data: | Initial (As-Received) | | Final (At-Test) |
|---|---|---|---|
| **Height, in** | 2.98 | | 2.94 |
| **Diameter, in** | 2.87 | | 2.83 |
| **Area, in2** | 6.45 | | 6.27 |
| **Volume in3** | 19.18 | | 18.43 |
| **Total Volume, cc** | 314.3 | | 302.0 |
| **Volume Solids, cc** | 137.5 | | 137.5 |
| **Volume Voids, cc** | 176.8 | | 164.5 |
| **Void Ratio** | 1.3 | | 1.2 |
| **Total Porosity, %** | 56.3 | | 54.5 |
| **Air-Filled Porosity (θa),%** | 0.5 | | 0.2 |
| **Water-Filled Porosity (θw),%** | 55.8 | | 54.3 |
| **Saturation, %** | 99.2 | | 99.7 |
| **Specific Gravity** | 2.70 | Assumed | 2.70 |
| **Wet Weight, gm** | 546.5 | | 535.2 |
| **Dry Weight, gm** | 371.2 | | 371.2 |
| **Tare, gm** | 0.00 | | 0.00 |
| **Moisture, %** | 47.2 | | 44.2 |
| **Wet Bulk Density, pcf** | 108.5 | | 110.6 |
| **Dry Bulk Density, pcf** | 73.7 | | 76.7 |
| **Wet Bulk Dens.ρb, (g/cm$^3$)** | 1.74 | | 1.77 |
| **Dry Bulk Dens.ρb, (g/cm$^3$)** | 1.18 | | 1.23 |

Remarks:

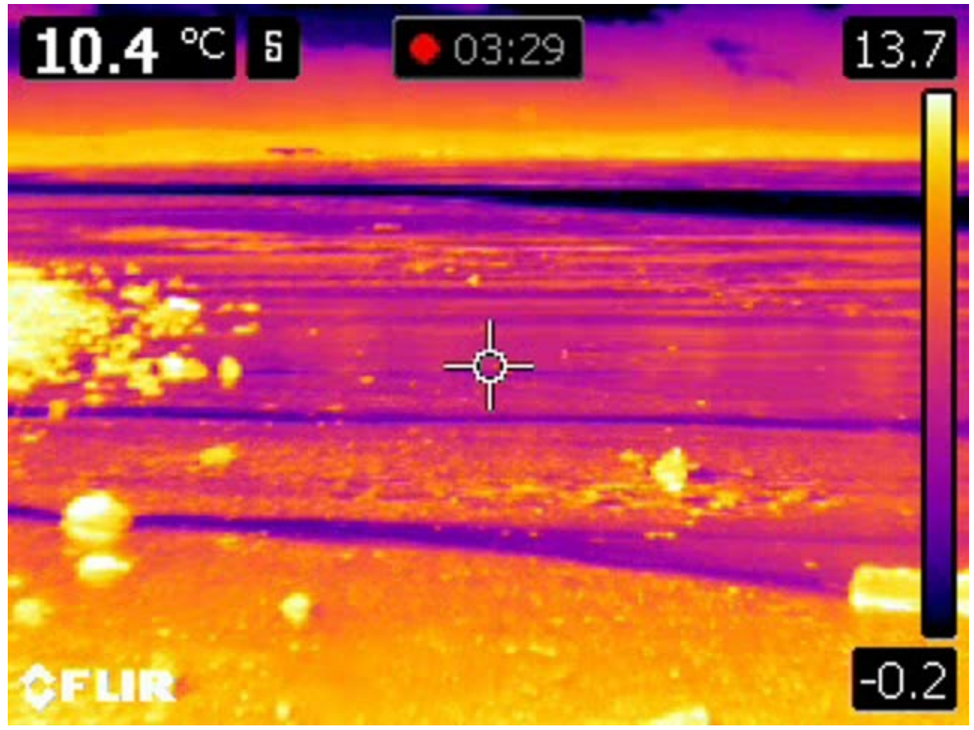
# APPENDIX 3

## Thermal Images of Possible Seeps

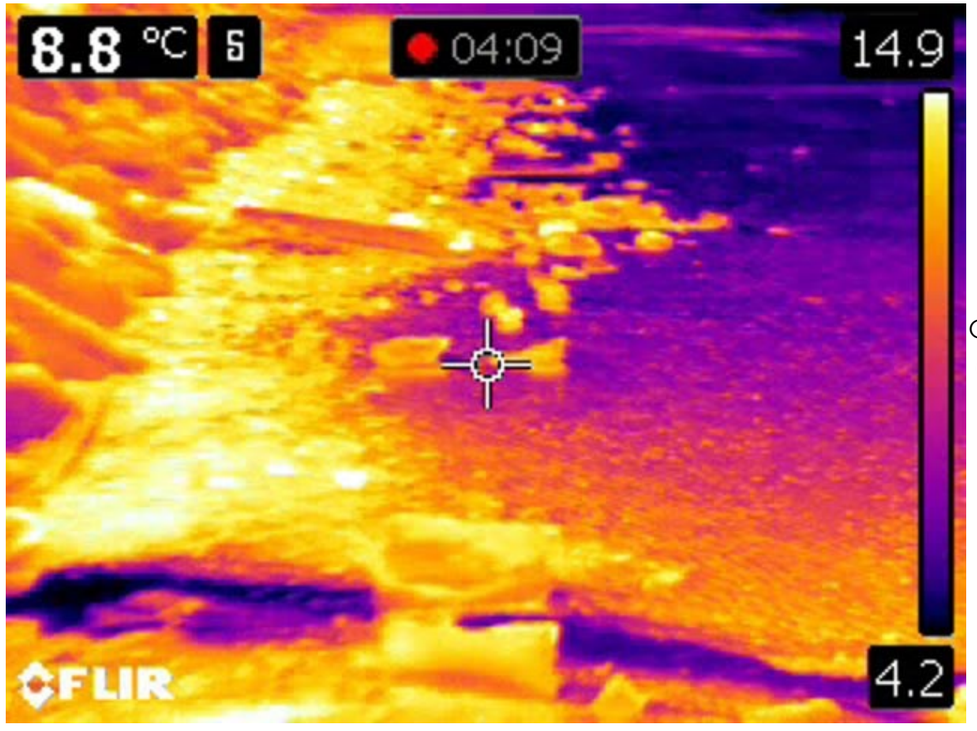
Possible Seep 1: approximately 450 feet from outfall



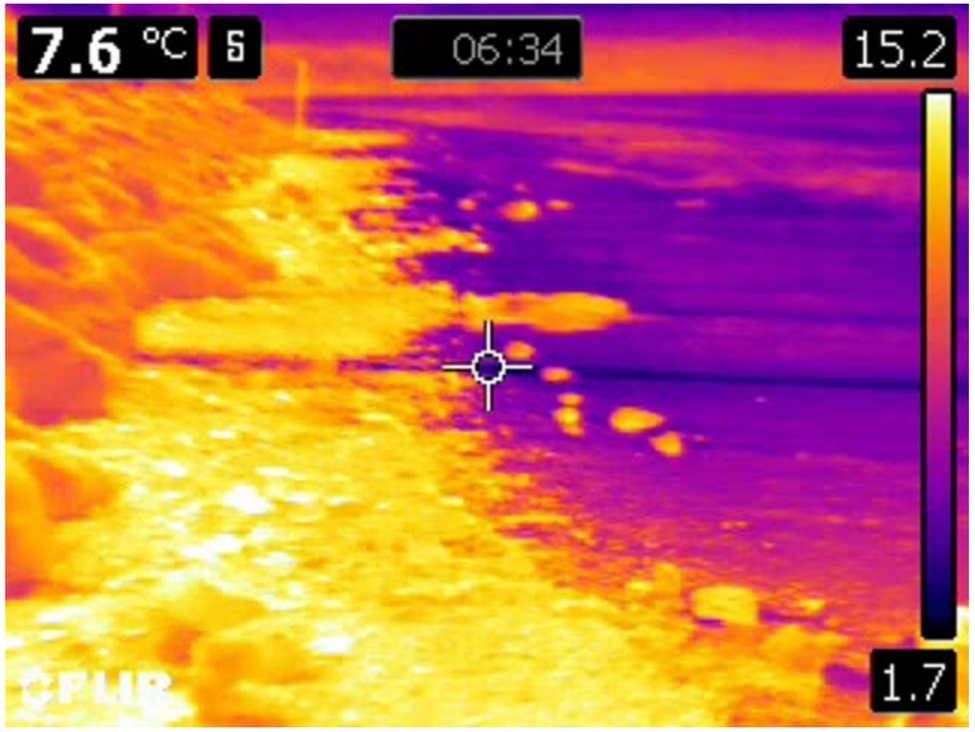

Possible Seep 2: approximately 480 feet from outfall



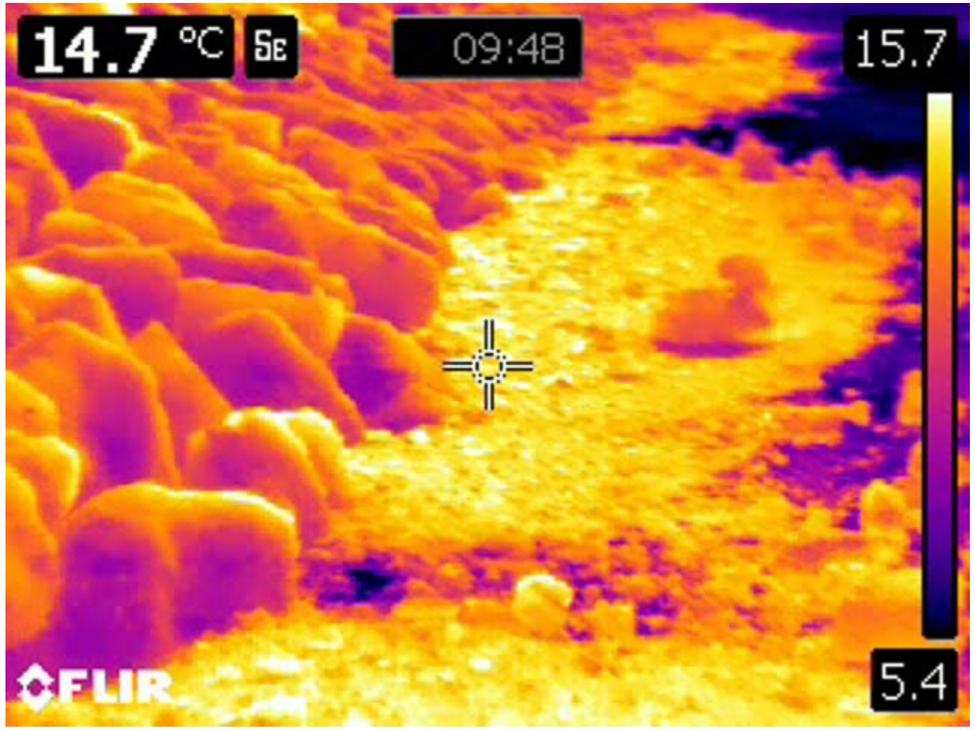

Other Channel noted by thermal observation



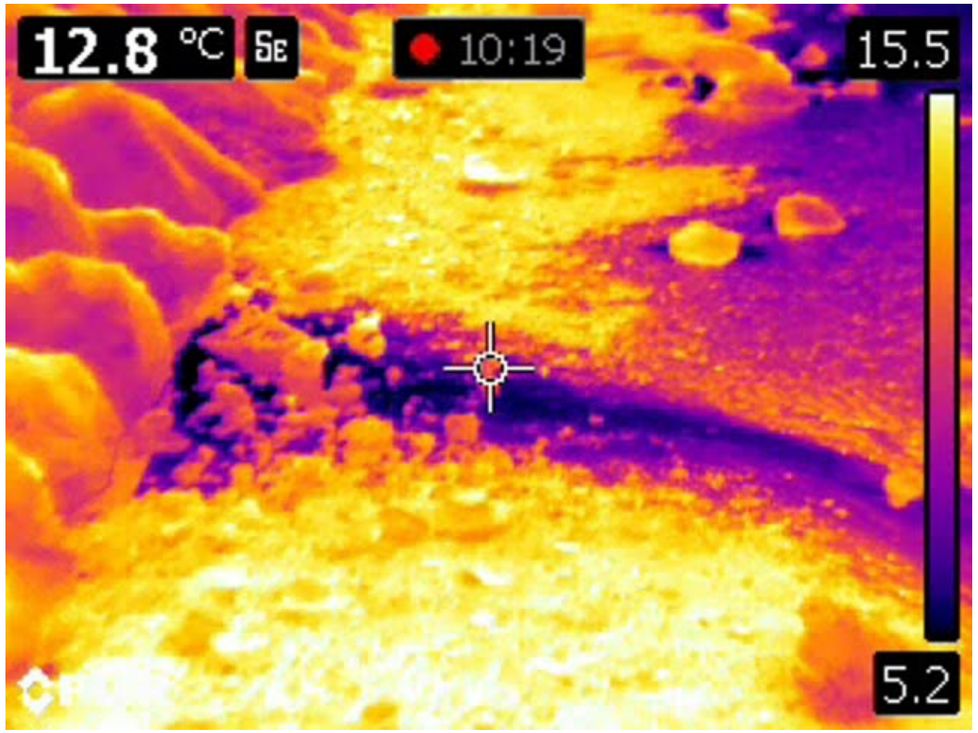

Other Channel noted by thermal observation



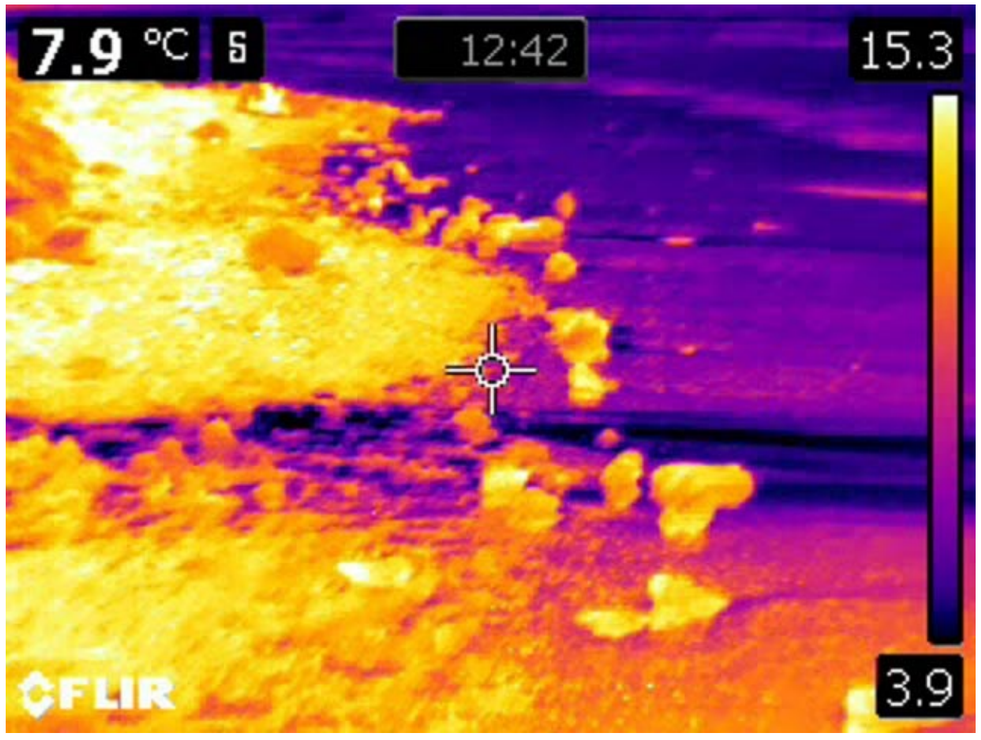
Possible Seep 3: approximately 1,500 feet from outfall



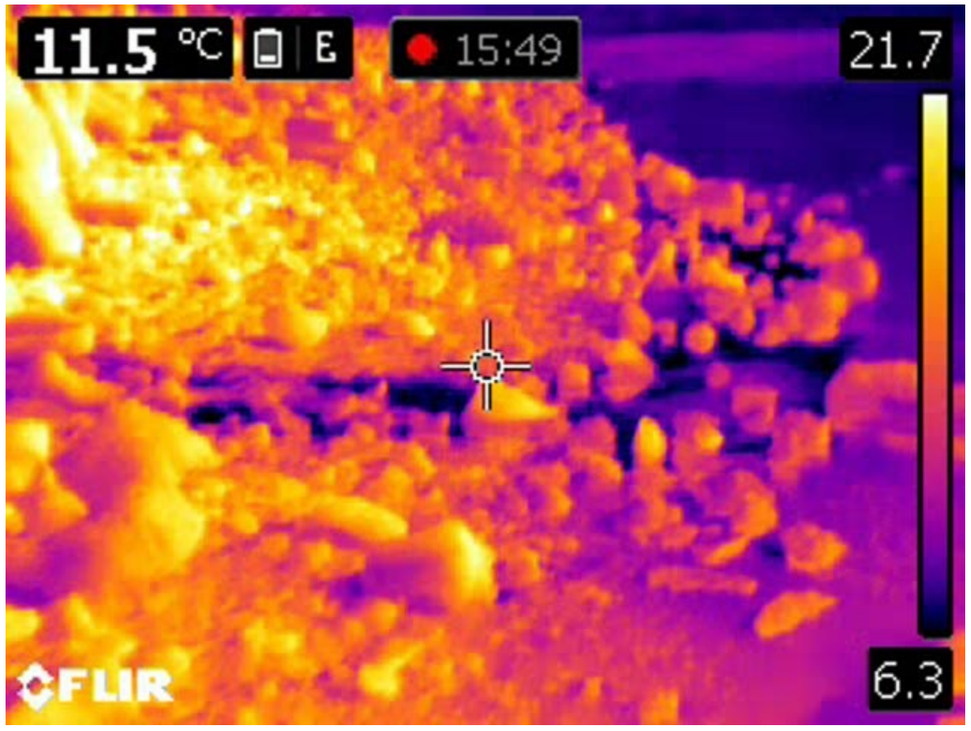

Possible Seep 4: approximately 1,700 feet from outfall



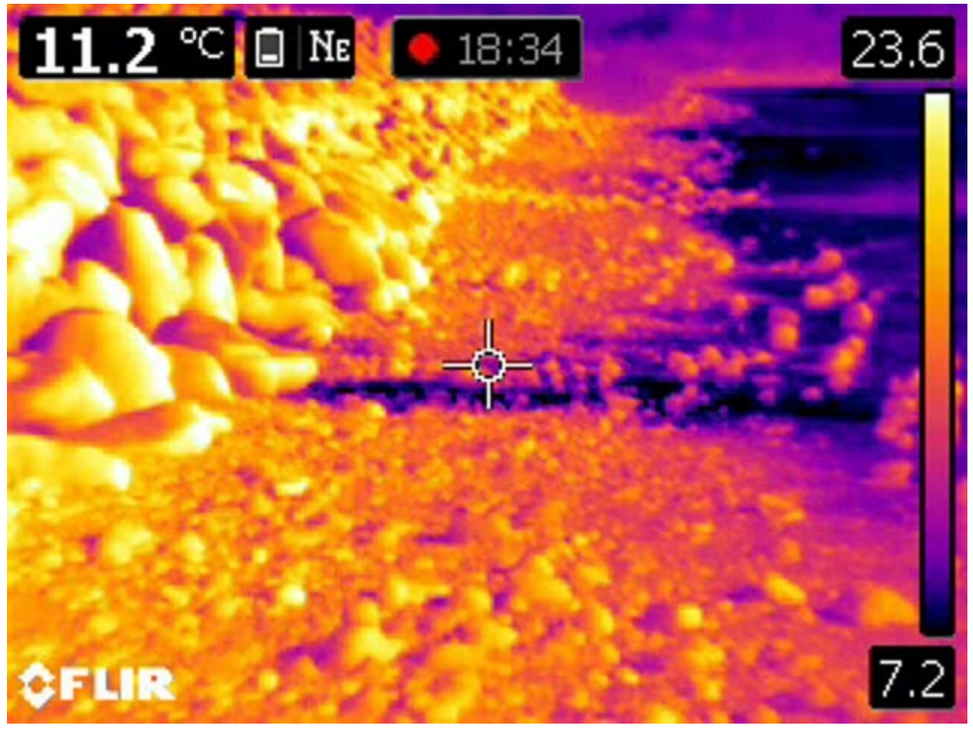

Possible Seep 5: approximately 1,740 feet from outfall



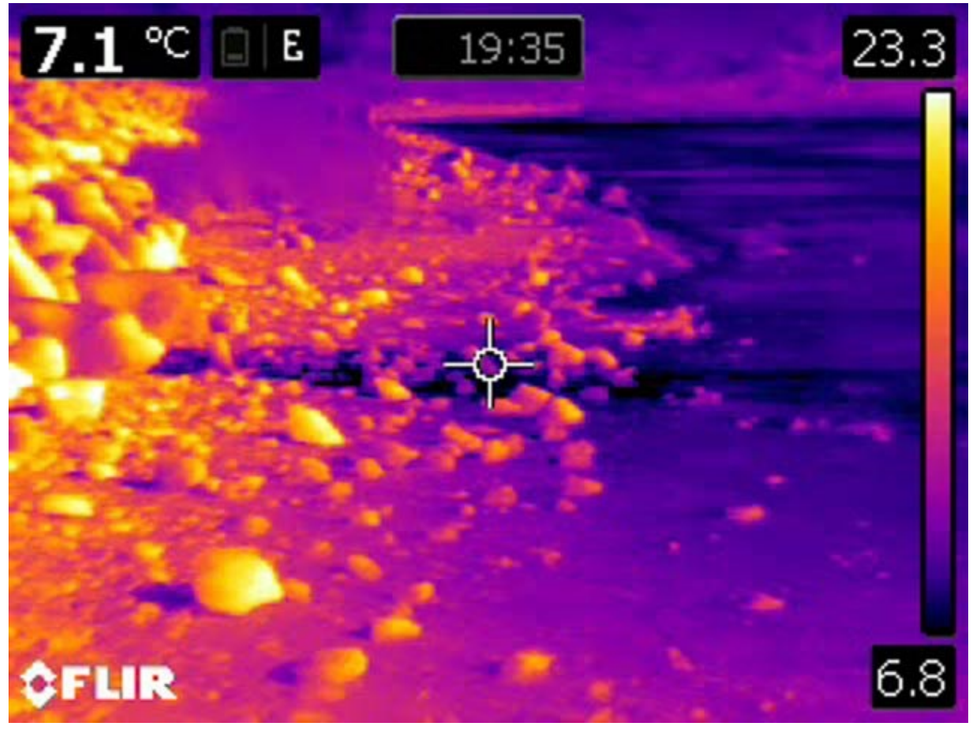

Possible Seep 6: approximately 1,750 feet from outfall



Possible Seep 7: approximately 900 feet from old out-fall

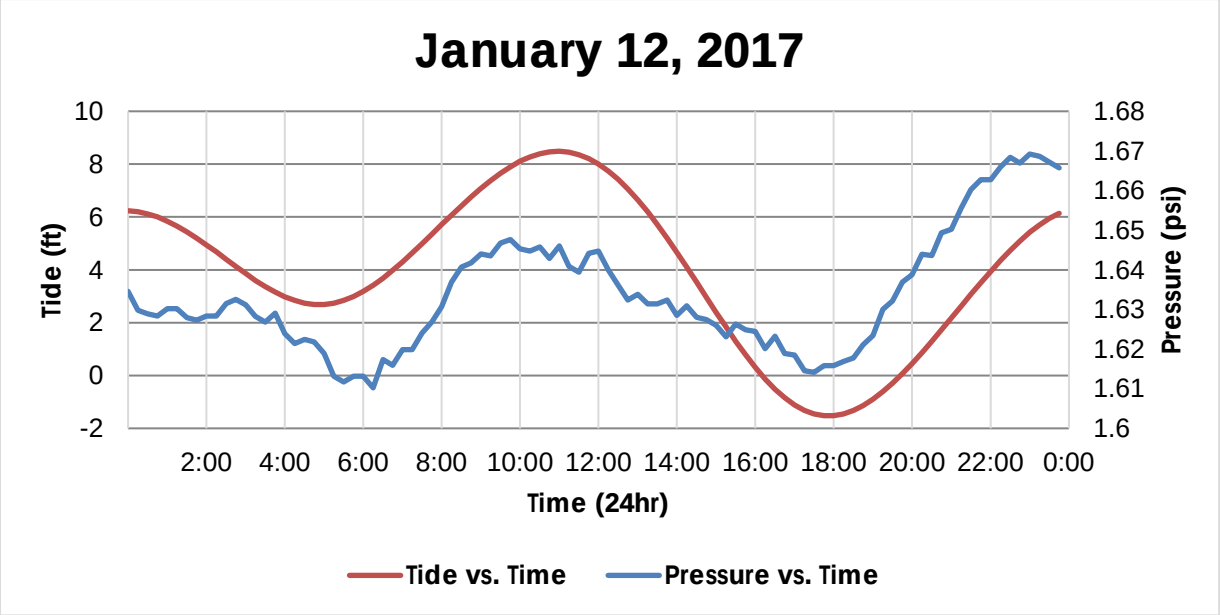


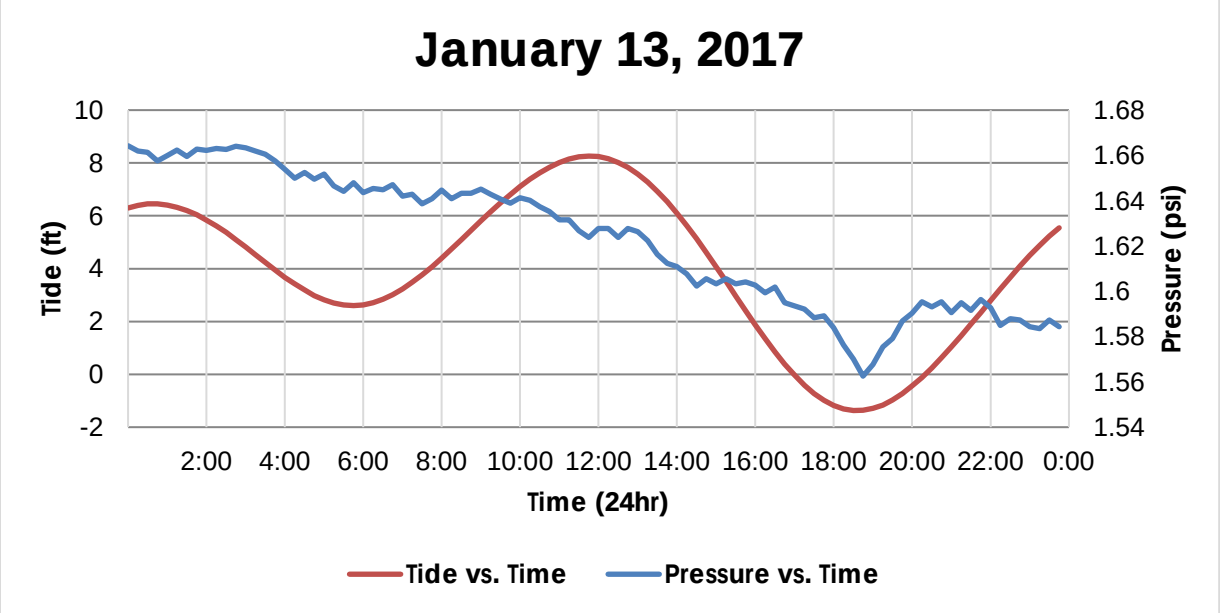

Possible Seep 8: approximately 530 feet from old outfall

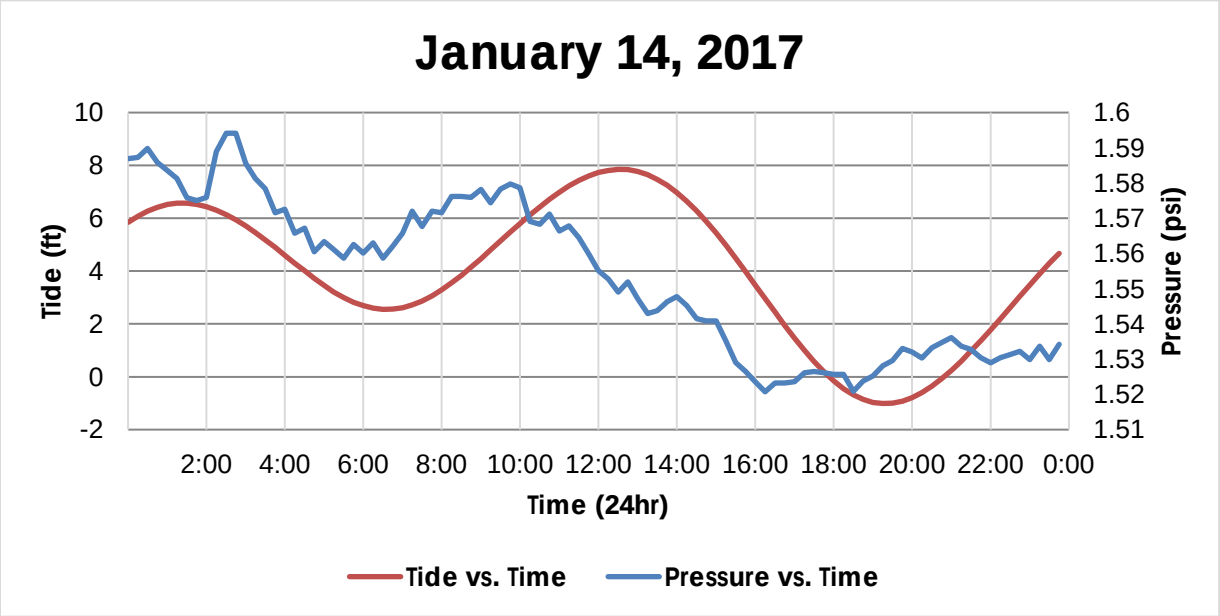


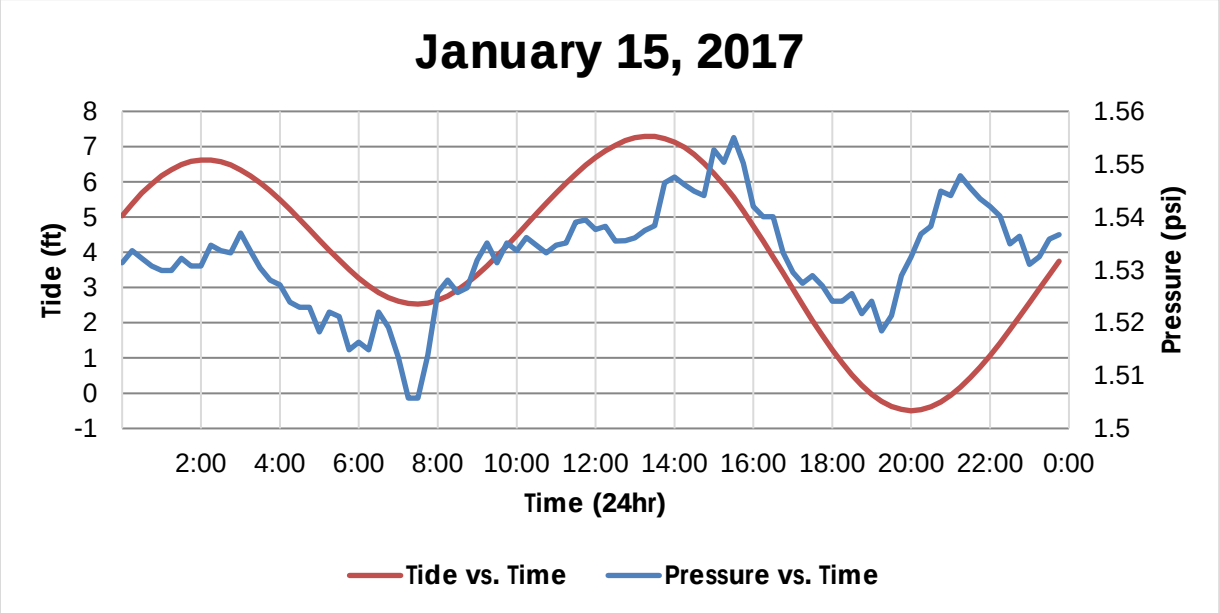
# APPENDIX 4

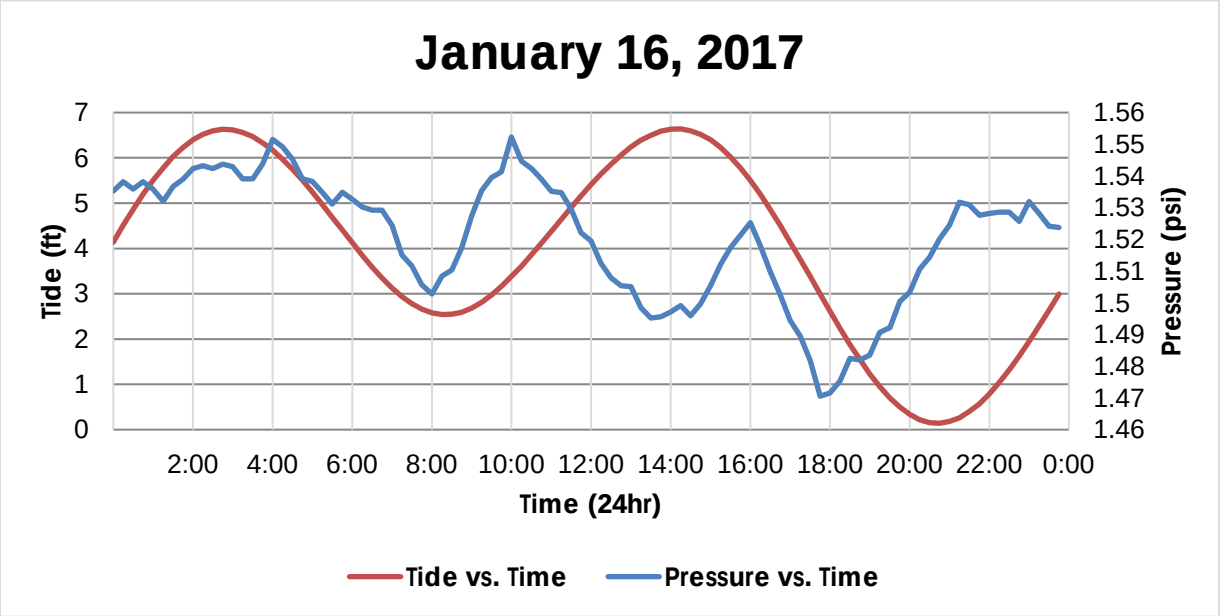
## Daily Tide and Pressure versus Time

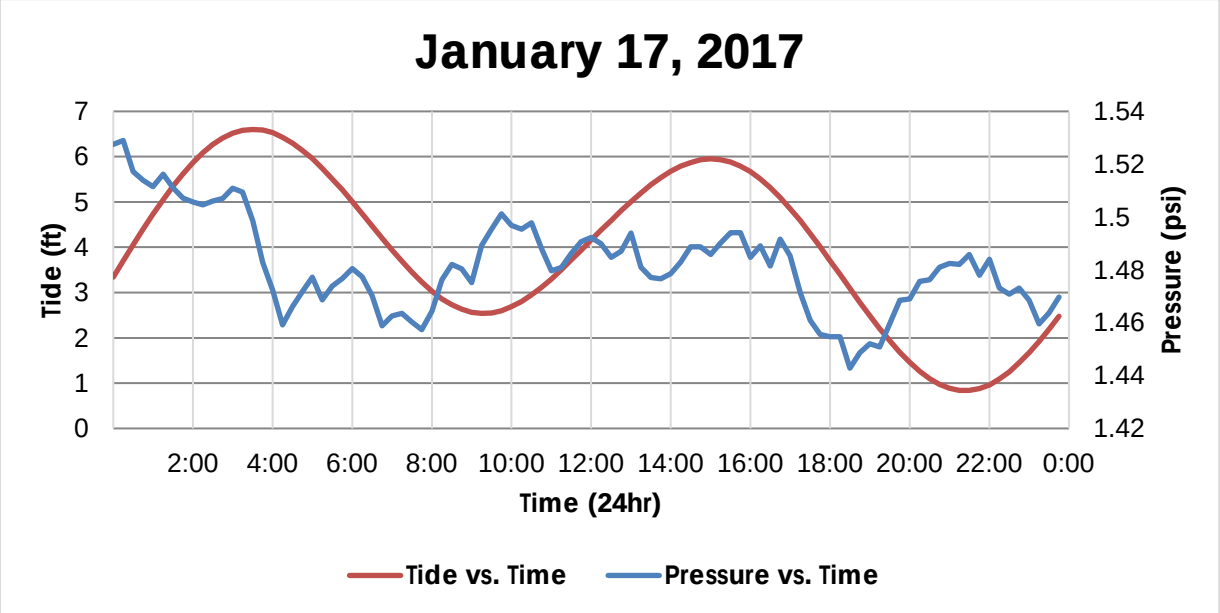

January 12, 2017
Tide (ft)
10
8
6
4
2
0
-2
Pressure (psi)
1.68
1.67
1.66
1.65
1.64
1.63
1.62
1.61
1.6
2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00
Time (24hr)
Tide vs. Time
Pressure vs. Time

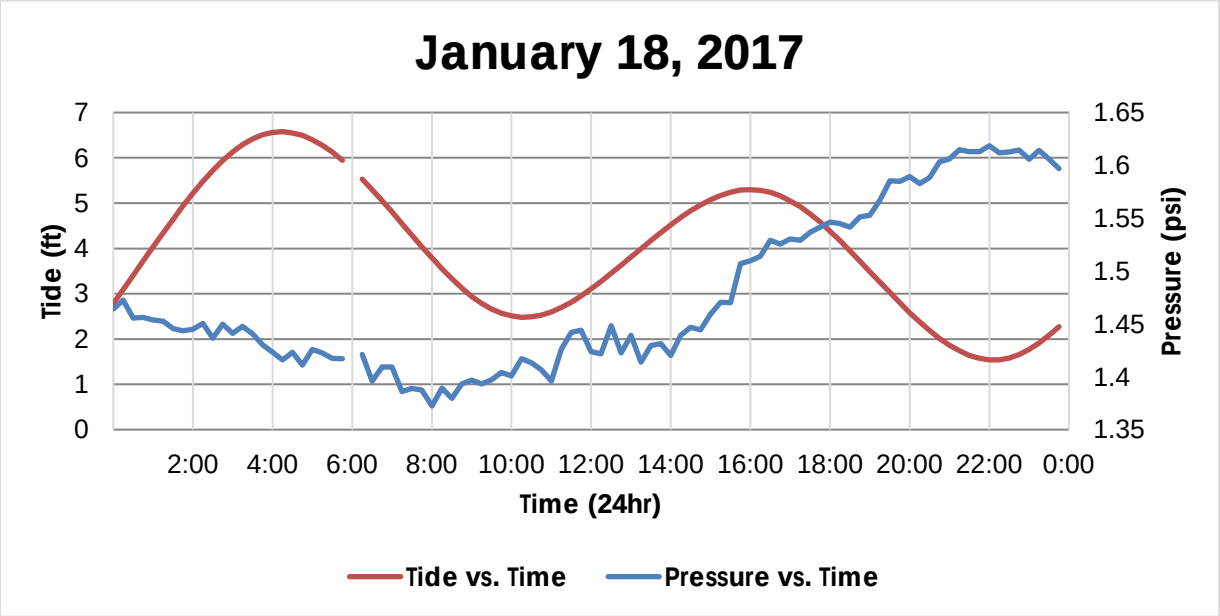

January 13, 2017
Tide (ft)
10
8
6
4
2
0
-2
Pressure (psi)
1.68
1.66
1.64
1.62
1.6
1.58
1.56
1.54
2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00
Time (24hr)
Tide vs. Time
Pressure vs. Time


January 14, 2017
Tide (ft)
10
8
6
4
2
0
-2
Pressure (psi)
1.6
1.59
1.58
1.57
1.56
1.55
1.54
1.53
1.52
1.51
2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00
Time (24hr)
Tide vs. Time
Pressure vs. Time


January 15, 2017
Tide (ft)
8
7
6
5
4
3
2
1
0
-1
Pressure (psi)
1.56
1.55
1.54
1.53
1.52
1.51
1.5
2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00
Time (24hr)
Tide vs. Time
Pressure vs. Time


January 16, 2017
Tide (ft)
Pressure (psi)
Time (24hr)
2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00
Tide vs. Time
Pressure vs. Time


January 17, 2017
Tide (ft)
Pressure (psi)
Time (24hr)
2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00
Tide vs. Time
Pressure vs. Time


January 18, 2017
Tide (ft)
Pressure (psi)
7
6
5
4
3
2
1
0
1.65
1.6
1.55
1.5
1.45
1.4
1.35
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time (24hr)
Tide vs. Time
Pressure vs. Time

# APPENDIX 5

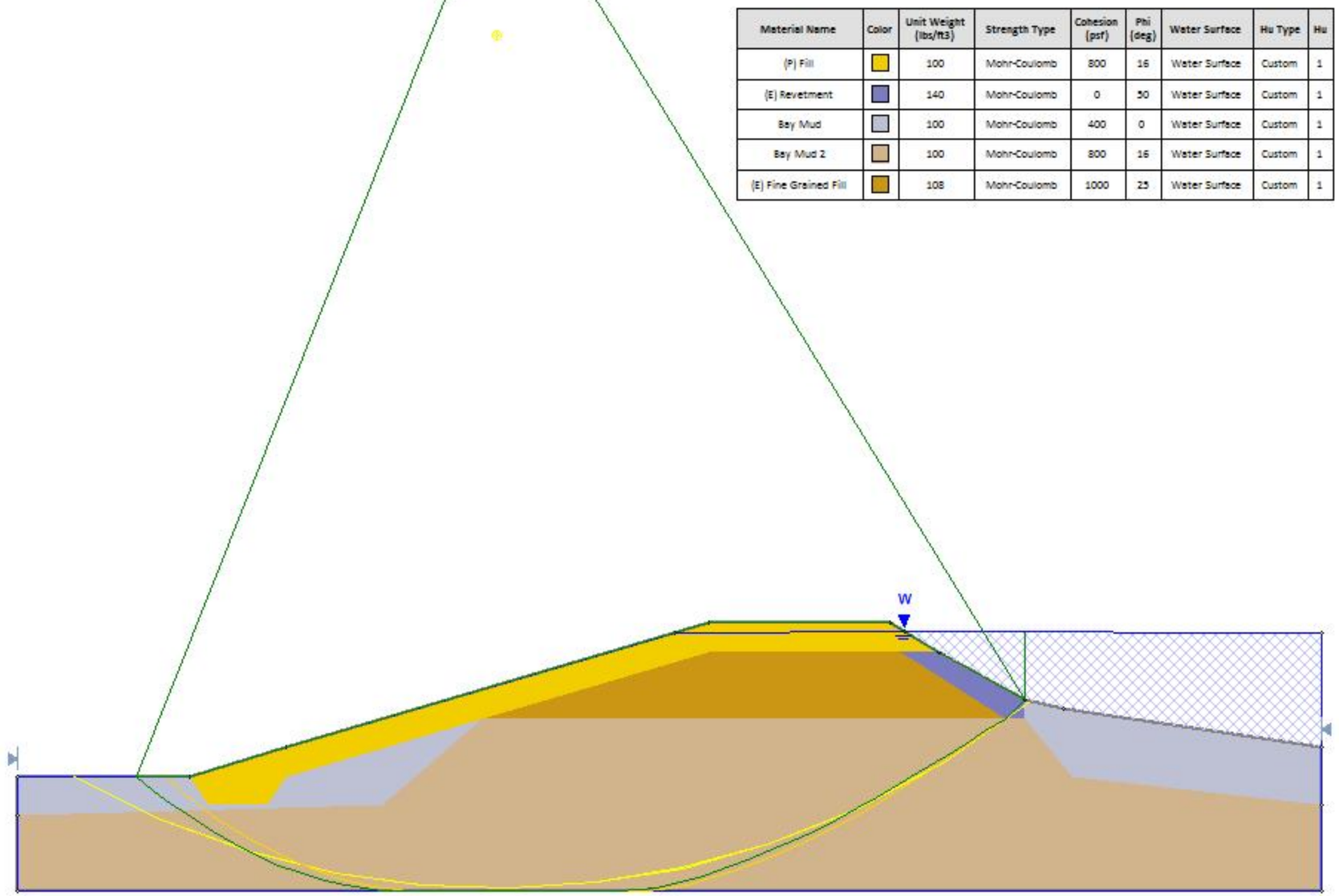
## Slope Stability Analysis

# SECTION 16+00, EMPTY POND - SEA LEVEL RISE - KING TIDE

1.491 Critical Failure Surface Factor of Safety

0.28 Pseudo Static Seismic Coefficent

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| (P) Fill | | 100 | Mohr-Coulomb | 800 | 16 | Water Surface | Custom | 1 |
| (E) Revetment | | 140 | Mohr-Coulomb | 0 | 50 | Water Surface | Custom | 1 |
| Bay Mud | | 100 | Mohr-Coulomb | 400 | 0 | Water Surface | Custom | 1 |
| Bay Mud 2 | | 100 | Mohr-Coulomb | 800 | 16 | Water Surface | Custom | 1 |
| (E) Fine Grained Fill | | 108 | Mohr-Coulomb | 1000 | 25 | Water Surface | Custom | 1 |

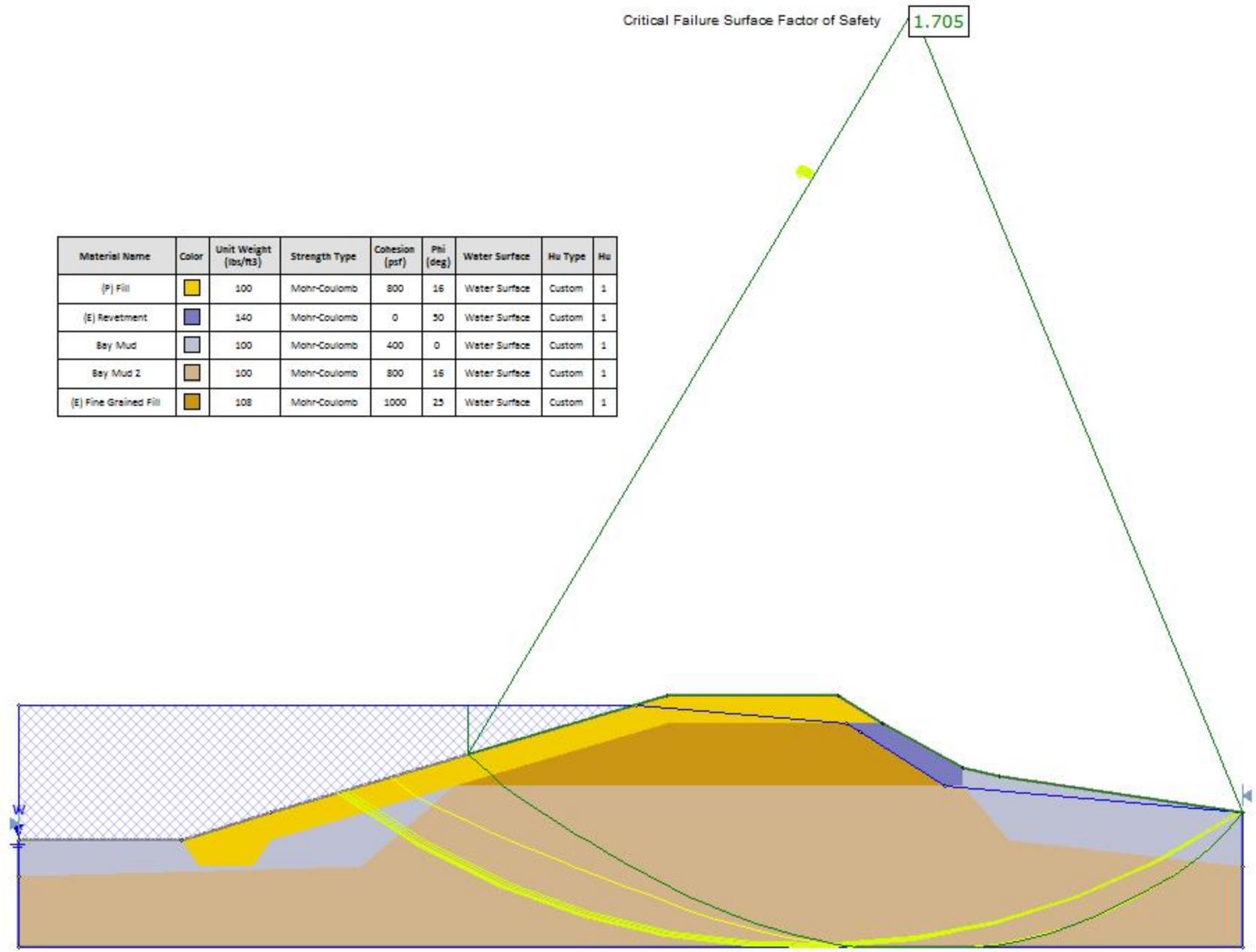


# SECTION 16+00, FULL POND - LOW TIDE

Pseudo Static Seismic Coefficent 0.28

Critical Failure Surface Factor of Safety 1.705

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| (P) Fill | | 100 | Mohr-Coulomb | 800 | 16 | Water Surface | Custom | 1 |
| (E) Revetment | | 140 | Mohr-Coulomb | 0 | 50 | Water Surface | Custom | 1 |
| Bay Mud | | 100 | Mohr-Coulomb | 400 | 0 | Water Surface | Custom | 1 |
| Bay Mud 2 | | 100 | Mohr-Coulomb | 800 | 16 | Water Surface | Custom | 1 |
| (E) Fine Grained Fill | | 108 | Mohr-Coulomb | 1000 | 25 | Water Surface | Custom | 1 |

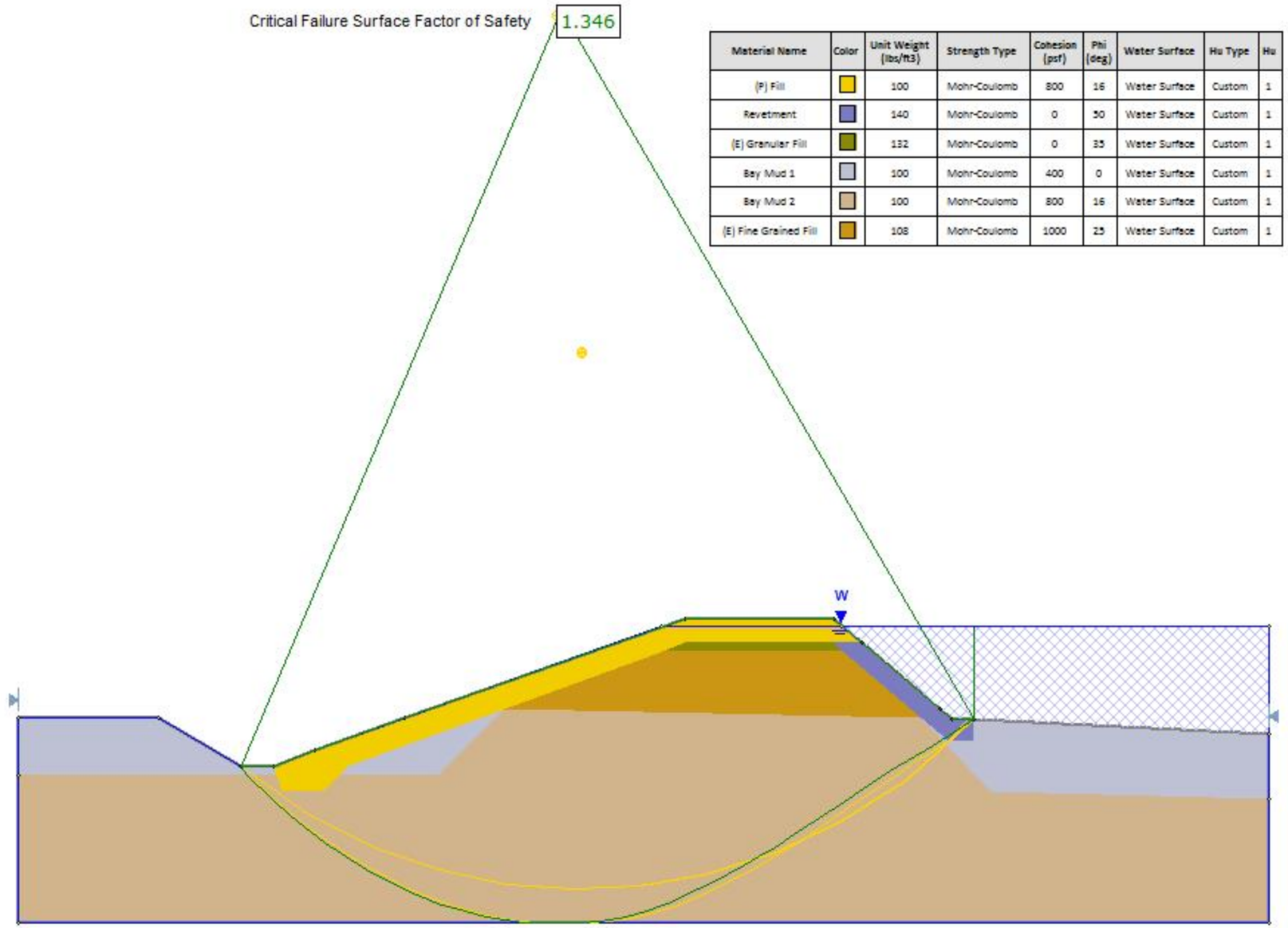


Pseudo Static Seismic Coefficent 0.28

# SECTION 31+00, EMPTY POND - SEA LEVEL RISE - KING TIDE

Critical Failure Surface Factor of Safety 1.346

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| (P) Fill | | 100 | Mohr-Coulomb | 800 | 16 | Water Surface | Custom | 1 |
| Revetment | | 140 | Mohr-Coulomb | 0 | 50 | Water Surface | Custom | 1 |
| (E) Granular Fill | | 132 | Mohr-Coulomb | 0 | 35 | Water Surface | Custom | 1 |
| Bay Mud 1 | | 100 | Mohr-Coulomb | 400 | 0 | Water Surface | Custom | 1 |
| Bay Mud 2 | | 100 | Mohr-Coulomb | 800 | 16 | Water Surface | Custom | 1 |
| (E) Fine Grained Fill | | 108 | Mohr-Coulomb | 1000 | 25 | Water Surface | Custom | 1 |

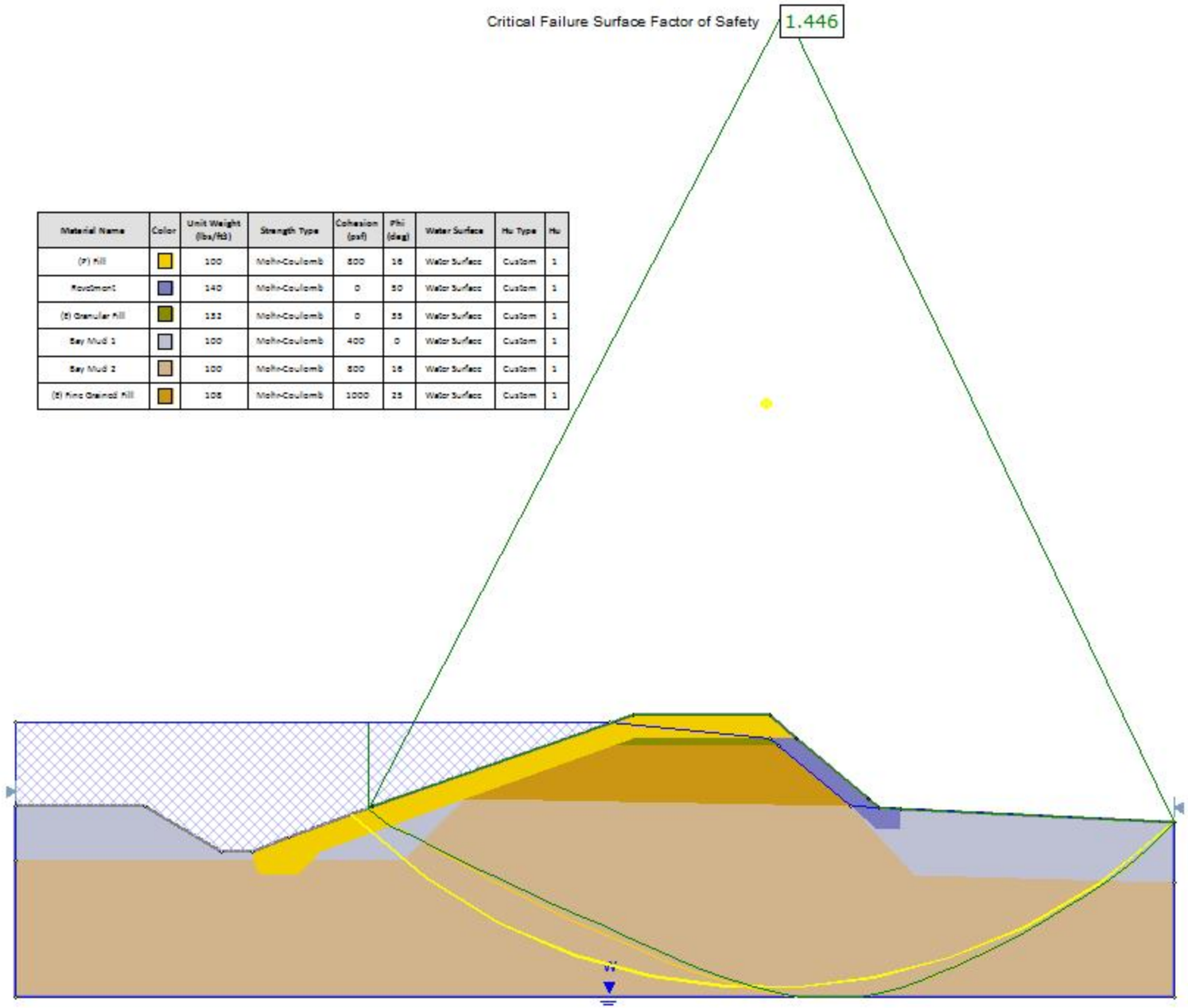


# SECTION 31+00, FULL POND - LOW TIDE

Pseudo Static Seismic Coefficent 0.28

Critical Failure Surface Factor of Safety 1.446

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Ru Type | Ru |
|---|---|---|---|---|---|---|---|---|
| (F) Fill | | 100 | Mohr-Coulomb | 500 | 16 | Water Surface | Custom | 1 |
| Revetment | | 140 | Mohr-Coulomb | 0 | 50 | Water Surface | Custom | 1 |
| (E) Granular Fill | | 132 | Mohr-Coulomb | 0 | 33 | Water Surface | Custom | 1 |
| Bay Mud 1 | | 100 | Mohr-Coulomb | 400 | 0 | Water Surface | Custom | 1 |
| Bay Mud 2 | | 100 | Mohr-Coulomb | 500 | 16 | Water Surface | Custom | 1 |
| (E) Fine Grained Fill | | 105 | Mohr-Coulomb | 1000 | 25 | Water Surface | Custom | 1 |

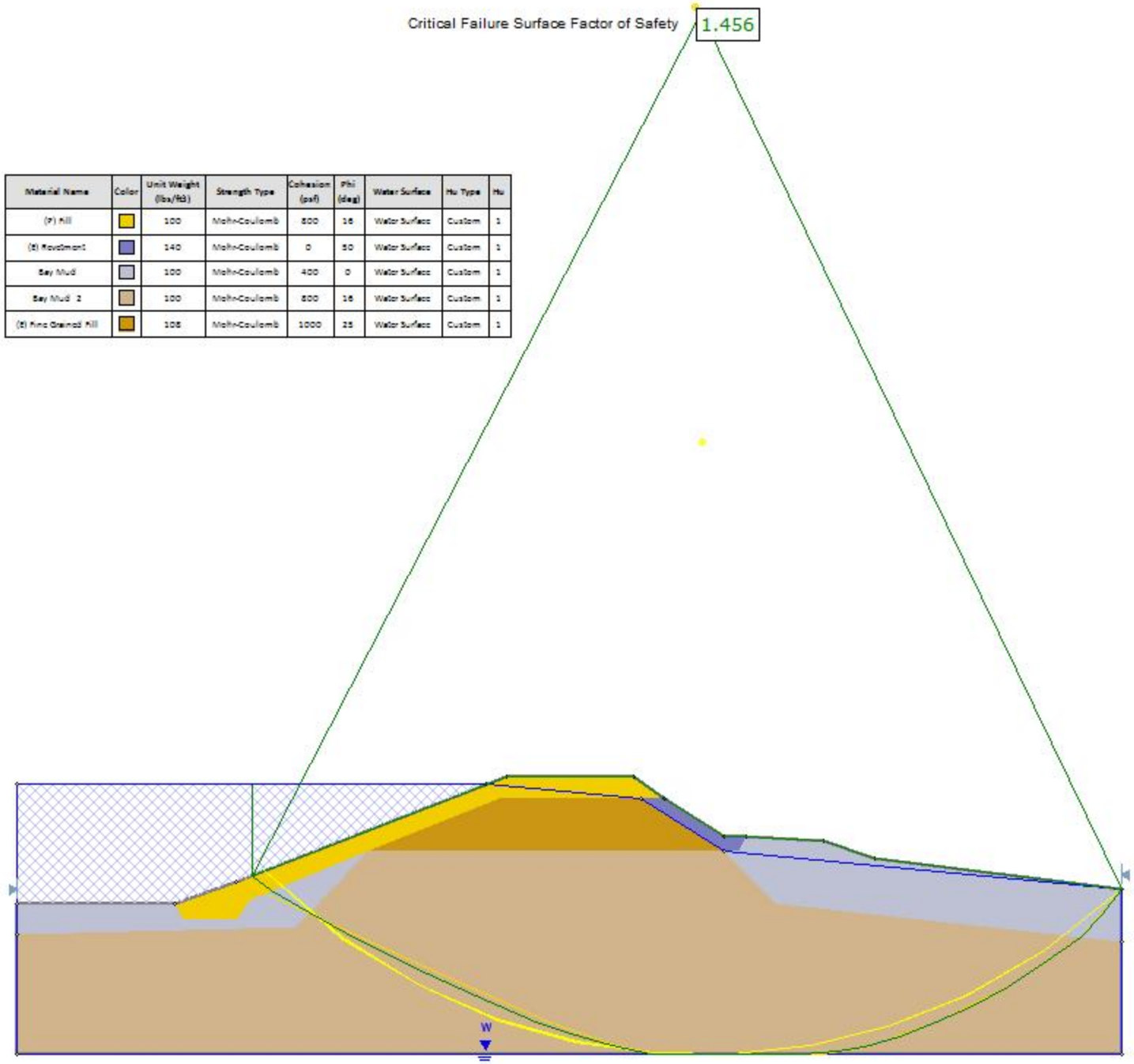


# SECTION 39+00, FULL POND - LOW TIDE

Critical Failure Surface Factor of Safety 1.456

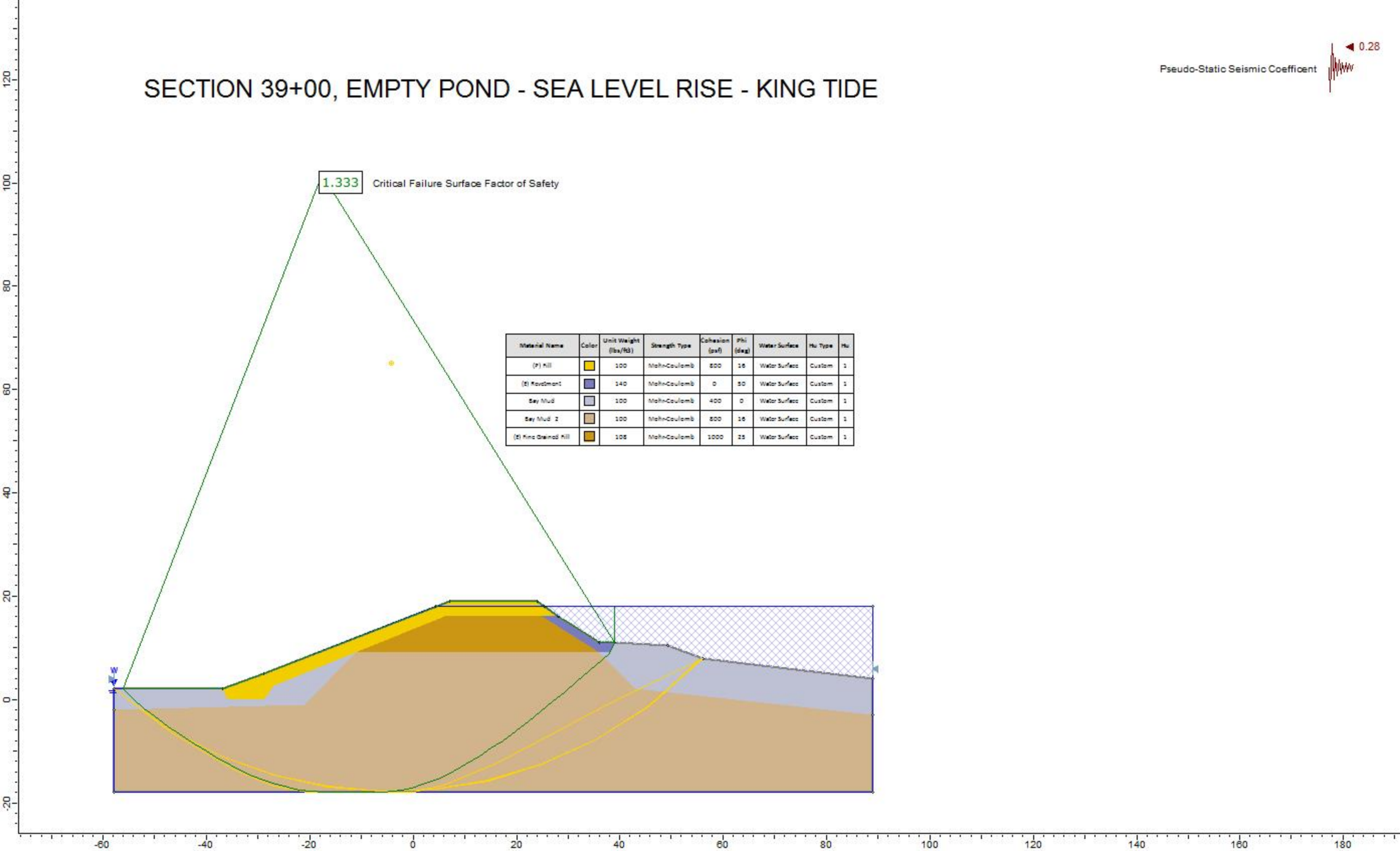
Pseudo-Static Seismic Coefficent 0.28

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Ru Type | Ru |
|---|---|---|---|---|---|---|---|---|
| (F) Fill | | 100 | Mohr-Coulomb | 500 | 16 | Water Surface | Custom | 1 |
| (E) Revetment | | 140 | Mohr-Coulomb | 0 | 50 | Water Surface | Custom | 1 |
| Bay Mud | | 100 | Mohr-Coulomb | 400 | 0 | Water Surface | Custom | 1 |
| Bay Mud 2 | | 100 | Mohr-Coulomb | 500 | 16 | Water Surface | Custom | 1 |
| (E) Fine Grained Fill | | 105 | Mohr-Coulomb | 1000 | 25 | Water Surface | Custom | 1 |



# SECTION 39+00, EMPTY POND - SEA LEVEL RISE - KING TIDE

Pseudo-Static Seismic Coefficent 0.28




| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Ru Type | Ru |
|---|---|---|---|---|---|---|---|---|
| (P) Fill | | 100 | Mohr-Coulomb | 600 | 16 | Water Surface | Custom | 1 |
| (E) Revetment | | 140 | Mohr-Coulomb | 0 | 50 | Water Surface | Custom | 1 |
| Bay Mud | | 100 | Mohr-Coulomb | 400 | 0 | Water Surface | Custom | 1 |
| Bay Mud 2 | | 100 | Mohr-Coulomb | 600 | 16 | Water Surface | Custom | 1 |
| (E) Fine Grained Fill | | 105 | Mohr-Coulomb | 1000 | 25 | Water Surface | Custom | 1 |

# ATTACHMENT 3

United State Environmental Protection Agency (EPA). Sole Source Aquifers. Available at: https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=9ebb047ba3ec41ada1877155fe31356b

Accessed on: 9/21/20


project site
Idaho
Oregon
Boise
Medford
Nevada
Carson City
Sacramento
San Francisco
San Jose
California
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

# ArcGIS Web Map




12/17/2018 1:25:34 PM

1:9,244,649

Sole Source Aquifers - Labels

SSA

0 115 230 460 mi

0 185 370 740 km

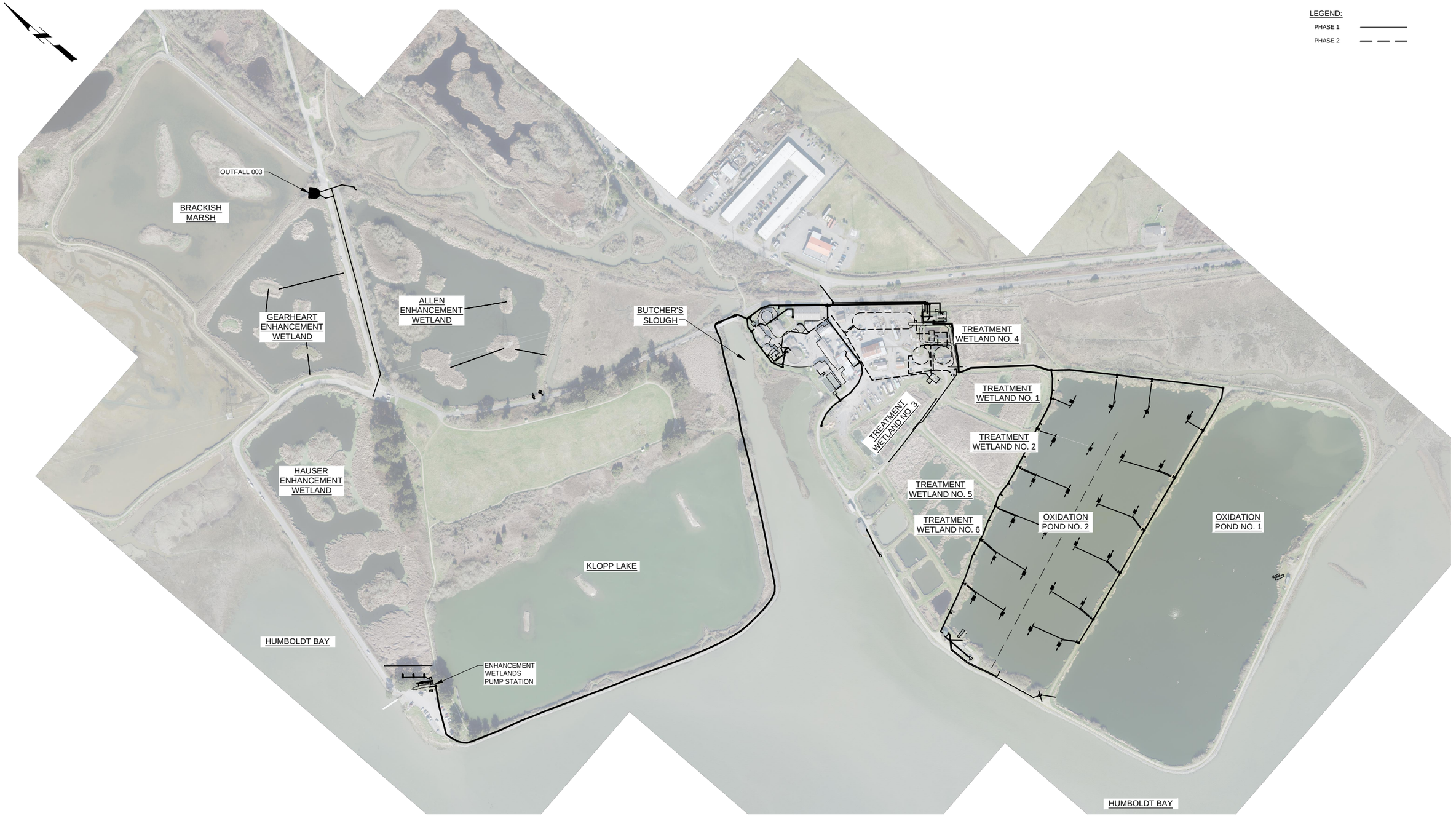
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community
Map Service and data: US EPA Office of Environmental Information

# ATTACHMENT 4

Carollo Engineers. *Project Figures.*

2020.

Plot Date: 7/23/2020 8:12:36 AM




**OVERALL SITE PLAN**

CITY OF ARCATA

carollo

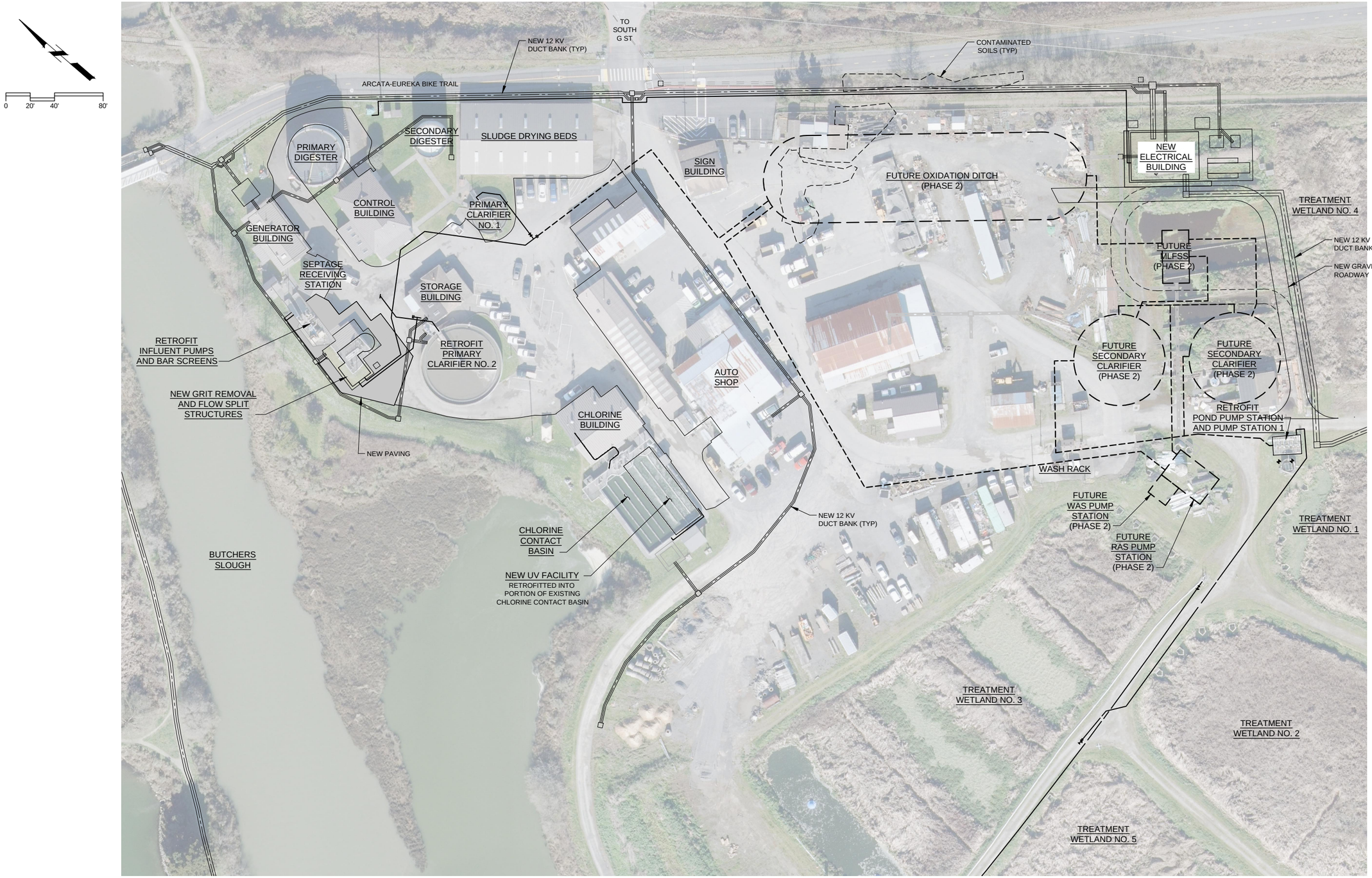



# OXIDATION PONDS AND TREATMENT WETLANDS SITE PLAN

CITY OF ARCATA

carollo

File: E:\ICSforPDFWorking\160217\1008788_3\9913B10F\GES-1.dgn
Plot Date: 23-JUL-2020 7:55:53 AM
User: svcPW

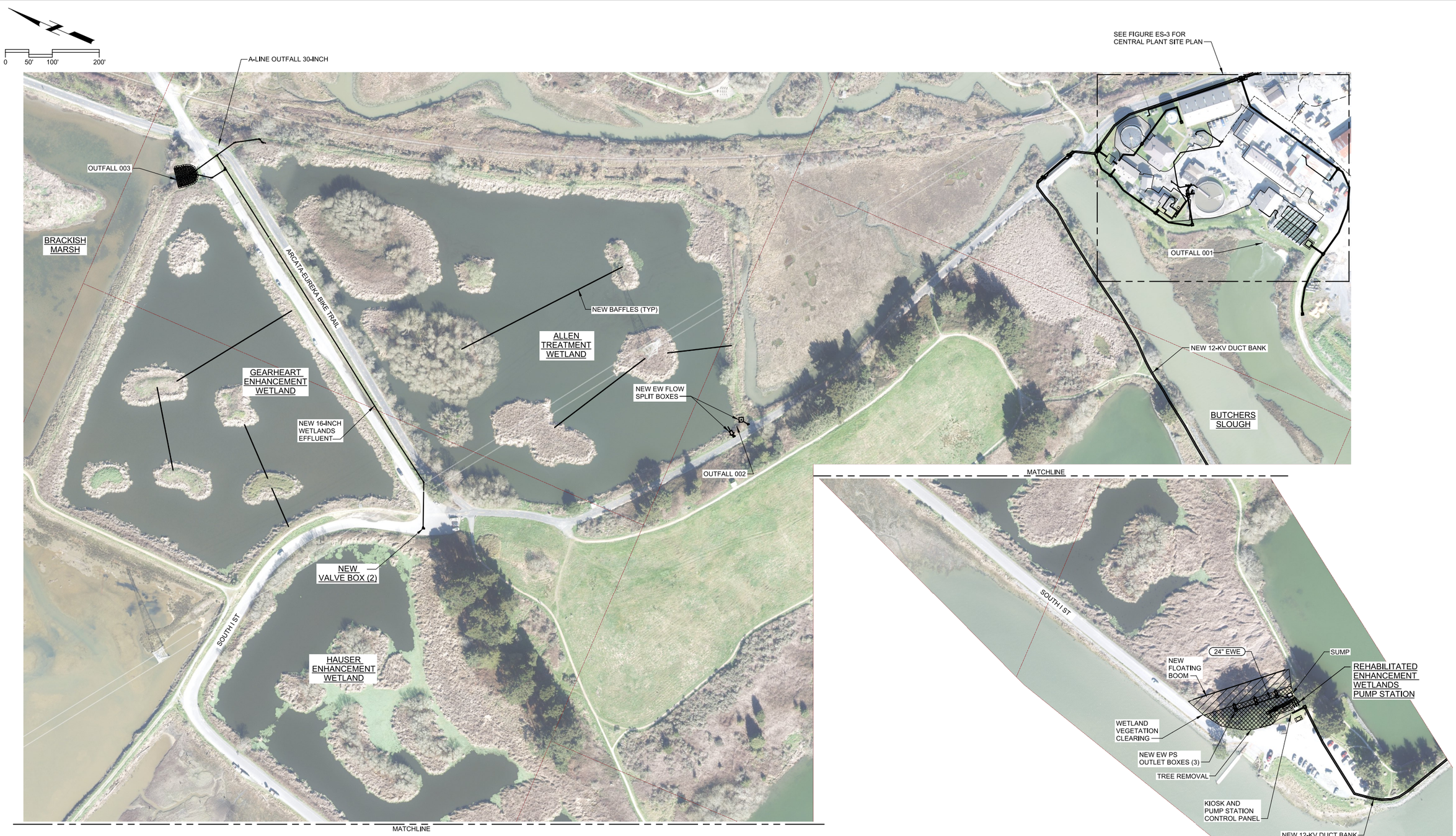



**CENTRAL SITE PLAN**

CITY OF ARCATA

carollo

File: E:\ICSforPDFWorking\160217\1008788_2\9913B10FIGES-2.dgn
Plot Date: 23-JUL-2020 7:55:55 AM
User: svcPW




LEGEND:

PHASE 1 ———

# ENHANCEMENT WETLANDS SITE PLAN

CITY OF ARCATA

carollo

# ATTACHMENT 5

*DZC Archeology and Cultural Resource Management. Cultural Resource Assessment Report for the City of Arcata Wastewater Treatment Facilities Improvement Project. November 2019.*

# CULTURAL RESOURCE ASSESSMENT REPORT FOR THE CITY OF ARCATA WASTEWATER TREATMENT FACILITIES IMPROVEMENT PROJECT,

## ARCATA, HUMBOLDT COUNTY, CALIFORNIA



**Submitted to:**

**City of Arcata**
**Arcata City Hall**
**736 F Street**
**Arcata, CA 95521**

**Prepared for:**

City of Arcata
Arcata City Hall
736 F Street
Arcata, CA 95521

**Prepared by** :

Dimitra Zalarvis-Chase, M.A., RPA
Sydney Kerkhove-Peltier, B.A.
Jaques Kerkhove-Peltier, M.A.
Kelly Hollreiser, B.A. Author

DZC Archaeology & Cultural Resource Management

455 I Street, Suite 204 Arcata, Ca 95521

November 2019

# CULTURAL RESOURCE ASSESSMENT REPORT FOR THE CITY OF ARCATA WASTEWATER TREATMENT FACILITIES IMPROVEMENT PROJECT, ARCATA, HUMBOLDT COUNTY, CALIFORNIA

---

**SUBMITTED TO:**

City of Arcata
Arcata City Hall
736 F Street
Arcata, CA 95521

**PREPARED FOR:**

City of Arcata
Arcata City Hall
736 F Street
Arcata, CA 95521

**PREPARED BY:**

Dimitra Zalarvis-Chase, M.A., RPA
Sydney Kerkhove-Peltier, B.A.
Jaques Kerkhove-Peltier, M.A.
Kelly Hollreiser, B.A.

November 2019

USGS 7.5-Minute Series Arcata South Quadrangle;
Township 6 North, Range 1 West, Section 32; Township 5 North, Range 1 East, Unsectioned; 123-acre study area

**Keywords:**
City of Arcata, Arcata Wastewater Treatment Facilities Improvements, Arcata Marsh Wildlife Sanctuary, State Water Resources Control Board, North Coast Regional Water Quality Control Board, National Pollutant Discharge Elimination System permit, Arcata and Mad River Railroad/Union Wharf and Plank Walk Company

*STATEMENT OF CONFIDENTIALITY*

***This document is not for public distribution.*** ***This report identifies the locations of cultural resource sites. Disclosure of this information to the public may be in violation of both federal and state laws. Applicable United States laws include, but may not be limited to, Section 304 of the National Historic Preservation Act (NHPA) (16 U.S.C. 470w-3), the Archaeological Resources Protection Act (ARPA) [16 U.S.C. Section 9(a) and Section 470(hh)], and Executive Order 13007. In California, such laws include, but may not be limited to, Government Code Section 6254.10. Site location information is confidential and is not for public disclosure.***

***Additionally, records maintained or in the possession of the Native American Heritage Commission or state and local agencies that are exempt from public disclosure include those that contain information on Native American graves, cemeteries, and sacred places, and include records obtained during consultation with Native Americans (California Government Code §6254(r) and §6254.10).***

*LIMITATIONS STATEMENT*

***This report has been prepared based on certain key assumptions made by DZC Archaeology & Cultural Resource Consulting, LLC (DZC) that substantially affect the conclusions and recommendations of this report. These assumptions, although thought to be reasonable and appropriate, may not prove to be true in the future. The conclusions and recommendations of DZC are conditioned upon these assumptions.***

***These assumptions include confidential information provided by the Native American Heritage commission on September 10, 2019, by the Northwest Information Center on July 19, 2019, and by direct observation of site conditions and other information that is generally applicable as of October 9, 2019. The conclusions and recommendations herein are therefore applicable only to that timeframe. Information obtained from these sources in this timeframe is assumed to be correct and complete. DZC will not assume any liability for findings or lack of findings based upon misrepresentation of information presented to the project team or for items not visible, made available, accessible, or present at the site at the time of the Project site survey.***

# MANAGEMENT SUMMARY

This report details the results of a Phase I Cultural Resources Inventory conducted by DZC Archaeology & Cultural Resource Consulting, LLC (DZC) on portions of Humboldt County Accessor's Parcel Numbers (APN) 503-241-010, 503-232-013, 503-251-012, 503-211-026, 503-241-016, 503-251-009, 503-241-011, 503-241-013, 503-211-005, 503-241-012, and one unnumbered parcel. The parcels combined represent the City of Arcata Wastewater Treatment Facility (AWTF) and City Corporate Yard. The City of Arcata retained DZC to conduct the inventory in support of a National Pollutant Discharge Elimination System (NPDES) permit through the North Coast Regional Water Quality Control Board (NCRWQCB).

Approximately 123 acres comprise the Area of Potential Effects (APE), located in the City of Arcata, Humboldt County, California. The legal location of the APE is Township 6 North, Range 1 West, Section 32, and Township 5 North, Range 1 East Unsectioned, of the Arcata South 7.5-Minute USGS Quadrangle (Humboldt Baseline Meridian). The Environmental Study Limits (ESL) constitute a 0.5 mile radius around the APE.

The City of Arcata is the Lead Agency providing regulatory oversight for the permitting process. The purpose of this cultural resources inventory is to satisfy the requirements of the National Environmental Policy Act (NEPA) of 1969, Section 106 of the National Historic Preservation Act (NHPA) of 1966, and the California Environmental Quality Act (CEQA) of 1970 (all as amended), and the City of Arcata Historical Preservation Element.

In advance of a field survey of the APE, DZC completed historical research for the APE and ESL at the Northwest Information Center of the California Historic Resources Information System (NWIC). The review identified 16 previously conducted archaeological surveys of interest: 10 surveys within the APE, and six outside the APE but either partially or completely within the ESL. Five previously recorded resources were identified within the ESL and one within the APE. The geoarchaeological research indicated a low potential for buried and surface prehistoric resources, and a moderate potential for buried and surficial historical resources within the APE.

A field survey of the APE was undertaken on October 9th, 2019, and November 5th, 2019, by Dimitra Zalarvis-Chase, M.A., RPA a U.S. Secretary of the Interior qualified archaeologist and staff archaeologist Kelly Hollreiser (B.A.). Of the 123 acres, 75 acres were intensively surveyed in transects of 15 meters or less. Approximately 48 acres within the APE are unsurveyable ponds, wetlands, and marshes. Impediments to ground visibility included dense vegetation, imported gravels, and paved areas. The surface scrapes were utilized where visibility was poor.

One built environment complex, the AWTF, and a mapped alignment of a California Historical Landmark (CHL) No.842 (The Arcata and Mad River Railroad/Union Wharf and Plank Walk Company) are present within the APE. The AWTF was determined ineligible for the National Register of Historic Places in 2006. Portions of CHL No.842 within the APE are limited to a historically mapped alignment; the remaining physical elements are located outside of and immediately adjacent to the APE.

This report recommends a Finding of No Impacts to historical, archaeological, or tribal cultural resources, as defined by CEQA, and a Finding of No Effects, as defined by NEPA. It is best practice to avoid cultural resources whenever possible. Additional survey will be required if the project changes to include areas not previously surveyed.

# CONTENTS


STATEMENT OF CONFIDENTIALITY ..... ii

LIMITATIONS STATEMENT ..... ii

1.0 Introduction ..... 1

1.1 Project Description ..... 1

1.2 Project Location ..... 1

1.3 Delineation of the APE & ESL ..... 1

2.0 Regulatory Setting ..... 4

2.1 State ..... 4

2.1.1 California Environmental Quality Act (CEQA) ..... 5

2.1.2 Clean Water State Revolving Fund (CWSRF) Program ..... 5

2.1.3 Assembly Bill 52 (AB 52) Native American Consultation & CEQA ..... 6

2.2 Humboldt County ..... 6

2.2.1 Goals ..... 6

2.2.2 Policies ..... 6

2.3 City of Arcata Historical Preservation ..... 7

3.0 Setting ..... 8

3.1 Natural setting ..... 8

3.2 Cultural Setting ..... 8

3.3 Ethnographic Background ..... 10

3.4 Historical Background ..... 11

4.0 Methods ..... 13

4.1 NWIC Archival Record Search Results ..... 13

4.1.1 Previously Recorded Cultural Resources within the APE and ESL ..... 14

4.1.2 Prior Cultural Resource Studies within the APE and ESL ..... 14

4.2 Native American Coordination ..... 17

4.3 Parcel Specific History ..... 18

4.3.1 Initial Land Ownership and Development ..... 18

4.3.2 APE Parcel Specific Topographic Maps and Aerial Photographs ..... 19

4.3.3 The Arcata Marsh - Environmental Innovation ..... 21

4.4 Geoarchaeological Research ..... 21

4.4.1 Hydrology of the ESL ..... 22

4.5 Cultural Resource Survey Expectations ..... 23

5.0 Report of Findings ..... 23
5.1 Archaeological Survey Results ..... 23
6.0 Resource Discussion ..... 24
6.1 Resource Evaluation Criteria ..... 24
6.1.1 National Register of Historic Places ..... 24
6.1.2 California Register of Historical Resources ..... 24
6.2 Resource Evaluation ..... 25
6.2.1 AWTF Infrastucture ..... 25
6.2.2 Arcata and Mad River Railroad/union Wharf and Plank Walk Company – California Historic Landmark No. 842 (CHL 842) ..... 26
7.0 Recommendations and Conclusions ..... 27
7.1 CEQA - Finding of No Impacts ..... 27
7.2 NEPA – Finding of No Effects to Historic Properties ..... 27
7.3 Native American Consultation & Coordination ..... 27
7.4 Management Considerations ..... 28
8.0 References ..... 29

Appendix A – Project Maps
Appendix B – Northwest Information Center Correspondance
Appendix C – Native American Coordination
Appendix D – Historical Documents
Appendix E – Project Location Photos
Appendix F – CONFIDENTIAL Resource Location Map

## FIGURES

Figure 1 Project Vicnity ..... 2
Figure 2 Project Location ..... 3
Figure 3. Borax Wide Stem Type of the Borax Lake Pattern (Figure 13 from Justice 2002: 104). ..... 9
Figure 4. Tuluwat Pattern distribution (Map 53 from Justice 2002: 417). ..... 10
Figure 5. Aerial view of Union (Arcata) and the Union Wharf circa 1947 ..... 13
Figure 6. Northeastern shore of Humboldt Bay circa 1865 (Doolittle 1865) ..... 18
Figure 7. Northeastern shore of Humboldt Bay circa 1922 (Belcher Abstract Title Company). ..... 19

## TABLES

Table 1. Project location descriptions. ..... 4
Table 2. Previously recorded resources within the APE and ESL. ..... 14
Table 3. Previous reports within the ESL. ..... 15
Table 4. State volume patents and serial patents within the project APE and ESL. ..... 19

# TABLE OF ABBREVIATED TERMS

| | |
|---|---|
| AB 52 | Assembly Bill 52 |
| APE | Area of Potential Effects |
| ac | Acres |
| APN | Assessor's Parcel Number |
| ARPA | Archaeological Resources Protection Act |
| AWTF | Arcata Wastewater Treatment Facility |
| Caltrans | California Department of Transportations |
| CCR | California Code of Regulations |
| City | City of Arcata |
| CEQA | California Environmental Quality Act |
| CFR | Code of Federal Regulations |
| CHL | California Historic Landmark |
| CHRIS | California Historic Resources Information System |
| CRHC | California Register of Historical Resources |
| CWSRF | Clean Water State Revolving Fund |
| DZC | DZC Archaeology & Cultural Resource Consulting |
| DHPE | Design and Historical Preservation Element |
| ESL | Environmental Study Limits |
| FEMA | Federal Emergency Management Agency |
| HBWA | Humboldt Bay Wastewater Authority |
| NAHC | Native American Heritage Commission |
| NCA | Neighborhood Conservation Areas |
| NEPA | National Environmental Policy Act |
| NETR | National Environmental Title Research |
| NHPA | National Historic Preservation Act |
| NPDES | National Polluant Discharge Elimination System |
| NRHP | National Register of Historic Places |
| NWIC | Northwest Information System |
| PRC | Public Resource Code |
| NCRWQCB | North Coast Regional Water Quality Control Board |
| SWRCB | State Water Resources Control Board |
| TCP | Traditional Cultural Property |
| USEPA | United States Environmental Protection Agency |
| USGS | United States Geological Survey |

# 1.0 INTRODUCTION

## 1.1 PROJECT DESCRIPTION

The City of Arcata Wastewater Treatment Facilities (AWTF) Improvements Project aims to improve local water management facilities by addressing National Pollutant Discharge Elimination System (NPDES) requirements for wastewater treatment in Arcata, California (City of Arcata 2019). The goals of the project are to address sea level rise and long-term community requirements through improvements to current and future infrastructure at the AWTF. The project will be completed in two phases and will include improvements to oxidation ponds, treatment wetlands, and other infrastructure at their northern Humboldt Bay location (Appendix A, Figures A1-A4).

The city of Arcata retained DZC Archaeology & Cultural Resource Consulting, LLC (DZC) to conduct a cultural resource investigation of the AWTF Improvements Project to support compliance of State and Federal regulations regarding cultural resources, Native American resources, and historic properties. DZC is an environmental consulting firm with over 10 years of experience with projects throughout northern California. DZC conducts cultural resource studies in accordance with the Secretary of the Interior's standards and in compliance with all applicable federal, state, and local codes, acts, regulations, and orders relating to cultural resources, where applicable. This cultural resources inventory report was prepared by Dimitra Zalarvis-Chase, a Registered Professional Archaeologist, who meets the Department of the Interior's Professional Qualifications Standards in Prehistoric and Historic Archaeology, with contributions by Sydney Kerkhove-Peltier, B.A., Jaques Kerkhove-Peltier, M.A., and Kelly Hollreiser, B.A.

## 1.2 PROJECT LOCATION

The 123-acre (ac) project area is situated in Humboldt County, California, along the northern shoreline of Humboldt Bay and south of Humboldt State University (Figure 1). The legal location of the project area is Township 6 North, Range 1 East, Section 32; Township 5 North, Range 1 East, Unsectioned; Humboldt Base Meridian, of the United States Geological Survey (USGS) Arcata South 7.5-Minute Series (1959) Quadrangle (Figure 2).

## 1.3 DELINEATION OF THE APE & ESL

The physical location with the potential for impact to archaeological resources is designated as the Area of Potential Effects (APE). The Environmental Study Limits (ESL) for the project area constitutes an additional 0.5-mi background review radius around the APE.

An APE varies depending on the potential impacts of the project, the type of environmental clearance required, and the Lead Agency. The 123 ac area constitutes the APE for this project. The proposed project must meet National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) standards, as the project requires a permit from the North Coast Regional Water Quality Control Board (NCRWQCB), funded by the Clean Water State Revolving Fund (CWSRF), a federal financing program discussed further in Section 2.1.1 of this report.

Horizontal boundaries for the APE were provided to DZC by the City of Arcata. The APE is composed of four separate study units, including four staging areas (Figure 2, Table 1). Unit 1 (Staging Area 1) measures 388 ft (north-south) by 300 ft (east-west); Unit 2 (Staging Area 2) measures 466 ft (north-south) by 139 ft

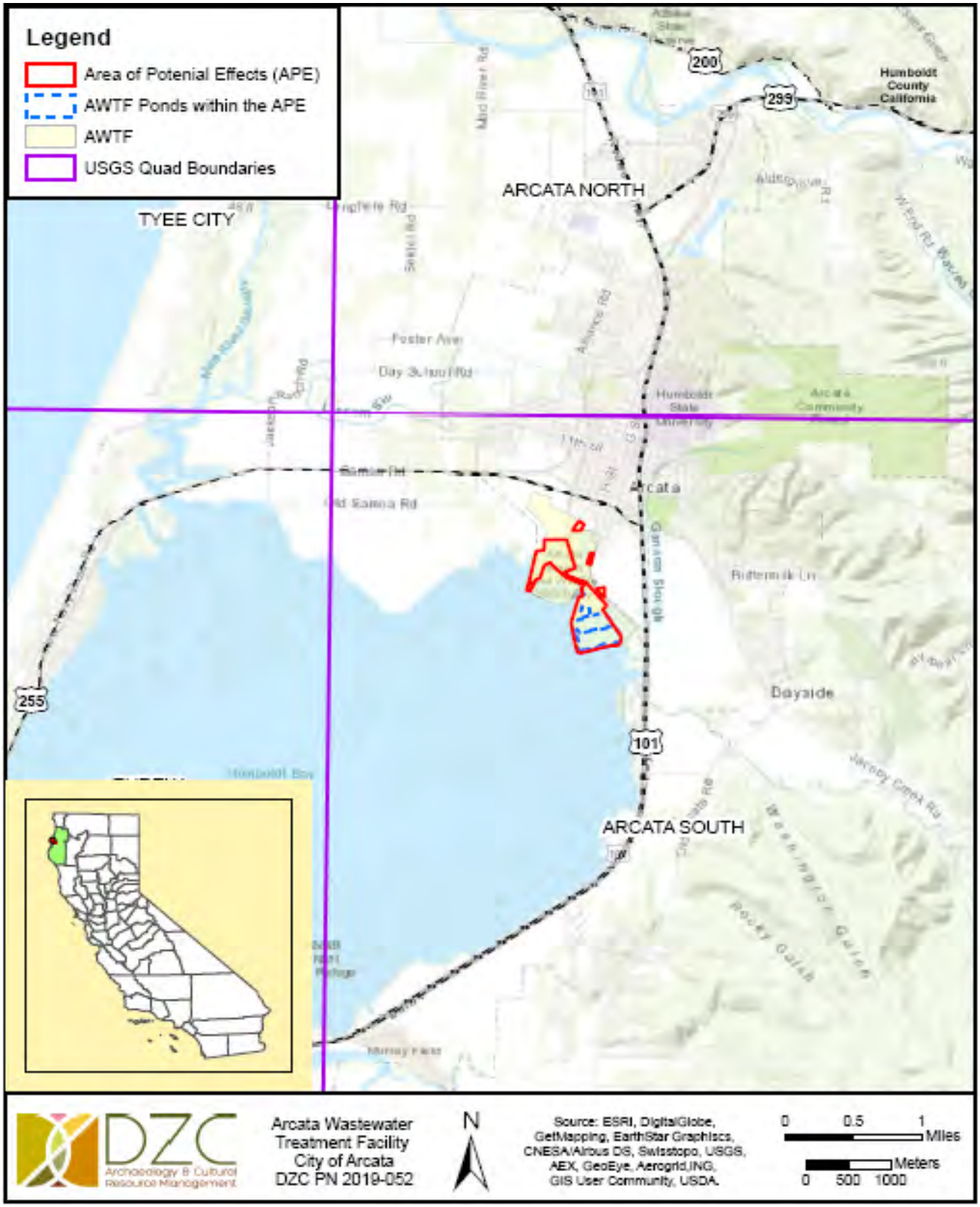



**Figure 1 Project Vicinity**

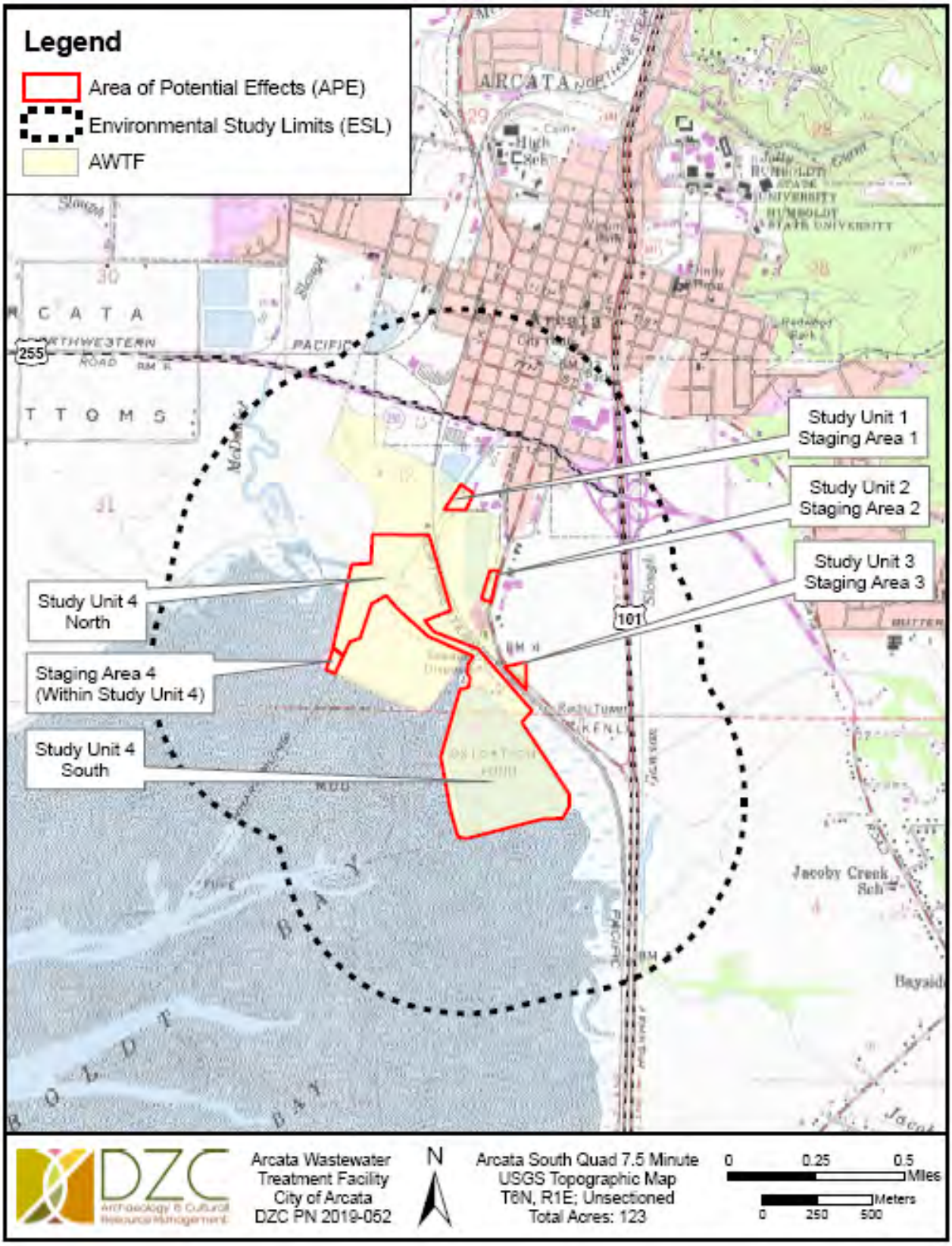



**Figure 2 Project Location**

(east-west); Unit 3 (Staging Area 3) measures 288 ft (north-south) by 302 ft (east west); and Unit 4 (Staging Area 4) measures 257 ft (north-south) by 168 ft (east-west). Staging Area 4 is completely encompassed in the northern section of the largest APE polygon. Unit 5 is the largest area, consisting of northern and southern sections. It also encompasses Staging Area 4. The horizontal boundaries of the northern section of APE Unit 5 measure approximately 2,173 ft (north-south) by 1,495 ft (east-west). The horizontal boundaries of the southern section measure approximately 2,520 ft (north-south) by 1,827-ft (east west).

**Table 1. Project location descriptions.**

| APE Study Unit | Legal Location | AWTF Association | Acreage |
|---|---|---|---|
| **1** | Arcata South Quad T6N, R1E, Section 32 | Staging Area 1 | 2.1 acres |
| **2** | Arcata South Quad T6N, R1E, Section 32 | Staging Area 2 | 1.5 acres |
| **3** | Arcata South Quad T6N, R1E, Section 32 | Staging Area 3 | 1.5 acres |
| **4** | Arcata South Quad T6N, R1E, Section 32 | Staging Area 4 | 1.1 acres |
| **4** | Arcata South Quad T6N, R1E, Section 32; T5N, R1E, Unsectioned | Arcata Marsh; Treatment Ponds; City Yard | 117 acres |

DZC did not have access to the structural engineering designs for the AWTF project, and therefore the vertical APE for this study is based limited information concerning the types and diameters of pipes that are proposed to be installed (Appendix A, Figures A-3 through A-6). The largest of these is 30 inches (in.) in diameter, and therefore the expected vertical excavation depth would be approximately 3-5 ft below the ground surface. The vertical APE is expected to range from -5 ft below to approximately +10 ft above the ground surface.

It is highly desirable to conduct all surveys prior to ground disturbance. However, ground disturbance in the form of grading, facilities and levee construction, and pond, marsh, and wetland excavations all occurred on site prior to the archaeological survey.

# 2.0 Regulatory Setting

## 2.1 State

The following sections discuss the regulatory guidelines for this Cultural Assessment Report.

### 2.1.1 California Environmental Quality Act (CEQA)

The lead agency for this project is the City of Arcata. CEQA requires a lead agency to determine whether a project may have a significant effect on historical resources (Section 21084.1). If it can be demonstrated that a project will cause damage to resources Eligible for or Listed in the California Register of Historical Resources (CRHR), Tribal Cultural Resources (TCRs), and other resources on county or local lists, or those determined by the lead agency to be significant, the lead agency may require reasonable efforts be made to permit any or all of the resources to be preserved in place or left in an undisturbed state. To the extent that they cannot be left undisturbed, mitigation measures are required (Section 21083.2[a], [b], and [c]).

A historical resource is a resource listed, or determined to be eligible for listing, in the CRHR (Section 21084.1); in a local register of historical resources (Section 15064.5[a][2]); or any object, building, structure, site, area, place, record, or manuscript that a lead agency determines to be historically significant (Section 15064.5[a][3]).

Public Resource Code (PRC) Section 5024.1, Section 15064.5 of the CEQA Guidelines, and PRC Sections 21083.2 and 21084.1 were used as the basic guidelines for this cultural resources study. PRC Section 5024.1 requires an evaluation of historical resources to determine their eligibility for listing in the CRHR. The purpose of the register is to maintain listings of the state's historical resources and to indicate which properties are to be protected from substantial adverse change. The criteria for listing resources on the CRHR were expressly developed to be in accordance with previously established criteria developed for listing in the National Register of Historic Places (NRHP), enumerated below.

According to PRC Section 5024.1(c) (1–4), a resource is considered historically significant if it (i) retains "substantial integrity," and (ii) meets at least one of the following criteria:

1. Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;
2. Is associated with the lives of persons important in our past;
3. Embodies the distinctive characteristics of a type, period, region or method of installation, or represents the work of an important creative individual, or possesses high artistic values; or
4. Has yielded, or may be likely to yield, information important in prehistory or history.

Impacts to significant cultural resources that affect the characteristics of any resource that qualify it for the NRHP or adversely alter the significance of a resource listed on or eligible for listing in the CRHR are considered a significant effect on the environment. These impacts could result from "physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of an historical resource would be materially impaired" (CEQA Guidelines, Section 15064.5 [b] [1], 2000). Material impairment is defined as demolition or alteration "in an adverse manner [of] those characteristics of an historical resource that convey its historical significance and that justify its inclusion in, or eligibility for inclusion in, the California Register…" (CEQA Guidelines Section 15064.5[b] [2] [A]).

### 2.1.2 Clean Water State Revolving Fund (CWSRF) Program

The CWSRF program is partially funded by the United States Environmental Protection Agency (USEPA) that provides low- interest financing and is administered by the Division under the California State Water Resources Control Board (SWRCB). The purpose of the CWSRF Program is to implement the Clean Water

Act and various state laws by providing low-interest financing for construction and improvement of wastewater treatment facilities.

Due to the federal nexus with USEPA, federal laws and regulations (e.g. federal cross-cutters) apply to all projects pursuing CWSRF financing. Under the CWSRF program, the Division under the State Water Board uses the CEQA document plus the federal cross-cutting documentation in place of a National Environmental Policy Act (NEPA) documents, which is defined "CEQA_Plus" documentation. The State Water Board does not complete a NEPA review process, but rather completes the "NEPA-like" process of CEQA-Plus.

#### 2.1.3 Assembly Bill 52 (AB 52) Native American Consultation & CEQA

In 2016, CEQA established a consultation process with all California Native American Tribes, including both federally and non-federally recognized tribes that are historically connected and culturally affiliated with the project location. This bill has established the TCR classification and requires consideration of Tribal Cultural Values in determination of project impacts and mitigation, requires tribal notice of the project, and requires meaningful consultation.

In accordance with PRC Section 21080.3.2(b), consultation ends when either both parties agree to mitigation measures, other agreements to avoid a significant effect on TCR's, or, when a party, acting in good faith and after reasonable effort concludes that mutual agreement cannot be reached.

### 2.2 Humboldt County

Approved by the County in May of 2012, Section 10.6 of the General Plan, Cultural Resources of the Humboldt County Conservation and Open Space Element Chapter, provides general guidance for the protection of cultural and paleontological resources within the County. Section 10.6.3 outlines the goals and policies of the County:

#### 2.2.1 Goals

CU-G1: Protection and Enhancement of Cultural Resources. Protected and enhanced significant cultural resources, providing heritage, historic, scientific, educational, social and economic values to benefit to present and future generations.

#### 2.2.2 Policies

CU-P1: Identification and Protection. The potential for significant impacts to cultural resources shall be identified during ministerial and discretionary permit review, assessed as to significance, and if found to be significant, protected from substantial adverse change.

CU-P2: Consultation. Native American Tribes (as defined), historical organizations, other interested parties, and applicable agencies shall be consulted during discretionary project review for the identification, and protection and mitigation of adverse impacts to cultural resources. Consultation on ministerial permits shall be initiated if it has been determined the project may create a substantial adverse change in the significance of a cultural resource. At their request, Tribes shall be afforded the opportunity to review and provide comments to the County early in project review and planning (screening) about known or potential significant Native American cultural resources located in project areas within their respective tribal geographical area of concern.

CU-P3: Avoid Loss or Degradation. Projects located in areas known to have historic or prehistoric ruins, burial grounds, or archeological sites shall be conditioned and designed to avoid loss or substantial degradation of these resources, including standard provisions for post-review inadvertent discoveries of archaeological or Native American remains.

CU-P4: Findings Necessary for Loss or Destruction. Cultural resources shall not be knowingly destroyed or lost through a ministerial or discretionary action unless:

1. The site or resource has been found not to be of significant value after consultation by representatives of the cultural resources community and relevant experts; or
2. There is an overriding public benefit from the project, and compensating mitigation to offset the loss is made part of the project.

CU-P5: Mitigation. Mitigation measures shall be required for any permitted project or County action that would adversely impact significant cultural resources

The General Plan also includes recommendations for implementation of these goals and policies:

- Adopt procedures for review and approval of all City-permitted projects involving ground disturbance and all building and/or demolition permits that will affect buildings, structures, or objects "identified as historically significant" (City of Eureka 1997b:5-8).
- Adopt preservation incentive programs, including the Mills Act, Historic Preservation Easement program, and Certified Local Government Program.
- "Preparation, adoption, and implementation of a cultural resources ordinance that provides definitions and standards for identification and protection of cultural resources and provides penalties for their disturbance" (City of Eureka 1997b:5-8).
- Preparation and updating of a citywide cultural resource database.

The General Plan also designates Neighborhood Conservation Areas (NCAs) within the city of Arcata as areas that are historically noteworthy where review is conducted to assure that new construction, modifications or alterations are harmonious with the existing character of the neighborhood.

## 2.3 City of Arcata Historical Preservation

The City of Arcata General Plan includes a Historical Preservation element. As the AWTF project requires a permit from the City, it is subject to compliance with this element.

The following is excerpted from the Design and Historical Preservation Element (DHPE) (City of Arcata 2010):

> "An inventory of Arcata's historical structures and sites in 1979 [Susie Van Kirk: Reflections of Arcata's History: eighty years of architecture, 1979] identified four early periods of residential building styles: settlement (1850-1885) Victorian (1885-1900), Transitional (1900-1910) and Craftsman (1910-1930), in addition to the modern period (1930-present).
>
> The City's first historic preservation ordinance [Ordinance No. 935] was adopted by the City Council in 1980. Since that time, 85 structures or sites have been formally designated by ordinance as local historic landmarks. The City retains a map of Historic Landmarks, Neighborhood Conservation Areas, and Specific

Plan Districts. [Throughout this element the name of the Historic Landmarks Commission has been changed to Historic and Design Review Commission, per Ordinance No. 1377, September 2008.]"

The Guiding Principles and Goals of the DHPE are the following:

A. Promote preservation of structures and sites that are representative of the various periods of the city's social and physical development.
B. Preserve the historical character of the Plaza and the surrounding commercial district.
C. Encourage owners of eligible structures to seek historic landmark status and to invest in restoration efforts.
D. Conserve the many examples of early residential building styles found in the city's older neighborhoods, from Bayside to Arcata Heights.
E. Assure that new construction and additions to existing historically-designated buildings maintain the character and livability of the historic neighborhoods.
F. Promote interest in and appreciation of the value of Arcata's history and its heritage of historic buildings.
G. Encourage tourism and economic development through historic resource preservation.
H. Prevent destruction of archaeological and cultural resources and assure that any artifacts receive proper disposition.

# 3.0 SETTING

The following sections provide the environmental and cultural context of the APE and ESL.

## 3.1 NATURAL SETTING

The APE is located in the Coast Range geomorphic province in northwestern California (Wagner 2002). A review of the bedrock and surficial geology of the APE and the ESL on the Redding Sheet of the Geologic Atlas of California (Strand 1962) reflects the APE & ESL as underlain entirely by Recent Alluvium deposit, which is composed of alluvium, old alluvium, and young stream terrace deposits (ibid.).

The climate of the Humboldt Bay region is classified as Mediterranean in the Köppen Climate System (Köppen 1936), with average annual rainfall and temperatures of 68 in. and 44-85 degrees Fahrenheit, respectively (WRCC 2016).

As defined by Mayer & Laudenslayer (1988), the habitat setting is Wet Meadow (WTM), Fresh Emergent Wetlands (FEW), and Saline Emergent Wetlands (SEW), hosting a diverse array of wetland plants and animals.

## 3.2 CULTURAL SETTING

Early studies of prehistoric chronological sequences on the California north coast include efforts by Loud (1918), Bickel (1979), Hayes et al. (1980), and Moratto (1984). A review of these studies by Hayes et al. (1985) cites difficulties in compiling an in-depth sequence for the coastal stretch of Mendocino County due in part to the paucity of comparative information available for the area. However, as a larger marine and intermountain region, a unified chronology is in use that spans southern coast of Oregon down to Cape Mendocino, and from the ocean east into the Klamath-Trinity Mountains.

Literature regarding prehistoric north coast settlement patterns is primarily focused on the entry of diverse groups (Fredrickson 1984). Although Whistler (1979) proposes a sequence based on language, the overall culture between diverse groups in the area is remarkably similar. There is some disagreement among archaeologists over the mode and tempo of cultural evolution on the coast. Some archaeologists are inclined to see all aspects of ethnographic culture as developing together at the same time, while others see cultural evolution on the coast as a mosaic, in which different aspects of the ethnographic pattern developed at different times and at different rates (Ames 1994). Numerous predictive models have emerged in anthropological literature over the years to analyze the validity of both arguments. Current anthropological literature strongly characterizes Northwestern Pacific California settlement patterns to be mosaic in nature.

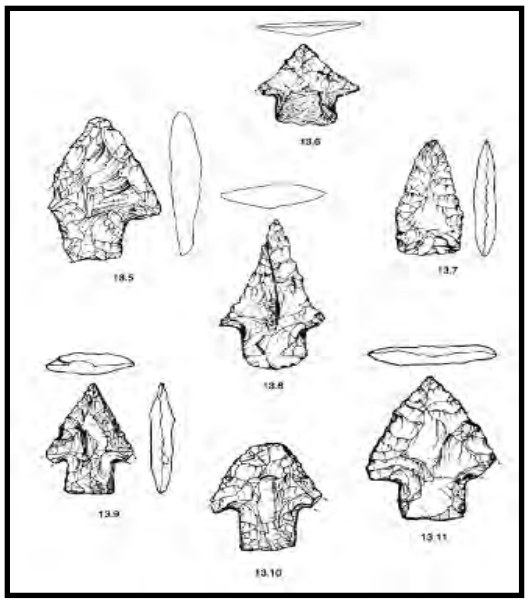


**Figure 3. Borax Wide Stem Type of the Borax Lake Pattern (Figure 13 from Justice 2002: 104).**

The major patterns noted for the region are Borax Lake (10,000 Years Before Present [BP] – 2,800 BP), Mendocino Pattern (2,800 PB – 1,100 BP), and Tuluwat (Gunther) Pattern (1,100 BP – ca. 150 BP).

Following a post-glacial warming trend, Whistler (1979) posits that the earliest migrations of human habitants to the area focused on inland riverine exploits. The earliest pattern, identified as the Borax Lake Pattern, is characterized as highly mobile family groups who utilized hunting and gathering strategies centered on migration and seasonal resources such as elk, acorns, and edible seeds (Eidsness 1988; Hayes et al. 1985). The Borax Lake Site (CA-LAK-36) is the first published archaeological work to identify the Borax Lake Pattern. It was conducted by M. R. Harrington, who claimed that the artifacts of the site were similar in age to the Clovis points found across North America, due to the fluted characteristics of the Borax Lake projectile points. This location is one of the earliest habitation sites in California; possibly as old as 12,000 BP. However, a re-examination of the site conducted by Meighan and Haynes (1968) concluded that the likely earliest dates lie between 10,000 and 8,000 BP (White 1999:9; Greenway 1988:59).

Regionally, the Borax Lake Pattern has been uncovered in the mountains of Humboldt and Mendocino Counties, Santa Rosa Plain, and most prominently in the Clear Lake Basin where assemblages are reflected by flaked stone only (i.e. wide-stemmed points [Figure 1], ovoid flake tools, and bladelet flakes) (Jones & Klar 2007:89). Artifact assemblages comprised hand-stones, milling slabs, and large wide-stemmed spear points made of locally sourced chert or obsidian. In Humboldt and Mendocino areas, obsidian is relatively rare in records from this period. Additional evidence indicates extensive use of high-elevation sites and mountain ridge systems for mobility (Wylie 1976).

Studies from Middle Period sites indicate an adaptation from mobile resource procurement to low elevation semi-permanent villages focused on salmon-bearing streams and acorn exploitation, referred to as the Mendocino Pattern. Storage practices indicate increased sedentism and a shift to bringing

resources back to a central location. This may have been influenced by a climatic shift, cooling the interior of California and resulting in declining food sources at higher elevations (Eidsness 1988; Hildebrandt & Hayes 1983, 1984). Artifact tool assemblages show enhanced diversity comprising spear and atlatl tips, increased use of slab mortars and pestles over hand-stones and milling slabs, and a diminutive refinement of point types (Eidsness 1988). Whistler (1979) suggests this is the period in which the Wiyot settled the coastal strip, indicating the Yurok arrival was nearly 200 years later.




**Figure 4. Tuluwat Pattern distribution (Map 53 from Justice 2002: 417).**

The Tuluwat (formerly known as Gunther) Pattern is set firmly in marine and estuarine practices, reflecting a similarity with greater northwest influences (Eidsness 1988). The pattern is distributed throughout the whole of Northern California and some locations in Southern Oregon (Figure 2). Artifact assemblages are characterized by enhanced woodworking skills (habitations, dugout canoes), steatite bowls and pipes, harpoon points of bone and antler, and the small, distinctive Tuluwat barbs (Eidsness 1988). Exchange networks and measures of religion and wealth are evidenced by dentalium money and large ceremonial obsidian blades, sourced from material nearly 400 kilometers distant (Eidsness 1988; Loud 1918; Hughes 1978). Baskets are a high art form, integrated for all manners of resource procurement, storage, and everyday use. Whistler (1979) credits the firm settlement of the Yurok and Wiyot with the emergence of the Tuluwat pattern and the ability to fully exploit the marine and riverine resources. Excavations show an increased complexity and options in funerary practices including pre-internment grave burning, cremation, and the destruction of personal property (Heizer and Elsasser 1964; Fenega 1968).

## 3.3 Ethnographic Background

Pre-European contact ethnographic information is presented for the Wiyot, the cultural group identified for the project location.

The Wiyot resided in and around the area encompassing the lower Mad and lower Eel rivers, and the estuaries of Humboldt Bay. According to Kroeber (1976: 112), the designation as “Wiyot" actually refers to the lower Eel river area, with proper names for the Humboldt Bay and lower Mad River districts noted as Wiki and Batawat, respectively. Kroeber defines the Wiyot territory as:

> “…just south of Little River, at whose mouth stood the Yurok town of Metsko. On Mad River, near Blue Lake, near the forks, was still Wiyot. The north fork was without villages and is in doubt. The Wiyot owned at least half the lower portion…and the whole of the drainage has been assigned to them. From Mad River south to Eel River Wiyot territory extended to the first range inland. Jacoby, Freshwater, and Salmon Creeks, Elk River and Boynton Prairie were thus Wiyot…On Eel River the boundary came at Eagle Prairie near Rio Dell. Southwest of Eel River, the Bear River Mountains separated the Wiyot from another Athabascan division,

the Mattole. The spurs of this range reach the sea at Cape Fortunas, between Guthrie and oils Creek (1976; 113)".

The traditional territory encompasses approximately 525 square miles (mi), and comprises ocean dunes, riverine and estuarine lands, foot hills, open prairies, and wooded mountains. Loud (1918) estimated the pre-contact aboriginal population to be between 800-1,000 Wiyot between the three districts. Geographically, the location is restrictive and considered culturally insular.

The Wiyot language is a member of the Ritwan group, and linguistically related to the Algonquin language of the Algic family (Golla 2007), which has roots in central and eastern North America (Gruhne 1988). For a complete discussion of structural composition and comparison see Haas (1967), Sapir (1913), and Voegelin (1942); for taxonomy see Haas (1967), Teter (1964), and Michelson (1914); for sociolinguistics see Durbin (1967), Gruhn (1988), and Kinkade & Powell (1976); for dialects and language family see and Frachtenberg (1918), and Dixon & Kroeber (1913). The Wiyot language is currently undergoing a renewal with new research, documentation, and digital interactive language tools.

According to Loud (1918), there were no formal chiefdoms, but instead families of distinction, as designated by their wealth and standing in their districts. For further discussion on geography and migration in relationship to social structure and development see Rogers et al (1990), Milke et al (1949), and Kroeber (1909). For further discussion on cultural development, kinship structures, and burial practices, see Fenega (1968) and Loud (1918).

Like their neighbors, as different resources became available throughout the year, the Wiyot broke into small family bands and traveled to various locations within their territory to fish, hunt, and gather edible and medicinal plants. Subsistence patterns tended to follow both seasonal and socially conscripted routines (Loud 1918). These seasonal rounds took them to outlying areas where they established seasonal base camps and a series of radiating temporary camps and task-related activity stations.

The Wiyot today are represented by one band in each traditional Wiyot District including the Blue Lake Rancheria, Batawat District; the Wiyot Tribe of Table Bluff, Wiki District; and the Bear River Band of the Rohnerville Rancheria. Tribal members still use this area, continue to harvest plant resources, especially for basket resources, and are manifesting a cultural resurgence within their cultural territory (Seidner 1999).

## 3.4 HISTORICAL BACKGROUND

The project area is located along the northern shore of Humboldt Bay and south of the city of Arcata. Humboldt County is closely tied to important themes in California history including early settlement, westward expansion, the Gold Rush, development of the timber industry, and early environmental activism in the City of Arcata.

### 3.4.1 The Arcata Wharf

The following information regarding Arcata's Union Wharf was extracted from Susie Van Kirk's Arcata Marsh History (2015) unless cited otherwise. Van Kirk's (2015: 5) accounting of the recognized need for construction of a commercial wharf is as follows:

> *Union Wharf. The slough did yeoman service, but some Union men saw the limitations of slough freighting and proposed a facility to serve an ocean trade. The town was growing, its merchants*

*busily filing orders for the mines in response to a demand that exceeded any previous time (Humboldt Times 16 Sept. 1854). And another industry was showing its muscle. Within four years of settlement, twenty miles of logging "railroads" were operating around Humboldt Bay where two hundred men were engaged in the woods (Humboldt Times 9 Sept. 1854). It was clear that a shipping facility for goods coming in and lumber going out would stimulate both trades, benefit the town's economy and reward its developers.*

*On November 21, 1854, mill owners Thomas Titlow and Dunbar Averill entered into an agreement with Stillman Daby, Byron Deming and Henry W. Walker, whereby Daby and partners would, within ten months, construct a wharf "from the town of Union to ship channel on Humboldt Bay." Titlow and Averill would advance them $1,500 and provide the construction lumber, consisting of three-inch planks 16 feet long and four-by-four inch scantling. The amount of lumber needed was estimated at 250,000 feet (Recorder's Office, Miscellany A: 29; amended A:31).*

*The wharf company received a Certificate of Incorporation on December 15, 1854. The Union Plank Walk Rail Track and Wharf Company declared its intention to build a walk, track and wharf from the "southwest corner of the public square in the town of Union…and running in a southwesterly direction and in a straight line across the marsh and the flats in Humboldt Bay to the ship channel…for the purpose of transporting freight and passengers over the same and for such other purposes." Incorporated for twenty years, the company had a capital stock of $15,000 divided into 60 shares and there were five directors, including Daby, president and Deming, secretary with Walker, Walter Van Dyke and J.E. Wyman as the remaining directors (Misc. A:23). Before the end of December 1854, the wharf company leased a 30 x 50 foot lot at the northeast corner of Block 153 (present site of the Arcata Post Office) from M.M. Steinthal for the construction of a warehouse, along with a right-of-way over the south half of the block (Misc. A:25).*

*The east and south halves of this block (bounded by 7th, 8th, H and I streets) served as the warehouse and depot location, first for the wharf company, later for the Arcata and Mad River Railroad, and still later as the regional bus depot. Running the track in a "straight line" from the Plaza to the wharf was no exaggeration; the wharf company was definitely committed to the "shortest-distance-between-two-points" principle. From the back of the warehouse block, the track proceeded directly to a ship channel at a 45 degree angle.*

*Crossing the block between 6th and 5th and H and I streets, the line created a pie-shaped parcel that remains today (the Marsh House). An 1887 deed describes the property as bounded on the east by the "roadbed of the Arcata and Mad River Railroad" (Recorder's Office, Deeds 23:448). Never veering an iota, the line headed directly across the marsh and mud flats to its deep-water destination. A 1947 aerial photograph provides one of the best views of that "straight-as-an-arrow" railroad.*



**Figure 5. Aerial view of Union (Arcata) and the Union Wharf circa 1947 (photo by Mel Schuster 1947, reproduced in Van Kirk 2015).**

For further details see Susie Van Kirk's 2005 paper "Arcata Marsh History: Union Wharf, Mad River Canal, Reclamation, Lumber Mills, City Designs."

# 4.0 METHODS

To obtain historical background information, archival research included an examination of multiple sources concerning known archaeological sites, historic properties, and historical activities within and/or adjacent to the APE. Repositories and agencies consulted include the following:

- The California Historical Resources Information System (CHRIS) at Sonoma State University
- The Native American Heritage Commission (NAHC)

## 4.1 NWIC ARCHIVAL RECORD SEARCH RESULTS

A record search request was sent to the CHRIS at Sonoma State University on July 18, 2019. The search included a 0.5-mi radius around the APE for previously recorded archaeological sites and previous surveys (Appendix B).

The following resources were consulted at the Northwest Information Center (NWIC):

- National Register of Historic Places – Listed and Determined eligible Properties (2012)
- California Register of Historical Resources (2012)
- California Points of Historical Interest (2012)
- California Historical Landmarks (2012)

- Directory of Properties in the Historic Property Data Files for Humboldt County (2012)
- Caltrans Local and State Historic Bridge Inventory
- Handbook of North American Indians, Vol. 8, California (1970)
- The Handbook of California Indians (1975)
- City of Arcata Historical Landmarks (South of Samoa Blvd and west of Hwy 101 only)

### 4.1.1 Previously Recorded Cultural Resources within the APE and ESL

The record and literature search revealed no previously recorded cultural resources within the APE, but one resource (site Loud 42) was previously recorded within the ESL (Table 2).

**Table 2. Previously recorded resources within the APE and ESL.**

| Resource Identifier | Resource Description; Date Recorded and by Whom | Source | NRHP/CRHR Status | APE or ESL Location |
|---|---|---|---|---|
| P-12-000100; CA-HUM-00042; Loud 42 | Village site; not occupied in 1850 nor named; Site is believed to be obliterated due to construction of South G Street and Hwy 101 (Loud 1918) | NWIC/ CHRIS | 7 Unevaluated | ESL |
| HUM 101 | Gannon Slough Bridge 4-024L (Caltrans 1986) | SHPO | Ineligible | ESL |
| None | A segment of the Northwest Pacific Railroad (T. Keefe 2006) | Keefe 2006 | 6Z – Determined Not Eligible through field survey | ESL |
| California Historic Landmark #842 | Arcata and Mad River Railroad; Union Wharf and Plank Walk Company (Unknown) | Belcher 1922; Rich 2012 | CHL Listed Resource No. 842 | APE |
| None | H.N. Ry Railroad | Belcher 1922 | Unknown | ESl |
| CA-HUM-001156 | Arcata Bay Levy | HSU-CRF | Unknown | ESL |

Resource P-12-000100 was recorded as a result of Loud's ethnographic survey of the Wiyot. Other than location data, very few details are available from the original site recording.

### 4.1.2 Prior Cultural Resource Studies within the APE and ESL

The record and literature search revealed 10 previous cultural resource studies having been conducted within the APE, and 6 previous studies conducted outside the APE but within the ESL (Table 3).

**Table 3. Previous reports within the ESL.**

| Report Number | Report Title | Date Reported & By Whom | Within APE or ESL |
|---|---|---|---|
| **S-000132** | An Archaeological Survey of the Proposed McKinleyville Sewage Collection and Treatment Facility | David A Fredrickson, Sonia Tamez, and Pamela R. Roberts, 1975 | APE |
| **S-006403** | Archaeological Survey Report for a proposed sewage collection system for Bayside in Arcata, California | Barry Kevin Douglas, 1984 | ESL |
| **S-006669** | Archaeological Survey Report, Butcher's Slough Wetlands Restoration Project, Arcata, California | Barry K. Douglas, 1984 | APE |
| **S-014210** | An Archaeological Investigation of Assessor's Parcel Number 21-184-05, Located in Arcata, Humboldt County, California | James M. Roscoe, 1992 | APE |
| **S-015199** | A Cultural Resources Study of the Proposed Marsh Commons Project, Located in Arcata, California | James Roscoe, 1993 | APE |
| **S-017469** | Historical and Technological Significance of the Humboldt Bay Jetties, Humboldt Bay, California | Carroll W. Pursell, Jr., 1981 | APE |
| **S-022314** | Archaeological Survey for City of Arcata, Janes Creek culvert and Drainage Improvements, FEMA HMGP #1008-6283 (letter report) | David Fukutomi, 1999 | APE |
| **S-029030** | Archaeological Assessment of a 1.5-Acre Parcel (APN 367-180-010), Located at 915 Deer Creek Drive, Martinez, Contra Costa County, California (letter report) | Leigh Martin, 2004 | ESL |
| **S-037718** | A Cultural Resources Investigation of the Proposed McDaniel Slough Marsh Enhancement Project, Located near Arcata, Humboldt County, California | William Rich, James Roscoe, and Susan Van Kirk, 2003 | APE |
| **S-038304** | Historic Property Survey Report for the Proposed Eureka-Arcata Corridor Projects on California State Highway 101 at Post Mile 79.9/86.3 in Humboldt County, California | Timothy Keefe, 2006 | ESL |

| Report Number | Report Title | Date Reported & By Whom | Within APE or ESL |
|---|---|---|---|
| **S-038434** | Archaeological Inventory and Evaluation for the Wal-Mart Mitigation at the Old Lynch Canyon Homestead Project, Solano County, California | Charlane Gross and Jason Coleman, 2011 | APE |
| **S-040249** | Cultural Resources Survey Report for the South G Street (Christie) WRP Project, Humboldt County, California | Jason A. Coleman | ESL |
| **S-041725** | A Cultural Resources Investigation of the Daylighting of Jolly Giant Creek Project, located in Humboldt County, California | Nick Angeloff and James Roscoe, 2004 | ESL |
| **S-041786** | Historic Property Survey, Archaeological Survey, and Historical Resources Evaluation Reports, Highway 255 Gateway Improvements, CALTRANS District 1, Humboldt County, CA | Leslie S. Heald, 2002 | ESL |
| **S-048287** | A Cultural Resources Investigation of three Coastal Access Points for the Humboldt Bay Water Trails Implementation Program, Located in Humboldt County, California | James Roscoe and William Rich, 2012 | APE |
| **S-050908** | A Cultural Resources Investigation of the Arcata Wastewater Inflow and Infiltration Project, Arcata, Humboldt County, California | Nick Angeloff and Lynette Mullen, 2016 | APE |

The 1975 cultural resources study by Sonoma State's David Fredrickson, Sonia Tamez, and Pamela R. Roberts (Report number S-000132; Fredrickson et al., 1975) included work in the project APE. This study encompassed 3,660 acres and 25.5 linear miles and identified four cultural resources. However, none of these resources were identified within the ESL of this project.

Barry Kevin Douglas conducted two cultural resources studies in 1984, one within the APE (S-006669) and one within the ESL (S-006403). Report S-006403 describes a survey completed for installation of a sewage collection system for Bayside Arcata (Douglas 1984A), while report S-006669 details a 30 ac wetlands restoration project within the APE. One cultural resource was identified as a result of this investigation, site Loud 42 (P-12-000100), which is located within the project APE (Douglas 1984B).

James M. Roscoe and associates conducted five cultural investigations in the area during the 1990s and early 2000s. Report S-014210 details a cultural resources study that was completed for a 0.3 ac accessor's parcel, on which no cultural resources were identified (Roscoe 1992). Report S-015199 details a cultural resources study that was completed for a Marsh Commons project consisting of 1.5 ac, in which no cultural resources were identified as a result for this investigation (Roscoe 1993). Roscoe along with

William Rich and Susie Van Kirk conducted a cultural resources study for the proposed Slough Marsh Enhancement project in Arcata, in which three cultural resources were identified. Loud 42 (P-12-000100) was noted within the project APE (Roscoe et al 2003). Report S-041725 details a cultural resources study that was completed by Humboldt State University, in which no cultural resources were identified (Angeloff and Roscoe 2004). Report S-048287 details a cultural resources study that was completed for implementation of Humboldt Bay Water trails. No cultural resources were identified as a result of this investigation (Roscoe and Rich 2012).

Report S-017460 details a cultural resources study that was completed for determination of historical significance of the Humboldt Bay Jetties, in which no cultural resources were identified (Pursell 1981). Report S-022314 details a cultural resources study that was completed for drainage and Culvert Improvements for FEMA work in Arcata. No cultural resources were identified as a result of this investigation, neither of which are within the project's ESL (Fukutomi 1999). Report S-029030 details a cultural resources study that was completed for 1.0 ac accessor's parcel, in which no cultural resources were identified (Martin 2004). Report S-050908 details a cultural resources study that was completed for the Arcata Wastewater Inflow and Infiltration project, in which twenty-nine cultural resources were identified. Loud 42 (P-12-000100) is the only cultural resource identified within the APE (Angeloff and Mullen 2016).

Report S-038434 describes the cultural resources study completed for an inventory and evaluation of the Old Lynch Canyon Homestead. A single cultural resource was identified, which is located outside the project's ESL (Gross and Coleman, 2011). Coleman also conducted a cultural resources study for the South G Street WRP project, in which no cultural resources were identified (Coleman 2013).

Caltrans completed two cultural resources studies in the area during the early 2000s. Report S-038304 (Keefe 006) details a cultural resources study that was completed along 4.5 linear miles for the proposed Eureka-Arcata corridor along California State Highway 101. Eleven cultural resources were identified as a result of this investigation, but all are located outside of this project's ESL. However, this report also determined that the Arcata Wastewater Treatment plant was found Ineligible for inclusion in the National Register at that time. Report S-041786 (Heald 2002) describes the cultural resources study completed for Highway 255 Gateway improvements. Seventeen cultural resources were identified as a result of this investigation, but none within this project's ESL (Heald 2002).

## 4.2 Native American Coordination

In accordance with PRC § 5097.91-5097-94, the Native American Heritage Commission (NAHC) maintains a catalog pertaining to places of special religious or social significance to Native Americans. In order to identify if places of religious or social significance exist within the APE, DZC contacted the NAHC on August 30, 2019 to request a review of their Sacred Lands Files.

The NAHC responded by email on September 19, 2019, stating that the Sacred Lands File search was negative and provided a list of individuals to be contacted regarding the project.

PRC § 21080.3.1, subd. (b), declares that California Native American Tribes traditionally and culturally affiliated with a geographic area may have expertise concerning their tribal cultural resources. As such, DZC contacted persons on the designated contact list maintained by the NAHC, providing each with a

project description, location map, a request to respond to DZC with any relevant information, and a request to respond to the lead agency within 30 days, should the tribe wish to engage in formal government-to-government Consultation. Email or hard-copy notifications were sent to all parties on the NAHC list on October 10, 2019.

Janet Eidsness, THPO of Blue Lake Rancheria responded on October 11, 2019. THPO Eisdness acknowledged the proximity of P-12-000042 (CA-HUM-00042/Loud 42) within the ESL, concurred that the resource is outside of the APE, and offered that Blue Lake Rancheria had no knowledge of any additional sites in the APE.

As of October 31, 2019, no response was received from (1) Bear River Band of the Rohnerville Rancheria: Barry Brenard, Chairperson; Celeste Ruiz, Executive Secretary; and Erika Cooper, THPO; (2) Cher-Ae-Heights Indian Community of the Trinidad Rancheria: Claudia Brundin and Garth Sundberg, Sr., Chairpersons; and (3) Wiyot Tribe: Ted Hernandez, Chairperson.

Formal government-to-government Consultation, as defined by PRC § 21080.3.1 (a), is the purview of the lead agency, the City of Arcata. Records pertaining to formal consultation are on file with the City of Arcata. All correspondence regarding Native American coordination conducted by DZC is included in Appendix C.

## 4.3 Parcel Specific History

The following sections detail initial land ownership and development of the APE utilizing public records and historical maps, followed by an analysis of topographic maps, aerial photographs, and satellite imagery.

### 4.3.1 Initial Land Ownership and Development

The historic map review included analysis of the A. J. Doolittle Map (1865), the Stanley Forbes Company map (1886), the J.N. Lentell map (1914), and the Belcher Abstract & Title Company map (1922).

The A. J. Doolittle (1865) indicates that the APE and surrounding area had been moderately surveyed by 1865. The depiction of Northern Bay has several noted landmarks surrounding the APE, but not within the APE. The majority of the project area was historically a marsh. Along the immediate western boundary of the APE, a railroad extends into Humboldt Bay. Although it is unclear on Doolittle's map if it overlaps the APE, the landowner along the




**Figure 6. Northeastern shore of Humboldt Bay circa 1865 (Doolittle 1865).**

marsh boundary is “Phillips” (Doolittle 1865).

The Hickey and Standish (1895) map does not indicate a landowner for the APE in 1895. The J.N. Lentell (1914) map does not indicate a landowner for the APE in 1914. However, two railroad lines are depicted as extending through the APE and ESL including a segment of the Arcata and Mad River Railroad (Union Wharf and Plank Walk Company, California Historic Landmark No.842) and a segment of the Northwestern Pacific Railroad.

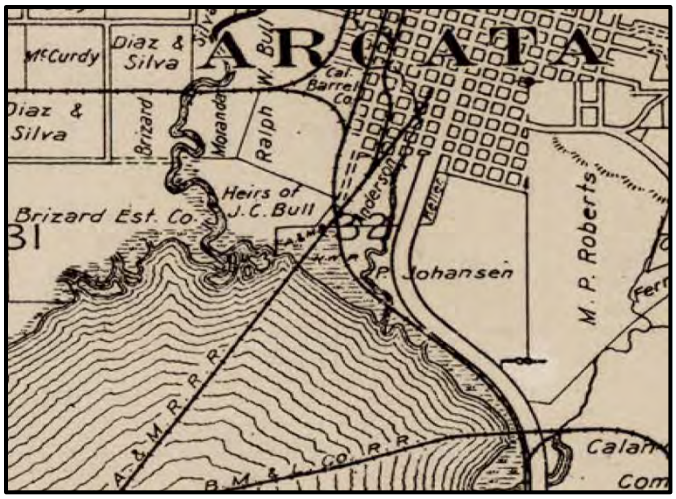



**Figure 7. Northeastern shore of Humboldt Bay circa 1922 (Belcher Abstract Title Company).**

The Belcher Abstract & Title Company map (1922) depicts several landowners along the northern shore of Humboldt Bay associated with the APE. The Annie and Mary Railroad owned property directly on the shore of Humboldt Bay and owned the railroad line that extended northeast-southwest into the Bay (Union Wharf and Plank Walk Company, California Historic Landmark No.842). A segment of the Northwestern Pacific Railroad is also depicted within the APE and ESL. Neighboring landowners in or near the APE included Heirs of J.C. Bull, Ralph W. Bull, and P. Johansen.

See Appendix D for the approximate location of the APE on these historical maps.

A state volume patent and a serial patent were issued for the APE the 19th and 20th century. Below is a table detailing state volume patents and serial patents within the project’s APE and ESL (Table 4). Historical documents regarding the development of the APE and ESL are included in Appendix D.

**Table 4. State volume patents and serial patents within the project APE and ESL.**

| Name | Date | Quadrant | Township/Range/Section | GLO Source | Project Segment overlap |
|---|---|---|---|---|---|
| State of California | January 12, 1903 | Arcata South | T6N/R1E/ Section 32 | Serial Patent; GLO 1903 | Study Unit 1, 2, 3, 4, and 5 |
| Marc Teremater | November 11, 1867 | Arcata South | T6N/R1E/ Section 32 | State Volume Patent; GLO 1867 | Study Unit 1 |

### 4.3.2 APE Parcel Specific Topographic Maps and Aerial Photographs

Utilizing the National Environmental Title Research (NETR) website, DZC reviewed the USGS topographic maps of the APE and ESL. The USGS maps are hereby referred to as NETR (1933, 1942, 1948, 1953, 1961,

1966, 1972B, 1974, 2012B, 2015) and encompasses Arcata South 7.5-minute quadrangle map Township 6 North, Range 1 East, Section 32 and Township 5 North, Range 1 East, Unsectioned and all four previously designated polygons pertaining to the APE (Table 1).

In 1933, two prominent linear landmarks are demarcated on the historical topographic map while the majority of the APE is designated as marshland. The Arcata and Mad River Railroad line or wharf runs in a northeast-southwest direction along the APE's northwestern boundary. The Redwood Northwestern Highway is adjacent to the APEs eastern boundary. A clearly delineated grid system is established in Arcata and is featured within the projects northern ESL (USGS 1933). Between 1948 and 1953, three buildings are constructed adjacent to Study Unit 1 and three ponds, designated as reservoir, are established near Study Unit 1 and 2, but within the ESL (USGS 1948, 1953). By 1961, the "Oxidation Pool", which encompasses the southern portion of the APEs Unit 5, is established. Two of the three ponds built between 1948 and 1953 are merged into one pond by 1961 (USGS 1961). Just five years later in 1966, several buildings are constructed on the eastern side of the Redwood Highway within the ESL as well as a Radio Tower. Within the APE, the Oxidation Pond, previously built facilities, and two smaller ponds are labeled Sewage Disposal (USGS 1966).

Between 1972 and 1974, the northern portion of Study Unit 5 is no longer labeled as marshland and has a clear boundary around what will eventually become Klopp Lake. The previously labeled Arcata and Mad River Railroad line is labeled Wharf (Ruins) by this time and part of the railroad along the APEs eastern boundary is labeled Northwestern Pacific Railroad (USGS 1972B, 1974). In 2012, the area encompassing the northern portion of Study Unit 5 is labeled Jolly Giant C and is situated between roads Marina W. and South G St, which are within the western and eastern portion of the ESL (USGS 2012). By 2015, no significant changes are demarcated except a large pond, which is located in the northern portion of Study Unit 5 (USGS 2015).

DZC also examined aerial photos of the APE from the NETR website (1956, 1972A, 1989, 1993, 2005, 2009, 2010, 2012A, 2014, 2016). The earliest aerial photographs of the area, from 1956, are poor quality. What can be demarcated on the landscape shows that Study Unit 5 is a combination of marshland, mud, and vegetation. A single structure is located between Study Units 2 and 5 within the ESL (USGS 1956). By 1972, all of the ponds within the APE, including the Oxidation Pond, are clearly demarcated on the landscape as well as some smaller buildings near Study Unit 2 and a few dirt roads, but none of which are well developed (USGS 1972A). By 1989, the APE and surrounding area are far more established as evidenced by clear pond designations and buildings, which are concentrated near Study Units 3 and 5. The Oxidation pond has also been internally divided into 13 rectangular polygons (USGS 1989). No significant changes occur within the APE or ESL until 2016, in which green vegetation becomes more prominent in the surrounding ESL (USGS 2010, 2012A, 2014, 2016).

Satellite imagery from Google (2016) indicates that several of the ponds have designated names. Within Study Unit 2 is east of the South G Street Storm Water Pond, Study Unit 3 is located adjacent to No-name Pond, and Study Unit 5's southern portion is designated as North Oxidation Pond and South Oxidation Pond. Study Unit 5's northern portion encompasses Hauser Marsh along South I St. and Gearheart Marsh. Several structures are located within the ESL east of South G St (Google 2016).

### 4.3.3 THE ARCATA MARSH - ENVIRONMENTAL INNOVATION

The following summary of the social justice aspects and physical processes of the AWTF is summarized from a manuscript written by Amanda Suutari, published in June 2006.

In 1972, Federal Water Pollution Control Act Amendments called for the improvement of the water quality in Humboldt Bay and at that time, Arcata's former wastewater treatment plant was not adequately treating the city's wastewater. Originally constructed in the 1940s, wastewater discharged into the bay from the treatment plant received only primary treatment. The facilities were expanded in 1958, which increased the level of treatment by adding chlorination. However, by 1974 these processes were not only deemed inadequate by the standards of the Water Pollution Control Act Amendments of 1972 but were also becoming socially unacceptable when considering sustainable fisheries and other aquatic life. By 1974, the City of Arcata and its community entered into the "Wastewater Wars" when the State and Regional Governments proposed a wastewater treatment plant that would serve Arcata as well as other areas on the bay, a project that would make the rural region vulnerable to strip development and increased sewage disposal costs.

In the spirit of local activism, community members had recently created the first Community owned forest in the country and prevented a new federal freeway from further bisecting their town. Riding that wave with the backing of local notables including Dr. George Allen, Dr. Robert Gearheart, Dan Hauser, and Franklin Klopp, the citizenry focused on creating the Arcata Marsh and Wildfire Sanctuary and proving to State and federal government agencies that the facility's wastewater would "enhance" the bay (Esther Scott et. al. 1989). The overall goal was to remove the remnants of the derelict lumber mill and associated ponds, compromised concrete foundations, and the unkempt landfill and replace it with the wastewater treatment plant that would remain independent while providing wildlife habitat and recreational opportunities. Primary processes included industrial remediation by the National Guard, installation of temporary dikes, sediment removal, terraforming, and native plant revegetation.

The resulting infrastructure currently supports primary treatment, which separates liquids from solids, and secondary treatment, which addresses harmful pathogens. Major components include the headworks, primary clarification retention facilities, digesters, oxidation ponds, treatment marshes, and disinfection prior to final discharge into enhancement marshes.

The initial AWTF was completed in 1986 with subsequent expansions of 3.51 ac funded by the California State Coastal Conservancy and the addition of the Arcara Marsh Interpretive Center in 1993. The marsh complex today is internationally renowned as a first-class example of an innovative, cost effective, environmentally integrated facility.

For further details regarding the historic, political and industrial processes surrounding the formation of the AWTF, the reader is referred to the full publication by Amanda Suuti, included in Appendix D.

## 4.4 GEOARCHAEOLOGICAL RESEARCH

To assess the potential for buried archaeological sites within the proposed project components, this assessment considers factors that either encourage or discourage human use or occupation of certain landforms (e.g., geomorphic setting and distance to water), combined with those that affected the subsequent preservation (i.e., erosion or burial) of those landforms. It is well-known, for instance, that

prehistoric archaeological sites in California are most often found on relatively level landforms near natural water sources (e.g., springs, streams, rivers, or estuaries), which is often where two or more environmental zones (ecotones) are present. Landforms with this combination of variables are frequently found at or near the contact between a floodplain and a higher and older geomorphic surface, such as an alluvial fan or stream terrace (Hanson 2004:5).

An attempt is given to forecast the burial sensitivity by looking at the intersection of existing geomorphic, stratigraphic, soils spatial variables, land use, and past impacts as well as any behavioral variables that may forecast human occupation. The following describes the project site in terms of these variables and generates an archaeological sensitivity forecast. This is not an analysis of whether a particular area was attractive for human activity, but whether the conditions are favorable for buried archaeological deposits.

Soil Composition

A review of the USDA Soil Survey Geographic Database Soil Series for Humboldt County, California (CA600) revealed that 92% of the APE consists predominantly of Miscellaneous Water and Water. The remainder includes Urban land-Anthraltic Xerorthents association (0-2% slopes), and Hydraquents (0-3% slopes) (USDA 2019). Together with water dominating the majority of the APE, these two soil families represent 8% of soils found in the APE.

The Urban land-Anthraltic Xerorthents soil type is found in the central part of the APE and is associated with Fluviomarine terraces and backslopes. The parent material consists of coarse-loamy fluviomarine deposits and/or coarse-loamy dredge spoils (USDA 2019). Depth to the water table is roughly 24 in. and this class is moderately well-drained. Water movement in the most restrictive layer is high (ibid.). A typical soil profile for this soil type reads 1.) 0-6 in.: gravely loam fine sand; 2.) 6-31 in.: sandy loam; 3.) 31-43 in.: gravelly sand; and 4.) 43-65 in.: sand (ibid.).

The Hydraquents-Wassents soil type is found the central and western portion of the APE and is associated with tidal flats. The parent material consists of mucky, silty, and clayey estuarine deposits (ibid.). Depth to restrictive layer is 0 in. to aslic and 20 to 79 in. to sulfuric and this class is very poorly drained. The depth to water table is about 0 inches (ibid.). A typical soil profile for this soil type reads 1.) 0-59 in.: mucky silty clay loam (ibid).

These two soil profiles together form approximately 100 percent of the recorded surface in the APE that is not water. Within the APE, Meyer's predictive model (Meyer et al. 2013:102) for surface deposit potential in the aquatic terrain is moderately high to high based on favorable distance to water, low elevations below 4,000 ft, 0- to 3-degree slopes, proximity to waterways confluences, and slightly convex or concave landforms. The age of the two soil types present, which are Urban land-Anthraltic Xerorthents and Hydraquents-Wassents, is recent (Meyer et al. 2013, Appendix B).

### 4.4.1 HYDROLOGY OF THE ESL

With reference to the USGS 7.5-minute Topographic Map, Arcata South (1959), the directional groundwater flow through the APE is westward towards the Pacific Ocean. The Federal Emergency Management Agency national flood hazard map does indicate the APE to be within the path of a 100-year flood event (FEMA 2016).

### 4.5 Cultural Resource Survey Expectations

The results of archival research, the Sacred Lands Search, previous surveys adjacent to and within the study area, and the environmental context all contribute to an assessment of the sensitivity level for a given project area. Based on the geomorphological and topographic characteristics of the project area, the results of the records and literature search, the age the soils mapped in the area, and the level of historic disturbance, the APE is considered to have a low potential for buried and surficial prehistoric resources, a moderate potential for buried historic resources, and a low potential for surficial historic resources.

## 5.0 Report of Findings

### 5.1 Archaeological Survey Results

DZC conducted the archaeological survey of the APE on October 9, 2019 and on November 5, 2019. Within the APE, designated project Study Units 1-5 were targeted for archaeological survey coverage, which includes Staging Areas 1-4 (Appendix A, Figure A-7). The City of Arcata identified 123 ac of land for Intensive survey.

The primary constraint to survey efforts was poor ground visibility. Generally, ground visibility was less than five percent since most surfaces were either paved, vegetated, or covered with imported gravel. To circumvent this, vegetation was scraped clear at select intervals to obtain a clear view of the mineral surface. This method was employed in other areas within the APE where low-lying and dense vegetation was present. Some soils were occasionally visible because of gopher holes and occasional bare patches of ground without vegetation cover. The soils observed varied greatly and included light sandy loam, dark loam aggregated rounded and subangular cobbles associated with commercial imported gravels. Fragmentary refuse, including crushed cement tailings and modern broken glass, were observed but not in sufficient quantities to obtain interpretive data aside from industrial use association.

In Staging Area 1 poor visibility was due to low-lying dense vegetation and surfaces covered with imported gravel. Staging Area 2 provided similar constraints to survey efforts with poor visibility due to paved asphalt and low dense vegetation surrounding the Arcata Marsh Parking lot on South G Street. Constraints of Staging Area 3 included the presence of low dense vegetation, briars, and imported gravels. Staging area 4 constraints were similar to those of Staging Area 2, with paved asphalt and low dense vegetation surrounding the Arcata Marsh Parking lot on South I Street.

Pedestrian survey efforts resulted in 100% coverage of the target acres excluding wetlands, ponds and marshes, and provided intensive coverage in transects of 15 m or less for all acres covered (Appendix A, Figure A-7 Survey Coverage and Results).

The survey was negative for precontact resources. Two built environment features were identified within the APE including the AWTF and a remnants of the Arcata Mad River Railroad/Union Wharf and Plank Walk Company.

# 6.0 RESOURCE DISCUSSION

## 6.1 RESOURCE EVALUATION CRITERIA

### 6.1.1 NATIONAL REGISTER OF HISTORIC PLACES

To be eligible for listing on the National Register, a resource must be significant in American history, architecture, archaeology, engineering, or culture. Districts, sites, buildings, structures, and objects of potential significance must meet one or more of the following four established criteria:

- Criterion A - Are associated with events that have made a significant contribution to the broad patterns of our history;
- Criterion B - Are associated with the lives of persons significant to our past;
- Criterion C - Embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master; or that possess high artistic values; or that represent a significant and distinguishable entity whose components may lack individual distinction;
- Criterion D - Have yielded, or may be likely to yield, information important in prehistory or history.

In addition to meeting one or more of the above criteria, a resource must retain integrity to be considered eligible for listing on the NRHP. Integrity is the authenticity of the physical identity that is evidenced by the survival of characteristics that existed during the resource's period of significance. The seven aspects of integrity are outlined in the National Register Bulletin No. 15 and consist of: location, design, setting, materials, workmanship, feeling, and association (Shrimpton 2002). Resources must retain enough of their character or appearance to be recognizable as resources and to convey the reasons for their significance. Further, unless the resource possesses exceptional significance, it generally must be at least 50 years old to be eligible for National Register listing.

Section 101(d)(6)(A) of the National Historic Preservation Act (NHPA) allows properties of traditional religious and cultural importance to a Native American tribe to be determined eligible for NRHP inclusion. In addition, a broader range of Traditional Cultural Properties (TCPs) is also considered and may be determined eligible for or listed in the NRHP. A TCP is a property associated with the cultural practices or beliefs of a living community; TCPs are rooted in that community's history and are important in maintaining the continuing cultural identity of the community. In the NRHP programs, "culture" is understood to mean the traditions, beliefs, practices, lifeways, arts, crafts, and social institutions of any community, be it a Native American tribe, a local ethnic group, or the nation as a whole.

### 6.1.2 CALIFORNIA REGISTER OF HISTORICAL RESOURCES

As provided in California Public Resources Code Section 5020.4, the California Legislature established the CRHR in 1992. The CRHR is used as a guide by state and local agencies, private groups, and citizens to identify the state historical resources and properties to be protected, to the extent prudent and feasible, from substantial adverse change. The CRHR automatically includes all California properties already listed in the NRHP and those formally determined to be eligible for listing in the NRHP. The CRHR may also include various other types of historical resources that meet the criteria for eligibility, including the following:

- Individual historic resources
- Resources that contribute to a historic district

- Resources identified as significant in historic resource surveys
- Resources with a significance rating of Category 3 through Category 5 in the State Inventory (Categories 3 and 4 refer to potential eligibility for the NRHP; Category 5 indicates a property with local significance)

The CRHR follows the lead of the NRHP in utilizing the 50-year threshold: a resource is usually considered for its historical significance only after it reaches the age of 50 years. This threshold is not absolute, but was selected as a reasonable span of time after which a professional evaluation of historical value/importance should be made. The criteria for listing resources in the CRHR were expressly developed to be in accordance with previously established criteria developed for listing on the NRHP.

Section 15064.5(a)(3) of the CEQA Guidelines states that "Generally, a resource shall be considered by the lead agency to be 'historically significant' if the resource meets the criteria for listing on the California Register of Historical Resources," which are as follow:

- Criterion 1 - Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;
- Criterion 2 - Is associated with lives of persons important in our past;
- Criterion 3 - Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values; or
- Criterion 4 - Has yielded, or may be likely to yield, information important in prehistory or history.

Using the information outlined above, the first level of evaluation is to determine whether a resource is considered eligible for the CRHR and is, therefore, significant. Significance, in part, is determined based on a historical resource's integrity. Integrity in the context of the CRHR means a resource is sufficiently intact to yield important information regarding the past. Integrity encompasses the following factors: location, setting, design, materials, workmanship, association, and feeling.

## 6.2 Resource Evaluation

### 6.2.1 AWTF Infrastructure

The AWTF was initially constructed in the 1940s with various parts of the system being replaced or improved multiples times since that time. With respect to the AWTF's cultural significance, wastewater treatment facilities are ubiquitous features found in most cities and towns. No evidence has been found to suggest that the initial construction and materials used in the AWTF are in any way unique. Further, ongoing repairs and maintenance continue to upgrade and improve the design, workmanship, and material qualities of the original construction. However the expansion of the AWTF in 1986 may represent both an innovative design, which may be considered a unique construction method, and social justice activism associated with the City of Arcata. As such, this discussion regarding the criteria for evaluation aims to identify persons and events relative to the AWTF.

NEPA and CEQA mandate that resources older than 50 years may qualify for eligibility on the National Register of Historic Places or the California Register of Historic Resources.

A/1: AWTF was originally constructed in in the 1940s in order to facilitate wastewater disposal for the City of Arcata. Since that time, it has undergone multiple modifications and improvements, however the processes remain true to the original idea. Wastewater treatment plants are ubiquitous facilities found throughout most towns and cities. However, research has shown that the AWTF is associated with significant local events of environmental activism. Projects occurring within the AWTF post-2036 should consider evaluation of the facility for the NRHP/CRHR.

B/2: Research has shown four figures of historical significance to be related to the construction of the AWTF or its operation. Dr. George Allen, professor and Fisheries Sciences at Humboldt State University; Dr. Robert Gearheart, professor of Environmental Engineering at Humboldt State University; Mr. Dan Hauser, City Council Member and Mayor of the City of Arcata from 1974-1982; and Mr. Frank Klopp, City Engineer since 1968 and Director of Public Works. These individuals were part of the seminal force for the formation of the water treatment plant and several ponds and marshes within the AWTF are named in their honor. Subsequent evaluation efforts warrant further investigation into the roles and responsibilities these individuals had into the formation of the AWTF.

C/3: The materials and construction of the AWTF is considered typical. The treatment plant does not embody a distinctive characteristic of a type, period, or method of construction, does not represent the work of a master; does not possess high artistic values. However, upon reaching the threshold for evaluation in 2036, the facility may represent a significant and distinguishable entity whose components may exhibit engineering distinction.

D/4: The AWTF is regularly maintained and is currently used for treating wastewater derived from within and near the city limits. This facility is unlikely to yield information important in prehistory or history.

NEPA and CEQA mandate that resources older than 50 years may qualify for eligibility on the National Register of Historic Places or the California Register of Historic Resources. Although the plant does not currently meet the age threshold for evaluation consideration, projects undertaken after 2036 may require formal evaluation of the AWTF.

In 2006, Tim Keefe (Senior Environmental Planner and Archaeologist/Caltrans, District 1) determined the AWTF as Ineligible for inclusion in the National Register. This assessment still stands and no additional information value is expected to be provided by facility at this time.

### 6.2.2 Arcata and Mad River Railroad/union Wharf and Plank Walk Company – California Historic Landmark No. 842 (CHL 842)

The background literature review and historic photo analysis revealed that the historic alignment of the Arcata Mad River Railroad - Union Plank Walk and Wharf Company, California's first organized railroad (formally designated CHL 842) built circa 1855, traverses Study Units 1 and 4. The review also indicated that Study Unit 1/Staging area 1 underwent major remediation to remove industrial contaminants and structures. The remediation efforts, along with the construction of the Arcata Marsh, resulted in the removal of all terrestrial features associated with CHL 842 formerly within the APE. The remnant pilings of CHL 842 are located in the waters of Humboldt Bay, outside of the APE.

As a California Historic Landmark Listed resource, no further evaluation is warranted at this time.

As Study Area 1/Staging Area retains no remnants of CHL 842, and Staging Area 4 is completely paved over, this study determines that current Project plans to use these areas for the temporary staging of equipment and materials has no potential to impair any aspect of the historic significance of CHL 842.

# 7.0 Recommendations and Conclusions

## 7.1 CEQA - Finding of No Impacts

CEQA aims to "develop and maintain a high-quality environment now and in the future, and take all action to protect, rehabilitate, and enhance the environmental quality of the state (PRC § 21001)". Historical and tribal cultural resources are part of the environment and as such, a project with an effect that may cause a substantial adverse change in the significance of an historical resource is a project that may have a significant effect on the environment.

One historical property alignment is mapped within the APE (CHL #842). The portion of the property within the APE is limited to a mapped alignment and as such retains no physical remnants within the APE. The remaining physical features associated with CHL #842 are located outside of the APE. Additionally, Project activities in the vicinity of the mapped alignment will not cause sub-surface disturbances. Therefore, this study concludes a **Finding of No Impacts** to historic resources as defined by PRC § 5024.1, Title 14 CCR, Section 482.

## 7.2 NEPA – Finding of No Effects to Historic Properties

This Project is funded in part by State Revolving Funds Program. As such, the project is considered a Federal undertaking and is subject to NEPA and NHPA (as amended, 16 United States Code [USC] 470f). Cultural resources are considered during federal undertakings under Section 106 of NHPA, through its implementing regulations at 36 CFR 800 (Protection of Historic Properties).

One significant historic property alignment is mapped within the APE (CHL #842). The portion of the property within the APE is limited to a mapped alignment and as such retains no physical remnants within the APE. The remaining physical features associated with CHL #842 are located outside of the APE. Additionally, Project activities in the vicinity of the mapped alignment will not cause sub-surface disturbances. Therefore, this study concludes a **Finding of No Effects** to Historic Properties as defined by 36 CFR 800.16 (i).

## 7.3 Native American Consultation & Coordination

As a result of initiating a Sacred Land File & Native American Contacts List Request with the NAHC, DZC has contacted the tribes identified with the APE requesting knowledge of, or concerns for, cultural resources within the APE and Project vicinity.

Communications with, and responses from, the Native American community are included in Appendix B.

The outreach conducted by DZC may be considered Native American coordination. Coordination seeks to solicit information, build partnerships, and identify if and when formal Consultation is needed. Coordination does not substitute for Native American Consultation as defined by Section 106 of the NHPA, which requires government-to-government communications between tribal entities and the Lead Agency.

As the Lead Agency, it is the responsibility of the City of Arcata to formally engage in Consultation with the APE affiliated cultural groups.

## 7.4 Management Considerations

DZC recommends the project proceed with the following stipulations, which should be included on all project plans:

1. It is best practice to avoid cultural resources whenever possible. In cases of inadvertent (unplanned) discovery of cultural resources or human remains, the following procedures are required:
    a. If buried cultural materials are encountered during construction, it is required that work stop in that area until a qualified archaeologist can evaluate the nature and significance of the find [CCR 15064.5(f)].
    b. Immediately notify a qualified archaeologist to evaluate the nature and significance of the find [36 CFR 800.13]. A local archaeologist may be contacted at:

DZC Archaeology and Cultural Resource Consulting, LLC
445 I Street, Suite 204
Arcata, CA. 95521
707-599-9842
dimitra@dzcarc.com

2. If human remains are encountered during future construction, it is required that work stop immediately in that area and notification be made to the Humboldt County Coroner (CCR 15064.5(e) (1) (A); HSC Sec.7050.5).
3. Contact information for the Chief Deputy Coroner office at the time of this report:

Ernest Stewart
Humboldt County Chief Deputy Coroner
3012 I Street, Eureka, CA. 95501
Phone: 707-445-7242

4. If the coroner determines the remains to Native American, the Coroner shall contact the NAHC within 24 hours and collaboratively determine the Most Likely Descendant (CCR 15064.5(e)(1)(B)

The information and results contained in this document are based on the existing information provided to the archaeological firm as of August 29, 2019. Additional survey will be required if the project changes to include areas not previously surveyed.

# 8.0 REFERENCES

Angeloff, Nick and Lynette Mullen. 2016. A Cultural Resources Investigation of the Arcata Wastewater Inflow and Infiltration Project, Arcata, Humboldt County, California (S-050908). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Angeloff, Nick and James Roscoe. 2004. A Cultural Resources Investigation of the Daylighting of Jolly Giant Creek Project, located in Humboldt County, California (S-041725). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Bailey, E. H., W. P. Irwin, and D. L. Jones. 1964. Franciscan and related rocks and their significance in the geology of western California. California Div. Mines and Geology Bull. 183: 177.

Belcher Abstract & Title Company. 1922. Historic Map of Humboldt County. Atlas of Humboldt County; Sheet No. 16. Eureka, CA.

Coleman, Jason A. 2011. Cultural Resources Survey Report for the South G Street (Christie) WRP Project, Humboldt County, California (S-040249). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Doolittle, A.J. 1865. Historic Map of Humboldt County. A.J. Doolittle, San Francisco, CA.

Douglas, Barry K. 1984. Archaeological Survey Report, Butcher's Slough Wetlands Restoration Project, Arcata, California (S-006669). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Douglas, Barry Kevin. 1984. Archaeological Survey Report for a proposed sewage collection system for Bayside in Arcata, California (S-000643). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Eidsness, Janet P. 1988. A Summary of Cultural Resources Projects, Redwood National Park. Purchase Order No.1PX8480-7-0217, PX8480-7-0689, PX8480-8-0316. On file with Redwood National Park, Orick, California.

Esther Scott and Leslie Brunetta. 1989. Wastewater Wars. Havard Kennedy School Case Program. Electronic article accessed November 18, 2019. https://case.hks.harvard.edu/wastewater-wars/

FEMA – Federal Emergency Management Agency. 2016. National Flood Hazard Layer. Map Number 0645C1800F. Online database. FEMA Flood Map Service Center. Accessed July 25, 2019. https://msc.fema.gov/portal.

Fenega, Franklin. 1968. Review of University of California Archaeological Survey, No. 62, University of California. Archaeological Research Facility, Department of Anthropology, University of California, Berkeley.

Forbes, Stanly. 1886. Forbes Official Map of Humboldt County. Stanly Forbes Company.

Fredrickson, David A. 1984. Geysers Cultural Resources Management Plan: Prehistoric Archaeology. Bureau of Land Management, Ukiah district office.

Fredrickson, David A., Sonia Tomez, and Pamela R. Roberts. 1975. An Archaeological Survey of the Proposed McKinleyville Sewage Collection and Treatment Facility (S-000132). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Fukutomi, David. 1999. Archaeological Survey for City of Arcata, Janes Creek culvert and Drainage Improvements, FEMA HMGP #1008-6283 (letter report) (S-022314). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

GLO – General Land Office Records

1867. Teremater, Marc, State Volume Patent CA0910_.419, November 20, 1867. Bureau of Land Management. Online database. Accessed November 4, 2019. GLORecords.blm.gov.

1903. State of California. Serial Patent CACAAA 140332, January 12, 1903. Bureau of Land Management. Online database. Accessed November 4, 2019. GLORecords.blm.gov.

Hanson, I. 2004. The Importance of Stratigraphy in Forensic Investigation. In Forensic Geoscience: Principles, Techniques and Applications. Pye, K., Croft, D.J. (eds.), Geological Society Specialty Publications, pp. 5.

Hayes, John F., David A. Fredrickson, Adrian Praetzelis, and Mary Praetzelis. 1980. Description and Analysis of Prehistoric and Historic Artifacts from Archaeological Sites Within Redwood National Park, California. On file with Redwood National Park, Orick, California.

Hayes, John F., David A. Fredrickson, and Thomas M. Origer. 1985. An Analysis of Redwood National Park Artifacts. Pursuant to Purchase Orders No. PX 8480-5-0169 & PX 8480-5-0302. On file with Redwood National Park, Orick, California.

Heald, Leslie S. 2002. Historic Property Survey, Archaeological Survey, and Historical Resources Evaluation Reports, Highway 255 Gateway Improvements, CALTRANS District 1, Humboldt County, CA (S-041786). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Heizer, R.F., and A.B. Elsasser. 1964. Archaeology of Hum-67, the Gunther Island Site in Humboldt Bay, California. University of California Archaeological Survey Reports 61:1-122. Berkeley.

Hildebrandt, William R. and John F. Hayes. 1983. Archaeological Investigations on Pilot Ridge, Six Rivers National Forest. Six Rivers National Forest, Eureka.

Hughes, Richard. 1978. Aspects of Prehistoric Wiyot Exchange and Rank. Journal of California Anthropology 5(1):53-66.

Jones, Terry L. and Kathryn A. Klar. 2007. California Prehistory: Colonization, Culture, and Complexity. Altamira Press. Plymouth, U.K.

Justice, Noel D. 2002. Stone Age Spear and Arrow Points. Indiana University Press, Bloomington, Indiana.

Keefe, Timothy. 2006. Historic Property Survey Report for the Proposed Eureka-Arcata Corridor Projects on California State Highway 101 at Post Mile 79.9/86.3 in Humboldt County, California (S-038304). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Köppen, Wladimir. 1936. A Geographic System of Climates. Rudolf Greiger, Berlin: Borntraegar.

Kroeber, A. 1909. Classification Systems of Relationships. The Journal of Royal Anthropological Institute of Great Britain and Ireland, Vol. 39 (Jan-Jun. 1909). pp 77-84

Kroeber, 1976, Handbook of the Indians of California (reprint of 1925 publication). Bulletin No. 78 of the Bureau of American Ethnology, Smithsonian Institution, Washington D.C.

Lentell, J. N. 1914. Historic Map of Humboldt County, California. Britton and Rey. San Francisco, CA.

Loud, L.L. 1918. Ethnography and Archaeology of the Wiyot Territory. University of California publication in American Archaeology and Ethnology, Vol. 14, No. 3, pp. 221-436, plates 1-21, 15 text-figs. Dec 23, 1918.

Mayer, Kenneth E. and William F. Laudenslayer, Jr. 1988. A Guide to Wildlife Habitats of California. State of California, Resources Agency, Department of Fish and Game, Sacramento, California.

Meighan, C. W. and C. V. Haynes, Jr. 1968. New Studies on the Age of the Borax Lake Site. Southwest Museum, Masterkey 42: 4-9.

Moratto, Michael J. 1984. California Archaeology. San Francisco: Academic Press, Inc.

Most, Stephen. 2006. River of Renewal. Oregon Historical Society in association with University of Washington Press, Seattle and London.

Martin, Leigh. 2004. Archaeological Assessment of a 1.5-Acre Parcel (APN 367-180-010), Located at 915 Deer Creek Drive, Martinez, Contra Costa County, California (letter report) (S-029030). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

NETR – National Environmental Title Research. United States Geological Survey Historic Topographic Map, Arcata South Quadrangle. Online database. Site accessed on November 4, 2019. http://www.historicaerials.com/.

NETR – National Environmental Title Research. Aerial Photo; Arcata, California. Online database. Site accessed on November 4, 2019. http://www.historicaerials.com/.

2015. United States Geological Survey Historic Topographic Map, Arcata South Quadrangle. Online database. Site accessed on November 4, 2019. http://www.historicaerials.com/.

2016. Aerial Photo; Arcata, California. Online database. Site accessed on November 4, 2019. http://www.historicaerials.com/.

Pursell Jr., Carroll W. 1981. Historical and Technological Significance of the Humboldt Bay Jetties, Humboldt Bay, California (S-017469). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Rich, William, James Roscoe, and Susan Van Kirk. 2003. A Cultural Resources Investigation of the Proposed McDaniel Slough Marsh Enhancement Project, Located near Arcata, Humboldt County, California (S-037718). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Roscoe, James M. 1992. An Archaeological Investigation of Assessor's Parcel Number 21-184-05, Located in Arcata, Humboldt County, California (S-014210). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Roscoe, J. 1993. A Cultural Resources Study of the Proposed Marsh Commons Project, Located in Arcata, California (S-015199). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Roscoe, James and William Rich. 2012. A Cultural Resources Investigation of three Coastal Access Points for the Humboldt Bay Water Trails Implementation Program, Located in Humboldt County, California (S-048287). On file, Northwest Information Center, California Historic Resources Information. System, Sonoma State University, Rohnert Park, California.

Strand, Rudolph. 1962. Geologic Atlas of California – Redding Sheet. Geologic Atlas of California. Map No. 011, 1:250,000 scale. California Geologic Survey.

Suutari, Amanda. 2006. USA – California (Arcata) – Constructed Wetland: A Cost-Effective Alternative for Wastewater Treatment. Online article. Accessed November 18, 2019. http://www.ecotippingpoints.org/our-stories/indepth/usa-california-arcata-constructed-wetland-wastewater.html

USDA – United States Department of Agriculture. 2019. Soil Survey Geographic database Soil Map; ESL boundary. Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Online database. Accessed July 24, 2019.https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx.

Van Kirk, Susie. 2015. Arcata Marsh History: Union Wharf, Mad River Canal, Reclamation, Lumber Mills, City Designs. On file, Humboldt State University Digital Commons: Susie Van Kirk Papers. Accessed November 4, 2019. https://digitalcommons.humboldt.edu/svk.

Wagner, D. L. 2002. California Geomorphic Provinces. Sacramento, California: California Department of Conservation, California Geological Survey.

Whistler, K.W. 1979. Linguistic Prehistory of the Northwestern California Coastal Area. In A Study of Cultural Resources in Redwood National Park, California, P. McW. Bickel, ed.

White, Greg. 1999. Research Design for Archaeological Investigations in the Cache Creek Primitive Area, Bureau of Land Management, Ukiah Office. CSU Chico Archaeological Research Program.

Wylie, Henry G. 1976. Pilot Ridge Survey; A Graphic Summary of Borax Lake Points and Other Materials from the Six Rivers National Forest, Humboldt County, California. Paper presented at the annual meeting of the Society for California Archaeology, San Diego, California.

# Appendix A

## Project Maps

Figure A-3 Treatment Wetlands Site Plan



Figure A-4 Enhancement Wetlands Site Plan

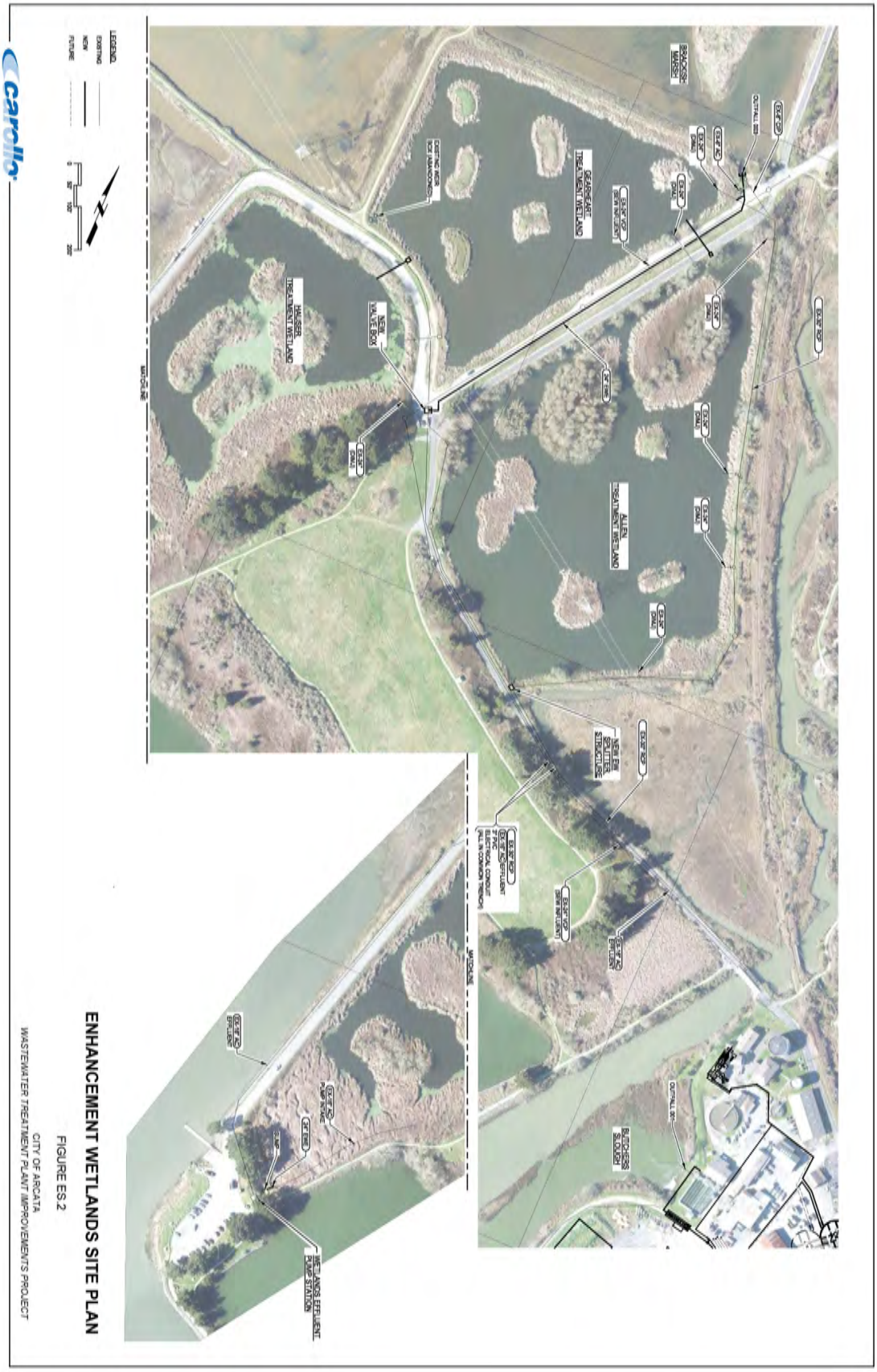

ENHANCEMENT WETLANDS SITE PLAN
FIGURE ES.2
CITY OF ARCATA
WASTEWATER TREATMENT PLANT IMPROVEMENTS PROJECT
carollo
LEGEND
EXISTING
NEW
FUTURE
GEARHEART TREATMENT WETLAND
ALLEN TREATMENT WETLAND
HAUSER TREATMENT WETLAND
EXISTING AGS OXIDATION DITCHES
BUTCHERS SLOUGH
MAD RIVER SLOUGH
OUTFALL 001
OUTFALL 002
WETLANDS EFFLUENT PUMP STATION
WETLANDS EFFLUENT FLOW METER
WETLANDS EFFLUENT PUMP STATION
WETLANDS EFFLUENT SPLITTER
WETLANDS EFFLUENT VALVE BOX
WETLANDS EFFLUENT SPLITTER
WETLANDS EFFLUENT SPLITTER
WETLANDS EFFLUENT SPLITTER

Figure A-5 Central Site Plan

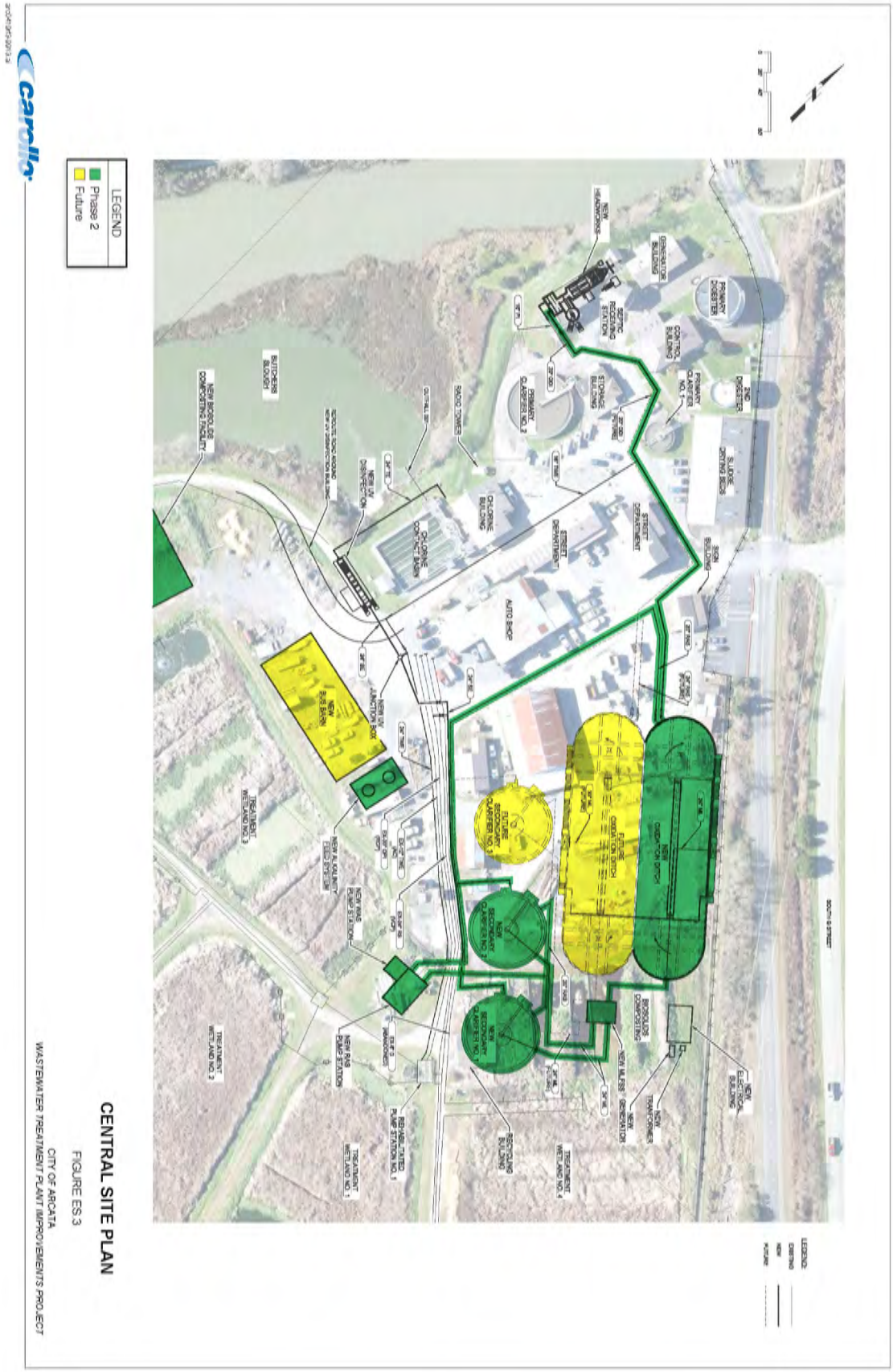


Figure A-6 Process Flow Diagram

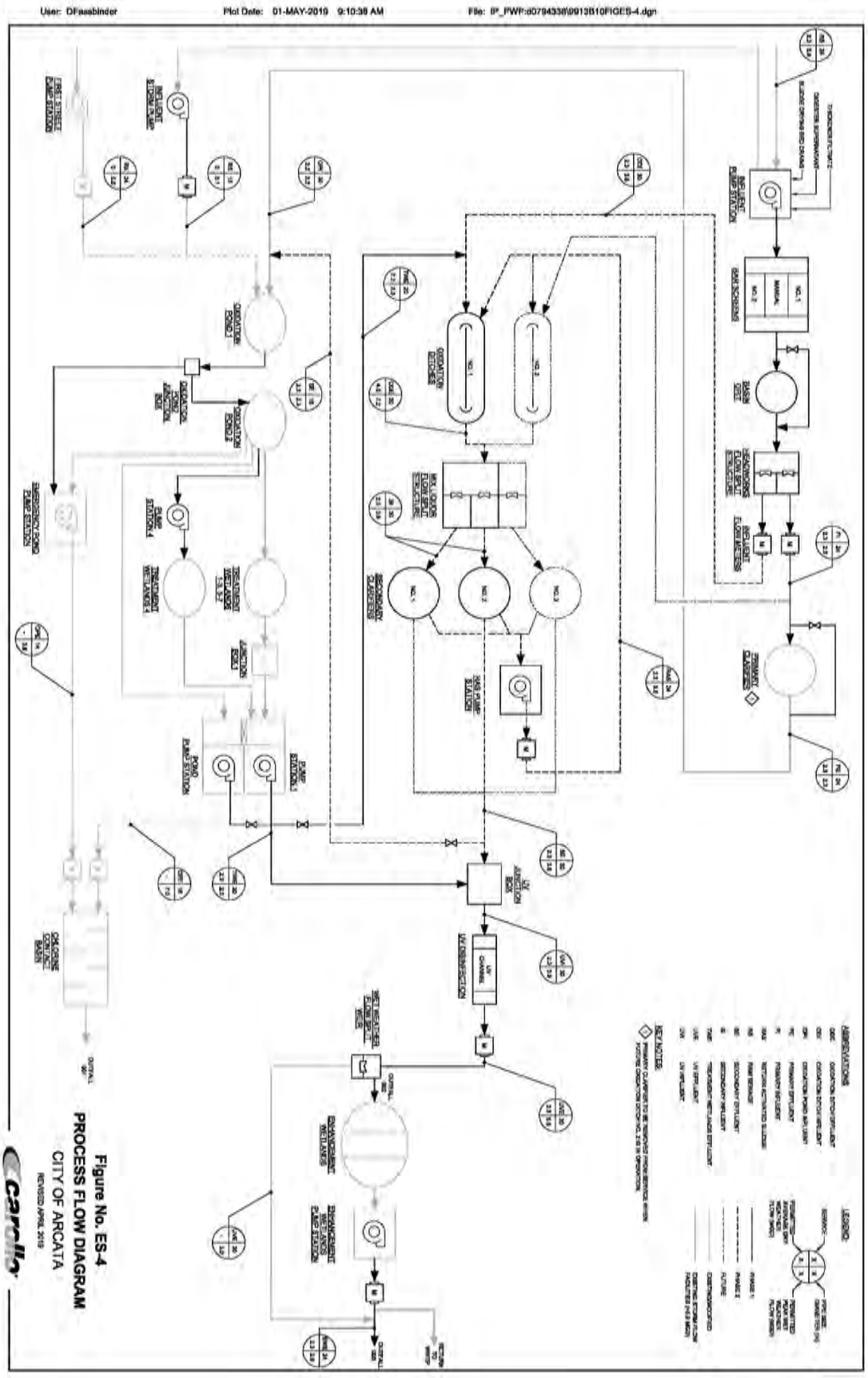
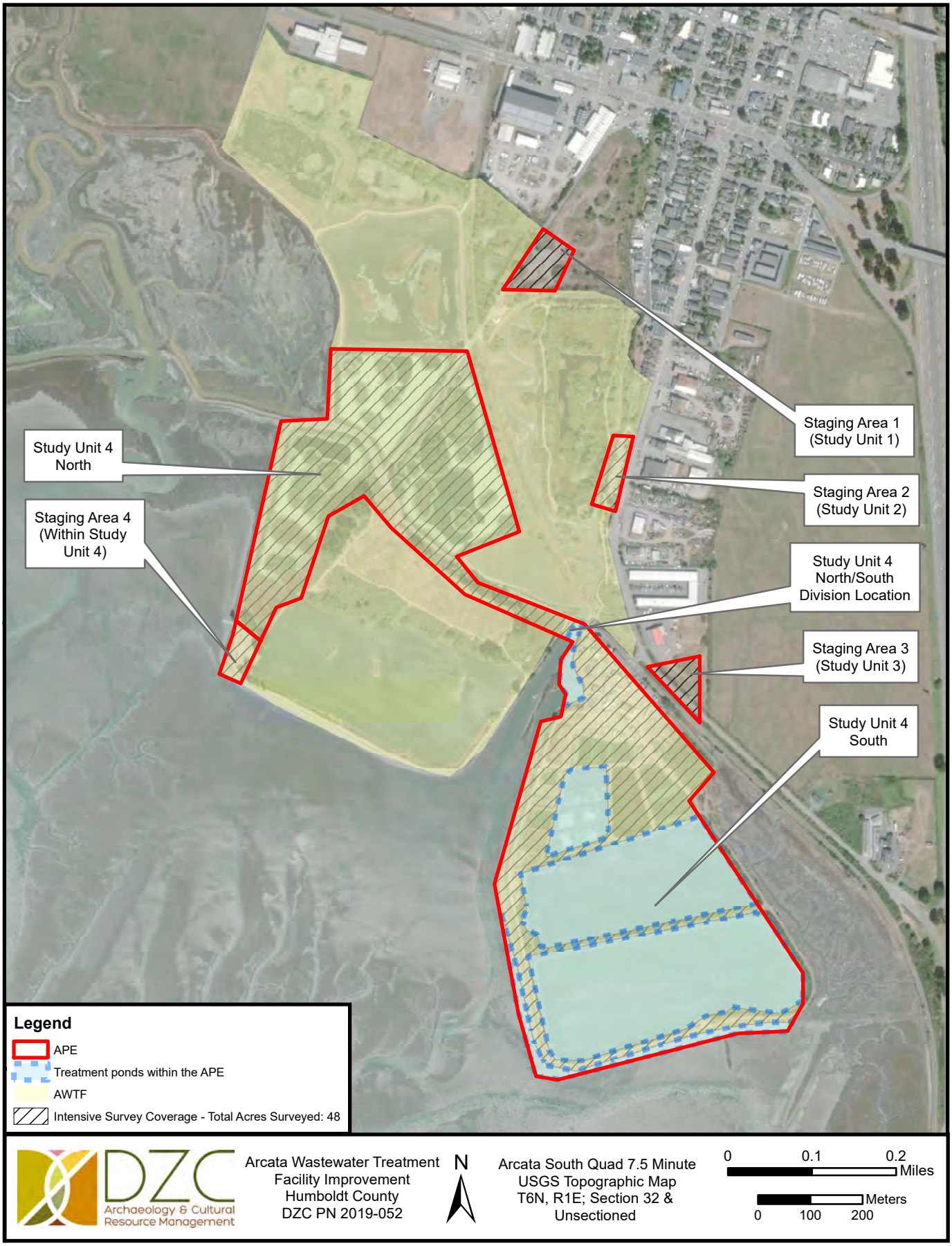


Figure A-7 Archaeological Survey Coverage



# Appendix B

## Native American Coordination

# Sacred Lands File & Native American Contacts List Request

**NATIVE AMERICAN HERITAGE COMMISSION**
1550 Harbor Blvd, Suite 100
West Sacramento, CA 95501
(916) 373-3710
(916) 373-5471 – Fax
nahc@nahc.ca.gov

*Information Below is Required for a Sacred Lands File Search*

Project: Arcata Wastewater Treatment Facility Improvements

County: Humboldt

USGS Quadrangle

Name: Arcata South

Township: 6 N Range: 1 E Section(s): Unsectioned

Company/Firm/Agency:

DZC Archaeology & Cultural Resource Consulting

Contact Person: Dimitra Zalarvis-Chase

Street Address: 455 I Street, Suite 204

City: Arcata, CA Zip: 95521

Phone: (707) 599-9842 Extension:

Fax:

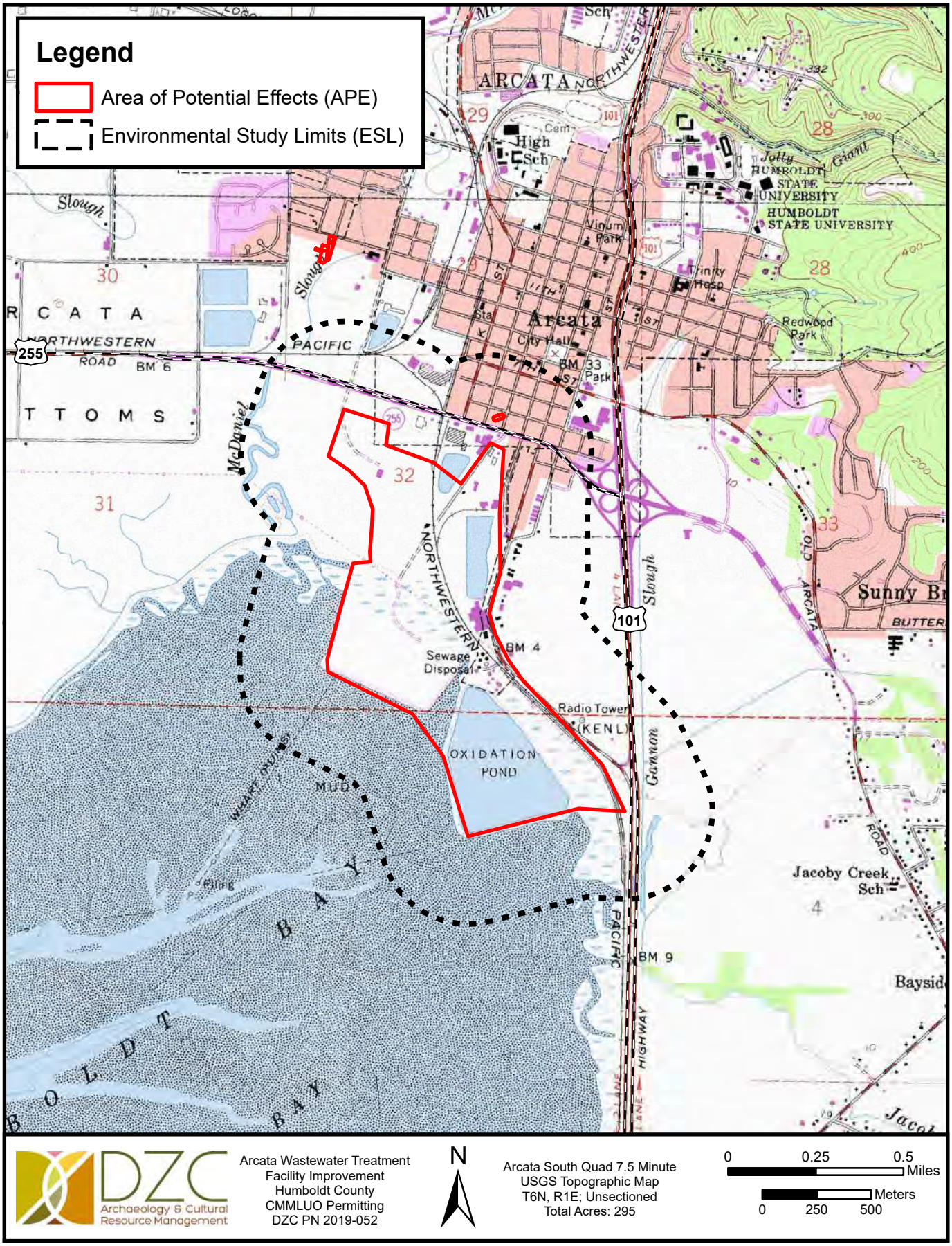
Email: Dimitrazc@gmail.com

Project Description:

DZC Archaeology & Cultural Resource Consulting has been retained by the City of Arcata in support of the proposed improvements at the Arcata Wasterwater Treatment Facility. The improvements are meant to increase the capacity and functioning capabilities of the facility. A map of the project location is attached.

☑ Project Location Map is attached

Figure A-2 Project Location & ESL




DZC Archaeology & Cultural Resource Management

Arcata Wastewater Treatment
Facility Improvement
Humboldt County
CMMLUO Permitting
DZC PN 2019-052

N

Arcata South Quad 7.5 Minute
USGS Topographic Map
T6N, R1E; Unsectioned
Total Acres: 295

0 0.25 0.5 Miles

0 250 500 Meters

**NATIVE AMERICAN HERITAGE COMMISSION**
**Cultural and Environmental Department**
**1550 Harbor Blvd., Suite 100**
**West Sacramento, CA 95691 Phone: (916) 373-3710**
**Email: nahc@nahc.ca.gov**
**Website: http://www.nahc.ca.gov**

September 19, 2019

Dimitra Zalaris-Chase
DZC Archaeology & Cultural Resource Consulting

VIA Email to: Dimitrazc@gmail.com

RE: Arcata Wastewater Treatment Facility Improvements, Humboldt County.

Dear Ms. Zalarvis-Chase:

A record search of the Native American Heritage Commission (NAHC) Sacred Lands File (SLF) was completed for the information you have submitted for the above referenced project. The results were negative. However, the absence of specific site information in the SLF does not indicate the absence of cultural resources in any project area. Other sources of cultural resources should also be contacted for information regarding known and recorded sites.

Attached is a list of Native American tribes who may also have knowledge of cultural resources in the project area. This list should provide a starting place in locating areas of potential adverse impact within the proposed project area. I suggest you contact all of those indicated; if they cannot supply information, they might recommend others with specific knowledge. By contacting all those listed, your organization will be better able to respond to claims of failure to consult with the appropriate tribe. If a response has not been received within two weeks of notification, the Commission requests that you follow-up with a telephone call or email to ensure that the project information has been received.

If you receive notification of change of addresses and phone numbers from tribes, please notify me. With your assistance, we can assure that our lists contain current information. If you have any questions or need additional information, please contact me at my email address: katy.sanchez@nahc.ca.gov.

Sincerely,

Katy Sanchez

KATY SANCHEZ
Associate Environmental Planner

Attachment

**Native American Heritage Commission**
**Native American Contacts List**
**9/20/2019**

Bear River Band of the Rohnerville Rancheria
Barry Brenard, Chairperson
266 Keisner Road
Loleta ,CA 95551
(707) 733-1900
(707) 733-1727 Fax
Wiyot
Mattole

Blue Lake Rancheria
Claudia Brundin, Chairperson
P.O. Box 428
Blue Lake ,CA 95525
lalbright@bluelakerancheria-nsn.gov
(707) 668-5101
(707) 668-4272 Fax
Wiyot
Yurok
Tolowa

Blue Lake Rancheria
Janet Eidsness, Historic Preservation Officer
P.O. Box 428
Blue Lake ,CA 95525-042
jeidsness@bluelakerancheria-nsn.gov
(707) 668-5101 ext. 1037
707-668-4272 - Fax
Wiyot
Yurok
Tolowa

Blue Lake Rancheria
Jacob Pounds, Assistant THPO
P.O. Box 428
Blue Lake ,CA 95525
jpounds@bluelakerancheria-nsn.gov
(707) 668-5101 ext 1038
Wiyot
Yurok
Tolowa

Cher-Ae Heights Indian Community of the Trinidad Rancheria
Garth Sundberg Sr., Chairperson
P.O. Box 630
Trinidad ,CA 95570-063
gsundberg@TrinidadRancheria.com
(707) 677-0211 Office
(707) 677-3921 Fax
Yurok
Karuk
Tolowa
Wiyot

Wiyot Tribe
Ted Hernandez, Chairperson
1000 Wiyot Drive
Loleta ,CA 95551
ted@wiyot.us
(707) 733-5055
(707) 733-5601 Fax
Wiyot

**This list is current as of the date of this document and is based on the information available to the Commission on the date it was produced.**

**Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code,Section 5097.94 of the Public Resources Code, or Section 5097.98 of the Public Resources Code.**

**This list is only applicable for contacting local Native Americans Tribes for the proposed: Arcata Wastewater Treatment Facility Improvements, Humboldt County.**

**NATIVE AMERICAN HERITAGE COMMISSION**
**Cultural and Environmental Department**
**1550 Harbor Blvd., Suite 100**
**West Sacramento, CA 95691 Phone: (916) 373-3710**
**Email: nahc@nahc.ca.gov**
**Website: http://www.nahc.ca.gov**

September 19, 2019

Dimitra Zalarvis-Chase
DZC Archaeology & Cultural Resource Consulting

VIA Email to: Dimitrazc@gmail.com

RE: Northern Realm, Humboldt County.

Dear Ms. Zalarvis-Chase:

A record search of the Native American Heritage Commission (NAHC) Sacred Lands File (SLF) was completed for the information you have submitted for the above referenced project. The results were negative. However, the absence of specific site information in the SLF does not indicate the absence of cultural resources in any project area. Other sources of cultural resources should also be contacted for information regarding known and recorded sites.

Attached is a list of Native American tribes who may also have knowledge of cultural resources in the project area. This list should provide a starting place in locating areas of potential adverse impact within the proposed project area. I suggest you contact all of those indicated; if they cannot supply information, they might recommend others with specific knowledge. By contacting all those listed, your organization will be better able to respond to claims of failure to consult with the appropriate tribe. If a response has not been received within two weeks of notification, the Commission requests that you follow-up with a telephone call or email to ensure that the project information has been received.

If you receive notification of change of addresses and phone numbers from tribes, please notify me. With your assistance, we can assure that our lists contain current information. If you have any questions or need additional information, please contact me at my email address: katy.sanchez@nahc.ca.gov.

Sincerely,

Katy Sanchez

KATY SANCHEZ
Associate Environmental Planner

Attachment

**Native American Heritage Commission**
**Native American Contacts List**
**9/20/2019**

Bear River Band of the Rohnerville Rancheria
Barry Brenard, Chairperson
266 Keisner Road
Loleta ,CA 95551
(707) 733-1900
(707) 733-1727 Fax

Wiyot
Mattole

Round Valley Reservation/ Covelo Indian Community
James Russ, President
77826 Covelo Road
Covelo ,CA 95428
tribalcouncil@rvit.org
(707) 983-6126
(707) 983-6128 Fax

Yuki ; Nomlaki
Pit River
Pomo
Concow
Wailaki; Wintun

**This list is current as of the date of this document and is based on the information available to the Commission on the date it was produced.**

**Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code,Section 5097.94 of the Public Resources Code, or Section 5097.98 of the Public Resources Code.**

**This list is only applicable for contacting local Native Americans Tribes for the proposed: Northern Realm, Humboldt County.**

Date
October 10, 2019

***REQUEST FOR COMMENT***

**TO:** Barry Brenard, Chairperson, Celeste Ruiz, Executive Secretary, and Erika Cooper, THPO, Bear River Band of the Rohnerville Rancheria
Claudia Brundin, Chairperson, Janet Eidsness, THPO, and Jacob Pounds, Assistant THPO, Blue Lake Rancheria,
Garth Sundberg, Sr., Chairperson, Cher-Ae-Heights Indian Community of the Trinidad Rancheria
Ted Hernandez, Chairperson, Wiyot Tribe

**FROM:** Dimitra Zalarvis-Chase, Archaeologist

**EMAIL:** dimitrazc@gmail.com

**PHONE:** (707) 599-9842

**PROPOSED PROJECT:** Arcata Wastewater Treatment Facilities Improvements

**SITE LOCATION:** Arcata South 7.5-Minute Quad; T6N, R1E, Section 32

**SITE SIZE:** 295 ± acres

DZC Archaeology and CRM Consulting is conducting the necessary records search and comment solicitation pursuant to the California Environmental Quality Act, and AB 52.

The proposed project is to improve the Arcata Wastewater Treatment Facilities infrastructure with the addition of a new secondary treatment system.

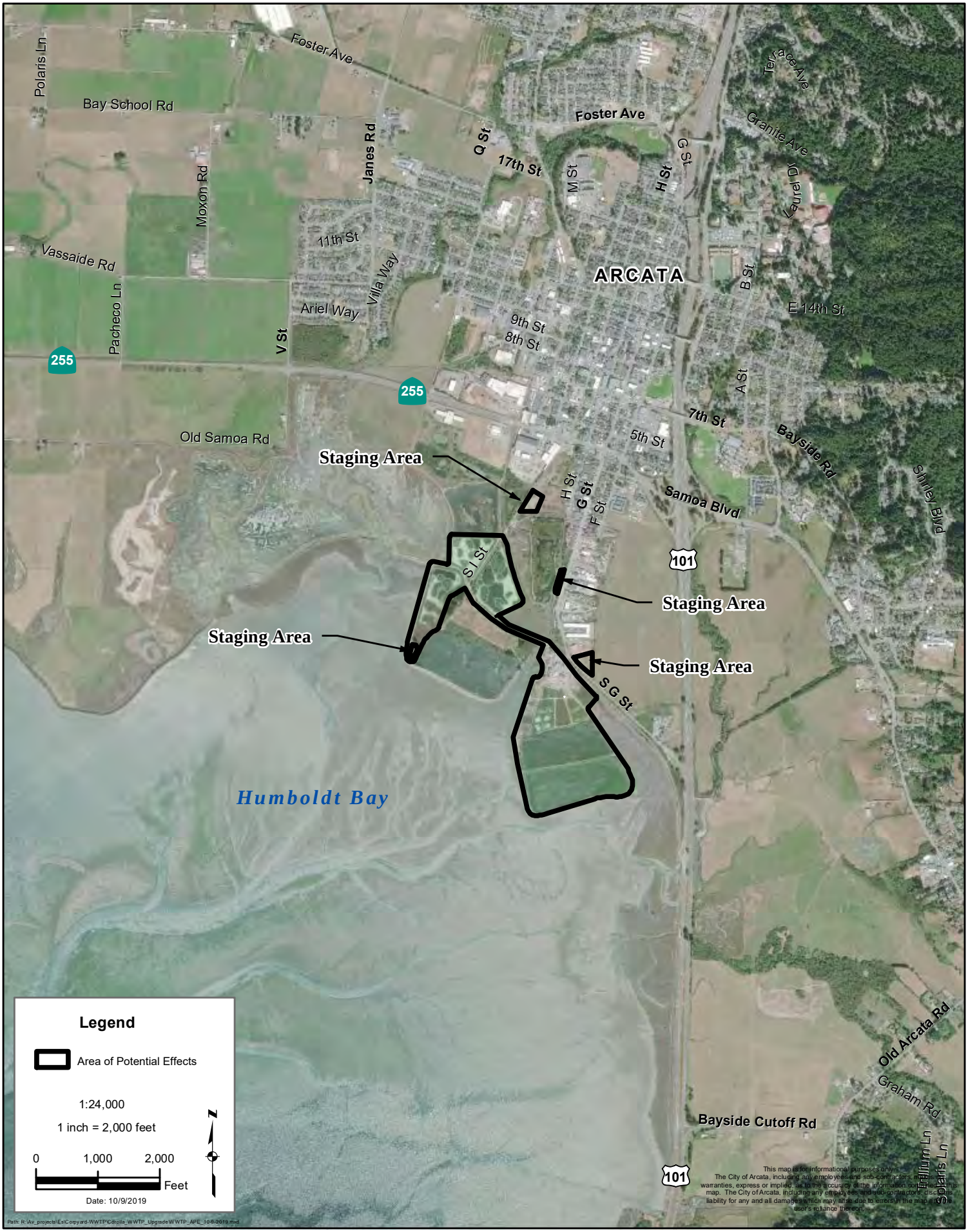
We would appreciate any information you could provide regarding known cultural resources in the project vicinity. If we have not received a response within 30 days from the date of this letter, we will assume you have no concerns or information to provide.

If this project is outside of your tribal area of sensitivity, please **also** contact the Native American Heritage Commission to refine your area of concern and avoid unwanted project notifications.

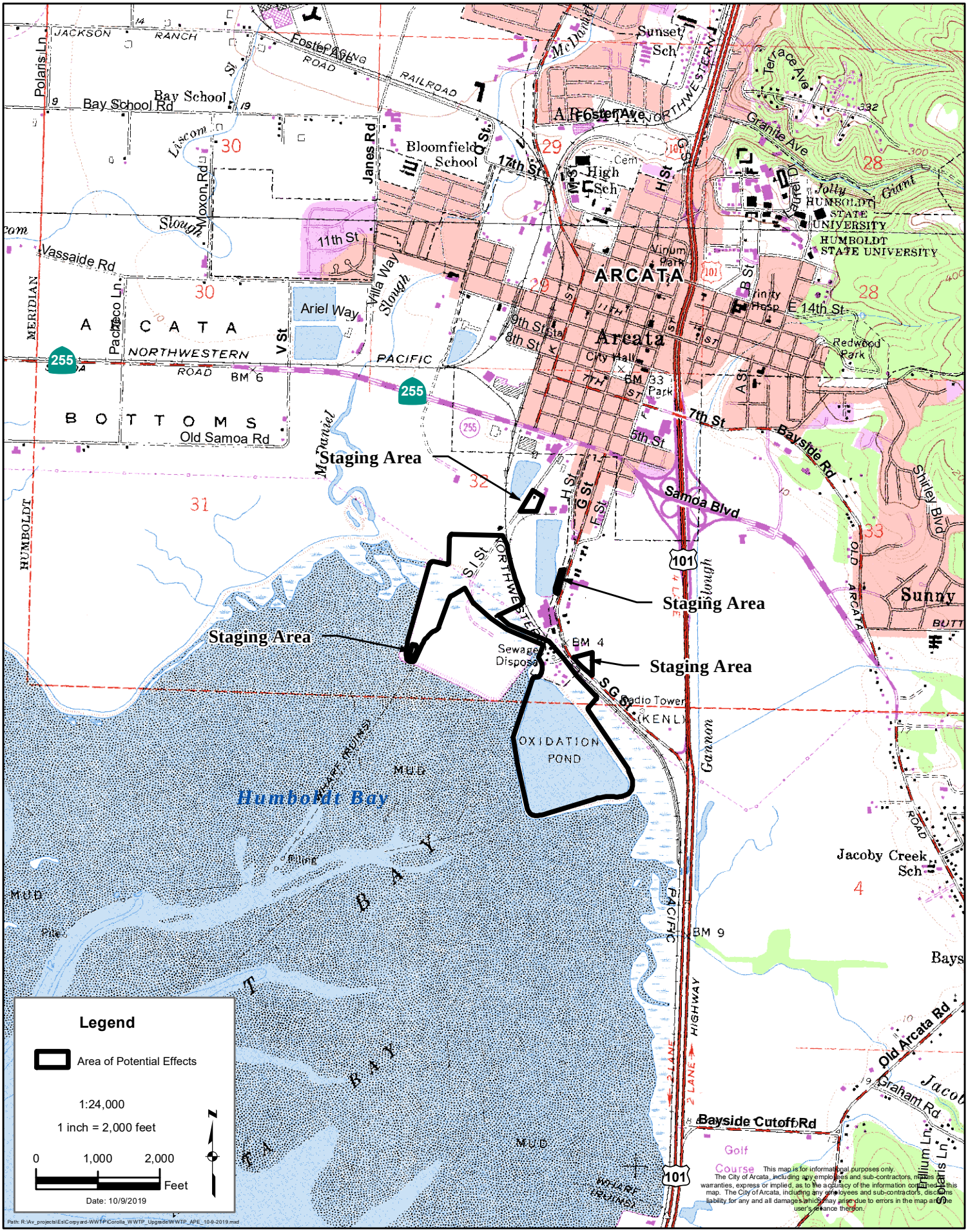
Thank you for your assistance.
Dimitra Zalarvis-Chase

Enclosed: Project Vicinity Map, Project Location Map

# Area of Potential Effects
# Arcata Wastewater Treatment Upgrade



# Area of Potential Effects
# Arcata Wastewater Treatment Upgrade



# Appendix C

## Northwest Information Center Correspondence

# Report Detail: S-000132

## Identifiers

*Report No.:* S-000132
*Other IDs:*
*Cross-refs:*

## Citation information

*Author(s):* David A. Fredrickson, Sonia Tamez, and Pamela R. Roberts
*Year:* 1975 (Mar)
*Title:* An Archaeological Survey of the Proposed McKinleyville Sewage Collection and Treatment Facility
*Affliliation:* The Anthropology Laboratory, California State College, Sonoma
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Field study
*Inventory size:* c 3660 ac + 25.50 li mi
*Disclosure:* Not for publication
*Collections:* No

## General notes

There was no surface evidence of a reported prehistoric site.

## Associated resources

| *Primary No.* | *Trinomial* | *Name* |
|---|---|---|
| P-12-000064 | CA-HUM-000006 | Loud 6, chumi' djome |
| P-12-000081 | CA-HUM-000023 | Loud 23, Digawethatkil - Tekewe |
| P-12-000083 | CA-HUM-000025 | Loud 25 |
| P-12-000097 | CA-HUM-000039 | Loud 39, mipa't |

*No. resources:* 4
*Has informals:* Yes

## Location information

*County(ies):* Humboldt
*USGS quad(s):* Arcata North, Arcata South, Eureka, Tyee City
*Address:*
*PLSS:*

## Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 4/7/2005 | nwic-main |
| *Last modified:* | 11/13/2017 | raelync |

*IC actions:*

| *Date* | *User* | *Action taken* |
|---|---|---|
| 4/7/2005 | jay | Appended records from NWICmain bibliographic database. |
| 1/13/2016 | hagell | edited notes |
| 11/13/2017 | raelync | Mapped in both Rep Poly and Approx to capture that access was not granted to portions of the northern area surveyed. |

*Record status:* Verified

# Report Detail: S-006403

### Identifiers

*Report No.:* S-006403
*Other IDs:*
*Cross-refs:*

### Citation information

*Author(s):* Barry Kevin Douglas
*Year:* 1984 (Feb)
*Title:* Archaeological Survey Report for a proposed sewage collection system for Bayside in Arcata, California
*Affliliation:*
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Field study
*Inventory size:*
*Disclosure:* Not for publication
*Collections:* No

### General notes

### Associated resources

*No. resources:* 0
*Has informals:* No

### Location information

*County(ies):* Humboldt
*USGS quad(s):* Arcata South
*Address:*
*PLSS:*

### Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 4/7/2005 | nwic-main |
| *Last modified:* | 5/30/2019 | hagell |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 4/7/2005 | jay | Appended records from NWICmain bibliographic database. |
| | 2/10/2015 | mikulikc | database incomplete: no affiliation submitted |

*Record status:* Verified

# Report Detail: S-006669

### Identifiers

*Report No.:* S-006669
*Other IDs:*
*Cross-refs:*

### Citation information

*Author(s):* Barry K. Douglas
*Year:* 1984 (Jun)
*Title:* Archaeological Survey Report, Butcher's Slough Wetlands Restoration Project, Arcata, California
*Affliliation:*
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Excavation, Field study
*Inventory size:* 30 ac.
*Disclosure:* Not for publication
*Collections:* No

### General notes

### Associated resources

| | *Primary No.* | *Trinomial* | *Name* |
|---|---|---|---|
| | P-12-000100 | CA-HUM-000042 | Loud 42 |

*No. resources:* 1
*Has informals:* No

### Location information

*County(ies):* Humboldt
*USGS quad(s):* Arcata South
*Address:*
*PLSS:* T6N R1E Sec. 32 MDBM

### Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 4/7/2005 | nwic-main |
| *Last modified:* | 11/15/2017 | moored |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 4/7/2005 | jay | Appended records from NWICmain bibliographic database. |
| | 11/13/2017 | raelync | no affiliation provided; added resource to list; |

*Record status:* Verified

# Report Detail: S-014210

### Identifiers

*Report No.:* S-014210
*Other IDs:*
*Cross-refs:*

### Citation information

*Author(s):* James M. Roscoe
*Year:* 1992 (Jun)
*Title:* An Archaeological Investigation of Assessor's Parcel Number 21-184-05, Located in Arcata, Humboldt County, California
*Affliliation:*
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Field study
*Inventory size:* c 0.3 ac
*Disclosure:* Not for publication
*Collections:* No

### General notes

### Associated resources

*No. resources:* 0
*Has informals:* No

### Location information

*County(ies):* Humboldt
*USGS quad(s):* Arcata South

| *Address:* | *Address* | *City* | *Assessor's parcel no.* | *Zip code* |
|---|---|---|---|---|
| | Samoa Boulevard | Arcata | 21-184-05 | |

*PLSS:*

### Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 4/7/2005 | nwic-main |
| *Last modified:* | 11/15/2017 | moored |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 4/7/2005 | jay | Appended records from NWICmain bibliographic database. |
| | 11/14/2017 | raelync | no affiliation provided |

*Record status:* Verified

# Report Detail: S-015199

## Identifiers

*Report No.:* S-015199
*Other IDs:*
*Cross-refs:*

## Citation information

*Author(s):* James Roscoe
*Year:* 1993 (Jun)
*Title:* A Cultural Resources Study of the Proposed Marsh Commons Project, Located in Arcata, California
*Affliliation:*
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Field study
*Inventory size:* c 1.5 ac
*Disclosure:* Not for publication
*Collections:* No

## General notes

The parcel APN's listed in the report have been subdivided into approx 14 parcels.

## Associated resources

*No. resources:* 0
*Has informals:* No

## Location information

*County(ies):* Humboldt
*USGS quad(s):* Arcata South

| *Address:* | *Address* | *City* | *Assessor's parcel no.* | *Zip code* |
|---|---|---|---|---|
| | | | 503-241-18 | |
| | | | 503-241-19 | |
| | | | 503-241-20 | |

*PLSS:*

## Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 4/7/2005 | nwic-main |
| *Last modified:* | 11/16/2017 | hagell |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 4/7/2005 | jay | Appended records from NWICmain bibliographic database. |
| | 4/2/2015 | mikulikc | database incomplete: no affiliation submitted |

*Record status:* Verified

# Report Detail: S-017469

## Identifiers

*Report No.:* S-017469

| *Other IDs:* | *Type* | *Name* |
|---|---|---|
| | Agency Nbr | DACW07-E-2f523 |

*Cross-refs:*

## Citation information

*Author(s):* Carroll W. Pursell, Jr.
*Year:* 1981 (Sep)
*Title:* Historical and Technological Significance of the Humboldt Bay Jetties, Humboldt Bay, California
*Affliliation:*
*No. pages:*
*No. maps:*
*Attributes:* Architectural/historical, Evaluation
*Inventory size:*
*Disclosure:* Not for publication
*Collections:* No

## General notes

## Associated resources

*No. resources:* 0
*Has informals:* No

## Location information

*County(ies):* Humboldt
*USGS quad(s):* Arcata South, Cannibal Island, Eureka, Fields Landing
*Address:*
*PLSS:*

## Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 4/7/2005 | nwic-main |
| *Last modified:* | 6/25/2019 | hagell |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 4/7/2005 | jay | Appended records from NWICmain bibliographic database. |
| | 4/2/2015 | mikulikc | database incomplete: affiliation not submitted |
| | 1/10/2017 | bentonb | added Cannibal Island as a quad |
| | 5/23/2019 | surgeonj | Added "Evaluation" ICDB report attribute, Changed GIS layer from "Other" to "Report Poly". |
| | 5/28/2019 | scannerwide | PDF Verified. Oversized pages have been scanned and added to PDF |

*Record status:* Verified

# Report Detail: S-022314

### Identifiers

*Report No.:* S-022314

*Other IDs:*

| *Type* | *Name* |
|---|---|
| Agency Nbr | FEMA HMGP #1008-6283 |

*Cross-refs:*

### Citation information

*Author(s):* David Fukutomi
*Year:* 1999 (Dec)
*Title:* Archaeological Survey for City of Arcata, Janes Creek Culvert and Drainage Improvements, FEMA HMGP #1008-6283 (letter report)
*Affliliation:* Federal Emergency Management Agency
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Field study
*Inventory size:*
*Disclosure:* Not for publication
*Collections:* No

### General notes

### Associated resources

*No. resources:* 0
*Has informals:* No

### Location information

*County(ies):* Humboldt
*USGS quad(s):* Arcata South
*Address:*
*PLSS:* T6N R1E Sec. 32

### Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 4/22/2005 | leigh |
| *Last modified:* | 3/24/2015 | paganob |

*IC actions:*
*Record status:* Verified

# Report Detail: S-029030

### Identifiers

*Report No.:* S-029030
*Other IDs:*
*Cross-refs:*

### Citation information

*Author(s):* Leigh Martin
*Year:* 2004 (Sep)
*Title:* Archaeological Assessment of a 1.5-Acre Parcel (APN 367-180-010), Located at 915 Deer Creek Drive, Martinez, Contra Costa County, California (letter report)
*Affliliation:* WSA
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Field study
*Inventory size:* c 1 ac
*Disclosure:* Not for publication
*Collections:* No

### General notes

### Associated resources

*No. resources:* 0
*Has informals:* No

### Location information

*County(ies):* Contra Costa
*USGS quad(s):* Briones Valley

| *Address:* Address | City | Assessor's parcel no. | Zip code |
|---|---|---|---|
| 915 Deer Creek Drive | Martinez | 367-180-010 | |

*PLSS:* T11N R3W Rancho El Pinole

### Database record metadata

| | Date | User |
|---|---|---|
| *Entered:* | 4/7/2005 | nwic-main |
| *Last modified:* | 11/15/2017 | moored |

| *IC actions:* Date | User | Action taken |
|---|---|---|
| 4/7/2005 | jay | Appended records from NWICmain bibliographic database. |

*Record status:* Verified

# Report Detail: S-037718

## Identifiers

*Report No.:* S-037718

| *Other IDs:* | *Type* | *Name* |
|---|---|---|
| | Voided | NCoIC S-24426 |

*Cross-refs:*

## Citation information

*Author(s):* William Rich, James Roscoe, and Susie Van Kirk

*Year:* 2003 (Apr)

*Title:* A Cultural Resources Investigation of the Proposed McDaniel Slough Marsh Enhancement Project, Located near Arcata, Humboldt County, California

*Affliliation:* Roscoe and Associates

*No. pages:*

*No. maps:*

*Attributes:* Archaeological, Architectural/historical, Field study

*Inventory size:*

*Disclosure:* Not for publication

*Collections:* No

## General notes

The historic Bull-Hunt Barn is within the project area. There was no evidence of CA-HUM-42. It may be located several hundred yards to the east of the property boundaries.

## Associated resources

| *Primary No.* | *Trinomial* | *Name* |
|---|---|---|
| P-12-000097 | CA-HUM-000039 | Loud 39, mipa't |
| P-12-000100 | CA-HUM-000042 | Loud 42 |
| P-12-002605 | CA-HUM-001156H | Arcata Land Improvement 1893 |

*No. resources:* 3

*Has informals:* Yes

## Location information

*County(ies):* Humboldt

*USGS quad(s):* Arcata South

*Address:*

*PLSS:*

## Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 2/24/2011 | guldenj |
| *Last modified:* | 3/4/2015 | mikulikc |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 2/26/2015 | rinerg | add CA-HUM-39 to resources |

*Record status:* Verified

# Report Detail: S-038304

## Identifiers

*Report No.:* S-038304

*Other IDs:*

| *Type* | *Name* |
|---|---|
| Voided | NCoIC S-25180 |
| Caltrans | EA 01-366000 |
| Caltrans | EA 01-363300 |

*Cross-refs:*

## Citation information

*Author(s):* Timothy Keefe

*Year:* 2006 (Sep)

*Title:* Historic Property Survey Report for the Proposed Eureka-Arcata Corridor Projects on California State Highway 101 at Post Mile 79.9/86.3 in Humboldt County, California

*Affliliation:* Caltrans; URS Corporation; JRP Historical Consulting Services

*No. pages:*

*No. maps:*

*Attributes:* Archaeological, Architectural/historical, Evaluation, Field study

*Inventory size:*

*Disclosure:* Not for publication

*Collections:* Unknown

---

*Sub-desig.:* a

*Author(s):* Sally Salzman Morgan, Sean David Dexter, and Brian Hatoff

*Year:* 2006 (Aug)

*Title:* Archaeological Survey Report: Eureka to Arcata Route 101 Corridor Improvement Project, Humboldt County, California

*Affiliation:* URS

*Report type(s):* Archaeological, Field study

*Inventory size:*

*No. pages:*

*Disclosure:* Not for publication

*Collections:* No

*PDF Pages:* 52-121

---

*Sub-desig.:* b

*Author(s):* Timothy Keefe

*Year:* 2006 (Sep)

*Title:* Supplemental Archaeological Survey Report for the Eureka-Arcata Corridor Projects, State Route 101, Humboldt County, California, 01-HUM-101, (PM 79.9/84.4)

*Affiliation:* Caltrans District 01

*Report type(s):* Archaeological, Field study

*Inventory size:*

*No. pages:*

*Disclosure:* Not for publication

*Collections:* No

*PDF Pages:* 122-164

## General notes

Site records and Attachments 5 - 8 (historic evaluation reports, Batini Dump Site action plan, & historic significance of bridges) were missing from this copy of the report. There was no conclusive surface evidence of CA-HUM-48, CA-HUM-49, or CA-HUM-50.

## Associated resources

| *Primary No.* | *Trinomial* | *Name* |
|---|---|---|
| P-12-000106 | CA-HUM-000048 | Loud 48 |
| P-12-000107 | CA-HUM-000049 | Loud 49 |
| P-12-000108 | CA-HUM-000050 | Loud 50 |

# Report Detail: S-038304

| | | | |
|---|---|---|---|
| | P-12-000717 | CA-HUM-000726H | Northwestern Pacific Railroad |
| | P-12-001397 | CA-HUM-001053H | Timber bridge ruins at Brainard |
| | P-12-001398 | | Void, see P-12-000717 |
| | P-12-001399 | | Isolate #1 - wood in water |
| | P-12-001400 | | Isolate #2 - Plank ditch |
| | P-12-001401 | | Isolate #3 - Chert Flake |
| | P-12-002662 | CA-HUM-001165H | Batini Dump |
| | P-12-003310 | | Murray Field Airport |
| *No. resources:* | 11 | | |
| *Has informals:* | No | | |

### Location information

| | |
|---|---|
| *County(ies):* | Humboldt |
| *USGS quad(s):* | Arcata South, Eureka |
| *Address:* | |
| *PLSS:* | |

### Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 11/9/2011 | blacke |
| *Last modified:* | 4/7/2015 | grahams |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 2/9/2015 | mikulikc | updated database; added additional citation information |

*Record status:* Verified

# Report Detail: S-038434

### Identifiers

*Report No.:* S-038434

*Other IDs:*

| *Type* | *Name* |
|---|---|
| OHP PRN | COE120426A |

*Cross-refs:*

### Citation information

*Author(s):* Charlane Gross and Jason Coleman
*Year:* 2011 (Dec)
*Title:* Archaeological Inventory and Evaluation for the Wal-Mart Mitigation at the Old Lynch Canyon Homestead Project, Solano County, California
*Affliliation:* Solano Archaeological Services
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Evaluation, Excavation, Field study
*Inventory size:*
*Disclosure:* Not for publication
*Collections:* Yes

---

*Sub-desig.:* a
*Author(s):* Charlane Gross and Jason A. coleman
*Year:* 2011 (Dec)
*Title:* (draft) Archaeological Inventory and Evaluation for the Wal-Mart Mitigation at the Old Lynch Canyon Homestead Project, Solano County, California
*Affiliation:* Solano Archaeological Services
*Report type(s):* Archaeological, Evaluation, Excavation, Field study
*Inventory size:*
*No. pages:*
*Disclosure:* Not for publication
*Collections:* Yes
*PDF Pages:* 111-218

---

*Sub-desig.:* b
*Author(s):* Jenan Saunders and Jane M. Hicks
*Year:* 2012 (May)
*Title:* Re: Wetlands restoration project at the Old Lynch Homstead (COE 120426A); File Number 2006-30352N
*Affiliation:* Office of Historic Preservation; US Army Corps of Engineers
*Report type(s):* OHP Correspondence
*Inventory size:*
*No. pages:*
*Disclosure:* Not for publication
*Collections:* No
*PDF Pages:* -

### General notes

### Associated resources

| *Primary No.* | *Trinomial* | *Name* |
|---|---|---|
| P-48-000388 | CA-SOL-000303/H | Williams and Morgan Homestea |

*No. resources:* 1
*Has informals:* No

### Location information

*County(ies):* Solano
*USGS quad(s):* Cordelia

# Report Detail: S-038434

| *Address:* | *Address* | *City* | *Assessor's parcel no.* | *Zip code* |
|---|---|---|---|---|
| | | Lynch Canyon | | |

*PLSS:* T4N R3W Sec. 16, 17 MDBM

**Database record metadata**

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 1/13/2012 | blacke |
| *Last modified:* | 9/24/2018 | carlosp |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 3/6/2018 | vickeryn | Assigned subdivision 'a' to additional citation 'a' |
| | 9/24/2018 | carlosp | fixed spelling for additional citation; added additional citation 'b' and 'c'; and OHP PRN |
| | 9/24/2018 | carlosp | |

*Record status:* Verified

# Report Detail: S-040249

### Identifiers

*Report No.:* S-040249
*Other IDs:*
*Cross-refs:*

### Citation information

*Author(s):* Jason A. Coleman
*Year:* 2013 (Jan)
*Title:* Cultural Resources Survey Report for the South G Street (Christie) WRP Project, Humboldt County, California
*Affliliation:* Solano Archaeological Services
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Field study
*Inventory size:*
*Disclosure:* Not for publication
*Collections:* No

### General notes

### Associated resources

*No. resources:* 0
*Has informals:* No

### Location information

*County(ies):* Humboldt
*USGS quad(s):* Arcata South
*Address:*
*PLSS:*

### Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 3/11/2013 | baileyl |
| *Last modified:* | 4/4/2013 | kloppl |

*IC actions:*
*Record status:* Verified

# Report Detail: S-041725

### Identifiers

*Report No.:* S-041725

| *Other IDs:* | *Type* | *Name* |
|---|---|---|
| | Voided | NCoIC S-23963 |

*Cross-refs:*

### Citation information

*Author(s):* Nick Angeloff and James Roscoe

*Year:* 2004 (Nov)

*Title:* A Cultural Resources Investigation of the Daylighting of Jolly Giant Creek Project, located in Humboldt County, California

*Affliliation:* Cultural Resources Facility, Center for Indian Community Development, Humboldt State University

*No. pages:*

*No. maps:*

*Attributes:* Archaeological, Field study

*Inventory size:*

*Disclosure:* Not for publication

*Collections:* No

### General notes

### Associated resources

*No. resources:* 0

*Has informals:* No

### Location information

*County(ies):* Humboldt

*USGS quad(s):* Arcata South

*Address:*

*PLSS:* T5N R1E Sec. 32 HBM

### Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 9/11/2013 | blacke |
| *Last modified:* | 11/16/2017 | hagell |

*IC actions:*

*Record status:* Verified

# Report Detail: S-041786

## Identifiers

*Report No.:* S-041786

*Other IDs:*

| *Type* | *Name* |
|---|---|
| Voided | NCoIC S-24030 |
| OHP PRN | FHWA 040302A |

*Cross-refs:*

## Citation information

*Author(s):* Leslie S. Heald
*Year:* 2002 (Dec)
*Title:* Historic Property Survey, Archaeological Survey, and Historical Resources Evaluation Reports, Highway 255 Gateway Improvements, CALTRANS District 1, Humboldt County, CA
*Affliliation:*
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Architectural/historical, Evaluation, Field study
*Inventory size:*
*Disclosure:* Not for publication
*Collections:* No

---

*Sub-desig.:* a
*Author(s):* James M. Roscoe
*Year:* 2002 (Oct)
*Title:* Archaeological Survey Report Arcata Highway 255 Improvement
*Affiliation:*
*Report type(s):* Archaeological, Field study
*Inventory size:*
*No. pages:*
*Disclosure:* Not for publication
*Collections:* No
*PDF Pages:* 21-23

---

*Sub-desig.:* b
*Author(s):* Leslie S. Heald
*Year:* 2002 (Nov)
*Title:* Historical Resources Evaluation Report Highway 255 Gateway Improvements
*Affiliation:*
*Report type(s):* Architectural/historical, Field study
*Inventory size:*
*No. pages:*
*Disclosure:* Unrestricted
*Collections:* No
*PDF Pages:* 24-155

## General notes

## Associated resources

| *Primary No.* | *Trinomial* | *Name* |
|---|---|---|
| P-12-002613 | | 524-540 3rd St. |
| P-12-002614 | | 513 4th St. |
| P-12-002615 | | 541 4th St |
| P-12-002616 | | 304-344 F Street & 566 3rd St. |
| P-12-002617 | | 309 F Street |
| P-12-002618 | | 345 F Street |
| P-12-002619 | | 347 F Street |
| P-12-002620 | | 407 F Street & 646 Samoa Blvd |

# Report Detail: S-041786

| | |
|---|---|
| P-12-002621 | 414 F Street |
| P-12-002622 | 389 H Street |
| P-12-002623 | 438 H Street |
| P-12-002624 | 460 I Street, 885 5th Street, 491 |
| P-12-002625 | 421 J Street |
| P-12-002626 | 901 Samoa Blvd |
| P-12-002627 | 940-960 Samoa Blvd |
| P-12-002628 | 1017-1117 Samoa Blvd |
| P-12-002629 | 1076 Samoa Blvd |

*No. resources:* 17

*Has informals:* No

## Location information

*County(ies):* Humboldt

*USGS quad(s):* Arcata South

*Address:*

*PLSS:*

## Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 9/12/2013 | HagelL |
| *Last modified:* | 11/16/2017 | hagell |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 2/25/2015 | rinerg | clean up identifiers, check resources; create additional citations for architechural survey report & archaeological survey report |
| | 3/4/2015 | mikulikc | database incomplete: no affiliation submitted |

*Record status:* Verified

# Report Detail: S-048287

### Identifiers

*Report No.:* S-048287
*Other IDs:*
*Cross-refs:*

### Citation information

*Author(s):* James Roscoe and William Rich
*Year:* 2012 (Jun)
*Title:* A Cultural Resources Investigation of three Coastal Access Points for the Humboldt Bay Water Trails Implementation Program, Located in Humboldt County, California
*Affliliation:* Roscoe and Associates - Cultural Resources Consultants
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Architectural/historical, Field study
*Inventory size:*
*Disclosure:* Not for publication
*Collections:* No

### General notes

### Associated resources

*No. resources:* 0
*Has informals:* No

### Location information

*County(ies):* Humboldt
*USGS quad(s):* Arcata South, Eureka
*Address:*
*PLSS:*

### Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 12/5/2016 | cabrala |
| *Last modified:* | 1/6/2017 | grahams |

*IC actions:*
*Record status:* Verified

# Report Detail: S-050908

## Identifiers

*Report No.:* S-050908

*Other IDs:*

| *Type* | *Name* |
|---|---|
| OTIS Report Number | EPA_2018_0110_001 |
| Other | CWSRF No 8127-110 |
| Other | NWIC 17-1254 |

*Cross-refs:*

## Citation information

*Author(s):* Nick Angeloff and Lynette Mullen
*Year:* 2016 (Jun)
*Title:* A Cultural Resources Investigation of the Arcata Wastewater Inflow and Infiltration Project, Arcata, Humboldt County, California
*Affliliation:* Archaeological Research and Supply Company
*No. pages:*
*No. maps:*
*Attributes:* Archaeological, Field study
*Inventory size:*
*Disclosure:* Not for publication
*Collections:* Yes

---

*Sub-desig.:* a
*Author(s):* Nick Angeloff
*Year:* 2017 (Nov)
*Title:* Addendum of: A Cultural Resources Investigation of the Arcata Wastewater Inflow And Infiltration Project, Arcata, Humboldt County, California, Addendum 1
*Affiliation:* Archaeological Research and Supply Company
*Report type(s):* Archaeological, Excavation, Field study, Management/planning
*Inventory size:*
*No. pages:*
*Disclosure:* Not for publication
*Collections:* Yes
*PDF Pages:* 140-174

---

*Sub-desig.:* b
*Author(s):* NICK ANGELOFF
*Year:* 2017 (Sep)
*Title:* Arcata Wastewater 1&1 Project Historic Resources Report, Amendment 2
*Affiliation:* Archaeological Research and Supply Company
*Report type(s):* Archaeological, Management/planning
*Inventory size:*
*No. pages:*
*Disclosure:* Not for publication
*Collections:* Yes
*PDF Pages:* -

# Report Detail: S-050908

*Sub-desig.:* c
*Author(s):* Julianne Polanco and Wendy Pierce
*Year:* 2018 (Mar)
*Title:* Section 106 Compliance for the City of Arcata's Inflow and Infiltration Reduction Project, Humboldt County, Clean Water State Revolving Fund Project No. 8127-110 (your letter of January 09, 2018) ( EPA_2018_0110_001 )
*Affiliation:* Office of Historic Preservation, CA State Water Resources Control Board
*Report type(s):* OHP Correspondence
*Inventory size:*
*No. pages:*
*Disclosure:* Unrestricted
*Collections:* No
*PDF Pages:* 185-192

*Sub-desig.:* d
*Author(s):* Nick Angeloff
*Year:* 2017 (Nov)
*Title:* Monitoring and Discovery Plan for The City Of Arcata CWSRF I&I Project, Humboldt County, California
*Affiliation:* Archaeological Research and Supply Company, City of Arcata
*Report type(s):* Archaeological, Management/planning
*Inventory size:*
*No. pages:*
*Disclosure:* Not for publication
*Collections:* Yes
*PDF Pages:* 193-382

*Sub-desig.:* e
*Author(s):* Nick Angeloff
*Year:* 2017 (Dec)
*Title:* Data Recovery Plan for the City Of Arcata CWSRF I&I Project, Humboldt County, California ( 8127-110 )
*Affiliation:* Archaeological Research and Supply Company, City of Arcata
*Report type(s):* Archaeological, Management/planning
*Inventory size:*
*No. pages:*
*Disclosure:* Not for publication
*Collections:* No
*PDF Pages:* 383-401

### General notes

### Associated resources

| *Primary No.* | *Trinomial* | *Name* |
|---|---|---|
| P-12-000100 | CA-HUM-000042 | Loud 42 |
| P-12-000101 | CA-HUM-000043 | Loud 43 |
| P-12-000102 | CA-HUM-000044 | Loud 44 |
| P-12-000363 | CA-HUM-000351/H | [none] |
| P-12-000364 | CA-HUM-000352 | Void, see P-12-000363 |
| P-12-001305 | | Campbell Creek Dam |
| P-12-001306 | | Campbell Creek corduroy road |
| P-12-001401 | | Isolate #3 - Chert Flake |
| P-12-002595 | | University Center, Humboldt Stat |
| P-12-002605 | CA-HUM-001156H | Arcata Land Improvement 1893 |
| P-12-002613 | | 524-540 3rd St. |
| P-12-002614 | | 513 4th St. |
| P-12-002615 | | 541 4th St |
| P-12-002616 | | 304-344 F Street & 566 3rd St. |
| P-12-002617 | | 309 F Street |

# Report Detail: S-050908

| | |
|---|---|
| P-12-002618 | 345 F Street |
| P-12-002619 | 347 F Street |
| P-12-002620 | 407 F Street & 646 Samoa Blvd |
| P-12-002621 | 414 F Street |
| P-12-002622 | 389 H Street |
| P-12-002623 | 438 H Street |
| P-12-002624 | 460 I Street, 885 5th Street, 491 |
| P-12-002625 | 421 J Street |
| P-12-002628 | 1017-1117 Samoa Blvd |
| P-12-003050 | Arcata Substation Control Buildi |
| P-12-003279 | 1825 11th St |
| P-12-003280 | Caldwel House / John Silva Resi |
| P-12-003281 | McKenzie House |
| P-12-003282 | Car Garage |

*No. resources:* 29

*Has informals:* No

## Location information

*County(ies):* Humboldt

*USGS quad(s):* Arcata North, Arcata South

| *Address:* | *Address* | *City* | *Assessor's parcel no.* | *Zip code* |
|---|---|---|---|---|
| | | Arcata | | |

*PLSS:*

## Database record metadata

| | *Date* | *User* |
|---|---|---|
| *Entered:* | 8/9/2018 | mcgurlm |
| *Last modified:* | 5/16/2019 | surgeonj |

| *IC actions:* | *Date* | *User* | *Action taken* |
|---|---|---|---|
| | 8/9/2018 | mcgurlm | Citations "a, b, c, d, e" |
| | 1/9/2019 | lucientesK | Updated report attributes of main report and additional citations. |

*Record status:* Verified

# Appendix D

## Historical Documents



photos.com

# Eco Tipping Points

## How a vicious cycle can become virtuous

### by Amanda Suutari and Gerald Marten

The cicadas are in full voice on a sultry morning in May as we make our way along a rickety wooden boardwalk that snakes through a community mangrove forest near Thung Dase village in southern Thailand. The mangroves offer welcome shade near a dock where a small boat is moored. Handmade bamboo traps are set to catch mud crabs when the tides go out. In a flash of orange and turquoise, a kingfisher swoops to a low-hanging branch.

It's hard to imagine that three decades ago the area's lush abundance was collapsing into a wasteland. "At one time," recalls Nom Ham Yak, chair of the forest's management committee, "our economic base was crabs, fisheries, and rubber. Then areas were leased as concessions to private contractors to clear for charcoal, and the forest became badly degraded."

The prospects for the area's villages were so bleak that a revival would have seemed a fantasy. What brought them back from the brink was an Eco Tipping Point.

Eco Tipping Points offer a new paradigm for restoring our communities, both natural and human. Conventional approaches to ecological problems – from piecemeal micromanagement, to techno-fixes, to top-down regulation – often fail or generate new messes. But Eco Tipping Points show how the same forces that endanger environments and communities can be harnessed to heal them.

To demonstrate what Eco Tipping Points are and how they work, consider two very different stories from two continents: the mangrove forests of Trang Province and the marshes of Arcata, California.

## From charcoal to pink gold

Five hundred thirty-five miles south of Bangkok, Trang Province is located on Thailand's southwest coast at the western shore of the Andaman Sea. Thung Dase and its neighboring villages lie in the watershed of the Palian and Trang Rivers, which drain into the sea from the Bandthad mountain range. The villages cluster along the mangrove-lined coastal wetlands, providing a fertile buffer zone for marine and terrestrial life. Besides offering a rich variety of foods, mangrove forests supply medicinal plants and materials such as thatch for housing and fishing gear. They are also refuges and nurseries for juvenile fish, crabs, shrimp, and mollusks.

Big changes came in the 1960s, when the Thai government embraced the Western model of export-led development. Industrial trawlers freely violated the no-fishing zone two miles from shore. They ravaged the sea bed and coral reefs, swallowing fish stocks faster than they could regenerate. As their coastal fishery waned, fishers spent more time on their boats and went further from shore. Some used explosives or poisons to harvest the remaining fish, or invested in better fishing equipment – causing stocks to plummet even faster.

Meanwhile, the government had granted mangrove concessions to the private sector to make charcoal briquettes. As mangroves dwindled, so did the diverse and useful products they provided. "Plants and animals, especially crabs, became scarce," explains Nom Ham Yak.

Their options narrowing, fishers began accepting menial jobs cutting mangroves for charcoal, working on commercial trawlers, or migrating into nearby cities for work. "Fishing incomes went down," Ham Yak says. "The people in the village had to leave for towns to find work in fish-canning factories, rubber-tapping plantations, general day labor, or construction. When the men went out to work and the wives stayed in the village, family relations would suffer. People also started selling pieces of land because there was no work at that time."

Worse, development agencies and banks had begun promoting shrimp farming in the mangrove forests. Unfortunately, the 'pink gold' of shrimp aquaculture can be a classic boom-bust venture in which the production from a shrimp pond declines drastically after the first five years. Local people discovered that initial quick returns were supplanted by mounting debts and environmental ruin as abandoned shrimp ponds spread across the landscape.

In 1999, a team led by economist Suthawan Sathirathai did a cost-benefit analysis of shrimp farming on a ▶




Sukree Sukplang / Reuters

*Industrial trawlers sometimes violate the shoreline no-fishing zone, swallowing fish stocks faster than they can regenerate.*



Sukree Sukplang / Reuters

*Mangrove forests supply medicinal plants and thatch for housing and fishing gear. They are also refuges for juvenile fish, shrimp, mollusks, and crab.*

coastal village in Surathani Province, southern Thailand, to compare the monetary value of mangroves versus shrimp farms. When taking into account only marketable products, shrimp farms brought higher returns, with a net value of $9,335 US per acre compared to $1,665 for mangroves. But calculating in the indirect value of mangroves dramatically reversed these figures. When they assigned a monetary value to environmental services such as nurseries for fish and protection from erosion and storms, the value of the mangroves rose to $14,428, more than 50 percent higher than shrimp aquaculture.

## The positive tip

As university students, Pisit Charnsnoh and his wife, Ploenjai, were part of a generation of democracy activists. After graduating from Khon Khaen University, Charnsnoh got involved with rural development and urban labor rights. In 1985, the couple moved to Ploenjai's hometown in Trang Province, where they started a small organization called Yadfon Association (Yadfon means 'raindrop' in Thai), aimed at helping the coastal villages in the region. At that time, Trang Province residents were locked into a vicious cycle of increasing poverty, unraveling society, and a deteriorating ecosystem.

Yadfon members spent nearly a year in dialogue with the villagers of Ban Leam Makham, working hard to gain the community's trust. The approach was to support residents' own insights into their shared crisis. Charsnoh points out that this method was more powerful than giving the villagers lectures. "We couldn't go in as outsiders and tell them, 'This or that species is disappearing, you have to be careful,' or 'You have to protect these forests.'" Over time, and with some success with micro-credit, well-digging, and other rural development schemes, Yadfon began to earn the villagers' respect.

Through a series of meetings with Yadfon, villagers developed the idea of reviving the badly degraded mangrove forests around Ban Leam Markham and Ban Thung Dase. Because the land was under government control, Yadfon staff acted as a go-between to obtain consent from provincial authorities to create a community mangrove forest. The first of its kind in Thailand, the forest covered 95 acres of land. It later became part of a 235-acre area that combined the mangrove forest with a sea grass conservation zone.

An emerging inter-village network created a system to manage the forest. Allowing use of some areas of the forest helped to get buy-in from a community that would otherwise break rules if the whole forest were declared off-limits. They prohibited shrimp farms inside the forests, set up no-fishing areas, discouraged the use of cyanide and dyna-

mite, and banned push-nets altogether. They replanted some areas of the forest and designated others untouchable, to allow for natural regeneration. The network also began replanting the sea grass beds in the coastal waters of nearby Chao Mai village.

Their efforts paid off. There was an increase in the near-shore fish catch, and a species of fish thought to have disappeared returned. These early results boosted the villagers' commitment and motivated them to further action. An endangered dugong spotted in the waters near Chao Mai village helped win government support for their seagrass protections zones; the dugong became a living symbol for conservation progress in the area.

## Cycles and tipping points

Creating community mangrove forests was an Eco Tipping Point. It tipped the local community and environment from a vicious cycle to a *virtuous* cycle, and the momentum switched from destruction to recovery.

Vicious and virtuous cycles are 'feedback loops.' These mutually reinforcing cycles of cause and effect are the heart of Eco Tipping Points. In the negative tip, as mangroves were cleared, fisheries began to decline. As fish stocks fell, fishers worked harder to get them, causing stocks to fall ever faster. In this way, they were locked into a vicious cycle of declining resources and an accelerating race to get what little remained.

After the positive tip, the fishery began to restore itself. In a study of 500 families between 1991 and 1994, total catch rose by 40 percent. Fishers spent three to four fewer hours per week on the water, while their net incomes increased by 200 percent. They could return with full boats without using dynamite or pushnets. In this virtuous cycle, less pressure from fishers allowed fish stocks to recover faster, making the fishers' jobs even easier.

The revival of the fishery spawned other virtuous cycles. Better incomes meant there was less need to migrate from villages. Instead of being locked into depletion, villagers were now locked into conservation, as the financial incentive to preserve mangroves now outweighed the incentive to destroy them.

Most importantly, investing in their future motivated the people to fight for it. A sense of ownership gave them the grit and confidence to confront encroaching trawlers and to lobby the government to enforce the two-mile no-fishing zone. It also made them less likely to sell off their land, which often ended up being converted to resort development. Reviving the forests also helped to put zoning limits on shrimp ponds. Charnsnoh explains that while many of their villages have shrimp ponds, they have kept the ponds outside the boundaries of the forests.

While the community mangrove forests started small, the virtuous cycles rippled out over time. Today, these districts include 10 community forests and four sea grass and dugong conservation areas totaling 50 square miles. Meanwhile, Yadfon has extended its involvement to some 60 villages in the three districts. Through a growing network of grassroots organizations, Charnsoh is involved with influencing policy at the national and international levels, lobbying for stronger legal standing for the forests, and gathering support to stop the practice of intensive shrimp farming. Meanwhile, Ploenjai is connecting with villages further inland, discovering new links between inland and ▶



Gerald Marten

*Humboldt County, California decided to treat wastewater as a resource rather than a problem, and built the Arcata Marsh and Wildlife Sanctuary. The marsh relies on natural systems to filter the city's sewage.*

coastal regions. "I was working with the fisherfolk since the beginning," she explains, "and have moved up [the watershed]. Now we work with the whole ecosystem."

## Treating wastewater with wetlands

Across the Pacific Ocean, a small university town nestled in the northern California coastal redwoods may seem worlds away from a fishing village of southern Thailand. But Arcata's pioneering wetland and wildlife sanctuary reveals a similar underlying story: tipping a coastal ecosystem from a vicious cycle into a virtuous one.

Home to Humboldt State University, Arcata is a vibrant little community some 280 miles north of San Francisco. Historic charm is visible in the thriving downtown, and green space abounds with the community forest and wetland areas framing the vista of Humboldt Bay. Arcata's Eco Tipping Point arrived when the community faced a sewage treatment crisis. Until the early 1950s the city discharged unchlorinated primary effluent into Humboldt Bay. Secondary treatment and chlorination were not added until the early 1970s. In 1974, federal water quality standards were revised, and state and regional authorities began cracking down.

The community faced a thorny dilemma: Buy into a proposed $25-million regional sewage processing plant to discharge treated, up-to-standard wastewater into Humboldt Bay – or devise a more environmentally acceptable alternative. The former would be a costly undertaking for a community whose population at the time was just 12,600. Also, the sewer pipeline was a potential nightmare, since ruptures under the bay could make the pollution worse.

Most importantly, the regional plant would have unleashed a vicious cycle of runaway sprawl. By laying the pipeline along the undeveloped land between Arcata and its neighbors, Arcatans believed developers would soon follow with strip malls, big-box retail zones, and subdivisions. More development would have affected the thriving downtown and locked residents into car-dependency. The sewage plant itself, along with the roads and infrastructure needed to support the development, would have demanded an unprecedented outlay from municipal coffers and taxpayers' wallets.

## The problem is the solution

The idea to treat the wastewater as a resource rather than a problem first came from Humboldt State University fisheries professor George Allen. In 1969, he had begun testing whether Pacific salmon and cutthroat trout could be raised in ponds of seawater and partially treated wastewater. Bob Gearhart, another Humboldt State University professor, expanded on Allen's idea. Why not use a marsh to treat municipal sewage more easily, more sustainably, and more economically? "The whole issue is the ownership of the wastewater – what you have control over," explains Gearhart. "It's not about disposal – it's a resource issue."

After a protracted and divisive political and legal battle known locally as 'The Wastewater Wars,' regional authorities reluctantly allowed the city to create a small version as a pilot project. If it was successful, the community would be free to expand to a fully functioning system.

The chosen site was a derelict brownfield that included a sealed landfill, two defunct logging mills, and a log pond. Creating the marsh first meant breaking up concrete where the lumber had once been stacked and stored on the old lumberyard site. National Guard engineers blew it up and carted it off. Next, a bulldozer terra-formed the ground, creating a micro-terrain similar to that of a wetland. Volunteers from the community planted several kinds of native marsh plants in order to have alternating areas of open water and vegetation. They took care to plant more densely in the farther reaches of the marsh in order to fully remove any solids that remained in the water. In 1986, the treatment system was completed and became operational.

Today, the Arcata Marsh and Wildlife Sanctuary covers 154 acres of freshwater and saltwater marshes, tidal mudflats, and grasslands. Wastewater is piped from homes and buildings to the 'headworks,' where debris is removed and solids settle. The solids are sent to digesters for use as compost on the town's community forest. The sewage is sent to oxidation ponds before entering a series of treatment and enhancement marshes. Naturally occurring processes progressively purify the water, then two rounds of chlorination bring it up to state standards before its release into Humboldt Bay.

When Eco Tipping Points launch virtuous cycles, they employ nature's own processes to do most of the work. Instead of a multi-million dollar treatment plant, Arcata has used the "free" services of a wetland to purify its wastewater. Roots and stems of wetland plants form a dense, netlike filter that removes suspended solids. Plants and algae remove nutrients such as nitrogen and phosphorus, while bacteria and fungi decompose the solids and remove dissolved organic material. Bulrushes provide a canopy of shade, controlling the growth of algae, and helping to slow water flow so the microorganisms can do their job.

Plants and microorganisms pass organic material up the food web to small aquatic animals and insects, and ultimately to top predators such as hawks, foxes, and otters that have come to symbolize the wildness of Arcata's wetland. As plants, animals, and microorganisms break down organic material to extract energy, the residue passes out of the wetland ecosystem and into

the atmosphere as carbon dioxide and water. Meanwhile, larger animals, birds, and flying insects move out of the wetland, carrying organic material and nutrients and distributing them around the surrounding countryside. They also bring in seeds from other areas, promoting and supporting biodiversity. The end result is a wetland and wildlife sanctuary that supports 300 species of birds and mammals, 100 species of plants, and six species of fish.

As the wetland regenerated nature's systems, it spun off virtuous cycles for humans as well. Arcata's wastewater and derelict brownfield became economically and socially valuable. 'Recycling' gave Arcatans access to their formerly blocked-off waterfront. They gained a community space for leisure and recreation that draws as many as 150,000 visitors a year. Walking through a pathway surrounded by the songs of thrushes hidden in dense foliage, it is hard to imagine that the wetlands are actually working to break down household sewage. By creating a physical barrier to development, the wetland became a *de facto* 'zoning restriction' that was more effective than any government regulation. Students at Humboldt State University gained a research site. In the process, they provided a level of technical support, data collection, and monitoring that the town could not have afforded on its own.

More critically, choosing this unorthodox path set Arcata apart from its more conventional neighbors and fed the city's sense of pride. The marsh became a shared symbol that has helped to shape local identity. The community's motto today is "Flush With Pride."

"I think the marsh has become symbolic of [the idea] that we can do things our way," says Julie Fulkerson, a former Arcata mayor and councilor. "Thinking of this community without the marsh is very depressing. For one thing, if the massive [treatment] system had been built, it would have cost millions of dollars, and we'd be paying for it. And with a pipeline between Eureka and Arcata, I just can't imagine why there would not have been development in that entire strip. It would have looked like any other blended community in California."

## Common ground

In spite of their obvious differences, a deeper look at both Arcata and Trang Province reveals Eco Tipping Points at the source of each community's revival. Both communities had found leverage points in the vicious cycles where targeted actions could reverse them. Feedback loops that created and reinforced environmental degradation were replaced by feedback loops that rescued the ecosystems. By allowing mangroves to regenerate, and by designing a system that could treat waste with very little external manipulation, the communities let nature do the work of restoring their shared resources. The cohesion that emerged as a result gave them the impetus to rise to new challenges.

Despite their successes, these communities are not utopias. Both are on steep learning curves towards sustainability, and new challenges emerge as old ones are tackled. But they show how human and natural systems can tip together out of decline and towards greater health and sustainability. They show that local citizens can devise their own environmental solutions, without elaborate government regulations or high-cost technologies. Sharing the stories of these Eco Tipping Points can demonstrate that achievements often considered unrealistic, costly, or otherwise unfeasible are not just desirable alternatives. They are practical ones. ✹

*Amanda Suutari is an environmental journalist based in Vancouver, Canada. Gerald Marten is an ecologist at the East-West Center in Honolulu (www.eastwestcenter.org).* *Steve Brooks and Ann Marten provided editorial contributions. The Eco Tipping Points project has documented approximately 100 environmental success stories to discover and communicate ingredients for success. The stories, lessons learned from them, and further explanation of how Eco Tipping Points work can be seen at www.ecotippingpoints.org. More details about Thailand's community mangrove forests and Arcata's constructed wetland are presented at www.ecotippingpoints.org/indepth/thailandmangrove.html and www.ecotippingpoints.org/indepth/usaarcata.html. Thanks to members of Yadfon Association, Arcata City Hall, and Humboldt State University for their extensive assistance.*



Gerald Marten

*The Arcata Marsh and Wildlife Sanctuary is a community leisure and recreation space that attracts some 150,000 visitors a year.*

# USA - California (Arcata) - Constructed Wetland: A Cost-Effective Alternative for Wastewater Treatment

ETP Share


- **Author**: Amanda Suutari
- **Posted**: June 2006
- Introduction by Ann Marten
- **Site visit assistance and editorial contributions**: Gerry Marten, Ann Marten


- This story was published in Earth Island Journal

- This in-depth ETP story features a Photogallery

**The city of Arcata, California was faced with a dilemma: Buy into an expensive regional sewage processing plant to bring their wastewater discharge into Humboldt Bay up to water quality standards, or come up with an acceptable alternative. They embarked on a pioneering journey, using wastewater to create and nourish a wetland where a logging pond and city dump had once been. The wetland provides prime wildlife habitat and recreation for the community at the same time it purifies the water.**

## Introduction

The people of Arcata, California, did not think of their sewage as a resource. In fact, like most of us, they did not think about their sewage much at all. But in 1974 they entered a period referred to as the "Wastewater Wars" when the need to reassess that view and assert their community's control of this "valuable" resource became essential.

Arcata is a small city located on Humboldt Bay, in the coastal redwood country of Northern California. In 1972 new federal legislation required that the water quality of the Bay be improved. Eureka, a larger city 5 miles south was often dumping raw sewage in to the bay, and Arcata's wastewater treatment plant was not adequately treating their wastewater. The State and regional government proposed a new

wastewater treatment plant that would serve this small university town and the other areas on the bay. This would be a very expensive undertaking for Arcata, population 12,600. Also, the sewer pipeline that would follow Highway 101 from McKinleyville on the north, through Arcata to Eureka and then out into the bay itself was a potential nightmare. Ruptures under the bay could make the pollution worse. And it would provide the infrastructure to open up the surrounding area to development.

Arcatans valued the unique character of their university town and their semi-rural setting. They had no desire to be engulfed by strip malls and housing developments. The regional wastewater treatment facility proposal was an engineer's and developer's dream. Turning that dream into their own is a story about taking charge of a local resource and tipping it from planned unsustainability to a sustainable, productive force in their community. The outcome was the Arcata Marsh and Wildlife Sanctuary (AMWF), 154 acres of freshwater and saltwater marshes, tidal mudflats and grasslands. It treats and disposes of the city's sewage while providing a wonderful natural recreational area, and has become an inspiration for other communities throughout the world.

In 1974, before this began, the area where the Arcata Marsh Interpretive Center (AMIC) now stands was surrounded by a derelict lumber mill with a log-filled marsh, cracking concrete and an unkempt landfill, affectionately known as Mt. Trashmore.

Arcata had recently fought a battle to prevent a new federal freeway from bisecting their town and developing the surrounding agricultural lands. Earlier on they had stopped the clear cutting of an adjoining redwood forest, turning it into a community park with hiking trails. It was the first community managed and owned forest in the country. Arcata also boasted the first recycling program in the country.

Despite their history of local environmental activism, taking on the State of California and the Feds was daunting. But there were things about Arcata that made it possible—though it didn't always seem that way in the midst of the fray. Arcata is the home of Humboldt State University, a campus known for its strong environmental programs. The more conservative surrounding areas see it as home to "kooks, tree huggers and flakes." Even within Arcata the town-gown split has traditionally mirrored this difference. However, a change in the federal electoral law had recently allowed 18 year olds to vote and the students and young residents used their new found voice to elect a new city council, one that campaigned on protecting the environment and near-by agricultural land. The university also contributed a faculty with incredible expertise and a willingness to share it.

Ironically, the shoreline of Humboldt Bay had not been accessible to the town for many years as it was blocked by the old saw mill, the landfill and the existing sewage treatment plant. Now it is the crown jewel of Arcata, used daily for recreation, birding and gazing by locals and tourists alike.

Committed and courageous leadership is essential to carry a campaign like this through to the end. The Arcata story had many. A trip around the marsh sanctuary introduces some of these leaders.

There is the George Allen Marsh on what was once an abandoned concrete log deck. In 1969 Dr. Allen, a professor of fisheries science at the university, had begun an experimental project intended to find out if Pacific Salmon and cutthroat trout could be raised in ponds with a mixture of partially treated wastewater and seawater. This project was the first to question the conventional paradigm of waste, accustoming Arcatan's to more elastic thinking about wastewater. In fact, the initial alternative proposal to the regional treatment plant was to use aquaculture based on some of Dr. Allen's ideas. Though this changed, he remained an important part of the development of the marsh.

Then we come to the Robert Gearheart Marsh, formerly minimally used pastureland. Dr. Gearheart was a professor of environmental engineering at the university. He always saw himself as a biologist first, and an engineer second. Like many of the important leaders in this project, he was willing to take a calculated risk —some would say a huge gamble. What they tried to do had never been done. He knew there was no guarantee his idea of a marsh would work. However, he was a careful scientist and an excellent communicator. His dedication to the vision of the marsh as way for the community to maintain control of its resources and uniqueness kept the torch alive. He feels that one of Arcata's strongest arguments was that "they were putting back into service 30-40 acres of unused wetland—basically ugly, industrial brownfields that nobody wanted."

Further on is Dan Hauser Marsh, the first marsh to be treated with wastewater. Dan served on the city council and as mayor from 1974—1982, and then spent 5 years as city manager. He felt the marsh grew out of political and land use issues rather than wastewater treatment. "When Bob Gearheart started explaining what a marsh could do and we began reading stories about what the marsh used to be like," Dan says, "I fell in love with the idea of marshes."

"The regional wastewater project was a good idea in theory, but it just didn't fit Arcata," according to Hauser. The proposed pipeline would increase pressure to develop the adjacent agricultural land. In fact, in 1974 one of Dan and the new city

council's first acts had been to deny water for development of a newly annexed area pushed through by the old guard. This effectively stopped the project.

Hauser and the council estimated that "The wastewater treatment plant and pipeline would have been the largest energy consumer in the county, costing a bundle to run." Even the environmental community was not wholly behind the marsh idea. David Joseph, an environmentalist, was the head of the North Coast Regional Water Quality Control Board (RWQCB), the body that was in charge of the proposed regional treatment plant. He was concerned that the city was trying "to get out of something." Also, at that time Eureka, the larger city down the road, was discharging raw sewage into the bay. He was afraid if the project didn't go through this wouldn't stop.

Continuing around the Marsh, Franklin Klopp Lake comes into view. Frank had been a city engineer since 1968, graduating to Director of Public Works. He was an "old guard" engineer and says he didn't object to the new treatment plant until he got to the last 4 pages of the report and saw the cost. It would mean doubling the sewer rates just to get it going. He had just pushed through a doubling of the rates and had taken quite a bruising. He was not anxious to repeat that. He started listening much more carefully to Bob Gearheart. But he needed to see an actual working example. Words were not enough. They went on a visit to Mountain View, a town on the peninsula south of San Francisco. There they saw "a simulated marsh made up in part of beer cans filled with foam and wood chips processing sewage." He figured with Arcata's resources it could work even better. He also gambled that the costs of developing the marsh for sewage treatment would be less than the regional plant. He figured it would have cost Arcata $10 million for their share of the construction of the regional system as opposed to the $5 million they spent. And the annual maintenance cost is about $500,000 instead of $1.5 million.

Today the marsh not only treats all of Arcata City's municipal sewage and wastewater, it also supports approximately 100 species of plants, 6 species of fish, and a multitude of bird and mammal species that have populated it naturally from the surrounding region, including otters. The marsh lies on the Pacific Flyway, which is the permanent or temporary home to over 200 species of birds. The Aleutian Goose, for example, takes off from the tip of the Aleutian Islands, flies across the Gulf of Alaska, and makes landfall in Humboldt County.

And most important, more than 200,000 people a year get to enjoy the marsh for recreation, birding, or scientific study, and the whole area now has access to the bay. The community support organization, Friends of Arcata Marsh, hosts regular birding tours. Moreover, since 1996 Arcata has hosted the annual 3-day Godwit Days festival, a birding event held at the peak of the spring migration, which

features field trips, boating excursions, lectures and other community activities for birders.

The vicissitudes of the political battle that led to the marsh are complex. It came down to the pro-marsh forces being able to prove that the marsh would "enhance" the water quality of the bay, meeting a key legal requirement. We will leave most of the politics aside for now and focus on the marsh itself.

---

## The Setting and Its History

Arcata city, population 16,651, lies on the north-east shore of Humboldt Bay, 280 miles north of San Francisco. It was established in 1850 as a supply port during the gold rush era that precipitated the timber boom which was to follow. Arcata rests in the heart of Northern California's "redwood county" and is home to Humboldt State University. In 1970, the population was 8,985, and it has risen to 12,850 in 1980 and to 15,197 in 1990. Today it has about 16,381. About half of Arcata's residents are students at Humboldt State University, and the overwhelming majority of the population (81.3 %) is Caucasian. It is a progressive town in an otherwise conservative region. The decline of the logging and fishing industries has caused the regional economy to flounder economically over the past three decades. Where Arcatans see an unspoiled landscape, small cottage industries and extensive community involvement as ongoing goals, others in the region would like to see industries that bring jobs, convenient shopping and affordable housing so they can stay there.

People have inhabited the region of Humboldt Bay for thousands of years. The indigenous Yurok and Wiyot people settled here because of its abundant resources and easy access to transportation. In those days, the Bay was surrounded by salt marshes, freshwater swampy meadows, and forest. Despite the Wiyot peoples' presence, the landscape remained relatively unchanged over centuries.

From 1849, however, European explorers arrived and began to settle in the area. The settlers forcibly displaced and sometimes massacred the indigenous communities, so that by 1860 the native population was down to less than 5% of its pre-Europe population. From 1870 the settlers began draining the marshes for agriculture, and built a wharf and California's first railroad track. The railroad linked dry land and a shipping channel built further out into the Bay that remained functional until the 1920s.

In 1945, two lumber mills operated in the area (one where the Interpretive Center is now located and the other where Allen Marsh is located). There was a log deck for

storing lumber. Butcher's Slough was elongated to make a channel for the mills, and a nine-acre log pond was built. The mills closed down in the late 1960's as the region's logging economy began to implode. The mills' condition further deteriorated over the years as a result of fires and neglect.

In 1964, the area that is now nicknamed "Mount Trashmore" was drained and diked in order to create a 40-acre landfill. Within a decade of the landfill starting operation, the ecosystem deteriorated as the overpopulation of cats and gulls began unraveling the food web, and leachate from the landfill contaminated the Bay. In 1973 the landfill was condemned, shut down, and sealed using mud from the Bay. This raised the question of what to do with the closed landfill,. Suggestions floated included a marina, motor cross area, golf course, baseball field and nature center/marsh restoration area. The City of Arcata finally decided to restore the area to a wetland. This coincided with the time that the federal and State government began strictly regulating wastewater.

---

## The History of Wastewater Treatment in Arcata

Arcata's former wastewater treatment plant was constructed in the 1940s, when the town's first sewers were installed. There was only primary treatment of the wastewater, with no chlorination, before it was discharged into the bay. It did not reduce Biological Oxygen Demand (BOD) or remove suspended solids and possible pathogens. Biological Oxygen Demand, a key standard for measuring treated wastewater, is the measure of oxygen required to break down organic materials in water. With untreated (or improperly treated) sewage high organic loads may reduce the amount of oxygen available to sustain fish or other aquatic life.

Fifty-five acres of oxidation ponds were added to the facility in 1958, which raised the level of treatment to secondary standards, followed by chlorination facilities in 1968. De-chlorination facilities were added in 1975. At this time, the State of California was getting tougher on municipalities' wastewater management policies in response to the Federal Water Pollution Control Act Amendments of 1972, the predecessor of the Clean Water Act.

In April of 1974, the California State Water Resources Control Board (SWRCB) adopted a Comprehensive Basin Plan for the North Coast Region. In a nutshell, the policy regarding discharges into the Bay was that it be "phased out at the earliest practicable date." However, the Regional Water Quality Control Board could grant exceptions if the discharging municipality could prove that "the wastewater in question would consistently be treated and discharged in such a manner that it would enhance the quality of receiving waters above that which would occur in the

absence of the discharge." This meant that a municipality would somehow have to prove that the wastewater, if discharged into the Bay, would enhance the water quality in the Bay. It was assumed that this would only be feasible if all the municipalities along the bay pooled resources to build a regional treatment plant. No single municipality was large enough to afford a treatment system advanced enough to satisfy these federal regulations.

In response to this plan, a “Joint Powers Agency” was created in 1973 to resolve the issue. The Agency consisted of the municipalities of Eureka, Arcata and McKinleyville in Humboldt County. An engineering firm, Metcalf & Eddy, developed a design for a regional facility that would serve these communities. The facility would be located on the Samoa Peninsula and was estimated to cost $25 million. In 1974, the Humboldt Bay Wastewater Authority (HBWA) was formed. It included the Joint Powers Agency and the McKinleyville and Humboldt Community Services Districts, and was charged with the responsibility of constructing the regional wastewater treatment plant.

The proposed plant would have large interceptors around the perimeter of the bay, with a major line crossing under the water in the region of active navigation. Effluent from the plant would be released offshore into an area of shifting sea bottom and heavy seas during winter storms. The facility would have been capital- and energy-intensive, and no one agency could afford it, so sharing expenses was believed to be the only solution to solving the Bay communities’ collective wastewater problems. However, as plans progressed, the logistical challenges of incorporating all communities as well as the costs--economic, social and ecological--became increasingly apparent. The plan became a hot political issue. A major concern, especially in Arcata, was that the creation of a sewer interceptor line running from McKinleyville to Eureka along Highway 101 would open up agricultural areas to suburban-style sprawl. The resulting strip malls and subdivisions would render the communities indistinct from one another and eliminate the rural character of the area. Another concern was that some of Arcata’s investments, both in the aquaculture project, and in the existing treatment plant, would be lost. For two years, the City Council tried to convince the Regional Water Quality Control Board (RWQCB) and HBWA that there had to be other alternatives to the regional treatment plant.

From the time the Comprehensive Plan was created, Arcata descended into a politically volatile period sometimes referred to as the "wastewater wars." The main factions split along two lines. The supporters were the development and financial interests, the engineering community consisting of the RWQCB as well as State officials, the bulk of Arcata’s "old-timers," and environmentalists who feared that if

Arcata opted out of the plan, HBWA would collapse and neighboring Eureka would continue to discharge its partially untreated effluent into the Bay. Supporters of the marsh were led by City Councillor Dan Hauser, Humboldt State University environmental engineering professor Bob Gearheart, then-Public Works director Frank Klopp, and Humboldt State University fisheries professor George Allen. Arcata citizens against the project tended to be environmentalists, professors and students, and newcomers who were fleeing other built-up areas further south, all of whom valued Arcata's natural beauty and historic rural charm.

In 1975, critics of the regional plan formed a coalition called "Citizens for a Sewer Referendum." They launched a campaign to call for a vote on the project. Their persistence paid off in eventually helping to stall the project. However, it became increasingly clear that if Arcata were to opt out of the plan it would effectively block the regional treatment plant. Other communities in HBWA could not afford to go forward without Arcata. Part of the antagonism towards the Arcata critics of the plan was that as time went on, inflation was rapidly increasing the cost of the project.

At this point, Arcata had to come up with an alternative plan that would not only assure treatment of the sewage, but that would satisfy the "enhancement" requirement in the Comprehensive Basin Plan. The idea to build its own wastewater treatment plant came about in 1976 amidst this divisive controversy. The City began exploring the design of a decentralized system which made use of constructed wetlands. The idea had its origins in the aquaculture work of Dr. George Allen. In 1969, Dr. Allen had begun an experimental project intended to find out if Pacific Salmon and cutthroat trout could be raised in ponds with a mixture of seawater and partially treated wastewater. This type of project challenged the conventional paradigm of waste in two ways. First, it said waste was a valuable resource rather than a harmful, expensive nuisance that had to be disposed of. It also declared that communities themselves—rather than centralized bureaucratic regulatory bodies—could manage this resource if given the freedom to do so. The idea of creating and using a marsh began to grow in the mind of Robert Gearheart, another Humboldt State University professor. Using the fish aquaculture project and a treatment marsh as probable ways to prove "enhancement," a city task force proposed that the natural processes of a wetland could be harnessed to effectively and efficiently treat municipal wastewater. This was a huge departure from business as usual.

In 1977, the City of Arcata team, consisting of George Allen, Bob Gearheart, Public Works director Frank Klopp and City Councillor Dan Hauser put their proposal to the Regional Water Quality Control Board. They would have a wastewater treatment process that used the existing primary sedimentation facilities, a 22.3 hectare oxidation pond facility, and three new constructed marshes. The effluent from the

marsh system would then flow through a 6.9 hectare lake before being discharged into the Bay. The city insisted that this system would not only protect all of the existing beneficial uses of the Bay, but would enrich them and even create new ones such as greater bird habitat and extensive recreational space. They presented this plan at RWQCB meetings and before the SWRCB, as well as to the citizens of Arcata itself. There was much quibbling over whether or not this was the type of enhancement outlined in the regulations. They challenged the Chair of the SWRCB to define exactly what was meant by enhancement. When he could not do it, the marsh supporters were able to prove that 'enhancement' of the Bay' was a meaningless term and legislation was introduced to eliminate this requirement.

Meanwhile, the Coastal Conservancy, a California non-profit organization became involved. The Coastal Conservancy purchases critical coastal habitat and conservation easements and works with communities to restore coastal land. They had been observing the events in Arcata and offered to help fund the wetlands restoration that was part of the three original marshes.

The University and the city formed the Task Force on Wastewater Treatment that created the pilot project Arcata was finally granted permission to undertake. The State Water Resources Control Board funded the 3-year study which began in September of 1979. It experimented with partially treated wastewater and the natural processes of wetland ecosystems. The results of the pilot project promisingly showed that not only could the constructed wetlands effectively treat wastewater, but that it would also enhance the biological productivity of the wetland environment into which wastewater was discharged. At the end of the pilot project in 1983, the Board agreed that the marsh system would indeed "enhance" the beneficial uses of the Bay for scenic enjoyment and educational study, and that a full-scale marsh system would satisfy the requirements of the Basin Plan. As the Task Force's original leaders emphasized, the plan was a simple, cost-effective application of an appropriate technology.

With the help of the Arcata City Council and political representatives in Sacramento, in 1983 the city received the go-ahead to develop the marsh.

---

## Constructing the Marsh

Sections of Arcata's old industrial sites by the shore of the bay had concrete where the lumber had been stacked and stored. To create the marshes, they had to break up the concrete. This was done as an activity with the National Guard combat engineers. They came in one Sunday, blew the concrete up, and carried it off. A lot of other residue from the saw mills also had to be taken out.

The section that is now Gearheart Marsh was originally pasture land. Because the terrain was slightly lower than the surrounding area, it had relatively large areas of open water once the water was let in. Marsh plants were allowed to grow in naturally.

When the landfill was closed, a dike was set up around the Bay. Sediment was scooped out and put on top of the landfill to seal it. The current wetlands surround the landfill, but none are on top of it. The landfill has been monitored for seepages of any kind and so far no contaminants have been found to have leached out of it.

The last marsh was "terraformed" to be various depths, deeper in some places, shallower in others. Moving the dirt around to create this "micro-terrain" was done by bulldozer. Differing depths was necessary because if it was kept shallow, the tubers of the sago pondweed would spread everywhere uniformly and undermine the biodiversity needed for the marsh to do its work. Flow in the marsh is faster at the edges of groups of aquatic plants than in the middle.

Vegetation was added to about one third of the last marsh, Hauser Marsh, to provide denser vegetation towards the end of the system. This ensures that the marsh will strip out any remaining solids in the effluent. They used native Hardstem bulrush brought in from a near by fishing lake. This marsh has alternating areas of open water and vegetation. Everyone said they wanted islands but they didn't work as well as planned and were removed. This was one important lesson they learned about creating a constructed wetland.

Sago pondweed seeds were broadcast into all the deep areas of all the marshes. Ducks love to eat this seed, providing a natural harvest to keep it from taking over. The team learned a lot about planting, often by trial and error. Some of the unsuccessful methods they used included burying the whole plant by the roots and throwing sprigs of the plants into the water. Unfortunately the waterfowl would eat everything immediately. Their greatest success came when they trucked in plants, cut off their tops, but kept a substrate of some of the original soil around the tuber. Previous orders of plants had come with their original dirt stripped away and they were unable to make the transition to the marsh. It takes about two years for the soil encrusted plants to grow to maturity.

A floating plant, Hydrocotyl, can sometimes take over and excessively shade the marsh, so it is periodically harvested. It is then mixed with sludge settled out from the first stage of treatment and used as compost in the Arcata Community Forest.

In 1986, the treatment system was completed and became operational. In the same year, the Coastal Conservancy provided funds to restore Butcher's Slough which

expanded the Sanctuary to its current size. The slough was refigured into a more natural channel, thereby enlarging the saltwater wetlands, and creating another freshwater marsh in a former log pond.

In order to extend the area of the marsh further, 3.15 acres of land on the inland side of the wetland area has been acquired, and a pond has been created there. Aquaculture still continues in parts of the marsh, though the fish are not raised for commercial purposes. However, more than half of the oysters grown in California are produced in a subsection of Humboldt Bay known as Arcata Bay.

---

## The Wastewater Treatment System

All municipal sewage treatment, whether conventional or alternative, is broken down into two main phases. Primary treatment is largely a mechanical process which separates the solids from the liquids, while secondary treatment removes contaminants and pathogens harmful to humans. The AMWS's primary treatment occurs in the headworks and clarifiers, while the secondary treatment occurs at the oxidation ponds, chlorination basins, treatment marshes and enhancement marshes.

The flow between components occurs through underground tunnels. Water levels in the marsh are not intentionally changed, for example, by adjusting weir levels. Once they are set, they are left to function on their own.

1. The Headworks. This is the first phase in the treatment of raw sewage. Water is piped underground from Arcata households to the headworks. Here inorganic materials are removed from the water using two Archimedes screw pumps that lift the raw sewage fifteen feet up and pass it through bar screens and grit separators before it enters the clarifiers.
2. Primary Clarification. The water sits for about four hours in the clarifiers. Two clarifiers (26 feet and 60 feet in diameter) are used for settling out any remaining suspended material that makes it past the headworks. The liquid effluent from the clarification process is sent to the oxidation ponds. The solids that settle out from the clarification process are sent to digesters.
3. Digesters. The remaining sludge from the clarifiers is pumped to the primary and secondary digesters respectively. Anaerobic microorganisms in the digesters consume the nutrients in the sludge as their food, and produce carbon dioxide, methane and hydrogen sulphide as by-products. The digesters mix the sludge by recirculating

methane gas with compressors. The remaining sludge goes onto a sludge drying bed. It is then mixed with yard waste and hydrocotyl, the aquatic plant, and is used to fertilize the soil in the Community Forest.

4. Oxidation Ponds. These ponds cover an area of 55 acres. They were built in the late 1950's. They are approximately five feet deep, and are used for settling out smaller solids not removed by primary treatment. The effluent is channeled by underground tunnel into the oxidation ponds to treat it to secondary standards. "Secondary standards" means that at least half of the BOD (biochemical oxygen demand) and suspended solids that remain after primary treatment have been removed. Breakdown of the floating and settling organic matter in the sewage is facilitated by algae growth and microbial/bacteria activities in the ponds. Sunlight is key to this process, because algae produce oxygen through the process of photosynthesis,. Algae also consume nitrogen and phosphorus, two common nutrients found in municipal wastewater. Microbes and bacteria use oxygen produced by the algae to break down and use the nutrients in the waste for their own metabolism. The by-product of this is carbon dioxide, which is then used by the algae to produce more oxygen for the microbes. Mechanical aerators are used in the oxidation ponds as well, to aid the algae in oxygen production.

5. Treatment Marshes. The treatment marshes reduce the remaining BOD concentrations, dead algae, and other suspended solids that remain in the oxidation pond effluent. There are three treatment marshes, each of which is two acres in area. They are located north of the oxidation ponds. They were created by subdividing the original oxidation ponds. All the marshes were planted with hardstem bulrush. This helps settle out the suspended solids by slowing down the water flow and preventing growth of new algae. The wastewater circulates through a marsh system before it is combined at a pump station and flows into the disinfection facility.

6. Disinfection. There are two separate stages of disinfection. The first occurs after the effluent passes through the treatment marshes. The second takes place after passing through the enhancement marshes just before its release into Humboldt Bay. Disinfection is necessary to kill any viruses or pathogens present in the water. Technically the second chlorination is unnecessary given the effectiveness of the enhancement marshes, but is required by regulators in order to conform to fecal coliform standards. Ironically, the standards are 'violated' only because birds are discharging excrement into the enhancement marshes. Because of the double chlorination, two

chlorine contact basins are necessary. The basins are located immediately south of the headworks. Any free chlorine remaining in the final effluent after the 60 minute contact time is removed with sulphur dioxide. After the second chlorination, depending on how much water is coming into the marsh, it is either released into the Bay or sent to the enhancement marshes. Usually it is mixed with water from the enhancement marshes and released into the Bay.

7. Enhancement Marshes. After the first chlorination process, the effluent flows into the enhancement marshes located northwest of the oxidation ponds. The three marshes, each named after George Allen, Bob Gearheart, and Dan Hauser respectively, cover a total of 31 acres. The flow is controlled through the use of sluice gates and weirs, though the water flow is rarely interfered with. The natural processes occurring in the marshes simultaneously purify the wastewater by removing excess nutrients and 'feed' the marsh plants with water high in nitrogen-rich organic matter. Nutrients are taken up by the plants and thus removed from the wastewater. The roots and stems of the plants also clean the water by forming a dense netlike filter that removes large quantities of suspended solids. Algae, fungi, bacteria and micro-organisms attached to the roots of these plants feed on these solids. This nutrient-rich habitat attracts many birds to the sanctuary. It has become an exceptional and cherished place for birders, recreation, research and education. Before discharge into Humboldt Bay, the water returns to the disinfection facility for a second chlorination. In total, all wastewater that enters the system spends about fifty days there from its first contact with the headworks to its release into Humboldt Bay.

---

## Marsh Specifications

- Design Population: 19,056
- Average Annual Flow: 2.3 million gallons/day (mgd)
- Maximum Monthly Flow: 5.9 mgd
- Peak Flow: 16.5 mgd
- BOD's Load: 4100 lbs/day
- TSS Load: 3400 lbs/day

---

## The Arcata Marsh Interpretive Center

All the work and ingenuity that went into the marsh was rewarded in 1987 when Arcata received the Innovations in Government Award from the Ford Foundation/Harvard University Kennedy School of Government and $100,000 to begin building the Arcata Marsh Interpretive Center. Open to the public since 1993, the Interpretive Center has exhibits on the political, ecological and technical aspects of the marsh. It is staffed by city employees on weekdays and by community volunteers on weekends and holidays. The Friends of the Arcata Marsh offers free educational tours of the AMWS and treatment facility.

---

## Spin-Offs

Creation of the marsh allowed not only reuse of wastewater but also ecological restoration of industrial, agricultural, and public service land:

- "Zoning." An important aspect of the case was that it not only prevented development in the agricultural areas between the communities, but it also restored a degraded waterfront area. Before the marsh, the land consisted of an abandoned lumbermill pond, channelized sloughs, low-quality pasture land, and a sealed landfill.
- A window to Humboldt Bay. Before the marsh was created, Arcata citizens had no access to its waterfront. After the AMWS, the entire area was opened up. As the disused landfill, "Mount Trashmore," was on higher ground, it now allows people a broad view of the Bay.
- Habitat creation. Some 60,000 acres of wetland are lost annually, mainly to draining and reclamation for development and agriculture. Of the remaining 100 million acres, many are severely degraded. Creating the Arcata wetlands not only provided a cost-effective, low-energy, low-maintenance essential service, it also locally reversed the trend of wetland loss.
- Green city. Arcata City Hall is environmentally active and maintains various other programs including a greenhouse gas reduction plan, solid waste reduction, Open Spaces initiative, pesticide reduction plan, pedestrian/bicycle plan, and community forest.

---

## The Community Forest

Arcata's Community Forest is comprised of approximately 622 acres of 120+ year old redwood forest obtained in several purchases financed by bond measures over a

50 year period. This acquisition process culminated in the dedication of the Community Forest in 1955.

The forestland was used as a source for the municipal water supply until 1964. Since then it has served many functions including recreation, education, sustainable timber harvesting, and wildlife habitat. It is also an outdoor laboratory for students and 'citizen scientists'. The forest serves as the headwaters of many of Arcata's urban streams. The main tree species is California Redwood but Douglas Fir, Grand Fir, Western Hemlock and Sitka are also present.

In 1979, a "Forest Management and Parkland Initiative" ballot measure was passed by Arcatans. Its intent was to create a long-term management program governed by 'ecological principles' that would preserve its recreational uses as well as generate revenue for further forest acquisition by carefully harvesting the forest's timber. This was the nation's first forest to be certified by the Forest Stewardship Council (FSC) as eligible for the "Smartwood" designation which denotes sustainably harvested wood.

Annual revenue generated by the forest is $500,000-700,000 per year. Trees are generally harvested every other year. Revenues from the sale of timber go into acquisition of land through outright purchase or by granting conservation "easements," where land owners are paid a fee to sustainably manage a given parcel of land. The focus is on areas contiguous to the forest or otherwise ecologically sensitive habitat. Land acquisition is contingent upon funding, mostly from grants.

---

## Conditions Contributing to Arcata's Success

1. Public Works Director Frank Klopp was an "old paradigm engineer" who subscribed to the belief that wastewater had to be disposed of and not utilized, typically through command-and-control and technology. He initially supported the regional wastewater treatment pipeline plan until he saw the cost to Arcata. He realized Arcata would never be able to afford it. This led him to seriously consider the merits of the 'other side's' plans. Through discussions with the marsh's main proponents and after witnessing a similar project in the San Francisco Bay area, he 'converted'. He then became a key figure in enlisting buy-in from engineers in the HBWA, SWRCB, and RWQCB as well as the more conservative members of the community in a way that someone outside his profession could not.
2. There was a reduction in the national voting age in 1971 from 21 years of age to 18. This new political clout among younger people had

particular impact in a university town like Arcata.

3. The change in political climate helped facilitate the "changing of the old political guard," which brought in a new generation of politically progressive leadership in City Hall.
4. The city displayed a high level of creativity in finding alternatives to the 'bust' that characterized the region's extraction-based fishing-forestry economy (possibly due to #2 and #3) (see Julie Fulkerson's and Dan Hauser's comments below).
5. The Marsh and the Community Forest became de facto 'zoning' initiatives because development could not occur there. This was more effective than any regulation, as the community forest and wetland became physical barriers to development, impregnable to the power or political machinations of the development crowd.
6. While initial concern over the pipeline was that it would allow development between Arcata and neighboring Eureka and McKinleyville, this bled into other concerns such as the mounting costs and potential liability issues if the pipelines under the Bay were to malfunction or rupture.
7. The presence of Humboldt State University meant access to cost-effective, often free, technical support, data collection, monitoring and research that continues to this day. This level of scientific and technical knowledge would not have been otherwise affordable to Arcata. Humboldt State is unique in that it has the only program known as "environmental resources engineering," which integrates fields which have normally been fragmented. It integrates biology, chemistry, physics and ecology. Partly as a result of Bob Gearheart's involvement with the marsh this program was redesigned so that engineering students, in their formative undergraduate years, get a more comprehensive outlook on the world (see Bob Gearheart's comments).

---

## Environmental Tipping Point Elements

1. Positive feedback. The trend in North America towards development that opens up formerly agricultural or virgin land was partially halted by the marsh in two ways: **i)** The Regional plan with its pipeline following Highway 101 would have provided the infrastructure for easy development of the agricultural land between McKinleyville and Eureka. Creating the marsh prevented the "freeing up" of this land. **ii)**

Creating the marsh efficiently reused disused land which had fallen onto the City because no one wanted it, rather than using new land which would have set in motion the feedback loops in i).

2. "Nature Doing the Work." Wetlands are well-known biological filters and perform critical cycling, filtering, purifying, water storage and flood prevention services for free. Using a wetland to treat waste simply takes advantage of natural biological processes occurring in wetlands. The main function of wetlands in wastewater treatment is the uptake or removal of nitrate, ammonium, phosphate, and possibly heavy metals.

---

### A Few of Many Examples of Nature "Doing the Work" in the Marsh:

· The structure of a wetland itself, with its slow flow and shallow depths allow sediments to settle as water passes through it. Also, the slow flow allows long contact times between the water and the surfaces in the wetland, allowing for crucial exchanges to happen at the microbial level.

· Two processes are of particular importance for nitrogen cycling:

1) Dentrification: The conversion of nitrates found in wastewater by bacteria into nitrogen gas through removal of oxygen in the anoxic conditions found in the detrital layers of the wetland.

2) Nitrification: The conversion of ammonium to nitrates (which must happen in oxygen rich regions of the soil, usually near the clumps of vegetation) which can then be converted into nitrogen gas through dentrification.

· Plants, primarily bulrushes, provide a "canopy" of shade over the water which inhibits algae growth, cools the water, slows down its flow, blocks UV rays, reduces the level of evaporation and helps to oxygenate the water through the process of photosynthesis. It also provides the habitat for microorganisms such as beneficial bacteria, on the roots of these plants. These bacteria are beneficial because they consume the suspended solid particles. Floating plants that block light are generally harvested by aquatic birds (although, as stated earlier, periodically they must be harvested if excessive). These floating plants also reduce the level of evaporation.

· The layer of litter on the soil surface of a wetland is known as the "detrital layer." It is in a generally constant state of slow decomposition by bacteria and other organisms. Generally wetlands have ample detritus because the anaerobic conditions in the wetland slow down decomposition. It offers surface area for decomposers such as fungi and bacteria that nitrify and dentrify (see above).

Acinomycetes is one particularly active microorganism that helps to cycle nutrients. Sediments in the oxygen-poor detrital layer also provide conditions for breaking down complex organics (i.e. greases, fats, solvents, fuels). As well, they sequester metals and provide a source of carbon, nitrogen and phosphorus to drive microbial processes.

· Sunlight, through the process of photosynthesis, produces oxygen needed to facilitate the processing of nutrients in the wastewater by microorganisms.

· Single and multi-celled organisms reduce the carbon and organic material and "pass it up the food chain" in the form of insects and birds which then fly away and carry it out of the wetland. Birds also bring in seeds from other areas which foster biodiversity and ensure continued growth of flora.

· Insect larvae and other insects such as beetles consume the solids which settle out of the partially treated wastewater.

3. "Success Breeding Success." The success and popularity of the marsh gave those in City Hall the freedom to imagine more possibilities for the marsh and other projects. It also has created a stronger base for support of environmentally friendly projects in the town.

4. Replication: Arcata's story has become a landmark in alternative wastewater treatment. It has attracted interest and visitors nationally and internationally. Bob Gearheart and other key players have traveled to various parts of the world to promote and provide technical support to other communities interested in adopting similar models. They have visited Oaxaca in Mexico, the West Bank, Egypt, Thailand, Indonesia, Palo Alto and Petaluma in California, and some smaller towns in the San Francisco Bay Area. Neighboring McKinleyville and Eureka are creating similar systems, though they are loathe to admit it has anything to do with influence from Arcata. Replication is not always easy to trace. Multiple sources may be consulted. Sometimes communities try and fail, others adopt some aspects of the Arcata model, and still others may not yet have done so, but the 'seeds' are lying dormant, needing only a final impetus to start bearing fruit.

---

## References


- US EPA et al. "Design Manual: Constructed Wetlands and Aquatic Plant Systems for Municipal Wastewater Treatment." pp. 27-30.
- Davis, Luise. "A Handbook of Constructed Wetlands." USDA-Natural Conservation Service and US EPA, region II. Online link

- A site visit to Arcata City including a tour of the marsh and interviews with Dr. Robert Gearheart, former Councilor Julie Fulkerson, City Manager Dan Hauser, former Public Works Director Frank Klopp
- Maria Streshinsky. "From Blighted to Beautiful: Five fabulous makeovers for Mother Earth." Via Online: The AAA Travellers Companion, November 1999.
- Jordan, Fred. 1990. "The Wastewater Wars," in *Innovating America*, Chapter 8. A Ford Foundation report. Profiles of eight award-winning projects (1986-1988) in the Innovations in State and Local Government awards Program, which is sponsored by the Ford Foundation and administered by the John F. Kennedy School of Government at Harvard University. The awards honor exemplary programs and policies addressing important social and economic problems at the state and local levels.


## Acronyms

- **SWRCB**: The State Water Resources Control Board
- **RWQCB**: The Regional Water Quality Control Board
- **HBWA**: Humboldt Bay Wastewater Authority
- **AMIC**: Arcata Marsh Interpretive Center
- **AMWS**: Arcata Marsh and Wildlife Sanctuary

Back to top

Copyright © 2006-Now | The EcoTipping Point Project | ALL RIGHTS RESERVED
Website users are welcome to download and distribute any materials from this website. Please acknowledge ecotippingpoints.org as the source.

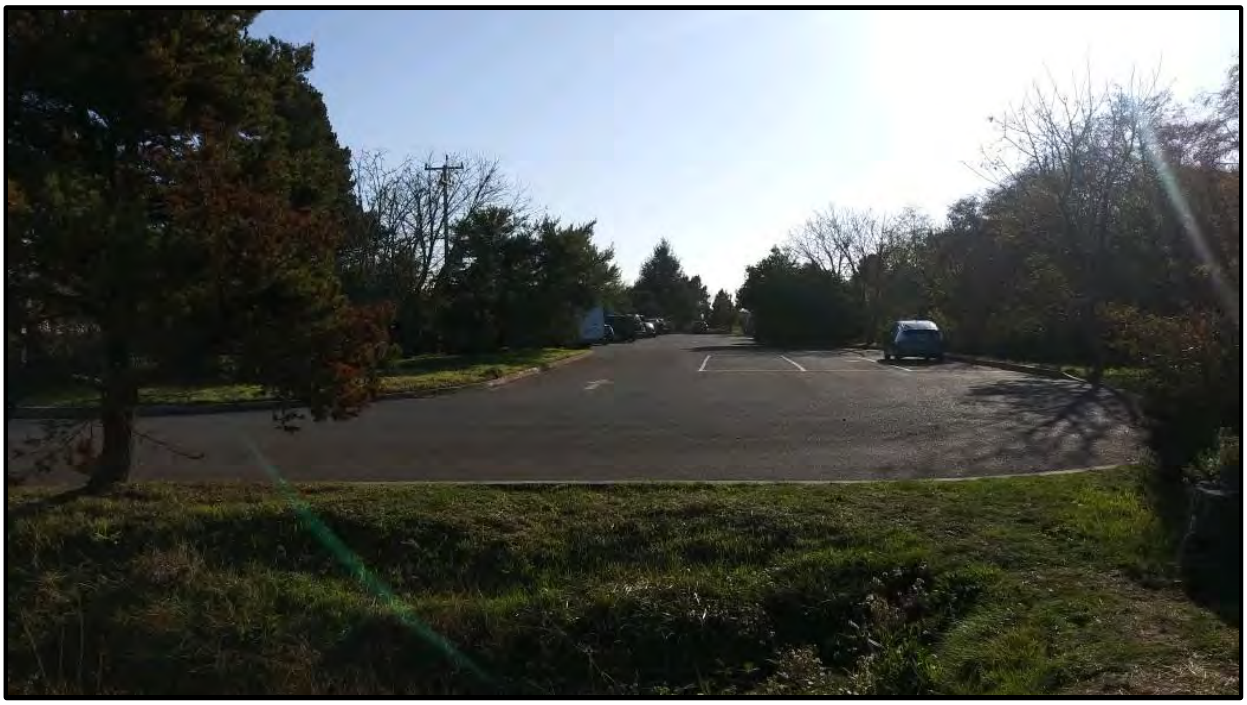
# Appendix E

## Project Location Photographs

**Appendix E - Project Photos**



**View (south) of Staging Area 1, the southwest corner of APN 503-232-013**



**View (south) of Staging Area 2, the south G st parking lot of the Arcata Wildlife Marsh and Sanctuary, adjacent to the Arcata Marsh Interpretive Center**



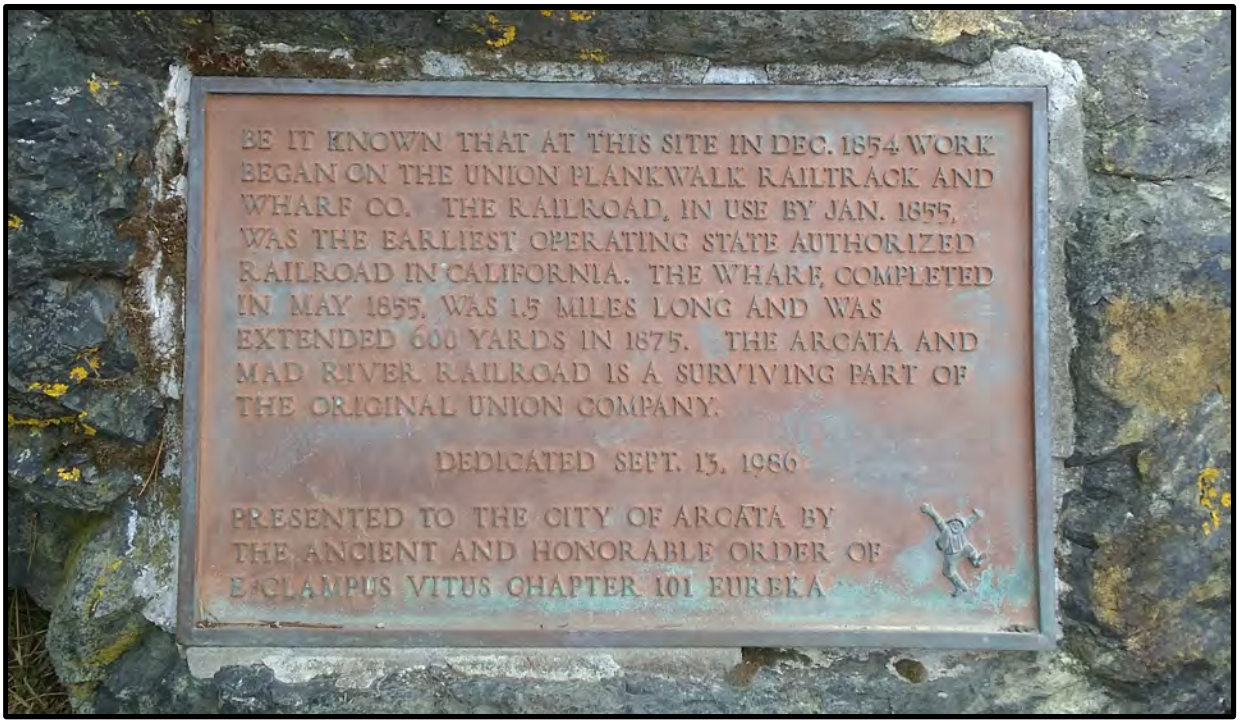
View (east) of Staging Area 3, the southern section of APN 503-211-026



View (south) of Staging Area 4, the south I st, parking lot of the Arcata Wildlife Marsh and Sanctuary



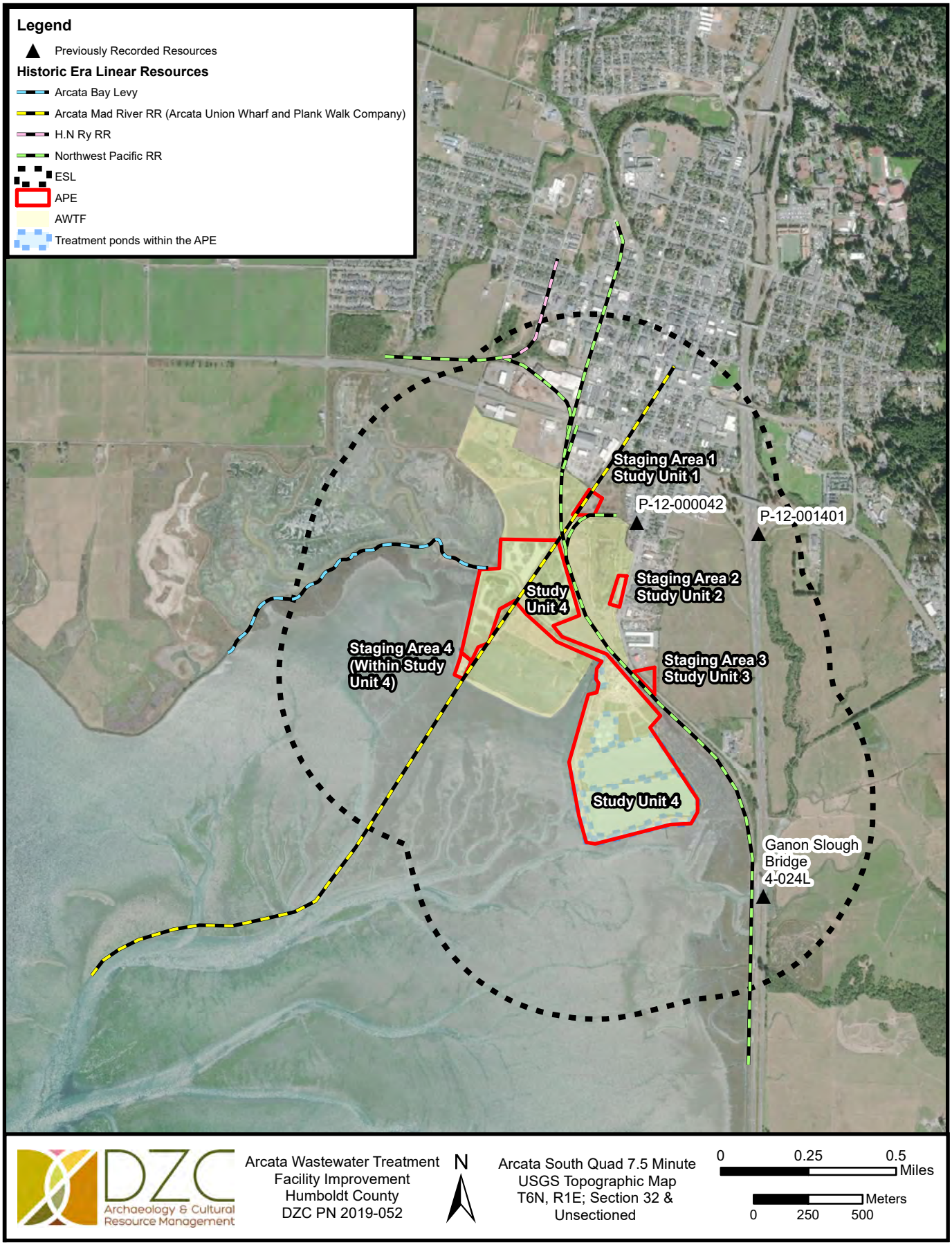
View (southwest) of the Arcata Wharf Ruins




Detail view of the commemorative plaque posted along the trail adjacent to the Arcata Wharf Ruins

# Resource Location Map

Figure F-1 CONFIDENTIAL Resource Location Map



# ATTACHMENT 6

*U.S. Census Bureau Website. 2019. City of Arcata: Quick Facts. Available at: www.factfinder.census.gov.* Accessed on 9/10/20

# QuickFacts

## Arcata city, California

QuickFacts provides statistics for all states and counties, and for cities and towns with a ***population of 5,000 or more***.

## Table

| PEOPLE | |
|---|---|
| **Population** | |
| **Population estimates, July 1, 2019, (V2019)** | **18,431** |
| Population estimates base, April 1, 2010, (V2019) | 17,410 |
| Population, percent change - April 1, 2010 (estimates base) to July 1, 2019, (V2019) | 5.9% |
| Population, Census, April 1, 2010 | 17,231 |
| **Age and Sex** | |
| Persons under 5 years, percent | ⚠ 2.2% |
| Persons under 18 years, percent | ⚠ 9.9% |
| Persons 65 years and over, percent | ⚠ 11.5% |
| Female persons, percent | ⚠ 51.4% |
| **Race and Hispanic Origin** | |
| White alone, percent | ⚠ 78.1% |
| Black or African American alone, percent (a) | ⚠ 3.1% |
| American Indian and Alaska Native alone, percent (a) | ⚠ 1.7% |
| Asian alone, percent (a) | ⚠ 2.3% |
| Native Hawaiian and Other Pacific Islander alone, percent (a) | ⚠ 0.4% |
| Two or More Races, percent | ⚠ 7.4% |
| Hispanic or Latino, percent (b) | ⚠ 16.5% |
| White alone, not Hispanic or Latino, percent | ⚠ 71.7% |
| **Population Characteristics** | |
| Veterans, 2014-2018 | 738 |
| Foreign born persons, percent, 2014-2018 | 3.8% |
| **Housing** | |
| Housing units, July 1, 2019, (V2019) | X |
| Owner-occupied housing unit rate, 2014-2018 | 39.8% |
| Median value of owner-occupied housing units, 2014-2018 | $333,600 |
| Median selected monthly owner costs -with a mortgage, 2014-2018 | $1,632 |
| Median selected monthly owner costs -without a mortgage, 2014-2018 | $486 |
| Median gross rent, 2014-2018 | $953 |
| Building permits, 2019 | X |
| **Families & Living Arrangements** | |
| Households, 2014-2018 | 7,311 |
| Persons per household, 2014-2018 | 2.22 |
| Living in same house 1 year ago, percent of persons age 1 year+, 2014-2018 | 62.6% |
| Language other than English spoken at home, percent of persons age 5 years+, 2014-2018 | 14.9% |
| **Computer and Internet Use** | |
| Households with a computer, percent, 2014-2018 | 93.3% |
| Households with a broadband Internet subscription, percent, 2014-2018 | 87.8% |
| **Education** | |
| High school graduate or higher, percent of persons age 25 years+, 2014-2018 | 95.5% |
| Bachelor's degree or higher, percent of persons age 25 years+, 2014-2018 | 52.2% |
| **Health** | |
| With a disability, under age 65 years, percent, 2014-2018 | 9.3% |
| Persons without health insurance, under age 65 years, percent | ⚠ 8.2% |
| **Economy** | |
| In civilian labor force, total, percent of population age 16 years+, 2014-2018 | 63.5% |
| In civilian labor force, female, percent of population age 16 years+, 2014-2018 | 62.8% |
| Total accommodation and food services sales, 2012 ($1,000) (c) | 56,345 |

| | |
|---|---|
| Total health care and social assistance receipts/revenue, 2012 ($1,000) (c) | 107,014 |
| Total manufacturers shipments, 2012 ($1,000) (c) | 134,093 |
| Total merchant wholesaler sales, 2012 ($1,000) (c) | |
| Total retail sales, 2012 ($1,000) (c) | 169,546 |
| Total retail sales per capita, 2012 (c) | $9,565 |
| **Transportation** | |
| Mean travel time to work (minutes), workers age 16 years+, 2014-2018 | 16.5 |
| **Income & Poverty** | |
| Median household income (in 2018 dollars), 2014-2018 | $31,674 |
| Per capita income in past 12 months (in 2018 dollars), 2014-2018 | $23,790 |
| Persons in poverty, percent | ⚠ 37.4% |

All Topics

Population estimates, July 1, 2019, (V2019)

## BUSINESSES

| | |
|---|---|
| **Businesses** | |
| Total employer establishments, 2018 | X |
| Total employment, 2018 | X |
| Total annual payroll, 2018 ($1,000) | X |
| Total employment, percent change, 2017-2018 | X |
| Total nonemployer establishments, 2018 | X |
| All firms, 2012 | 1,957 |
| Men-owned firms, 2012 | 948 |
| Women-owned firms, 2012 | 748 |
| Minority-owned firms, 2012 | 261 |
| Nonminority-owned firms, 2012 | 1,598 |
| Veteran-owned firms, 2012 | 140 |
| Nonveteran-owned firms, 2012 | 1,719 |

## GEOGRAPHY

| | |
|---|---|
| **Geography** | |
| Population per square mile, 2010 | 1,894.1 |
| Land area in square miles, 2010 | 9.10 |
| FIPS Code | 0602476 |

About datasets used in this table

All Topics

Population estimates, July 1, 2019, (V2019)

**Value Notes**

⚠ Estimates are not comparable to other geographic levels due to methodology differences that may exist between different data sources.

Some estimates presented here come from sample data, and thus have sampling errors that may render some apparent differences between geographies statistically indistinguishable. Click the Quick Info ⓘ icon to th row in TABLE view to learn about sampling error.

The vintage year (e.g., V2019) refers to the final year of the series (2010 thru 2019). *Different vintage years of estimates are not comparable.*

**Fact Notes**

- **(a)** Includes persons reporting only one race
- **(b)** Hispanics may be of any race, so also are included in applicable race categories
- **(c)** Economic Census - Puerto Rico data are not comparable to U.S. Economic Census data

**Value Flags**

- **-** Either no or too few sample observations were available to compute an estimate, or a ratio of medians cannot be calculated because one or both of the median estimates falls in the lowest or upper in open ended distribution.
- **D** Suppressed to avoid disclosure of confidential information
- **F** Fewer than 25 firms
- **FN** Footnote on this item in place of data
- **N** Data for this geographic area cannot be displayed because the number of sample cases is too small.
- **NA** Not available
- **S** Suppressed; does not meet publication standards
- **X** Not applicable
- **Z** Value greater than zero but less than half unit of measure shown

QuickFacts data are derived from: Population Estimates, American Community Survey, Census of Population and Housing, Current Population Survey, Small Area Health Insurance Estimates, Small Area Income and P Estimates, State and County Housing Unit Estimates, County Business Patterns, Nonemployer Statistics, Economic Census, Survey of Business Owners, Building Permits.



/

# ATTACHMENT 7

*Attachment 7: LACO Associates. 2019. Geotechnical Exploration and Geologic Hazards Report Part One.*

# Geotechnical Exploration and Geologic Hazards Report

## Arcata Wastewater Treatment Facility Improvements Project
## 736 F Street, Arcata, California

March 15, 2019

Prepared for:
Carollo Engineers, Inc.

Prepared By:
LACO Associates, Inc
21 West 4th Street
Eureka, California 95501
707-443-5054

Project No. 7986.01

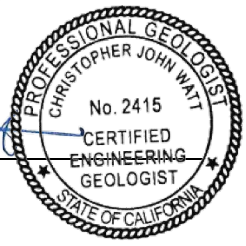
LACO
advancing the quality of life for generations to come

Design
Planning
Engineering
Geology and Geotechnical
Environmental Science
Materials Testing
Survey

800 515-5054
www.lacoassoicates.com
Eureka | Ukiah | Santa Rosa




J. Erich Rauber, P.E., G.E.
Senior Geotechnical Engineer




Christopher J. Watt, C.E.G., C.H.G.
Principal Engineering Geologist

# TABLE OF CONTENTS

1.0 Introduction ..... 1
1.1 Project Description ..... 1
1.2 Scope of Services ..... 2
2.0 Exploration ..... 2
3.0 Site and Subsurface Conditions ..... 4
3.1 Site Conditions ..... 4
3.2 Geologic Setting ..... 4
3.3 Subsurface Conditions ..... 4
4.0 Geologic Hazards ..... 5
4.1 Seismic Ground Shaking ..... 5
4.2 Liquefaction ..... 5
4.2.1 SPT Data Evaluations ..... 5
4.2.2 Discussion ..... 6
4.3 Volcanism ..... 6
4.4 Slope Instability/Landsliding ..... 7
4.5 Flooding ..... 7
4.6 Tsunami Inundation ..... 7
4.7 High Groundwater ..... 7
4.8 Soil Corrosivity ..... 7
4.9 Soil Swelling or Shrinkage Potential ..... 8
5.0 Conclusions ..... 8
6.0 Recommendations ..... 9
6.1 Site Preparation and Grading ..... 9

6.2 Foundations ..... 10
6.2.1 Driven Piles ..... 10
6.3 Utilities ..... 13
6.4 Retaining Walls ..... 14
6.5 Concrete Slab on Grade Floors ..... 14
6.6 Pavement ..... 15
6.7 Surface Drainage ..... 15
6.8 Seismic Design Parameters ..... 15
6.9 I Street Improvements ..... 16
7.0 Future Geotechnical Services ..... 16
8.0 Limitations ..... 17
9.0 References ..... 18

## Figures

Figure 1 Vicinity Map
Figure 2A-B Site Plans
Figure 3 Tsunami Inundation Map
Figure 4 Allowable Uplift Capacity
Figure 5 Allowable Vertical Downward Capacity
Figure 6 Allowable Vertical Pile Capacity Accounting for Downdrag
Figure 7 Retaining Wall Lateral Earth Pressure
Figure 8 Retaining Wall Back Drain

## Appendices

Appendix 1 Boring Logs
Appendix 2 CPT Logs
Appendix 3 Laboratory Test Results
Appendix 4 CPT Analysis
Appendix 5 Site-Specific Ground Motion Analysis
Appendix 6 Liquefaction Assessment Results - SPT Data
Appendix 7 Liquefaction Assessment Results - CPT Data
Appendix 8 LPile Results

# 1.0 INTRODUCTION

This report presents the results of a geotechnical exploration performed by LACO Associates (LACO) in connection with the City of Arcata's existing wastewater treatment facility (WWTF) improvements project in Arcata, California. The WWTF is located on the northeast fringe of Arcata Bay at 736 F Street, approximately 0.4 miles west of U.S. Highway 101 in Arcata, California (the Site). The project also includes a proposed effluent pipeline beneath I Street, approximately 0.4 miles northwest of the WWTF. The Site in relation to adjacent streets and landmarks is presented in Figure 1 - Vicinity Map.

## 1.1 Project Description

The project consists of constructing improvements to the existing WWTF to replace/repair aging infrastructure, address deferred maintenance, maximize existing natural systems, and provide reliable capacity. Planned new improvements, along with their anticipated dimension, foundation elevations, loads, and occupancy categories, is presented in Table 1. The location of these improvements is shown on Figure 2 - Site Plans.

*Table 1. List of Improvement Components*

| Group | Improvement Component | Anticipated Plan Dimensions (feet) | Anticipated Foundation Elevation (feet) | Anticipated Foundation Loads (ksf) | Occupancy Category |
|---|---|---|---|---|---|
| 1 | Headworks | 22 x 52 | 3.3 | 2.5 | 3 |
| 1 | Headworks Wetwell | 17 x 15 | -1.9 | 2 | 3 |
| 1 | New ML Flow Split Structure | 29 x 22 | 6.3 | 2 | 3 |
| 1 | New RAS Pump Station | 26 x 40 | -3.8 | 1.5 | 3 |
| 1 | New WAS Pump Station | 18 x 18 | 8 | 1.5 | 3 |
| 1 | Oxidation ditch | 65 x 266 | 1.5 | 2 | 3 |
| 1 | Secondary Clarifier (2) | 75 (diameter) | -3.8 | 2 | 3 |
| 1 | Thickener – at grade portion | 20 x 25 | 8 | 1.5 | 3 |
| 1 | Thickener – below grade portion | 22 x 15 | 5 | 1.5 | 3 |
| 1 | UV Disinfection channels and canopy | 14 x 58 | 6 | 2 | 3 |
| 1 | UV Disinfection Electrical Building | 10 x 24 | 8 | 2 | 3 |
| 2 | Chemical storage facility | 20 x 50 | 8 | 1.5 | 3 |
| 2 | New Bus Barn | 140 x 60 | 8 | 1.5 | 3 |
| 2 | New Electrical Building | 24 x 37 | 8 | 1.5 | 3 |
| 2 | New Generator | 5 x 12 | 8 | 1.5 | 3 |
| 2 | New Transformer | 5 x 5 | 8 | 1.5 | 3 |

ksf–kips per square foot

Group 1 represents heavy and/or settlement-sensitive structures that if supported on shallow foundations will undergo excessive settlement. Group 2 represents lighter and less sensitive structures could be supported on shallow footings bearing on engineered fills. Groups have been determined with limited structural information and should reevaluated before the final design.

## 1.2 Scope of Services

LACO's scope of services is outlined in Task Order No. 1 issued by Carollo Engineers, Inc. (Carollo) and dated April 12, 2018.

# 2.0 EXPLORATION

On April 24 through 26, and May 7 through 10, 2018, LACO explored subsurface conditions at the Site by (1) advancing 11 cone penetration test (CPT) probes to a maximum depth of 60 feet below ground surface (bgs), and (2) drilling 7 test borings to a maximum depth of 51.5 feet bgs. Approximate CPT and test boring locations are shown in Figure 2. Under the direction of a LACO geologist, CPT probes were advanced by Gregg Drilling, Martinez, California using a 15 square centimeter ($cm^2$) standard cone. Test borings were drilled by Clear Heart Drilling, Inc. using a DR7K track-mounted drill rig equipped with an 8-inch diameter hollow stem auger, both. Our geologist logged the test borings in general accordance with the American Society for Testing and Materials (ASTM) D2488 and obtained relatively undisturbed and disturbed soil samples for visual classification and laboratory testing. Boring logs and CPT logs are presented in Appendix 1 and 2, respectively.

Soil samples collected during the exploration effort were transported to our laboratory in Eureka, California, where they were examined to confirm field classifications and select samples for laboratory testing. Selected soil samples were subjected to the following laboratory tests:

- Particle Size Finer than No. 200 sieve (ASTM C117);
- Atterberg Limits (ASTM D4318);
- Consolidation (ASTM D2435);
- Direct Shear (ASTM D3080);
- Unconfined Compressive Strength Test (ASTM D2166);
- Moisture Content (ASTM D2216) and Unit Weight (ASTM D2937); and,
- Basic Corrosivity (pH, resistivity, electrical conductivity, sulfate, chloride)

Laboratory test results are presented in Appendix 3 and summarized in Table 2 and in Boring Logs (Appendix 1). The computer program CPeT-IT v.2.0, developed by GeoLogismiki, Athens, Greece, was used to estimate soil properties; the results are presented in Appendix 4

*Table 2. Laboratory Test Results*

| Boring | Depth (feet bgs) | USCS Soil Type | Finer Than No. 200 Sieve (%) | Moisture / Density | | Atterberg Limits | | Direct Shear | | Unconfined Compressive Strength Test (psf) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | DD (pcf) | MC (%) | LL (%) | PI (%) | c (psf) | Φ (degrees) | |
| GBH-1 | 5 | CL | - | 59.01 | 68.8 | - | - | - | - | 514 |
| GBH-1 | 11 | CL | - | 97.2 | 28.4 | - | - | - | - | - |
| GBH-1 | 15.5 | SP-SC | - | 102.2 | 26.9 | - | - | - | - | - |
| GBH-2 | 2.5 | CL | 28.1 | - | - | - | - | - | - | - |
| GBH-2 | 5 | CL | - | 58.1 | 67.7 | - | - | - | - | 703 |
| GBH-2 | 10 | CL | 89.0 | - | - | - | - | - | - | - |
| GBH-2 | 20 | SM | 13.7 | 83.4 | 34.6 | NP | NP | 229 | 37.6 | - |
| GBH-2 | 35 | SM | 93.3 | - | - | 23.4 | 4.9 | 400 | 35 | - |
| GBH-2 | 45 | SM | - | 99.8 | 25.0 | - | - | - | - | 1479 |
| GBH-2 | 50 | SC | 18.2 | 103 | 23.0 | NP | NP | - | - | 196 |
| GBH-3 | 5 | CL | - | 50.7 | 64.5 | - | - | - | - | 809 |
| GBH-4 | 16 | CL | - | 121 | 17.1 | - | - | - | - | - |
| GBH-4 | 21 | CL | - | 111 | 23.7 | - | - | - | - | - |
| GBH-5 | 2.5 | SC | - | 131 | 7.6 | - | - | - | - | - |
| GBH-5 | 5 | SC | - | 92.7 | 22.2 | - | - | - | - | 493 |
| GBH-5 | 10.5 | CL | 94.9 | - | - | - | - | - | - | - |
| GBH-5 | 11 | CL | - | 75.0 | 44.2 | - | - | - | - | 358 |
| GBH-5 | 15.5 | CL | 97.5 | - | - | - | - | - | - | - |
| GBH-5 | 16 | CL | - | 92.0 | 30.2 | - | - | - | - | 871 |
| GBH-5 | 20 | SC | 7.1 | 93.8 | 29.0 | NP | NP | 794 | 28.9 | 922 |
| GBH-5 | 30 | MH | 59.4 | - | - | - | - | - | - | - |
| GBH-5 | 30.5 | MH | - | 67.5 | 54 | - | - | - | - | 1713 |
| GBH-5 | 31 | MH | 95.5 | - | - | - | - | - | - | - |
| GBH-5 | 35 | MH | 99.8 | 79.52 | 40.4 | 61.8 | 30.2 | 349 | 23.4 | 2888 |
| GBH-5 | 37 | CL | - | 70.2 | 50.6 | - | - | - | - | - |
| GBH-5 | 40 | MH | 59.9 | - | - | - | - | - | - | - |
| GBH-5 | 40.5 | MH | 92.7 | - | - | - | - | - | - | - |
| GBH-5 | 41 | MH | - | 105.7 | 24.9 | - | - | - | - | 1800 |
| GBH-5 | 45.5 | SP-SC | 10.6 | - | - | NP | NP | - | - | - |
| GBH-5 | 51 | SP-SC | 49.1 | 105.4 | 22.8 | - | - | - | - | 643 |
| GBH-6 | 4.5 | SC | 31.6 | - | - | - | - | - | - | - |
| GBH-7 | 5 | CL | - | 59.0 | 72.7 | - | - | - | - | - |

*Legend* – next page

***Table 2 Legend***
USCS – Unified Soil Classification System
DD – Dry Density (pounds per cubic foot)
MC – Moisture Content
PI – Plasticity Index
LL – Liquid Limit
C – Cohesion
Φ- Internal Friction Angle (degrees)
pcf – pounds per cubic foot
psf – pounds per square foot

# 3.0 SITE AND SUBSURFACE CONDITIONS

## 3.1 Site Conditions

The Site is relatively flat, currently occupied by an existing wastewater treatment facility. The Site is situated in the marsh of the north-eastern edge of the Arcata Bay at approximately 10 feet above mean sea level.

## 3.2 Geologic Setting

The Site is located in the Coast Ranges geomorphic province which is characteristic of northwest-trending ridges and valleys running subparallel to the San Andreas Fault Zone. Prior to development, the site was in a tidally influenced marsh, that was reclaimed by covering the underlying delta marsh with imported fill soil. Published geologic maps (CDMG, 1983; McLaughlin et. al., 2000) indicate, the site is underlain by a layer of alluvial fan and marine deposits that include clays, silts, and fine sands. Coarser deposits of sand and gravel are present in isolated areas as discontinuous lenses within the otherwise fine grain deposits. At unknown depth, the alluvial deposits unconformably overlie poorly cemented alluvial deposits of the early to middle-Pleistocene Falor Formation. Based on the morphology of the slopes in the vicinity, the contact between the unconsolidated bay margin sediments and underlying poorly unconformably overlies the Jurassic to Cretaceous age Franciscan Formation bedrock.

## 3.3 Subsurface Conditions

Our exploration indicates the Site is blanketed by a layer of fill approximately 5 feet thick, marsh deposits (bay mud) approximately 40 to 60 feet thick, and old terrace deposits. The fill consists of dense clayey sand with gravel; bay mud consists of soft fat/elastic silt, clay and fine sand; and the terrace deposits consist of dense clayey sand that is comprised of fine to coarse sand with sub angular to rounded gravel. During drilling, free groundwater was encountered in our borings at depths between 2 to 8 feet bgs.

# 4.0 GEOLOGIC HAZARDS

## 4.1 Seismic Ground Shaking

The site is located in a seismically active region of California and thus will likely be subjected to severe ground shaking during the economic life of the project. The level of anticipated seismic ground shaking is a function of the following factors:

- The closest distance from the seismic source (fault system) to the site.
- The magnitude of the postulated earthquake on the fault system.

A splay of the Fickle Hill fault is approximately 1.3 miles northeast of the Site (CDMG, 1983). The upper-bound earthquake considered likely to occur on the nearby Fickle Hill fault has an estimated moment magnitude (mw) of 6.9 (ICBO-CDMG, 1998). Peak ground accelerations of at least 0.635 g (63.5 percent of the force of gravity), and possibly more, may be expected to occur on this site as a result of this regional design basis earthquake (Petersen et al, 1999; CGS 2008;).

Recent and ongoing research into the seismicity of the Pacific Northwest has shown that the Cascadia subduction zone is capable of generating major earthquakes which will affect the site. The Cascadia subduction zone marks the boundary between the North American plate and the subduction Gorda and Juan De Fuca plates. It extends from offshore of Cape Mendocino, Humboldt County, to Victoria Island, British Columbia, and is considered capable of rupturing along its entire length and generating an upper-bound earthquake with a Mw of 9.0 (Satake et. al., 2003). Seismic design parameters are presented in Recommendations section 6.8 and details presented in Appendix 5.

The site is not located within an Alquist-Priolo earthquake fault zone (CDMG, 2000). Therefore, the potential for active surface fault rupture to adversely affect the project site is considered low.

## 4.2 Liquefaction

A state of soil liquefaction occurs when, as a result of cyclic fluctuations in pore fluid pressure, sediment grains lose contact with one another, causing a loss of effective stress and consequently of shear strength. Liquefaction is most commonly initiated by earthquake ground motions. A soil in a saturated, loose state and one which may generate significant pore water pressure when sheared, is highly susceptible to liquefaction. Liquefaction is more likely to occur in sandy or non-plastic, silty soils, but may, in rare cases, occur in gravels and sensitive clays. Deposits most susceptible to liquefaction include young (Holocene-age, deposited within the last 10,000 years) sands and silts of similar grain size (poorly graded), in beds at least 1 meter thick, and saturated with water.

To evaluate the potential for induced liquefaction settlement to occur at the Site, we utilized the results obtained from CPT probes, laboratory tests, and Standard Penetration Test (SPT) data obtained from our test borings; site specific response analysis; and the computer program LiqSVs (by GeoLogismiki).

### *4.2.1 SPT Data Evaluations*

In our SPT data evaluations, we used the logs for test boring GBH-2, and GBH-5, a groundwater level during drilling of 4 and 6.5 feet bgs for GBH-2 and GBH-5, respectively, and assumed a groundwater level of 0 feet

during a hypothetical seismic event. Fine-grained soils with a plasticity index of 7 or greater that have fine grained fractions exceeding 35 percent were input as not liquefiable because they tend to exhibit clay-like behavior (Boulanger and Idriss 2006). The results of our analyses are presented in Appendix 6 and settlement values are summarized in Table 3.

*Table 3. Liquefaction Induced Settlement Estimates Calculated from SPT Data*

| Boring | Estimated Liquefaction Induced Settlement (inches) | Estimated Lateral Displacement (Feet) |
|---|---|---|
| GBH-2 | 10.3 | 12.0 |
| GBH-5 | 14.0 | 2.2 |

As shown, results indicate the potential for liquefaction induced settlement generated from the LiqSVs program is approximately 10 and 14 inches for GBH-2 and GBH-5, respectively.

To further evaluate the potential for liquefaction induced settlement we used CPT data and the computer software CLiq v.2.2.1.11 (by GeoLogismiki). The results of our analyses are presented in Appendix 7; settlement and lateral displacement estimates are summarized in Table 4.

*Table 4. Liquefaction Induced Settlement Estimates Calculated from CPT Data*

| Cone Penetration Test | Estimated Liquefaction Induced Settlement (inches) | Estimated Lateral Displacement (Feet) |
|---|---|---|
| CPT-1 | 7.1 | 7.8 |
| CPT-2 | 4.2 | 1.6 |
| CPT-3 | 4.6 | 2.2 |
| CPT-6 | 4.1 | 0 |
| CPT-9 | 2.2 | 0 |

### *4.2.2 Discussion*

As shown, SPT-based liquefaction induced settlement estimates range between 10 and 14 inches, CPT-based estimates range between 2.2 inches and 7.1 inches, with an average value of 4.4 inches. CPT based results tend to be more reliable as they provide an almost continuous penetration resistance profile for stratigraphic interpretation and the repeatability of the test results tend to be better than SPT based values (SCEC,1999). On this basis coupled with our experience, we judge that CPT based results (Table 4) are the more reliable settlement values.

## 4.3 Volcanism

According to the United States Geologic Survey (USGS) Volcano Hazards Program, the Site is not situated in a volcanically active area. The nearest volcano (Mt. Shasta) is located over 100 miles to the east. The likelihood of the Site experiencing active volcanism is low (USGS, 2017).

## 4.4 Slope Instability/Landsliding

Given the relatively flat site, we consider the potential for slope instability to adversely affect the Site to be negligible. This being said, heavy loads placed adjacent to waterfront areas on the site may result in slope instability given the soft, weak bay mud. In addition, as described in Section 4.2, liquefaction-induced lateral spreading magnitudes within approximately 200 feet of the shoreline have the potential to be significant.

## 4.5 Flooding

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps, (Map Number 06023C0852G, effective June 21, 2017), the Site is mapped as flood zone AE, which is inside of the special flood hazard area. A special flood hazard area is defined by the annual chance of a 100-year flood equaling or exceeding 1percent. Consequently, we conclude the likelihood of significant flooding occurring during the economic lifespan of the project is high (FEMA, 2017).

## 4.6 Tsunami Inundation

The Site resides in the Arcata South Quadrangle of the California Geological Survey (CGS) California Emergency Management Agency models a tsunami inundation map for emergency planning. Tsunami inundation was evaluated using a number of local and distance sources with moment magnitudes ranging from 8.4 to 9.4. The location in relation to projected tsunami inundation is shown in Figure 3.

## 4.7 High Groundwater

As noted in Section 3.3 of this report, groundwater was observed during our subsurface exploration between 2 to 8 feet bgs at the time drilling, with historically high groundwater levels judged to be less than 1 foot bgs. Consequently, the risk of encountering groundwater in relatively shallow utility trenches or other required earthwork excavations for the project is high.

## 4.8 Soil Corrosivity

Corrosion is the deterioration of a metal through a chemical reaction with its environment. Factors that contribute to corrosion potential include the presence of soluble salts, soil and water resistivity, soil and water pH, and the presence of oxygen.

Corrosion potential of soils in the vicinity of the proposed school building was assessed by obtaining 12 soil samples across the site. The samples were analyzed for sulfate, chloride, sulfide, resistivity, oxidation/reduction potential, and pH. The results of these tests are summarized in Table 5 with full lab results presented in Appendix 3

*Table 5. Corrosion Test Results*

| Sample | pH | Min. Resistivity (Ohm-cm) | Electrical Conductivity (µmhos/cm) | Sulfate (ppm) | Chloride (ppm) |
|---|---|---|---|---|---|
| GBH-1 at 3 feet | 7.16 | 643 | 1556 | 294 | 370 |
| GBH-2 at 10.5 feet | 7.92 | 163 | 6135 | 450 | 2,370 |
| GBH-2 at 51 feet | 8.27 | 614 | 1628 | 234 | 1,125 |
| GBH-3 at 4 feet | 6.44 | 225 | 444 | 750 | 870 |
| GBH-3 at 25 feet | 8.66 | 119 | 8403 | 1,725 | 2,550 |
| GBH-4 at 3 feet | 6.21 | 1,880 | 532 | 78 | 390 |
| GBH-4 at 4 feet | 6.07 | 1,285 | 778 | 450 | 330 |
| GBH-5 at 10 feet | 7.59 | 118 | 8446 | 825 | 7,650 |
| GBH-5 at 26 feet | 8.04 | 123 | 8130 | 525 | 6,600 |
| GBH-5 at 50.5 feet | 7.86 | 572 | 1748 | 138 | 840 |
| GBH-6 at 4 feet | 5.80 | 3,366 | 297 | 138 | 300 |
| GBH-7 at 10 feet | 6.48 | 558 | 1794 | 102 | 840 |

ppm – parts per million

For structural elements, CalTrans considers a site to be corrosive if one or more of the following conditions exist for the representative soil and/or water samples taken at the Site: chloride concentration is 500 ppm or greater, sulfate concentration is 2,000 ppm or greater, or the pH is 5.5 or less. A minimum resistivity value for soil and/or water less than 1,000 ohm-cm indicates the presence of high quantities of soluble salts and a higher propensity for corrosion (CDOT, 2012). As shown, the majority of the soil at the Site has a high propensity for corrosion. An engineer specializing in corrosion should be retained to evaluate whether or not a corrosion risk exists, and if so, design a system to minimize the detrimental effects of corrosion impacts to project components.

### 4.9 Soil Swelling or Shrinkage Potential

Expansive soils, generally consisting of cohesive fine-grained clay soils, represent a significant structural hazard to buildings founded on them, especially where seasonal fluctuations in soil moisture occur at the foundation-bearing depth. Surface soils encountered during our field exploration consist of coarse- and fine-grained soils, with a low expansion potential. However, marsh deposits below the fill possess relatively high expansive soil characteristics.

## 5.0 CONCLUSIONS

The results of our exploration indicate the project is feasible from a geotechnical engineering standpoint. As described above, the proximity of the Site to Arcata Bay exposes it to significant flooding and tsunami inundation risk. The primary geotechnical challenges include weak, compressible sandy clay/silt (bay mud) underlying the fill, and the potential for liquefaction induced settlement and lateral spreading in the event of a major earthquake.

Heavy and/or settlement-sensitive structures (Group 1) supported on shallow foundations will undergo excessive settlement (up to and in some instances exceeding 10 inches); lighter, less settlement sensitive (Group 2) structures constructed on shallow footings bearing on engineered fill will undergo total static settlement between 3 and 4 inches. Soil improvement techniques (e.g., surcharge loading and/or

preloading)[1] can be implemented to reduce consolidation settlement, however, these techniques will not ameliorate the potential for liquefaction induced settlement discussed in Section 4.2.

Following discussions with Carollo regarding settlement potential and mitigation options, it was decided that both Group 1 and 2 structures will be supported on driven piles deriving their load-carrying capacity in medium dense/stiff clayey sand/sandy clay underlying the bay mud at depths exceeding 40 feet below ground surface. If designed and constructed per the recommendations presented in this report, we estimate structures will undergo total static settlement of less than 1 inch, with differential settlement estimated at ½ inch over distance of approximately 20 feet.

As described previously, the potential for the liquefaction to occur at the site is high. Liquefaction consequences include significant ground surface settlement and lateral spreading, and downdrag loads on pile foundations. Mitigating the effects of liquefaction will by costly; conversely, ignoring this potential entirely could significantly affect the ability of the treatment facility to function after a major earthquake. In developing the recommendations that follow, LACO has attempted to provide recommendations to minimize the effects of liquefaction on planned new structures, and, where this is less than the case, has identified potential risks for designers to consider.

# 6.0 RECOMMENDATIONS

## 6.1 Site Preparation and Grading

Areas to be graded should be stripped of vegetation and soil containing organic material. The resulting subgrade should be scarified to a depth of 6 inches, moisture conditioned to near the optimum moisture content, and compacted to at least 90 percent relative compaction.[2] Fill meeting the requirements for structural fill described below should be placed on the prepared subgrade in layers, approximately 8 inches in loose thickness, moisture conditioned as necessary and compacted to 90 percent relative compaction. In pavement areas, the upper 6 inches of final subgrade should be compacted to 95 percent relative compaction.

Where circumstances are such that fill has be placed directly on bay mud, methods to stabilize the subgrade will likely be required. These methods may include at a minimum, a 12-inch thick layer of clean 3-inch minus crushed rock and a layer of triaxial geogrid (such as Tensar TX5 or equivalent).

To minimize ground surface settlement and thus downdrag loads on new and existing pile foundations, the net increase in site grades should be less than 1 foot.

---

[1] Preloading refers to placing fill material over a planned building site well in advance of building construction to strengthen soft cohesive soil and reduce settlement; surcharging refers to placing additional fill material on preload fill to reduce the time to achieve the desired strength increase and settlement reduction.

[2] Relative compaction refers to the ratio of the in place dry density of the soil to the maximum dry density as described in the latest addition of the ASTM D1557 compaction test procedure. Optimum moisture content is the water content as a percentage of the dry weight of the soil corresponding to the maximum dry density.

Structural fill should be composed of soil material having a low expansion potential and free of organic content, debris, and/or other deleterious matter. It should not contain rocks larger than 3 inches in greatest dimension, or more than 15 percent larger than 2 inches, and conform to the following requirements:

| | |
|---|---|
| Plasticity Index: | less than 15 percent |
| Liquid Limit: | less than 35 percent |
| Percent passing No. 200 sieve: | 50 maximum, 5 minimum |

Structural fill should be placed on an approved subgrade as described above. Subgrade soils should be kept wet until covered with structural fill. Our exploration indicates that the majority of on-site surficial fill is suitable for use as structural fill; soil underly the fill will be unsuitable for this purpose.

## 6.2 Foundations

### *6.2.1 Driven Piles*

Structures should be supported on driven piles deriving their load carrying capacity primarily via end bearing in medium dense to dense clayey sand below an approximate mean sea level elevation (EL.) -30. As requested, we have presented pile capacity recommendations for 12-, 14-, and 16-inch square precast prestressed concrete piles. Maximum allowable vertical pile capacity verses elevation graphs are presented in Figures 4 through 6. Practical driving refusal may be encountered at or below EL. 40. Piles driven to practical refusal (as defined in the subsequent section) may be capable of supporting the net allowable structural capacity of the pile. In order to achieve the necessary lateral load resistance, pile tips should extend at least 10 feet into medium dense to dense clayey sand which equates to a minimum tip elevation of EL. -40 in our subsurface conceptual model.

As shown, Figures 4 through 6 show plots for vertical downward capacity, vertical downward capacity accounting for the effects of downdrag, and uplift capacity. When evaluating the effects of liquefaction, the plots that contemplate downdrag should be used.

#### 6.2.1.1 *Pile Driving*

Piles should be driven continuously with a hammer developing at least 40,000 foot-pounds of energy until the design tip elevation or practical driving refusal is attained. Refusal blow count criteria should be evaluated during construction when the hammer size is known, and its efficiency known. For planning purposes, we suggest that the refusal blow count criteria shown on Table 6 be used.

*Table 6. Refusal Blow Count Criteria*

| Hammer Size (foot pounds) | Practical Refusal Blow Count (blows per foot) |
|---|---|
| 40,000 | 55 |
| 60,000 | 35 |

To facilitate penetration of surface fill and to reduce noise, we recommend pile locations be predrilled through the fill using an auger no greater than 2 inches less than the pile diameter.

Piles should be spaced a minimum of 6-pile widths, center-to-center or 3-pile widths if lateral load resistance is not provided by piles. (Pile spacing is discussed further in Section 6.2.1.4.) We believe the piles will penetrate

10 feet or more into the clayey sand layer below approximately EL. -30. Because the surficial fill was placed approximately 40 years ago, we believe that consolidation of the bay mud due to the fill is essentially complete. Consequently, if no significant amounts of fill are subsequently placed in the site vicinity, we judge that downdrag loads on the piles resulting from consolidation of the bay mud will be insignificant. However, as discussed in section 6.2.1, downdrag resulting from liquefaction remains a risk.

#### 6.2.1.2 *Indicator Piles*

Before production piles are cast, we recommend that a minimum of six indicator piles be driven. Where practical, they should be located near our test borings/CPT probes. We will assist your structural engineer in selecting indictor pile locations as required. The purpose of the indicator piles will be to (1) provide blow count data to correlate with information obtained from test borings/CPT probes, and (2) aid in estimating production pile lengths. Indicator piles should be driven with the same equipment that will be used to drive production piles. We recommend that indicator piles be at least 50 feet long.

#### 6.2.1.3 *Lateral Capacity*

The pile caps and the upper portion of the piles may be relied upon to develop resistance to lateral loads by passive bearing against the surrounding soil. For pile caps/grade beams in fill, we recommend a passive pressure of 300 pounds per cubic foot (pcf) equivalent fluid pressure. For pile caps in bay mud below the fill, use a uniform passive pressure of 1,000 pounds per square foot (psf). We estimate movement required to mobilize passive pressures in the fill and in the underlying bay mud will be approximately 1 inch and 2 inches, respectively (Wilson et al. 2010). These pressures should be assumed to act over an area defined by two pile widths and the upper five feet of the piles. Any voids around the pile caps should be backfilled with select fill and compacted as described in Section 6.1.

To evaluate load-deflection relationships of piles, and to evaluate associated shear and bending moments within the piles, LACO utilized the computer program L-Pile, developed by Ensoft, Inc., and the results of our exploration. From the L-Pile results, we developed plots of moment and shear resistance resulting from lateral pile head displacements of ½ inch and 1 inch for both free and fixed conditions. The results are summarized in Table 7 and 8, respectively, with detailed analysis results presented in Appendix 8.

*Table 7. Summary of LPile Results - 0.5-inch Deflection*

| | | Pile Width (12 in) | Pile Width (14 in) | Pile Width (16 in) |
|---|---|---|---|---|
| Fixed Head (Case 1) | Shear (kips) | 21.65 | 25.70 | 30.89 |
| | Depth (in) | 0 | 0 | 0 |
| | Moment (in-kips) | -840.27 | -1,086.50 | -1,491.54 |
| | Depth (in) | 0 | 0 | 0 |
| Free Head (Case 2) | Shear (kips) | 12.60 | 15.91 | 19.48 |
| | Depth (in) | 0 | 0 | 0 |
| | Moment (in-kips) | 447.90 | 591.44 | 772.44 |
| | Depth (in) | 54 | 60 | 78 |
| Fixed Head No Fill (Case 1) | Shear (kips) | 10.80 | 13.78 | 17.88 |
| | Depth (in) | 0 | 0 | 0 |
| | Moment (in-kips) | -689.54 | -941.63 | -1,355.97 |
| | Depth (in) | 0 | 0 | 0 |
| Free Head No Fill (Case 2) | Shear (kips) | 5.14 | 6.85 | 8.69 |
| | Depth (in) | 0 | 0 | 0 |
| | Moment (in-kips) | 306.57 | 458.51 | 642.56 |
| | Depth (in) | 96 | 108 | 126 |

- Shear and Moment values provided represent maximum values at dept indicated.
- Depth is from top of Pile

*Table 8. Summary of LPile Results 1-inch Deflection*

| | | Pile Width (12 in) | Pile Width (14 in) | Pile Width (16 in) |
|---|---|---|---|---|
| Fixed Head (Case 1) | Shear (kips) | 25.75 | 31.60 | 38.36 |
| | Depth (in) | 0 | 0 | 0 |
| | Moment (in-kips) | -1,029.13 | -1,349.28 | -1,773.06 |
| | Depth (in) | 0 | 0 | 0 |
| Free Head (Case 2) | Shear (kips) | 16.94 | 20.97 | 26.12 |
| | Depth (in) | 0 | 0 | 0 |
| | Moment (in-kips) | 652.86 | 822.62 | 1,091.68 |
| | Depth (in) | 54 | 66 | 84 |
| Fixed Head No Fill (Case 1) | Shear (kips) | 14.48 | 18.23 | 23.72 |
| | Depth (in) | 0 | 0 | 0 |
| | Moment (in-kips) | -902.48 | -1,202.38 | -1,740.15 |
| | Depth (in) | 0 | 0 | 0 |
| Free Head No Fill (Case 2) | Shear (kips) | 7.49 | 9.61 | 12.35 |
| | Depth (in) | 0 | 0 | 0 |
| | Moment (in-kips) | 496.29 | 698.73 | 994.97 |
| | Depth (in) | 108 | 120 | 132 |

- Shear and Moment values provided represent maximum values at dept indicated.
- Depth is from top of Pile

#### 6.2.1.4 *Pile Groups*

Pile groups (i.e., piles spaced less than approximately 6-pile diameters from one another) should be avoided if possible. Whether considering vertical or lateral load capacity, pile group capacity divided by the number of piles in the group will tend to be less than the capacity of an individual pile all else being equal. Pile group efficiency will tend to be higher when the pile, in relation to its diameter/width, is short, the spacing is wide and the number of the piles in the group low. Because piles are anticipated to develop their vertical load carrying capacity primarily in end bearing in non-cohesive soils, and efficiency of unity can be assumed.

With regarding lateral resistance then, capacity reduction or pile group efficiency changes significantly depending of the size and configuration of the pile group, pile fixity, and pile spacing. In addition, each pile within the group experience different loading scenarios and contribute to the overall lateral resistance of the cap: piles on the leading edge, particularly corner piles, contribute the greatest, while pile(s) within the outer pile circumference the least.

A detailed analysis of lateral resistance provided by a pile group requires a pile group configuration which is presently not available and in any case is beyond the scope of the present effort. This being said, if designers can maintain a pile spacing of 6 pile diameters, pile group effects can be minimized, and similarly, the need for detailed pile group evaluations reduced or eliminated.

## 6.3 Utilities

Underground utilities should avoid areas of abrupt changes in surface elevation which would impact differential settlement. Flexible connections should be employed where utilities cross from areas of new fill to existing streets or buildings. They should also be used where utilities connect to pile-supported structures and tanks. Because of the saline conditions, corrosion protection for buried utilities should be considered.

Utility trenches should be backfilled with clean, free-draining pea gravel where trench excavation extends below the ground-water table or below the bottom of the fill. Pea gravel should be compacted by vibrating during placement. Utility bench backfill under roads should be capped with at least 3 feet of subgrade fill compacted to 90 percent relative compaction and under native areas should be capped with at least 3 feet of bay mud fill compacted to at least 80 percent relative compaction.

When excavation extends into bay mud, soft clays stabilization fabric or crushed rock may be required to form an adequate working surface. Shallow groundwater was encountered during our exploration and should be anticipated during installation of underground utilities. Groundwater that accumulates in trenches should be pumped out prior to placement of fill, utilities or pipe bedding.

The contractor is responsible for the stability of temporary slopes and trenches excavated at the Site, and the design and construction of any required shoring. Shoring and bracing, if necessary, should be designed and constructed in accordance with applicable local, state, and federal safety regulations, including the current OSHA excavation and trench safety standards. Because of the potential for variable soil conditions, field modifications of temporary cut slopes may be required. Unstable materials encountered on the slopes during the excavation should be trimmed off, even if this requires cutting the slope back at flatter inclinations.

## 6.4 Retaining Walls

Retaining walls should be designed to resist the lateral earth pressures presented in Figure 7. Retaining walls free to rotate on the top should be designed to resist "active" lateral earth pressures; if walls are restrained to prevent rotation or supporting compacted engineered fill, they should be designed for "at-rest" lateral earth pressures. Retaining walls should be designed to resist the following equivalent fluid earth pressures:

| | |
|---|---|
| Active Pressure (level backfill) (5H:1V or less) | 40 psf/ft |
| At Rest Pressure (level backfill) (5H:1V or less) | 65 psf/ft |

Where vehicles may operate near the top of retaining walls, they should be designed using an additional 2 feet in height to account for traffic-induced surcharge loads. To reduce the potential for the buildup of hydrostatic pressure behind the walls, they should be designed with back drains as depicted in Figure 8. On-site soils containing at least 20 percent clay should be used for the top 12 inches to limit surface-water from flowing into the drain rock.

Retaining wall can be supported on shallow footings bearing on compacted fill. Footings should extend at least 12 inches below lowest adjacent grade and designed using a maximum allowable bearing pressures of 3,400 psf. This value can be increased by one-third when considering wind or seismic loads. below.

Retaining wall backfill should be placed and compacted as described in Section 6.1.

Retaining walls and backfill that extend above existing site grades may cause the underlying bay mud to consolidate resulting in settlement in response to the imposed loads. Where such improvements are planned, LACO should review then to check that induced settlement is tolerable.

Lateral load resistance may be developed via (1) friction between the footing bottoms and underlying soil, and (2) passive resistance between the vertical faces of footings. For design, use an allowable friction coefficient of 0.35 and a passive soil pressure of 300 pcf equivalent fluid pressure. Passive pressure should be neglected in the upper one-foot of soil unless confined by concrete slabs or pavements. If friction and passive resistances are to be combined, reduce the lesser value by 50 percent.

Footings adjacent to existing utility trenches or other footings should be deepened enough to bear below a 1:1 (horizontal to vertical) plane extending upwards from the bottom edge of the utility trench or footing excavation. A representative of the project geotechnical engineer should observe the footing excavations prior to the placement of reinforcing steel and concrete forms to see that they are founded in suitable bearing materials and have been properly cleaned of loose soil.

## 6.5 Concrete Slab-on-Grade Floors

Concrete slabs-on-grade should be constructed on a smooth, non-yielding subgrade. The upper 6 inches should be scarified, moisture conditioned to within 2 percent of the optimum moisture content and compacted to at least 90 percent relative compaction.

To provide a capillary moisture break between the slab and the supporting soil, we recommend the concrete slab be constructed on a 4-inch-thick layer of clean ¾ inch crushed rock. The crushed rock should be placed as soon as possible after moisture conditioning and compaction of the select subgrade materials to reduce the potential for drying and cracking of the subgrade soil. Where the risk of moisture vapor movement

through the slab may be detrimental to its intended use, the capillary break material should be covered by an impermeable membrane consisting of 15-mil Stego® Wrap sheeting, or equivalent, installed in accordance with the manufacturer's recommendations.

Special precautions should be taken during the placement and curing of concrete slabs. Excessive slump (high water-cement ratio) of the concrete and/or improper curing procedures used during either hot- or cold-weather conditions could lead to excessive shrinkage, cracking, or curling of the slabs. High water-cement ratio, and/or improper curing also greatly increase the water vapor permeability of concrete. We recommend concrete placement and curing operations be performed in accordance with the American Concrete Institute (ACI) manual.

## 6.6 Pavement

The soil subgrade in areas to be paved should be smooth and non-yielding. The upper 6 inches should be scarified, moisture conditioned to near the optimum moisture content, and compacted to at least 95 percent relative compaction. The laboratory test results on existing surface soil indicate an R-value of 30 is appropriate. Using this value, and CalTrans flexible pavement design procedures, we calculated pavement section thicknesses presented in Table 9.

*Table 9. Recommended Pavement Section Thicknesses*

| Location | Traffic Index | Hot Mix Asphalt (feet) | Aggregate Base (feet) |
|---|---|---|---|
| Parking Areas | 5 | 0.25 | 0.50 |
| Driveways | 6 | 0.30 | 0.67 |

Aggregate base should conform to the requirement for Class 2 Aggregate Base described in the CalTrans Standard Specifications, latest edition. It should be placed in layers not exceeding 8 inches in loose thickness, moisture conditioned to near the optimum moisture content and compacted to at least 95 percent relative compaction.

## 6.7 Surface Drainage

The Site should generally be graded to provide positive drainage away from foundations. A minimum gradient of 3 percent should be maintained for hardscaped areas. A minimum 5 percent gradient should be maintained for landscaped areas within 10 feet of a structure. The grading or landscaping design and construction should not allow water to pond on the Site nor to migrate beneath any structure. Runoff from hardscaped areas, roofs, patios, and other impermeable surfaces should be contained, controlled, collected, and directed to the Site storm drainage system.

## 6.8 Seismic Design Parameters

Earthquake design parameters are presented in the site-specific response analysis report presented in Appendix 5.

### 6.9 I Street Improvements

This project also includes a planned pipeline extending beneath a section of South I Street roadway located approximately 2,000 feet northwest of the wastewater treatment plant entrance (Figure 2). The Site is relatively flat and bounded by treatment wetlands. Our exploration for the planned new pipeline consisted of drilling 1 boring and advancing 2 CPT probes to a depth of 21.5 and 15 feet, respectively. Groundwater was encountered approximately 5 feet bgs. Borings and CPT probes indicate that the alignment is underlain by approximately 5 feet of fill that is in turn underlain by bay mud.

The results of our exploration indicate that the pipeline is feasible from a geotechnical engineering standpoint. Where the pipeline extends to or through the fill and into bay mud, construction impediments such as soft soil subgrade, the presence of groundwater, and caving/squeezing of trench sidewalls will need to be considered.

Soft soil subgrade can be stabilized by a layer of 1 ½ inch crushed rock underlain by a layer of geogrid (such as Tensar TX140, or equivalent). Although the bay mud underlying the fill is cohesive, sand layers/lenses within the bay mud may require a robust dewatering system to maintain groundwater levels at/below the trench bottom. To ameliorate caving, shoring may be required, especially where pipeline trenches extend more than 5 feet below the bottom of the fill. Pipeline settlement is anticipated to be within tolerable limits provided post-construction surface grades conform to pre-construction grades.

Pipe bedding should conform to pipe manufacturer's recommendations. It should be placed on a stable subgrade and should extend from trench bottom to a height up to 50 percent of the outside diameter of the pipe. Select fill should then be placed and compacted to a minimum 90 percent relative compaction following the recommendations presented in Section 6.1. Backfill should extend above the pipe a minimum of 30 inches or one-half the pipe diameter (whichever is greater) before power-operated hauling or rolling equipment is used over the pipe.

When evaluating the superimposed loads on buried pipes, use a unit weight of 130 pounds per cubic foot, a coefficient of friction of 0.35 and a Rankines ratio of 0.33. Use a modulus of subgrade reaction of 1,000 pounds per square inch (psi) for depths up to 10 feet of cover and a value of 1,400 psi for depths over 10 feet of cover.

## 7.0 FUTURE GEOTECHNICAL SERVICES

To further understand and quantify the depth to and character of the layer the will support driven pile foundations, we recommend additional subsurface exploration and engineering analysis be performed. The effort will also allow us an opportunity refine our recommendation as the design of WWTF improvements progress. Supplemental exploration would consist of at least three (3) additional cone penetrometer tests (CPTs) advanced at key locations across the site to allow minimum required pile lengths to be estimated more definitely and provide additional insight into liquefaction induced settlement and mitigation methods. This work is beyond our current scope of services and thus would be performed under a separate services agreement.

Upon completion of the design effort, LACO should be retained to review project plans and specifications to check for conformance with the intent of the recommendations presented in this report. During construction, we should observe the driving of indicator and production piles and observe the placement

and compaction of fill and backfill to check that the geotechnical aspects of the work is performed consistent with the construction drawings and specifications.

# 8.0 LIMITATIONS

This report has been prepared for the exclusive use of Carollo its contractors, and consultants; and appropriate public authorities for specific application to the development of the Site. LACO has exercised a standard of care equal to that generated for this industry to ensure that the information contained in this report is current and accurate.

Data generated for this report represent information gathered at that time and at the indicated locations. Subsurface conditions may change with time and under anthropologic influences. As such, recommendations included in this report are based, in part, on assumptions about subsurface conditions that may only be observed and/or tested during subsequent project earthwork. Accordingly, the validity of these recommendations is contingent upon review of subsurface conditions exposed during construction in order to check that they are consistent with those characterized in this report. Upon request, LACO can discuss the extent of (and fee for) observations and tests required to check the validity of the recommendations presented herein.

LACO disclaims any and all liability for any errors, omissions, or inaccuracies in the information and data presented in this report and/or any consequences arising therefrom, whether attributable to inadvertence or otherwise. LACO makes no representations or warranties of any kind including, but not limited to, any implied warranties with respect to the accuracy or interpretations of the data furnished. This report is valid solely for the purpose, site, and project described in this document. Any alteration, unauthorized distribution, or deviation from this description will invalidate this report. LACO assumes no responsibility for any third-party reliance on the data presented. Additionally, the data presented should not be utilized by any third-party to present data for any other time or location.

# 9.0 REFERENCES

Boulanger, R.W. and Idriss, I.M., 2006. Liquefaction Susceptibility Criteria for Silts and Clays, Journal of Geotechnical and Geoenvironmental Engineering, American Society of Civil Engineers, November.

California Department of Transportation (CDOT) Division of Engineering Services Materials Engineering and Testing Services Corrosion and Structural Concrete Field Investigation (CSCFI) Branch, 2012. Corrosion Guidelines Version 2.0. November 2012.

California Division of Mines and Geology (CDMG), 1983. State of California Special Studies Zones, Arcata South 7.5-Minute Quadrangle, Humboldt County, California.

California Division of Mines and Geology (CDMG), 2000. Digital Images of Official Maps of Alquist-Priolo Earthquake Fault Zones of California, Northern and Eastern Region.

California Geological Survey (CGS), 2008. Probabilistic Seismic Hazards Mapping (http://www.conservation.ca.gov/cgs/rghm/pshamap/pshamain.html), Ground Motion Page.

Federal Emergency Management Agency (FEMA) 2017. Flood Insurance Rate Map: Humboldt County, California. Map Number 06023C0852G, Panel 852of 1150, Department of Homeland Security.

International Conference of Building Officials-California Division of Mines and Geology (ICBO-CDMG), 1998. Maps of Known Active Fault Near Source Zones in California and Adjacent Portions of Nevada.

McLaughlin, R.J., Ellen, S.D., Blake, M.C., Jayko, A.S., Irwin, W.P., Aalto, K.R., Carver, G.A., Clarke, S.H., Barnes, J.B., Cecil, J.D., and Cyr, K.A., 2000. Geology of the Cape Mendocino, Eureka, Garberville, and southwestern part of the Hayfork 30 X 60 minute quadrangles and adjacent offshore area, northern California, with digital database: U.S. Geological Survey, Miscellaneous Field Studies Map MF-2336, scale 1:100,000

Petersen, M.D., D. Beeby, W. Bryant, C. Cao, C. Cramer, J. Davis, M. Reichle, G. Saucedo, S. Tan, G. Taylor, T. Toppozada, J. Treiman, and C. Wills, 1999. Seismic Shaking Hazard Maps of California. Division of Mines and Geology, Map Sheet 48.

Satake, K., Wang, K., and Atwater, B.A., 2003. Fault Slip and Seismic Moment of the 1700 Cascadia Earthquake inferred from Japanese Tsunami Descriptions. Journal of Geophysical Research, Vol. 108, No. B11, 2535, doi;10.109/2003JB002521.

Seed, H.B. and Idriss, I.M., 1982. Ground Motions and Soil Liquefaction During Earthquakes Earthquake Engineering Research Institute.

Southern California Earthquake Center, University of Southern California (SCEC), 1999. Recommended Procedures for Implementation of DMG Special Publication 117 Guidelines for Analyzing and Mitigating Liquefaction Hazards in California. March.

United States Geological Survey (USGS) Program, V. H. (n.d.). Mount Shasta California Volcano Observatory. https://volcanoes.usgs.gov/volcanoes/clear_lake/. Accessed on June 1, 2017.

Wilson, Patrick and Elgamal, Ahmed, 2010. Passive Earth Pressure Force-Displacement Relationships, International Conferences on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics. 20.

# FIGURES

**Figure 1** **Vicinity Map**

**Figure 2A-B** **Site Plans**

**Figure 3** **Tsunami Inundation Map**

**Figure 4** **Allowable Uplift Capacity**

**Figure 5** **Allowable Vertical Downward Capacity**

**Figure 6** **Allowable Vertical Pile Capacity Accounting for Downdrag**

**Figure 7** **Retaining Wall Lateral Earth Pressure**

**Figure 8** **Retaining Wall Back Drain**

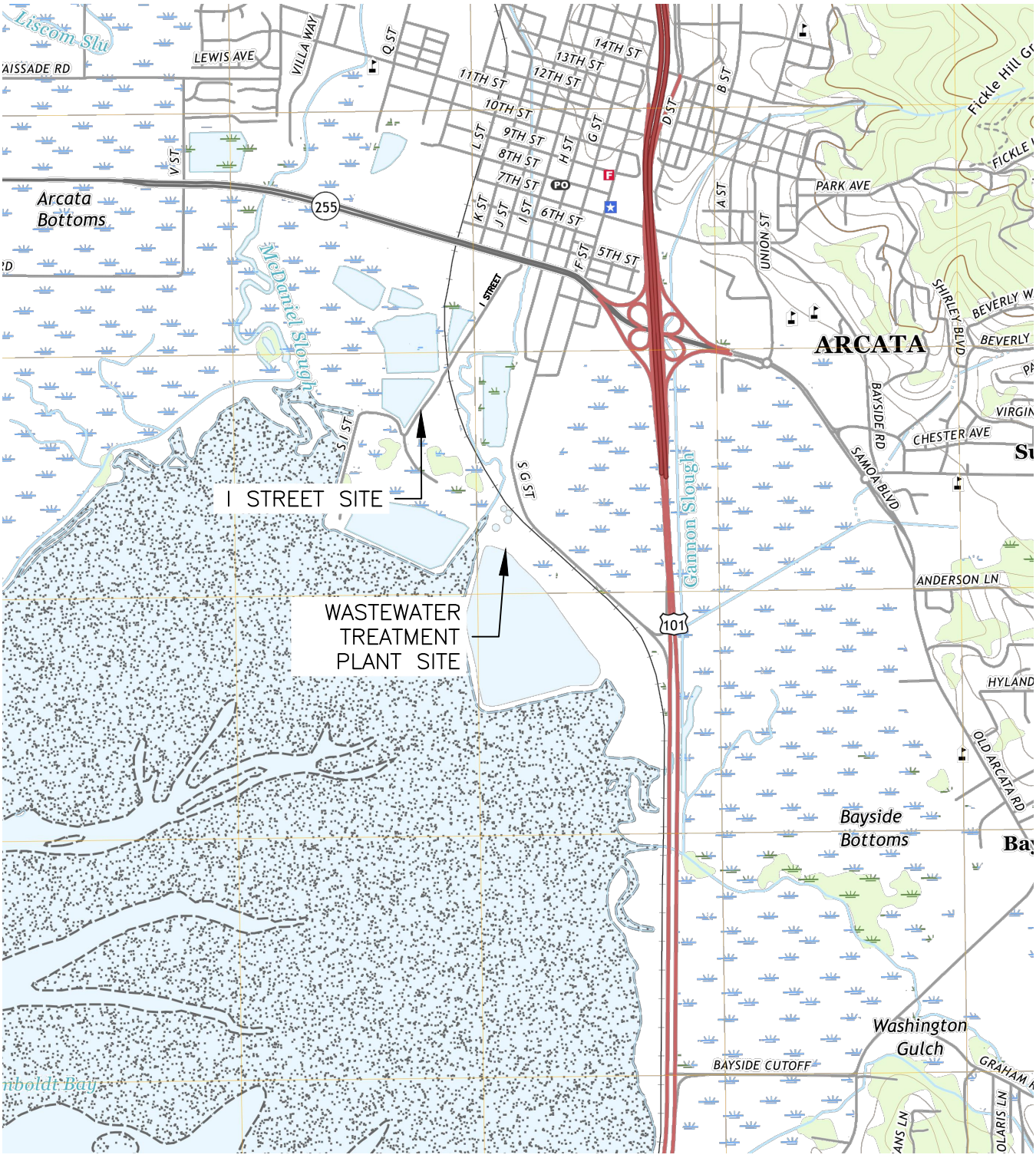
LACO

EUREKA • UKIAH • SANTA ROSA

1-800-515-5054 WWW.LACOASSOCIATES.COM

| | | | |
|---|---|---|---|
| PROJECT | WASTEWATER TREATMENT PLANT IMPROVEMENTS | BY CRGT | FIGURE 1 |
| CLIENT | CAROLLO ENGINEERS, INC. | DATE 1/24/19 | |
| LOCATION | ARCATA, CA | CHECK JER | JOB NO. 7986.01 |
| | VICINITY MAP | SCALE AS SHOWN | |

REUSE OF DOCUMENTS: This document and the ideas and design incorporated herein, as an instrument of professional service, is the property of LACO Associates and shall not be reused in whole or part for any other project without Laco Associates express written authorization.




0 500’ 1000’ 2000’ 3000’

SCALE: 1”=1000’

Feb 15,2019–8:32am T:\Cadfiles\7900\7986.01 ARCATA WASTEWATER TREATMENT FACILITY DESIGN\DWG\ 7986.01 SITE AND VICINITY MAP.dwg

REUSE OF DOCUMENTS: This document and the ideas and design incorporated herein, as an instrument of professional service, is the property of LACO Associates and shall not be reused in whole or part for any other project without Laco Associates express written authorization.




## LEGEND

- APPROXIMATE LOCATIONS OF TEST BORINGS DRILLED BY LACO MAY, 2018
- APPROXIMATE LOCATIONS OF CPT BORINGS DRILLED BY LACO APRIL, 2018
- APPROXIMATE LOCATIONS OF TEST BORINGS DRILLED BY SELVAGE & HEBER MARCH, 1984

0 40' 80' 160' 240'

SCALE: 1"=80'

LACO
EUREKA • UKIAH • SANTA ROSA
1-800-515-5054 www.lacoassociates.com

| NO. | HISTORY / REVISION | BY | CHK. | DATE |
|---|---|---|---|---|

WASTEWATER TREATMENT PLANT IMPROVEMENTS
GEOTECHNICAL EXPLORATION
WASTEWATER TREATMENT PLANT SITE PLAN

CAROLLO ENGINEERS INC.

| | |
|---|---|
| DRAWN | CRGT |
| CHECK | JER |
| APPROVED | JER |
| DATE | 1/24/19 |
| JOB NUMBER | 7986.01 |
| FIGURE | 2A |

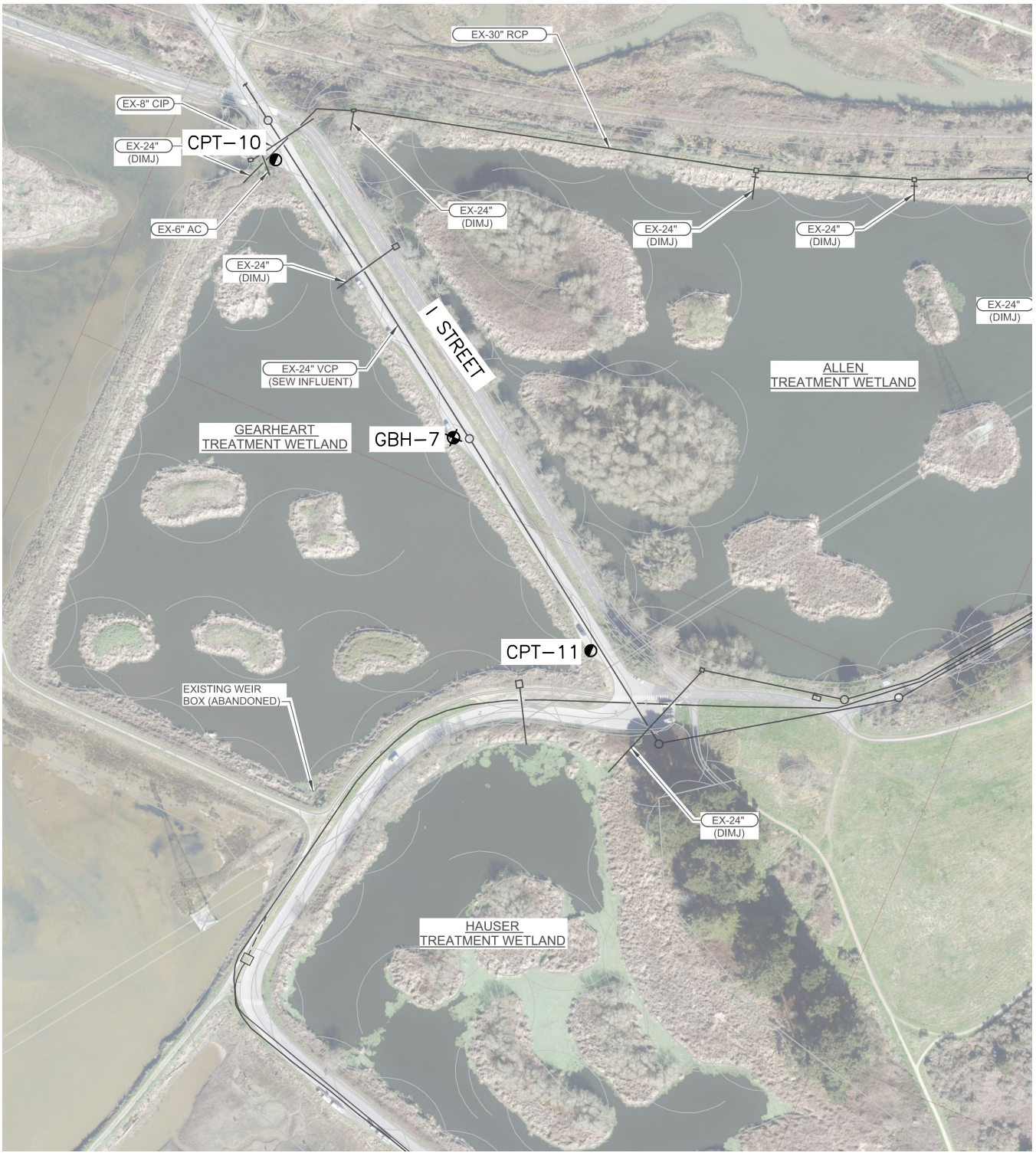
LACO

EUREKA • UKIAH • SANTA ROSA

1-800-515-5054 WWW.LACOASSOCIATES.COM

| | | | |
|---|---|---|---|
| PROJECT | WASTEWATER TREATMENT PLANT IMPROVEMENTS | BY CRGT | FIGURE 2B |
| CLIENT | CAROLLO ENGINEERS, INC. | DATE 1/24/19 | |
| LOCATION | ARCATA, CA | CHECK JER | JOB NO. 7986.01 |
| | I STREET SITE PLAN | SCALE AS SHOWN | |

REUSE OF DOCUMENTS: This document and the ideas and design incorporated herein, as an instrument of professional service, is the property of LACO Associates and shall not be reused in whole or part for any other project without Laco Associates express written authorization.




0 100' 200' 400' 600'

SCALE: 1"=200'

Feb 11,2019–2:58pm T:\Cadfiles\7900\7986.01 ARCATA WASTEWATER TREATMENT FACILITY DESIGN\DWG\ 7986.01 SITE AND VICINITY MAP – No Cross Sections.dwg

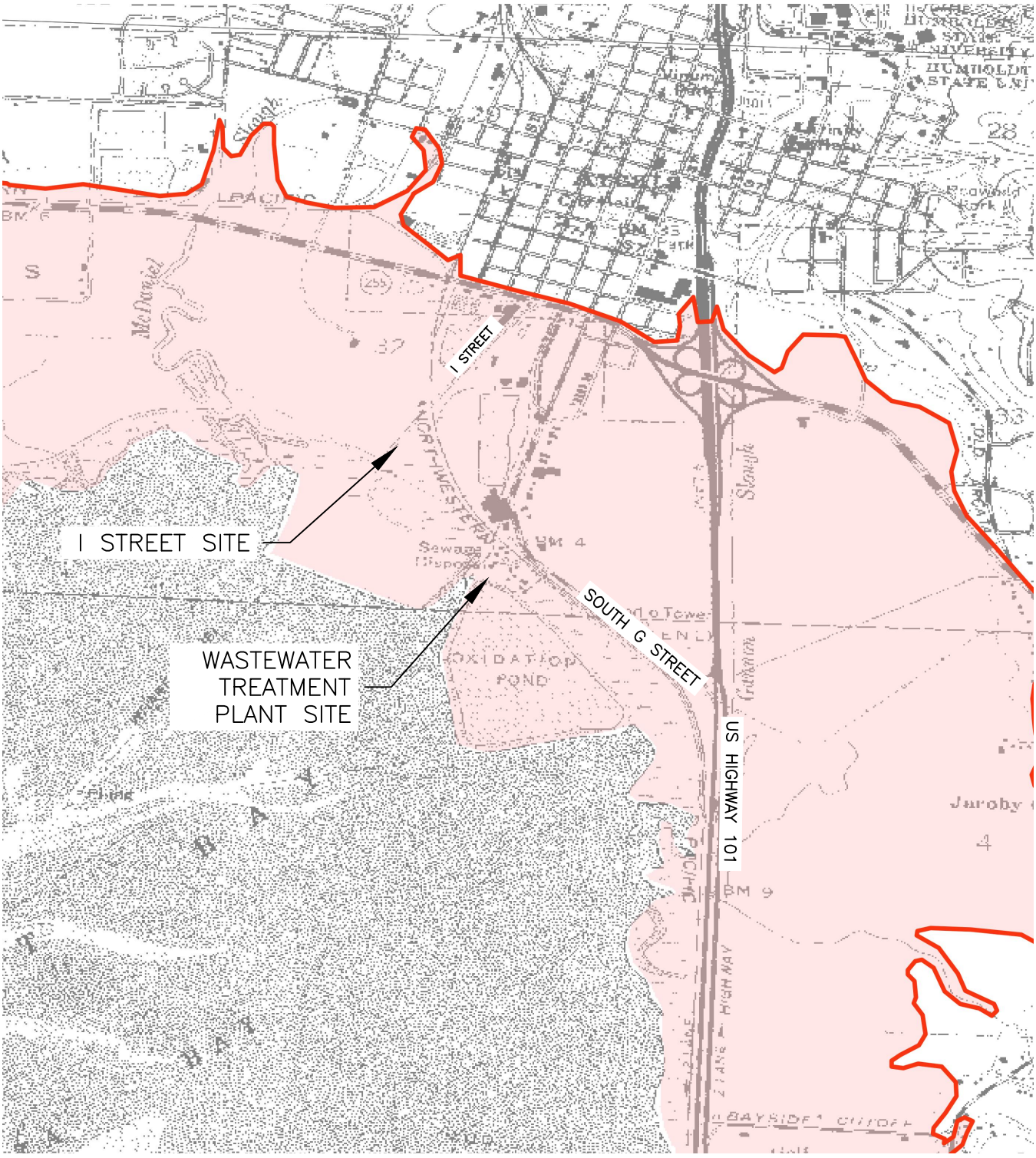
LACO

EUREKA • UKIAH • SANTA ROSA

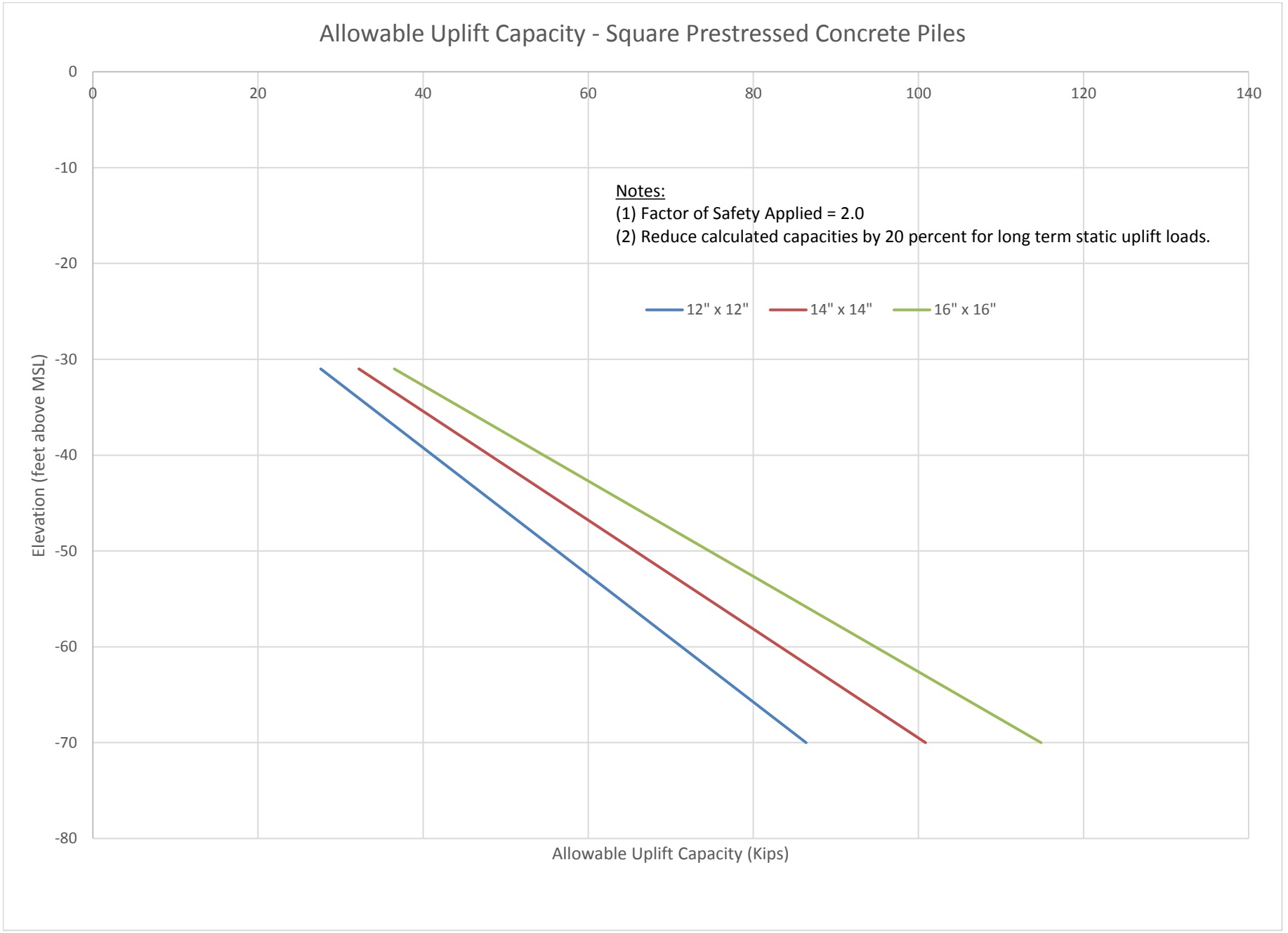
1-800-515-5054 WWW.LACOASSOCIATES.COM

| | | | |
|---|---|---|---|
| PROJECT | WASTEWATER TREATMENT PLANT IMPROVEMENTS | BY CRGT | FIGURE 3 |
| CLIENT | CAROLLO ENGINEERS, INC. | DATE 1/24/19 | |
| LOCATION | ARCATA, CA | CHECK JER | JOB NO. 7986.01 |
| | TSUNAMI INUNDATION MAP | SCALE AS SHOWN | |

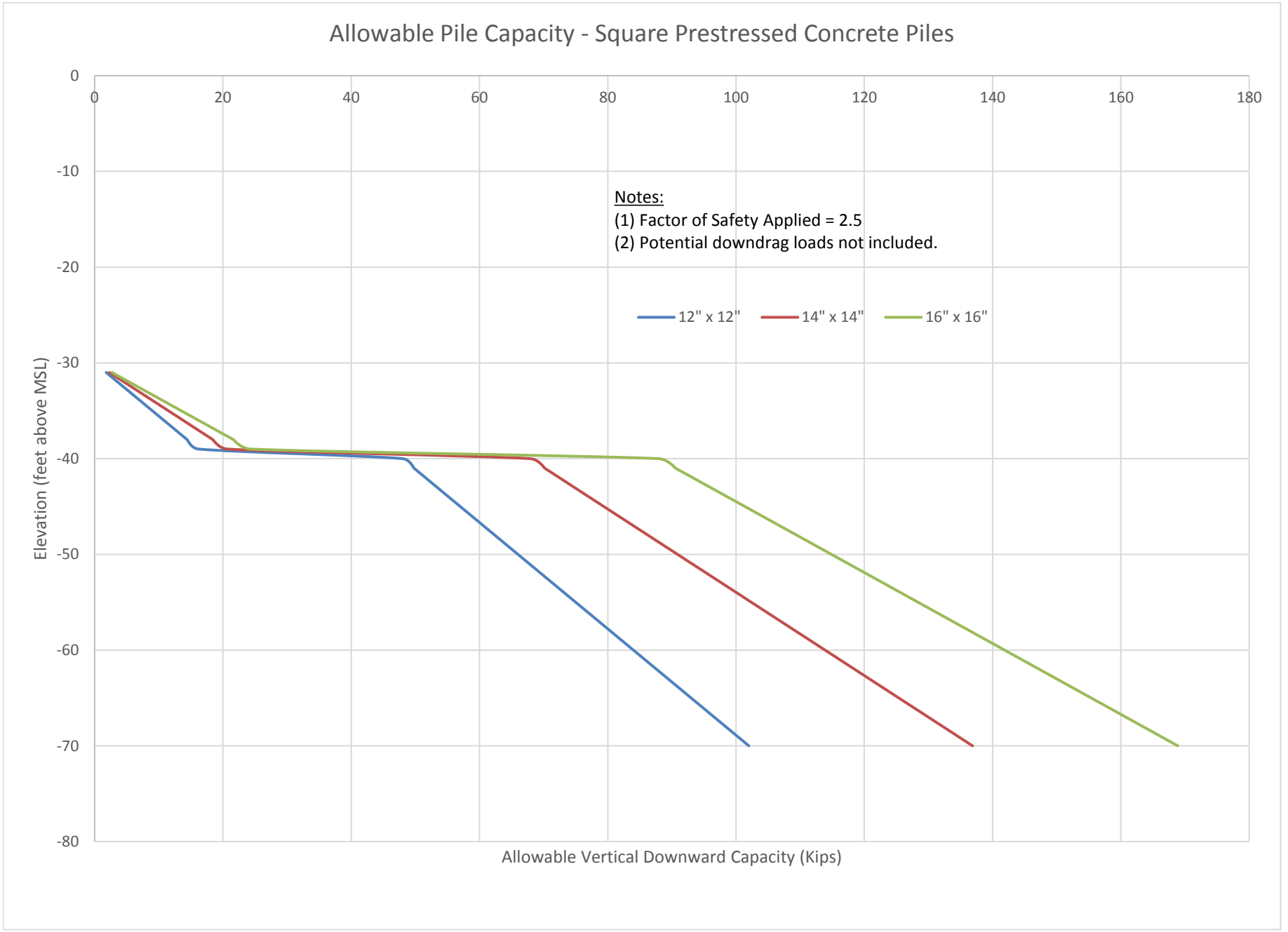
REUSE OF DOCUMENTS: This document and the ideas and design incorporated herein, as an instrument of professional service, is the property of LACO Associates and shall not be reused in whole or part for any other project without Laco Associates express written authorization.



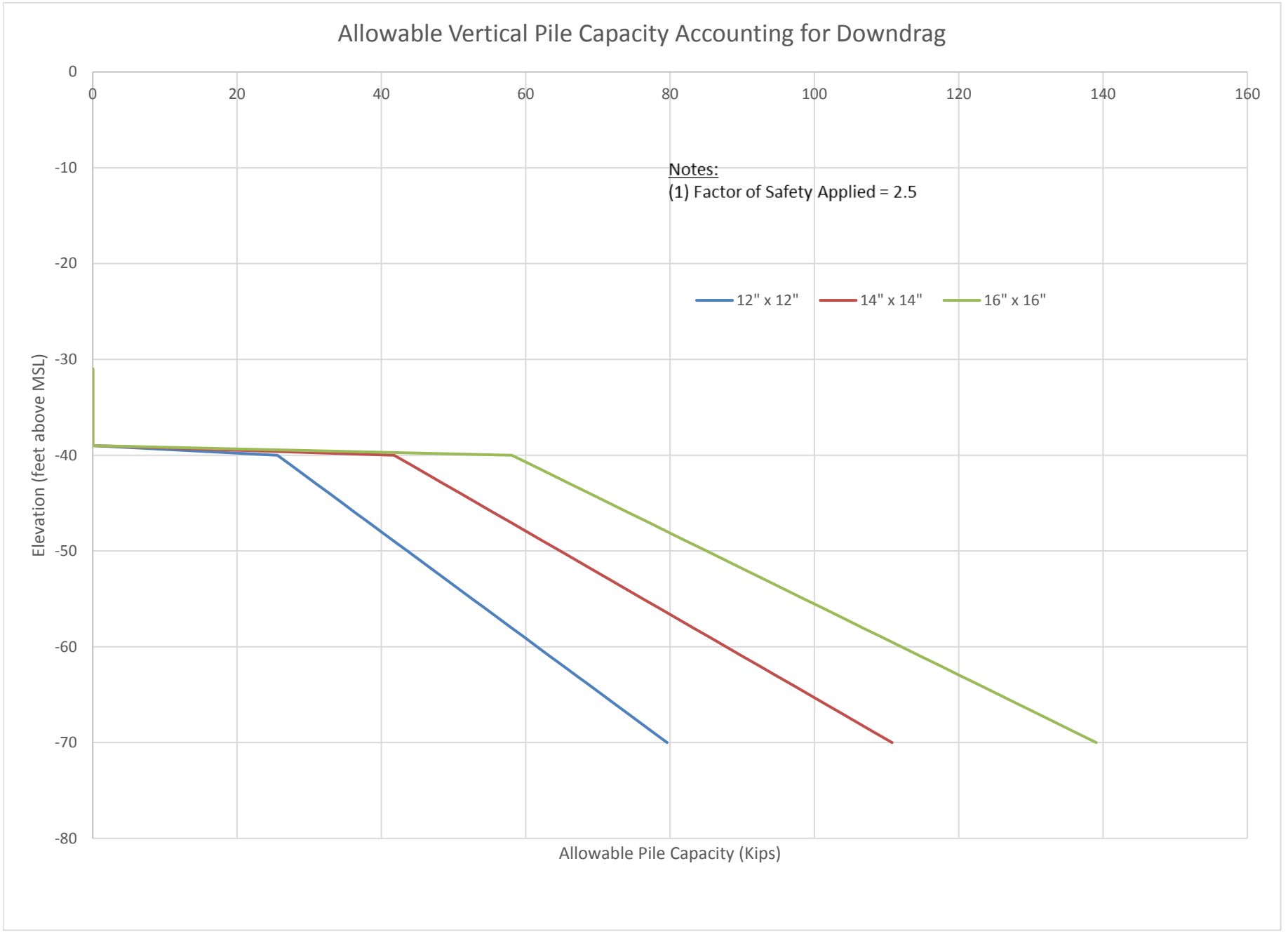

Feb 15,2019-8:36am T:\Cadfiles\7900\7986.01 ARCATA WASTEWATER TREATMENT FACILITY DESIGN\DWG\ 7986.01 TSUNAMI INUNDATINO MAP.dwg




| | | | |
|---|---|---|---|
| LACO<br>EUREKA • UKIAH • SANTA ROSA<br>1-800-515-5054 www.lacoassociates.com | PROJECT WASTEWATER TREATMENT PLANT IMPROVEMENTS | BY JER | FIGURE 4 |
| | CLIENT CAROLLO ENGINEERS, INC. | DATE 1/9/19 | |
| | LOCATION ARCATA, CA | CHECK CJW | JOB NO. 7986.01 |
| | ALLOWABLE UPLIFT CAPACITY | | |




| | | | |
|---|---|---|---|
| LACO<br>EUREKA • UKIAH • SANTA ROSA<br>1-800-515-5054 www.lacoassociates.com | PROJECT WASTEWATER TREATMENT PLANT IMPROVEMENTS | BY JER | FIGURE 5 |
| | CLIENT CAROLLO ENGINEERS, INC. | DATE 1/9/19 | |
| | LOCATION ARCATA, CA | CHECK CJW | JOB NO. 7986.01 |
| | ALLOWABLE VERTICAL DOWNARD CAPACITY | | |

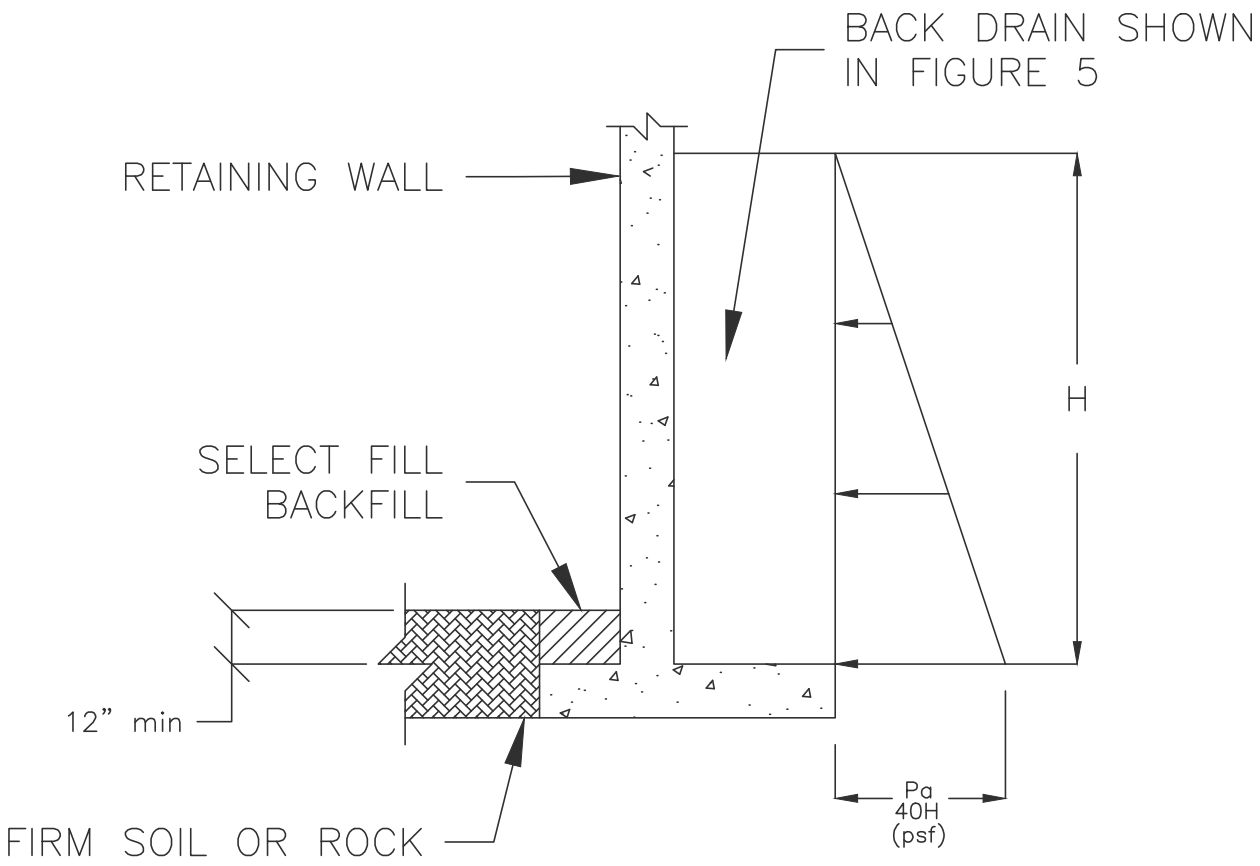



| | | | |
|---|---|---|---|
| LACO<br>EUREKA • UKIAH • SANTA ROSA<br>1-800-515-5054 www.lacoassociates.com | PROJECT WASTEWATER TREATMENT PLANT IMPROVEMENTS | BY JER | FIGURE 6 |
| | CLIENT CAROLLO ENGINEERS, INC. | DATE 1/9/19 | |
| | LOCATION ARCATA, CA | CHECK CJW | JOB NO. 7986.01 |
| | ALLOWABLE VERTICAL PILE CAPACITY ACCOUNTING FOR DOWNDRAG | | |

LACO
EUREKA • UKIAH • SANTA ROSA
1-800-515-5054 WWW.LACOASSOCIATES.COM

| | | | |
|---|---|---|---|
| PROJECT | WASTEWATER TREATMENT PLANT IMPROVEMENTS | BY CRGT | FIGURE 7 |
| CLIENT | CAROLLO ENGINEERS, INC. | DATE 1/24/18 | |
| LOCATION | ARCATA, CA | CHECK JER | JOB NO. 7986.01 |
| | RETAINING WALL LATERAL EARTH PRESSURE | SCALE N.T.S. | |

REUSE OF DOCUMENTS: This document and the ideas and design incorporated herein, as an instrument of professional service, is the property of LACO Associates and shall not be reused in whole or part for any other project without Laco Associates express written authorization.




NOTES:

(1) The above are soil pressures only and do not include lateral loads resulting from such as traffic, floor loads, adjacent foundations or other vertical loads.

(2) If the wall at surface of the backfill cannot yield about 0.1% of its height, at-rest soil pressures should be used.

(3) The above pressures assume a drained condition. See Figure 5 for drainage backfill details. If wall back drains are not provided for retaining walls, use the following combined earth and hydrostatic equivalent fluid pressures (triangular distributions).

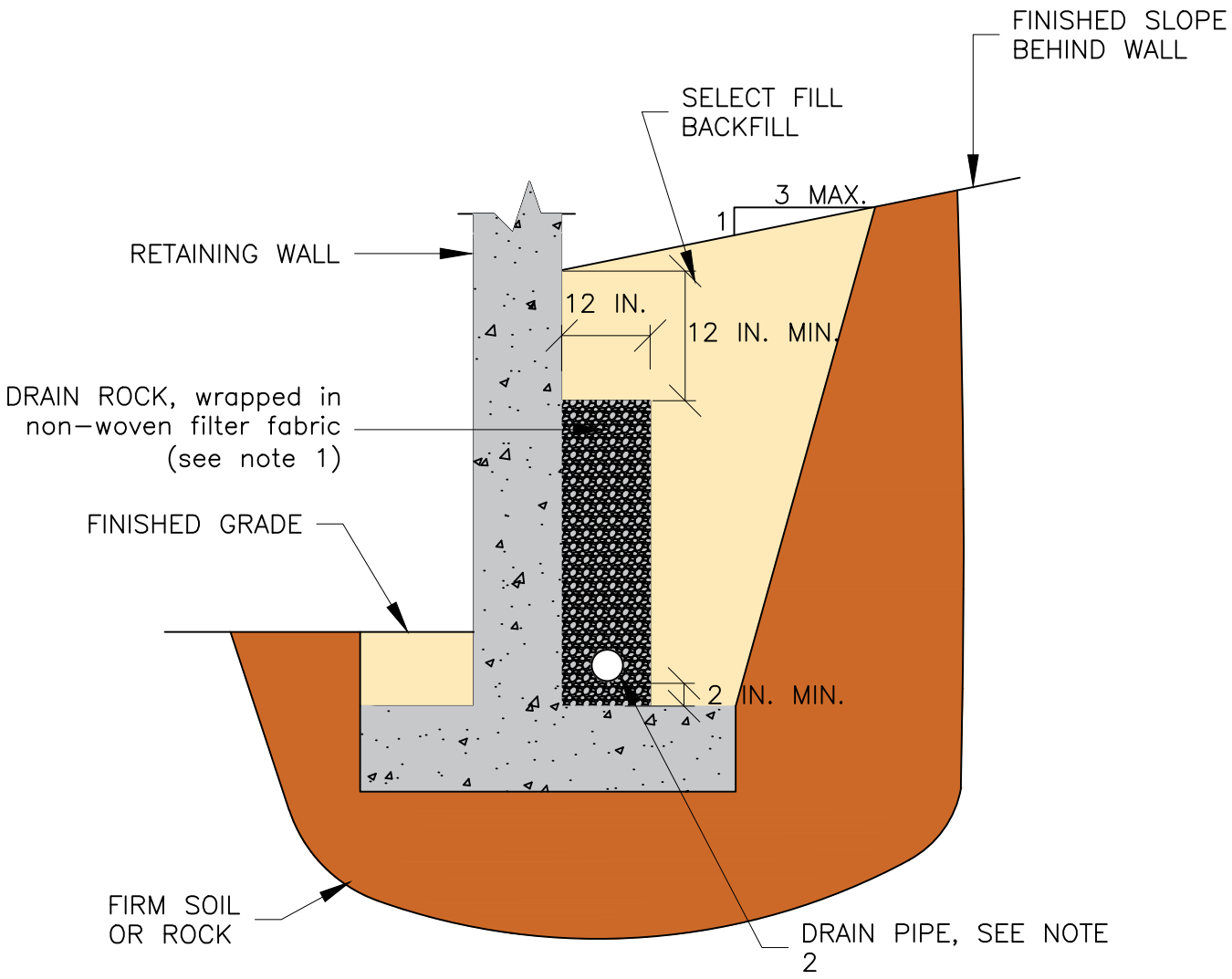
| Wall Condition | Equivalent Fluid Pressure |
|---|---|
| Active | 40 pcf |
| At-Rest | 65 pcf |

(4) The above pressures should be used where backfill slope is flatter than 5 horizontal to 1 vertical (5H:1V).

Feb 11,2019-3:00pm R:\SR Geotech\DWG\ RETAINING WALL.dwg

| LACO | PROJECT WASTEWATER TREATMENT PLANT IMPROVEMENTS | BY CRGT | FIGURE 8 |
|---|---|---|---|
| EUREKA • UKIAH • SANTA ROSA | CLIENT CAROLLO ENGINEERS, INC. | DATE 1/24/19 | |
| 1-800-515-5054 www.lacoassociates.com | LOCATION ARCATA, CA | CHECK JER | JOB NO. 7986.01 |
| | RETAINING WALL BACKDRAIN | SCALE N.T.S. | |

REUSE OF DOCUMENTS: This document and the ideas and design incorporated herein, as an instrument of professional service, is the property of LACO Associates and shall not be reused in whole or part for any other project without LACO Associates express written authorization.




**NOTES:**

(1) Drain rock should meet the Class 1 Type B permeable material requirements in the latest version of the Caltrans standard specifications.

(2) Drain pipe should be SDR 35 or equivalent, placed with perforation down, and sloped at a minimum of 1% to drain to gravity outlet or sump with automatic pump.

(3) A clean-out pipe with cap should be installed at the up-slope end of perforated pipe, and pipe elbows should be 45 degrees or less (for "snake" access)

Nov 07,2018-9:09am R:\SR Geotech\DWG\ GEOTECH DETAILS.dwg

# APPENDIX 1

## Boring Logs

# BORING NUMBER GBH-1



LACO

**CLIENT** Carollo Engineers, Inc.
**PROJECT NAME** Wastewater Treatment Plant Improvements
**PROJECT NUMBER** 7986.01
**PROJECT LOCATION** Arcata, California
**DATE STARTED** 5/9/18 **COMPLETED** 5/10/18
**GROUND ELEVATION** 10 feet WGS 84 **HOLE SIZE** 3 inches
**DRILLING CONTRACTOR** Clear Heart
**GROUND WATER LEVELS:**
**DRILLING METHOD** Hollow Stem Auger
▽ **AT TIME OF DRILLING** 5.00 feet / Elevation 5.00 feet
**LOGGED BY** VSD **CHECKED BY** BAV
**AT END OF DRILLING** ---
**NOTES**

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | TESTS AND REMARKS | WET UNIT WT. (pcf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTIC LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | FINES CONTENT (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | 3" Asphaltic Concrete over 3" Aggregate Base | | | | | | | | | | | |
| | | (SC) Brown Clayey Sand with Gravel (FILL)<br>dry, medium dense<br>fine to coarse sand, fine rounded to subangular gravel | SPT | 100 | 4-12-7 (19) | | | | | | | | |
| 5 | | (CL) Gray Lean Clay with Sand<br>saturated, soft<br>fine to coarse sand | SH | 100 | | UC 257 | | | | | | | |
| 10 | | | SPT | 67 | 1-1-3 (4) | | 125 | 97 | 28 | | | | |
| 15 | | (SP-SC) Gray Poorly Graded Sand with Clay<br>saturated, loose<br>fine to coarse sand | SPT | 94 | 4-5-8 (13) | | 130 | 102 | 27 | | | | |
| | | | SPT | 100 | 3-3-3 (6) | | | | | | | | |
| 20 | | | SPT | 94 | 3-1-2 (3) | | | | | | | | |

Bottom of borehole at 21.5 feet.

GEOTECH BORING NEW - GINT STD US LAB.GDT - 8/23/18 13:14 - P:\GINT FILES\PROJECTS\7986.01 CAROLLO ARCATA WWTP GBH 1-7.GPJ

# BORING NUMBER GBH-2



LACO

**CLIENT** Carollo Engineers, Inc. **PROJECT NAME** Wastewater Treatment Plant Improvements

**PROJECT NUMBER** 7986.01 **PROJECT LOCATION** Arcata, California

**DATE STARTED** 5/9/18 **COMPLETED** 5/9/18 **GROUND ELEVATION** 10 feet WGS 84 **HOLE SIZE** 3 inches

**DRILLING CONTRACTOR** Clear Heart **GROUND WATER LEVELS:**

**DRILLING METHOD** Hollow Stem Auger ▽ **AT TIME OF DRILLING** 4.00 feet / Elevation 6.00 feet

**LOGGED BY** VSD **CHECKED BY** BAV **AT END OF DRILLING** ---

**NOTES**

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | TESTS AND REMARKS | WET UNIT WT. (pcf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTIC LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | FINES CONTENT (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | (CL) Brown Sandy Lean Clay (FILL)<br>dry, medium stiff<br>fine to coarse sand | | | | | | | | | | | |
| | | | SPT | 83 | 6-4-4 (8) | | | | | | | | 28 |
| 5 | | ▽ | | | | | | | | | | | |
| | | (CL) Gray Lean Clay with Sand<br>saturated, medium stiff<br>fine to coarse sand | SH | 87 | | Consol See Apx 3<br>UC 351 | 97 | 58 | 68 | | | | |
| 10 | | | SPT | 100 | 2-3-4 (7) | | | | | | | | 89 |
| 15 | | | SPT | 100 | 2-3-6 (9) | | | | | | | | |
| 20 | | (SM) Gray Silty Sand<br>saturated, medium stiff<br>fine to coarse sand | | | | | | | | | | | |
| | | (CL) Gray Lean Clay with Sand<br>saturated, very soft to soft<br>fine to coarse sand | SH | 97 | | DS 1010(1077)<br>1997(1626)<br>3000(2609)<br>Consol See Apx 3 | 112 | 83 | 35 | NP | NP | NP | 14 |
| 25 | | | SPT | 94 | 1-1-1 (2) | | | | | | | | |
| 30 | | | SPT | 100 | 1-2-2 (4) | | | | | | | | |
| 35 | | | | | | | | | | | | | |

*(Continued Next Page)*

GEOTECH BORING NEW - GINT STD US LAB.GDT - 8/23/18 13:14 - P:\GINT FILES\PROJECTS\7986.01 CAROLLO ARCATA WWTP GBH 1-7.GPJ

# BORING NUMBER GBH-2



LACO

**CLIENT** Carollo Engineers, Inc. **PROJECT NAME** Wastewater Treatment Plant Improvements

**PROJECT NUMBER** 7986.01 **PROJECT LOCATION** Arcata, California

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | TESTS AND REMARKS | WET UNIT WT. (pcf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTIC LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | FINES CONTENT (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 | | (SC) Gray Silty Sand<br>saturated, stiff<br>fine to coarse sand | SH | 80 | | DS 3497(2903)<br>5000(4179)<br>6496(4737) | 104 | 85 | 23 | 23 | 19 | 5 | |
| 40 | | | SPT | 94 | 3-5-6<br>(11) | Consol See Apx 3 | | | | | | | |
| 45 | | | SH | 93 | | UC 739 | | | | | | | |
| 50 | | | SPT | 89 | 3-3-6<br>(9) | UC 98 | | | | NP | NP | NP | 18 |
| 55 | | (SC) Gray Clayey Sand with Gravel<br>saturated, dense<br>fine to coarse sand, fine subrounded to subangular gravel | SPT | 94 | 19-19-19<br>(38) | | | | | | | | |

Bottom of borehole at 56.5 feet.

GEOTECH BORING NEW - GINT STD US LAB.GDT - 8/23/18 13:14 - P:\GINT FILES\PROJECTS\7986.01 CAROLLO ARCATA WWTP GBH 1-7.GPJ

# BORING NUMBER GBH-3



LACO

**CLIENT** Carollo Engineers, Inc.
**PROJECT NAME** Wastewater Treatment Plant Improvements
**PROJECT NUMBER** 7986.01
**PROJECT LOCATION** Arcata, California
**DATE STARTED** 5/7/18 **COMPLETED** 5/7/18
**GROUND ELEVATION** 10 feet WGS 84 **HOLE SIZE** 3 inches
**DRILLING CONTRACTOR** Clear Heart
**GROUND WATER LEVELS:**
**DRILLING METHOD** Hollow Stem Auger
▽ **AT TIME OF DRILLING** 4.00 feet / Elevation 6.00 feet
**LOGGED BY** VSD **CHECKED BY** BAV
**AT END OF DRILLING** ---
**NOTES**

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | TESTS AND REMARKS | WET UNIT WT. (pcf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTIC LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | FINES CONTENT (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | 3" Asphaltic Concrete over 3" Aggregate Base | | | | | | | | | | | |
| | | (SC) Gray Clayey Sand with Gravel<br>dry, loose<br>fine to coarse sand | | | | | | | | | | | |
| | | ▽ | | | | | | | | | | | |
| 5 | | (CL) Black Lean Clay with Sand<br>saturated, soft<br>fine to coarse sand | SH | 83 | | UC 405 | | | | | | | |
| 10 | | | SPT | 100 | 1-1-3 (4) | | | | | | | | |
| 15 | | | SPT | 100 | 1-1-2 (3) | | | | | | | | |

Bottom of borehole at 16.5 feet.

GEOTECH BORING NEW - GINT STD US LAB.GDT - 8/23/18 13:14 - P:\GINT FILES\PROJECTS\7986.01 CAROLLO ARCATA WWTP GBH 1-7.GPJ

# BORING NUMBER GBH-4



LACO

**CLIENT** Carollo Engineers, Inc.
**PROJECT NAME** Wastewater Treatment Plant Improvements
**PROJECT NUMBER** 7986.01
**PROJECT LOCATION** Arcata, California
**DATE STARTED** 5/8/18 **COMPLETED** 5/9/18
**GROUND ELEVATION** 11 feet WGS 84 **HOLE SIZE** 3 inches
**DRILLING CONTRACTOR** Clear Heart
**GROUND WATER LEVELS:**
**DRILLING METHOD** Hollow Stem Auger
▽ **AT TIME OF DRILLING** 2.00 feet / Elevation 9.00 feet
**LOGGED BY** VSD **CHECKED BY** BAV
**AT END OF DRILLING** ---
**NOTES**

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | TESTS AND REMARKS | WET UNIT WT. (pcf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTIC LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | FINES CONTENT (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | (SC) Brown Clayey Sand with Gravel (FILL)<br>dry, loose<br>▽ fine to coarse sand, fine rounded to subrounded gravel | | | | | | | | | | | |
| 5 | | (CL) Gray Clay with Sand<br>saturated, medium<br>fine to medium sand | SH | 97 | | | | | | | | | |
| 10 | | | SPT | 33 | 1-1-1 (2) | | | | | | | | |
| 15 | | | SPT | 94 | 1-3-10 (13) | | 142 | 121 | 17 | | | | |
| | | (SP-SC) Gray Poorly Graded Sand with Clay<br>saturated, very loose<br>fine to coarse sand | SPT | 94 | 4-2-2 (4) | | | | | | | | |
| 20 | | (CL) Gray Sandy Clay<br>saturated, medium stiff<br>fine to coarse sand | SPT | 100 | 3-4-3 (7) | | 138 | 111 | 24 | | | | |
| | | Bottom of borehole at 21.5 feet. | | | | | | | | | | | |

GEOTECH BORING NEW - GINT STD US LAB.GDT - 8/23/18 13:14 - P:\GINT FILES\PROJECTS\7986.01 CAROLLO ARCATA WWTP GBH 1-7.GPJ

# BORING NUMBER GBH-5



LACO

**CLIENT** Carollo Engineers, Inc.
**PROJECT NAME** Wastewater Treatment Plant Improvements
**PROJECT NUMBER** 7986.01
**PROJECT LOCATION** Arcata, California
**DATE STARTED** 5/8/18 **COMPLETED** 5/10/18
**GROUND ELEVATION** 11 feet WGS 84 **HOLE SIZE** 3 inches
**DRILLING CONTRACTOR** Clear Heart
**GROUND WATER LEVELS:**
**DRILLING METHOD** Hollow Stem Auger
▽ **AT TIME OF DRILLING** 8.00 feet / Elevation 3.00 feet
**LOGGED BY** VSD **CHECKED BY** BAV
**AT END OF DRILLING** ---
**NOTES**

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | TESTS AND REMARKS | WET UNIT WT. (pcf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTIC LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | FINES CONTENT (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | (SC) Brown Clayey Sand with Gravel (FILL)<br>dry, medium dense<br>fine to coarse sand, fine rounded to subangular gravel | SPT | 89 | 8-10-12 (22) | | 141 | 131 | 8 | | | | |
| 5 | | (SC) Gray Clayey Sand<br>dry to saturated, loose<br>fine to coarse sand | SH | 180 | | UC 246 | | | | | | | |
| 10 | | (CL) Gray Lean Clay<br>saturated, very soft<br>fine sand | SPT | 94 | 0-1-1 (2) | | | | 58 | | | | 95 |
| 15 | | | SPT | 94 | 1-1-3 (4) | | | | 32 | | | | 98 |
| 20 | | (SC) Gray Clayey Sand<br>saturated, soft<br>fine to coarse sand | SH | 93 | | UC 461<br>DS 1020(1299)<br>1997(2013<br>3002(2396) | | | | NP | NP | NP | 7 |
| 25 | | | SPT | 100 | 1-1-2 (3) | | | | | | | | |
| 30 | | (MH) Gray Elastic Silt<br>saturated, medium stiff<br>fine sand | SPT | 100 | 1-1-2 (3) | | | | 48 | | | | 59<br>96 |
| 35 | | | | | | | | | | | | | |

*(Continued Next Page)*

GEOTECH BORING NEW - GINT STD US LAB.GDT - 8/23/18 13:14 - P:\GINT FILES\PROJECTS\7986.01 CAROLLO ARCATA WWTP GBH 1-7.GPJ

# BORING NUMBER GBH-5



LACO

**CLIENT** Carollo Engineers, Inc. **PROJECT NAME** Wastewater Treatment Plant Improvements

**PROJECT NUMBER** 7986.01 **PROJECT LOCATION** Arcata, California

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | TESTS AND REMARKS | WET UNIT WT. (pcf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTIC LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | FINES CONTENT (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35 | | (MH) Gray Elastic Silt saturated, medium stiff fine sand *(continued)* | SH | 100 | | UC 1444 | | | | 62 | 32 | 30 | 100 |
| | | | | | | DS 3494(1871) 4993(2500) 6495(3171) | | | | | | | |
| 40 | | | SPT | 94 | 3-4-4 (8) | Consol See Apx 3 | | | 23 | | | | 93 60 |
| 45 | | (SP-SC) Gray Poorly Graded Sand with Clay saturated, loose fine to coarse sand | SH | 20 | | | | | | NP | NP | NP | 11 |
| 50 | | | SPT | 100 | 4-4-6 (10) | UC 322 | | | | | | | 49 |

Bottom of borehole at 51.5 feet.

GEOTECH BORING NEW - GINT STD US LAB.GDT - 8/23/18 13:15 - P:\GINT FILES\PROJECTS\7986.01 CAROLLO ARCATA WWTP GBH 1-7.GPJ

# BORING NUMBER GBH-6



LACO

**CLIENT** Carollo Engineers, Inc.
**PROJECT NAME** Wastewater Treatment Plant Improvements
**PROJECT NUMBER** 7986.01
**PROJECT LOCATION** Arcata, California
**DATE STARTED** 5/7/18 **COMPLETED** 5/8/18
**GROUND ELEVATION** 11 feet WGS 84 **HOLE SIZE** 3 inches
**DRILLING CONTRACTOR** Clear Heart
**GROUND WATER LEVELS:**
**DRILLING METHOD** Hollow Stem Auger
▽ **AT TIME OF DRILLING** 4.00 feet / Elevation 7.00 feet
**LOGGED BY** VSD **CHECKED BY** BAV
**AT END OF DRILLING** ---
**NOTES**

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | TESTS AND REMARKS | WET UNIT WT. (pcf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTIC LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | FINES CONTENT (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | (SC) Brown Clayey Sand (FILL)<br>moist, soft<br>fine to coarse sand | | | | | | | | | | | |
| 5 | | ▽ | | | | | | | | 32 | 19 | 13 | 32 |
| | | (CL) Black Sandy Lean Clay<br>saturated, very soft<br>fine to coarse sand | SH | 60 | | | | | | | | | |
| 10 | | | SPT | 83 | 1-1-1<br>(2) | | | | | | | | |
| 15 | | | SPT | 78 | 0-0-1<br>(1) | | | | | | | | |

Bottom of borehole at 16.5 feet.

GEOTECH BORING NEW - GINT STD US LAB.GDT - 8/23/18 13:15 - P:\GINT FILES\PROJECTS\7986.01 CAROLLO ARCATA WWTP GBH 1-7.GPJ

# BORING NUMBER GBH-7



LACO

**CLIENT** Carollo Engineers, Inc.
**PROJECT NAME** Wastewater Treatment Plant Improvements
**PROJECT NUMBER** 7986.01
**PROJECT LOCATION** Arcata, California
**DATE STARTED** 5/10/18 **COMPLETED** 5/10/18
**GROUND ELEVATION** 8 feet WGS 84 **HOLE SIZE** 3 inches
**DRILLING CONTRACTOR** Clear Heart
**GROUND WATER LEVELS:**
**DRILLING METHOD** Hollow Stem Auger
▽ **AT TIME OF DRILLING** 5.50 feet / Elevation 2.50 feet
**LOGGED BY** VSD **CHECKED BY** BAV
**AT END OF DRILLING** ---
**NOTES**

| DEPTH (ft) | GRAPHIC LOG | MATERIAL DESCRIPTION | SAMPLE TYPE NUMBER | RECOVERY % (RQD) | BLOW COUNTS (N VALUE) | TESTS AND REMARKS | WET UNIT WT. (pcf) | DRY UNIT WT. (pcf) | MOISTURE CONTENT (%) | ATTERBERG LIMITS: LIQUID LIMIT | ATTERBERG LIMITS: PLASTIC LIMIT | ATTERBERG LIMITS: PLASTICITY INDEX | FINES CONTENT (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | (SC) Brown Clayey Sand with Gravel (FILL)<br>dry to moist, very loose<br>fine to coarse sand, fine rounded to subangular gravel | SPT | 67 | 2-2-1 (3) | | | | | | | | |
| 5 | | ▽ | SH | 100 | | | 102 | 59 | 73 | | | | |
| 10 | | (CL) Gray Sandy Lean Clay<br>saturated, soft<br>fine to coarse sand | SPT | 100 | 1-1-2 (3) | | | | | | | | |
| 15 | | (SC) Gray Clayey Sand<br>saturated, loose<br>fine to coarse sand | SPT | 67 | 1-1-3 (4) | | | | | | | | |
| | | | SPT | 94 | 2-3-2 (5) | | | | | | | | |
| 20 | | | SPT | 94 | 1-2-4 (6) | | | | | | | | |

Bottom of borehole at 21.5 feet.

GEOTECH BORING NEW - GINT STD US LAB.GDT - 8/23/18 13:15 - P:\GINT FILES\PROJECTS\7986.01 CAROLLO ARCATA WWTP GBH 1-7.GPJ

# APPENDIX 2

## CPT Logs

4/30/18

LACO
Attn: Deborah Meiswinkel

Subject: CPT Site Investigation
Arcata Waste Water Treatment
Arcata, California
GREGG Project Number: 18-079-MA

Dear Ms. Meiswinkel:

The following report presents the results of GREGG Drilling & Testing's Cone Penetration Test investigation for the above referenced site. The following testing services were performed:

| | | | |
|---|---|---|---|
| 1 | Cone Penetration Tests | (CPTU) | ☒ |
| 2 | Pore Pressure Dissipation Tests | (PPD) | ☒ |
| 3 | Seismic Cone Penetration Tests | (SCPTU) | ☐ |
| 4 | UVOST Laser Induced Fluorescence | (UVOST) | ☐ |
| 5 | Groundwater Sampling | (GWS) | ☐ |
| 6 | Soil Sampling | (SS) | ☐ |
| 7 | Vapor Sampling | (VS) | ☐ |
| 8 | Pressuremeter Testing | (PMT) | ☐ |
| 9 | Vane Shear Testing | (VST) | ☐ |
| 10 | Dilatometer Testing | (DMT) | ☐ |

A list of reference papers providing additional background on the specific tests conducted is provided in the bibliography following the text of the report. If you would like a copy of any of these publications or should you have any questions or comments regarding the contents of this report, please do not hesitate to contact our office at (562) 427-6899.

Sincerely,
GREGG Drilling & Testing, Inc.



Mary Walden
Operations Manager

Cone Penetration Test Sounding Summary

-Table 1-

| CPT Sounding Identification | Date | Termination Depth (feet) | Depth of Groundwater Samples (feet) | Depth of Soil Samples (feet) | Depth of Pore Pressure Dissipation Tests (feet) |
|---|---|---|---|---|---|
| CPT-01 | 4/26/2018 | 60.04 | - | - | - |
| CPT-02 | 4/25/2018 | 49.87 | - | - | 44.6 |
| CPT-03 | 4/26/2018 | 50.03 | - | - | - |
| CPT-04 | 4/25/2018 | 14.93 | - | - | - |
| CPT-05 | 4/25/2018 | 14.93 | - | - | - |
| CPT-06 | 4/26/2018 | 49.87 | - | - | - |
| CPT-07 | 4/25/2018 | 14.93 | - | - | - |
| CPT-08 | 4/25/2018 | 15.09 | - | - | - |
| CPT-09 | 4/25/2018 | 60.04 | - | - | - |
| CPT-10 | 4/26/2018 | 14.93 | - | - | - |
| CPT-11 | 4/26/2018 | 14.93 | - | - | - |

# Bibliography

Lunne, T., Robertson, P.K. and Powell, J.J.M., "Cone Penetration Testing in Geotechnical Practice" E & FN Spon. ISBN 0 419 23750, 1997

Roberston, P.K., "Soil Classification using the Cone Penetration Test", Canadian Geotechnical Journal, Vol. 27, 1990 pp. 151-158.

Mayne, P.W., "NHI (2002) Manual on Subsurface Investigations: Geotechnical Site Characterization", available through www.ce.gatech.edu/~geosys/Faculty/Mayne/papers/index.html, Section 5.3, pp. 107-112.

Robertson, P.K., R.G. Campanella, D. Gillespie and A. Rice, "Seismic CPT to Measure In-Situ Shear Wave Velocity", Journal of Geotechnical Engineering ASCE, Vol. 112, No. 8, 1986 pp. 791-803.

Robertson, P.K., Sully, J., Woeller, D.J., Lunne, T., Powell, J.J.M., and Gillespie, D.J., "Guidelines for Estimating Consolidation Parameters in Soils from Piezocone Tests", Canadian Geotechnical Journal, Vol. 29, No. 4, August 1992, pp. 539-550.

Robertson, P.K., T. Lunne and J.J.M. Powell, "Geo-Environmental Application of Penetration Testing", Geotechnical Site Characterization, Robertson & Mayne (editors), 1998 Balkema, Rotterdam, ISBN 90 5410 939 4 pp 35-47.

Campanella, R.G. and I. Weemees, "Development and Use of An Electrical Resistivity Cone for Groundwater Contamination Studies", Canadian Geotechnical Journal, Vol. 27 No. 5, 1990 pp. 557-567.

DeGroot, D.J. and A.J. Lutenegger, "Reliability of Soil Gas Sampling and Characterization Techniques", International Site Characterization Conference - Atlanta, 1998.

Woeller, D.J., P.K. Robertson, T.J. Boyd and Dave Thomas, "Detection of Polyaromatic Hydrocarbon Contaminants Using the UVIF-CPT", 53rd Canadian Geotechnical Conference Montreal, QC October pp. 733-739, 2000.

Zemo, D.A., T.A. Delfino, J.D. Gallinatti, V.A. Baker and L.R. Hilpert, "Field Comparison of Analytical Results from Discrete-Depth Groundwater Samplers" BAT EnviroProbe and QED HydroPunch, Sixth national Outdoor Action Conference, Las Vegas, Nevada Proceedings, 1992, pp 299-312.

Copies of ASTM Standards are available through www.astm.org

# Cone Penetration Testing Procedure (CPT)

Gregg Drilling carries out all Cone Penetration Tests (CPT) using an integrated electronic cone system, *Figure CPT*.

The cone takes measurements of tip resistance ($q_c$), sleeve resistance ($f_s$), and penetration pore water pressure ($u_2$). Measurements are taken at either 2.5 or 5 cm intervals during penetration to provide a nearly continuous profile. CPT data reduction and basic interpretation is performed in real time facilitating on-site decision making. The above mentioned parameters are stored electronically for further analysis and reference. All CPT soundings are performed in accordance with revised ASTM standards (D 5778-12).

The 5mm thick porous plastic filter element is located directly behind the cone tip in the $u_2$ location. A new saturated filter element is used on each sounding to measure both penetration pore pressures as well as measurements during a dissipation test (*PPDT*). Prior to each test, the filter element is fully saturated with oil under vacuum pressure to improve accuracy.

When the sounding is completed, the test hole is backfilled according to client specifications. If grouting is used, the procedure generally consists of pushing a hollow tremie pipe with a "knock out" plug to the termination depth of the CPT hole. Grout is then pumped under pressure as the tremie pipe is pulled from the hole. Disruption or further contamination to the site is therefore minimized.

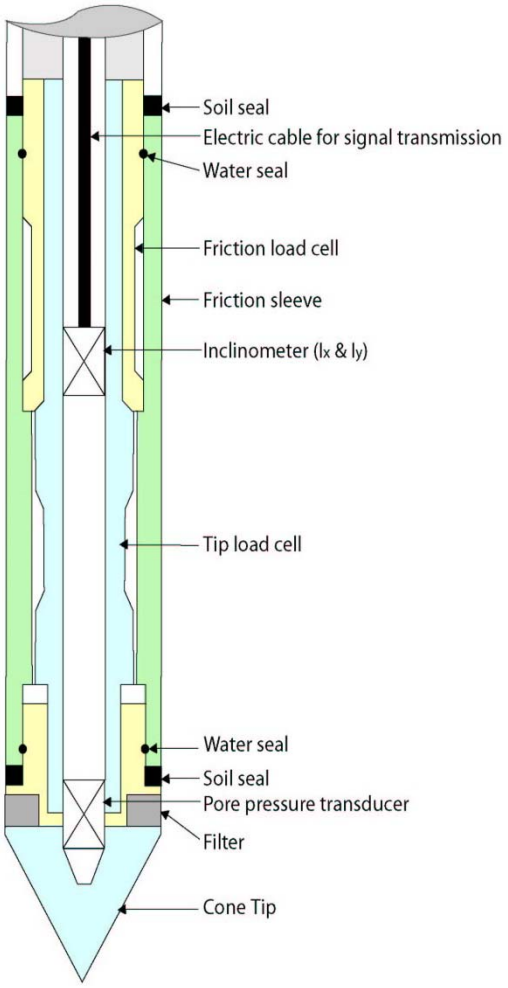



*Figure CPT*

Gregg 15cm$^2$ Standard Cone Specifications

| Dimensions | |
|---|---|
| Cone base area | 15 cm$^2$ |
| Sleeve surface area | 225 cm$^2$ |
| Cone net area ratio | 0.80 |
| | |
| **Specifications** | |
| **Cone load cell** | |
| Full scale range | 180 kN (20 tons) |
| Overload capacity | 150% |
| Full scale tip stress | 120 MPa (1,200 tsf) |
| Repeatability | 120 kPa (1.2 tsf) |
| | |
| **Sleeve load cell** | |
| Full scale range | 31 kN (3.5 tons) |
| Overload capacity | 150% |
| Full scale sleeve stress | 1,400 kPa (15 tsf) |
| Repeatability | 1.4 kPa (0.015 tsf) |
| | |
| **Pore pressure transducer** | |
| Full scale range | 7,000 kPa (1,000 psi) |
| Overload capacity | 150% |
| Repeatability | 7 kPa (1 psi) |

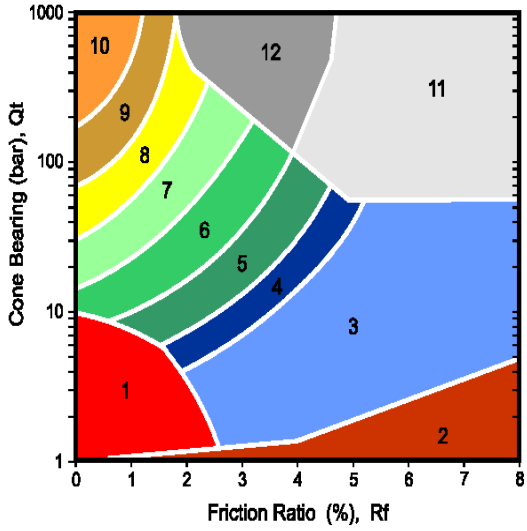
*Note: The repeatability during field use will depend somewhat on ground conditions, abrasion, maintenance and zero load stability.*

# Cone Penetration Test Data & Interpretation

The Cone Penetration Test (CPT) data collected are presented in graphical and electronic form in the report. The plots include interpreted Soil Behavior Type (SBT) based on the charts described by Robertson (1990). Typical plots display SBT based on the non-normalized charts of Robertson et al (1986). For CPT soundings deeper than 30m, we recommend the use of the normalized charts of Robertson (1990) which can be displayed as SBTn, upon request. The report also includes spreadsheet output of computer calculations of basic interpretation in terms of SBT and SBTn and various geotechnical parameters using current published correlations based on the comprehensive review by Lunne, Robertson and Powell (1997), as well as recent updates by Professor Robertson (Guide to Cone Penetration Testing, 2015). The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg Drilling & Testing Inc. does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software. Some interpretation methods require input of the groundwater level to calculate vertical effective stress. An estimate of the in-situ groundwater level has been made based on field observations and/or CPT results, but should be verified by the user.

A summary of locations and depths is available in Table 1. Note that all penetration depths referenced in the data are with respect to the existing ground surface.

Note that it is not always possible to clearly identify a soil type based solely on $q_t$, $f_s$, and $u_2$. In these situations, experience, judgment, and an assessment of the pore pressure dissipation data should be used to infer the correct soil behavior type.




| ZONE | | SBT |
|---|---|---|
| 1 | | Sensitive, fine grained |
| 2 | | Organic materials |
| 3 | | Clay |
| 4 | | Silty clay to clay |
| 5 | | Clayey silt to silty clay |
| 6 | | Sandy silt to clayey silt |
| 7 | | Silty sand to sandy silt |
| 8 | | Sand to silty sand |
| 9 | | Sand |
| 10 | | Gravely sand to sand |
| 11 | | Very stiff fine grained* |
| 12 | | Sand to clayey sand* |

*over consolidated or cemented

*Figure SBT (After Robertson et al., 1986) – Note: Colors may vary slightly compared to plots*

# Cone Penetration Test (CPT) Interpretation

Gregg uses a proprietary CPT interpretation and plotting software. The software takes the CPT data and performs basic interpretation in terms of soil behavior type (SBT) and various geotechnical parameters using current published empirical correlations based on the comprehensive review by Lunne, Robertson and Powell (1997). The interpretation is presented in tabular format using MS Excel. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software.

The following provides a summary of the methods used for the interpretation. Many of the empirical correlations to estimate geotechnical parameters have constants that have a range of values depending on soil type, geologic origin and other factors. The software uses 'default' values that have been selected to provide, in general, conservatively low estimates of the various geotechnical parameters.

**Input:**

1 Units for display (Imperial or metric) (atm. pressure, $p_a$ = 0.96 tsf or 0.1 MPa)
2 Depth interval to average results (ft or m). Data are collected at either 0.02 or 0.05m and can be averaged every 1, 3 or 5 intervals.
3 Elevation of ground surface (ft or m)
4 Depth to water table, $z_w$ (ft or m) – input required
5 Net area ratio for cone, a (default to 0.80)
6 Relative Density constant, $C_{Dr}$ (default to 350)
7 Young's modulus number for sands, α (default to 5)
8 Small strain shear modulus number
  a. for sands, $S_G$ (default to 180 for $SBT_n$ 5, 6, 7)
  b. for clays, $C_G$ (default to 50 for $SBT_n$ 1, 2, 3 & 4)
9 Undrained shear strength cone factor for clays, $N_{kt}$ (default to 15)
10 Over Consolidation ratio number, $k_{ocr}$ (default to 0.3)
11 Unit weight of water, (default to $\gamma_w$ = 62.4 lb/ft$^3$ or 9.81 kN/m$^3$)

**Column**

1 Depth, z, (m) – CPT data is collected in meters
2 Depth (ft)
3 Cone resistance, $q_c$ (tsf or MPa)
4 Sleeve resistance, $f_s$ (tsf or MPa)
5 Penetration pore pressure, u (psi or MPa), measured behind the cone (i.e. $u_2$)
6 Other – any additional data
7 Total cone resistance, $q_t$ (tsf or MPa) $q_t = q_c + u\,(1-a)$

| | | |
|---|---|---|
| 8 | Friction Ratio, $R_f$ (%) | $R_f = (f_s/q_t) \times 100\%$ |
| 9 | Soil Behavior Type (non-normalized), SBT | see note |
| 10 | Unit weight, γ (pcf or kN/m$^3$) | based on SBT, see note |
| 11 | Total overburden stress, $\sigma_v$ (tsf) | $\sigma_{vo} = \sigma\, z$ |
| 12 | In-situ pore pressure, $u_o$ (tsf) | $u_o = \gamma_w (z - z_w)$ |
| 13 | Effective overburden stress, $\sigma'_{vo}$ (tsf ) | $\sigma'_{vo} = \sigma_{vo} - u_o$ |
| 14 | Normalized cone resistance, $Q_{t1}$ | $Q_{t1} = (q_t - \sigma_{vo}) / \sigma'_{vo}$ |
| 15 | Normalized friction ratio, $F_r$ (%) | $F_r = f_s / (q_t - \sigma_{vo}) \times 100\%$ |
| 16 | Normalized Pore Pressure ratio, $B_q$ | $B_q = u - u_o / (q_t - \sigma_{vo})$ |
| 17 | Soil Behavior Type (normalized), $SBT_n$ | see note |
| 18 | $SBT_n$ Index, $I_c$ | see note |
| 19 | Normalized Cone resistance, $Q_{tn}$ (n varies with $I_c$) | see note |
| 20 | Estimated permeability, $k_{SBT}$ (cm/sec or ft/sec) | see note |
| 21 | Equivalent SPT $N_{60}$, blows/ft | see note |
| 22 | Equivalent SPT $(N_1)_{60}$ blows/ft | see note |
| 23 | Estimated Relative Density, $D_r$, (%) | see note |
| 24 | Estimated Friction Angle, ϕ', (degrees) | see note |
| 25 | Estimated Young's modulus, $E_s$ (tsf) | see note |
| 26 | Estimated small strain Shear modulus, Go (tsf) | see note |
| 27 | Estimated Undrained shear strength, $s_u$ (tsf) | see note |
| 28 | Estimated Undrained strength ratio | $s_u/\sigma_v'$ |
| 29 | Estimated Over Consolidation ratio, OCR | see note |

**Notes:**

1 Soil Behavior Type (non-normalized), SBT (Lunne et al., 1997 and table below)

2 Unit weight, γ either constant at 119 pcf or based on Non-normalized SBT (Lunne et al., 1997 and table below)

3 Soil Behavior Type (Normalized), $SBT_n$ Lunne et al. (1997)

4 $SBT_n$ Index, $I_c$ $I_c = ((3.47 - \log Q_{t1})^2 + (\log F_r + 1.22)^2)^{0.5}$

5 Normalized Cone resistance, $Q_{tn}$ (n varies with Ic)

$Q_{tn} = ((q_t - \sigma_{vo})/pa)\ (pa/(\sigma'_{vo})^n$ and recalculate $I_c$, then iterate:

When $I_c < 1.64$, n = 0.5 (clean sand)
When $I_c > 3.30$, n = 1.0 (clays)
When $1.64 < I_c < 3.30$, $n = (I_c - 1.64)0.3 + 0.5$
Iterate until the change in n, $\Delta n < 0.01$

6 Estimated permeability, $k_{SBT}$ based on Normalized $SBT_n$ (Lunne et al., 1997 and table below)

7 Equivalent SPT $N_{60}$, blows/ft Lunne et al. (1997)

$$\frac{(q_t/p_a)}{N_{60}} = 8.5\left(1 - \frac{I_c}{4.6}\right)$$

8 Equivalent SPT $(N_1)_{60}$ blows/ft $(N_1)_{60} = N_{60}\, C_N$,
where $C_N = (pa/\sigma'_{vo})^{0.5}$

9 Relative Density, $D_r$, (%) $D_r^2 = Q_{tn} / C_{Dr}$
*Only $SBT_n$ 5, 6, 7 & 8* *Show 'N/A' in zones 1, 2, 3, 4 & 9*

10 Friction Angle, ϕ', (degrees) $\tan\phi' = \frac{1}{2.68}\left[\log\left(\frac{q_c}{\sigma'_{vo}}\right) + 0.29\right]$
*Only $SBT_n$ 5, 6, 7 & 8* *Show'N/A' in zones 1, 2, 3, 4 & 9*

11 Young's modulus, $E_s$ $E_s = \alpha\, q_t$
*Only $SBT_n$ 5, 6, 7 & 8* *Show 'N/A' in zones 1, 2, 3, 4 & 9*

12 Small strain shear modulus, Go

a. $G_o = S_G\,(q_t\ \sigma'_{vo}\ pa)^{1/3}$ *For $SBT_n$ 5, 6, 7*

b. $G_o = C_G\, q_t$ *For $SBT_n$ 1, 2, 3& 4*

*Show 'N/A' in zones 8 & 9*

13 Undrained shear strength, $s_u$ $s_u = (q_t - \sigma_{vo}) / N_{kt}$
*Only $SBT_n$ 1, 2, 3, 4 & 9* *Show 'N/A' in zones 5, 6, 7 & 8*

14 Over Consolidation ratio, OCR $OCR = k_{ocr}\, Q_{t1}$
*Only $SBT_n$ 1, 2, 3, 4 & 9* *Show 'N/A' in zones 5, 6, 7 & 8*

The following updated and simplified SBT descriptions have been used in the software:

| **SBT Zones** | | **$SBT_n$ Zones** | |
|---|---|---|---|
| 1 | sensitive fine grained | 1 | sensitive fine grained |
| 2 | organic soil | 2 | organic soil |
| 3 | clay | 3 | clay |
| 4 | clay & silty clay | 4 | clay & silty clay |
| 5 | clay & silty clay | | |
| 6 | sandy silt & clayey silt | | |

| | | | |
|---|---|---|---|
| 7 | silty sand & sandy silt | 5 | silty sand & sandy silt |
| 8 | sand & silty sand | 6 | sand & silty sand |
| 9 | sand | | |
| 10 | sand | 7 | sand |
| 11 | very dense/stiff soil* | 8 | very dense/stiff soil* |
| 12 | very dense/stiff soil* | 9 | very dense/stiff soil* |

*heavily overconsolidated and/or cemented

Track when soils fall with zones of same description and print that description (i.e. if soils fall only within SBT zones 4 & 5, print 'clays & silty clays')

**Estimated Permeability** (see Lunne et al., 1997)

| $SBT_n$ | Permeability (ft/sec) | (m/sec) |
|---|---|---|
| 1 | $3x\ 10^{-8}$ | $1x\ 10^{-8}$ |
| 2 | $3x\ 10^{-7}$ | $1x\ 10^{-7}$ |
| 3 | $1x\ 10^{-9}$ | $3x\ 10^{-10}$ |
| 4 | $3x\ 10^{-8}$ | $1x\ 10^{-8}$ |
| 5 | $3x\ 10^{-6}$ | $1x\ 10^{-6}$ |
| 6 | $3x\ 10^{-4}$ | $1x\ 10^{-4}$ |
| 7 | $3x\ 10^{-2}$ | $1x\ 10^{-2}$ |
| 8 | $3x\ 10^{-6}$ | $1x\ 10^{-6}$ |
| 9 | $1x\ 10^{-8}$ | $3x\ 10^{-9}$ |

**Estimated Unit Weight** (see Lunne et al., 1997)

| SBT | Approximate Unit Weight ($lb/ft^3$) | ($kN/m^3$) |
|---|---|---|
| 1 | 111.4 | 17.5 |
| 2 | 79.6 | 12.5 |
| 3 | 111.4 | 17.5 |
| 4 | 114.6 | 18.0 |
| 5 | 114.6 | 18.0 |
| 6 | 114.6 | 18.0 |
| 7 | 117.8 | 18.5 |
| 8 | 120.9 | 19.0 |
| 9 | 124.1 | 19.5 |
| 10 | 127.3 | 20.0 |
| 11 | 130.5 | 20.5 |
| 12 | 120.9 | 19.0 |

# Pore Pressure Dissipation Tests (PPDT)

Pore Pressure Dissipation Tests (PPDT's) conducted at various intervals can be used to measure equilibrium water pressure (at the time of the CPT). If conditions are hydrostatic, the equilibrium water pressure can be used to determine the approximate depth of the ground water table. A PPDT is conducted when penetration is halted at specific intervals determined by the field representative. The variation of the penetration pore pressure (*u)* with time is measured behind the tip of the cone and recorded.

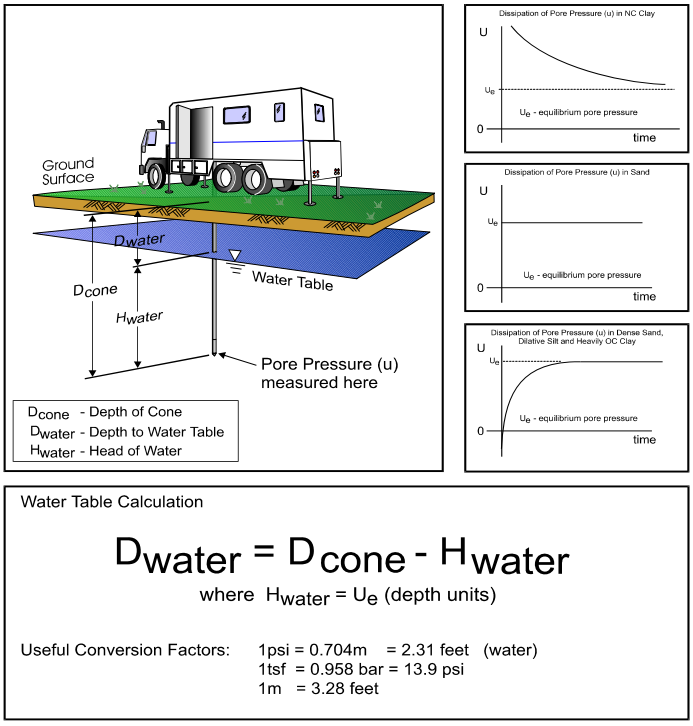
Pore pressure dissipation data can be interpreted to provide estimates of:

- Equilibrium piezometric pressure
- Phreatic Surface
- In situ horizontal coefficient of consolidation ($c_h$)
- In situ horizontal coefficient of permeability ($k_h$)

In order to correctly interpret the equilibrium piezometric pressure and/or the phreatic surface, the pore pressure must be monitored until it reaches equilibrium, *Figure PPDT*. This time is commonly referred to as $t_{100}$, the point at which 100% of the excess pore pressure has dissipated.

A complete reference on pore pressure dissipation tests is presented by Robertson et al. 1992 and Lunne et al. 1997.

A summary of the pore pressure dissipation tests are summarized in Table 1.




Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

where $H_{water} = U_e$ (depth units)

Useful Conversion Factors: 1psi = 0.704m = 2.31 feet (water)
1tsf = 0.958 bar = 13.9 psi
1m = 3.28 feet

*Figure PPDT*

# Seismic Cone Penetration Testing (SCPT)

Seismic Cone Penetration Testing (SCPT) can be conducted at various intervals during the Cone Penetration Test. Shear wave velocity (Vs) can then be calculated over a specified interval with depth. A small interval for seismic testing, such as 1-1.5m (3-5ft) allows for a detailed look at the shear wave profile with depth. Conversely, a larger interval such as 3-6m (10-20ft) allows for a more average shear wave velocity to be calculated. Gregg's cones have a horizontally active geophone located 0.2m (0.66ft) behind the tip.

To conduct the seismic shear wave test, the penetration of the cone is stopped and the rods are decoupled from the rig. An automatic hammer is triggered to send a shear wave into the soil. The distance from the source to the cone is calculated knowing the total depth of the cone and the horizontal offset distance between the source and the cone. To calculate an interval velocity, a minimum of two tests must be performed at two different depths. The arrival times between the two wave traces are compared to obtain the difference in time (Δt). The difference in depth is calculated (Δd) and velocity can be determined using the simple equation: $v = \Delta d/\Delta t$

Multiple wave traces can be recorded at the same depth to improve quality of the data.

A complete reference on seismic cone penetration tests is presented by Robertson et al. 1986 and Lunne et al. 1997.

A summary the shear wave velocities, arrival times and wave traces are provided with the report.

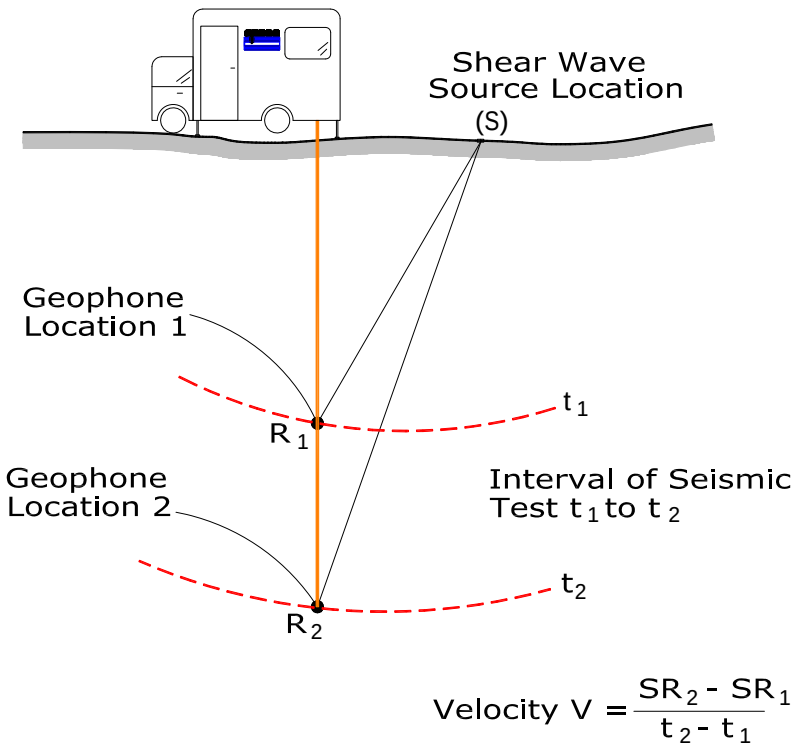



*Figure SCPT*

# Groundwater Sampling

Gregg Drilling & Testing, Inc. conducts groundwater sampling using a sampler as shown in *Figure GWS*. The groundwater sampler has a retrievable stainless steel or disposable PVC screen with steel drop off tip. This allows for samples to be taken at multiple depth intervals within the same sounding location. In areas of slower water recharge, provisions may be made to set temporary PVC well screens during sampling to allow the pushing equipment to advance to the next sample location while the groundwater is allowed to infiltrate.

The groundwater sampler operates by advancing 44.5mm (1¾ inch) hollow push rods with the filter tip in a closed configuration to the base of the desired sampling interval. Once at the desired sample depth, the push rods are retracted; exposing the encased filter screen and allowing groundwater to infiltrate hydrostatically from the formation into the inlet screen. A small diameter bailer (approximately ½ or ¾ inch) is lowered through the push rods into the screen section for sample collection. The number of downhole trips with the bailer and time necessary to complete the sample collection at each depth interval is a function of sampling protocols, volume requirements, and the yield characteristics and storage capacity of the formation. Upon completion of sample collection, the push rods and sampler, with the exception of the PVC screen and steel drop off tip are retrieved to the ground surface, decontaminated and prepared for the next sampling event.

*For a detailed reference on direct push groundwater sampling, refer to Zemo et. al., 1992.*

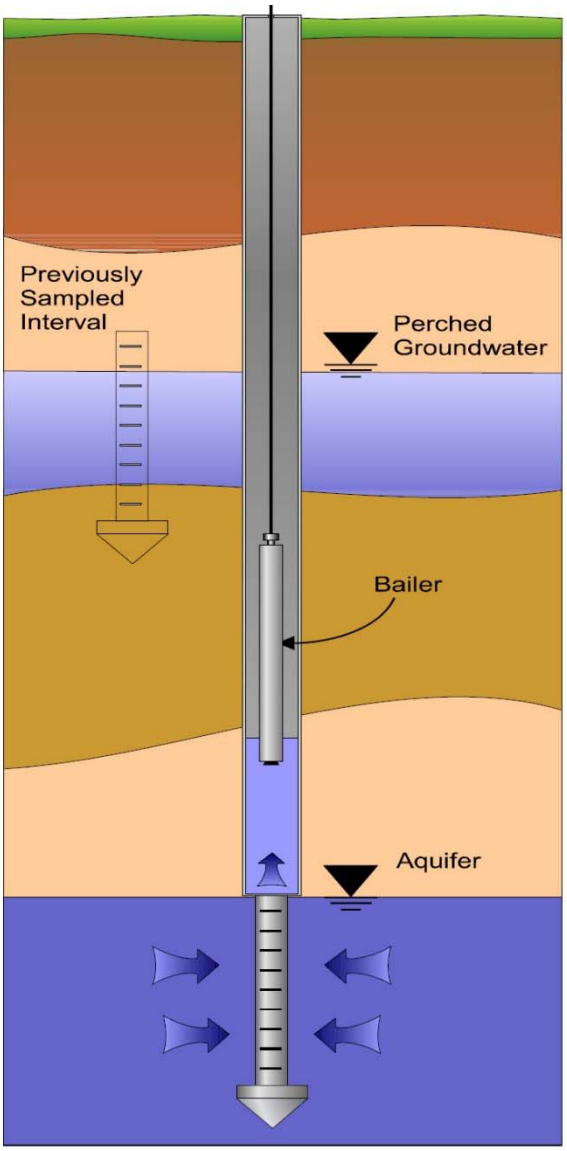



*Figure GWS*

# Soil Sampling

Gregg Drilling & Testing, Inc. uses a piston-type push-in sampler to obtain small soil samples without generating any soil cuttings, *Figure SS*. Two different types of samplers (12 and 18 inch) are used depending on the soil type and density. The soil sampler is initially pushed in a "closed" position to the desired sampling interval using the CPT pushing equipment. Keeping the sampler closed minimizes the potential of cross contamination. The inner tip of the sampler is then retracted leaving a hollow soil sampler with inner 1¼" diameter sample tubes. The hollow sampler is then pushed in a locked "open" position to collect a soil sample. The filled sampler and push rods are then retrieved to the ground surface. Because the soil enters the sampler at a constant rate, the opportunity for 100% recovery is increased. For environmental analysis, the soil sample tube ends are sealed with Teflon and plastic caps. Often, a longer "split tube" can be used for geotechnical sampling.

*For a detailed reference on direct push soil sampling, refer to Robertson et al, 1998.*

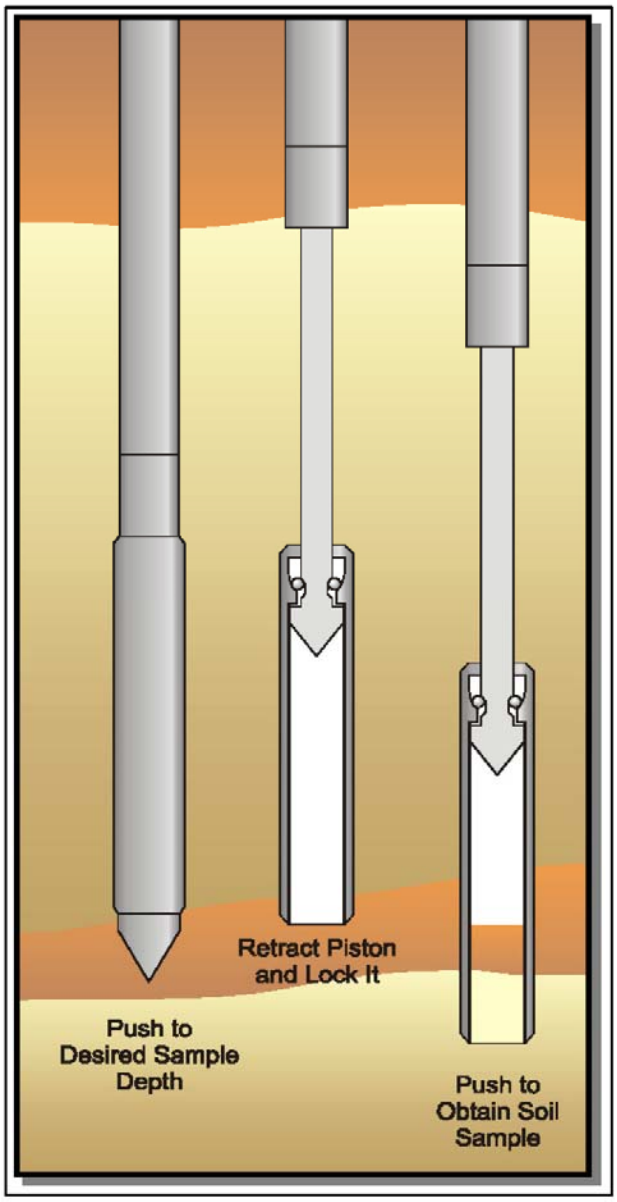



*Figure SS*

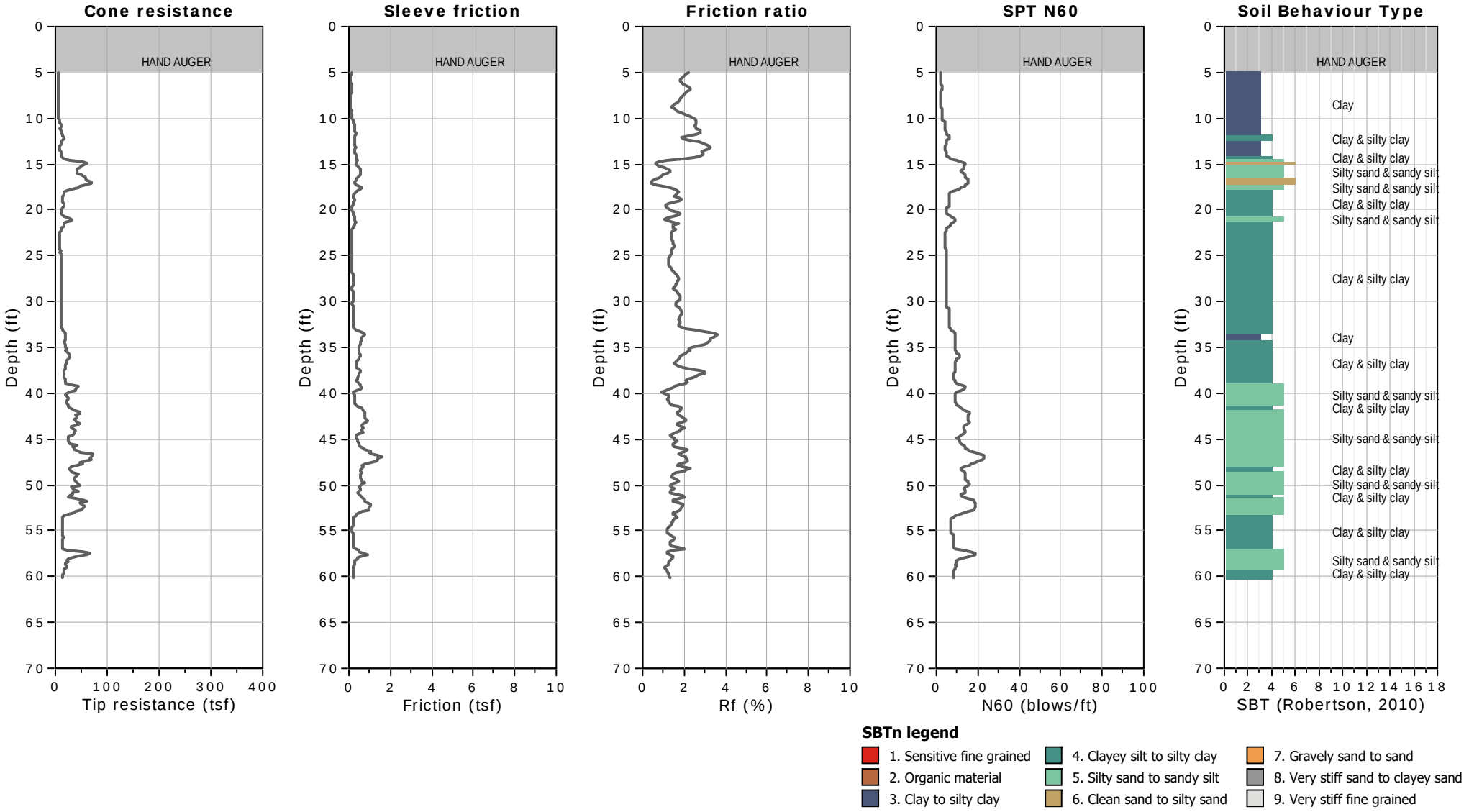
# CPT: CPT-01

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 60.04 ft, Date: 4/26/2018

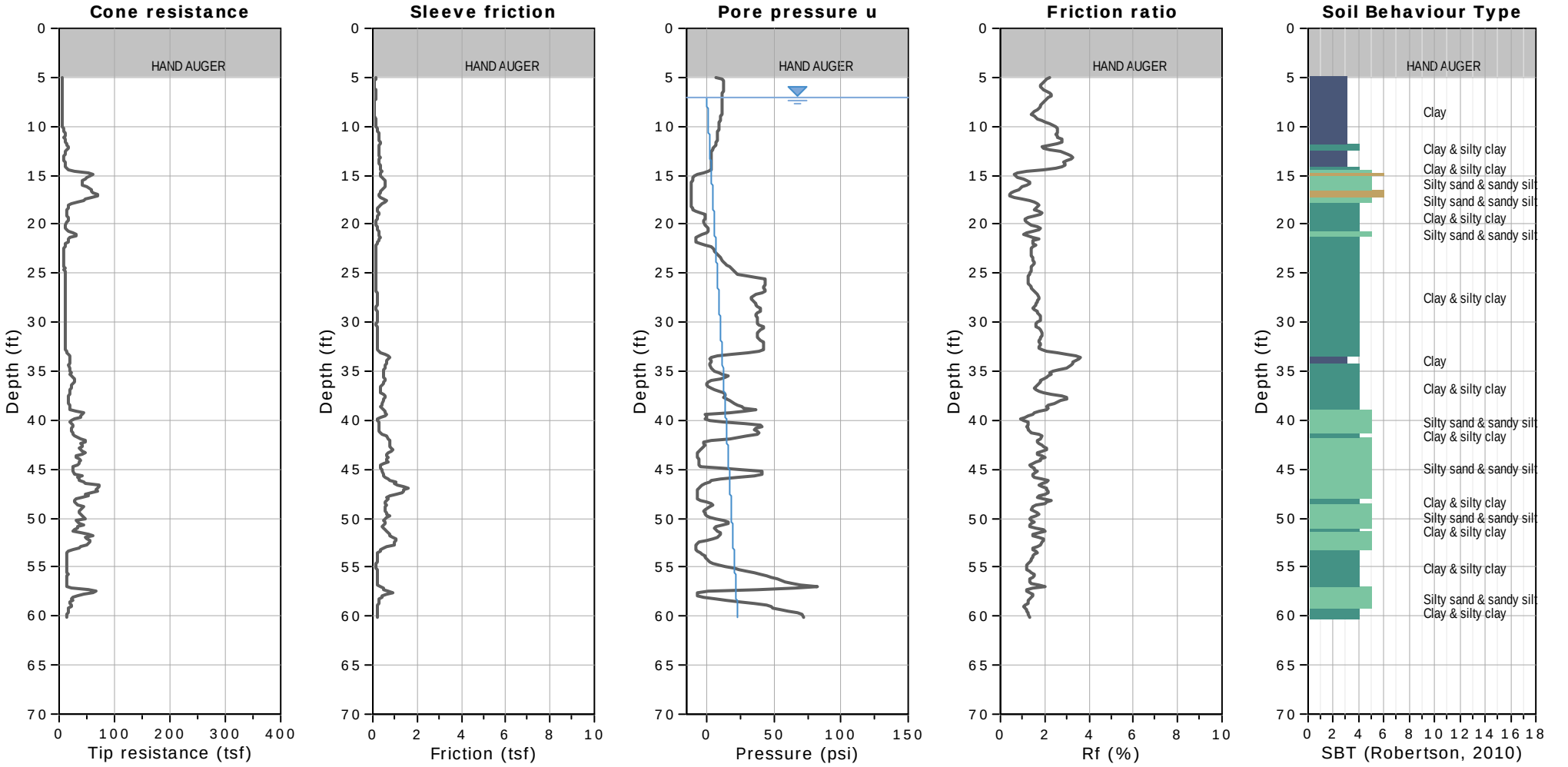


**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 60.04 ft, Date: 4/26/2018




**WATER TABLE FOR ESTIMATING PURPOSES ONLY**

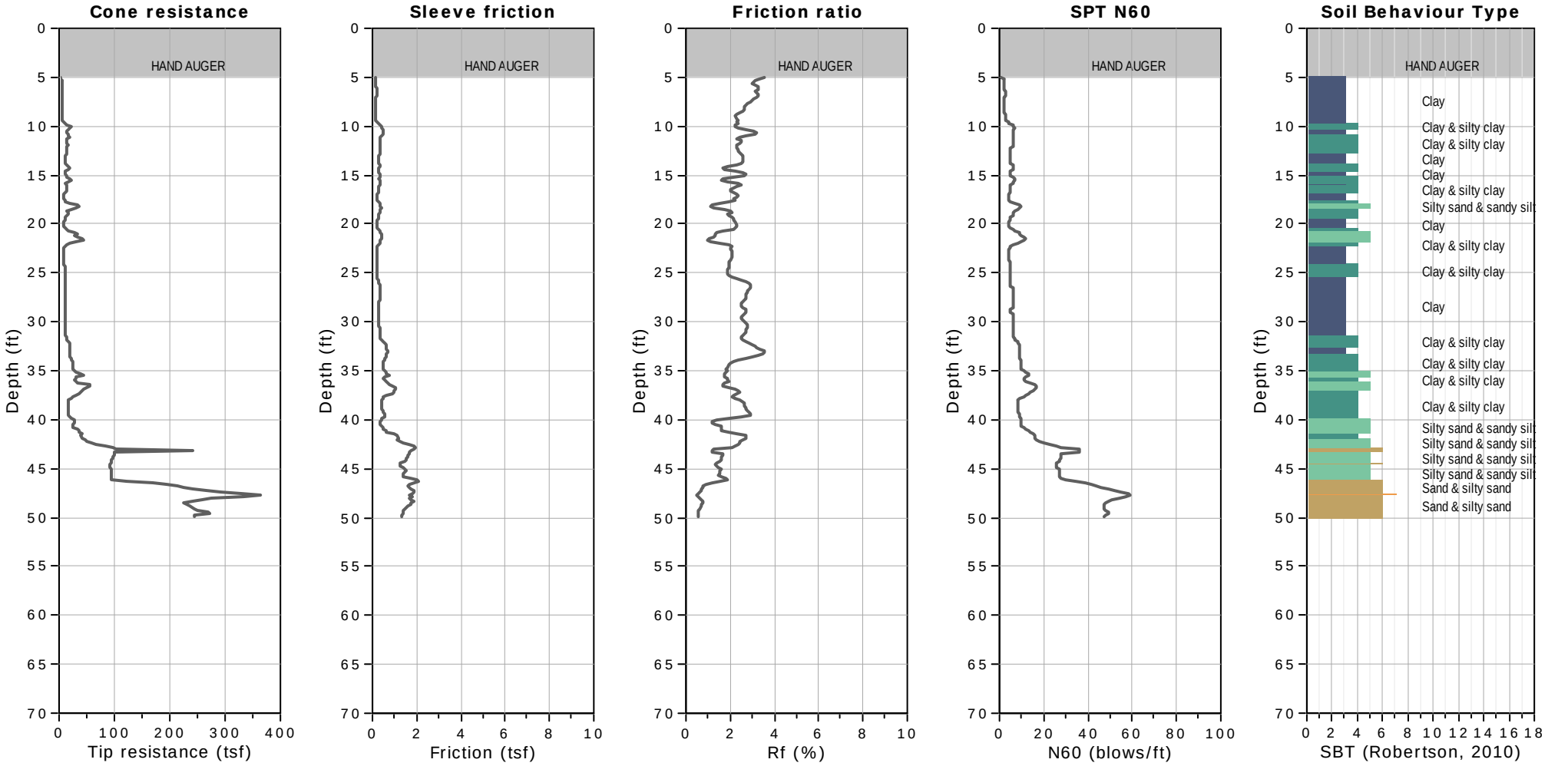
# CPT: CPT-02

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 49.87 ft, Date: 4/25/2018

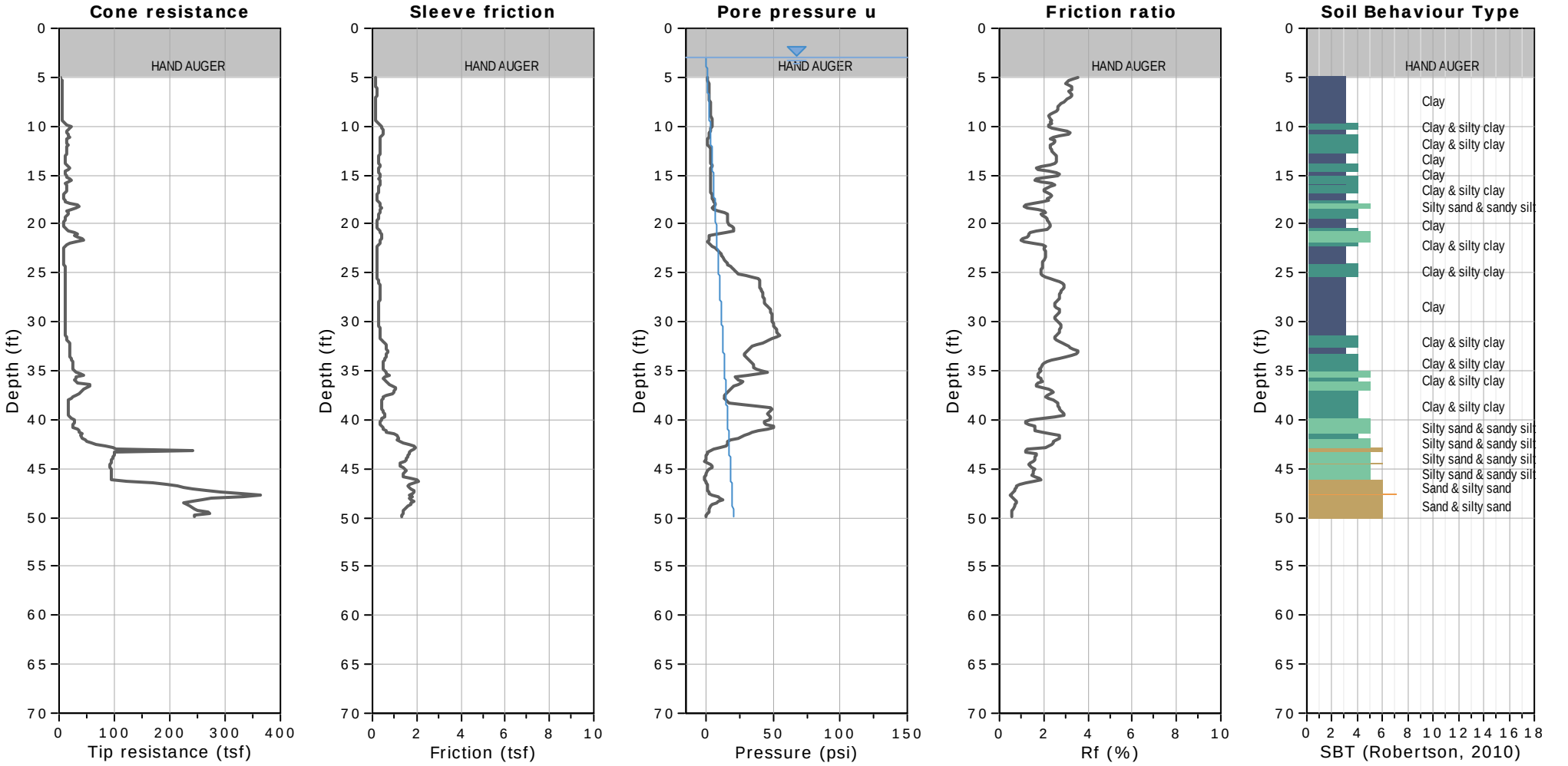


**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 49.87 ft, Date: 4/25/2018




**WATER TABLE FOR ESTIMATING PURPOSES ONLY**

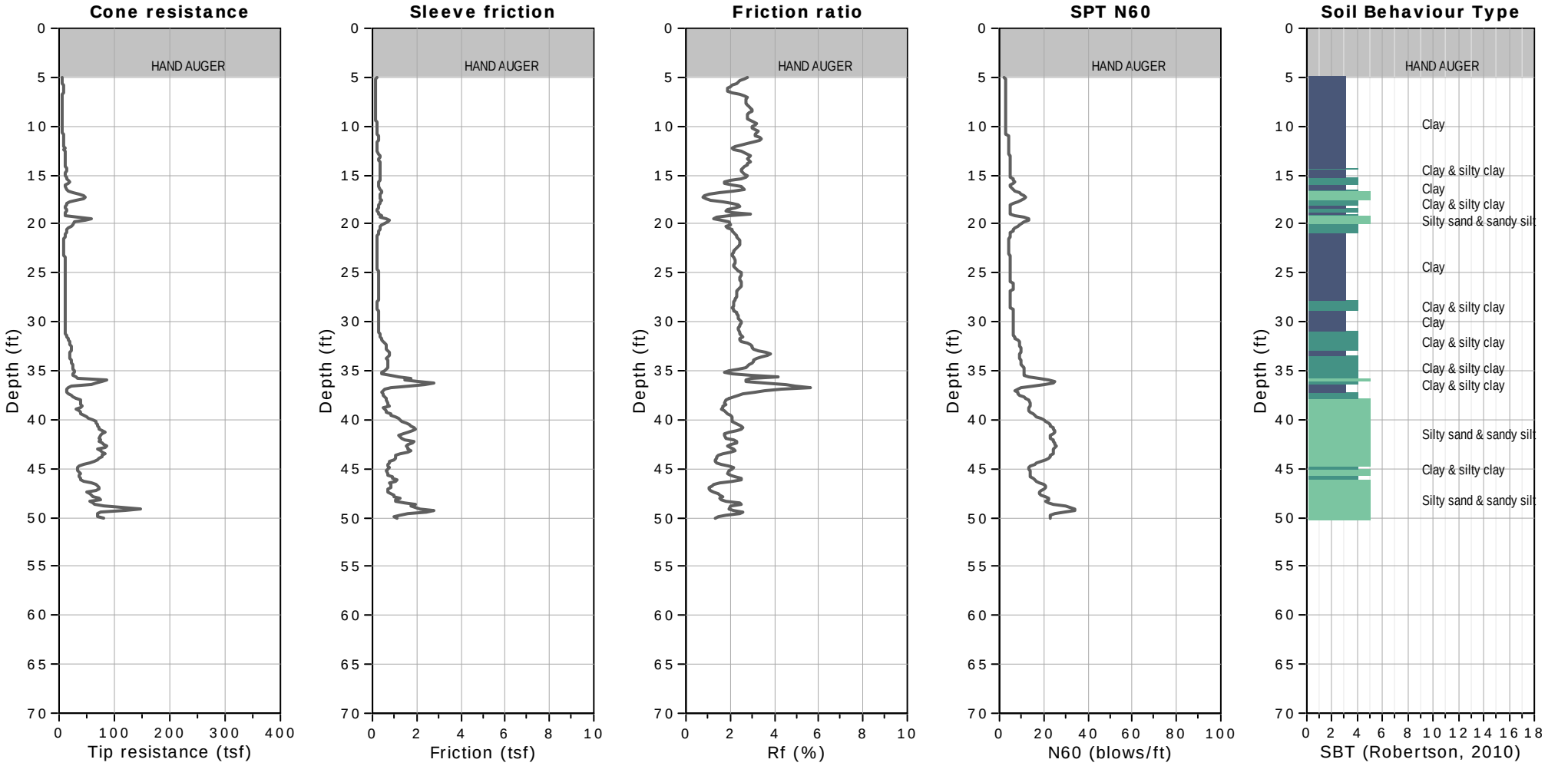
# CPT: CPT-03

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 50.03 ft, Date: 4/26/2018



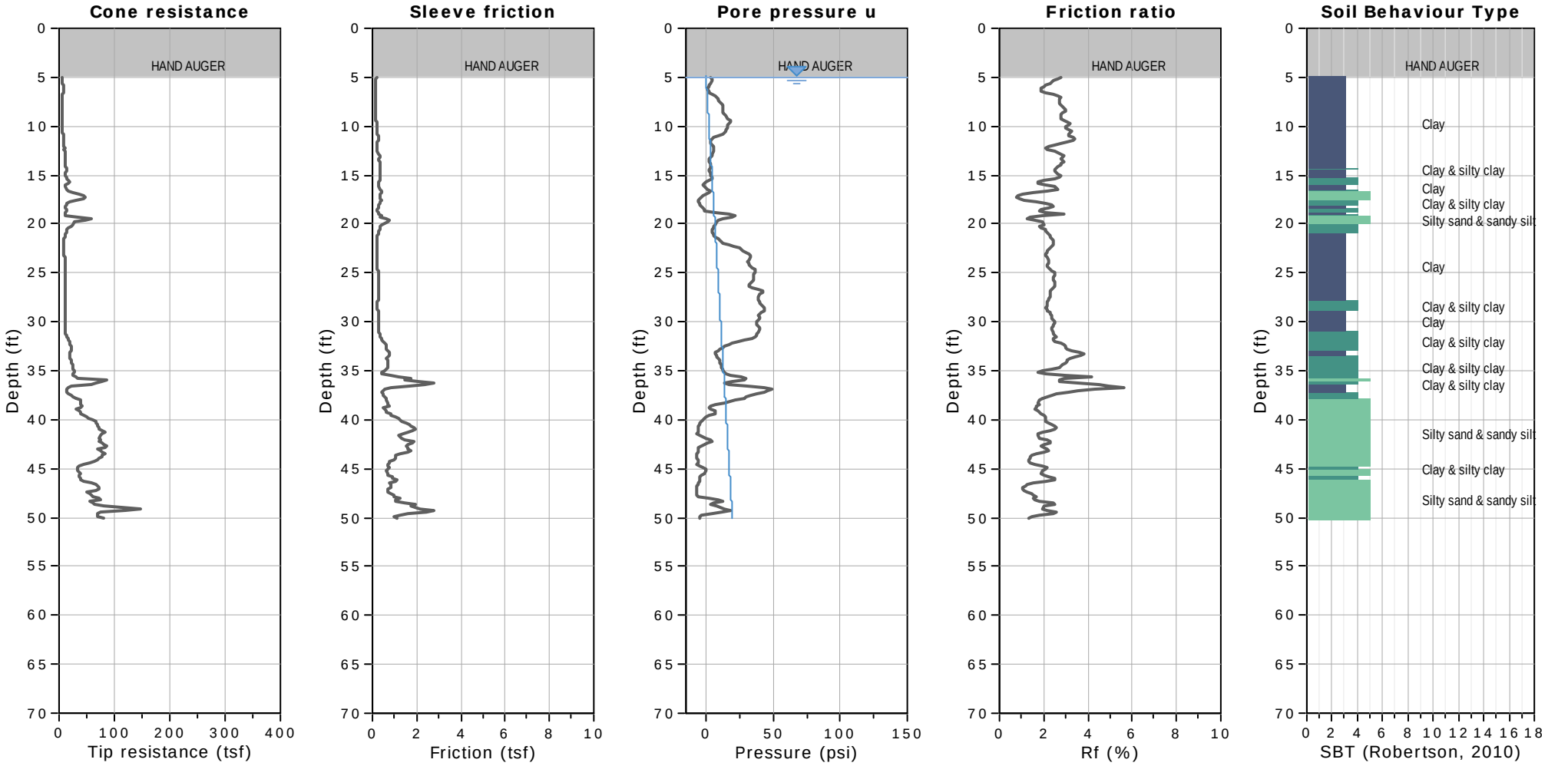
# CPT: CPT-03

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 50.03 ft, Date: 4/26/2018




**WATER TABLE FOR ESTIMATING PURPOSES ONLY**

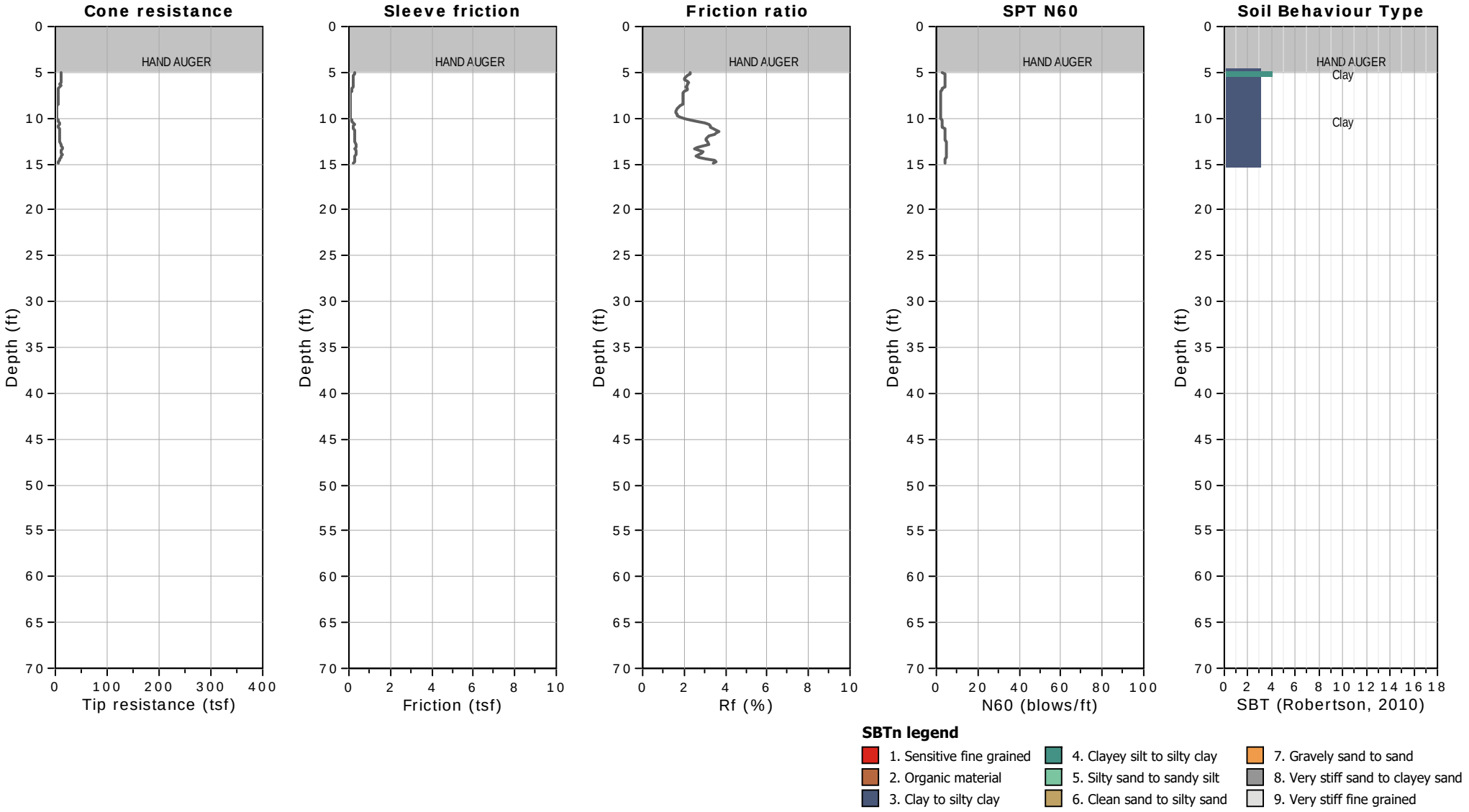
# CPT: CPT-04

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 14.93 ft, Date: 4/25/2018



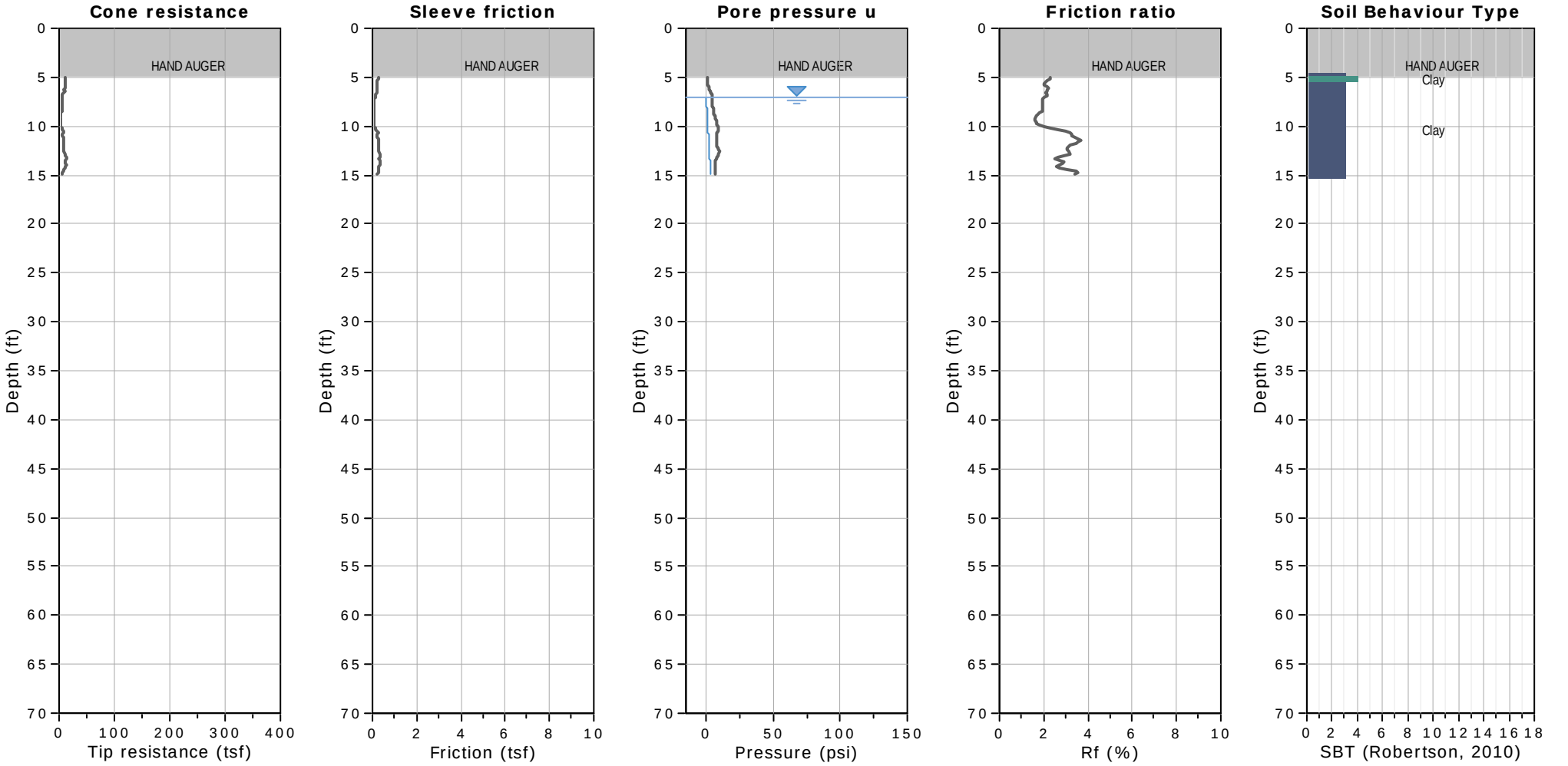
# CPT: CPT-04

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 14.93 ft, Date: 4/25/2018




**WATER TABLE FOR ESTIMATING PURPOSES ONLY**

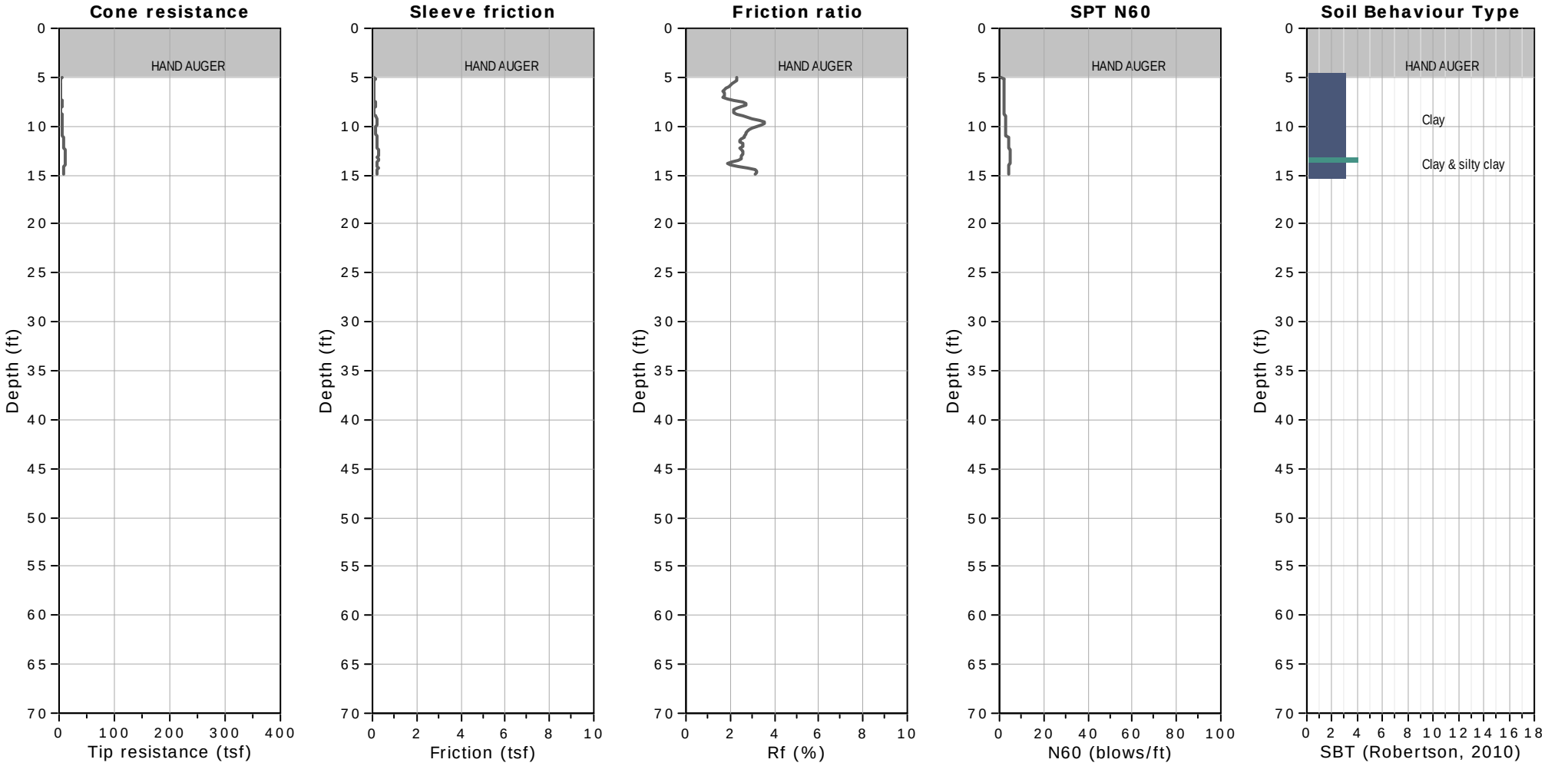
# CPT: CPT-05

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 14.93 ft, Date: 4/25/2018



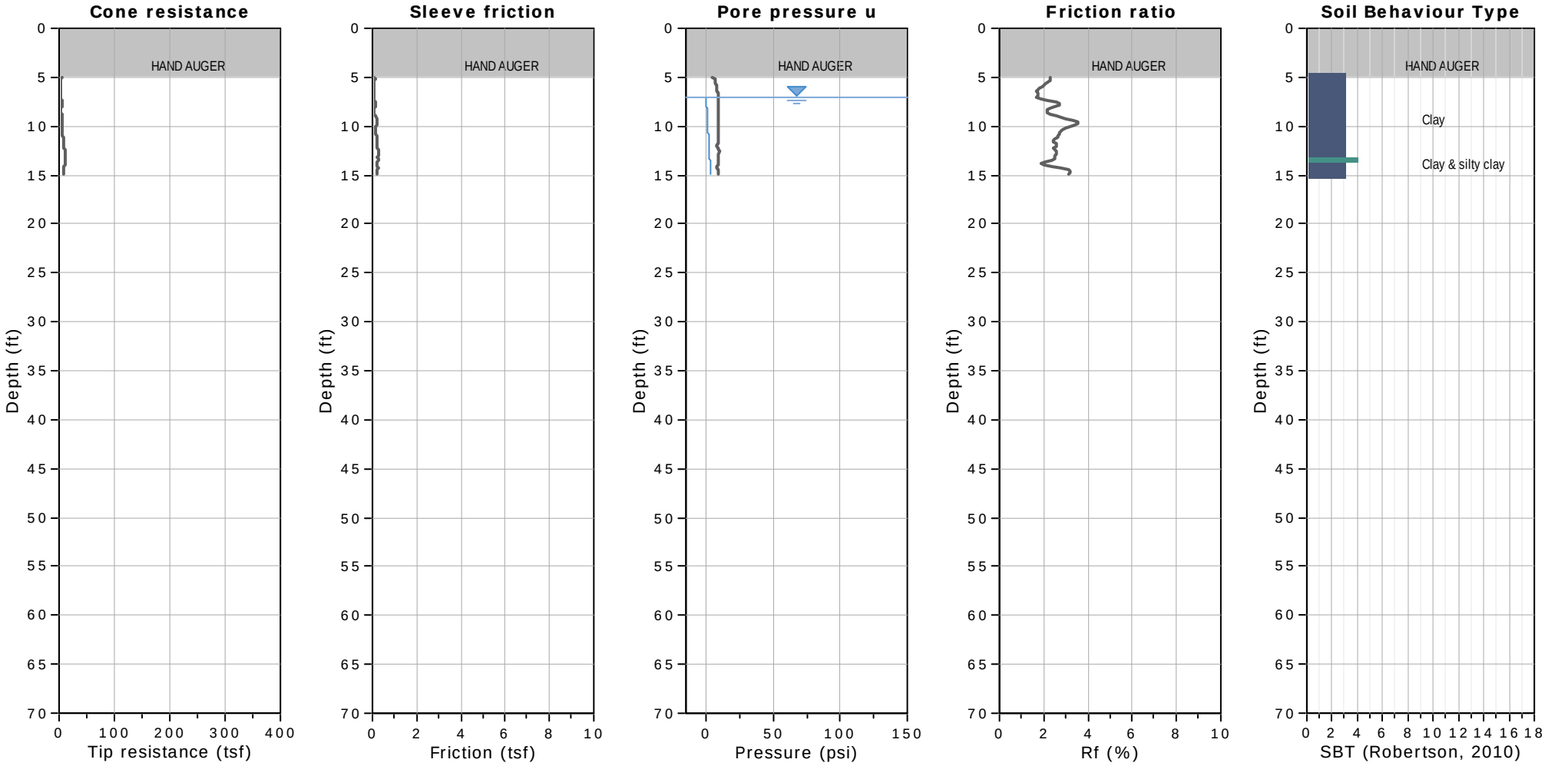
# CPT: CPT-05

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 14.93 ft, Date: 4/25/2018




**WATER TABLE FOR ESTIMATING PURPOSES ONLY**

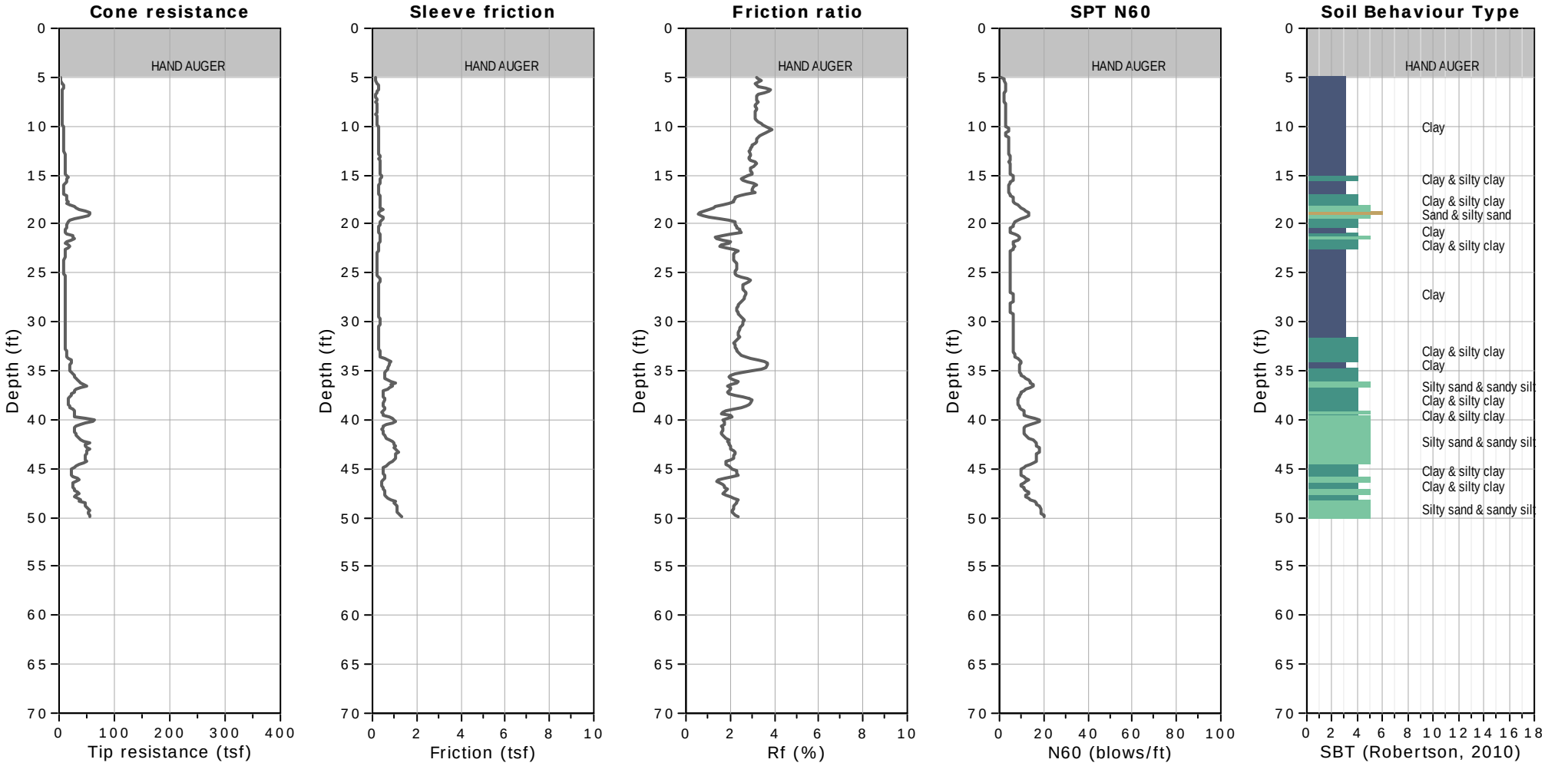
# CPT: CPT-06

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 49.87 ft, Date: 4/26/2018



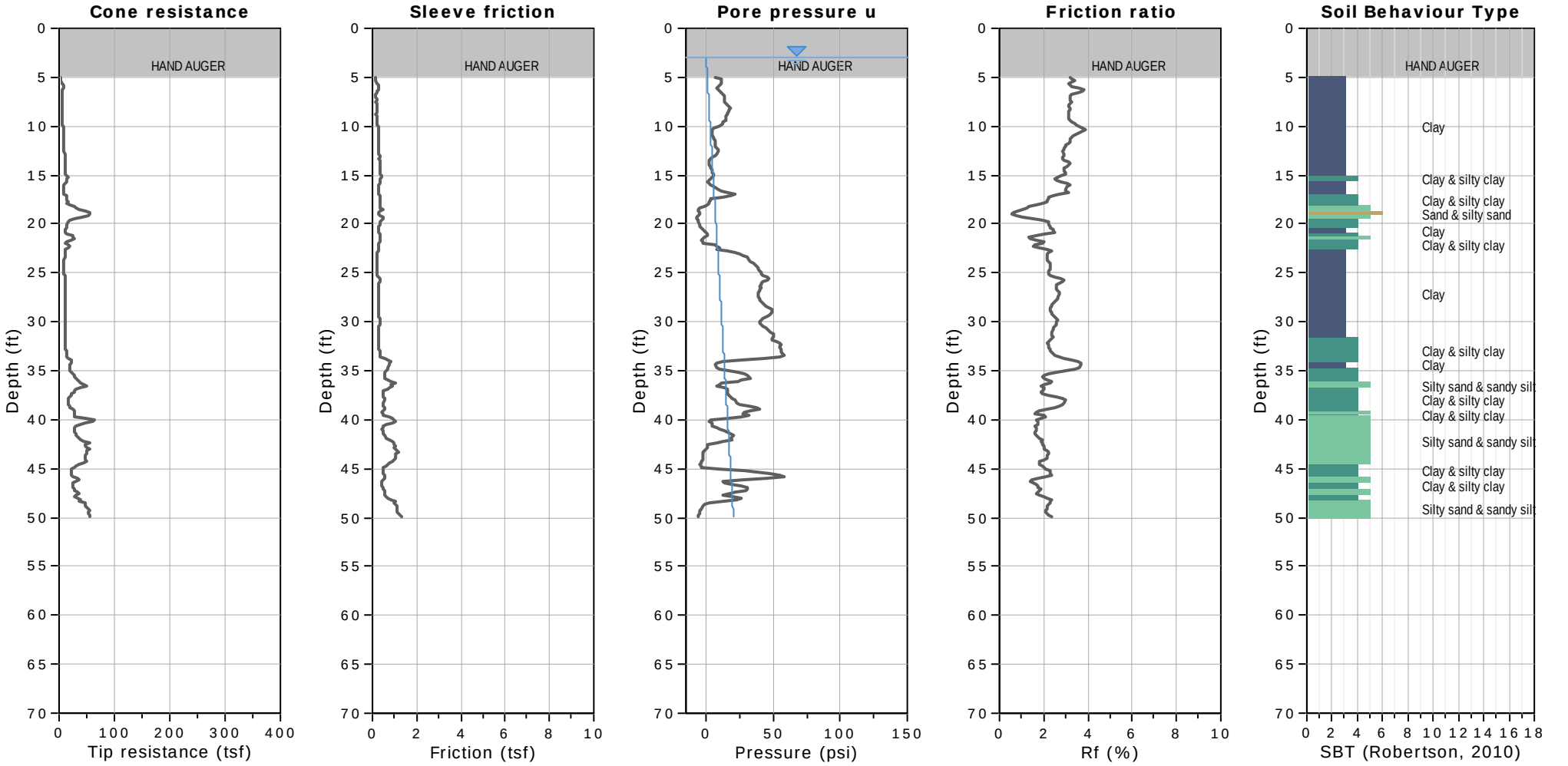
# CPT: CPT-06

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 49.87 ft, Date: 4/26/2018



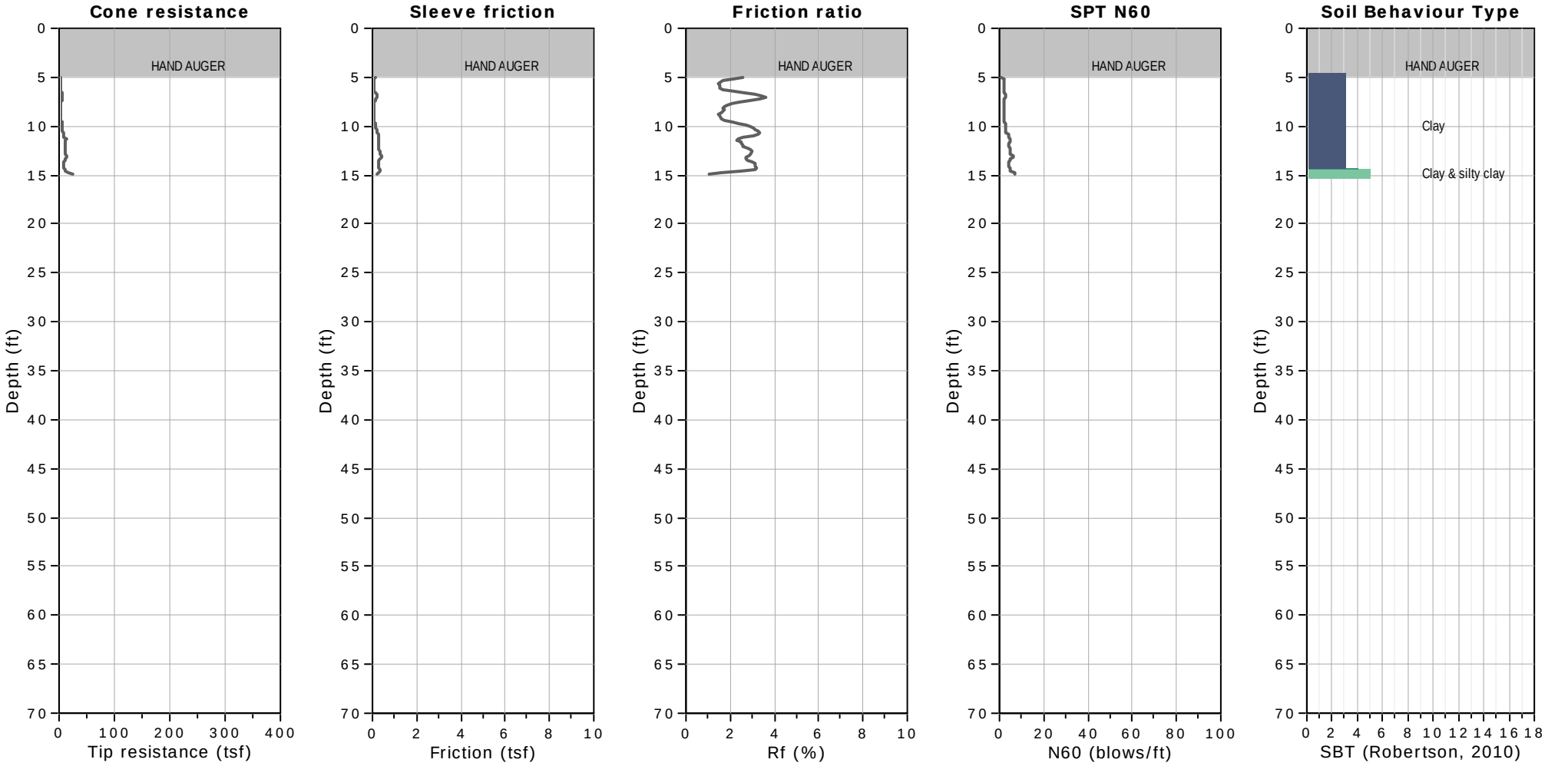

**WATER TABLE FOR ESTIMATING PURPOSES ONLY**

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 14.93 ft, Date: 4/25/2018



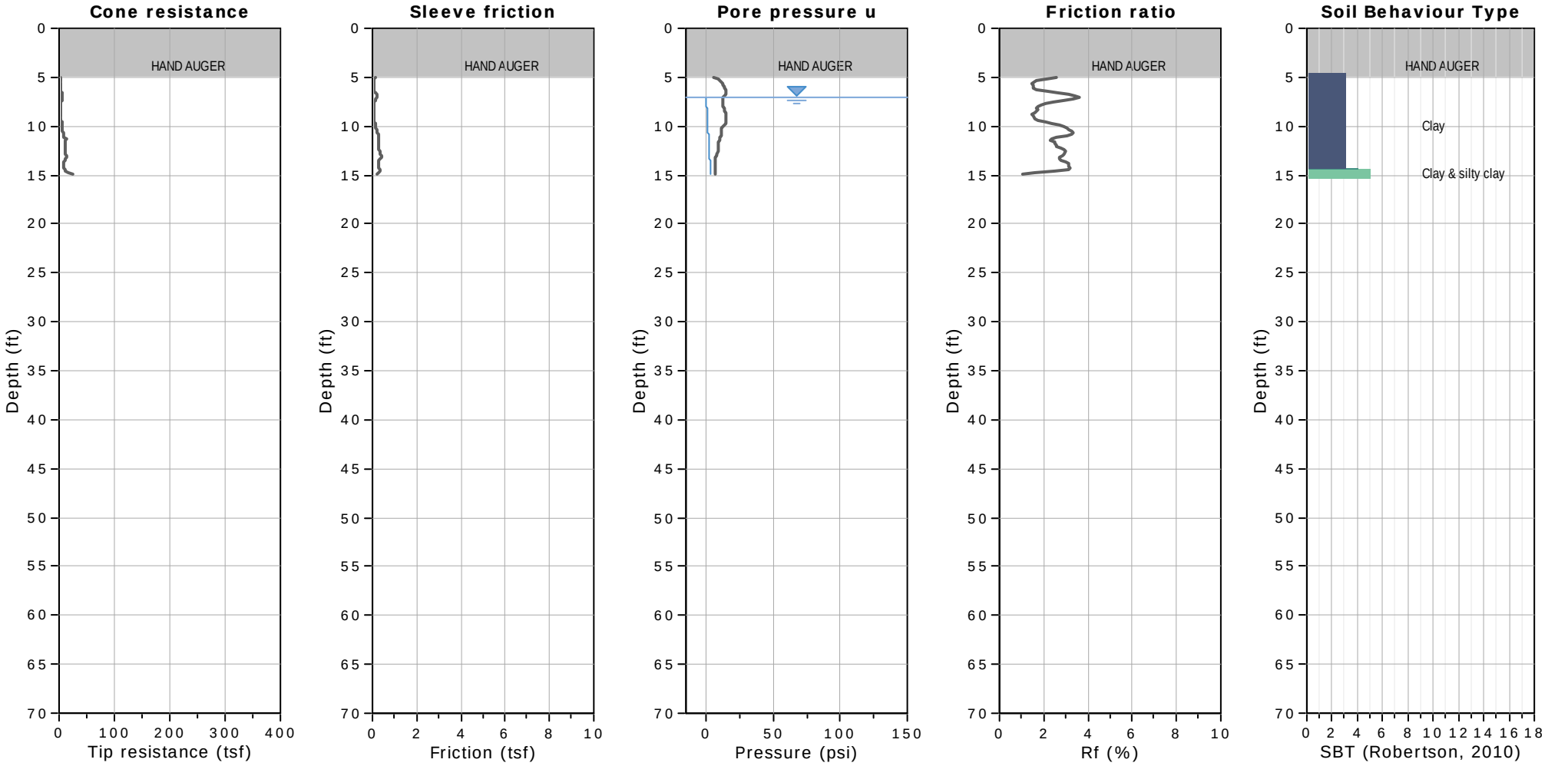
# CPT: CPT-07

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 14.93 ft, Date: 4/25/2018




**WATER TABLE FOR ESTIMATING PURPOSES ONLY**

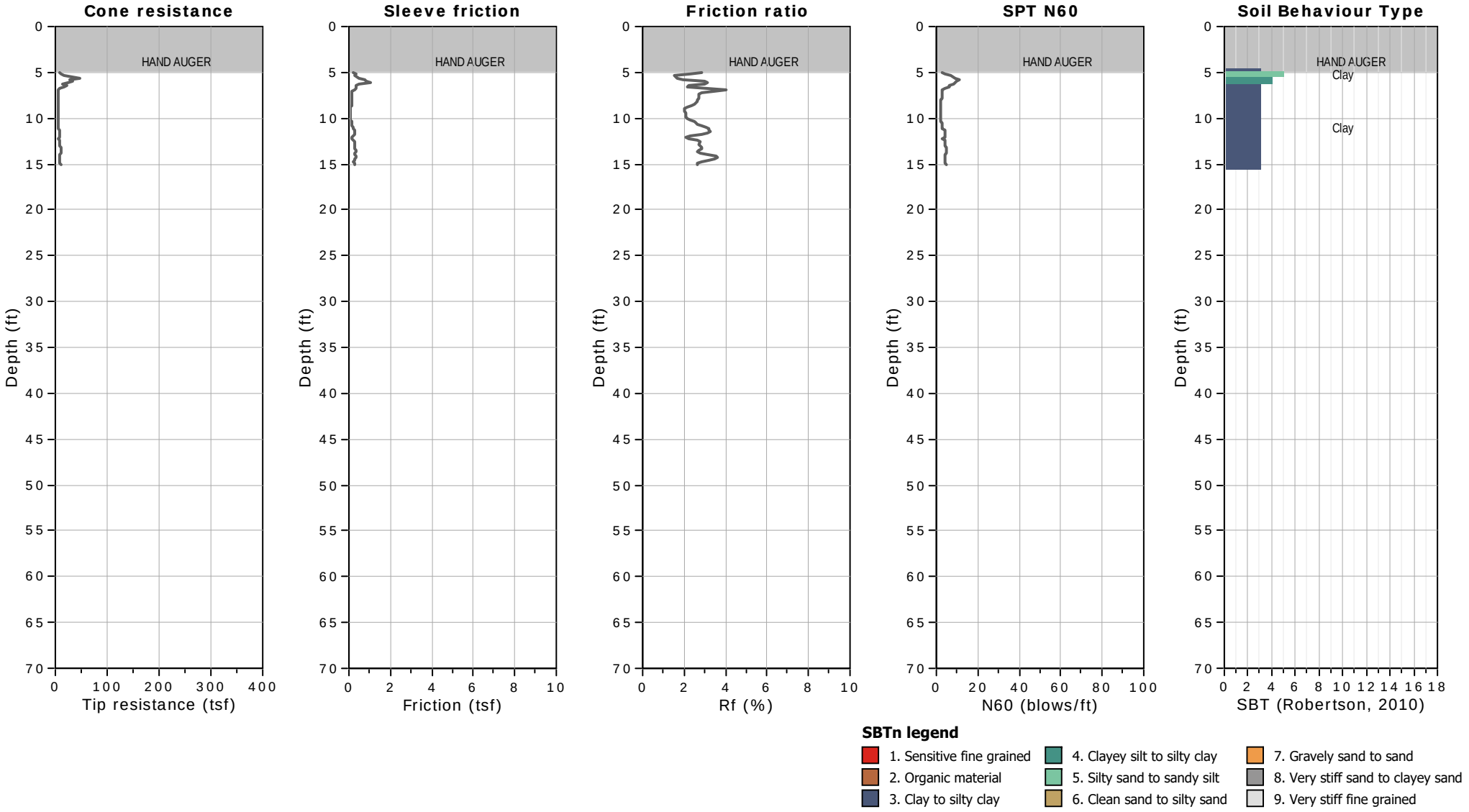
# CPT: CPT-08

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 15.09 ft, Date: 4/25/2018



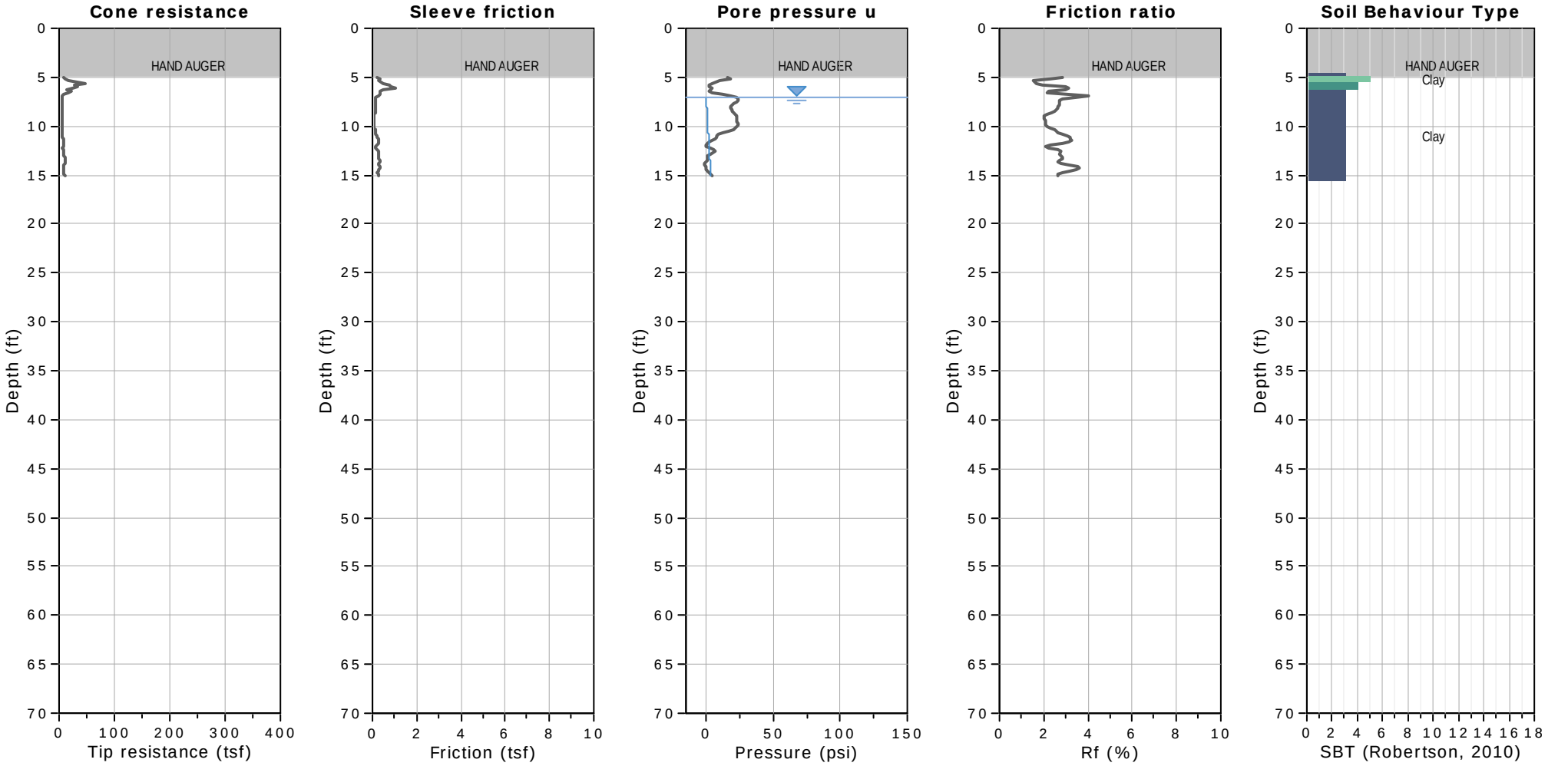
# CPT: CPT-08

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 15.09 ft, Date: 4/25/2018




**WATER TABLE FOR ESTIMATING PURPOSES ONLY**

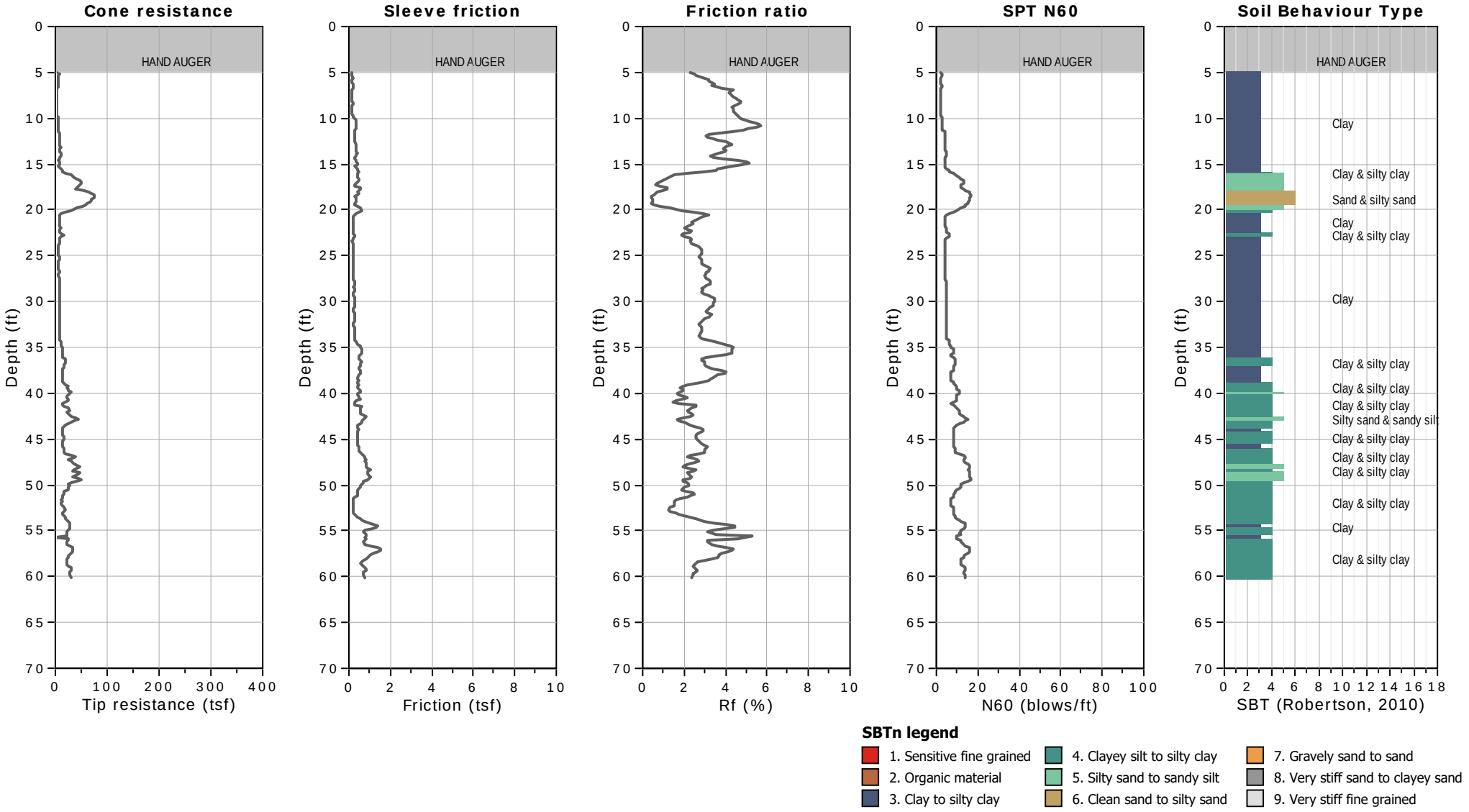
# CPT: CPT-09

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 60.04 ft, Date: 4/25/2018



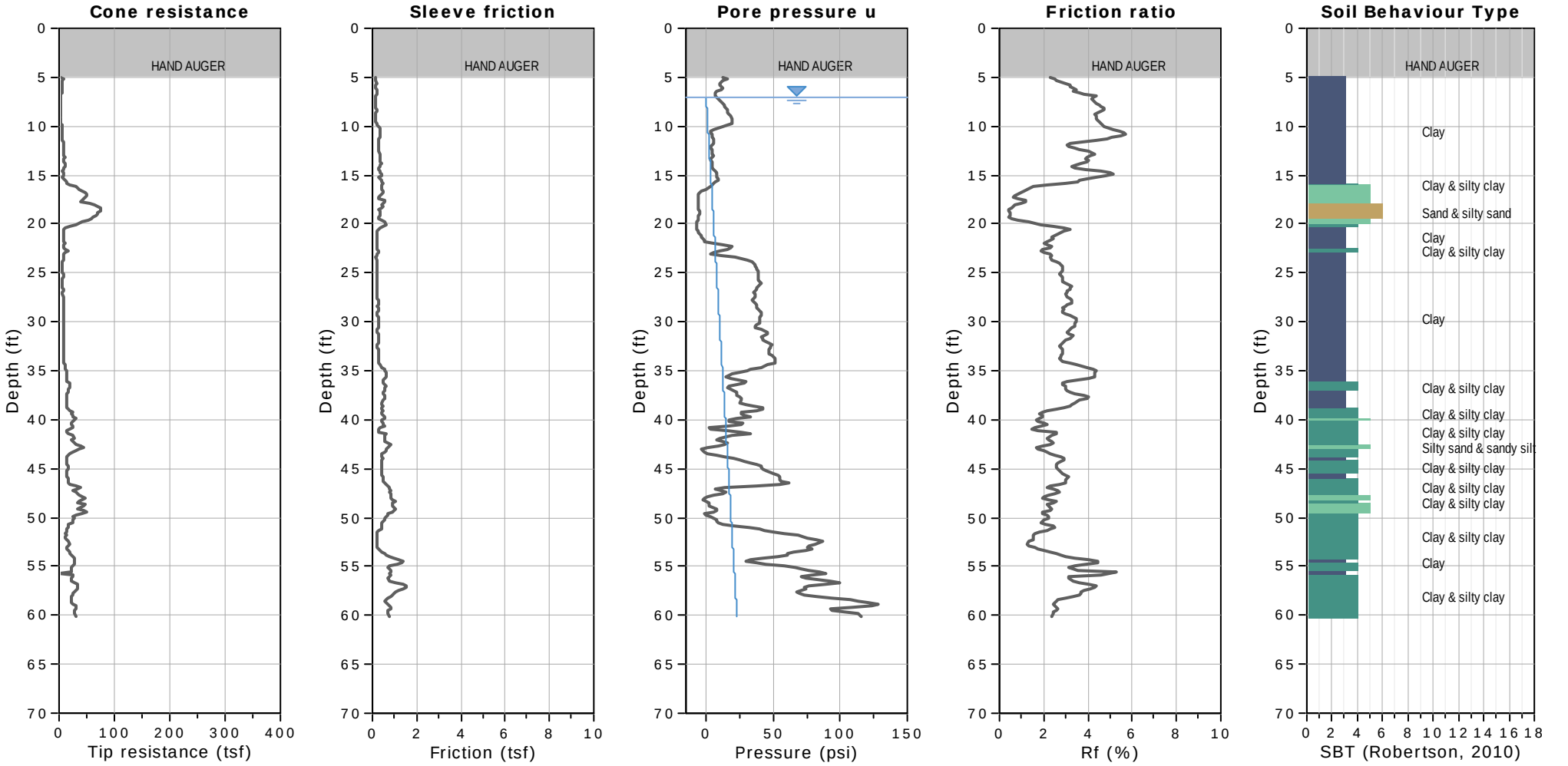
# CPT: CPT-09

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 60.04 ft, Date: 4/25/2018




**WATER TABLE FOR ESTIMATING PURPOSES ONLY**

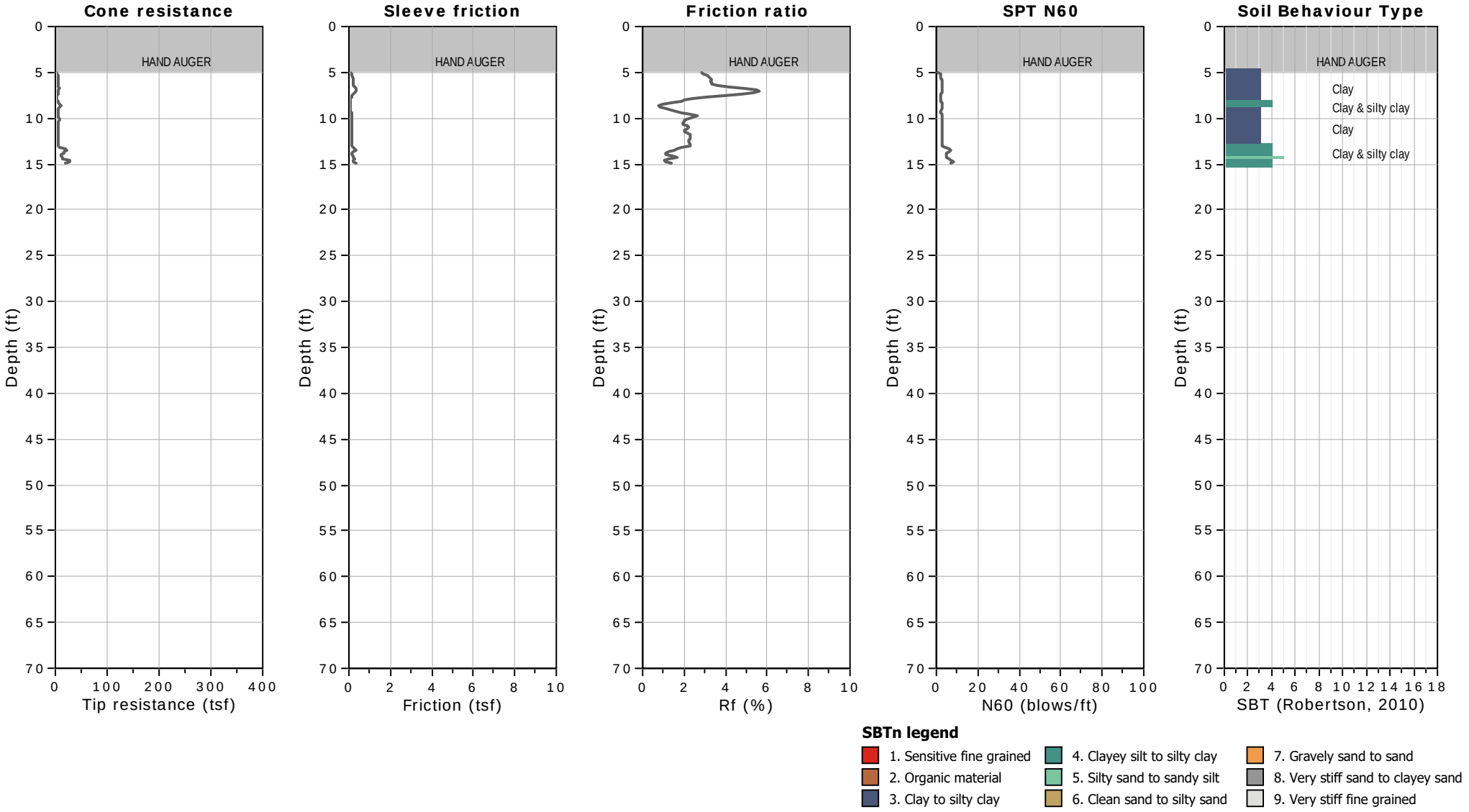
# CPT: CPT-10

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 14.93 ft, Date: 4/26/2018



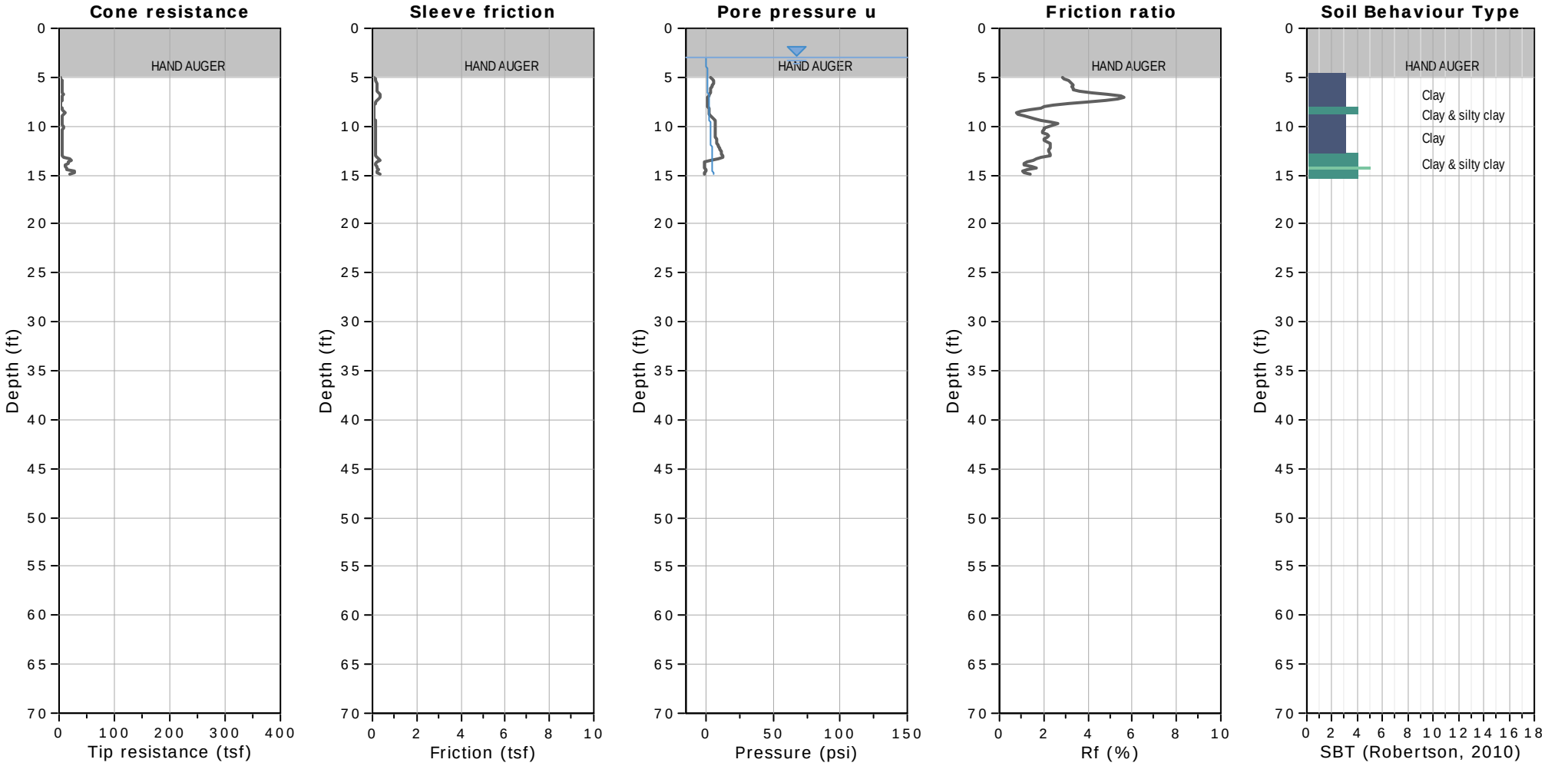
# CPT: CPT-10

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 14.93 ft, Date: 4/26/2018




**WATER TABLE FOR ESTIMATING PURPOSES ONLY**

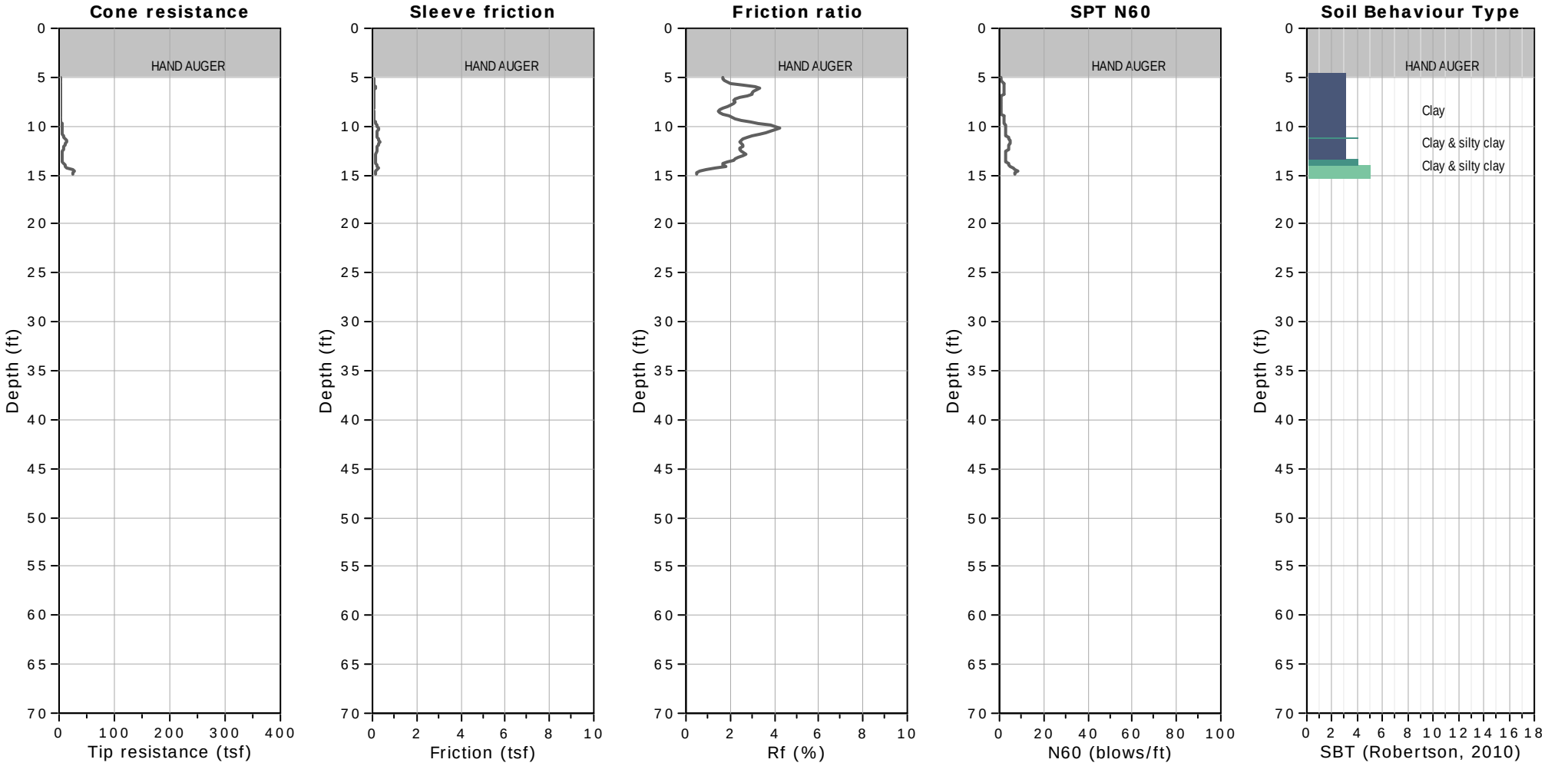
# CPT: CPT-11

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 14.93 ft, Date: 4/26/2018



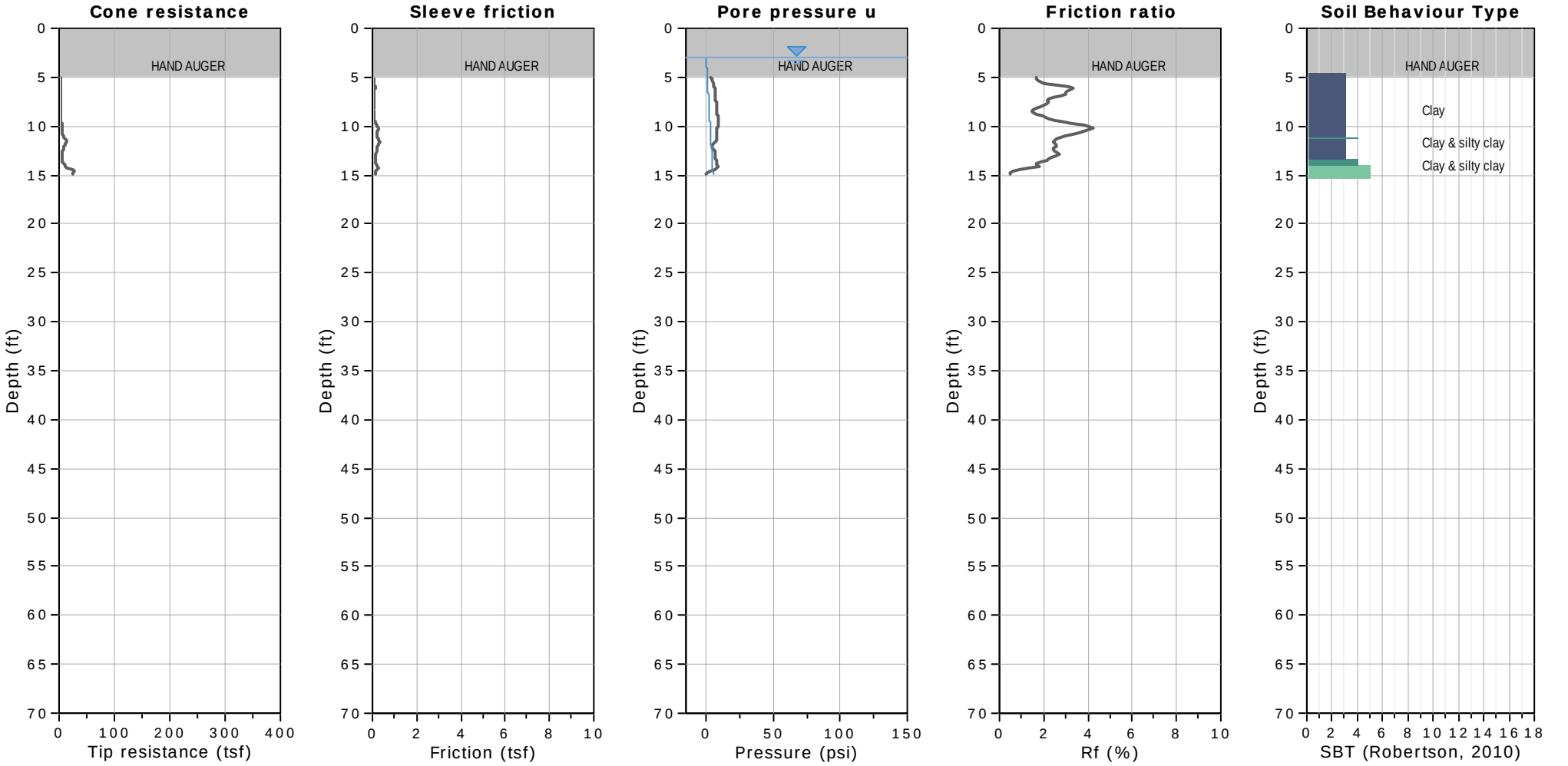
# CPT: CPT-11

**CLIENT: LACO**

**SITE: ARCATA WASTE WATER TREATMENT - ARCATA, CA**

**Field Rep: GARY MANHART**

Total depth: 14.93 ft, Date: 4/26/2018




**WATER TABLE FOR ESTIMATING PURPOSES ONLY**

# APPENDIX 3

## Laboratory Test Results

LACO

# MOISTURE / DENSITY
## ASTM D-2216 / 2937

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | LAB ID | 18-061EK | 1 of 1 |
| LOCATION | Arcata, California | TEST BY | CCR | DATE | 6/7/18 |
| SOIL TYPE | Various | CHECKED BY | CRGT | CHECK DATE | 6/26/2018 |

| **Sample Location** | GBH-4 | GBH-5 | GBH-7 | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sample Depth (ft bgs)** | 21ft | 2.5ft | 5ft | | | | | |
| **Soil Type (USCS)** | CL | SC | CL | | | | | |
| **Moisture Content (%)** | 23.7 | 7.6 | 72.7 | | | | | |
| **Wet Density (pcf)** | 137.6 | 141.3 | 101.8 | | | | | |
| **Dry Density (pcf)** | 111.3 | 131.3 | 59.0 | | | | | |
| **Void Ratio*** | 0.5 | 0.3 | 1.8 | | | | | |
| **% Saturation** | 128.3 | 76.8 | 106.4 | | | | | |
| | | | | | | | | |

*Void ratio calculation assumes a specific gravity of 2.65

**Unconfined compressive strength as measured with a pocket penetrometer. Average of three readings.

LACO

# MOISTURE / DENSITY
## ASTM D-2216 / 2937

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | LAB ID | 18-061EK | 1 of 1 |
| LOCATION | Arcata, California | TEST BY | CCR | DATE | 6/7/18 |
| SOIL TYPE | Various | CHECKED BY | CRGT | CHECK DATE | 6/26/2018 |

| **Sample Location** | GBH-1 | GBH-1 | GBH-4 | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sample Depth (ft bgs)** | 11ft | 15.5ft | 16ft | | | | | |
| **Soil Type (USCS)** | CL | SC | CL | | | | | |
| **Moisture Content (%)** | 28.4 | 26.9 | 17.1 | | | | | |
| **Wet Density (pcf)** | 124.8 | 129.7 | 141.8 | | | | | |
| **Dry Density (pcf)** | 97.2 | 102.2 | 121.1 | | | | | |
| **Void Ratio*** | 0.7 | 0.6 | 0.4 | | | | | |
| **% Saturation** | 107.0 | 114.8 | 123.3 | | | | | |
| | | | | | | | | |

*Void ratio calculation assumes a specific gravity of 2.65

**Unconfined compressive strength as measured with a pocket penetrometer. Average of three readings.

LACO

# FINER THAN #200 SIEVE
# ASTM C117/ASTM D-1140

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 1 of 2 |
| LOCATION | Arcata, California | TEST BY | CCR | DATE | 6/6/18 |
| SOIL TYPE | Various | CHECKED BY | CRGT | CHECK DATE | 6/26/2018 |

## GBH-2 @ 2.5ft

| | | | |
|---|---|---|---|
| (B) | Net sample (Dry) | 357.8 | gms |
| (C) | Dry sample after washing | 257.4 | gms |
| | Total Material finer than 200 sieve | 100.4 | gms |
| (A) | % Material finer than 200 sieve | **28.06%** | |
| | A=[(B-C)/B]X100 | | |

## GBH-2 @ 10ft

| | | | |
|---|---|---|---|
| (B) | Net sample (Dry) | 128.1 | gms |
| (C) | Dry sample after washing | 14.1 | gms |
| | Total Material finer than 200 sieve | 114.0 | gms |
| (A) | % Material finer than 200 sieve | **88.99%** | |
| | A=[(B-C)/B]X100 | | |

## GBH-2 @ 20ft

| | | | |
|---|---|---|---|
| (B) | Net sample (Dry) | 451.0 | gms |
| (C) | Dry sample after washing | 389.3 | gms |
| | Total Material finer than 200 sieve | 61.7 | gms |
| (A) | % Material finer than 200 sieve | **13.68%** | |
| | A=[(B-C)/B]X100 | | |

## GBH-2 @ 35ft

| | | | |
|---|---|---|---|
| (B) | Net sample (Dry) | 141.5 | gms |
| (C) | Dry sample after washing | 9.5 | gms |
| | Total Material finer than 200 sieve | 132.0 | gms |
| (A) | % Material finer than 200 sieve | **93.29%** | |
| | A=[(B-C)/B]X100 | | |

## GBH-2 @ 50ft

| | | | |
|---|---|---|---|
| (B) | Net sample (Dry) | 191.8 | gms |
| (C) | Dry sample after washing | 156.9 | gms |
| | Total Material finer than 200 sieve | 34.9 | gms |
| (A) | % Material finer than 200 sieve | **18.20%** | |
| | A=[(B-C)/B]X100 | | |

## GBH-5 @ 10.5ft

| | | | |
|---|---|---|---|
| (B) | Net sample (Dry) | 247.6 | gms |
| (C) | Dry sample after washing | 3.7 | gms |
| | Total Material finer than 200 sieve | 243.9 | gms |
| (A) | % Material finer than 200 sieve | **98.51%** | |
| | A=[(B-C)/B]X100 | | |

## GBH-5 @ 15.5ft

| | | | |
|---|---|---|---|
| (B) | Net sample (Dry) | 375.0 | gms |
| (C) | Dry sample after washing | 9.3 | gms |
| | Total Material finer than 200 sieve | 365.7 | gms |
| (A) | % Material finer than 200 sieve | **97.52%** | |
| | A=[(B-C)/B]X100 | | |

## GBH-5 @ 20ft

| | | | |
|---|---|---|---|
| (B) | Net sample (Dry) | 208.6 | gms |
| (C) | Dry sample after washing | 193.9 | gms |
| | Total Material finer than 200 sieve | 14.7 | gms |
| (A) | % Material finer than 200 sieve | **7.05%** | |
| | A=[(B-C)/B]X100 | | |

LACO

# FINER THAN #200 SIEVE
# ASTM C117/ASTM D-1140

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 2 of 2 |
| LOCATION | Arcata, California | TEST BY | CCR | DATE | 6/6/18 |
| SOIL TYPE | Various | CHECKED BY | CRGT | CHECK DATE | 6/26/2018 |

## GBH-5 @ 30ft

| | | | |
|---|---|---|---|
| (B) | Net sample (Dry) | 141.7 | gms |
| (C) | Dry sample after washing | 57.5 | gms |
| | Total Material finer than 200 sieve | 84.2 | gms |
| (A) | % Material finer than 200 sieve | **59.42%** | |
| | A=[(B-C)/B]X100 | | |

## GBH-5 @ 31ft

| | | | |
|---|---|---|---|
| (B) | Net sample (Dry) | 250.0 | gms |
| (C) | Dry sample after washing | 11.2 | gms |
| | Total Material finer than 200 sieve | 238.8 | gms |
| (A) | % Material finer than 200 sieve | **95.52%** | |
| | A=[(B-C)/B]X100 | | |

## GBH-5 @ 35ft

| | | | |
|---|---|---|---|
| (B) | Net sample (Dry) | 91.7 | gms |
| (C) | Dry sample after washing | 0.2 | gms |
| | Total Material finer than 200 sieve | 91.5 | gms |
| (A) | % Material finer than 200 sieve | **99.78%** | |
| | A=[(B-C)/B]X100 | | |

## GBH-5 @ 40ft

| | | | |
|---|---|---|---|
| (B) | Net sample (Dry) | 185.2 | gms |
| (C) | Dry sample after washing | 74.3 | gms |
| | Total Material finer than 200 sieve | 110.9 | gms |
| (A) | % Material finer than 200 sieve | **59.88%** | |
| | A=[(B-C)/B]X100 | | |

## GBH-5 @ 40.5ft

| | | | |
|---|---|---|---|
| (B) | Net sample (Dry) | 297.6 | gms |
| (C) | Dry sample after washing | 21.8 | gms |
| | Total Material finer than 200 sieve | 275.8 | gms |
| (A) | % Material finer than 200 sieve | **92.67%** | |
| | A=[(B-C)/B]X100 | | |

## GBH-5 @ 45.5ft

| | | | |
|---|---|---|---|
| (B) | Net sample (Dry) | 141.0 | gms |
| (C) | Dry sample after washing | 126.1 | gms |
| | Total Material finer than 200 sieve | 14.9 | gms |
| (A) | % Material finer than 200 sieve | **10.57%** | |
| | A=[(B-C)/B]X100 | | |

## GBH-5 @ 51ft

| | | | |
|---|---|---|---|
| (B) | Net sample (Dry) | 650.3 | gms |
| (C) | Dry sample after washing | 330.7 | gms |
| | Total Material finer than 200 sieve | 319.6 | gms |
| (A) | % Material finer than 200 sieve | **49.15%** | |
| | A=[(B-C)/B]X100 | | |

LACO

**ATTERBERG LIMITS**
**ASTM D-4318**

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID 18-061EK | 1 of 1 |
| LOCATION | GBH-2 at 20ft | TEST BY | CCR | DATE | 6/18/18 |
| SOIL TYPE | N/A | CHECKED BY | CCR | CHECK DATE | 6/18/18 |

## ASTM D4318 ATTERBERG LIMITS

**LIQUID LIMIT =** ***N/A**
**PLASTIC LIMIT =** **N/A**
**PLASTIC INDEX =** **NON PLASTIC**

**COMMENTS:** Unable to cut groove without tearing or keep from sliding in cup.

* PER ASTM D4318 SECTION 11.4, LIQUID LIMIT COULD NOT BE DETERMINED.

SAMPLE CLASSIFIED AS NON PLASTIC.

# ATTERBERG LIMITS
## ASTM D-4318

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 1 of 1 |
| LOCATION | GBH-2 at 35ft | TEST BY | CCR | DATE | 7/5/2018 |
| SOIL TYPE | CL-ML | CHECKED BY | CRGT | CHECK DATE | 7/11/2018 |

| | Point 1 | Point 2 | Point 3 |
|---|---|---|---|
| Tare + Wet Soil (gm) | 45.13 | 46.87 | 45.31 |
| Tare + Dry Soil (gm) | 38.58 | 39.51 | 37.98 |
| Water (gm) | 6.55 | 7.36 | 7.33 |
| Tare (gm) | 8.56 | 8.52 | 8.43 |
| Dry Soil (gm) | 30.02 | 30.99 | 29.55 |
| Water Content (%) | **22%** | **24%** | **25%** |
| * Number of Blows | **34** | **25** | **17** |

* Groove closure = 13mm

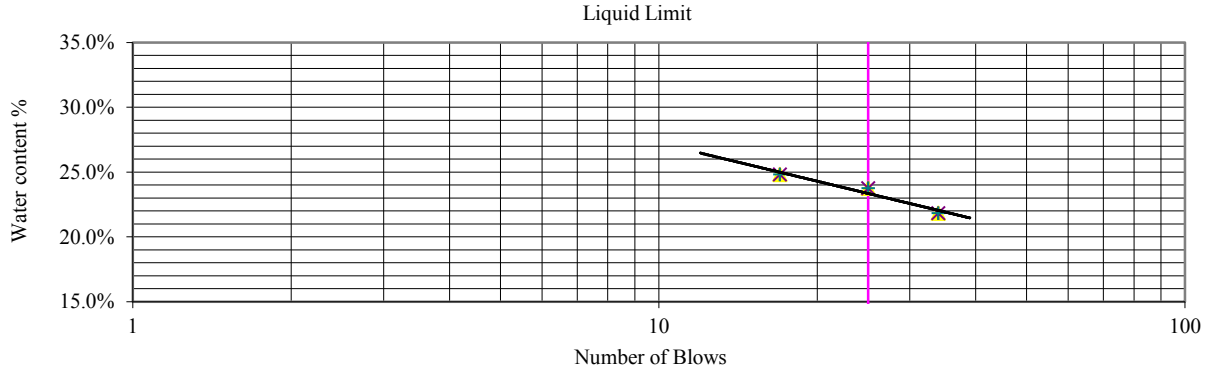
**PLASTIC LIMIT**

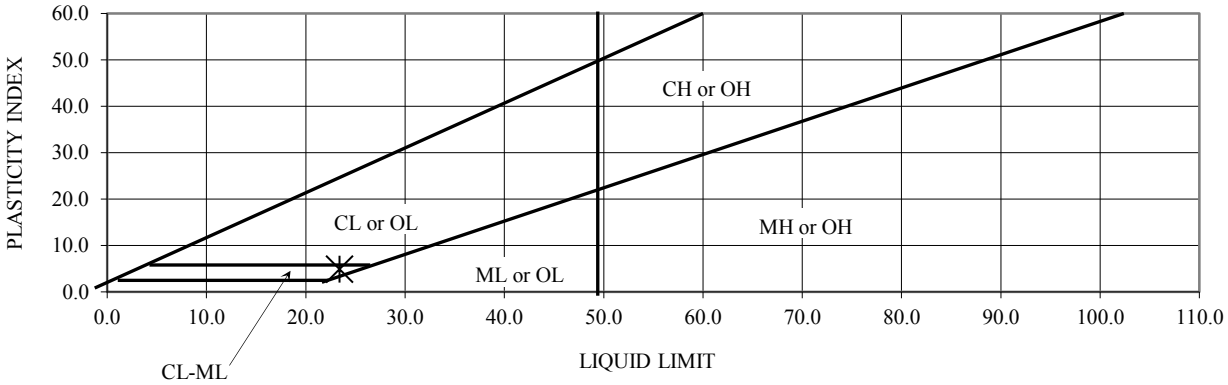
| Run 1 | Run 2 | Run 3 |
|---|---|---|
| 20.45 | 20.14 | |
| 18.56 | 18.36 | |
| 1.89 | 1.78 | |
| 8.51 | 8.62 | |
| 10.05 | 9.74 | |
| **19%** | **18%** | |

**LIQUID LIMIT =** **23.4**

**PLASTIC LIMIT =** **18.5**

**PLASTIC INDEX =** **4.9**




P:\7900\7986 Carollo Engineers\7986.01 Arcata Wastewater Treatment Facility Design\07 Material Testing\Lab Tests\7986.01 Atterberg Limits GBH-2 @ 35ft 18-061EK

LACO

**ATTERBERG LIMITS**
**ASTM D-4318**

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID 18-061SR | 1 of 1 |
| LOCATION | GBH-2 at 50ft | TEST BY | BC | DATE | 6/18/18 |
| SOIL TYPE | N/A | CHECKED BY | BC | CHECK DATE | 6/18/18 |

## ASTM D4318 ATTERBERG LIMITS

**LIQUID LIMIT =** ***N/A**
**PLASTIC LIMIT =** **N/A**
**PLASTIC INDEX =** **NON PLASTIC**

**COMMENTS:** Unable to cut groove without tearing or keep from sliding in cup.

* PER ASTM D4318 SECTION 11.4, LIQUID LIMIT COULD NOT BE DETERMINED.

SAMPLE CLASSIFIED AS NON PLASTIC.

LACO

**ATTERBERG LIMITS**
**ASTM D-4318**

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID 18-061EK | 1 of 1 |
| LOCATION | GBH-5 at 20ft | TEST BY | CCR | DATE | 6/18/18 |
| SOIL TYPE | N/A | CHECKED BY | CCR | CHECK DATE | 6/18/18 |

## ASTM D4318 ATTERBERG LIMITS

**LIQUID LIMIT =** ***N/A**
**PLASTIC LIMIT =** **N/A**
**PLASTIC INDEX =** **NON PLASTIC**

**COMMENTS:** Unable to cut groove without tearing or keep from sliding in cup.

* PER ASTM D4318 SECTION 11.4, LIQUID LIMIT COULD NOT BE DETERMINED.

SAMPLE CLASSIFIED AS NON PLASTIC.

# ATTERBERG LIMITS
## ASTM D-4318

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | 18-061EK | 1 of 1 |
| LOCATION | GBH-5 at 35' | TEST BY | CCR | DATE | 7/5/2018 | |
| SOIL TYPE | High Plasticity Silt | CHECKED BY | CRGT | CHECK DATE | 7/11/2018 | |

| | Point 1 | Point 2 | Point 3 |
|---|---|---|---|
| Tare + Wet Soil (gm) | 37.66 | 39.39 | 35.66 |
| Tare + Dry Soil (gm) | 26.60 | 27.60 | 24.99 |
| Water (gm) | 11.06 | 11.79 | 10.67 |
| Tare (gm) | 8.46 | 8.80 | 8.57 |
| Dry Soil (gm) | 18.14 | 18.80 | 16.42 |
| Water Content (%) | **61%** | **63%** | **65%** |
| * Number of Blows | **28** | **22** | **17** |

* Groove closure = 13mm

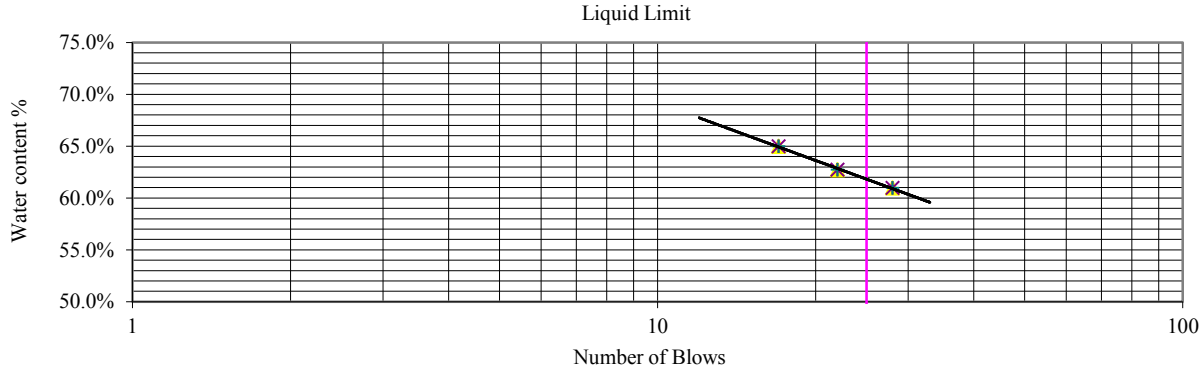
**PLASTIC LIMIT**

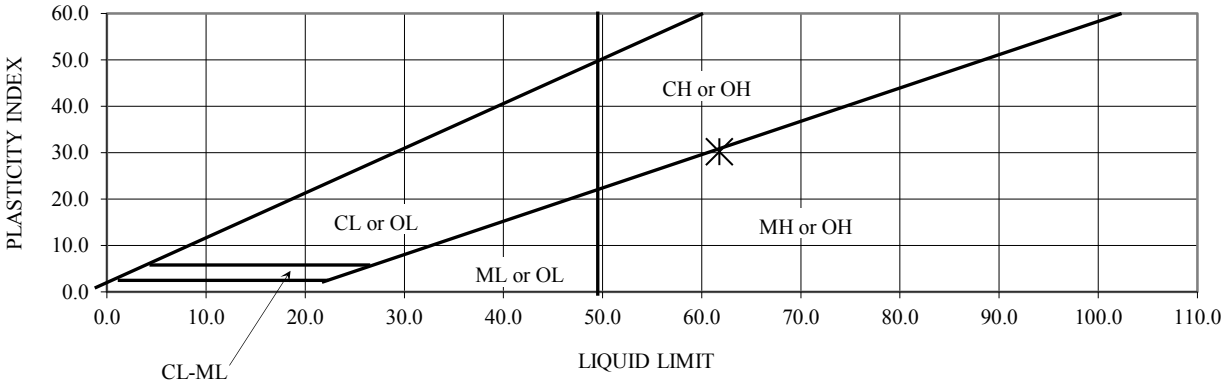
| Run 1 | Run 2 | Run 3 |
|---|---|---|
| 19.05 | 18.51 | |
| 16.53 | 16.12 | |
| 2.52 | 2.39 | |
| 8.62 | 8.49 | |
| 7.91 | 7.63 | |
| **32%** | **31%** | |

**LIQUID LIMIT =** **61.8**

**PLASTIC LIMIT =** **31.6**

**PLASTIC INDEX =** **30.2**




P:\7900\7986 Carollo Engineers\7986.01 Arcata Wastewater Treatment Facility Design\07 Material Testing\Lab Tests\7986.01 Atterberg Limits GBH-5 @ 35ft 18-061EK

LACO

**ATTERBERG LIMITS**
**ASTM D-4318**

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID 18-061EK | 1 of 1 |
| LOCATION | GBH-5 at 45.5ft | TEST BY | CCR | DATE | 6/18/18 |
| SOIL TYPE | N/A | CHECKED BY | CCR | CHECK DATE | 6/18/18 |

## ASTM D4318 ATTERBERG LIMITS

**LIQUID LIMIT =** ***N/A**
**PLASTIC LIMIT =** **N/A**
**PLASTIC INDEX =** **NON PLASTIC**

**COMMENTS:** Unable to cut groove without tearing or keep from sliding in cup.

* PER ASTM D4318 SECTION 11.4, LIQUID LIMIT COULD NOT BE DETERMINED.

SAMPLE CLASSIFIED AS NON PLASTIC.

# ATTERBERG LIMITS
## ASTM D-4318

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | 18-061SR | 1 of 1 |
| LOCATION | GBH-6 at 4.5' | TEST BY | BC | DATE | 7/5/2018 | |
| SOIL TYPE | Clayey Sand | CHECKED BY | CRGT | CHECK DATE | 7/11/2018 | |

| | Point 1 | Point 2 | Point 3 |
|---|---|---|---|
| Tare + Wet Soil (gm) | 24.92 | 25.20 | 25.41 |
| Tare + Dry Soil (gm) | 22.18 | 22.30 | 22.45 |
| Water (gm) | 2.74 | 2.90 | 2.96 |
| Tare (gm) | 13.47 | 13.34 | 13.38 |
| Dry Soil (gm) | 8.71 | 8.96 | 9.07 |
| Water Content (%) | **31%** | **32%** | **33%** |
| * Number of Blows | **33** | **21** | **17** |

* Groove closure = 13mm

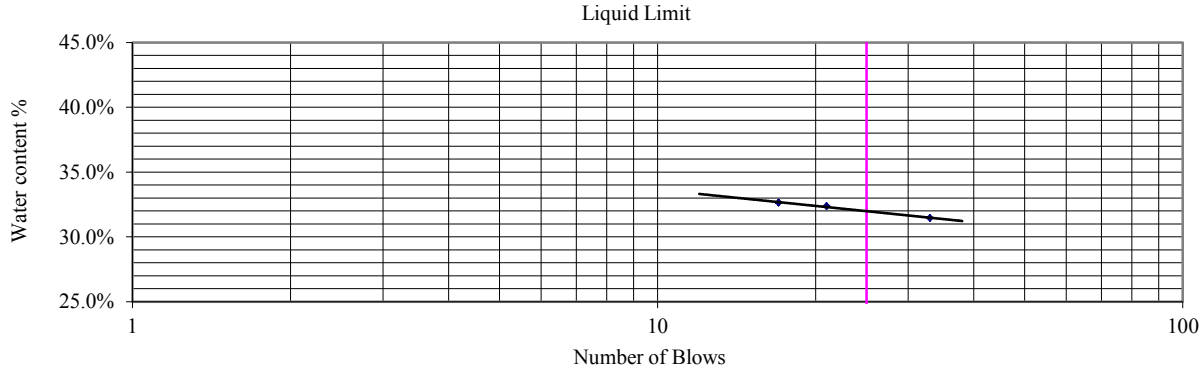
**PLASTIC LIMIT**

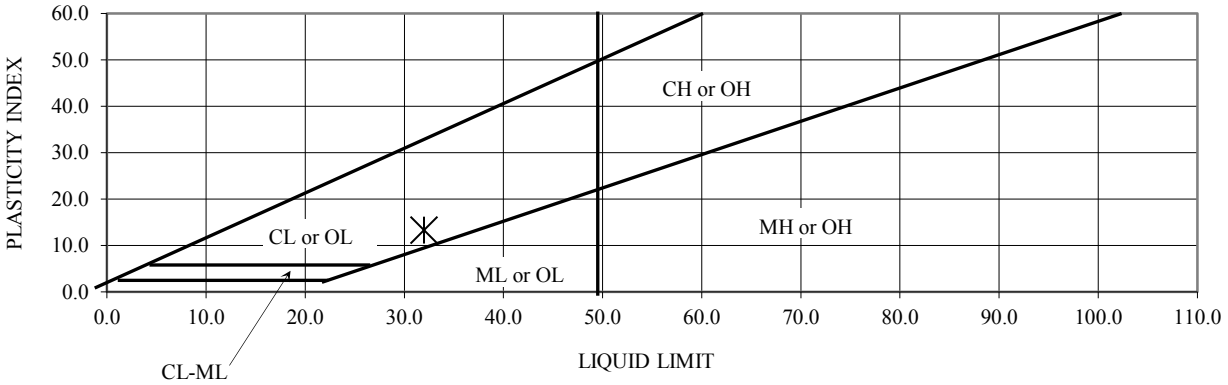
| Run 1 | Run 2 | Run 3 |
|---|---|---|
| 13.46 | 13.25 | |
| 12.49 | 12.33 | |
| 0.97 | 0.92 | |
| 7.28 | 7.45 | |
| 5.21 | 4.88 | |
| **19%** | **19%** | |

**LIQUID LIMIT =** **32.0**

**PLASTIC LIMIT =** **18.7**

**PLASTIC INDEX =** **13.3**



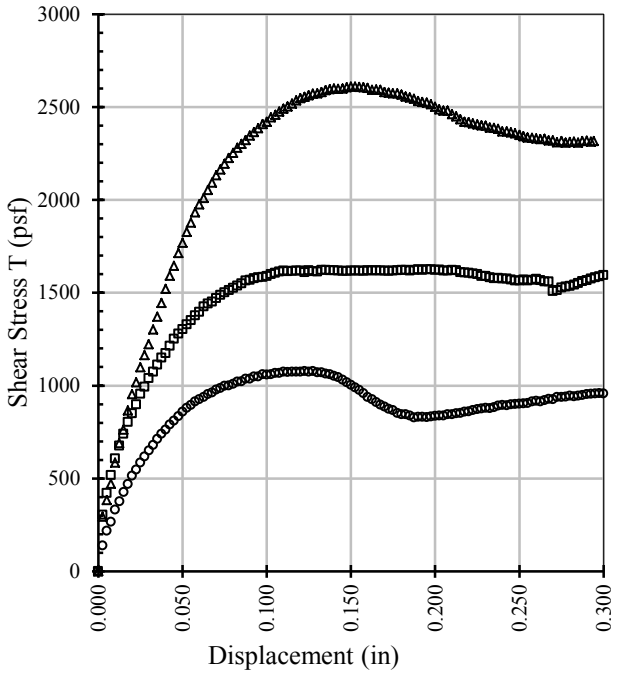




P:\7900\7986 Carollo Engineers\7986.01 Arcata Wastewater Treatment Facility Design\07 Material Testing\Lab Tests\7986.01 Atterberg Limits GBH-6 @ 4.5ft SR

# DIRECT SHEAR
## ASTM D-3080

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 1 of 1 |
| LOCATION | GHB2 at 20' | TEST BY | DLR | DATE | 6/19/18 |
| SOIL TYPE | Poorly Graded Sand with Clay | CHECKED BY | CRGT | CHECK DATE | 6/26/2018 |

### Shear Stress -vs- Displacement




### Sample Dimensions

| | |
|---|---|
| Diameter (inch) | 2.5 |
| Height (inch) | 1.0 |

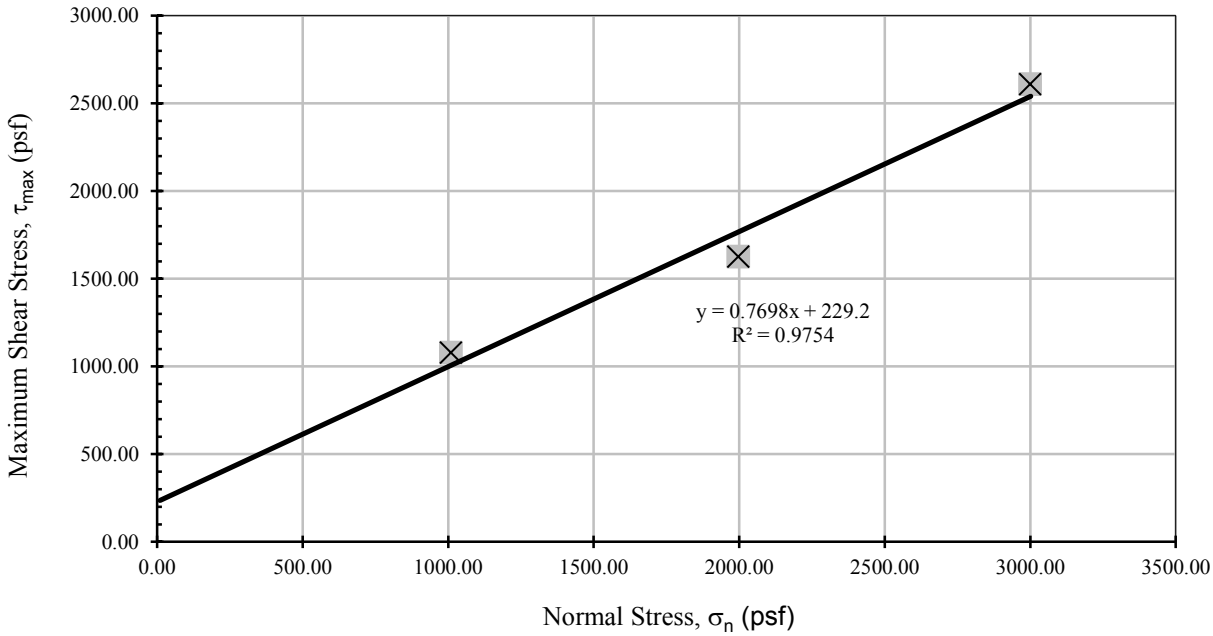
| | Point 1 | Point 2 | Point 3 | Average |
|---|---|---|---|---|
| Water Content (%) | 29.1 | 24.8 | 19.4 | 24.5 |
| Dry Density (pcf) | 93.7 | 96.6 | 98.2 | 96.2 |
| Void Ratio* | 0.8 | 0.7 | 0.7 | 0.7 |
| Peak Shear Stress (psf) | 1077.3 | 1626.1 | 2608.8 | |

*Void ratio calculation assumes a specific gravity of 2.65

| | |
|---|---|
| c - intercept (cohesion) | 229 |
| phi (internal friction angle) | 37.6° |

**Notes:** 0

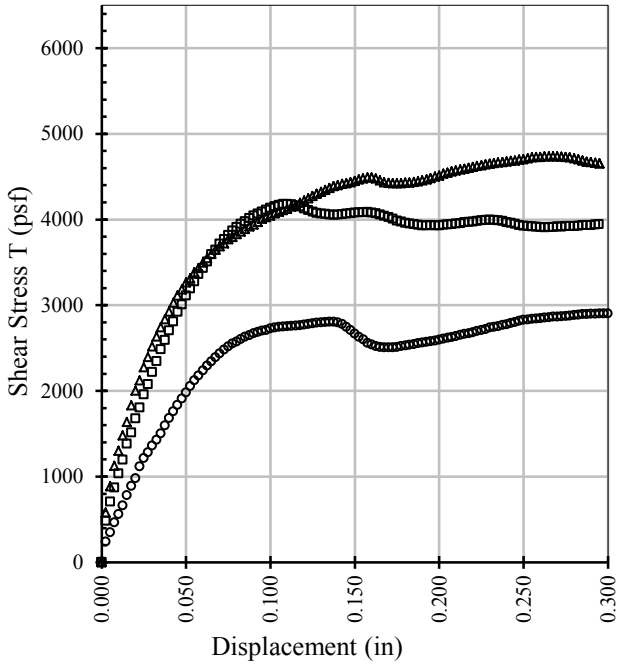
### Maximum Shear Stress -vs- Normal Stress



# DIRECT SHEAR
# ASTM D-3080

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 1 of 1 |
| LOCATION | GBH2 at 35' | TEST BY | DLR | DATE | 6/22/18 |
| SOIL TYPE | Clayey Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/2018 |

## Shear Stress -vs- Displacement




### Sample Dimensions

| | |
|---|---|
| Diameter (inch) | 2.5 |
| Height (inch) | 1.0 |

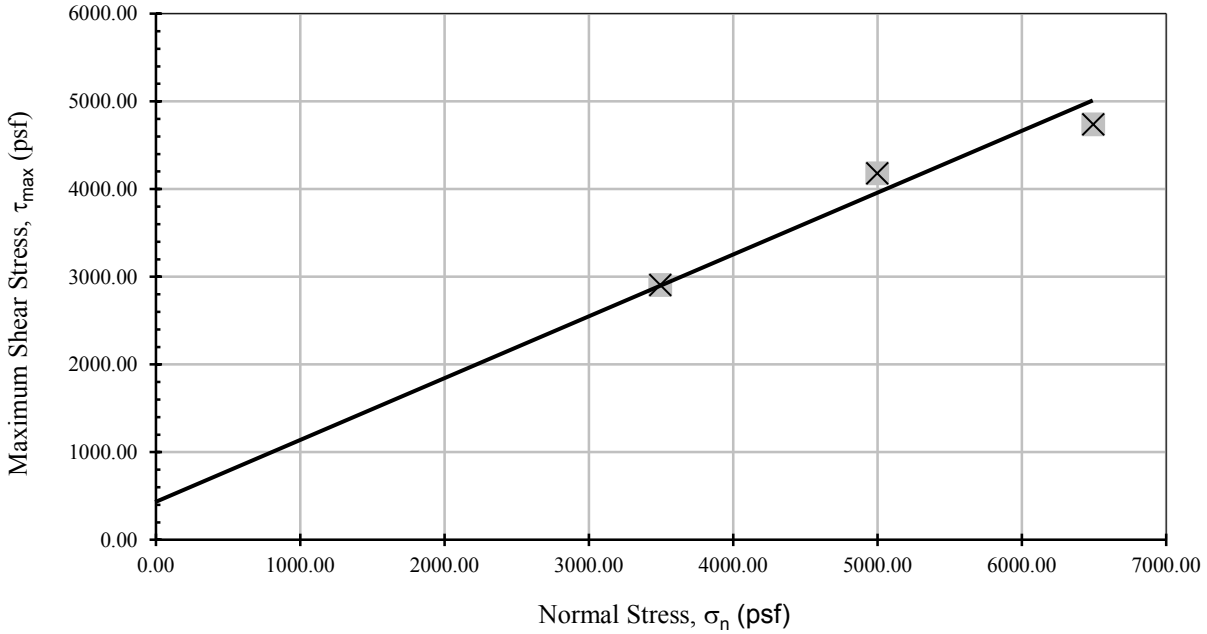
| | Point 1 | Point 2 | Point 3 | Average |
|---|---|---|---|---|
| Water Content (%) | 19.2 | 19.5 | 23.1 | 20.6 |
| Dry Density (pcf) | 100.3 | 99.8 | 101.5 | 100.5 |
| Void Ratio* | 0.7 | 0.7 | 0.6 | 0.6 |
| Peak Shear Stress (psf) | 2902.9 | 4178.8 | 4736.8 | |

*Void ratio calculation assumes a specific gravity of 2.65

| | |
|---|---|
| c - intercept (cohesion) | 400 |
| phi (internal friction angle) | 35° |

**Notes:** UNDISTURBED SHELBY

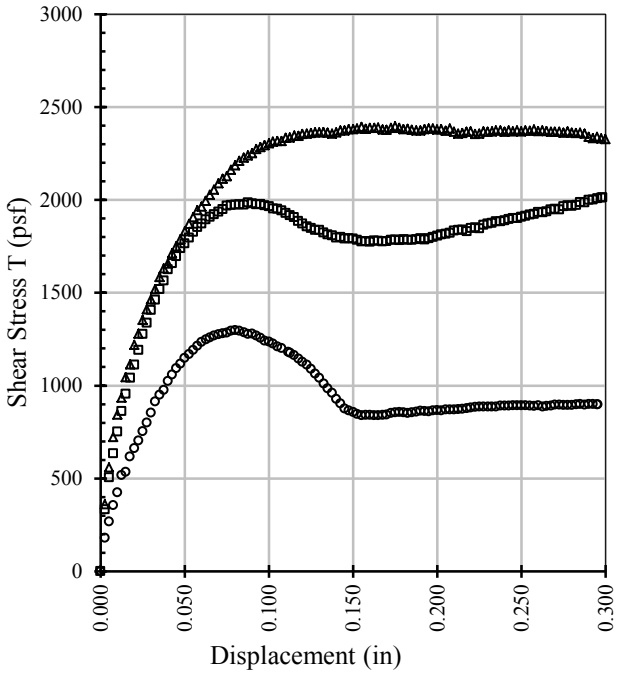
## Maximum Shear Stress -vs- Normal Stress



# DIRECT SHEAR
# ASTM D-3080

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 1 of 1 |
| LOCATION | GHB5 at 20' | TEST BY | DLR | DATE | 6/22/2018 |
| SOIL TYPE | Poorly Graded Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/2018 |

## Shear Stress -vs- Displacement




### Sample Dimensions

| | |
|---|---|
| Diameter (inch) | 2.5 |
| Height (inch) | 1.0 |

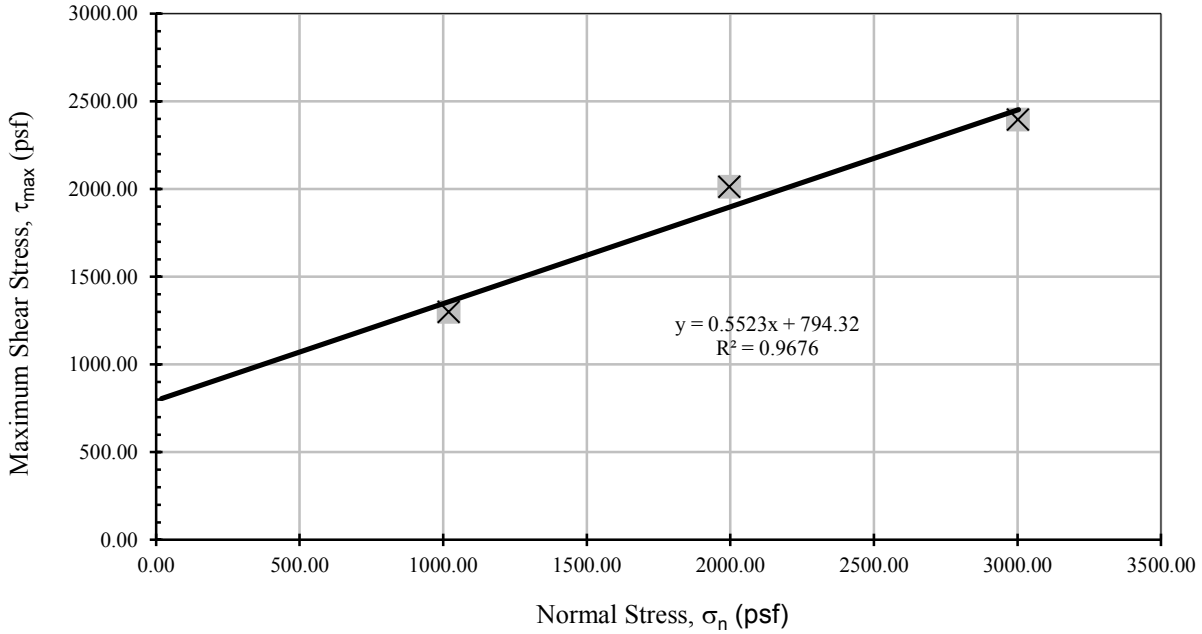
| | Point 1 | Point 2 | Point 3 | Average |
|---|---|---|---|---|
| Water Content (%) | 19.7 | 21.1 | 22.0 | 21.0 |
| Dry Density (pcf) | 94.4 | 96.2 | 90.0 | 93.5 |
| Void Ratio* | 0.8 | 0.7 | 0.8 | 0.8 |
| Peak Shear Stress (psf) | 1298.9 | 2013.1 | 2395.5 | |

*Void ratio calculation assumes a specific gravity of 2.65

| | |
|---|---|
| c - intercept (cohesion) | 794 |
| phi (internal friction angle) | 28.9° |

**Notes:** SAMPLE WAS DEWATERED DURING EXTRUDING

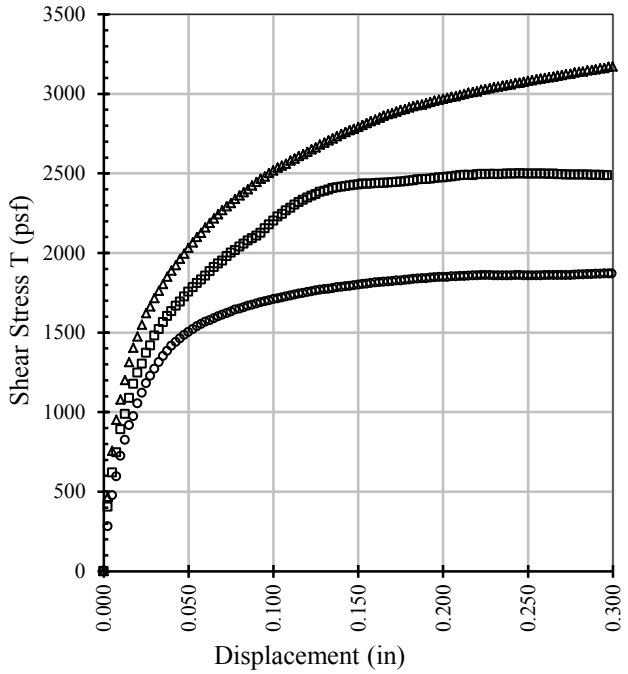
## Maximum Shear Stress -vs- Normal Stress



# DIRECT SHEAR
# ASTM D-3080

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 1 of 1 |
| LOCATION | GBH5 at 35' | TEST BY | DLR | DATE | 6/20/18 |
| SOIL TYPE | CLAY | CHECKED BY | CRGT | CHECK DATE | 6/26/2018 |

## Shear Stress -vs- Displacement




## Sample Dimensions

| | |
|---|---|
| Diameter (inch) | 2.5 |
| Height (inch) | 1.0 |

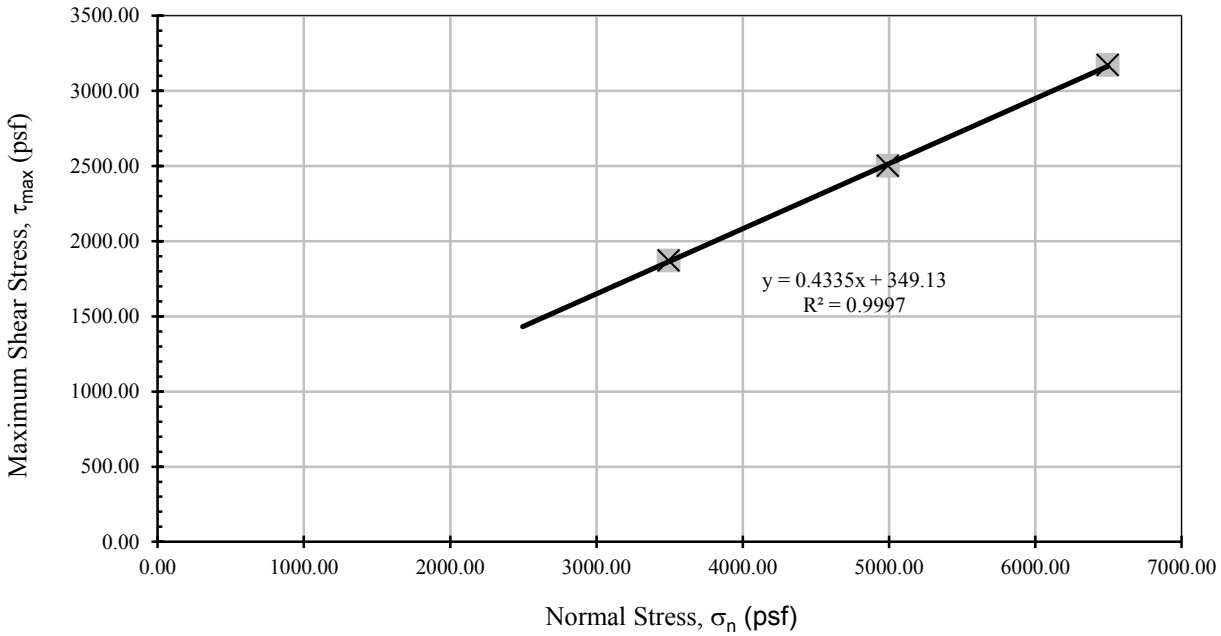
| | Point 1 | Point 2 | Point 3 | Average |
|---|---|---|---|---|
| Water Content (%) | 51.6 | 50.7 | 51.4 | 51.2 |
| Dry Density (pcf) | 68.6 | 68.9 | 69.8 | 69.1 |
| Void Ratio* | 1.4 | 1.4 | 1.4 | 1.4 |
| Peak Shear Stress (psf) | 1870.6 | 2500.3 | 3171.3 | |

*Void ratio calculation assumes a specific gravity of 2.65

| | |
|---|---|
| c - intercept (cohesion) | 349 |
| phi (internal friction angle) | 23.4° |

**Notes:** UNDISTURBED SHELBY

## Maximum Shear Stress -vs- Normal Stress



LACO

# CONSOLIDATION TEST
## ASTM D-2435

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 1 of 10 |
| LOCATION | GBH2 at 5.0' | TEST BY | DLR | DATE | 6/19/2018 |
| SOIL TYPE | Lean Clay | CHECKED BY | CRGT | CHECK DATE | 6/25/2018 |

| | | |
|---|---|---|
| Diameter of Sample | 6.35 | cm |
| Area of Sample | 31.7 | $cm^2$ |
| Density of Water $\rho_w$ | 1 | $gram/cm^3$ |
| Specific Gravity of Solids G | 2.65 | $gram/cm^3$ |

**PRECONSOLIDATION**

| | | |
|---|---|---|
| Initial Specimen Height $H_0$ | 2.53 | cm |
| **Water Content** | | |
| Wet soil + pan | 212.0 | gram |
| Dry soil + pan | 129.9 | gram |
| Pan | 8.6 | gram |
| Total water | 82.1 | gram |
| Dry soil | 121.3 | gram |
| Water Content $W_{fp}$ | 67.7% | |
| **Moisture Density** | | |
| Wet soil + consol assembly | 1111.8 | gram |
| Consol assembly | 986.7 | gram |
| Moist Mass of Specimen $M_{TI}$ | 125.1 | gram |
| Initial Volume of Sample $V_o$ | 80.1 | $cm^3$ |
| Wet Density | 1.6 | $gram/cm^3$ |
| Dry Mass of Specimen $M_d$ | 74.6 | grams |
| Initial Dry Density $\rho_d$ | 0.9 | $gram/cm^3$ |
| Dry Unit Weight | 58.1 | $lb/ft^3$ |
| Volume of Solids $V_s$ | 28.2 | $cm^3$ |
| Equivalent Height of Solids $H_s$ | 0.89 | cm |
| Void Ratio Before Test $e_o$ | 1.85 | |
| Initial Degree of Saturation $S_o$ | 97.2% | |

**POSTCONSOLIDATION**

| | | |
|---|---|---|
| Final Speciment Height $H_f$ | 2.53 | cm |
| **Water Content** | | |
| Wet soil + pan | 112.8 | gram |
| Dry soil + pan | 82.4 | gram |
| Pan | 8.5 | gram |
| Total water | 30.4 | gram |
| Dry soil | 73.9 | gram |
| Water Content $W_{fp}$ | 41.1% | |
| **Moisture Density** | | |
| Wet soil + consol assembly | 1091.1 | gram |
| Consol assembly | 986.7 | gram |
| Moist Mass of Specimen $M_{Tf}$ | 104.4 | gram |
| Final Volume of Sample $V_f$ | 80.1 | $cm^3$ |
| Wet Density | 1.3 | $gram/cm^3$ |
| Dry Mass of Specimen $M_d$ | 74.0 | grams |
| Final Dry Density | 0.9 | $gram/cm^3$ |
| Final Dry Unit Wieght | 57.6 | $lb/ft^3$ |
| Volume of Solids $V_s$ | 27.9 | $cm^3$ |
| Equivalent Height of Solids $H_s$ | 0.88 | cm |
| Void Ratio After Test $e_f$ | 1.87 | |
| Final Degree of Saturation Sf | 58.3% | |

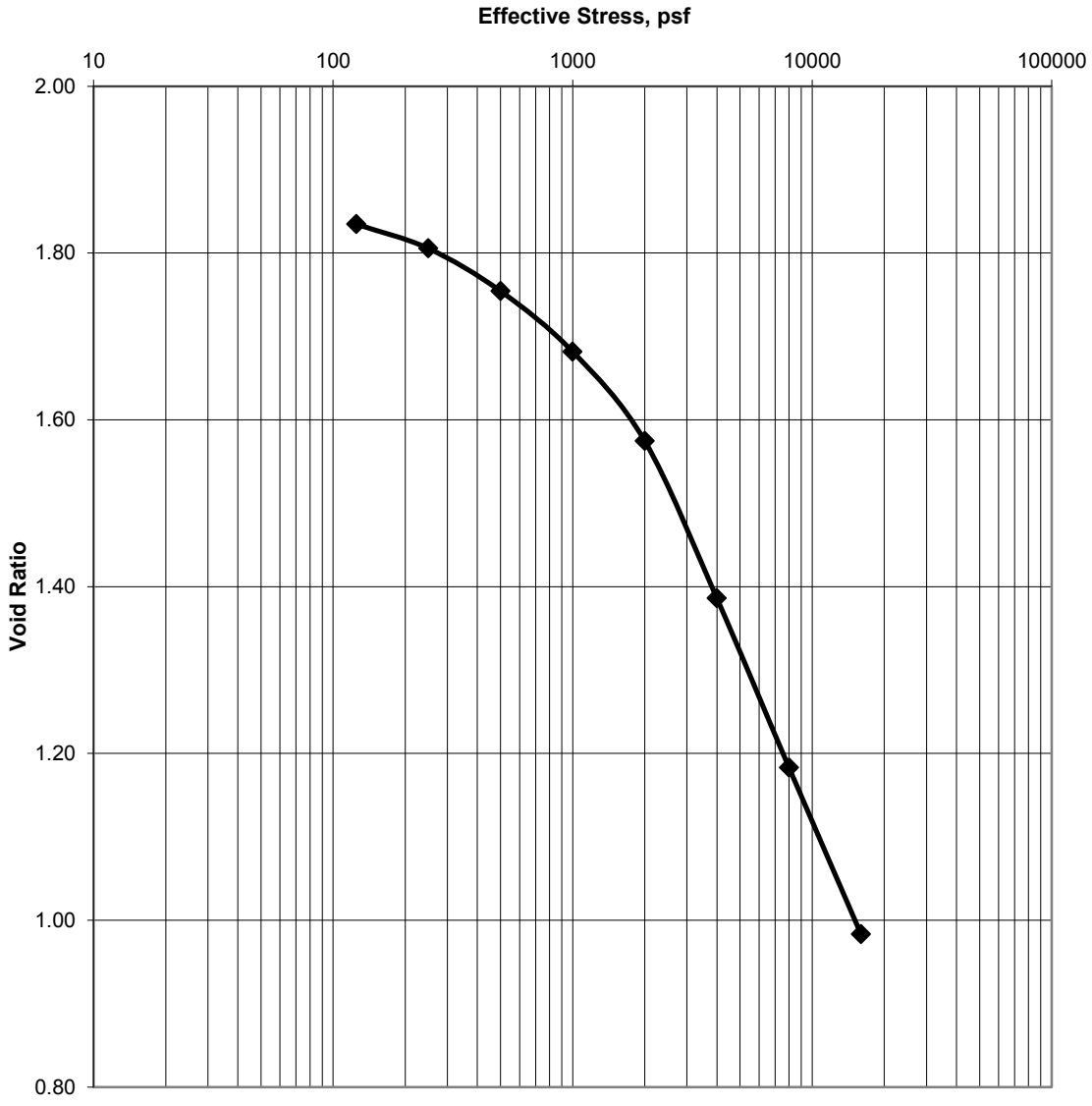
| Load Increment | Change in height $d_f$ (inches) | Change in height $d_f$ (cm) | $\sum\Delta H$ | Percent strain $\varepsilon = \sum\Delta H/H_0$ | Height $H=H_0-\Delta H$ | Void Ratio $e=(H-H_s)/H_s$ |
|---|---|---|---|---|---|---|
| Initial | 1 | | 0 | 0.00% | 2.53 | 1.85 |
| 125 | 0.0040 | 0.0102 | 0.0102 | 0.40% | 2.52 | 1.83 |
| 250 | 0.0102 | 0.0259 | 0.0361 | 1.43% | 2.49 | 1.81 |
| 500 | 0.0179 | 0.0455 | 0.0815 | 3.22% | 2.45 | 1.75 |
| 1000 | 0.0254 | 0.0645 | 0.1461 | 5.77% | 2.38 | 1.68 |
| 2000 | 0.0375 | 0.0953 | 0.2413 | 9.54% | 2.29 | 1.57 |
| 4000 | 0.0660 | 0.1676 | 0.4089 | 16.16% | 2.12 | 1.39 |
| 8000 | 0.0710 | 0.1803 | 0.5893 | 23.29% | 1.94 | 1.18 |
| 16000 | 0.0700 | 0.1778 | 0.7671 | 30.32% | 1.76 | 0.98 |
| 4000 | -0.3020 | -0.7671 | 0.0000 | 0.00% | 2.53 | 1.85 |
| 1000 | 0.0000 | 0.0000 | 0.0000 | 0.00% | 2.53 | 1.85 |
| 250 | 0.0000 | 0.0000 | 0.0000 | 0.00% | 2.53 | 1.85 |

LACO

# CONSOLIDATION TEST
## ASTM D-2435

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 2 of 10 |
| LOCATION | GBH2 at 5.0' | TEST BY | DLR | DATE | 6/19/2018 |
| SOIL TYPE | Lean Clay | CHECKED BY | CRGT | CHECK DATE | 6/25/2018 |

## Void Ratio-Log-P Curve



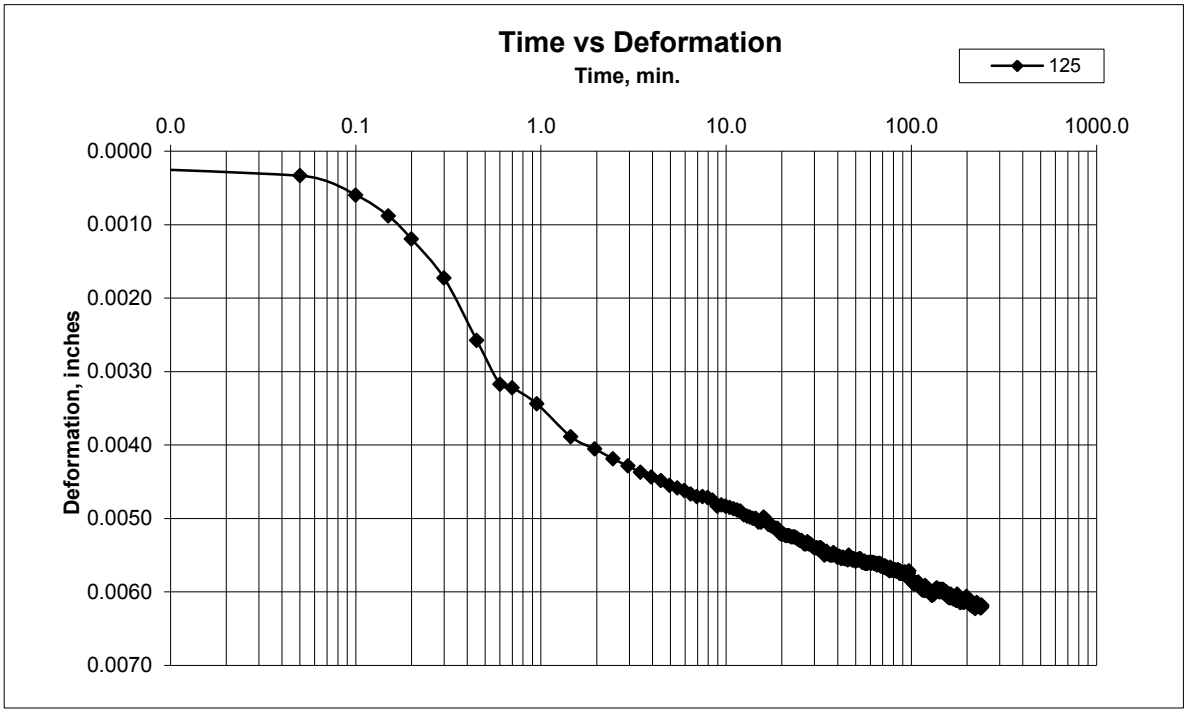

| | Initial | Final |
|---|---|---|
| Moisture % | 67.7% | 41.1% |
| Dry Density, pcf | 58.1 | 57.6 |
| Void Ratio | 1.85 | 1.87 |
| % Saturation | 97.2% | 58.3% |

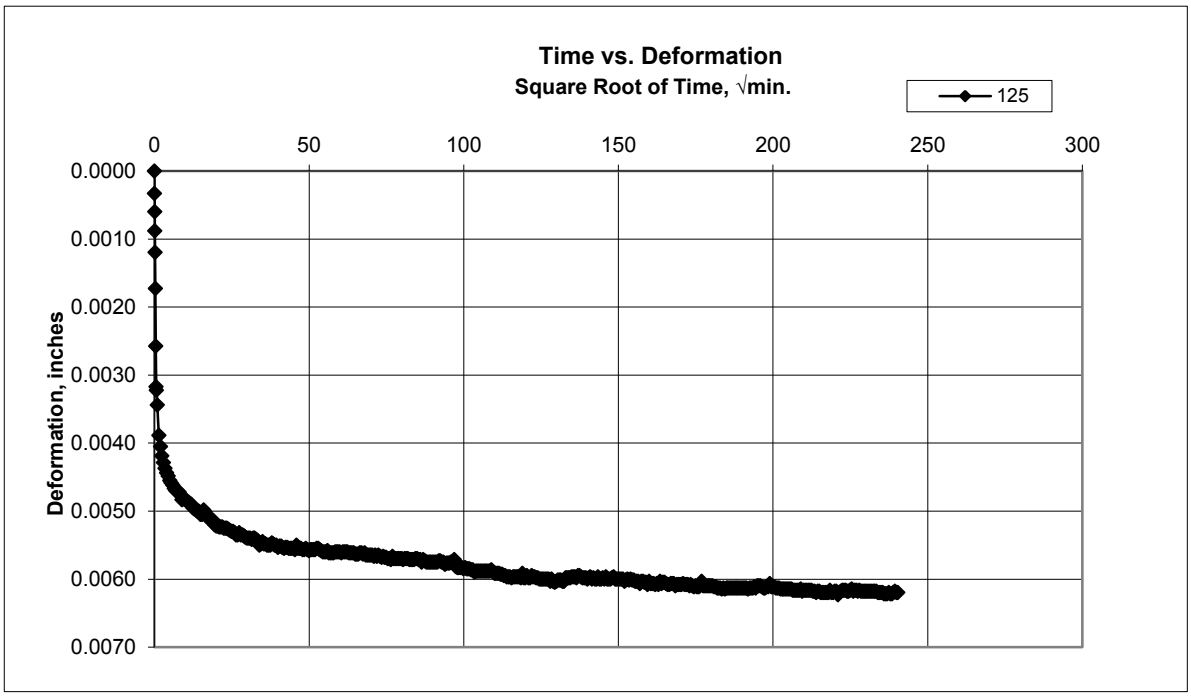
Assumed Specific Gravity = 2.65

**NOTES:**

# CONSOLIDATION TEST
# ASTM D-2435

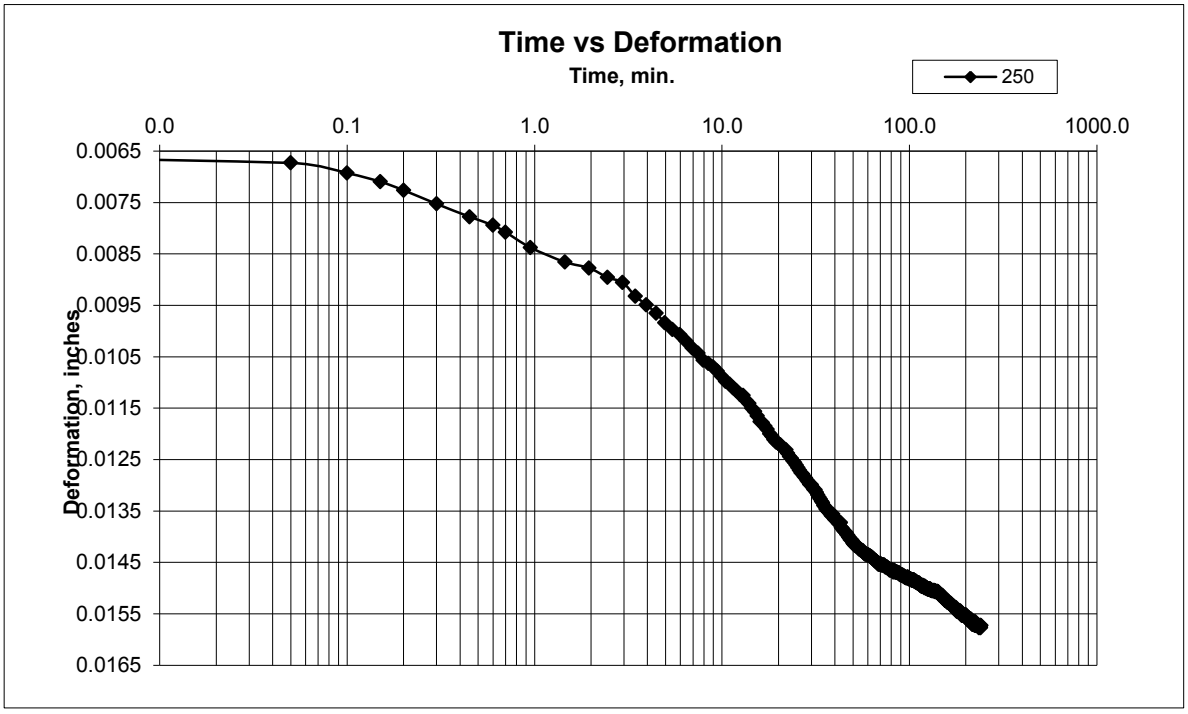
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 3 of 10 |
| LOCATION | GBH2 at 5.0' | TEST BY | DLR | DATE | 6/19/2018 |
| SOIL TYPE | Lean Clay | CHECKED BY | CRGT | CHECK DATE | 6/25/2018 |

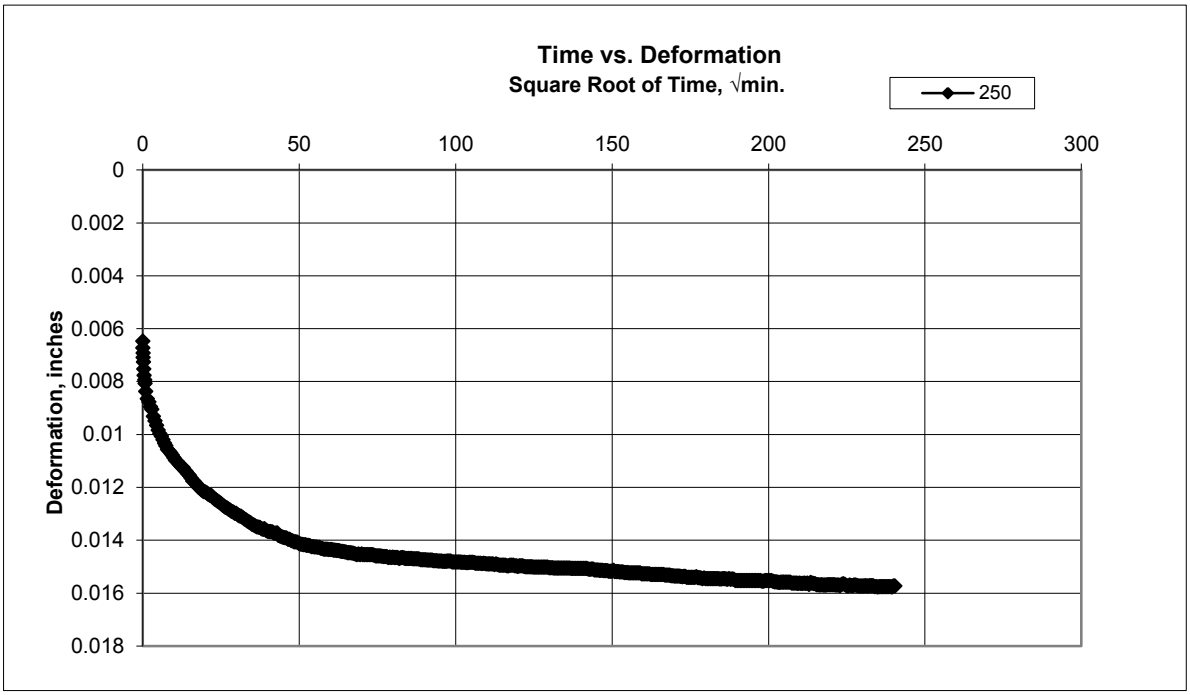


# CONSOLIDATION TEST
## ASTM D-2435

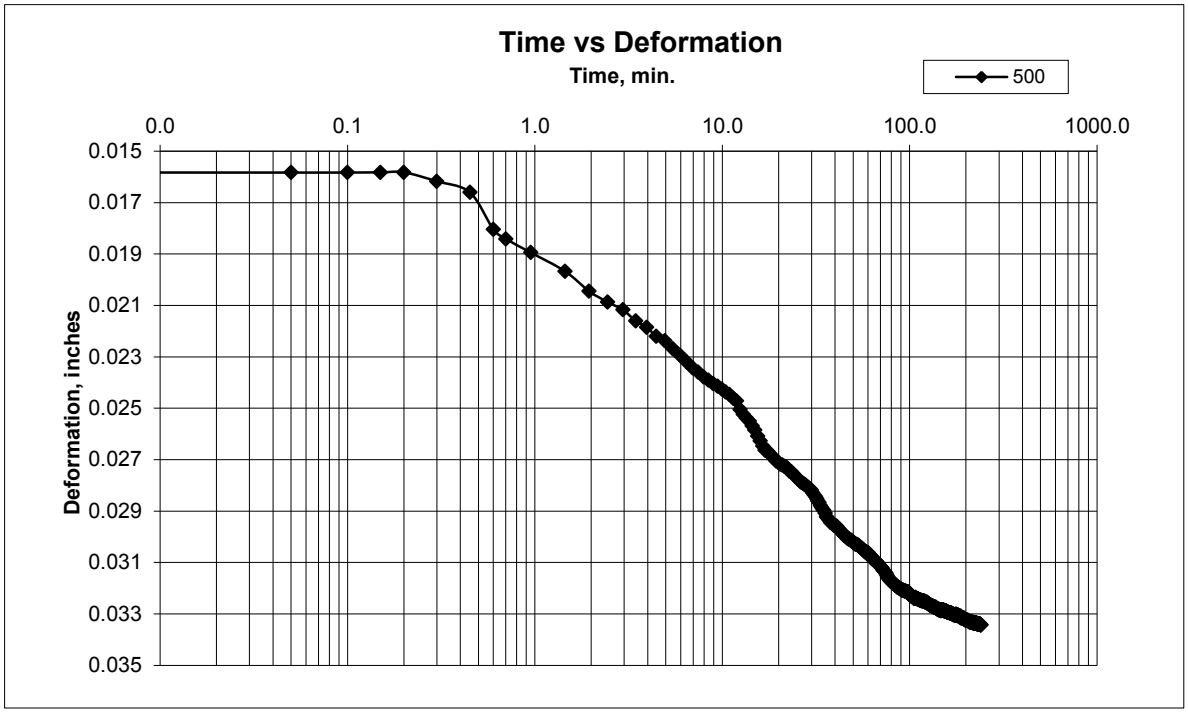
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 4 of 10 |
| LOCATION | GBH2 at 5.0' | TEST BY | DLR | DATE | 6/19/2018 |
| SOIL TYPE | Lean Clay | CHECKED BY | CRGT | CHECK DATE | 6/25/2018 |

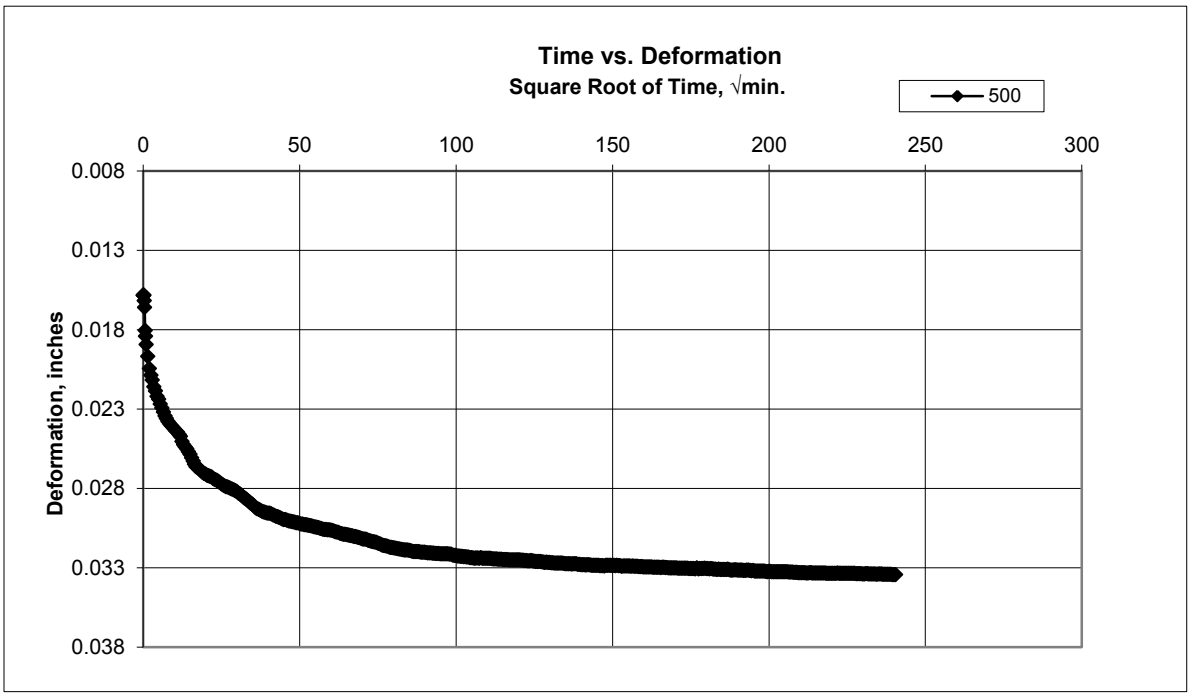


# CONSOLIDATION TEST
# ASTM D-2435

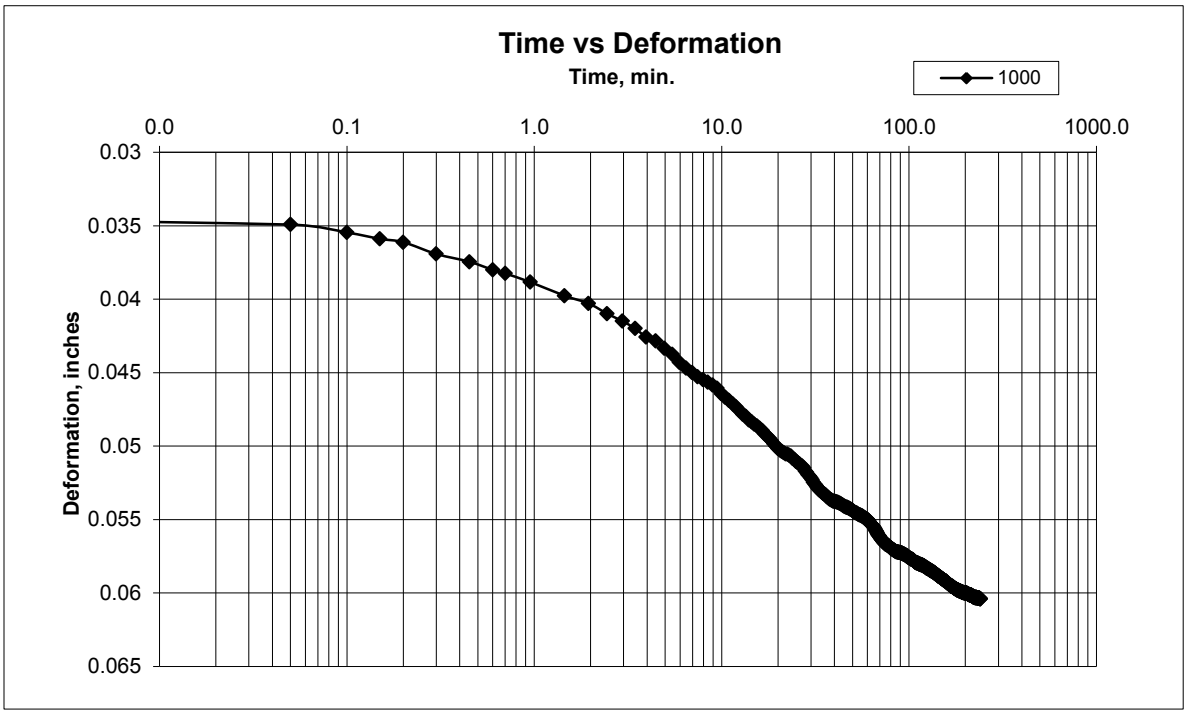
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 5 of 10 |
| LOCATION | GBH2 at 5.0' | TEST BY | DLR | DATE | 6/19/2018 |
| SOIL TYPE | Lean Clay | CHECKED BY | CRGT | CHECK DATE | 6/25/2018 |

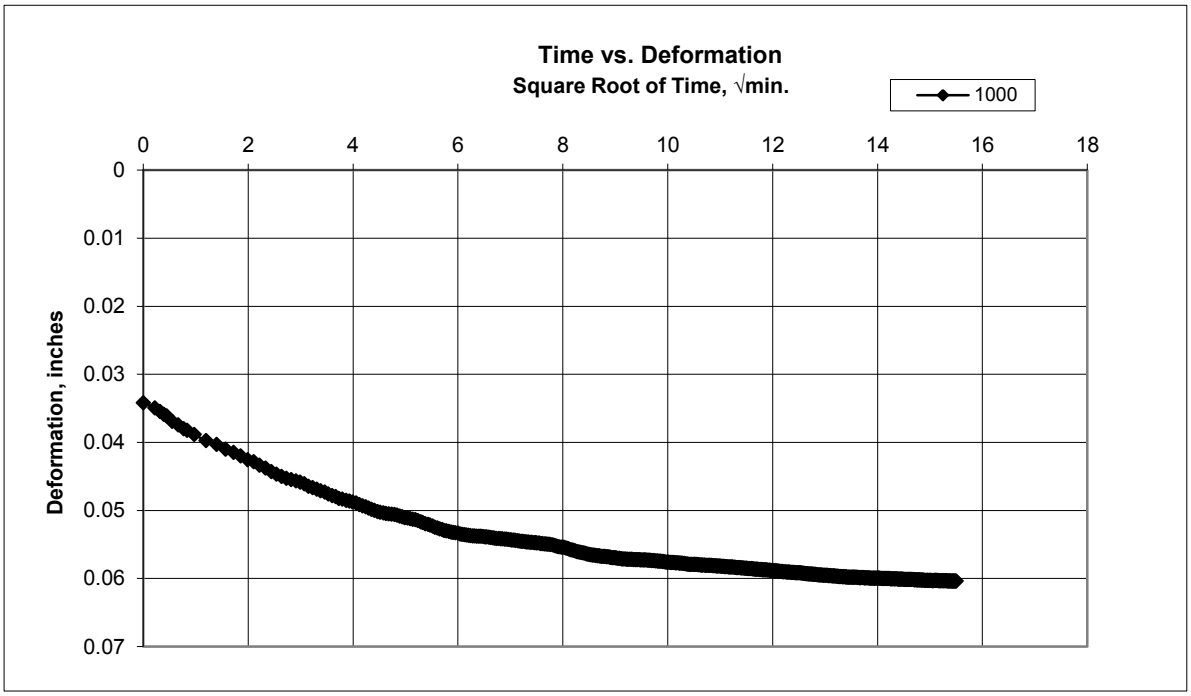


# CONSOLIDATION TEST
# ASTM D-2435

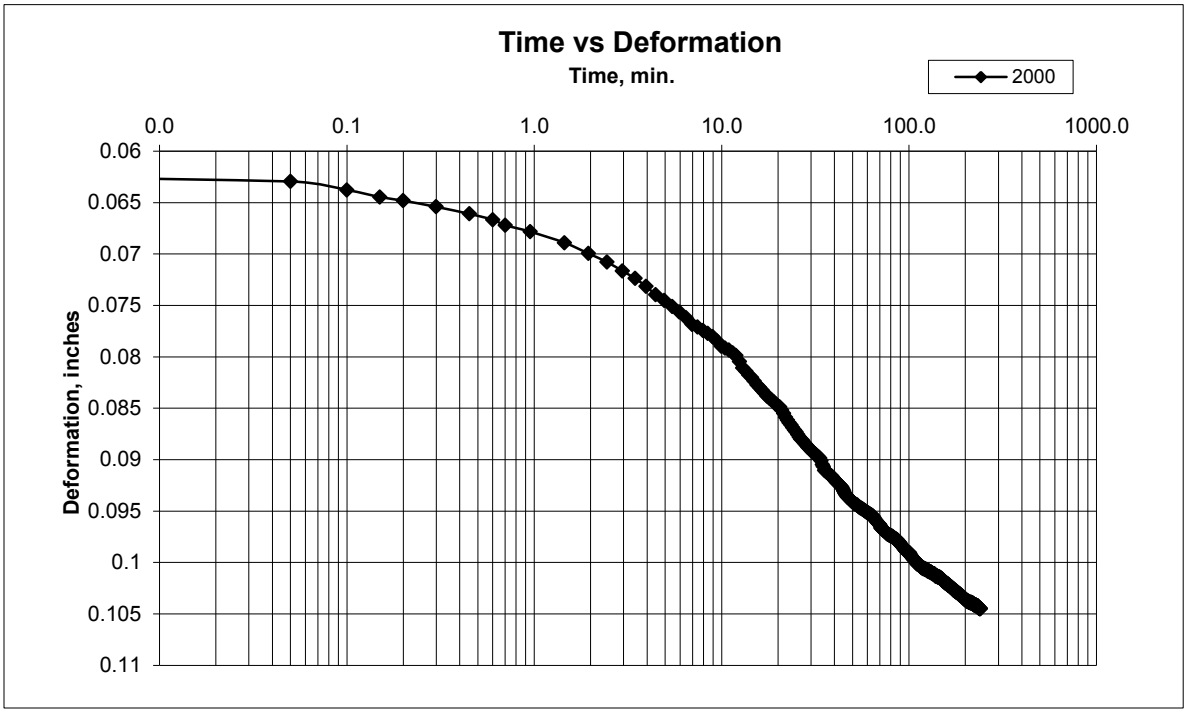
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 6 of 10 |
| LOCATION | GBH2 at 5.0' | TEST BY | DLR | DATE | 6/19/2018 |
| SOIL TYPE | Lean Clay | CHECKED BY | CRGT | CHECK DATE | 6/25/2018 |

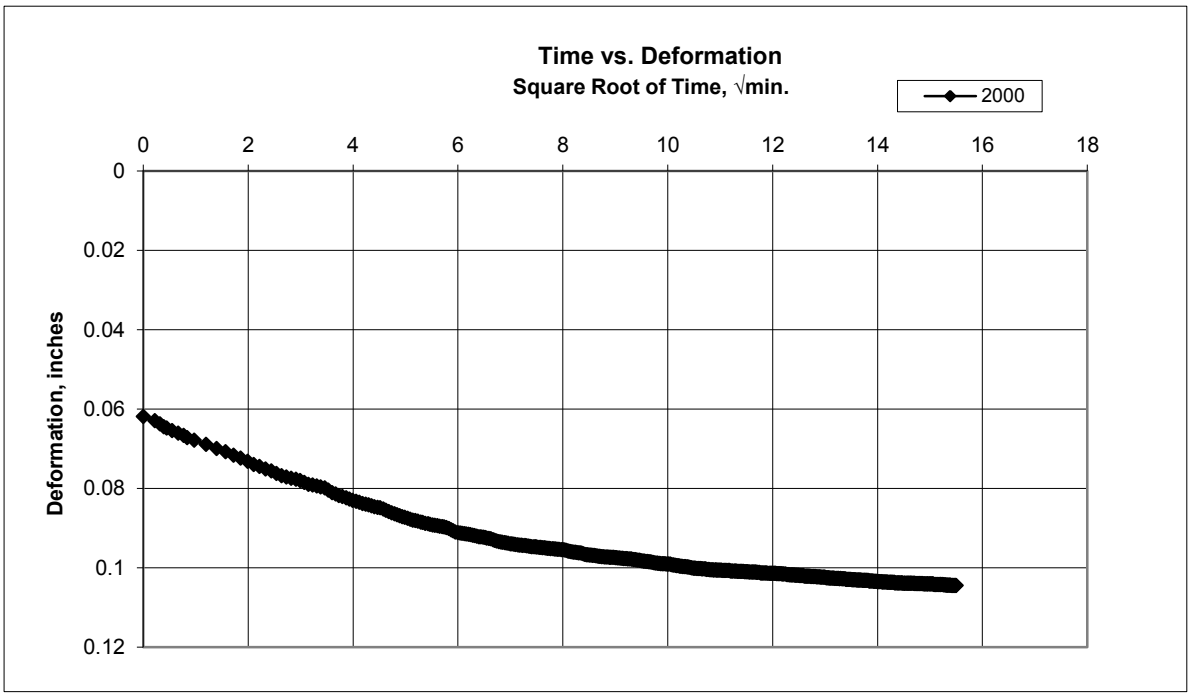


# CONSOLIDATION TEST
# ASTM D-2435

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 7 of 10 |
| LOCATION | GBH2 at 5.0' | TEST BY | DLR | DATE | 6/19/2018 |
| SOIL TYPE | Lean Clay | CHECKED BY | CRGT | CHECK DATE | 6/25/2018 |

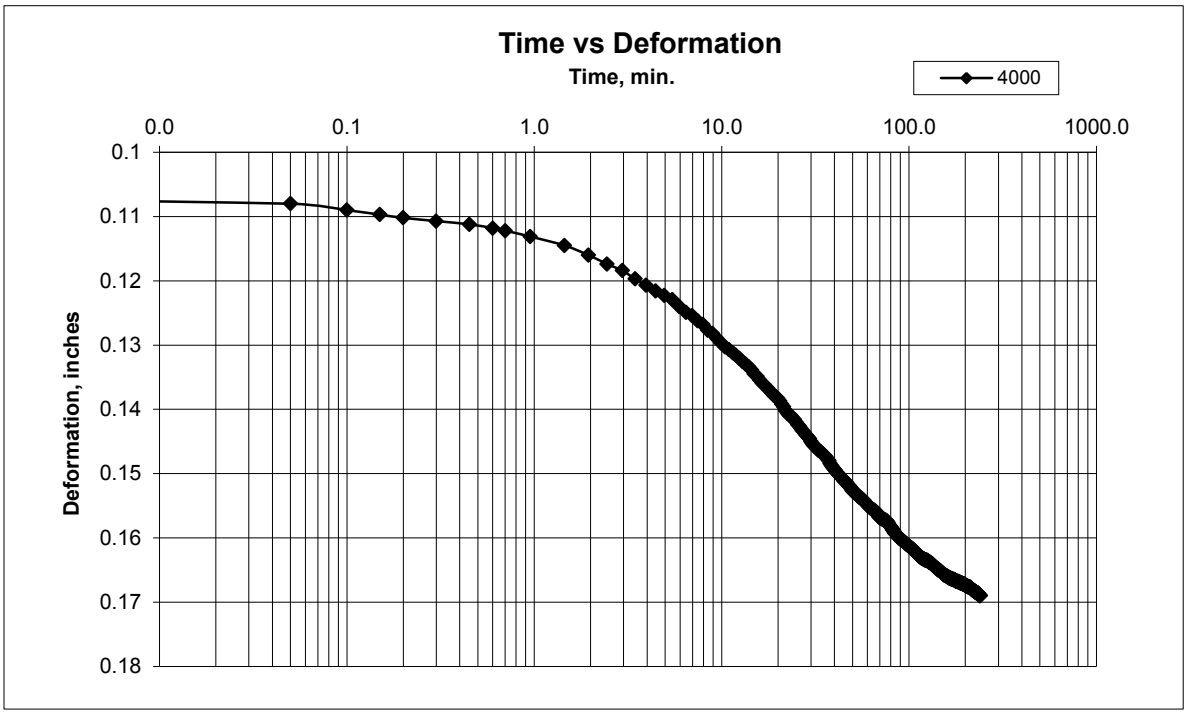


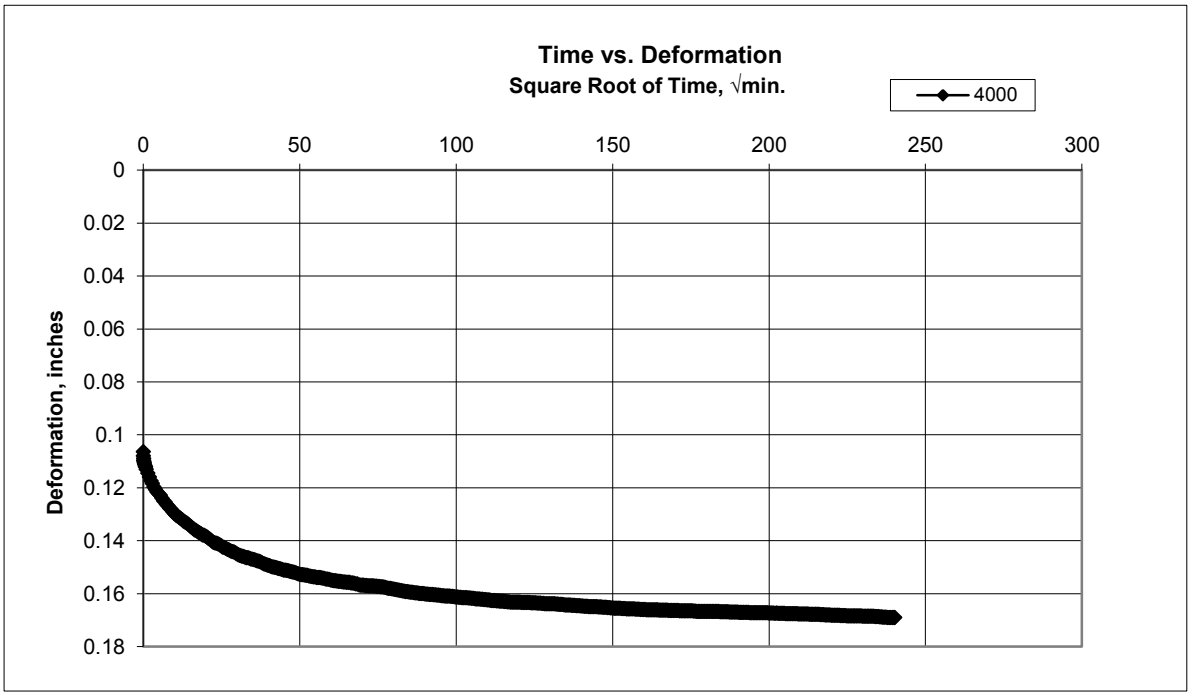



LACO

# CONSOLIDATION TEST
## ASTM D-2435

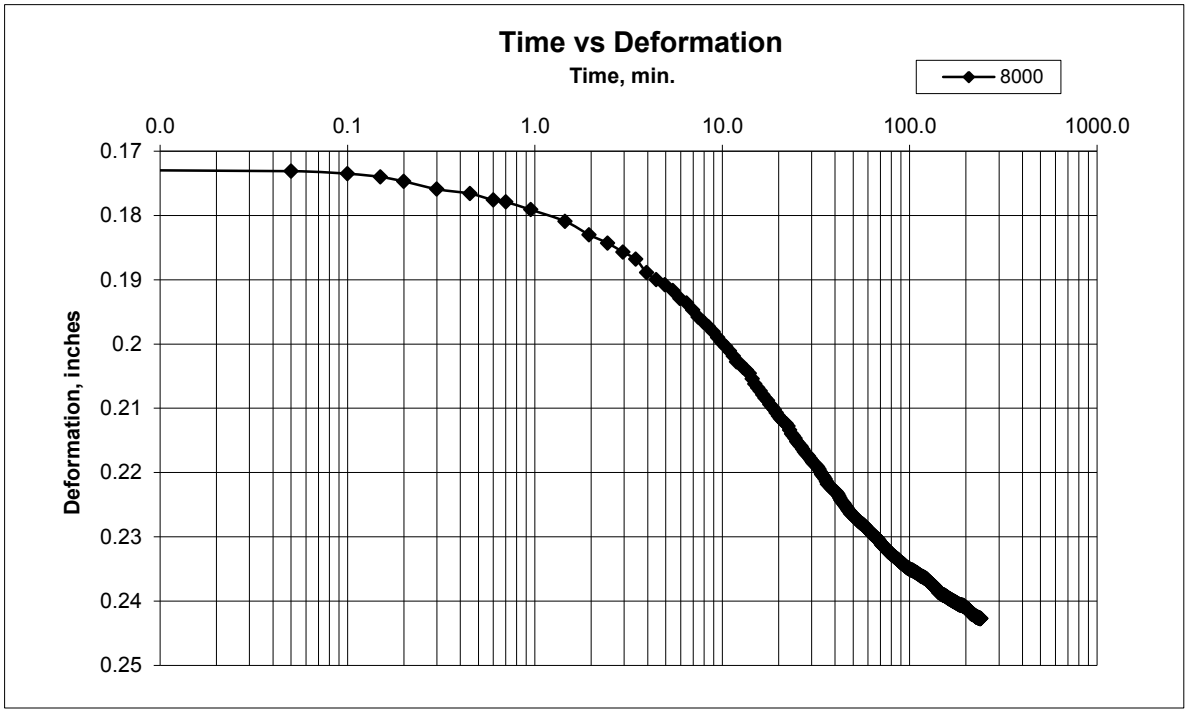
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 8 of 10 |
| LOCATION | GBH2 at 5.0' | TEST BY | DLR | DATE | 6/19/2018 |
| SOIL TYPE | Lean Clay | CHECKED BY | CRGT | CHECK DATE | 6/25/2018 |

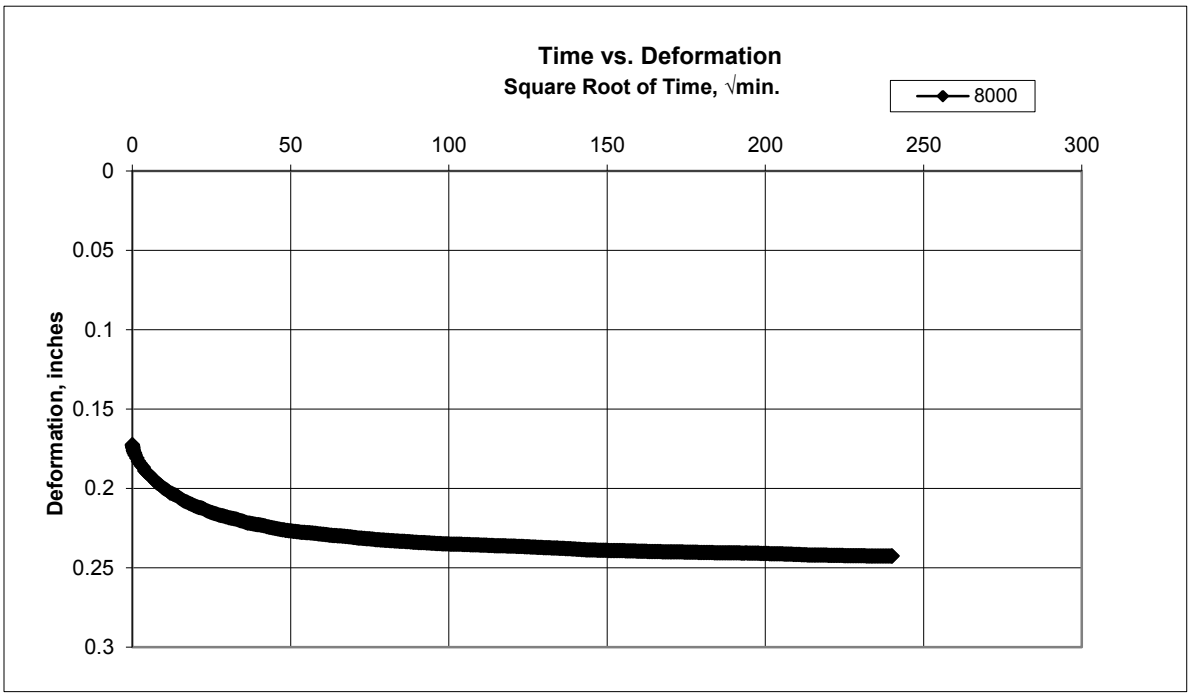


# CONSOLIDATION TEST
# ASTM D-2435

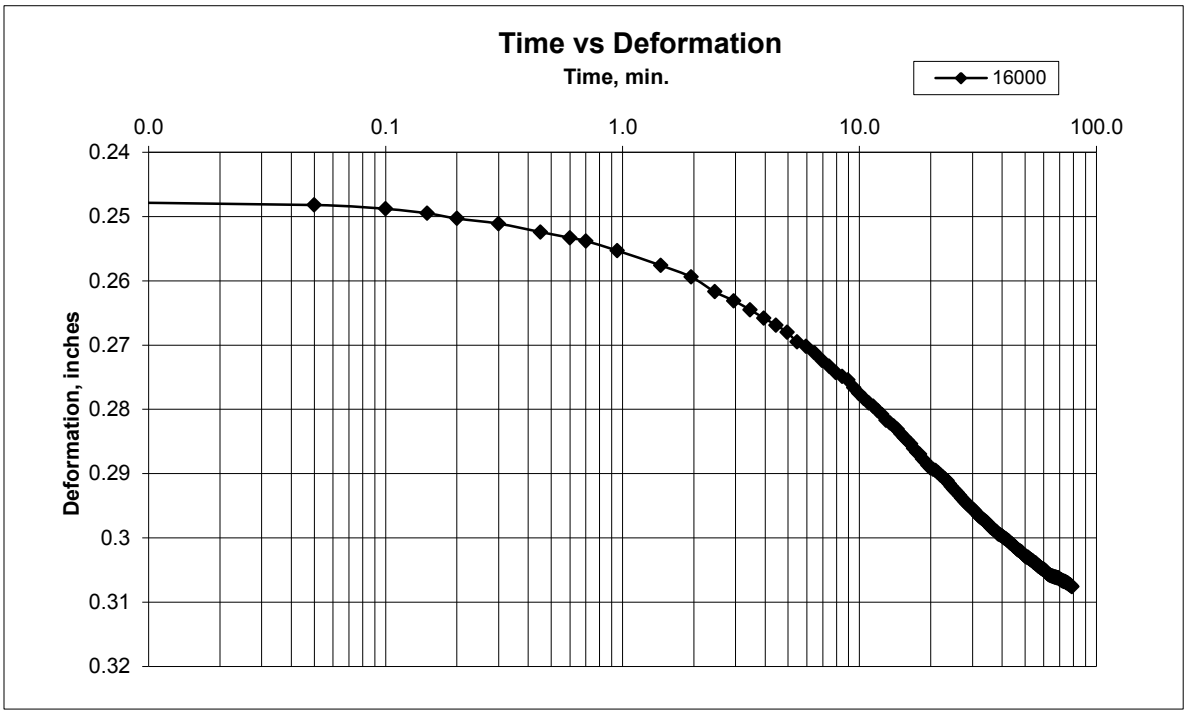
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 9 of 10 |
| LOCATION | GBH2 at 5.0' | TEST BY | DLR | DATE | 6/19/2018 |
| SOIL TYPE | Lean Clay | CHECKED BY | CRGT | CHECK DATE | 6/25/2018 |

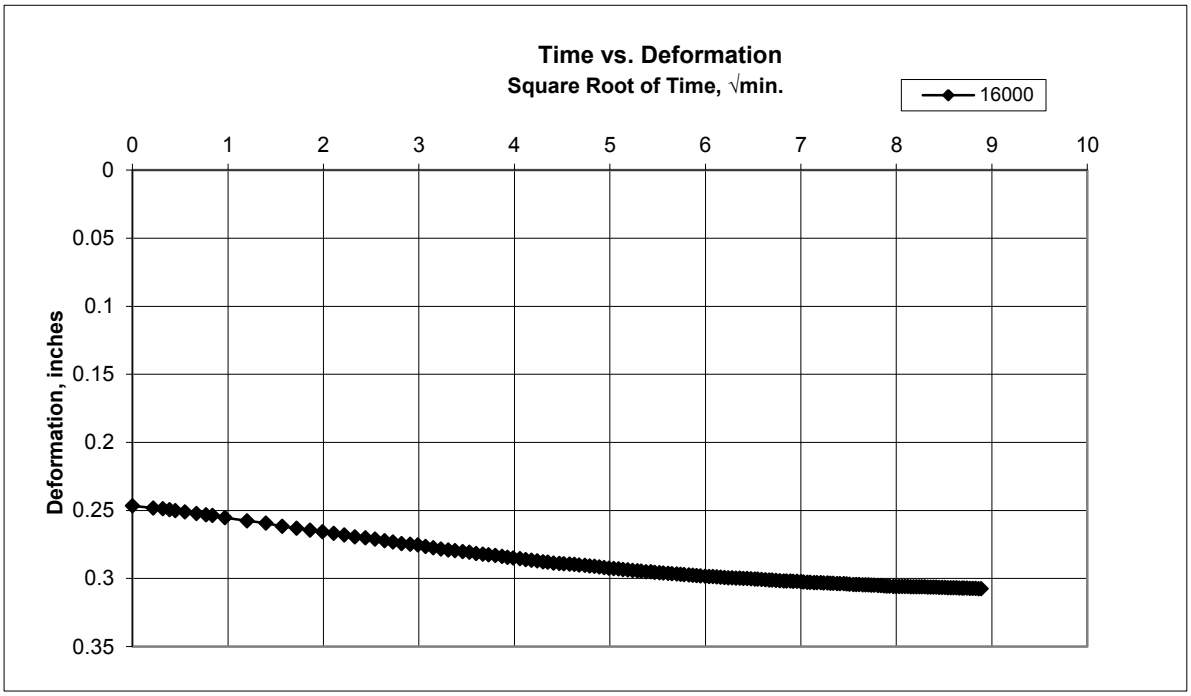


# CONSOLIDATION TEST
# ASTM D-2435

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 10 of 10 |
| LOCATION | GBH2 at 5.0' | TEST BY | DLR | DATE | 6/19/2018 |
| SOIL TYPE | Lean Clay | CHECKED BY | CRGT | CHECK DATE | 6/25/2018 |



LACO

# CONSOLIDATION TEST
## ASTM D-2435

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 1 of 10 |
| LOCATION | GHB2 at 20.0' | TEST BY | DLR | DATE | 6/19/18 |
| SOIL TYPE | Clayey Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 |

| | | |
|---|---|---|
| Diameter of Sample | 6.35 | cm |
| Area of Sample | 31.7 | $cm^2$ |
| Density of Water $\rho_w$ | 1 | $gram/cm^3$ |
| Specific Gravity of Solids G | 2.65 | $gram/cm^3$ |

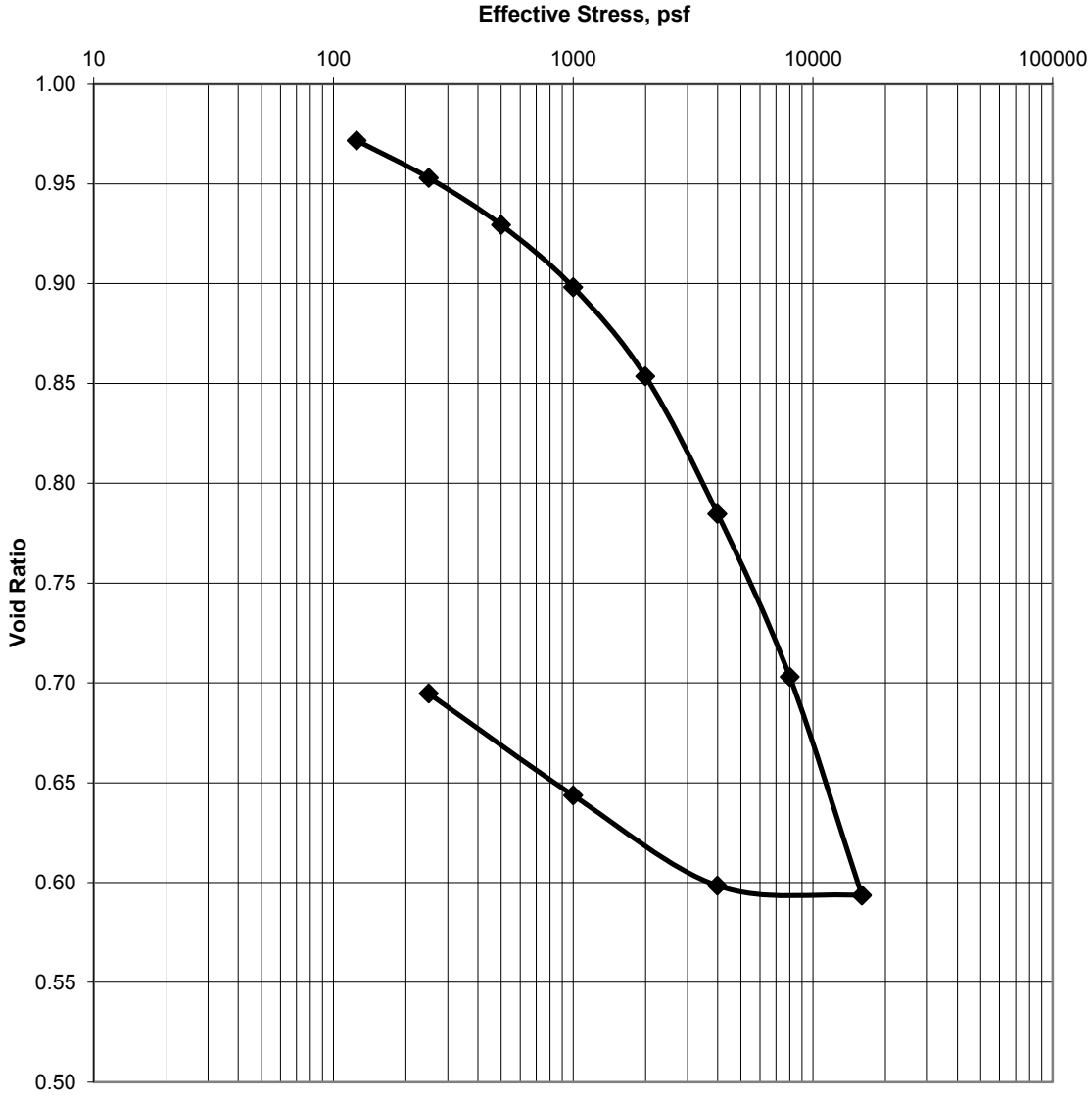
| PRECONSOLIDATION | | | POSTCONSOLIDATION | | |
|---|---|---|---|---|---|
| Initial Specimen Height $H_0$ | 2.53 | cm | Final Speciment Height $H_f$ | 2.04 | cm |
| **Water Content** | | | **Water Content** | | |
| Wet soil + pan | 356.7 | gram | Wet soil + pan | 143.5 | gram |
| Dry soil + pan | 267.1 | gram | Dry soil + pan | 109.2 | gram |
| Pan | 8.4 | gram | Pan | 8.5 | gram |
| Total water | 89.6 | gram | Total water | 34.3 | gram |
| Dry soil | 258.7 | gram | Dry soil | 100.7 | gram |
| Water Content $W_{fp}$ | 34.6% | | Water Content $W_{fp}$ | 34.1% | |
| **Moisture Density** | | | **Moisture Density** | | |
| Wet soil + consol assembly | 1132.3 | gram | Wet soil + consol assembly | 1127 | gram |
| Consol assembly | 988.2 | gram | Consol assembly | 988.1 | gram |
| Moist Mass of Specimen $M_{TI}$ | 144.1 | gram | Moist Mass of Specimen $M_{Tf}$ | 138.9 | gram |
| Initial Volume of Sample $V_o$ | 80.1 | $cm^3$ | Final Volume of Sample $V_f$ | 64.6 | $cm^3$ |
| Wet Density | 1.8 | $gram/cm^3$ | Wet Density | 2.2 | $gram/cm^3$ |
| Dry Mass of Specimen $M_d$ | 107.0 | grams | Dry Mass of Specimen $M_d$ | 103.6 | grams |
| Initial Dry Density $\rho_d$ | 1.3 | $gram/cm^3$ | Final Dry Density | 1.6 | $gram/cm^3$ |
| Dry Unit Weight | 83.4 | $lb/ft^3$ | Final Dry Unit Wieght | 100.2 | $lb/ft^3$ |
| Volume of Solids $V_s$ | 40.4 | $cm^3$ | Volume of Solids $V_s$ | 39.1 | $cm^3$ |
| Equivalent Height of Solids $H_s$ | 1.28 | cm | Equivalent Height of Solids $H_s$ | 1.23 | cm |
| Void Ratio Before Test $e_o$ | 0.98 | | Void Ratio After Test $e_f$ | 0.65 | |
| Initial Degree of Saturation $S_o$ | 93.3% | | Final Degree of Saturation Sf | 138.6% | |

| Load Increment | Change in height $d_f$ (inches) | Change in height $d_f$ (cm) | $\sum\Delta H$ | Percent strain $\varepsilon = \sum\Delta H/H_0$ | Height $H=H_0-\Delta H$ | Void Ratio $e=(H-H_s)/H_s$ |
|---|---|---|---|---|---|---|
| Initial | 1 | | 0 | 0.00% | 2.53 | 0.98 |
| 125 | 0.0061 | 0.0155 | 0.0155 | 0.61% | 2.51 | 0.97 |
| 250 | 0.0094 | 0.0239 | 0.0394 | 1.56% | 2.49 | 0.95 |
| 500 | 0.0118 | 0.0300 | 0.0693 | 2.74% | 2.46 | 0.93 |
| 1000 | 0.0157 | 0.0399 | 0.1092 | 4.32% | 2.42 | 0.90 |
| 2000 | 0.0224 | 0.0569 | 0.1661 | 6.57% | 2.36 | 0.85 |
| 4000 | 0.0346 | 0.0879 | 0.2540 | 10.04% | 2.28 | 0.78 |
| 8000 | 0.0410 | 0.1041 | 0.3581 | 14.16% | 2.17 | 0.70 |
| 16000 | 0.0550 | 0.1397 | 0.4978 | 19.68% | 2.03 | 0.59 |
| 4000 | -0.0025 | -0.0064 | 0.4915 | 19.43% | 2.04 | 0.60 |
| 1000 | -0.0227 | -0.0577 | 0.4338 | 17.15% | 2.10 | 0.64 |
| 250 | -0.0256 | -0.0650 | 0.3688 | 14.58% | 2.16 | 0.69 |

# CONSOLIDATION TEST
## ASTM D-2435

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 2 of 10 |
| LOCATION | GHB2 at 20.0' | TEST BY | DLR | DATE | 6/19/18 |
| SOIL TYPE | Clayey Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 |

## Void Ratio-Log-P Curve



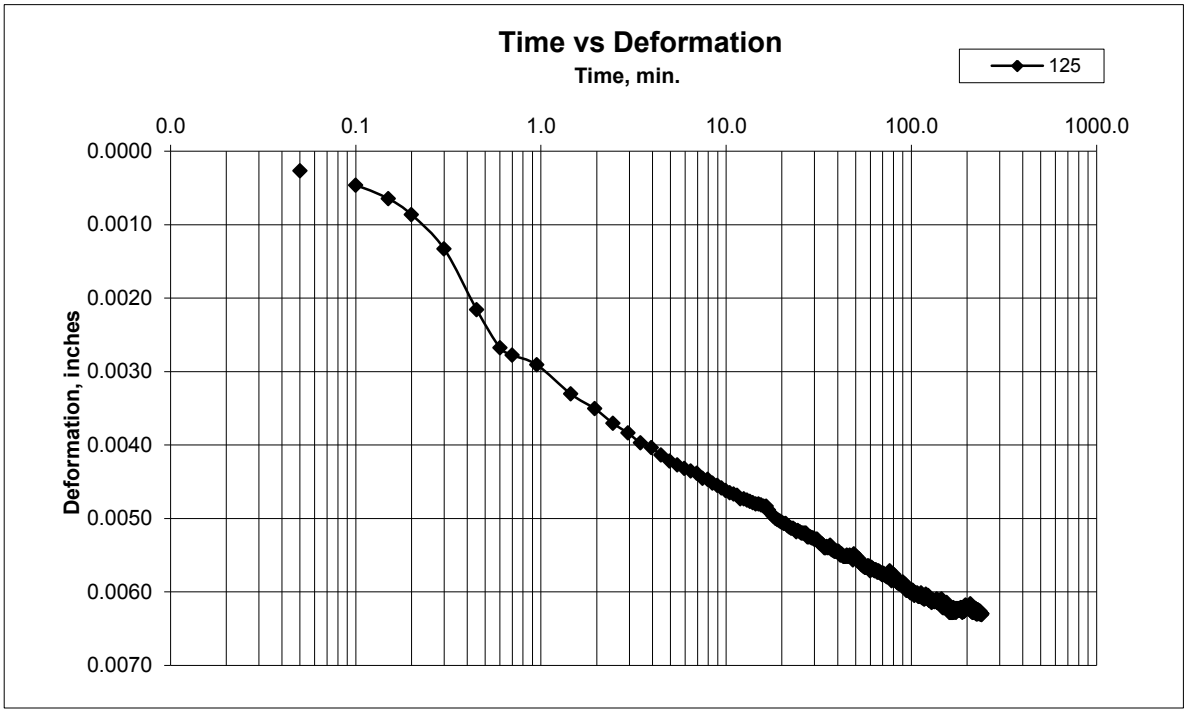

| | Initial | Final |
|---|---|---|
| **Moisture %** | 34.6% | 34.1% |
| **Dry Density, pcf** | 83.4 | 100.2 |
| **Void Ratio** | 0.98 | 0.65 |
| **% Saturation** | 93.3% | 138.6% |

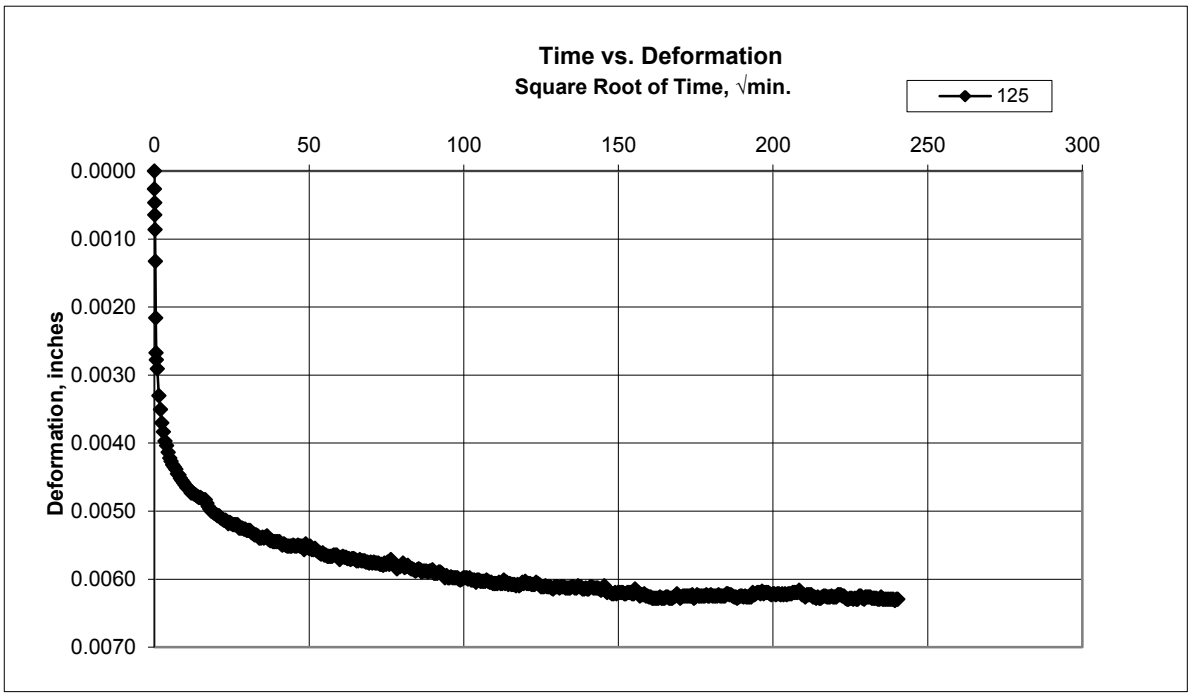
Assumed Specific Gravity = 2.65

**NOTES:**

# CONSOLIDATION TEST
# ASTM D-2435

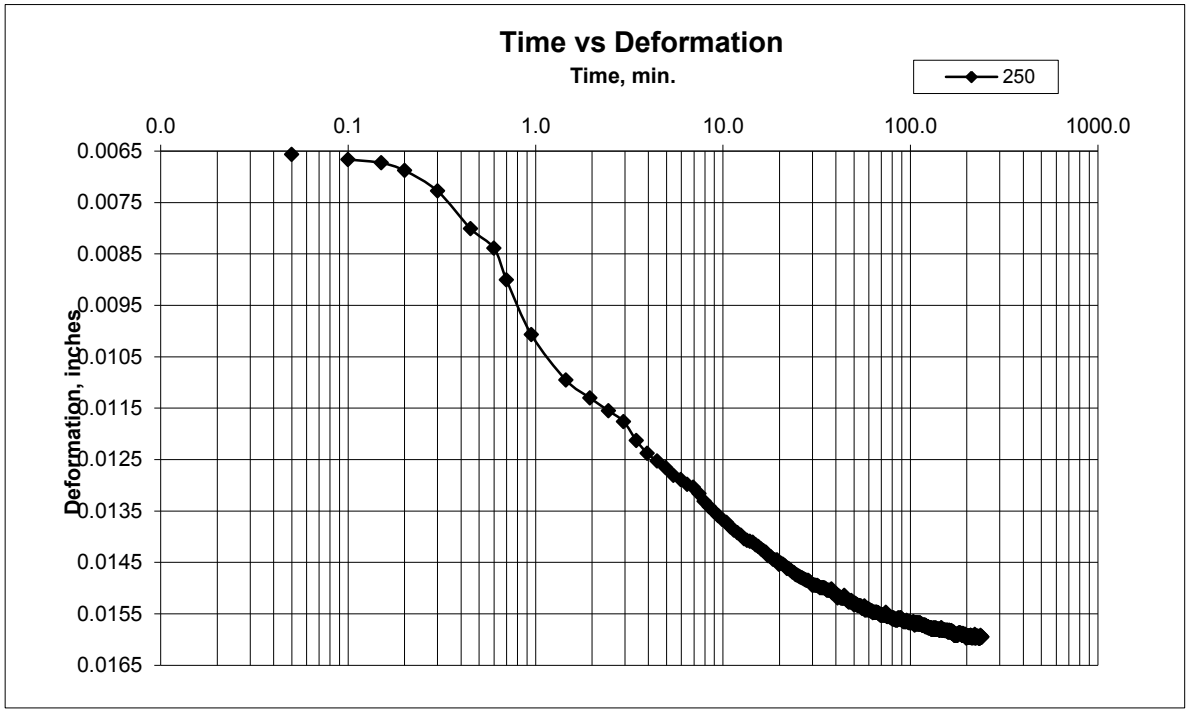
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 3 of 10 |
| LOCATION | GHB2 at 20.0' | TEST BY | DLR | DATE | 6/19/18 |
| SOIL TYPE | Clayey Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 |

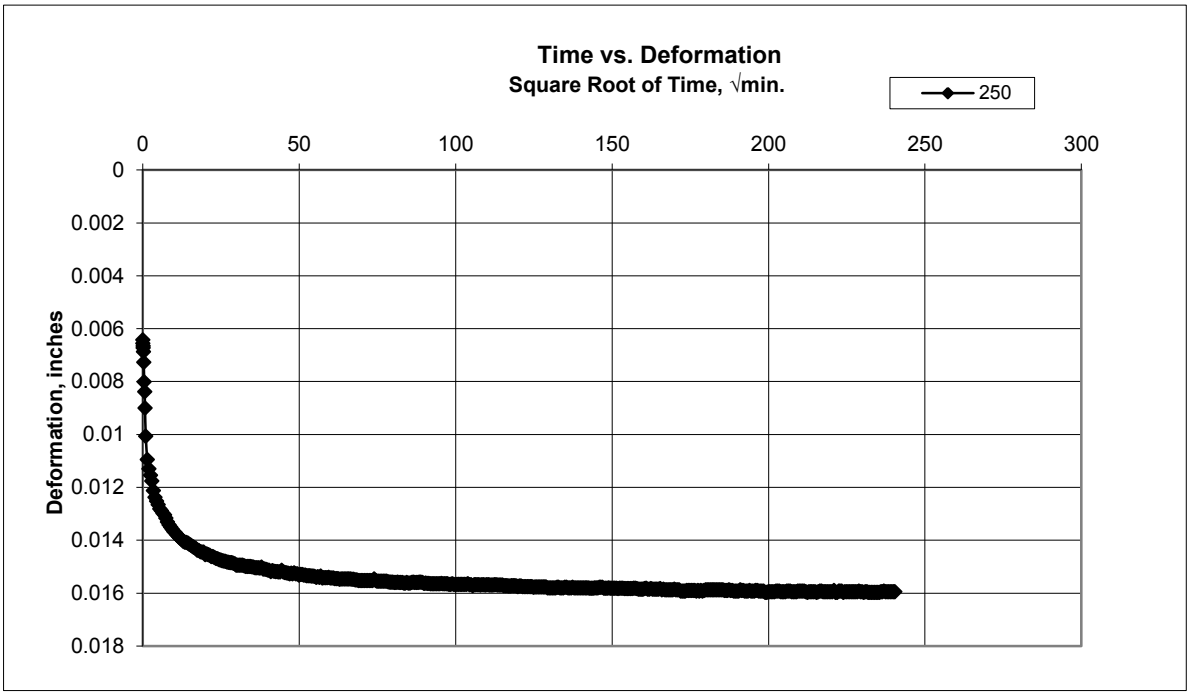


# CONSOLIDATION TEST
# ASTM D-2435

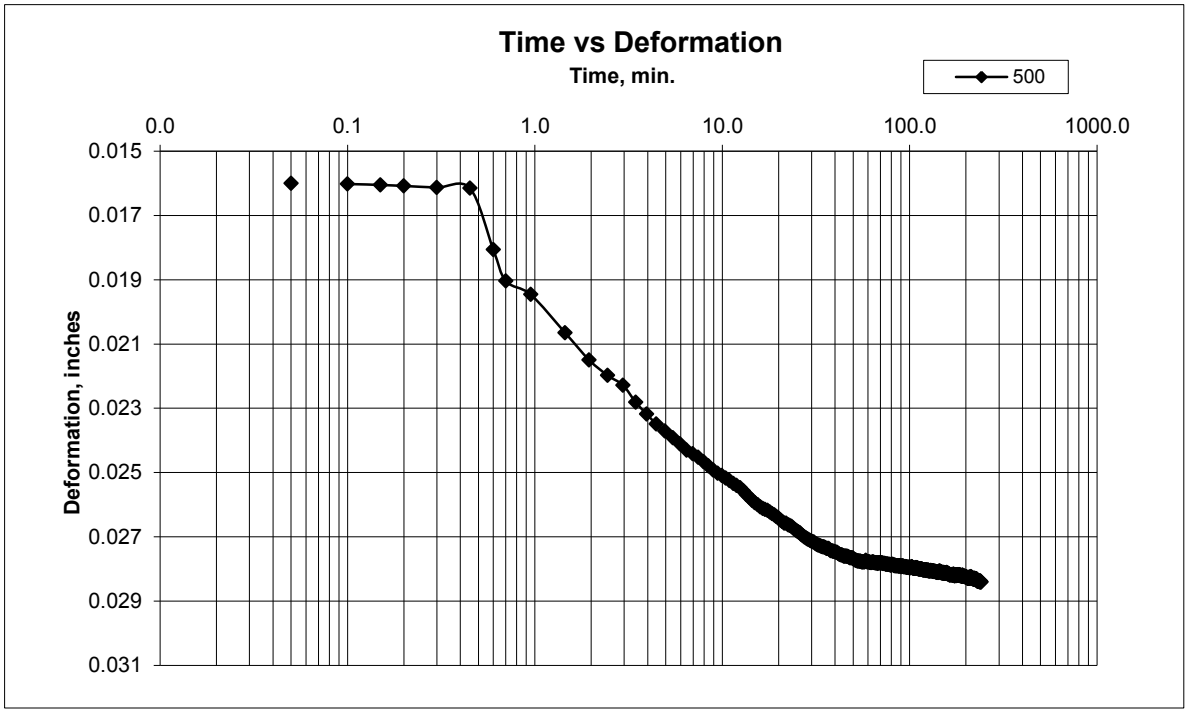
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 4 of 10 |
| LOCATION | GHB2 at 20.0' | TEST BY | DLR | DATE | 6/19/18 |
| SOIL TYPE | Clayey Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 |

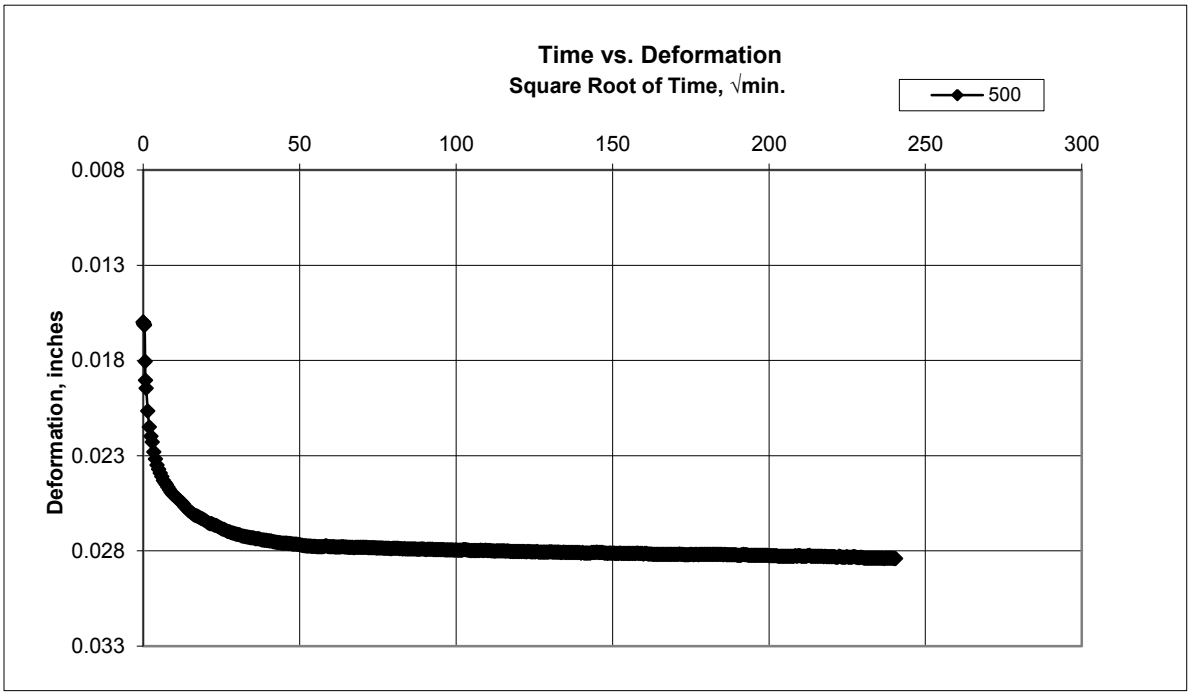


# CONSOLIDATION TEST
# ASTM D-2435

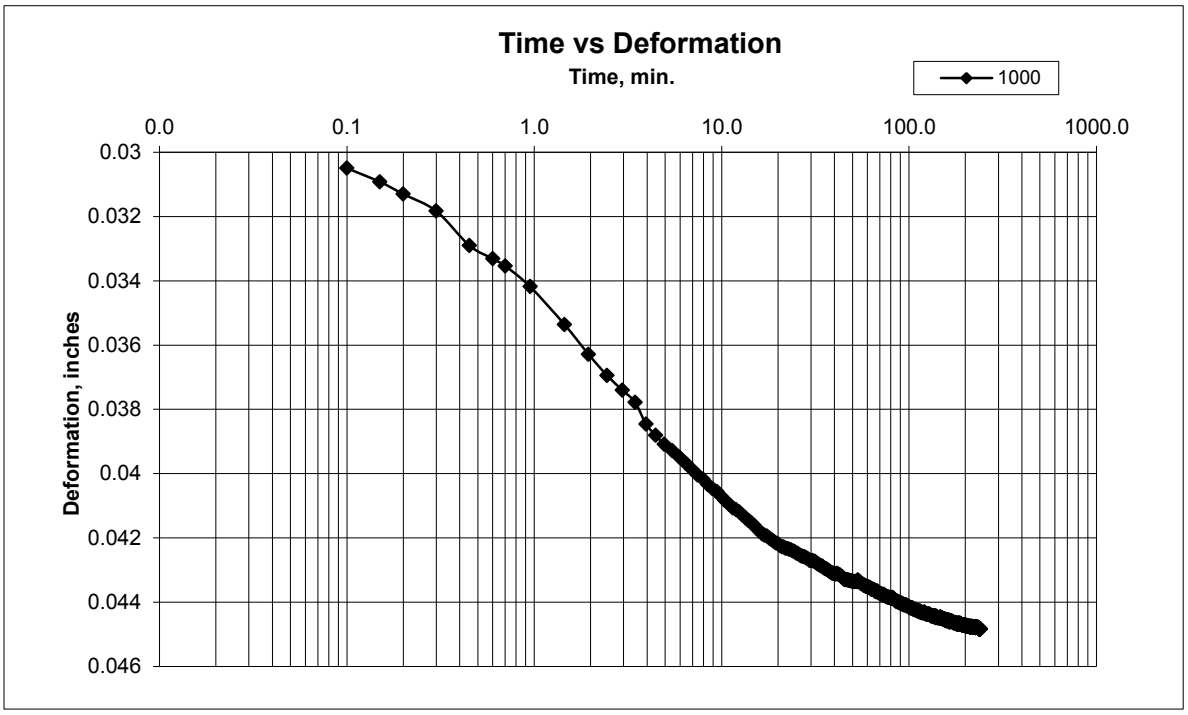
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 5 of 10 |
| LOCATION | GHB2 at 20.0' | TEST BY | DLR | DATE | 6/19/18 |
| SOIL TYPE | Clayey Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 |

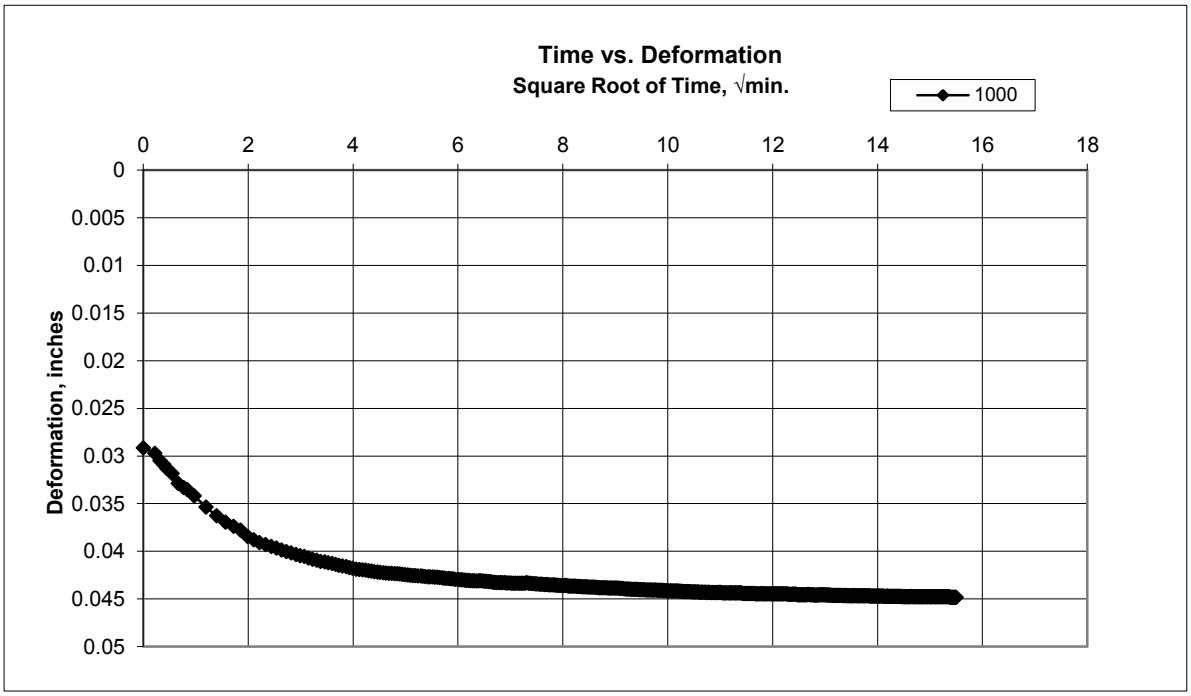


# CONSOLIDATION TEST
## ASTM D-2435

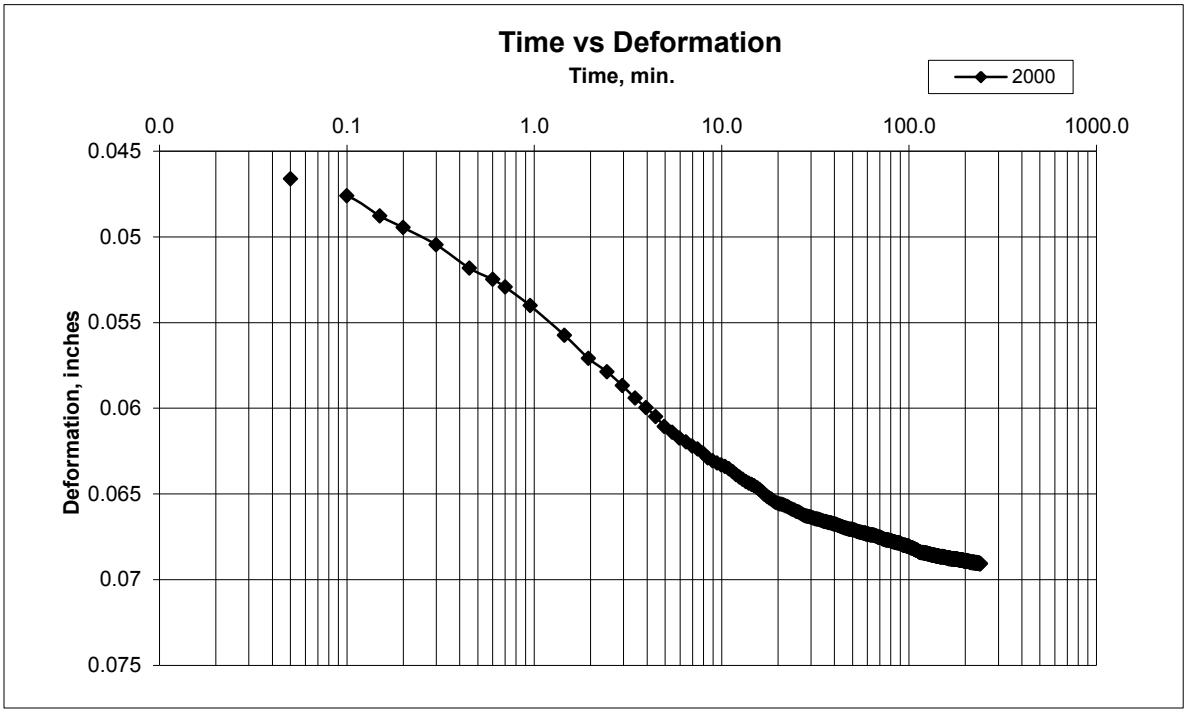
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 6 of 10 |
| LOCATION | GHB2 at 20.0' | TEST BY | DLR | DATE | 6/19/18 |
| SOIL TYPE | Clayey Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 |

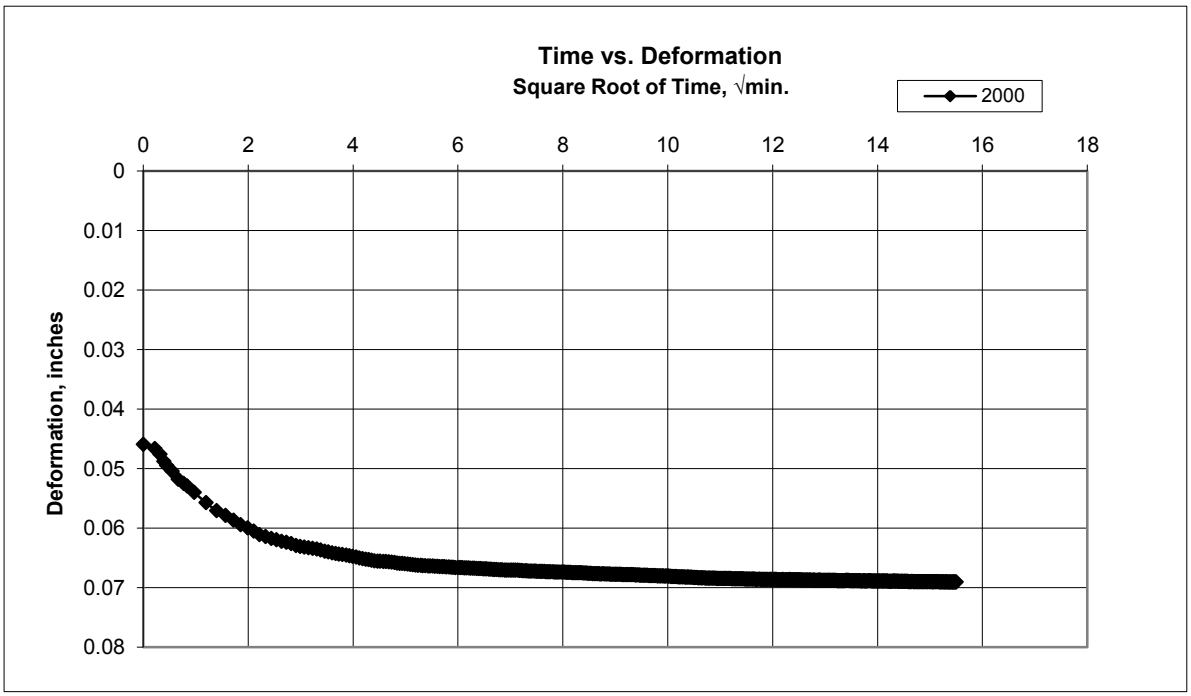


# CONSOLIDATION TEST
# ASTM D-2435

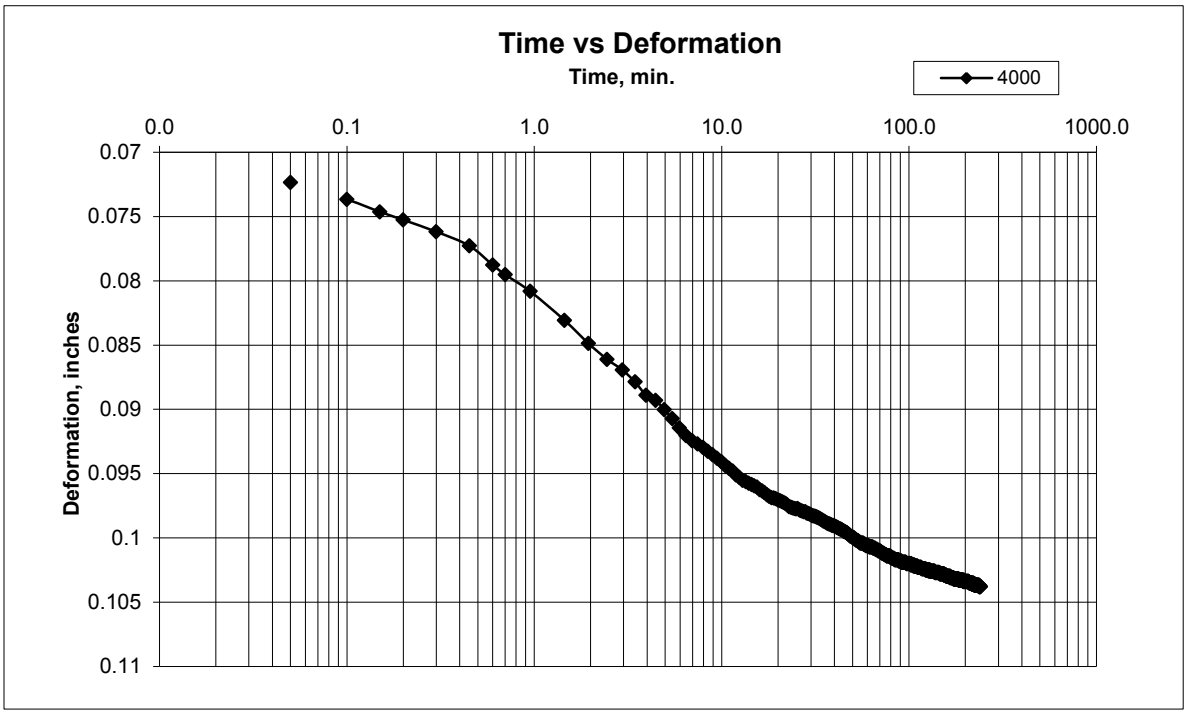
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 7 of 10 |
| LOCATION | GHB2 at 20.0' | TEST BY | DLR | DATE | 6/19/18 |
| SOIL TYPE | Clayey Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 |

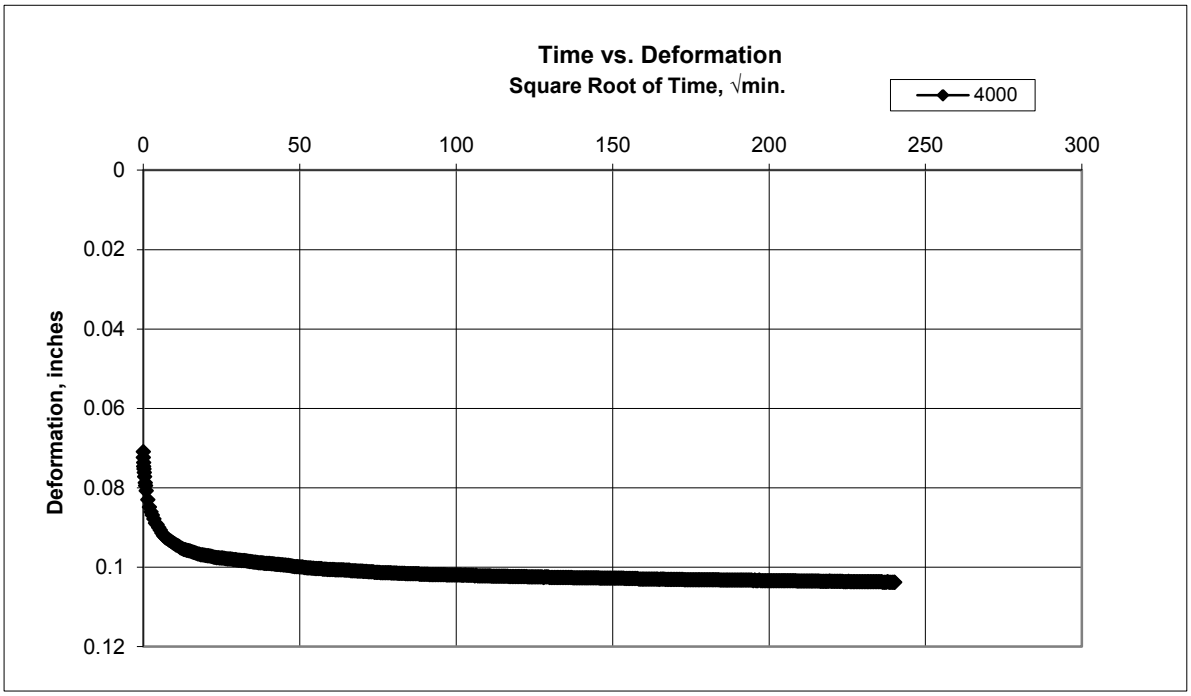


# CONSOLIDATION TEST
# ASTM D-2435

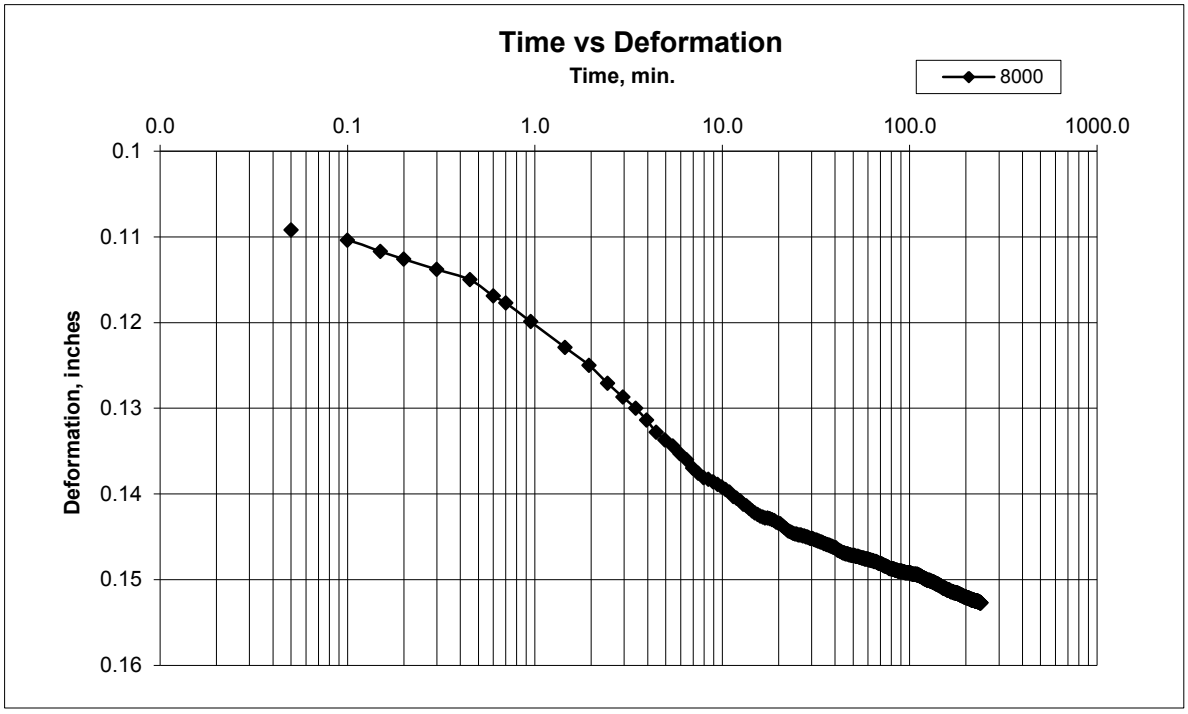
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 8 of 10 |
| LOCATION | GHB2 at 20.0' | TEST BY | DLR | DATE | 6/19/18 |
| SOIL TYPE | Clayey Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 |

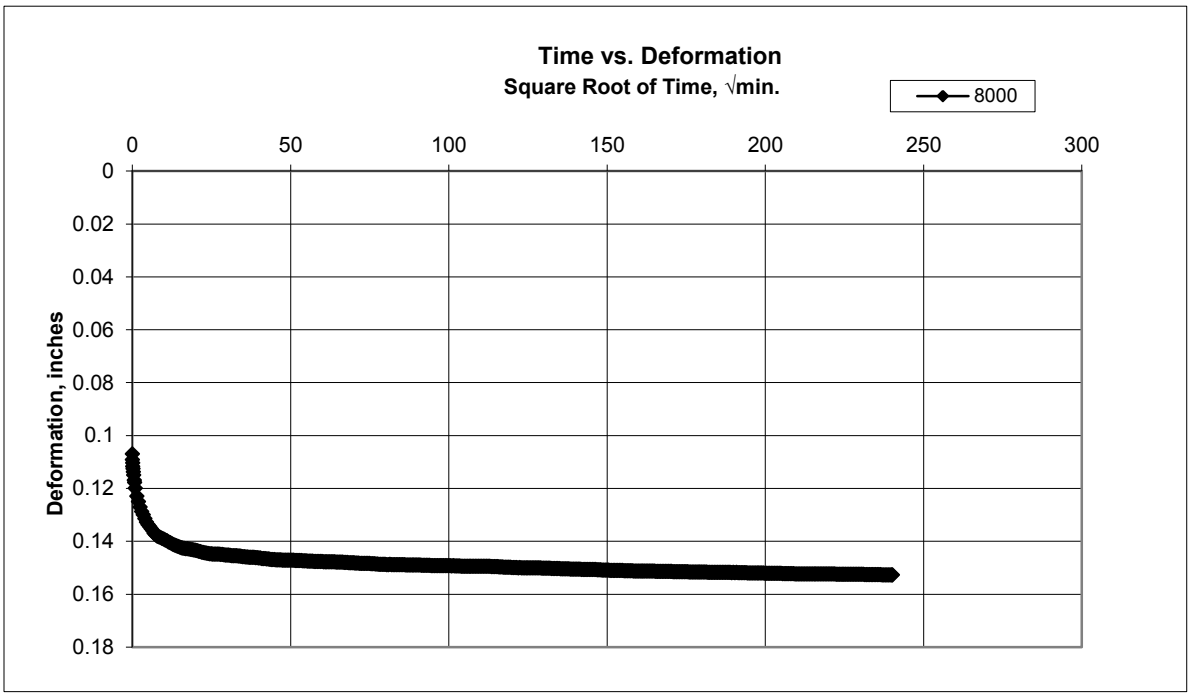


# CONSOLIDATION TEST
# ASTM D-2435

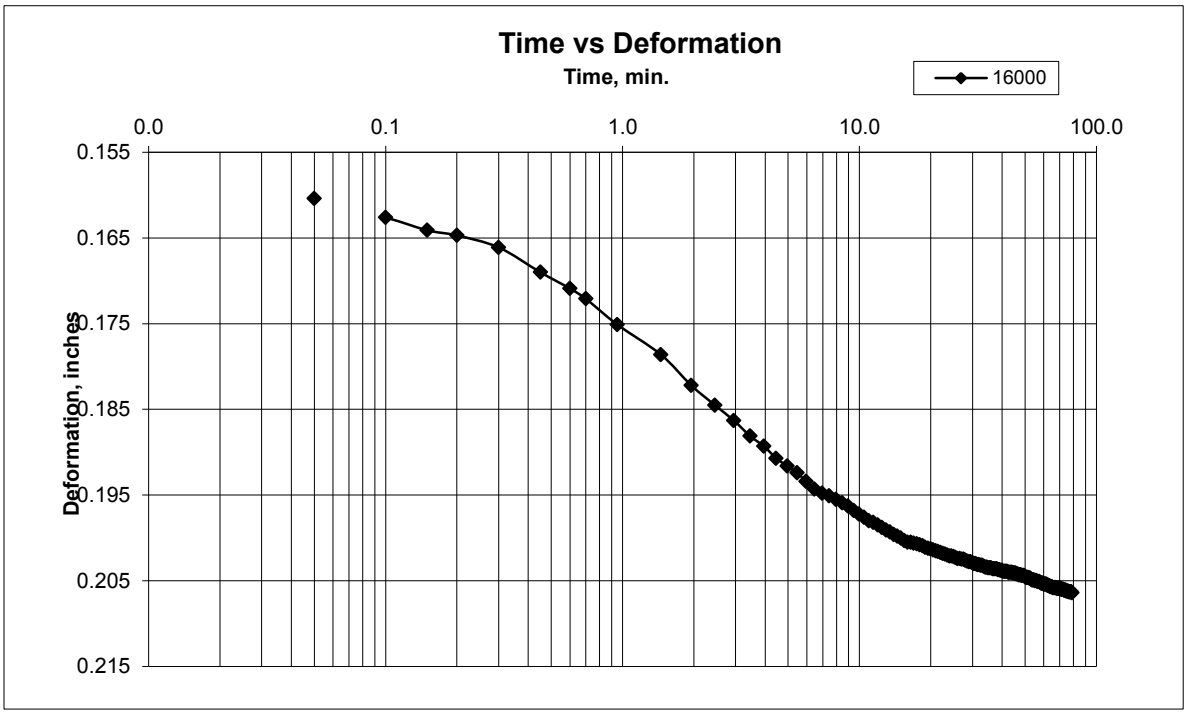
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 9 of 10 |
| LOCATION | GHB2 at 20.0' | TEST BY | DLR | DATE | 6/19/18 |
| SOIL TYPE | Clayey Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 |

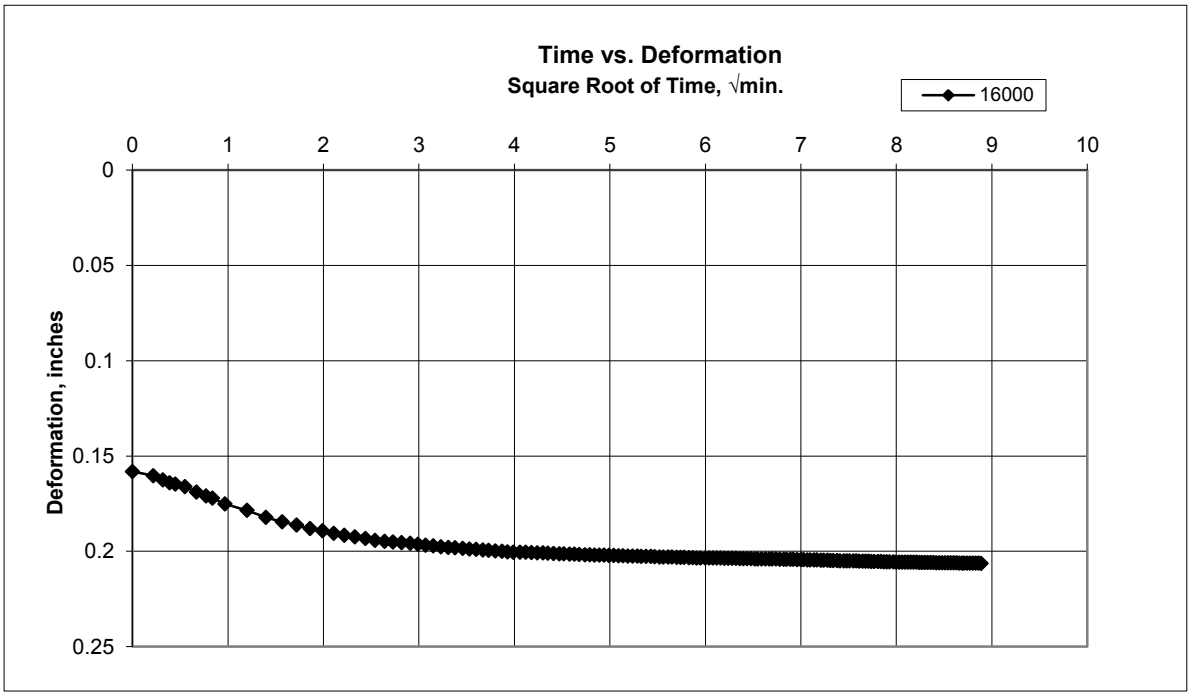


# CONSOLIDATION TEST
# ASTM D-2435

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 10 of 10 |
| LOCATION | GHB2 at 20.0' | TEST BY | DLR | DATE | 6/19/18 |
| SOIL TYPE | Clayey Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 |



LACO

# CONSOLIDATION TEST
## ASTM D-2435

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 1 of 10 |
| LOCATION | GHB2 at 45.0' | TEST BY | DLR | DATE | 7/20/18 |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 |

| | | |
|---|---|---|
| Diameter of Sample | 6.35 | cm |
| Area of Sample | 31.7 | $cm^2$ |
| Density of Water $\rho_w$ | 1 | $gram/cm^3$ |
| Specific Gravity of Solids G | 2.65 | $gram/cm^3$ |

| PRECONSOLIDATION | | | POSTCONSOLIDATION | | |
|---|---|---|---|---|---|
| Initial Specimen Height $H_0$ | 2.53 | cm | Final Speciment Height $H_f$ | 2.27 | cm |
| **Water Content** | | | **Water Content** | | |
| Wet soil + pan | 489.2 | gram | Wet soil + pan | 162.3 | gram |
| Dry soil + pan | 393.2 | gram | Dry soil + pan | 131.1 | gram |
| Pan | 8.8 | gram | Pan | 8.6 | gram |
| Total water | 96.0 | gram | Total water | 31.2 | gram |
| Dry soil | 384.4 | gram | Dry soil | 122.5 | gram |
| Water Content $W_{fp}$ | 25.0% | | Water Content $W_{fp}$ | 25.5% | |
| **Moisture Density** | | | **Moisture Density** | | |
| Wet soil + consol assembly | 1148.5 | gram | Wet soil + consol assembly | 1150.4 | gram |
| Consol assembly | 988.5 | gram | Consol assembly | 988.5 | gram |
| Moist Mass of Specimen $M_{TI}$ | 160 | gram | Moist Mass of Specimen $M_{Tf}$ | 161.9 | gram |
| Initial Volume of Sample $V_o$ | 80.1 | $cm^3$ | Final Volume of Sample $V_f$ | 71.8 | $cm^3$ |
| Wet Density | 2.0 | $gram/cm^3$ | Wet Density | 2.3 | $gram/cm^3$ |
| Dry Mass of Specimen $M_d$ | 128.0 | grams | Dry Mass of Specimen $M_d$ | 129.0 | grams |
| Initial Dry Density $\rho_d$ | 1.6 | $gram/cm^3$ | Final Dry Density | 1.8 | $gram/cm^3$ |
| Dry Unit Weight | 99.8 | $lb/ft^3$ | Final Dry Unit Wieght | 112.1 | $lb/ft^3$ |
| Volume of Solids $V_s$ | 48.3 | $cm^3$ | Volume of Solids $V_s$ | 48.7 | $cm^3$ |
| Equivalent Height of Solids $H_s$ | 1.53 | cm | Equivalent Height of Solids $H_s$ | 1.54 | cm |
| Void Ratio Before Test $e_o$ | 0.66 | | Void Ratio After Test $e_f$ | 0.48 | |
| Initial Degree of Saturation $S_o$ | 100.5% | | Final Degree of Saturation Sf | 142.0% | |

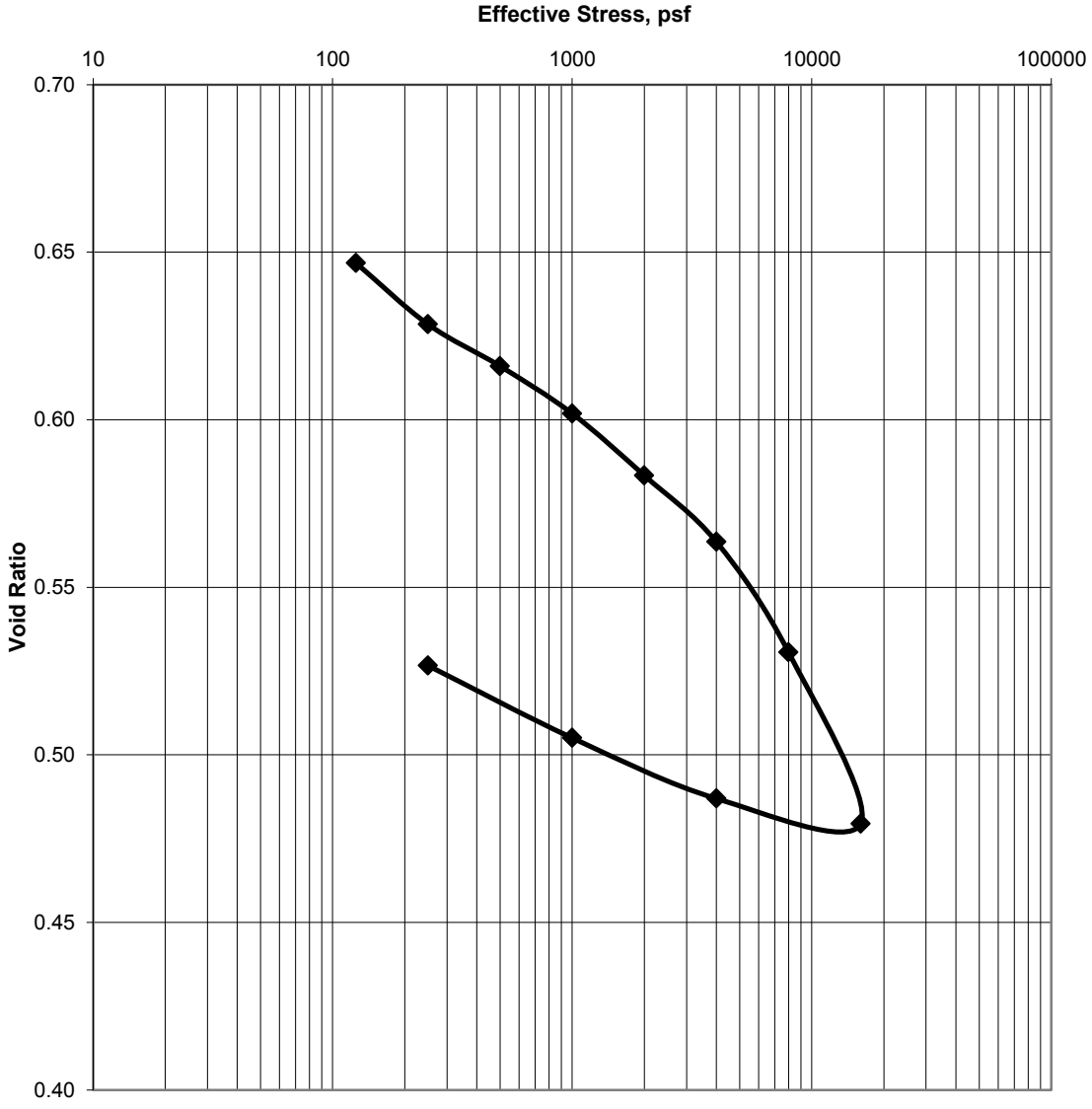
| Load Increment | Change in height $d_f$ (inches) | Change in height $d_f$ (cm) | $\sum\Delta H$ | Percent strain $\varepsilon = \sum\Delta H/H_0$ | Height $H=H_0-\Delta H$ | Void Ratio $e=(H-H_s)/H_s$ |
|---|---|---|---|---|---|---|
| Initial | 1 | | 0 | 0.00% | 2.53 | 0.66 |
| 125 | 0.0070 | 0.0178 | 0.0178 | 0.70% | 2.51 | 0.65 |
| 250 | 0.0110 | 0.0279 | 0.0457 | 1.81% | 2.48 | 0.63 |
| 500 | 0.0075 | 0.0191 | 0.0648 | 2.56% | 2.47 | 0.62 |
| 1000 | 0.0085 | 0.0216 | 0.0864 | 3.41% | 2.44 | 0.60 |
| 2000 | 0.0111 | 0.0282 | 0.1146 | 4.53% | 2.42 | 0.58 |
| 4000 | 0.0119 | 0.0302 | 0.1448 | 5.72% | 2.39 | 0.56 |
| 8000 | 0.0198 | 0.0503 | 0.1951 | 7.71% | 2.33 | 0.53 |
| 16000 | 0.0307 | 0.0780 | 0.2731 | 10.79% | 2.26 | 0.48 |
| 4000 | -0.0045 | -0.0114 | 0.2616 | 10.34% | 2.27 | 0.49 |
| 1000 | -0.0109 | -0.0276 | 0.2340 | 9.25% | 2.30 | 0.51 |
| 250 | -0.0130 | -0.0329 | 0.2011 | 7.95% | 2.33 | 0.53 |

LACO

# CONSOLIDATION TEST
## ASTM D-2435

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 2 of 10 |
| LOCATION | GHB2 at 45.0' | TEST BY | DLR | DATE | 7/20/18 |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 |

## Void Ratio-Log-P Curve



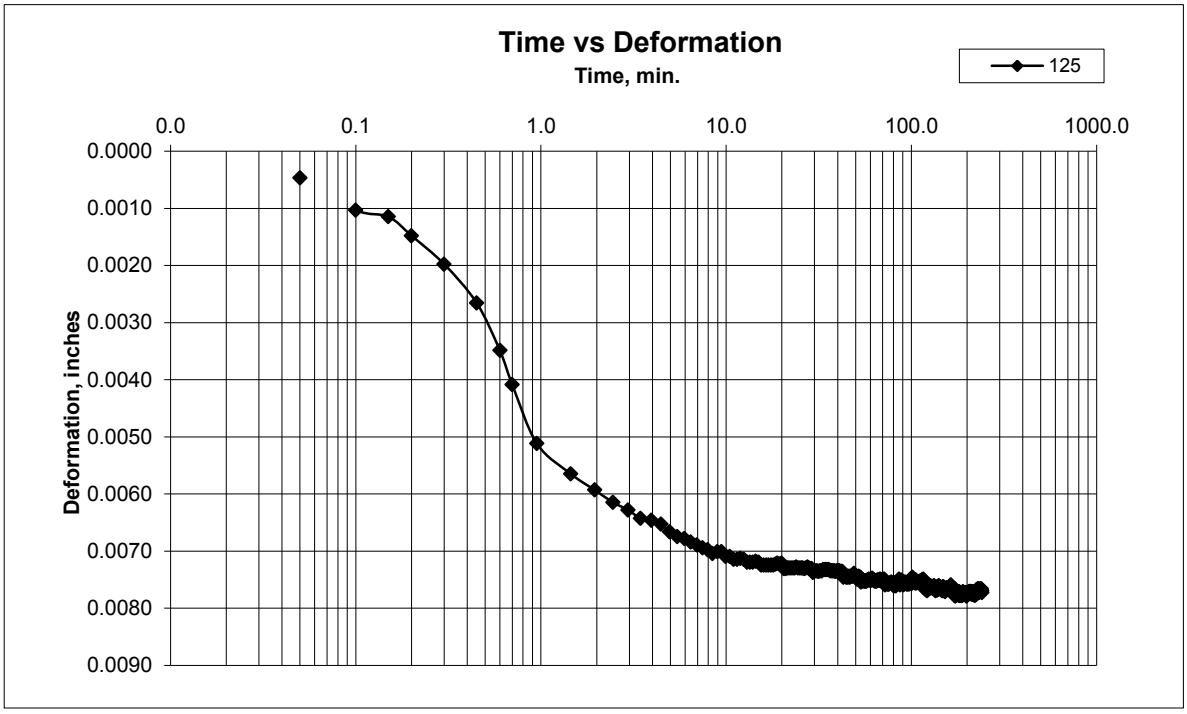

| | Initial | Final |
|---|---|---|
| **Moisture %** | 25.0% | 25.5% |
| **Dry Density, pcf** | 99.8 | 112.1 |
| **Void Ratio** | 0.66 | 0.48 |
| **% Saturation** | 100.5% | 142.0% |

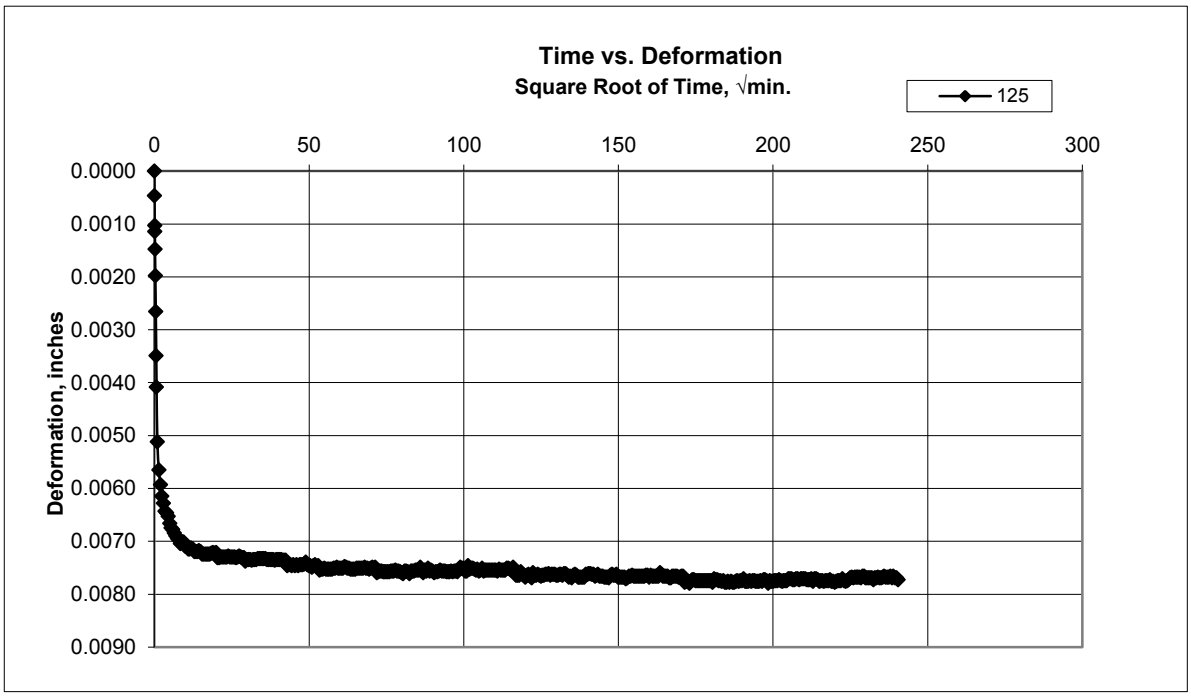
Assumed Specific Gravity = 2.65

**NOTES:**

# CONSOLIDATION TEST
# ASTM D-2435

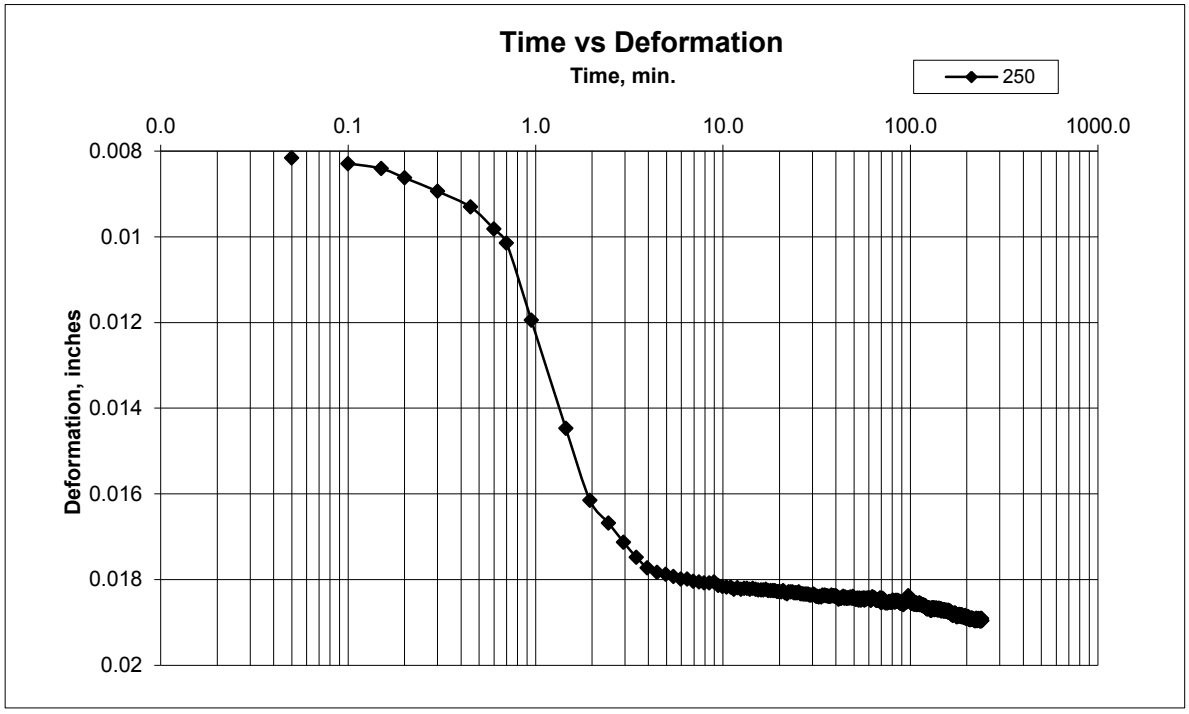
| | | | | | | |
|---|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | 18-061EK | 3 of 10 |
| LOCATION | GHB2 at 45.0' | TEST BY | DLR | DATE | 7/20/18 | |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 | |

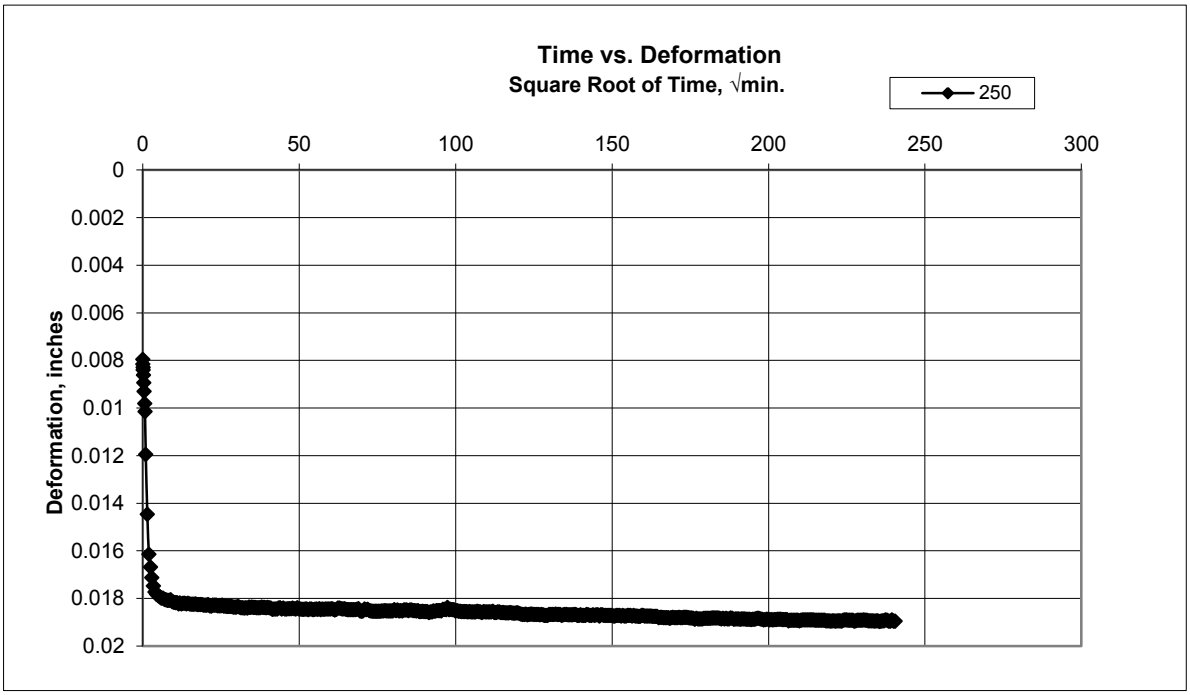


# CONSOLIDATION TEST
# ASTM D-2435

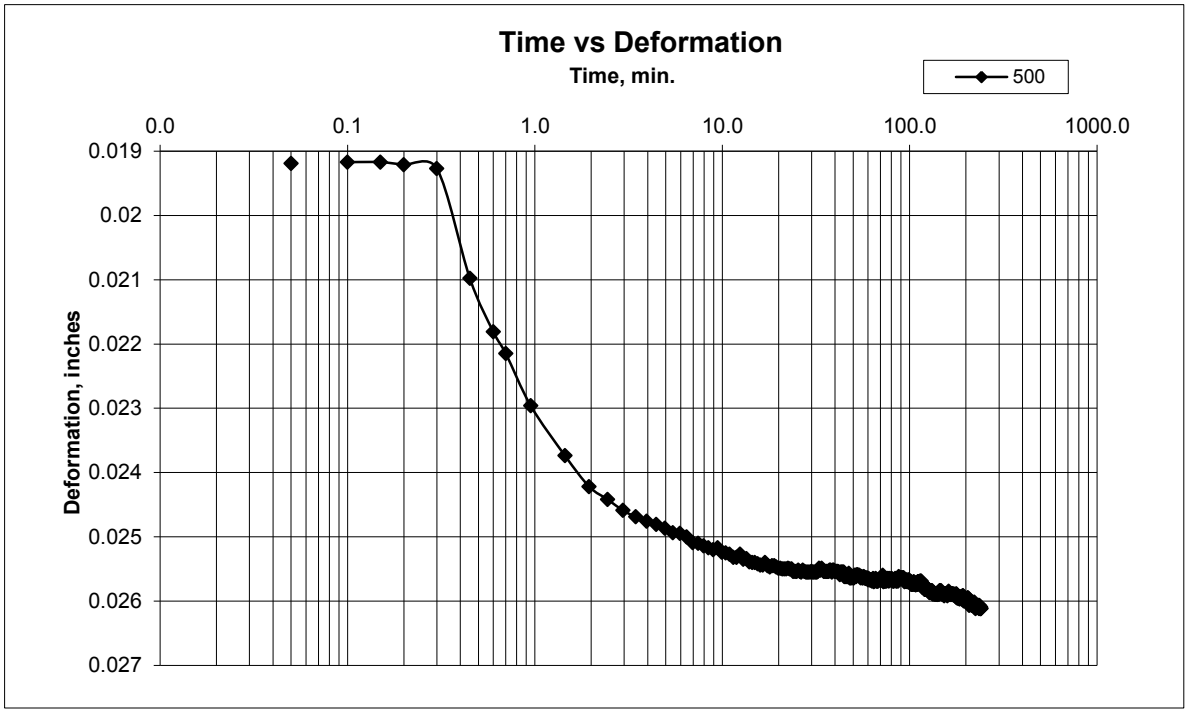
| | | | | | | |
|---|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | 18-061EK | 4 of 10 |
| LOCATION | GHB2 at 45.0' | TEST BY | DLR | DATE | 7/20/18 | |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 | |

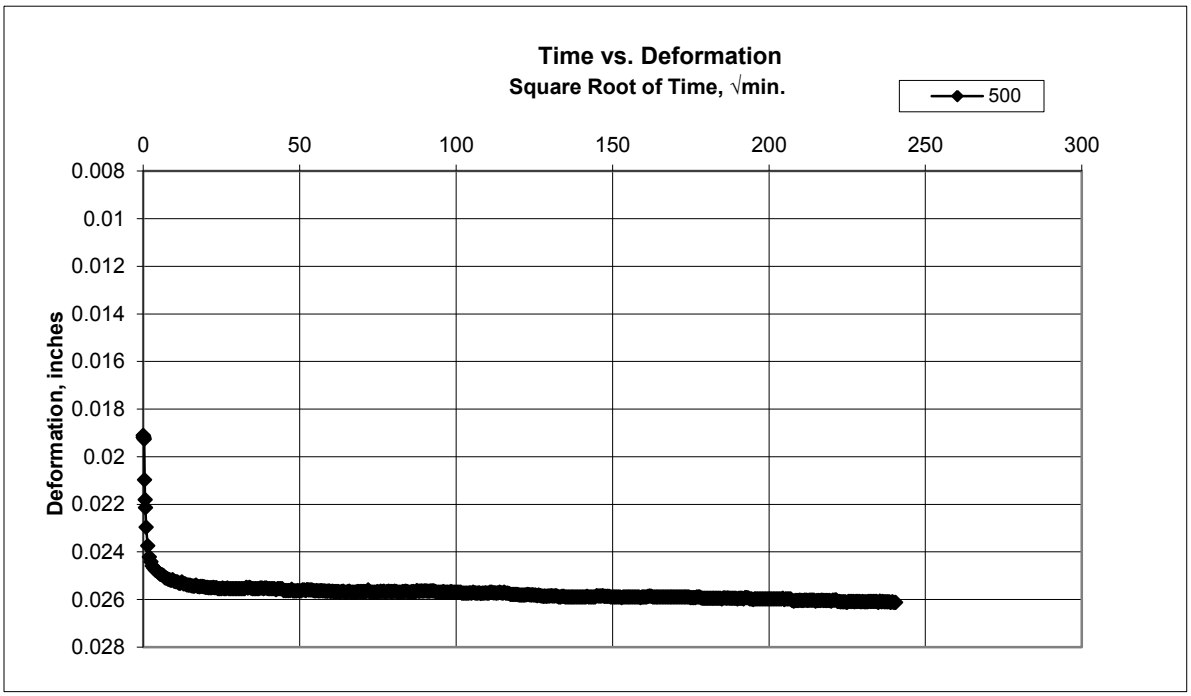


# CONSOLIDATION TEST
# ASTM D-2435

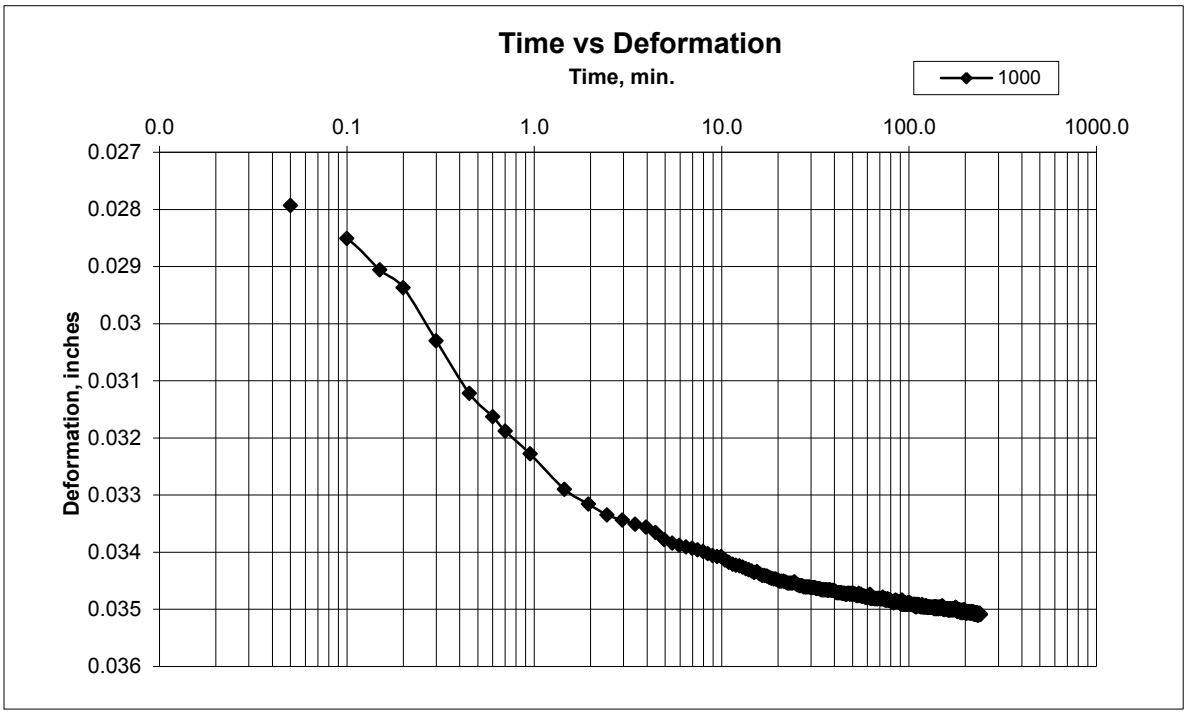
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | 18-061EK | | 5 of 10 |
| LOCATION | GHB2 at 45.0' | TEST BY | | DLR | DATE | | 7/20/18 |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | | 6/26/18 | |

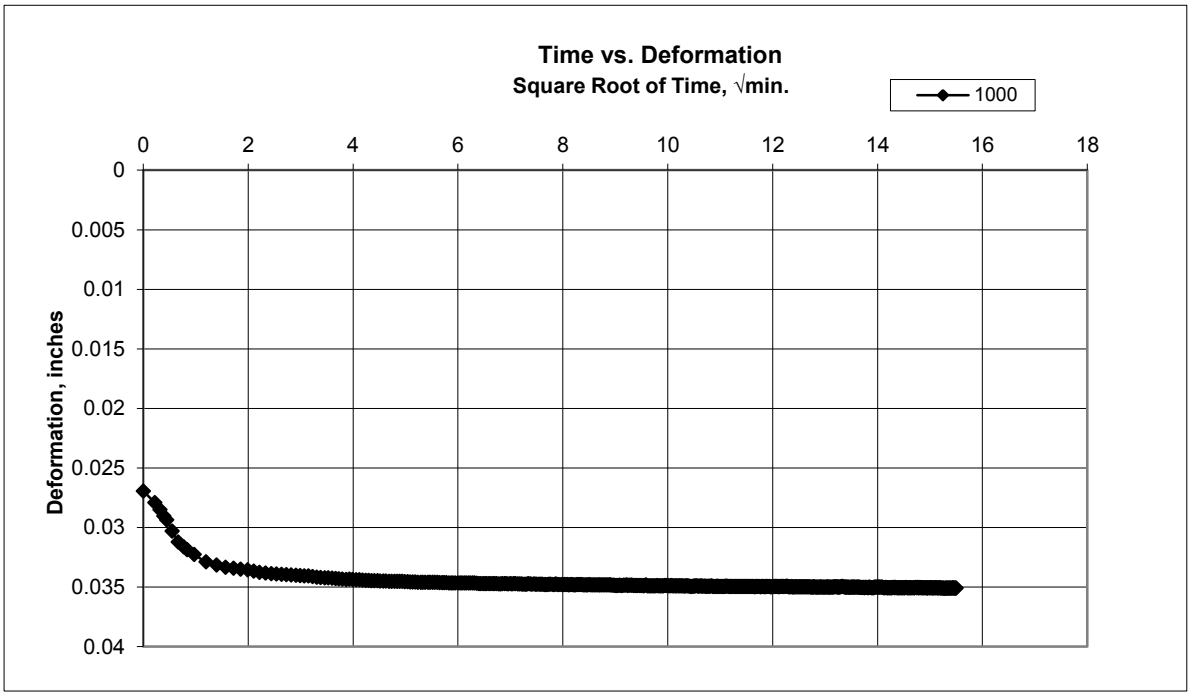


# CONSOLIDATION TEST
# ASTM D-2435

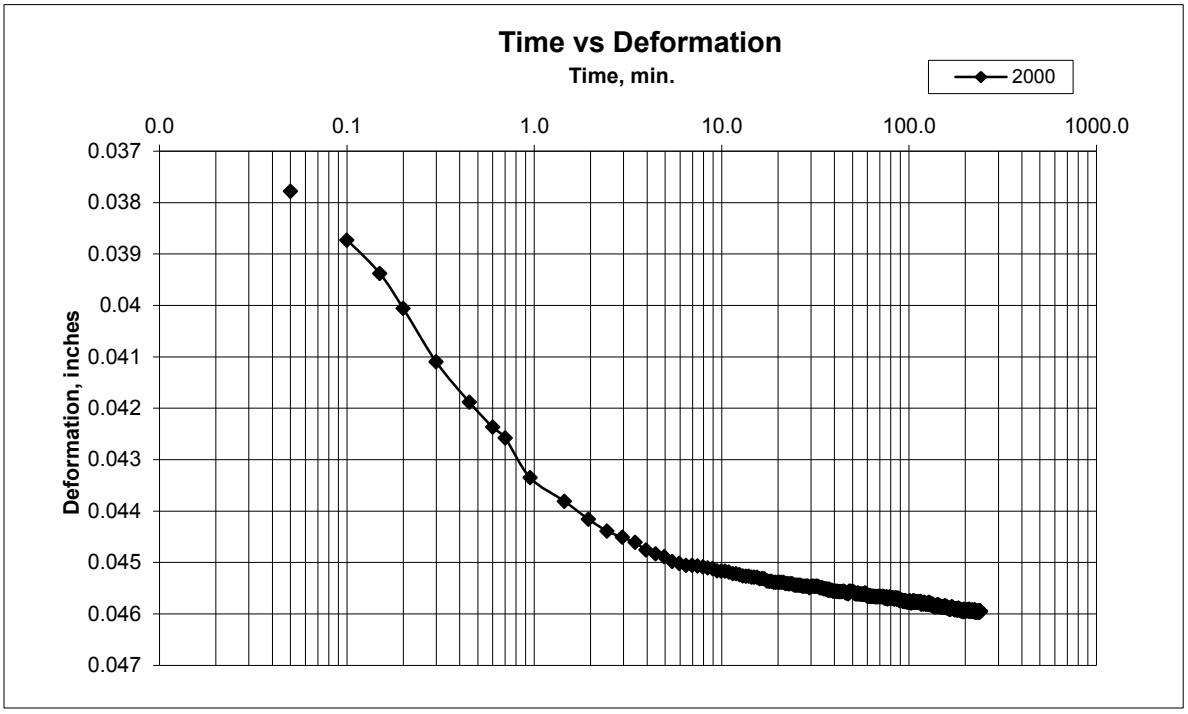
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 6 of 10 |
| LOCATION | GHB2 at 45.0' | TEST BY | DLR | DATE | 7/20/18 |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 |

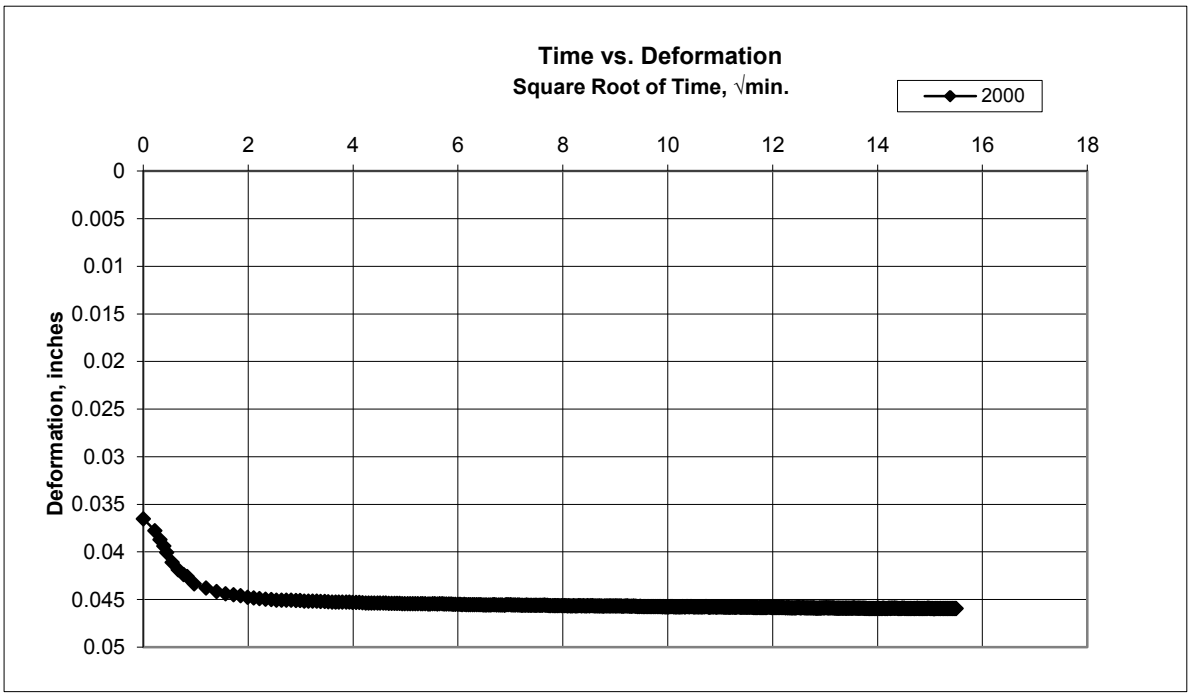


# CONSOLIDATION TEST
# ASTM D-2435

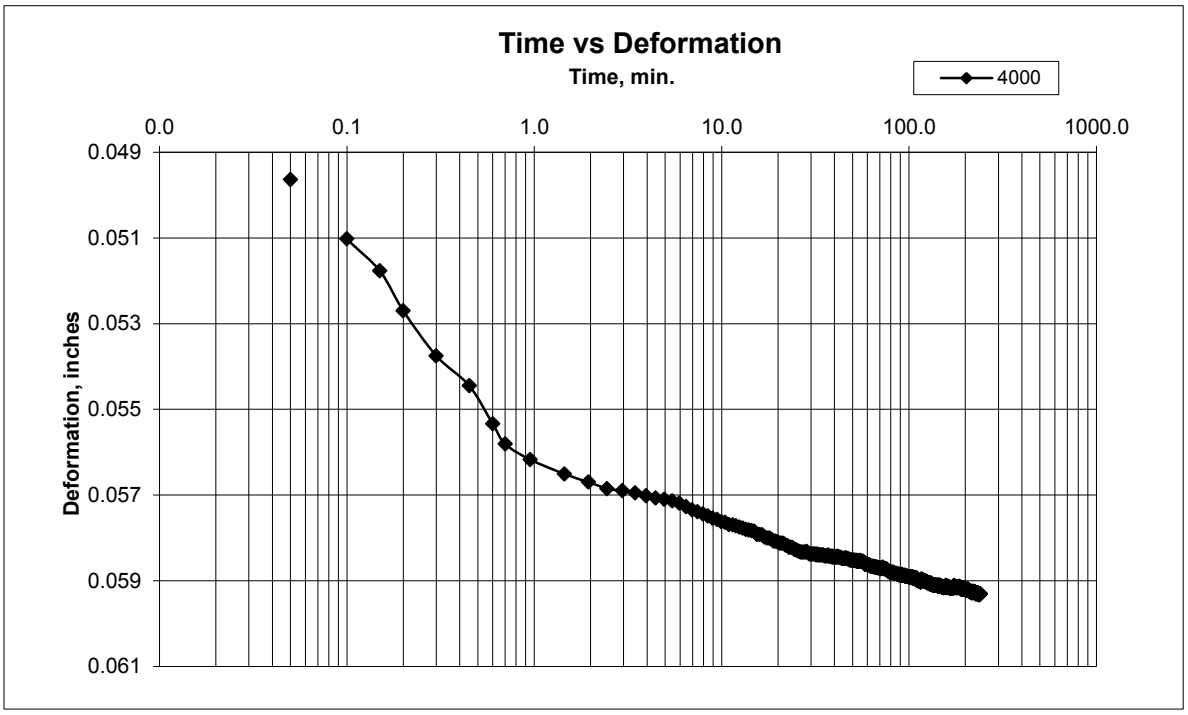
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 7 of 10 |
| LOCATION | GHB2 at 45.0' | TEST BY | DLR | DATE | 7/20/18 |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 |

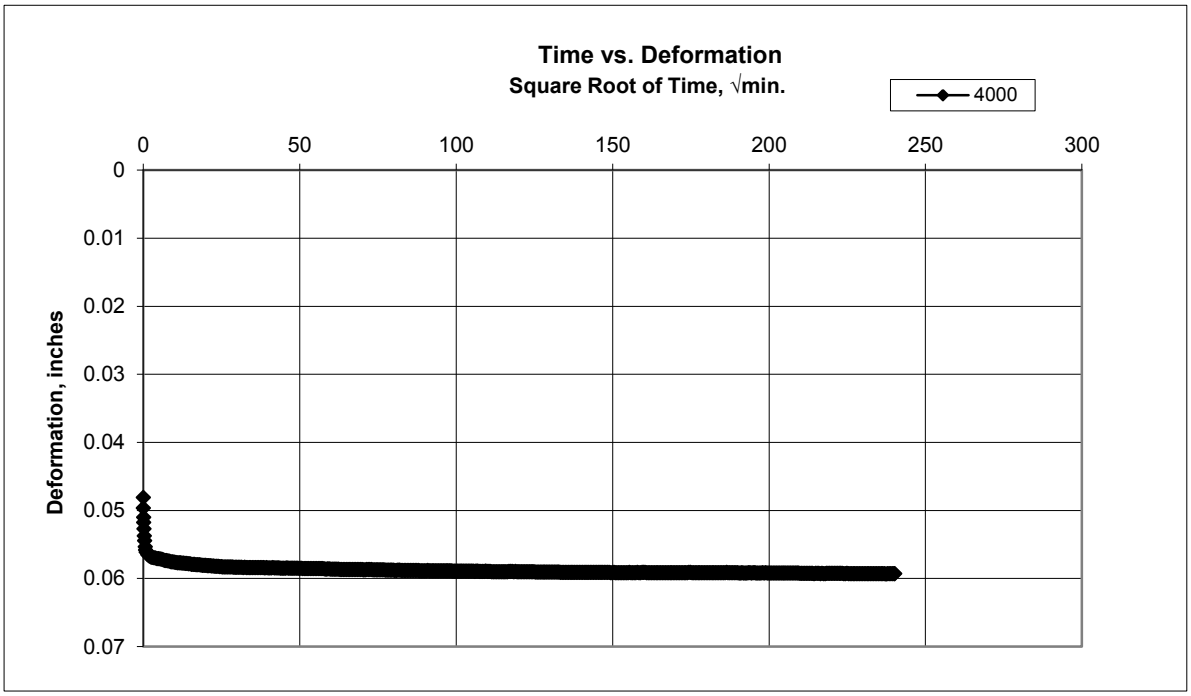


# CONSOLIDATION TEST
# ASTM D-2435

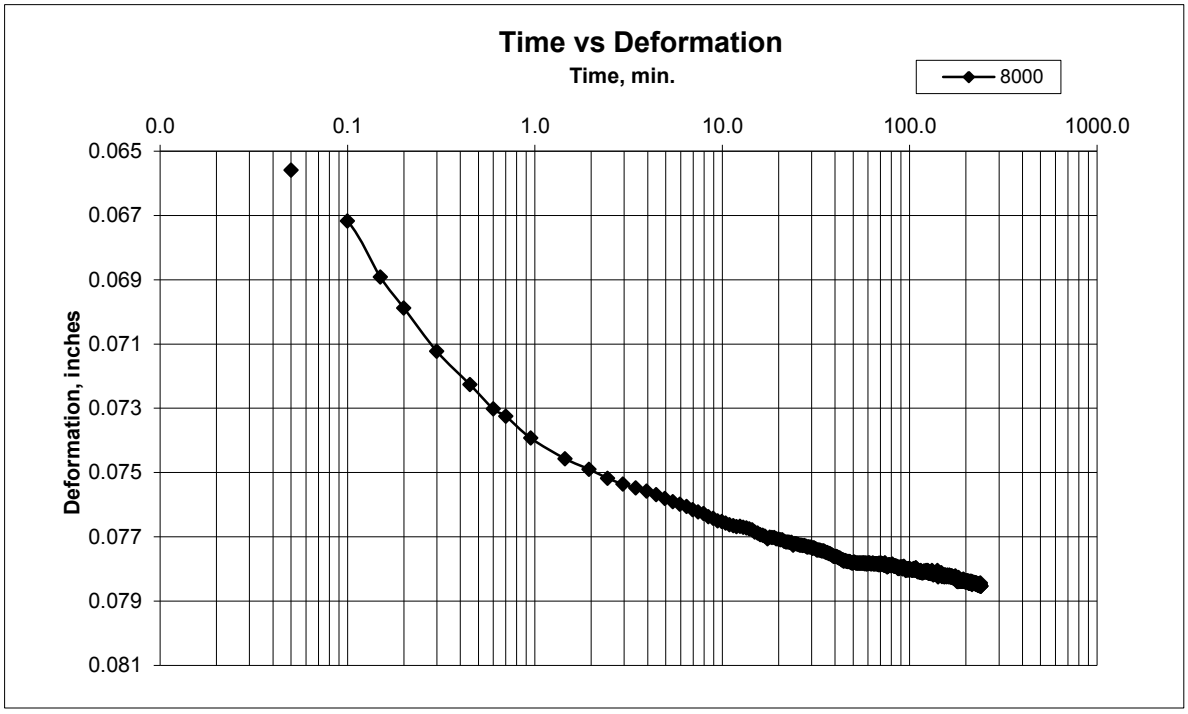
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 8 of 10 |
| LOCATION | GHB2 at 45.0' | TEST BY | DLR | DATE | 7/20/18 |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 |

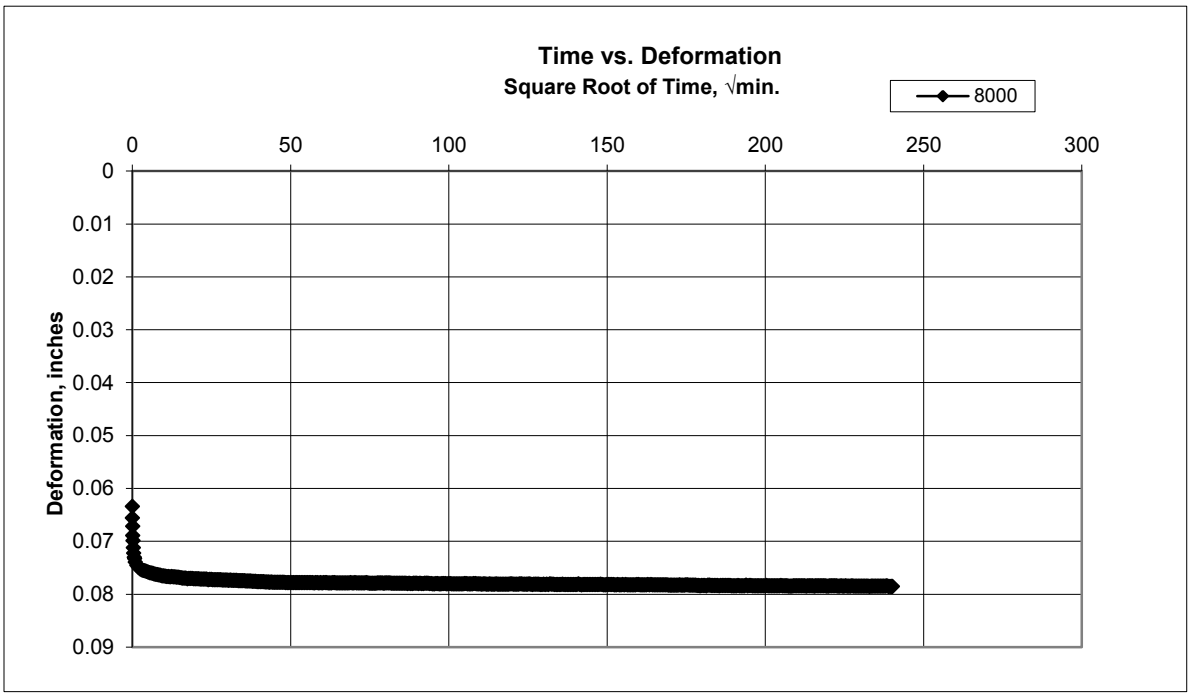


# CONSOLIDATION TEST
# ASTM D-2435

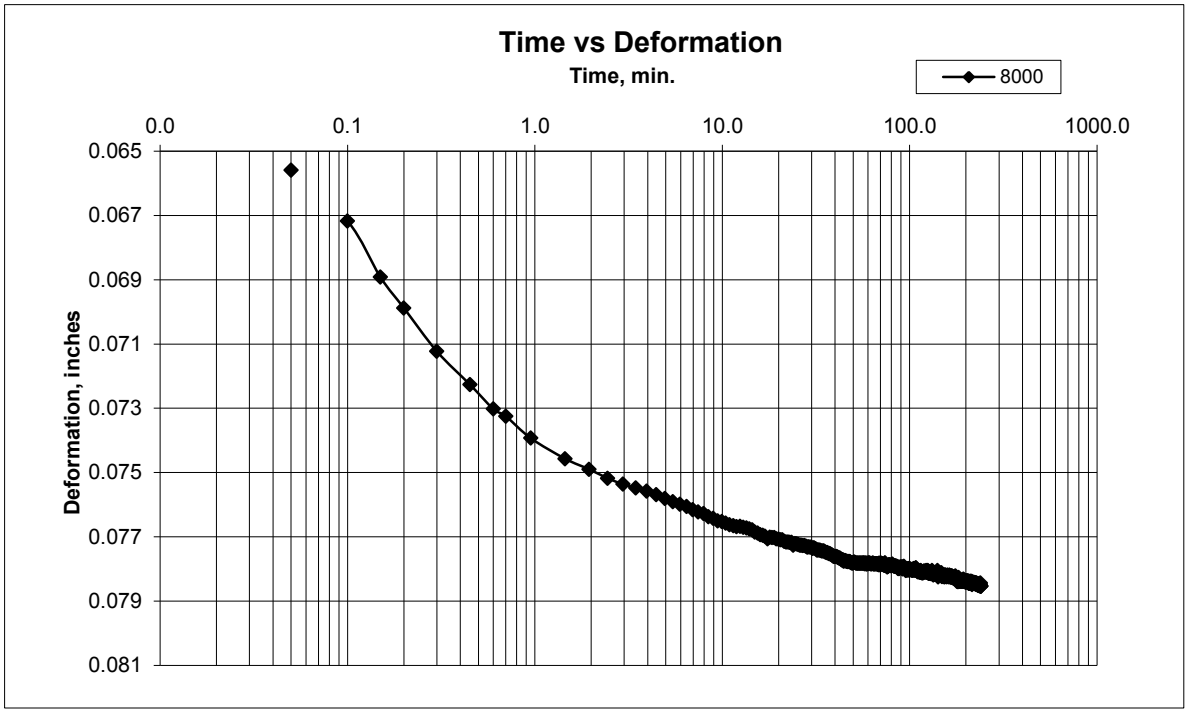
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 9 of 10 |
| LOCATION | GHB2 at 45.0' | TEST BY | DLR | DATE | 7/20/18 |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 |

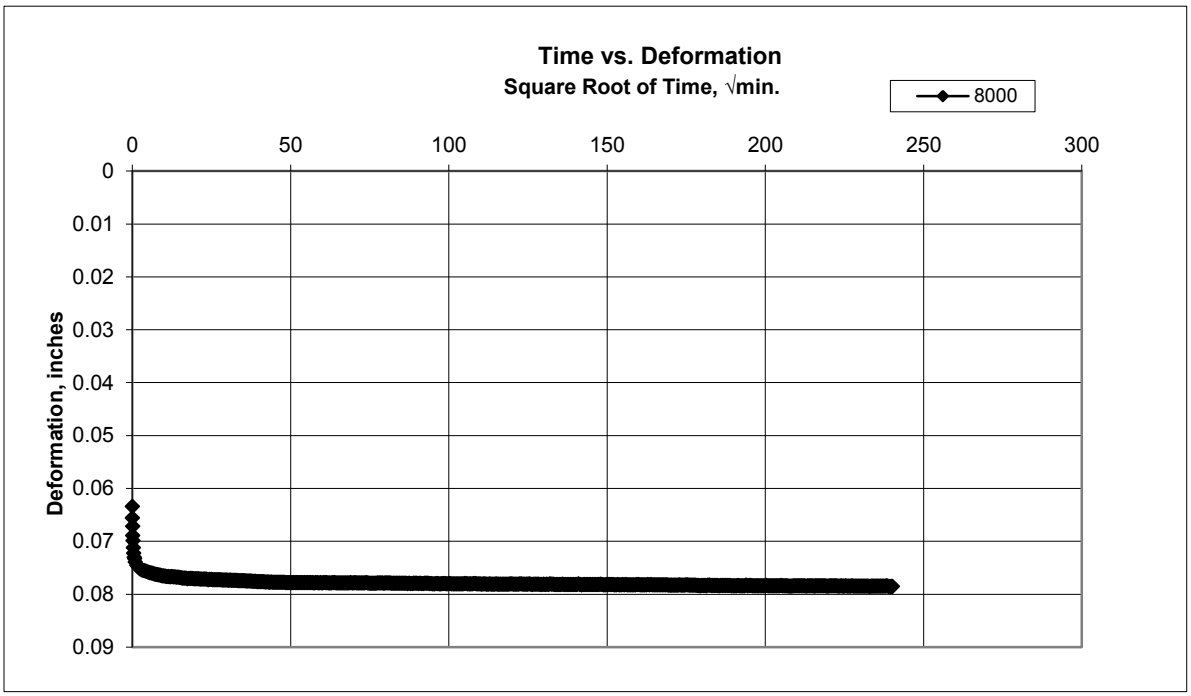


# CONSOLIDATION TEST
# ASTM D-2435

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 9 of 10 |
| LOCATION | GHB2 at 45.0' | TEST BY | DLR | DATE | 7/20/18 |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 6/26/18 |



LACO

# CONSOLIDATION TEST
## ASTM D-2435

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 1 of 10 |
| LOCATION | GHB5 at 37.0' | TEST BY | DLR | DATE | 7/30/18 |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 8/20/18 |

| | | |
|---|---|---|
| Diameter of Sample | 6.35 | cm |
| Area of Sample | 31.7 | $cm^2$ |
| Density of Water $\rho_w$ | 1 | $gram/cm^3$ |
| Specific Gravity of Solids G | 2.65 | $gram/cm^3$ |

| PRECONSOLIDATION | | | POSTCONSOLIDATION | | |
|---|---|---|---|---|---|
| Initial Specimen Height $H_0$ | 2.53 | cm | Final Speciment Height $H_f$ | 2.30 | cm |
| **Water Content** | | | **Water Content** | | |
| Wet soil + pan | 193.9 | gram | Wet soil + pan | 164.2 | gram |
| Dry soil + pan | 160.9 | gram | Dry soil + pan | 137.8 | gram |
| Pan | 8.5 | gram | Pan | 8.5 | gram |
| Total water | 33.0 | gram | Total water | 26.4 | gram |
| Dry soil | 152.4 | gram | Dry soil | 129.3 | gram |
| Water Content $W_{fp}$ | 21.7% | | Water Content $W_{fp}$ | 20.4% | |
| **Moisture Density** | | | **Moisture Density** | | |
| Wet soil + consol assembly | 1148.1 | gram | Wet soil + consol assembly | 1148 | gram |
| Consol assembly | 987.1 | gram | Consol assembly | 987.3 | gram |
| Moist Mass of Specimen $M_{TI}$ | 161 | gram | Moist Mass of Specimen $M_{Tf}$ | 160.7 | gram |
| Initial Volume of Sample $V_o$ | 80.1 | $cm^3$ | Final Volume of Sample $V_f$ | 72.8 | $cm^3$ |
| Wet Density | 2.0 | $gram/cm^3$ | Wet Density | 2.2 | $gram/cm^3$ |
| Dry Mass of Specimen $M_d$ | 132.3 | grams | Dry Mass of Specimen $M_d$ | 133.5 | grams |
| Initial Dry Density $\rho_d$ | 1.7 | $gram/cm^3$ | Final Dry Density | 1.8 | $gram/cm^3$ |
| Dry Unit Weight | 103.1 | $lb/ft^3$ | Final Dry Unit Wieght | 114.5 | $lb/ft^3$ |
| Volume of Solids $V_s$ | 49.9 | $cm^3$ | Volume of Solids $V_s$ | 50.4 | $cm^3$ |
| Equivalent Height of Solids $H_s$ | 1.58 | cm | Equivalent Height of Solids $H_s$ | 1.59 | cm |
| Void Ratio Before Test $e_o$ | 0.60 | | Void Ratio After Test $e_f$ | 0.44 | |
| Initial Degree of Saturation $S_o$ | 94.9% | | Final Degree of Saturation Sf | 121.7% | |

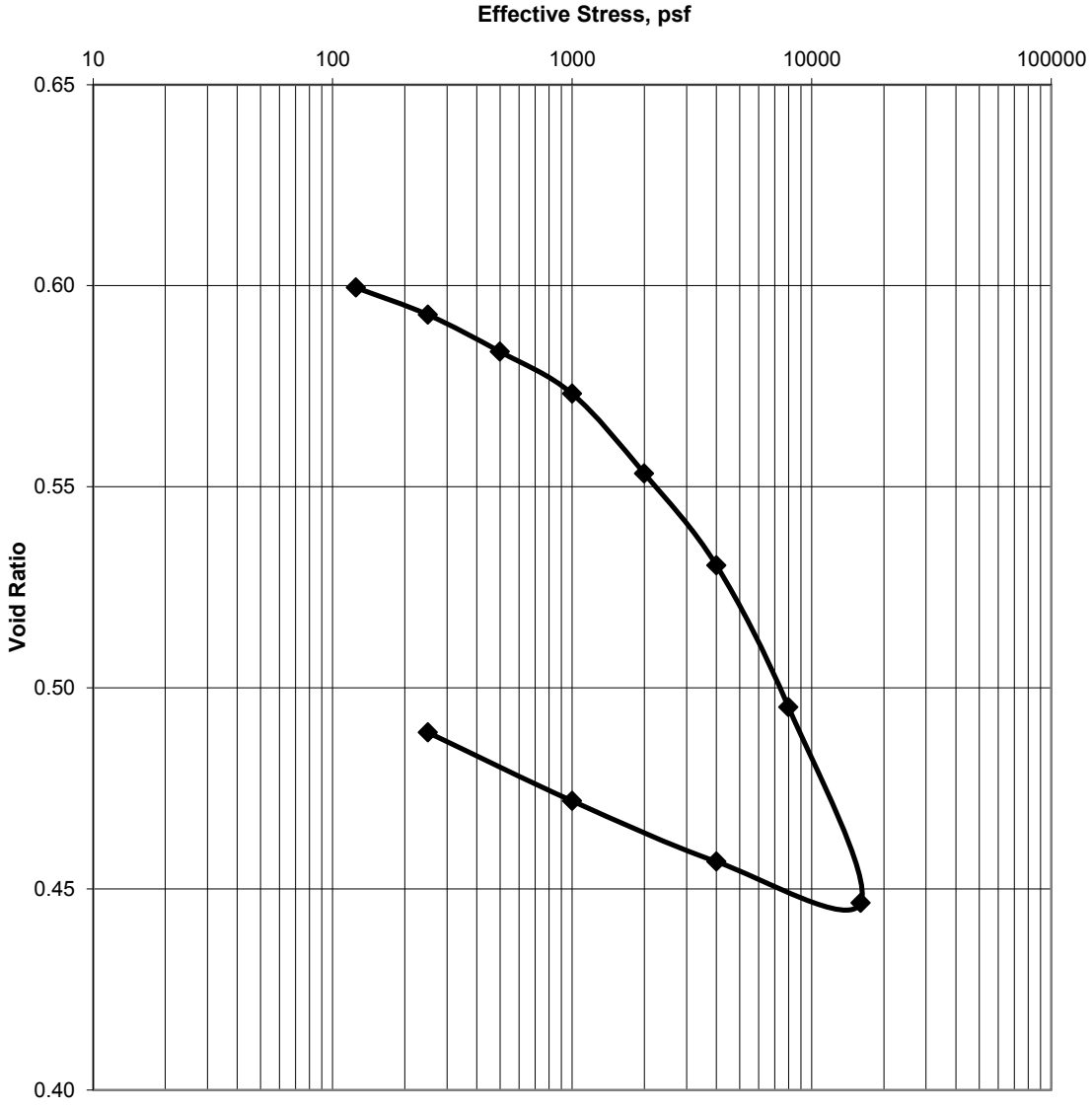
| Load Increment | Change in height $d_f$ (inches) | Change in height $d_f$ (cm) | $\sum\Delta H$ | Percent strain $\varepsilon = \sum\Delta H/H_0$ | Height $H=H_0-\Delta H$ | Void Ratio $e=(H-H_s)/H_s$ |
|---|---|---|---|---|---|---|
| Initial | 1 | | 0 | 0.00% | 2.53 | 0.60 |
| 125 | 0.0030 | 0.0076 | 0.0076 | 0.30% | 2.52 | 0.60 |
| 250 | 0.0042 | 0.0107 | 0.0183 | 0.72% | 2.51 | 0.59 |
| 500 | 0.0057 | 0.0145 | 0.0328 | 1.30% | 2.50 | 0.58 |
| 1000 | 0.0065 | 0.0165 | 0.0493 | 1.95% | 2.48 | 0.57 |
| 2000 | 0.0123 | 0.0312 | 0.0805 | 3.18% | 2.45 | 0.55 |
| 4000 | 0.0142 | 0.0361 | 0.1166 | 4.61% | 2.41 | 0.53 |
| 8000 | 0.0219 | 0.0556 | 0.1722 | 6.81% | 2.36 | 0.50 |
| 16000 | 0.0302 | 0.0767 | 0.2489 | 9.84% | 2.28 | 0.45 |
| 4000 | -0.0064 | -0.0162 | 0.2327 | 9.20% | 2.30 | 0.46 |
| 1000 | -0.0094 | -0.0238 | 0.2089 | 8.26% | 2.32 | 0.47 |
| 250 | -0.0106 | -0.0268 | 0.1821 | 7.20% | 2.35 | 0.49 |

LACO

# CONSOLIDATION TEST
## ASTM D-2435

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 2 of 10 |
| LOCATION | GHB5 at 37.0' | TEST BY | DLR | DATE | 7/30/18 |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 8/20/18 |

## Void Ratio-Log-P Curve



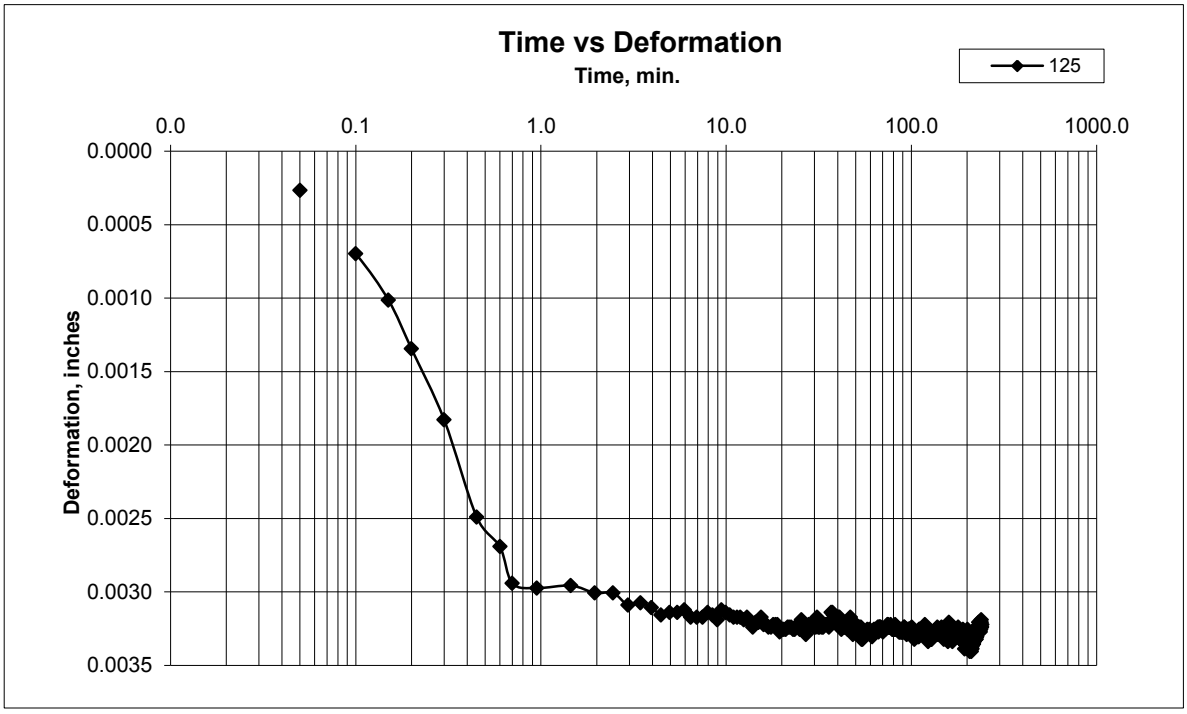

| | Initial | Final |
|---|---|---|
| **Moisture %** | 21.7% | 20.4% |
| **Dry Density, pcf** | 103.1 | 114.5 |
| **Void Ratio** | 0.60 | 0.44 |
| **% Saturation** | 94.9% | 121.7% |

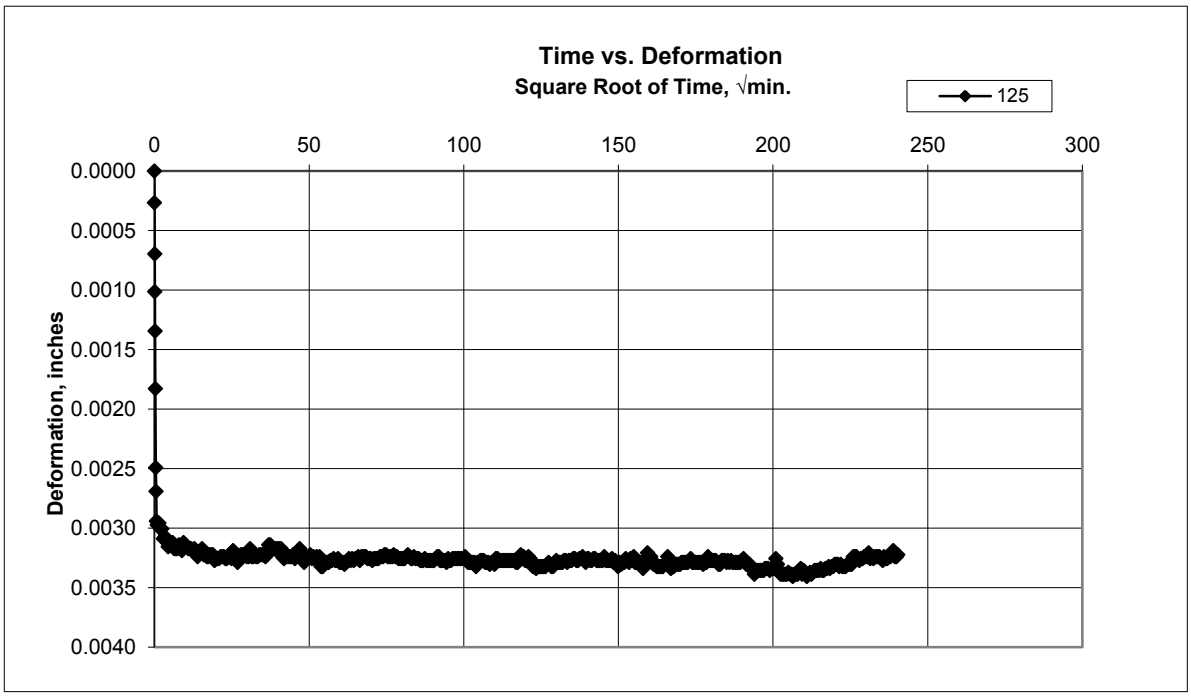
Assumed Specific Gravity = 2.65

**NOTES:**

# CONSOLIDATION TEST
# ASTM D-2435

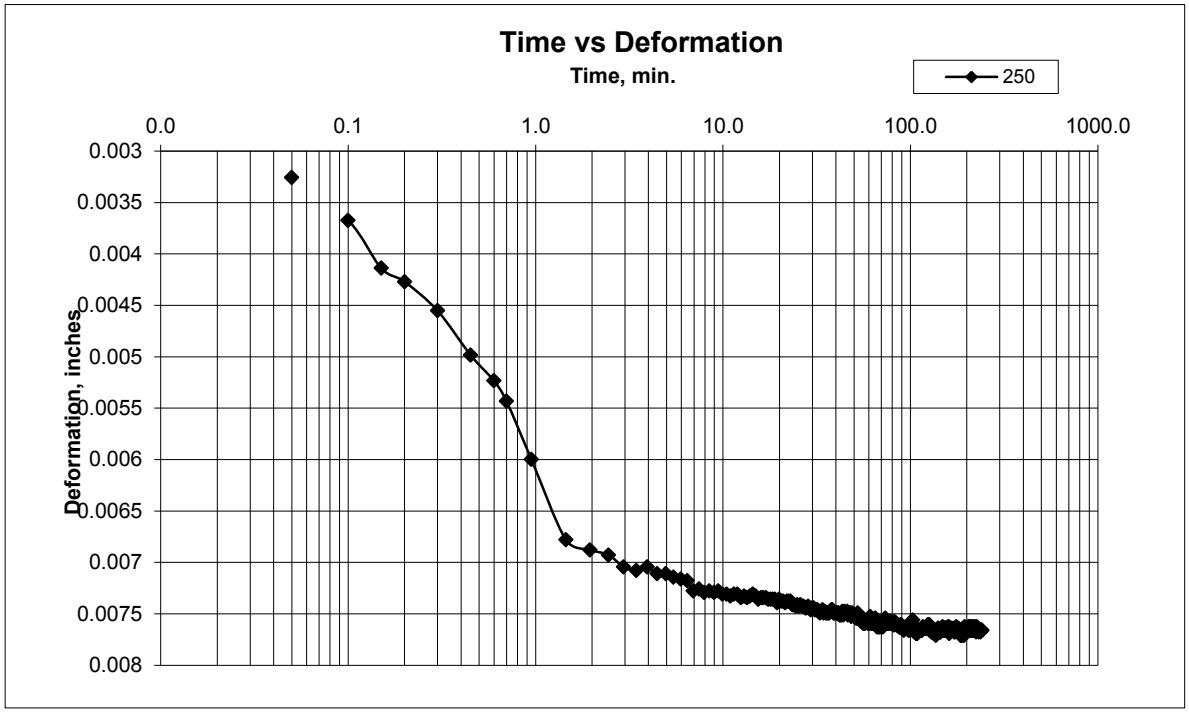
| | | | | | | |
|---|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | 18-061EK | 3 of 10 |
| LOCATION | GHB5 at 37.0' | TEST BY | DLR | DATE | 7/30/18 | |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 8/20/18 | |

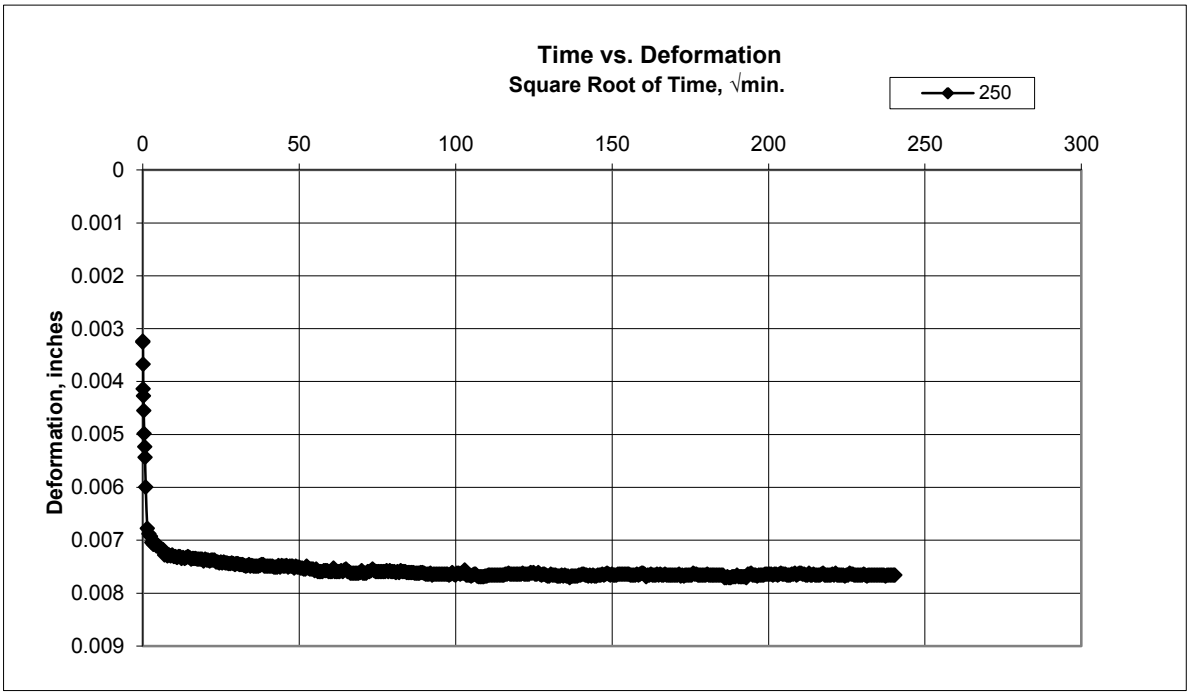


# CONSOLIDATION TEST
## ASTM D-2435

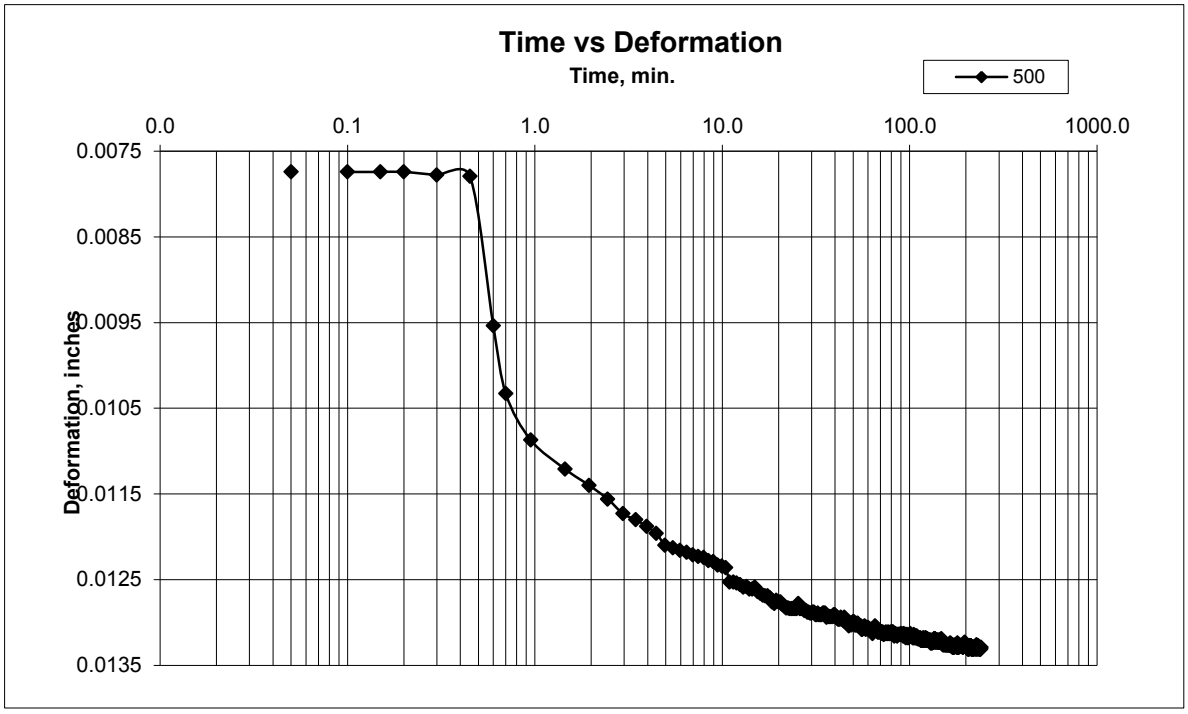
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 4 of 10 |
| LOCATION | GHB5 at 37.0' | TEST BY | DLR | DATE | 7/30/18 |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 8/20/18 |

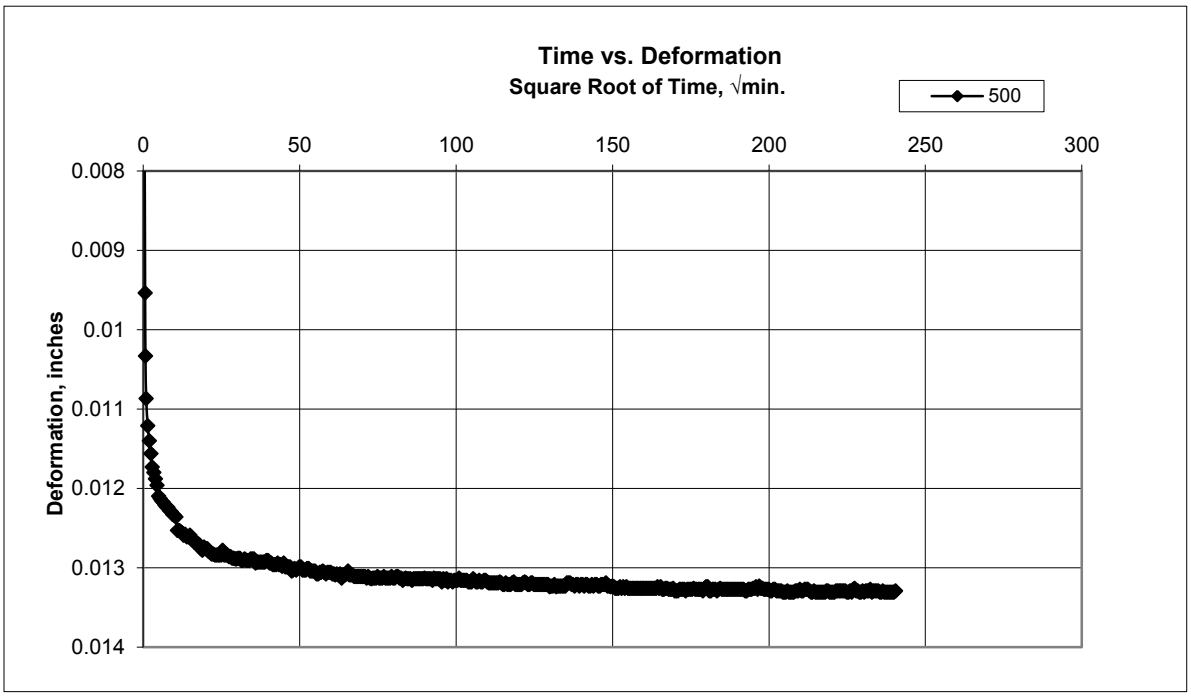


# CONSOLIDATION TEST
# ASTM D-2435

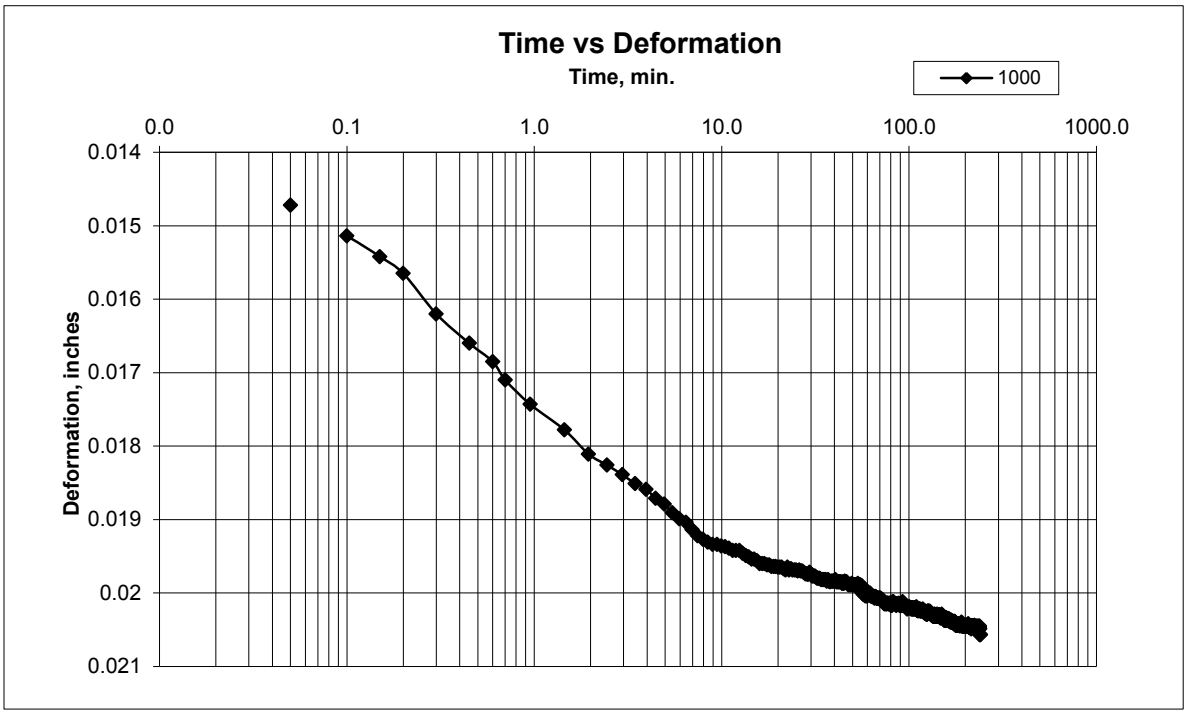
| | | | | | | |
|---|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | 18-061EK | 5 of 10 |
| LOCATION | GHB5 at 37.0' | TEST BY | DLR | DATE | 7/30/18 | |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 8/20/18 | |

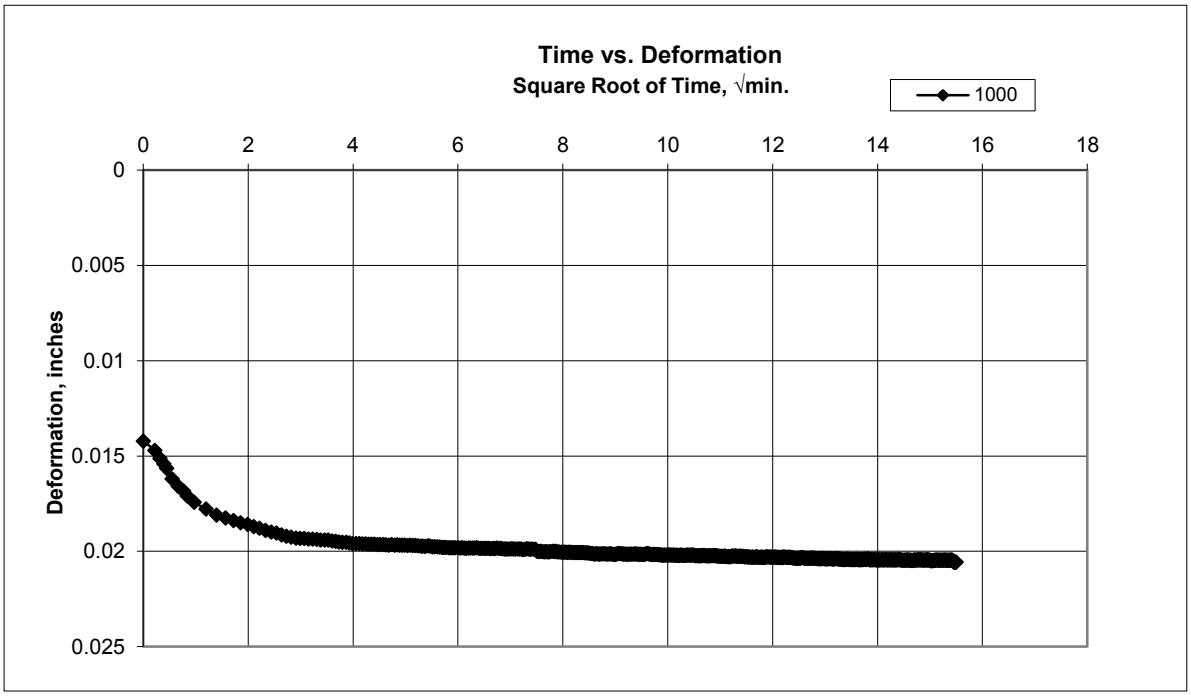


# CONSOLIDATION TEST
## ASTM D-2435

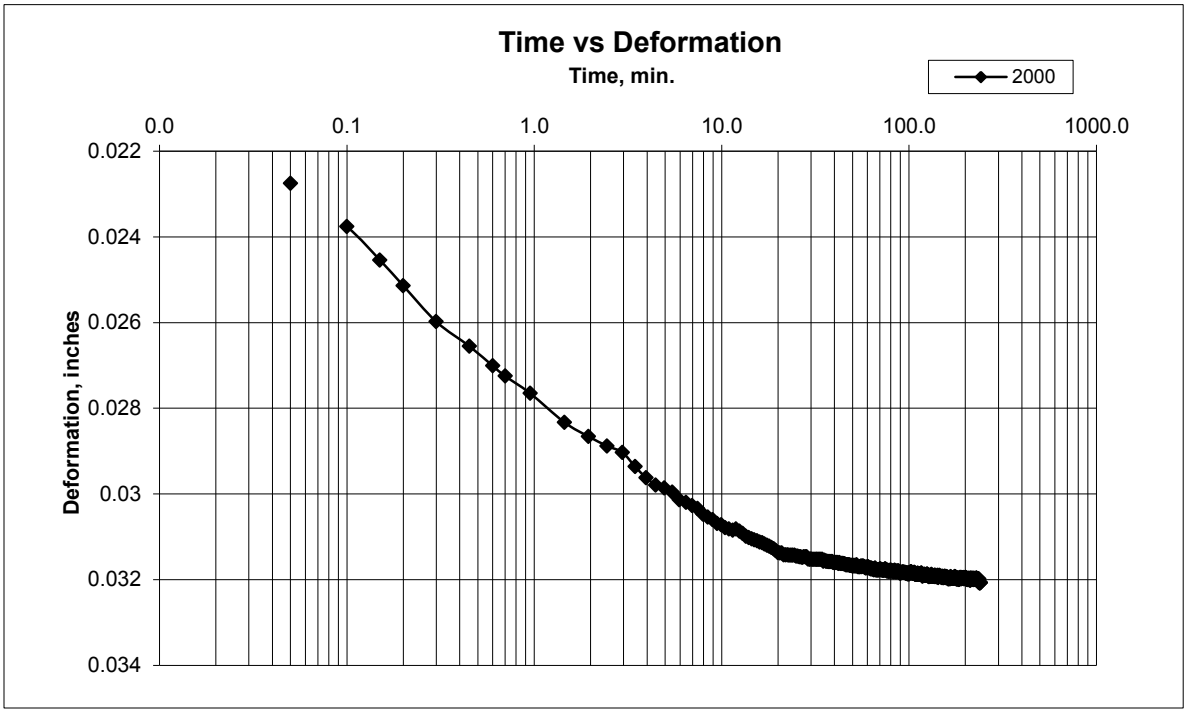
| | | | | | | |
|---|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | 18-061EK | 6 of 10 |
| LOCATION | GHB5 at 37.0' | TEST BY | DLR | DATE | 7/30/18 | |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 8/20/18 | |

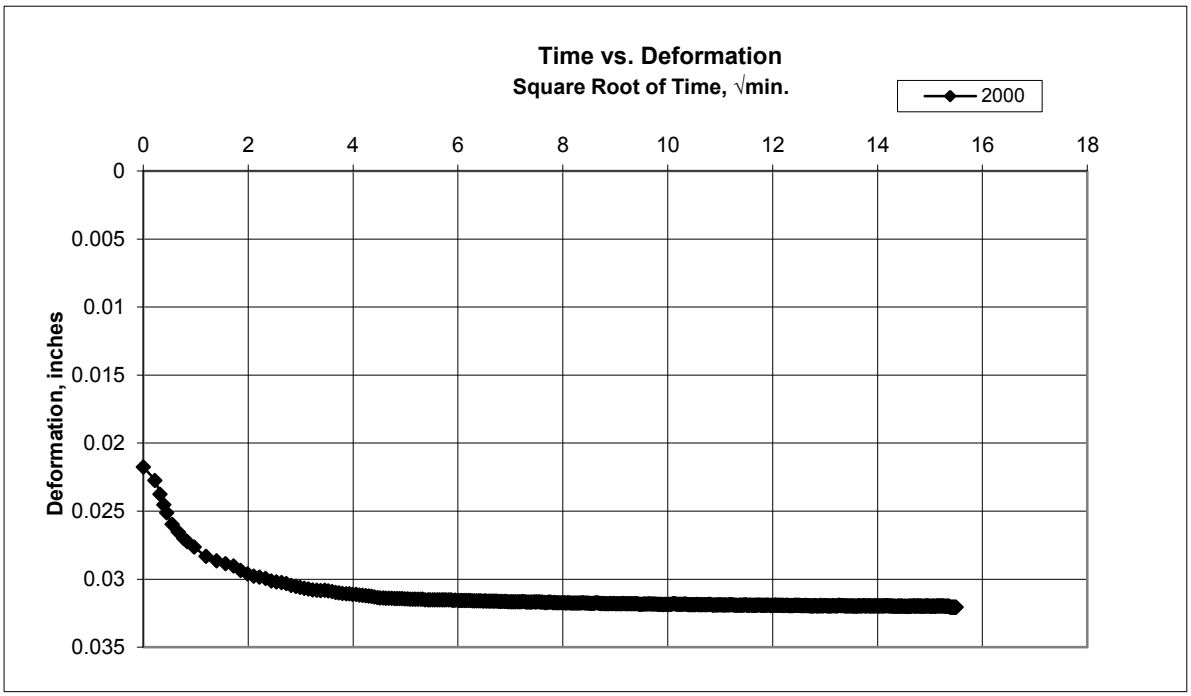


# CONSOLIDATION TEST
# ASTM D-2435

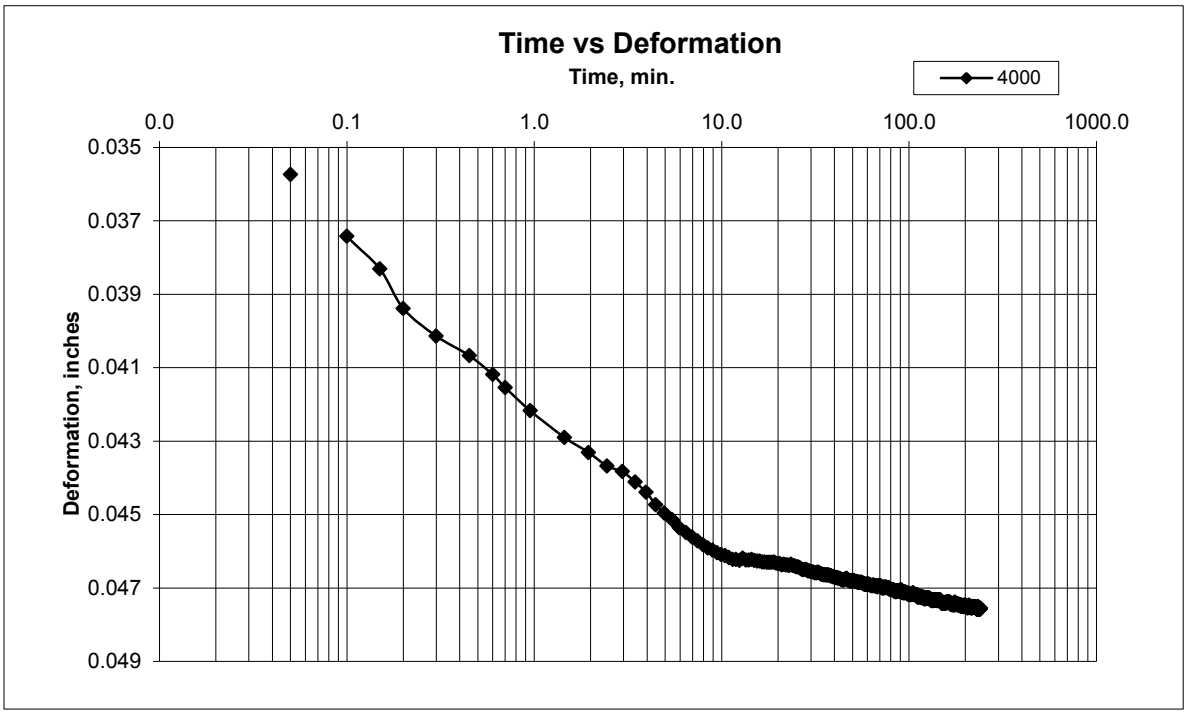
| | | | | | | |
|---|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | 18-061EK | 7 of 10 |
| LOCATION | GHB5 at 37.0' | TEST BY | DLR | DATE | 7/30/18 | |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 8/20/18 | |

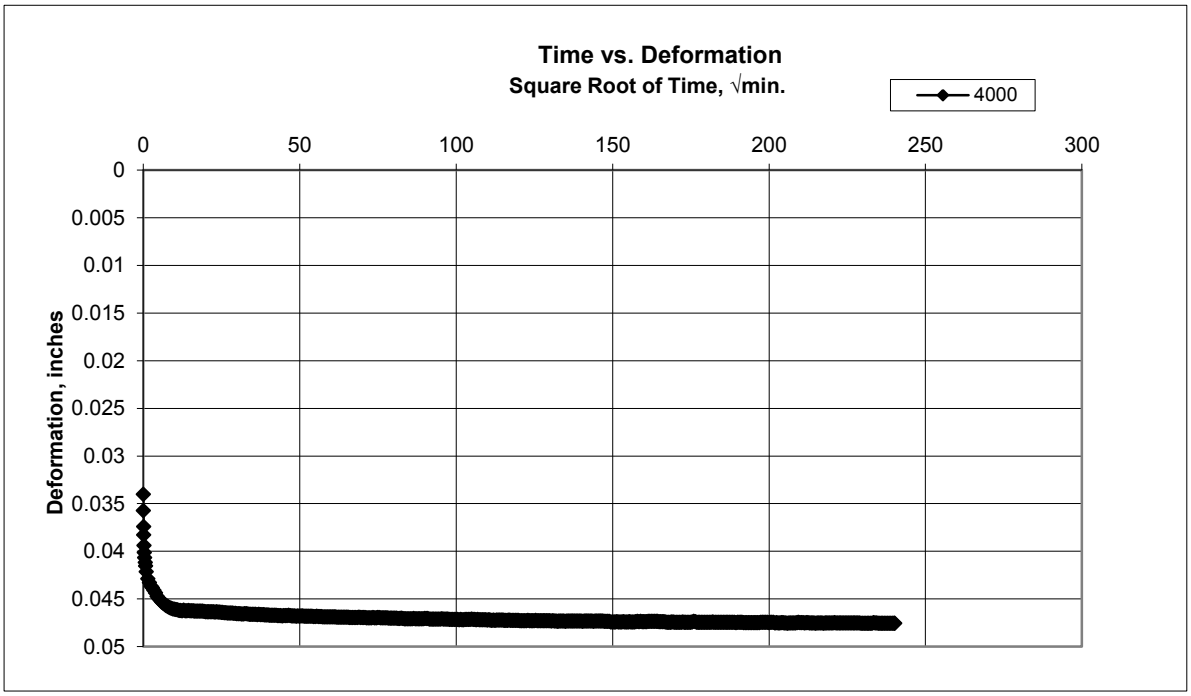


# CONSOLIDATION TEST
# ASTM D-2435

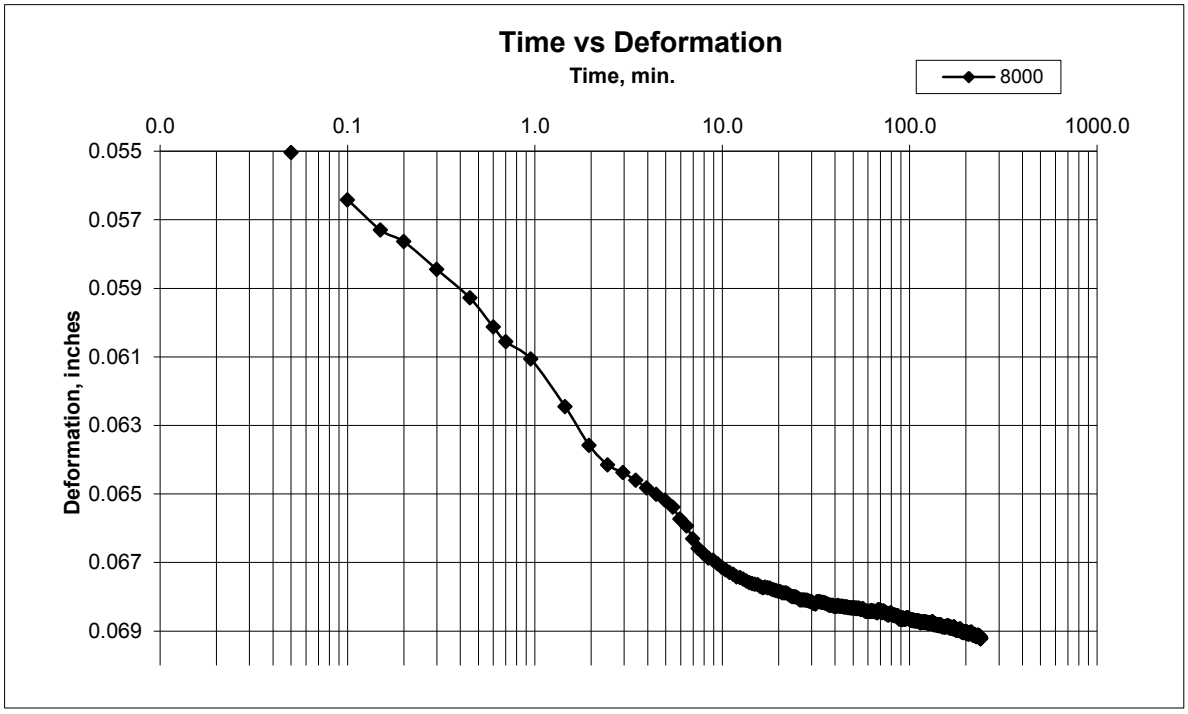
| | | | | | | |
|---|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | 18-061EK | 8 of 10 |
| LOCATION | GHB5 at 37.0' | TEST BY | DLR | DATE | 7/30/18 | |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 8/20/18 | |

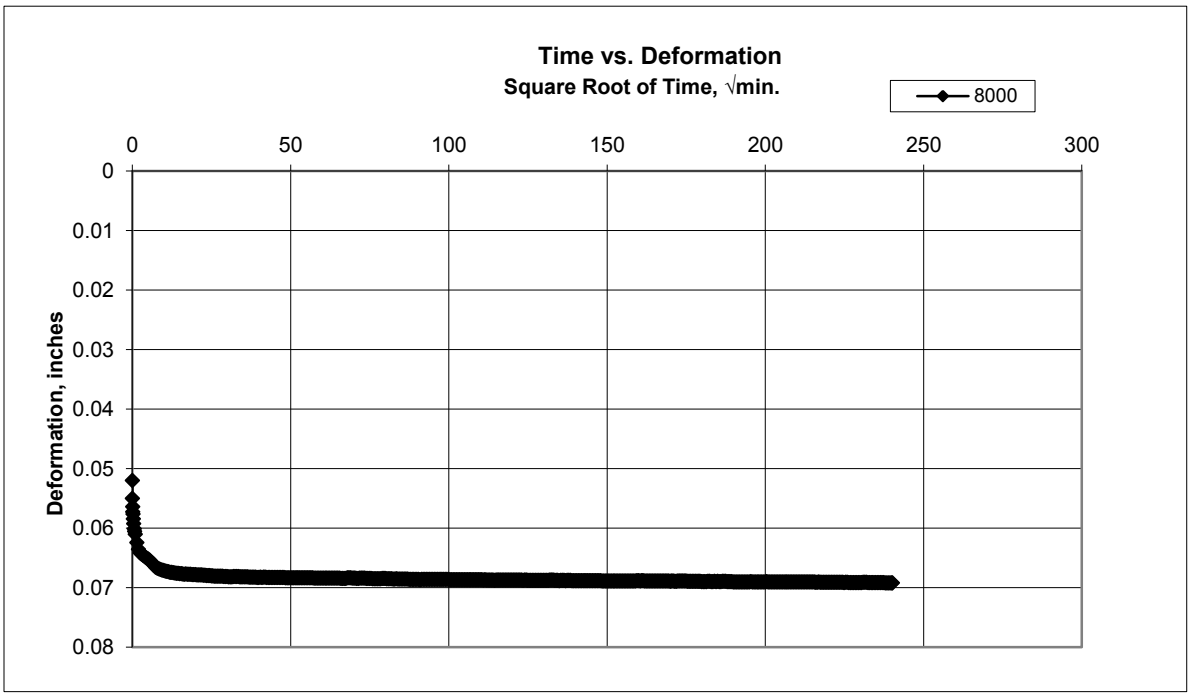


# CONSOLIDATION TEST
# ASTM D-2435

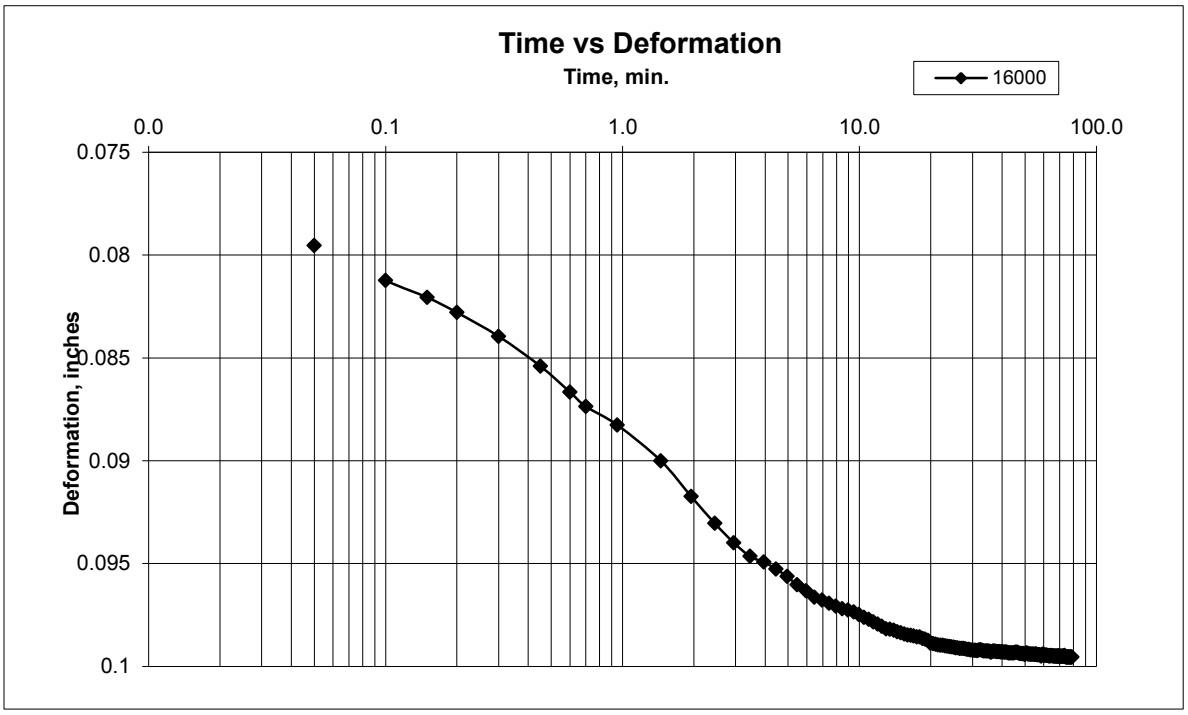
| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 9 of 10 |
| LOCATION | GHB5 at 37.0' | TEST BY | DLR | DATE | 7/30/18 |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 8/20/18 |

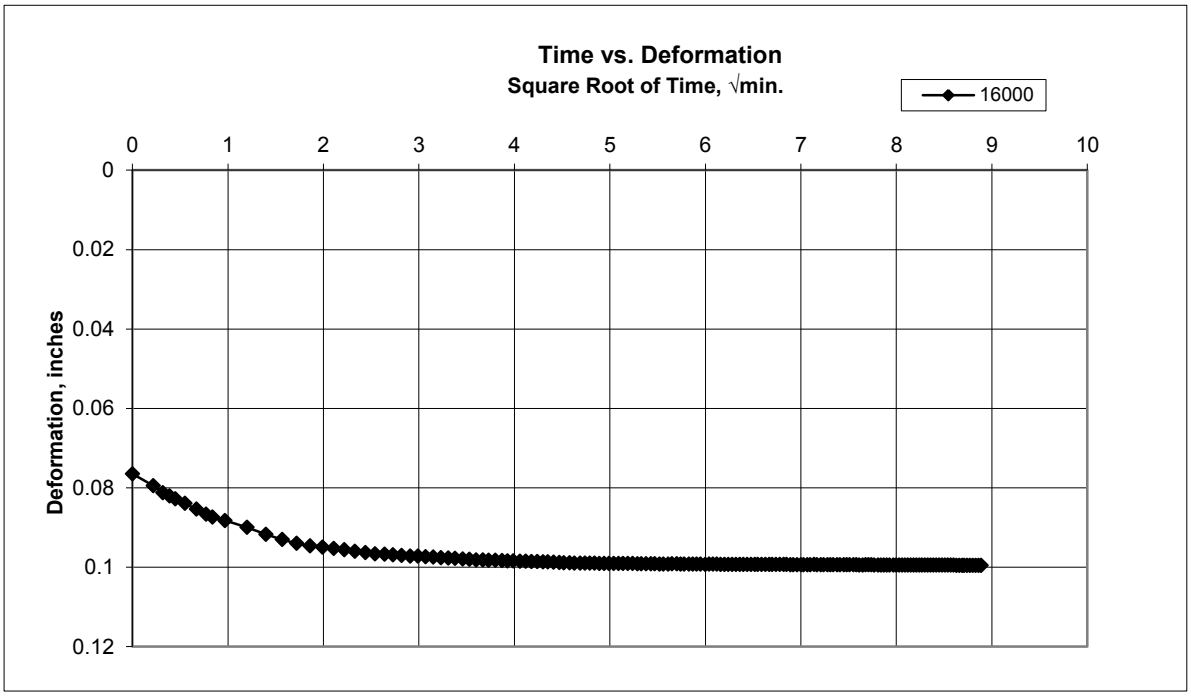


# CONSOLIDATION TEST
# ASTM D-2435

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carollo Engineers, Inc. | | SAMPLE ID | 18-061EK | 10 of 10 |
| LOCATION | GHB5 at 37.0' | TEST BY | DLR | DATE | 7/30/18 |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 8/20/18 |



LACO

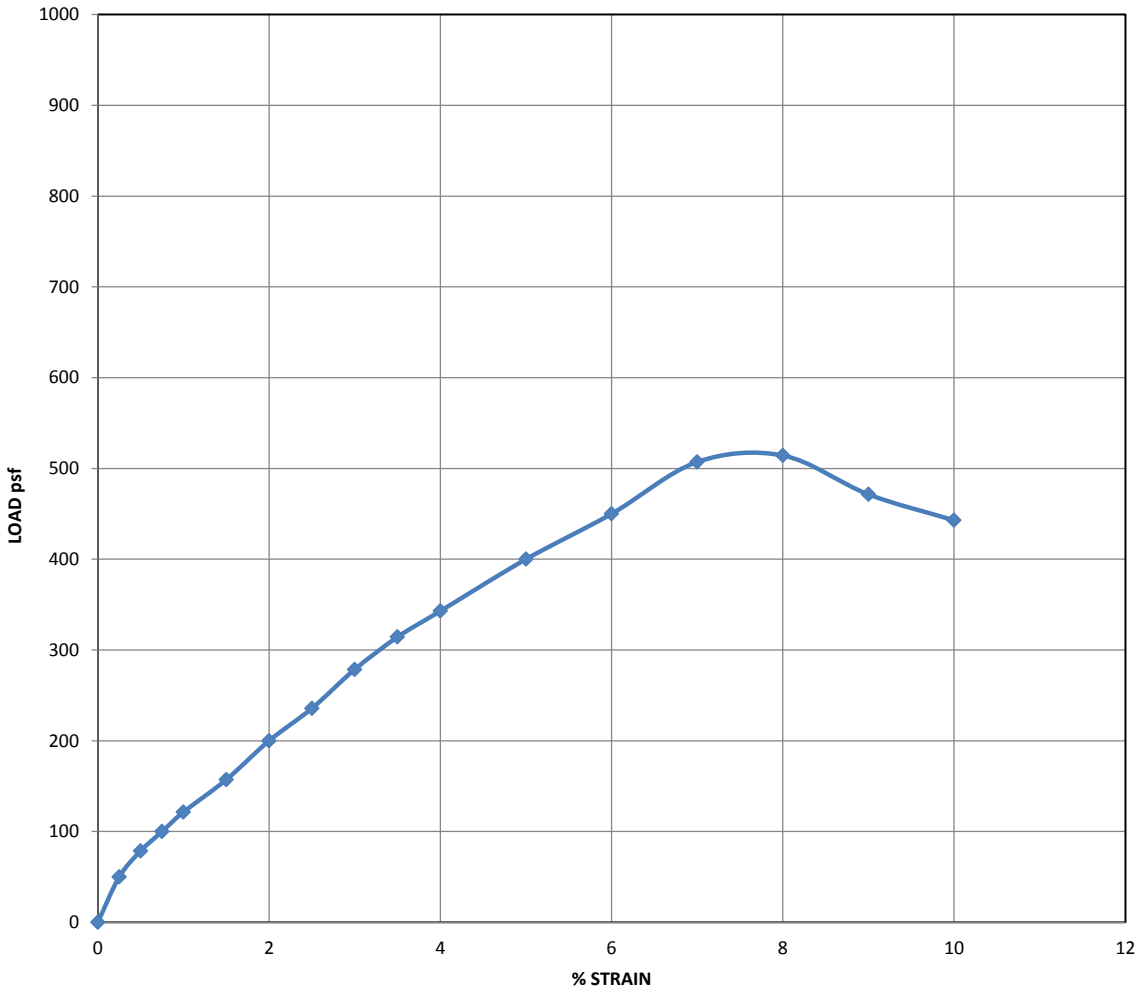
# Unconfined Compressive Strength Test

## ASTM D-2166

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | GBH-1 | Depth 5ft | 1 of 1 |
| LOCATION | Arcata, California | TEST BY | BC | DATE | | | 6/25/18 |
| SOIL TYPE | Clay | CHECKED BY | CRGT | CHECK DATE | | | 6/26/18 |

| | | |
|---|---|---|
| Failure strain | 12.5 | % |
| Unconfined Compressive Strength | 514 | psf |
| Undrained shear strength | 257 | psf |
| Strain rate | 1 | %/min |
| Sample Volume, $in.^3$ | 39.13 | |
| Unit Weight, Wet, pcf | 99.61 | |
| Unit Weight, Dry, pcf | 59.01 | |

| | | |
|---|---|---|
| Sample height | 6.31 | in |
| Sample diameter | 2.81 | in |
| Height / diameter ratio | 2.25 | |
| Moisture content | 68.8 | % |
| Void ratio | 1.85 | |
| Saturation | 100.1 | % |
| Specific gravity (assumed) | 2.70 | |



LACO

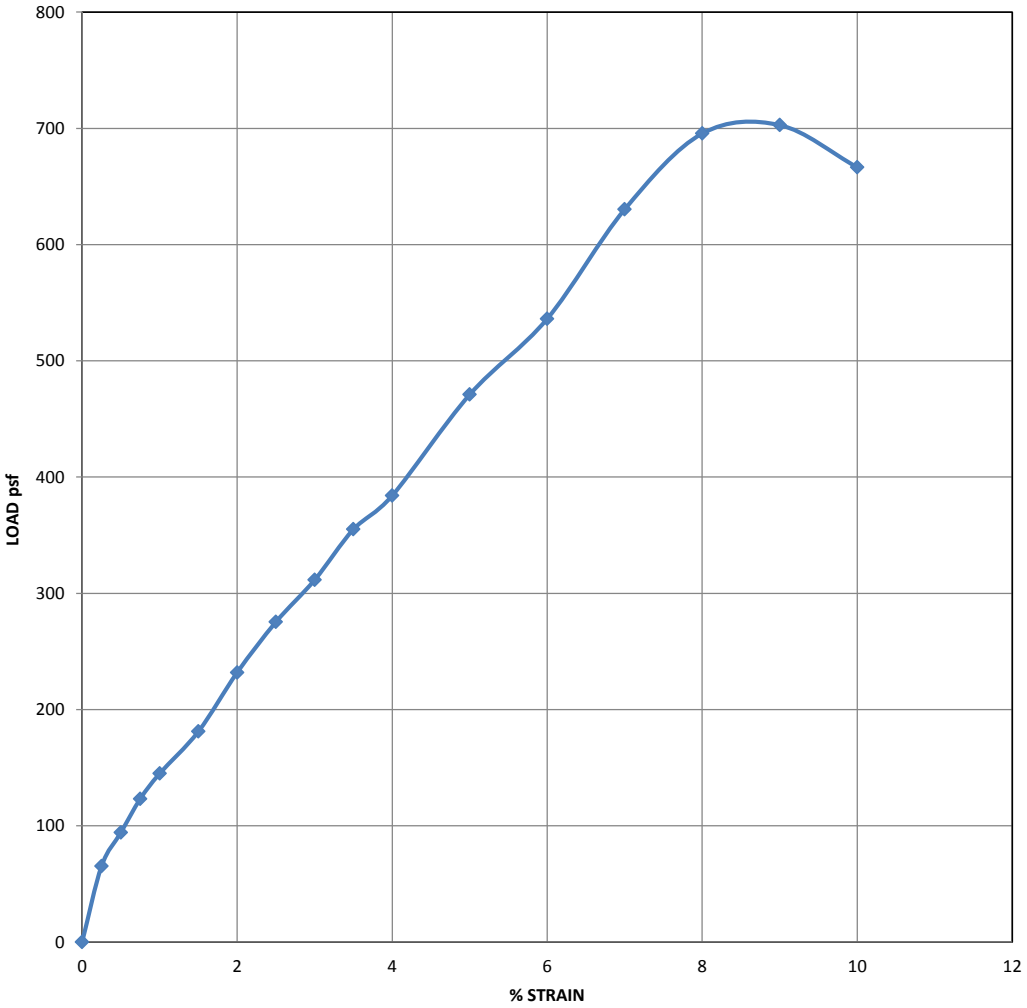
# Unconfined Compressive Strength Test

## ASTM D-2166

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | GBH-2 | Depth 5ft | 1 of 1 |
| LOCATION | Arcata, California | TEST BY | BC | DATE | 6/25/18 | | |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 6/27/18 | | |

| | |
|---|---|
| Failure strain | 12.5 % |
| Unconfined Compressive Strength | 703 psf |
| Undrained shear strength | 351 psf |
| Strain rate | 1 %/min |
| Sample Volume, $in.^3$ | 39.98 |
| Unit Weight, Wet, pcf | 101.58 |
| Unit Weight, Dry, pcf | 62.34 |

| | |
|---|---|
| Sample height | 6.54 in |
| Sample diameter | 2.79 in |
| Height / diameter ratio | 2.34 |
| Moisture content | 62.9 % |
| Void ratio | 1.70 |
| Saturation | 99.8 % |
| Specific gravity (assumed) | 2.70 |



LACO

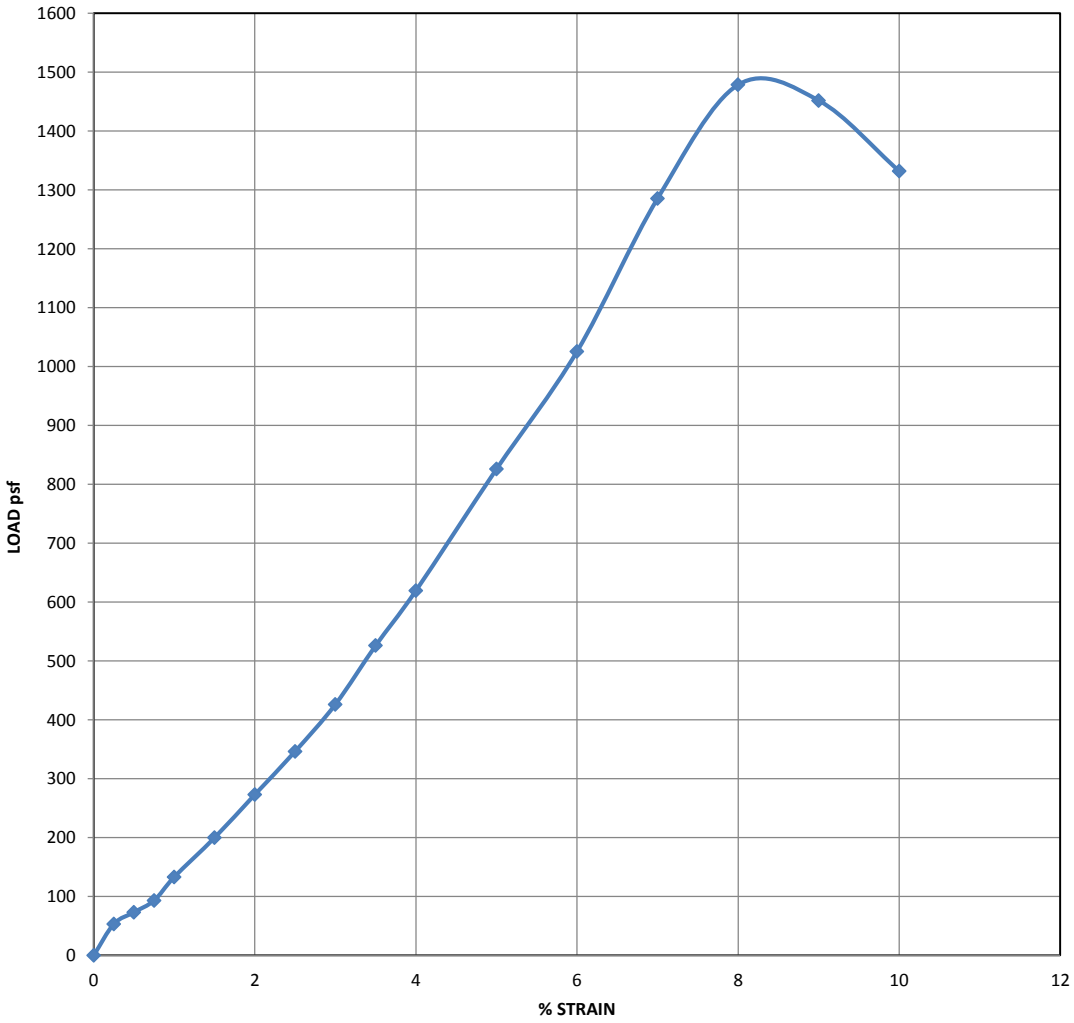
# Unconfined Compressive Strength Test

## ASTM D-2166

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | GBH-2 | Depth 45ft | 1 of 1 |
| LOCATION | Arcata, California | TEST BY | BC | DATE | 6/25/18 | | |
| SOIL TYPE | Clayey Sand | CHECKED BY | CRGT | CHECK DATE | 6/27/18 | | |

| | |
|---|---|
| Failure strain | 12.5 % |
| Unconfined Compressive Strength | 1479 psf |
| Undrained shear strength | 739 psf |
| Strain rate | 1 %/min |
| Sample Volume, $in.^3$ | 38.51 |
| Unit Weight, Wet, pcf | 127.34 |
| Unit Weight, Dry, pcf | 104.11 |

| | |
|---|---|
| Sample height | 5.79 in |
| Sample diameter | 2.91 in |
| Height / diameter ratio | 1.99 |
| Moisture content | 22.3 % |
| Void ratio | 0.62 |
| Saturation | 97.4 % |
| Specific gravity (assumed) | 2.70 |



LACO

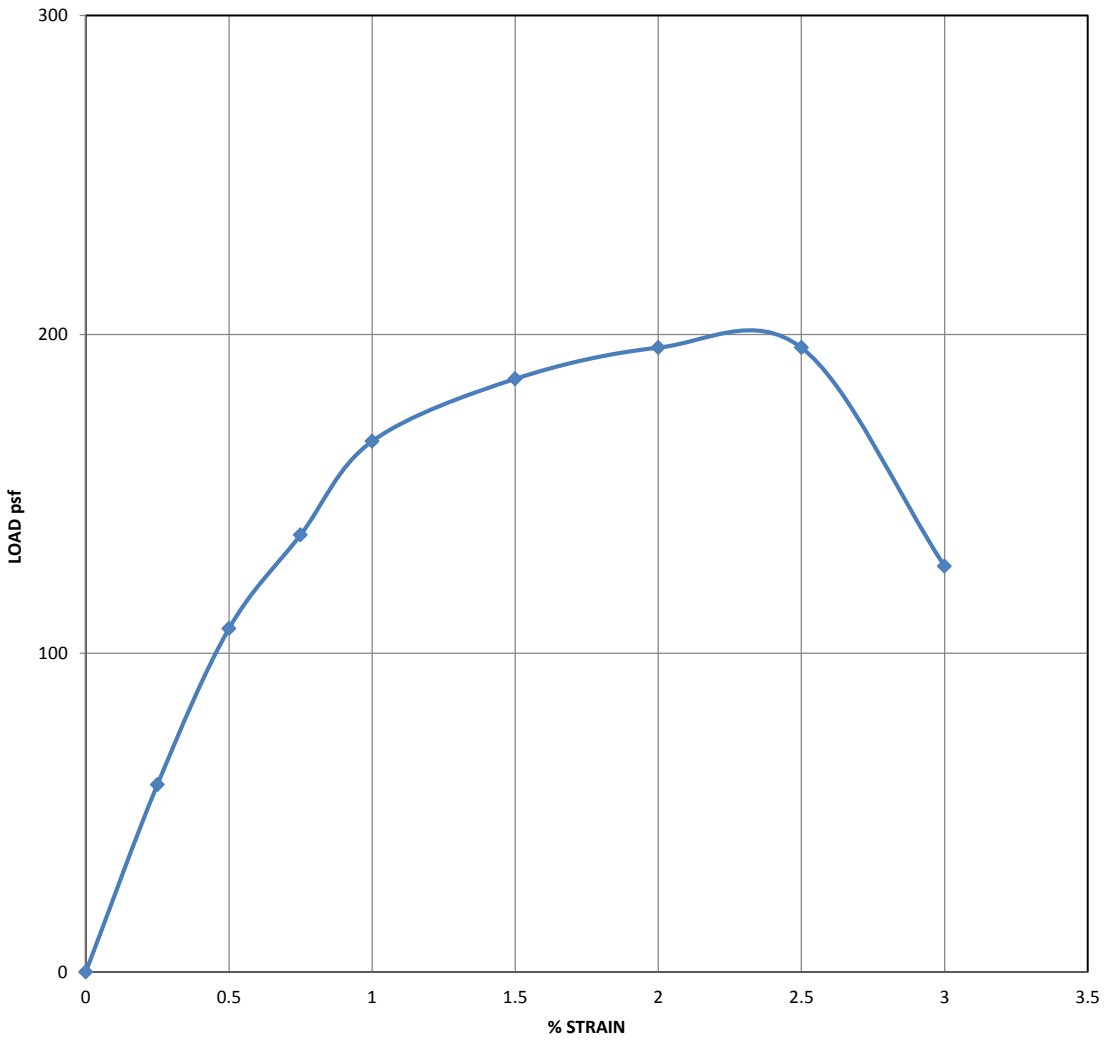
# Unconfined Compressive Strength Test

## ASTM D-2166

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | GBH-2 | Depth 50ft | 1 of 1 |
| LOCATION | Arcata, California | TEST BY | BC | DATE | 6/25/18 | | |
| SOIL TYPE | Clayey Sand | CHECKED BY | CRGT | CHECK DATE | 6/27/18 | | |

| | | |
|---|---|---|
| Failure strain | 12.5 | % |
| Unconfined Compressive Strength | 196 | psf |
| Undrained shear strength | 98 | psf |
| Strain rate | 1 | %/min |
| Sample Volume, $in.^3$ | 26.69 | |
| Unit Weight, Wet, pcf | 127.09 | |
| Unit Weight, Dry, pcf | 103.32 | |

| | | |
|---|---|---|
| Sample height | 5.90 | in |
| Sample diameter | 2.40 | in |
| Height / diameter ratio | 2.46 | |
| Moisture content | 23.0 | % |
| Void ratio | 0.63 | |
| Saturation | 98.5 | % |
| Specific gravity (assumed) | 2.70 | |



LACO

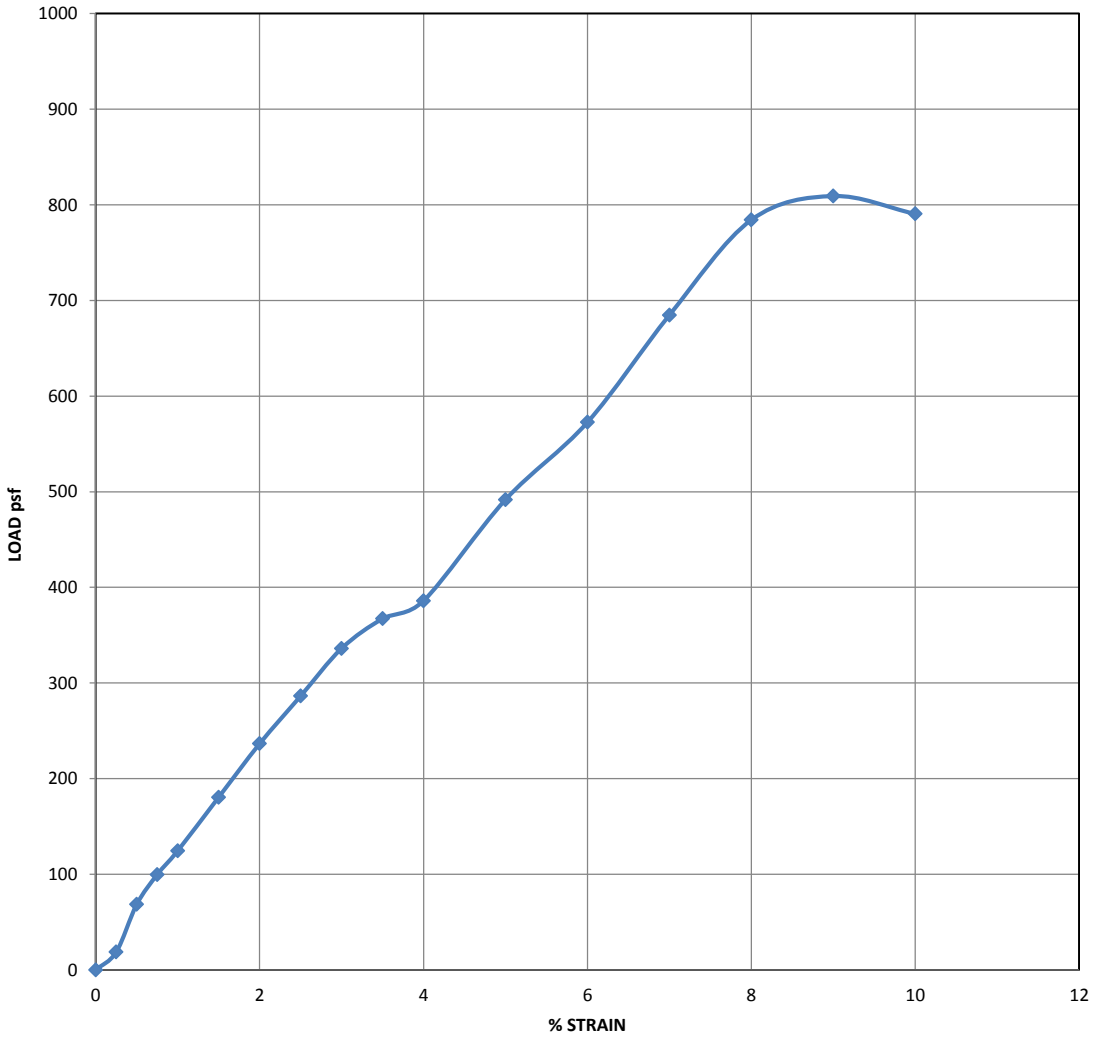
# Unconfined Compressive Strength Test

## ASTM D-2166

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | GBH-3 | Depth 5' | 1 of 1 |
| LOCATION | Arcata, California | TEST BY | BC | DATE | 6/25/18 | | |
| SOIL TYPE | Clay with Sand | CHECKED BY | CRGT | CHECK DATE | 6/27/18 | | |

| | |
|---|---|
| Failure strain | 12.5 % |
| Unconfined Compressive Strength | 809 psf |
| Undrained shear strength | 405 psf |
| Strain rate | 1 %/min |
| Sample Volume, $in.^3$ | 46.89 |
| Unit Weight, Wet, pcf | 83.43 |
| Unit Weight, Dry, pcf | 50.73 |

| | |
|---|---|
| Sample height | 6.59 in |
| Sample diameter | 3.01 in |
| Height / diameter ratio | 2.19 |
| Moisture content | 64.5 % |
| Void ratio | 2.32 |
| Saturation | 75.0 % |
| Specific gravity (assumed) | 2.70 |



LACO

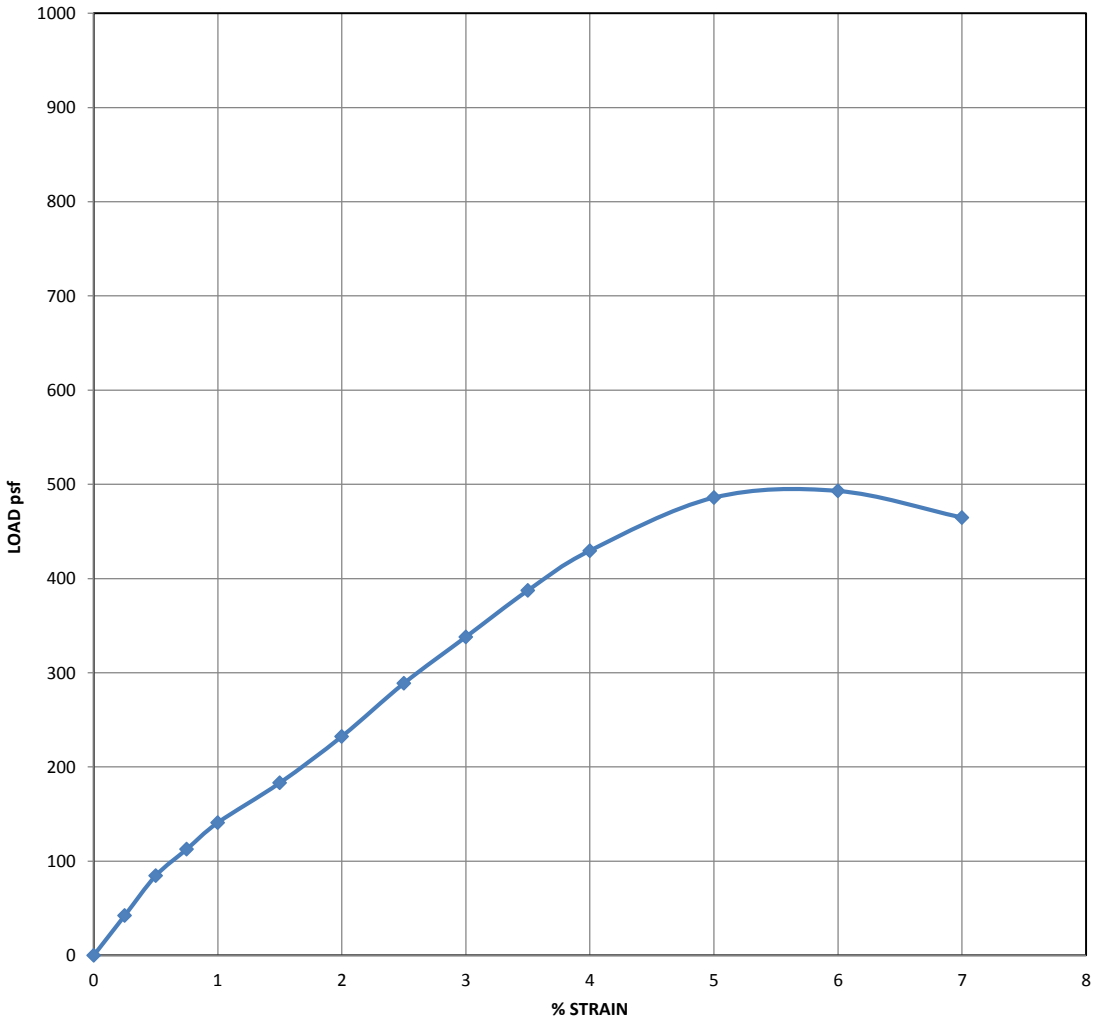
# Unconfined Compressive Strength Test

## ASTM D-2166

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | GBH-5 | Depth 5ft | 1 of 1 |
| LOCATION | Arcata, California | TEST BY | BC | DATE | 6/25/18 | | |
| SOIL TYPE | Clayey Sand | CHECKED BY | CRGT | CHECK DATE | 6/27/18 | | |

| | |
|---|---|
| Failure strain | 12.5 % |
| Unconfined Compressive Strength | 493 psf |
| Undrained shear strength | 246 psf |
| Strain rate | 1 %/min |
| Sample Volume, $in.^3$ | 39.69 |
| Unit Weight, Wet, pcf | 113.29 |
| Unit Weight, Dry, pcf | 92.71 |

| | |
|---|---|
| Sample height | 6.31 in |
| Sample diameter | 2.83 in |
| Height / diameter ratio | 2.23 |
| Moisture content | 22.2 % |
| Void ratio | 0.82 |
| Saturation | 73.3 % |
| Specific gravity (assumed) | 2.70 |

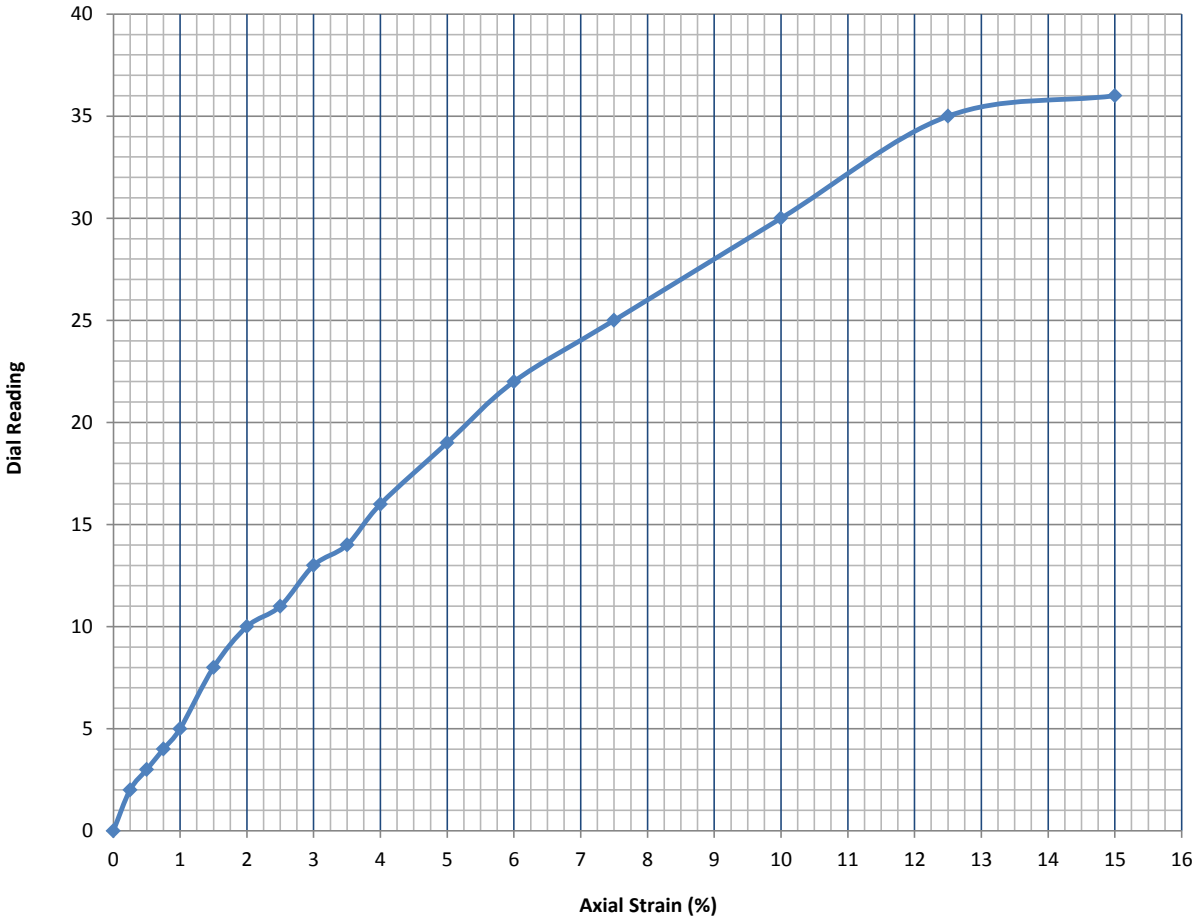


LACO

# Unconfined Compressive Strength Test

## ASTM D-2166

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carrollo Engineers, Inc. | | SAMPLE ID | GBH-5 at 11 ft | 1 of 1 |
| LOCATION | Arcata, California | TEST BY | BC | DATE | 7/13/18 |
| SOIL TYPE | Clay | CHECKED BY | CRGT | CHECK DATE | 7/18/18 |




| | |
|---|---|
| Failure strain | 12.5 % |
| Unconfined Compressive Strength | 358 psf |
| Undrained shear strength | 179 psf |
| Strain rate | 1 %/min |

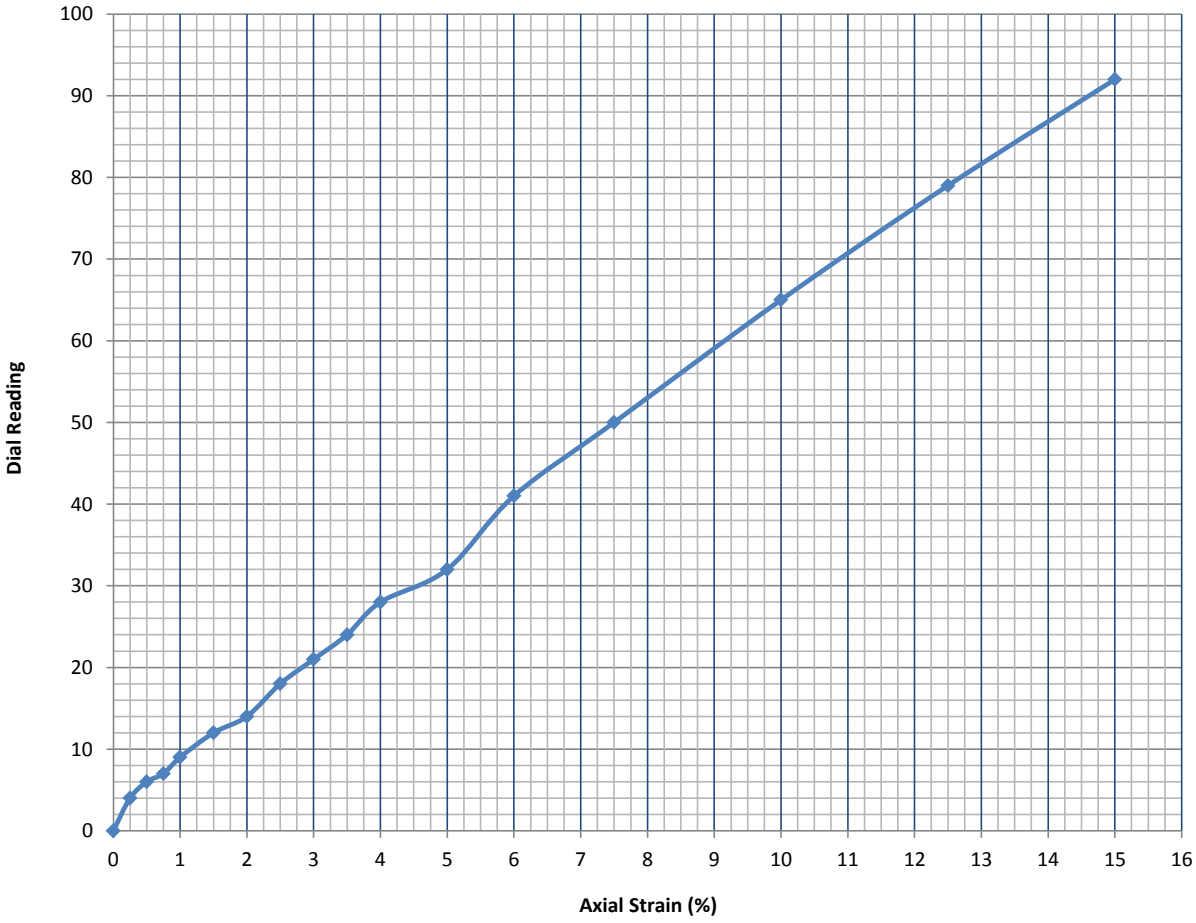
| | |
|---|---|
| Sample height | 4.37 in |
| Sample diameter | 2.38 in |
| Height / diameter ratio | 1.84 |
| Moisture content | 44.2 % |
| Void ratio | 1.25 |
| Saturation | 95.7 % |
| Specific gravity (assumed) | 2.70 |

LACO

# Unconfined Compressive Strength Test

## ASTM D-2166

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carrollo Engineers, Inc. | | SAMPLE ID | GBH-5 at 16' | 1 of 1 |
| LOCATION | Arcata, California | TEST BY | BC | DATE | 7/13/18 |
| SOIL TYPE | Clay | CHECKED BY | CRGT | CHECK DATE | 7/18/18 |




| | |
|---|---|
| Failure strain | 12.5 % |
| Unconfined Compressive Strength | 871 psf |
| Undrained shear strength | 436 psf |
| Strain rate | 1 %/min |

| | |
|---|---|
| Sample height | 5.46 in |
| Sample diameter | 2.44 in |
| Height / diameter ratio | 2.24 |
| Moisture content | 30.2 % |
| Void ratio | 0.83 |
| Saturation | 98.1 % |
| Specific gravity (assumed) | 2.70 |

LACO

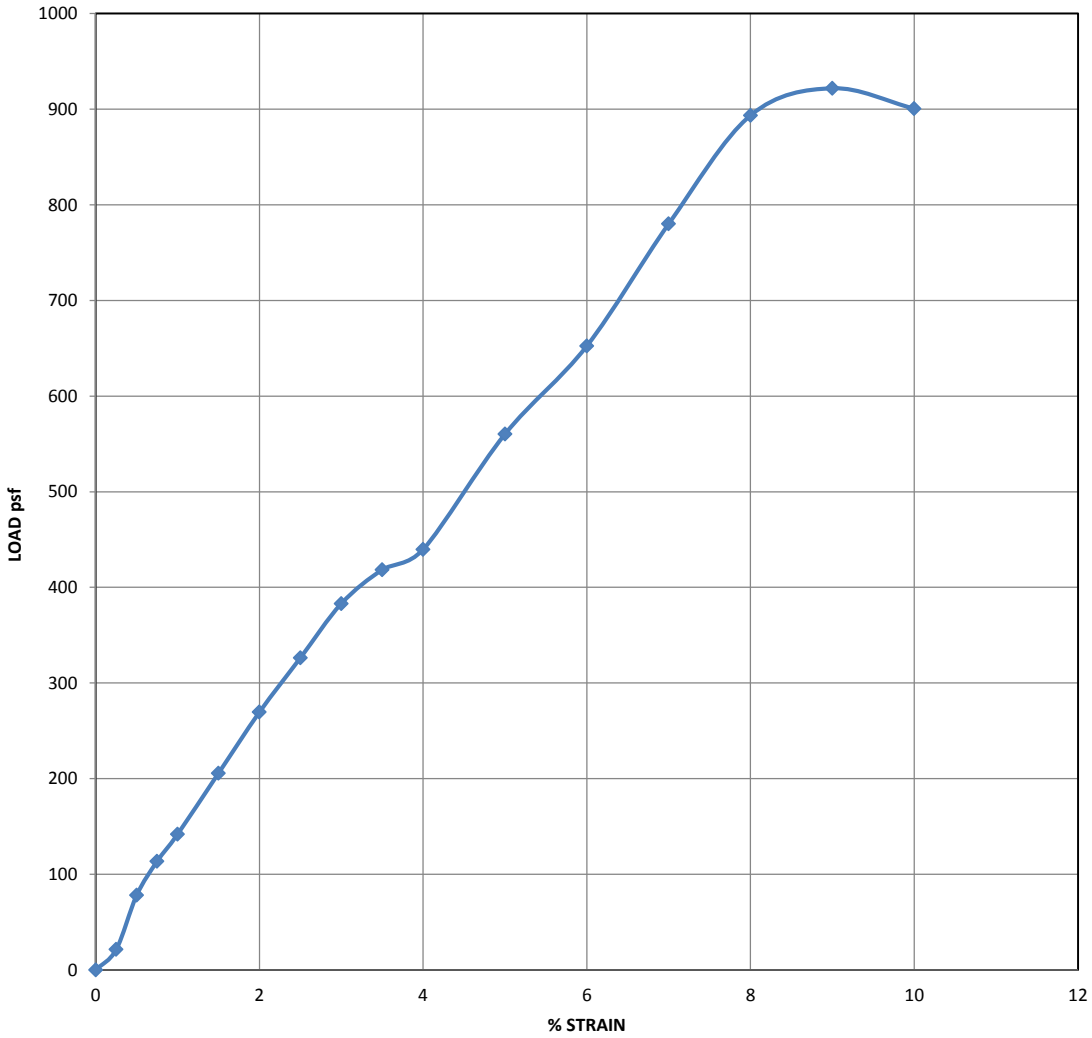
# Unconfined Compressive Strength Test

## ASTM D-2166

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | GBH-5 Depth 20' | | 1 of 1 |
| LOCATION | Arcata, California | TEST BY | BC | DATE | 6/25/18 | | |
| SOIL TYPE | Clay | CHECKED BY | CRGT | CHECK DATE | 6/27/18 | | |

| | |
|---|---|
| Failure strain | 12.5 % |
| Unconfined Compressive Strength | 922 psf |
| Undrained shear strength | 461 psf |
| Strain rate | 1 %/min |
| Sample Volume, $in.^3$ | 38.35 |
| Unit Weight, Wet, pcf | 121.01 |
| Unit Weight, Dry, pcf | 93.80 |

| | |
|---|---|
| Sample height | 6.14 in |
| Sample diameter | 2.82 in |
| Height / diameter ratio | 2.18 |
| Moisture content | 29.0 % |
| Void ratio | 0.80 |
| Saturation | 98.4 % |
| Specific gravity (assumed) | 2.70 |

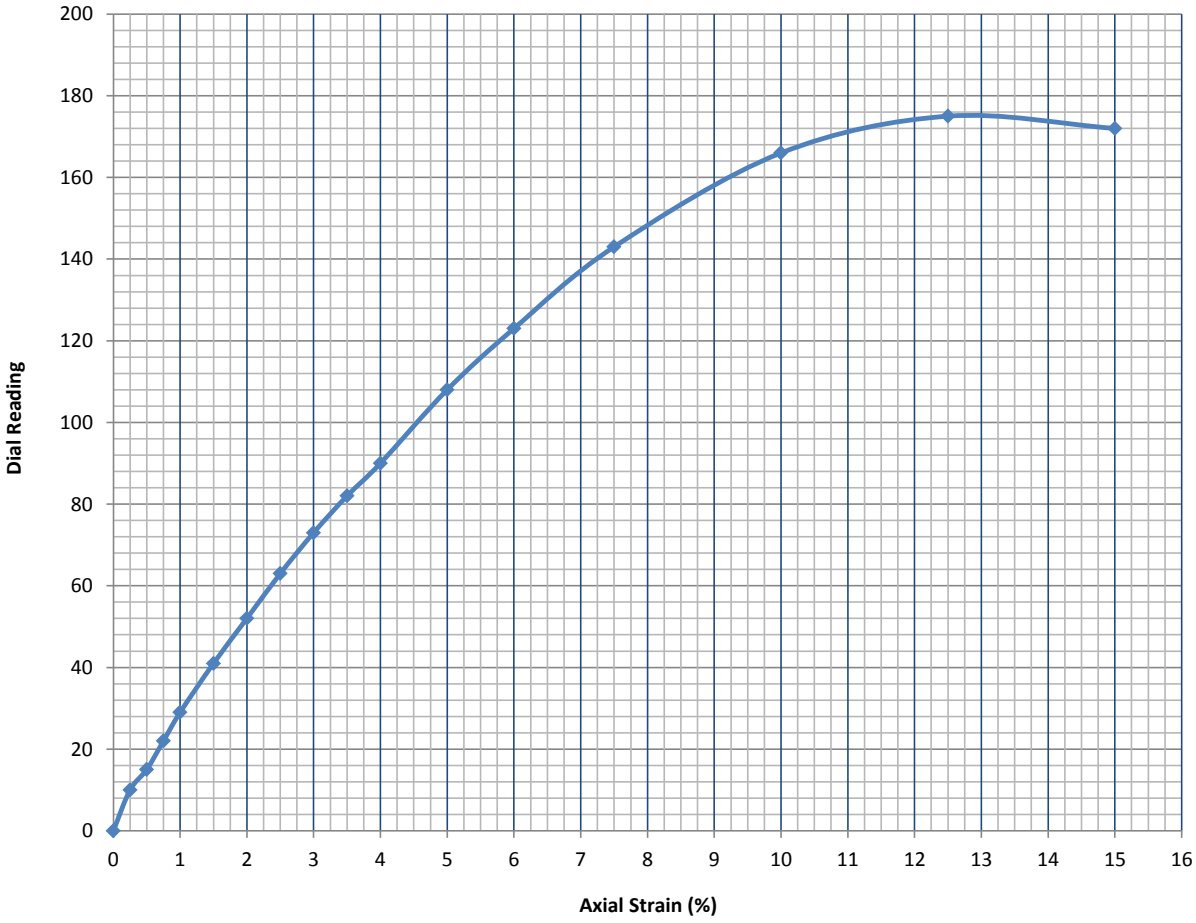


LACO

# Unconfined Compressive Strength Test

## ASTM D-2166

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | JOB NO. | 7986.01 | SHEET |
| CLIENT | Carrollo Engineers Inc. | | SAMPLE ID | GBH-5 at 30.5ft' | 1 of 1 |
| LOCATION | Arcata, California | TEST BY | BC | DATE | 7/13/18 |
| SOIL TYPE | Lean Clay | CHECKED BY | CRGT | CHECK DATE | 7/18/18 |




| | |
|---|---|
| Failure strain | 12.5 % |
| Unconfined Compressive Strength | 1713 psf |
| Undrained shear strength | 857 psf |
| Strain rate | 1 %/min |

| | |
|---|---|
| Sample height | 5.42 in |
| Sample diameter | 2.40 in |
| Height / diameter ratio | 2.26 |
| Moisture content | 54.0 % |
| Void ratio | 1.50 |
| Saturation | 97.4 % |
| Specific gravity (assumed) | 2.70 |

LACO

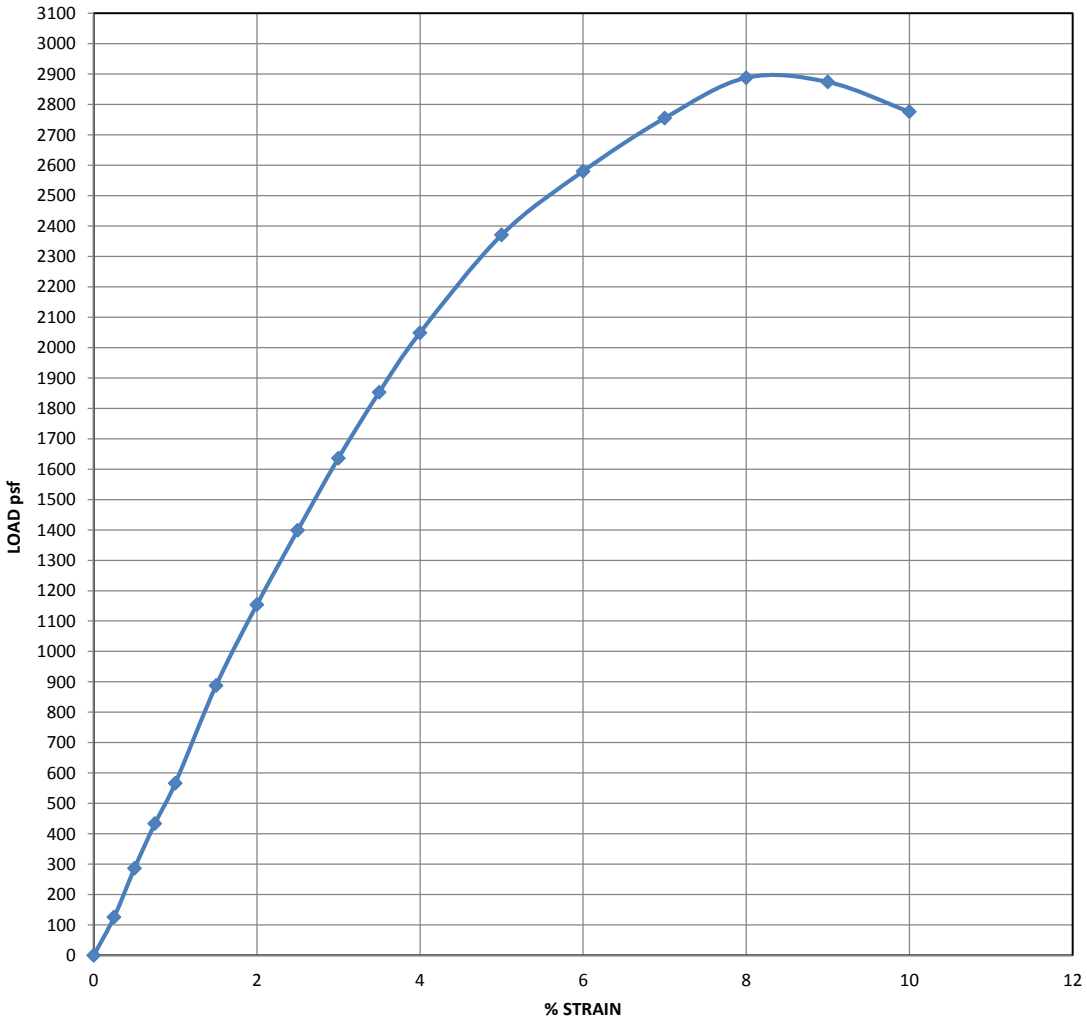
# Unconfined Compressive Strength Test

## ASTM D-2166

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | GBH-5 | Depth 35' | 1 of 1 |
| LOCATION | Arcata, California | TEST BY | BC | DATE | 6/25/18 | | |
| SOIL TYPE | Sandy Clay | CHECKED BY | CRGT | CHECK DATE | 6/27/18 | | |

| | |
|---|---|
| Failure strain | 12.5 % |
| Unconfined Compressive Strength | 2888 psf |
| Undrained shear strength | 1444 psf |
| Strain rate | 1 %/min |
| Sample Volume, $in.^3$ | 43.52 |
| Unit Weight, Wet, pcf | 111.65 |
| Unit Weight, Dry, pcf | 79.52 |

| | |
|---|---|
| Sample height | 6.87 in |
| Sample diameter | 2.84 in |
| Height / diameter ratio | 2.42 |
| Moisture content | 40.4 % |
| Void ratio | 1.12 |
| Saturation | 97.5 % |
| Specific gravity (assumed) | 2.70 |

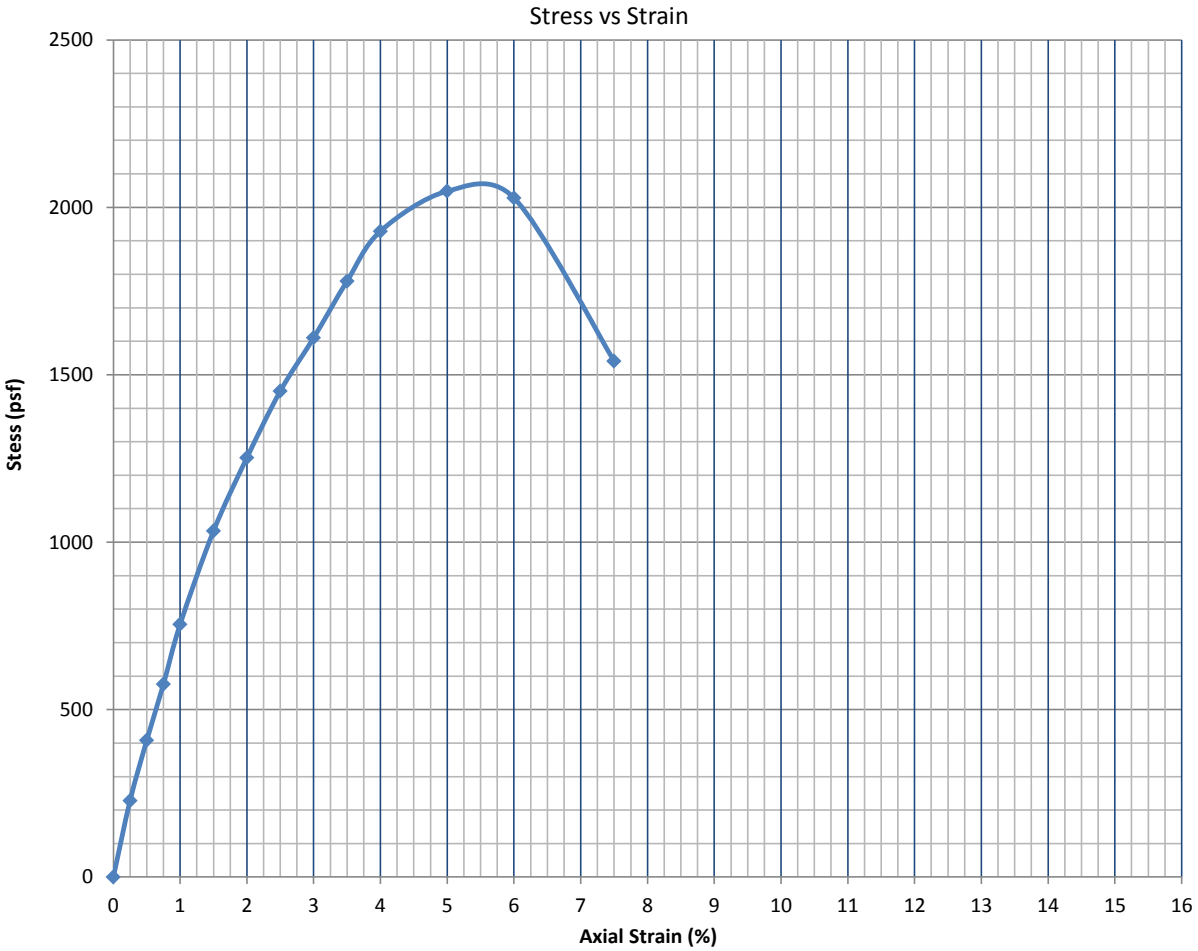


LACO

# Unconfined Compressive Strength Test

## ASTM D-2166

| | | | | | |
|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO.: 7986.01 | SHEET |
| CLIENT | Carrollo Engineers Inc. | | | SAMPLE ID: GBH-5 at 41' | 1 of 1 |
| LOCATION | Arcata, California | TEST BY | BC | DATE | 7/13/18 |
| SOIL TYPE | Clay | CHECKED BY | MAN | CHECK DATE | 8/1/18 |




| | |
|---|---|
| Failure strain | 5.5 % |
| Unconfined Compressive Strength | 1800 psf |
| Undrained shear strength | 900 psf |
| Strain rate | 1 %/min |

| | |
|---|---|
| Sample height | 5.66 in |
| Sample diameter | 2.39 in |
| Height / diameter ratio | 2.37 |
| Moisture content | 24.9 % |
| Void ratio | 0.59 |
| Saturation | 113.3 % |
| Specific gravity (assumed) | 2.70 |

LACO

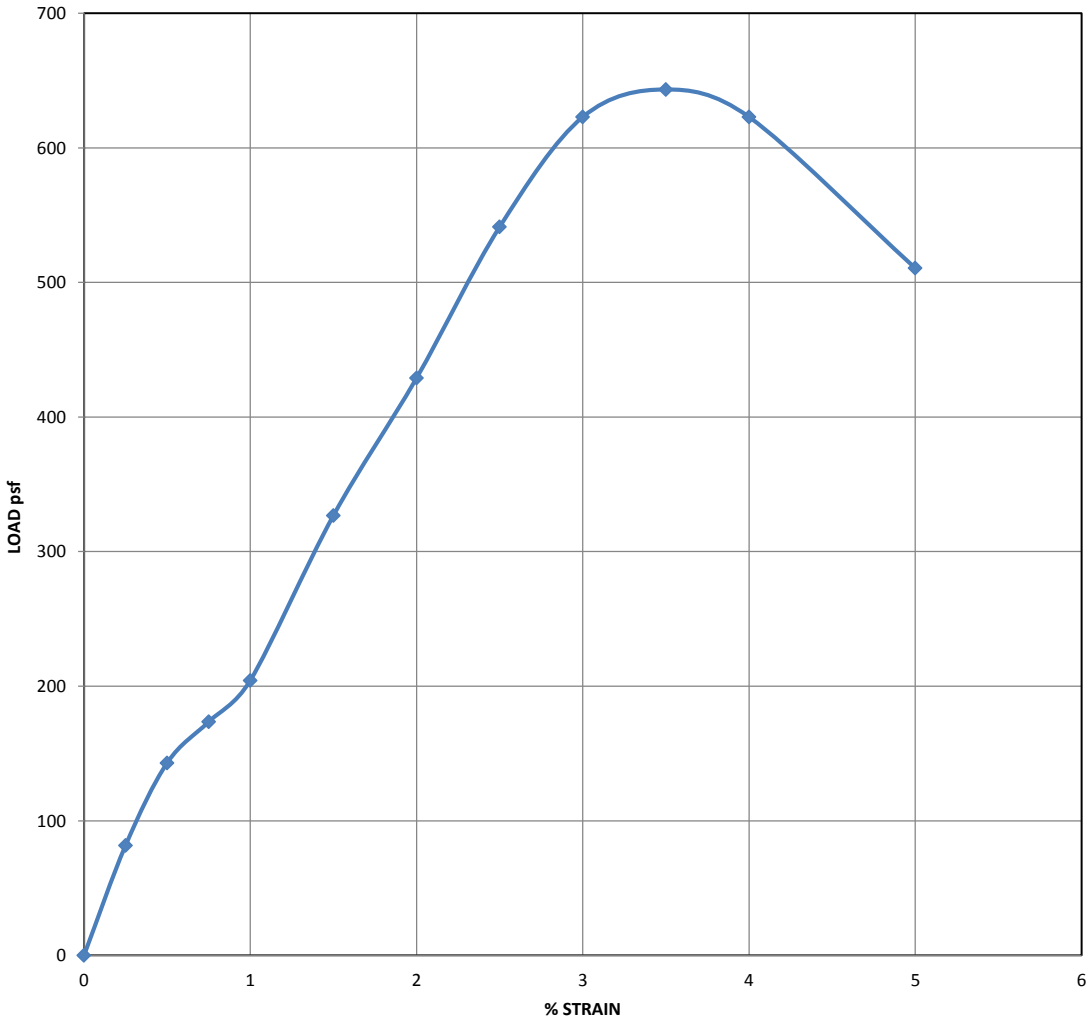
# Unconfined Compressive Strength Test

## ASTM D-2166

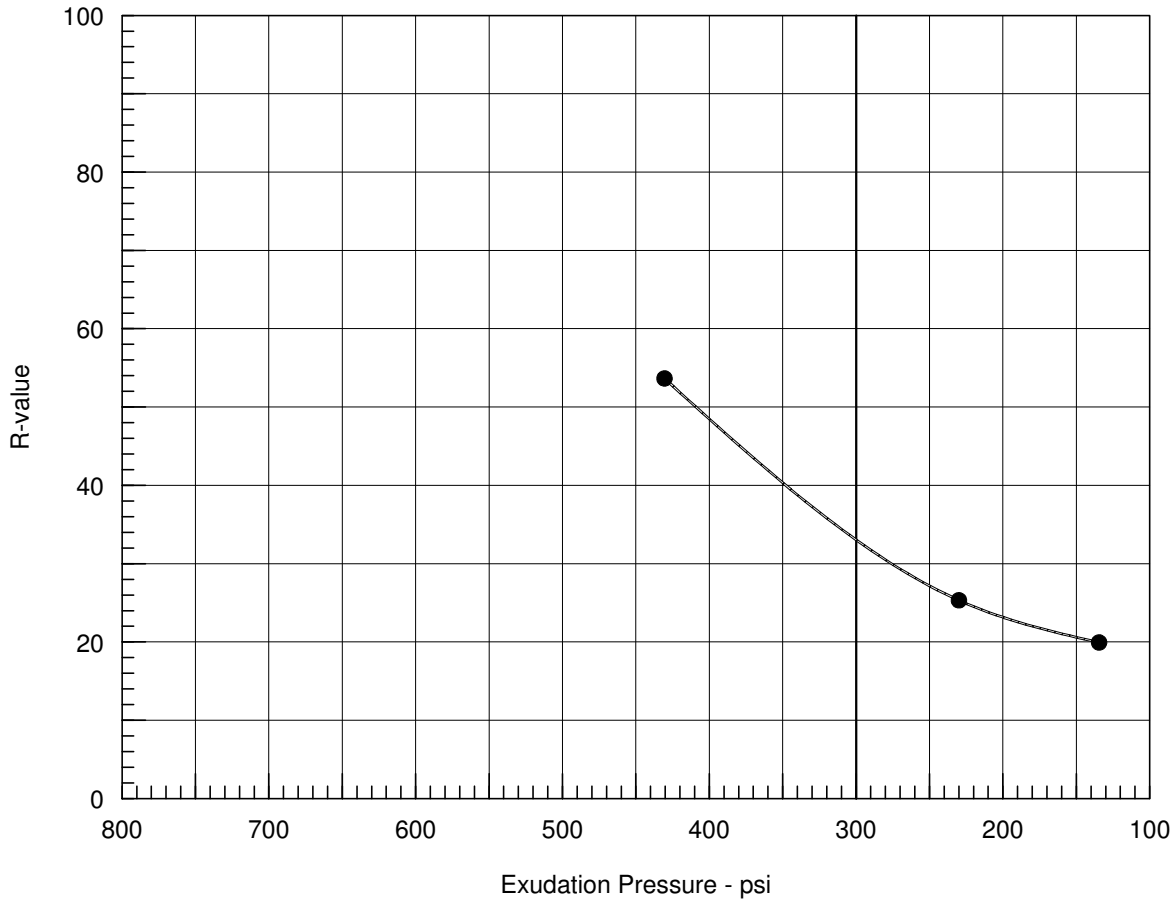
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PROJECT | Wastewater Treatment Plant Improvements | | | JOB NO. | 7986.01 | | SHEET |
| CLIENT | Carollo Engineers, Inc. | | | SAMPLE ID | GBH-5 | Depth 51ft | 1 of 1 |
| LOCATION | Arcata, California | TEST BY | BC | DATE | 6/25/18 | | |
| SOIL TYPE | Silty Clayey Sand | CHECKED BY | CRGT | CHECK DATE | 6/27/18 | | |

| | |
|---|---|
| Failure strain | 12.5 % |
| Unconfined Compressive Strength | 643 psf |
| Undrained shear strength | 322 psf |
| Strain rate | 1 %/min |
| Sample Volume, $in.^3$ | 23.51 |
| Unit Weight, Wet, pcf | 129.40 |
| Unit Weight, Dry, pcf | 105.38 |

| | |
|---|---|
| Sample height | 5.42 in |
| Sample diameter | 2.35 in |
| Height / diameter ratio | 2.31 |
| Moisture content | 22.8 % |
| Void ratio | 0.60 |
| Saturation | 102.8 % |
| Specific gravity (assumed) | 2.70 |



# R-VALUE TEST REPORT




**Resistance R-Value and Expansion Pressure - Cal Test 301**

| No. | Compact. Pressure psi | Density pcf | Moist. % | Expansion Pressure psi | Horizontal Press. psi @ 160 psi | Sample Height in. | Exud. Pressure psi | R Value | R Value Corr. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 140 | 121.8 | 12.5 | 0.00 | 117 | 2.50 | 134 | 20 | 20 |
| 2 | 220 | 123.1 | 11.3 | 0.00 | 109 | 2.50 | 230 | 25 | 25 |
| 3 | 350 | 125.0 | 10.2 | 0.00 | 60 | 2.48 | 431 | 54 | 54 |
| | | | | | | | | | |

| Test Results | Material Description |
|---|---|
| **R-value at 300 psi exudation pressure =** 33 | Brown Sandy Clay<br>Sampled by Others on 06/15/18 |

**Project No.:** 4005801
**Project:** Laco Associates Miscellaneous Lab Testings
**Location:** Accata WWTP / Composite
**Sample Number:** 10S180627-2
**Date:** 6/27/2018

**Tested by:** FS
**Checked by:** WY
**Remarks:**

# E T S

**Environmental Technical Services**

-Soil, Water & Air Testing & Monitoring
-Analytical Labs
-Technical Support

975 Transport Way, Suite 2
Petaluma, CA 94954
(707) 778-9605/FAX 778-9612
e-mail: *entech@pacbell.net*


***Serving people and the environment so that both benefit.***

| | | | |
|---|---|---|---|
| COMPANY: LACO Associates, 3450 Regional Parkway, Suite B2, Santa Rosa, CA 95403 | DATE RECEIVED 6/8/2018 | DATE of COMPLETION 6/20/2018 | ANALYST(S) S. Santos L. Quijano |
| ATTN: Bobby Voeks | | | SUPERVISOR D. Jacobson |
| JOB NAME: WWTP, Arcata, California | | | LAB DIRECTOR G.S. Conrad PhD |
| JOB #: 7986.01 | | | |

| LAB SAMPLE NUMBER | SAMPLE ID | DESCRIPTION of SOIL and/or SEDIMENT | SOIL pH -log[H+] | NOMINAL MIN RESISTIVITY ohm-cm | ELECTRICAL CONDUCTIVITY µmhos/cm | SULFATE SO4 ppm | CHLORIDE Cl ppm |
|---|---|---|---|---|---|---|---|
| 07798-1 | WWTP1/A | GBH-1 @ 3' | **7.16** | **643** | **[1556]** | **294** | **370** |
| 07798-2 | WWTP2/A | GBH-2 @ 10.5' | **7.92** | **163** | **[6135]** | **450** | **2,370** |
| 07798-3 | WWTP1/A | GBH-3 @ 25' | **8.66** | **119** | **[8403]** | **1,725** | **2,550** |
| Method | Detection | Limits ---> | --- | 1 | 0.1 | 1 | 1 |

| LAB SAMPLE NUMBER | SAMPLE ID | DESCRIPTION of SOIL and/or SEDIMENT | SALINITY ECe mmhos/cm | SOLUBLE SULFIDES (S=) ppm | SOLUBLE CYANIDES (CN=) ppm | REDOX mV | PERCENT MOISTURE % |
|---|---|---|---|---|---|---|---|
| 07798-1 | WWTP1/A | GBH-1 @ 3' | | **0.021** | | **+196.2** | |
| 07798-2 | WWTP2/A | GBH-2 @ 10.5' | | **0.156** | | **+110.9** | |
| 07798-3 | WWTP3/A | GBH-3 @ 25' | | **0.120** | | **+86.7** | |
| Method | Detection | Limits ---> | --- | 0.001 | 0.1 | 1 | 0.1 |

**********  COMMENTS  **********

Resistivities are at >500 ohm-cm, i.e., poor or <500 ohm-cm, i.e., very poor, and soil reactions (i.e., pHs) are mildly to moderately alkaline; sulfates are very mildly to greatly elevated (@ >200 & >1,000 ppm), and chlorides are very mildly to greatly elevated (i.e., @ >100 & >2,000 ppm); two sulfides are at a trace levels (@ >0.1 ppm); soils are moderately (@ 100-200 mV) to strongly reduced (@ <100 mV). The CalTrans (CT) times to perforation and full depth pitting times (following Uhlig) for these soils are determined based on the pertinent parameters [see table at left below]. Sulfate could have minor (WWTP1 & 2) to moderate (WWTP3) adverse impacts on concrete, cement, mortar or grout; chloride might have a very mild (WWTP1) to strong (WWTP2 & 3) adverse impact on rebar or buried steel in these soils. Indeed, calculated times to failure of std rebar in std cement is just 24-25 year in WWTP2 & 3; and is at ~55 yrs in WWTP1. In principle, lime or cement treatment would not be of any benefit in these soils because their pHs are already in the 7.5-8.5 range. Reducing pH in WWTP3 could readily be accomplished with the appropriate conditioner, although it is not very much over the upper limit. To increase longevity any more in these soils would require steel upgrading and/or other actions. All three of these soils would rate as very to extremely corrosive as they have high total point values. Thus, taking actions for their remediation and protection of construction materials would be necessary in all three cases. Various options for remediation include cathodic protection along with coating or wrapping steel assets; or specialized engineering fill, use of polymer or other coatings, or the use of plastic, fiberglass or concrete assets. Upgrading concrete mixes and rebar would be prudent, especially in WWTP2 & WWTP3 due to high levels of Cl, and elevated SO4 in WWTP3.

| SAMPLE ID | CT 18 ga | CT 12 ga | 2 mm (Uhlig) |
|---|---|---|---|
| *WWTP1/A* | *~18 yrs* | *~40 yrs* | *~10.5 yrs* |
| treated | <21 yrs | <46 yrs | ~12 yrs |
| WWTP2/A | <12 yrs | ~26 yrs | >3 yrs |
| treated | - | - | --- |
| WWTP3/A | >10 yrs | ~23 yrs | ~3 yrs |
| treated | - | - | --- |

| PARAMETER/ID | WWTP1/A | WWTP2/A | WWTP3/A |
|---|---|---|---|
| *pH* | Ø | Ø | *3* |
| Rs | 8-10 | 10 | 10 |
| SO4 / Cl | 1 / 3 | 1 / 5 | 3 / 5 |
| S= | Ø | 2 | 2 |
| Redox | Ø-4 | Ø-4 | 3.5-5 |
| TOTALS | 12-17 | 13-21 | 18.5-25 |

\\\\NOTES: Methods are from following sources: extractions by Cal Trans protocols as per Cal Test 417 (SO4), 422 (Cl), and 532/643 (pH & resistivity); &/or by ASTM Vol. 4.08 & ASTM Vol. 11.01 (=EPA Methods of Chemical Analysis, or Standard Methods); pH - ASTM G 51; Spec. Cond. - ASTM D 1125; resistivity - ASTM G 57; redox - Pt probe/ISE; sulfate - extraction Title 22, detection ASTM D 516 (=EPA 375.4); chloride - extraction Title 22, detection ASTM D 512 (=EPA 325.3); sulfides - extraction by Title 22, and detection EPA 376.2 (= SMEWW 4500-S D); cyanides - extraction by Title 22, and detection by ASTM D 4374 (=EPA 335.2).

# E T S

**Environmental Technical Services**

975 Transport Way, Suite 2
Petaluma, CA 94954
(707) 778-9605/FAX 778-9612
e-mail: *entech@pacbell.net*

-Soil, Water & Air Testing & Monitoring
-Analytical Labs
-Technical Support

***Serving people and the environment so that both benefit.***


| | | | | |
|---|---|---|---|---|
| COMPANY: LACO Associates, 3450 Regional Parkway, Suite B2, Santa Rosa, CA 95403 | | | ANALYST(S) | SUPERVISOR |
| ATTN: Bobby Voeks | | DATE of | S. Santos | D. Jacobson |
| JOB NAME: WWTP, Arcata, California | DATE RECEIVED | COMPLETION | L. Quijano | LAB DIRECTOR |
| JOB #: 7986.01 | 6/8/2018 | 6/20/2018 | | G.S. Conrad PhD |

| LAB SAMPLE NUMBER | SAMPLE ID | DESCRIPTION of SOIL and/or SEDIMENT | SOIL pH -log[H+] | NOMINAL MIN RESISTIVITY ohm-cm | ELECTRICAL CONDUCTIVITY µmhos/cm | SULFATE SO4 ppm | CHLORIDE Cl ppm |
|---|---|---|---|---|---|---|---|
| 07798-4 | WWTP4/A | GBH-2 @ 51' | **8.27** | **614** | **[1628]** | **234** | **1,125** |
| 07798-5 | WWTP5/A | GBH-3 @ 4' | **6.44** | **225** | **[4444]** | **750** | **870** |
| 07798-6 | WWTP6/A | GBH-4 @ 4' | **6.07** | **1,285** | **[778]** | **450** | **330** |
| Method | Detection | Limits ---> | --- | 1 | 0.1 | 1 | 1 |

| LAB SAMPLE NUMBER | SAMPLE ID | DESCRIPTION of SOIL and/or SEDIMENT | SALINITY ECe mmhos/cm | SOLUBLE SULFIDES (S=) ppm | SOLUBLE CYANIDES (CN=) ppm | REDOX mV | PERCENT MOISTURE % |
|---|---|---|---|---|---|---|---|
| 07798-4 | WWTP4/A | GBH-2 @ 51' | | **0.051** | | **+104.9** | |
| 07798-5 | WWTP5/A | GBH-3 @ 4' | | **0.027** | | **+75.4** | |
| 07798-6 | WWTP6/A | GBH-4 @ 4' | | **0.144** | | **+83.4** | |
| Method | Detection | Limits ---> | --- | 0.001 | 0.1 | 1 | 0.1 |

**********COMMENTS**********

Resistivities are at <1,000 & <500 ohm-cm, i.e., poor to very poor or >1,250 ohm-cm, i.e., low, and soil reactions (i.e., pHs) are moderately alkaline to very milldy acidic; sulfates are very mildly to mildly elevated (@ >200 & >1,000 ppm), and chlorides are very mildly to highly elevated (i.e., @ >100 & >1,000 ppm); one sulfide is at a trace level (@ >0.1 ppm); soils are moderately (@ 100-200 mV) to strongly reduced (@ <100 mV). The CalTrans (CT) times to perforation and full depth pitting times (following Uhlig) for these soils are determined based on the pertinent parameters [see table at left below]. Sulfate could have some minor adverse impact, especially in WWTP5, on concrete, cement, mortar or grout; chloride might have a very mild (WWT61) to mild (WWTP5) to moderate (WWTP4) adverse impact on rebar or buried steel in these soils. Indeed, calcuated times to failure of std rebar in std cement are just 34.5 & ~38 yrs in WWTP4 & 5; it is about 58 years in WWTP6. In principle, lime or cement treatment could be of benefit in one of these soils (WWTP6) in that raising soil pH to the 7.5-8.5 range would significantly increase perf and pitting times of this soil; this does not happen in WWTP5 due to passivation. To increase longevity any more in these soils would require steel upgrading and/or other actions. All three soils would rate as very to extremely corrosive as they have high total point values. Thus, taking actions for their remediation and protection of construction materials would be necessary in all three cases. Various options for remediation include cathodic protection along with coating or wrapping the steel assets; or specialized engineering fill, use of polymer or other coatings, or the use of plastic, fiberglass or concrete assets. Upgrading of concrete mixes and rebar would be prudent, especially in WWTP4 & WWTP5 due to elevated to high levels of Cl and SO4.

| SAMPLE ID | CT 18 ga | CT 12 ga | 2 mm (Uhlig) |
|---|---|---|---|
| *WWTP4/A* | *>20 yrs* | *~45 yrs* | *~10.5 yrs* |
| Treated | - | - | --- |
| WWTP5/A | ~2.6 yrs | <6 yrs | >6 yrs |
| Treated | ~13.5 yrs | <30 yrs | ~4 yrs |
| WWTP6/A | <11 yrs | ~24 yrs | >8 yrs |
| Treated | >27 yrs | <61 yrs | ~19 yrs |

| PARAMETER/ID | WWTP4/A | WWTP5/A | WWTP6/A |
|---|---|---|---|
| *pH* | Ø | Ø | Ø |
| Rs | 8-10 | 10 | 2-10 |
| SO4 / Cl | 1 / 4 | 2 / 3 | Ø / 3 |
| S= | Ø | Ø | 2 |
| Redox | Ø-4 | 3.5-5 | 3.5-5 |
| TOTALS | 13-19 | 15.5-18 | 7.5-20 |

\\\\NOTES: Methods are from following sources: extractions by Cal Trans protocols as per Cal Test 417 (SO4), 422 (Cl), and 532/643 (pH & resistivity); &/or by ASTM Vol. 4.08 & ASTM Vol. 11.01 (=EPA Methods of Chemical Analysis, or Standard Methods); pH - ASTM G 51; Spec. Cond. - ASTM D 1125; resistivity - ASTM G 57; redox - Pt probe/ISE; sulfate - extraction Title 22, detection ASTM D 516 (=EPA 375.4); chloride - extraction Title 22, detection ASTM D 512 (=EPA 325.3); sulfides - extraction by Title 22, and detection EPA 376.2 (= SMEWW 4500-S D); cyanides - extraction by Title 22, and detection by ASTM D 4374 (=EPA 335.2).

# E T S

**Environmental Technical Services**

975 Transport Way, Suite 2
Petaluma, CA 94954
(707) 778-9605/FAX 778-9612
e-mail: *entech@pacbell.net*

-Soil, Water & Air Testing & Monitoring
-Analytical Labs
-Technical Support

***Serving people and the environment so that both benefit.***


| | | | |
|---|---|---|---|
| COMPANY: LACO Associates, 3450 Regional Parkway, Suite B2, Santa Rosa, CA 95403 | | ANALYST(S) | SUPERVISOR |
| ATTN: Bobby Voeks | DATE of | S. Santos | D. Jacobson |
| JOB NAME: WWTP, Arcata, California | DATE RECEIVED: 6/8/2018 / COMPLETION: 6/20/2018 | L. Quijano | LAB DIRECTOR |
| JOB #: 7986.01 | | | G.S. Conrad PhD |

| LAB SAMPLE NUMBER | SAMPLE ID | DESCRIPTION of SOIL and/or SEDIMENT | SOIL pH -log[H+] | NOMINAL MIN RESISTIVITY ohm-cm | ELECTRICAL CONDUCTIVITY µmhos/cm | SULFATE SO4 ppm | CHLORIDE Cl ppm |
|---|---|---|---|---|---|---|---|
| 07798-7 | WWTP7/A | GBH-5 @ 10' | **7.59** | **118** | **[8446]** | **825** | **7,650** |
| 07798-8 | WWTP8/A | GBH-5 @ 26' | **8.04** | **123** | **[8130]** | **525** | **6,600** |
| 07798-9 | WWTP9/A | GBH5 @ 50.5' | **7.86** | **572** | **[1748]** | **138** | **840** |
| Method | Detection | Limits ---> | --- | 1 | 0.1 | 1 | 1 |

| LAB SAMPLE NUMBER | SAMPLE ID | DESCRIPTION of SOIL and/or SEDIMENT | SALINITY ECe mmhos/cm | SOLUBLE SULFIDES (S=) ppm | SOLUBLE CYANIDES (CN=) ppm | REDOX mV | PERCENT MOISTURE % |
|---|---|---|---|---|---|---|---|
| 07798-7 | WWTP7/A | GBH-5 @ 10' | | **0.057** | | **+84.2** | |
| 07798-8 | WWTP8/A | GBH-5 @ 26' | | **0.015** | | **+74.1** | |
| 07798-9 | WWTP9/A | GBH5 @ 50.5' | | **0.024** | | **+196.2** | |
| Method | Detection | Limits ---> | --- | 0.001 | 0.1 | 1 | 0.1 |

**********COMMENTS**********

Resistivities are at <500 ohm-cm, i.e., very poor or >500 ohm-cm, i.e., poor, and soil reactions (i.e., pHs) are basically mildly alkaline; two sulfates are mildly elevated (@ >500 ppm), and chlorides are mildly to hugely elevated (i.e., @ >500 ppm & @ >5,000 ppm); all sulfides are at a minuscule level (i.e., @ <0.1 ppm); soils are moderately (@ 100-200 mV) to strongly reduced (@ <100 mV). The CalTrans (CT) times to perforation and full depth pitting times (following Uhlig) for these soils are determined based on the pertinent parameters [see table at left below]. Sulfate could have some minor adverse impact in WWTP7 & 8 on concrete, cement, mortar or grout; chlorides might have a mild (WWTP9) but would have a strong (WWTP7 & 8) adverse impact on rebar or buried steel in these soils. Indeed, calculated times to failure of std rebar in std cement are only about 15-16 years in WWTP7 & 8, and at <39 years in WWTP9. In principle, lime or cement treatment would not be of any benefit in these soils because their pHs are already in the 7.5-8.5 range. To increase longevity any more in these soils would require steel upgrading and/or other actions. All three of these soils would rate as very to extremely corrosive as they have high total point values. Thus, taking actions for their remediation and protection of construction materials would be necessary in all three cases. Some options for remediation include cathodic protection along with coating or wrapping steel assets; or specialized engineering fill, use of polymer or other coatings, or the use of plastic, fiberglass or concrete assets. Upgrading concrete mixes and rebar would be prudent, especially in WWTP8 & WWTP9 due to very high levels of Cl, and elevated SO4.

| SAMPLE ID | CT 18 ga | CT 12 ga | 2 mm (Uhlig) |
|---|---|---|---|
| *WWTP7/A* | *>10 yrs* | *<23 yrs* | *~3 yrs* |
| treated | - | - | --- |
| WWTP8/A | <11 yrs | ~23 yrs | >3 yrs |
| treated | - | - | --- |
| WWTP9/A | <20 yrs | >43 yrs | ~9 yrs |
| treated | - | - | --- |

| PARAMETER/ID | WWTP7/A | WWTP8/A | WWTP9/A |
|---|---|---|---|
| *pH* | Ø | Ø | Ø |
| Rs | 10 | 10 | 8-10 |
| SO4 / Cl | 2 / 5 | 2 / 5 | Ø / 3 |
| S= | Ø | Ø | Ø |
| Redox | 3.5-5 | 3.5-5 | Ø-4 |
| TOTALS | 15.5-20 | 15.5-20 | 8-17 |

\\\\NOTES: Methods are from following sources: extractions by Cal Trans protocols as per Cal Test 417 (SO4), 422 (Cl), and 532/643 (pH & resistivity); &/or by ASTM Vol. 4.08 & ASTM Vol. 11.01 (=EPA Methods of Chemical Analysis, or Standard Methods); pH - ASTM G 51; Spec. Cond. - ASTM D 1125; resistivity - ASTM G 57; redox - Pt probe/ISE; sulfate - extraction Title 22, detection ASTM D 516 (=EPA 375.4); chloride - extraction Title 22, detection ASTM D 512 (=EPA 325.3); sulfides - extraction by Title 22, and detection EPA 376.2 (= SMEWW 4500-S D); cyanides - extraction by Title 22, and detection by ASTM D 4374 (=EPA 335.2).

# E T S

**Environmental Technical Services**

-Soil, Water & Air Testing & Monitoring
-Analytical Labs
-Technical Support

975 Transport Way, Suite 2
Petaluma, CA 94954
(707) 778-9605/FAX 778-9612
e-mail: *entech@pacbell.net*


***Serving people and the environment so that both benefit.***

| | | | |
|---|---|---|---|
| COMPANY: LACO Associates, 3450 Regional Parkway, Suite B2, Santa Rosa, CA 95403 | | ANALYST(S) | SUPERVISOR |
| ATTN: Bobby Voeks | DATE of | S. Santos | D. Jacobson |
| JOB NAME: WWTP, Arcata, California | DATE RECEIVED / COMPLETION | L. Quijano | LAB DIRECTOR |
| JOB #: 7986.01 | 6/8/2018 / 6/20/2018 | | G.S. Conrad PhD |

| LAB SAMPLE NUMBER | SAMPLE ID | DESCRIPTION of SOIL and/or SEDIMENT | SOIL pH -log[H+] | NOMINAL MIN RESISTIVITY ohm-cm | ELECTRICAL CONDUCTIVITY µmhos/cm | SULFATE SO4 ppm | CHLORIDE Cl ppm |
|---|---|---|---|---|---|---|---|
| 07798-10 | WWTP10/A | GBH-6 @ 4' | **5.80** | **3,366** | **[297]** | **168** | **300** |
| 07798-11 | WWTP11/A | GBH-4 @ 3' | **6.21** | **1,880** | **[532]** | **78** | **390** |
| 07798-12 | WWTP12/A | GBH7 @ 10' | **6.48** | **558** | **[1794]** | **102** | **840** |
| Method | Detection | Limits ---> | --- | 1 | 0.1 | 1 | 1 |

| LAB SAMPLE NUMBER | SAMPLE ID | DESCRIPTION of SOIL and/or SEDIMENT | SALINITY ECe mmhos/cm | SOLUBLE SULFIDES (S=) ppm | SOLUBLE CYANIDES (CN=) ppm | REDOX mV | PERCENT MOISTURE % |
|---|---|---|---|---|---|---|---|
| 07798-10 | WWTP10/A | GBH-6 @ 4' | | **0.291** | | **+152.1** | |
| 07798-11 | WWTP11/A | GBH-4 @ 3' | | **0.081** | | **+124.1** | |
| 07798-12 | WWTP12/A | GBH7 @ 10' | | **0.084** | | **+116.5** | |
| Method | Detection | Limits ---> | --- | 0.001 | 0.1 | 1 | 0.1 |

**********  COMMENTS  **********

Resistivities are at >2,500, >1,500 ohm-cm, and <1,000, i.e., fair to mediocre to poor, and soil reactions (i.e., pHs) are basically very milldy acidic; sulfates are low (@ >200 ppm), and chlorides are very mildly to mildly elevated (@ >100 & >500 ppm); one of the sulfides is at a trace level (@ >0.1 ppm), but they other two are minuscule (@ <0.1 ppm); soils are moderately reduced (@ 100-200 mV). The CalTrans (CT) times to perforation and full depth pitting times (following Uhlig) for these soils are determined based on the pertinent parameters [see table at left below]. Sulfate would have no measureable adverse impact on concrete, cement, mortar or grout; but chloride might have a very mild (WWT10 & 11) to mild (WWTP12) adverse impact on rebar or buried steels. Times to failure of std rebar in std cement are put at 60 yrs, <54 yrs & <39 yrs. In principle, lime or cement treatment could be of benefit in two soils (WWTP10 & 11) in that raising pHs to the 7.5-8.5 range would significantly increase perf and pitting times. To increase longevity any more in these soils would require steel upgrading and/or other actions. Only one soil (WWTP12) would rate as very corrosive with a fairly high total point value; the other two are somewhat corrosive due to pHs and redoxes, and sulfides in one case. Thus, taking actions for their remediation and protection of construction materials would be necessary at least for WWTP12, and probably would be prudent to some degree for the other two. Various options for remediation include cathodic protection along with coating or wrapping the steel assets; or specialized engineering fill, use of polymer or other coatings, or the use of plastic, fiberglass or concrete assets. Upgrading concrete mixes and rebar would be prudent, especially in the case of WWTP12 due to its low resistivity, elevated Cl, and a moderately strong redox.

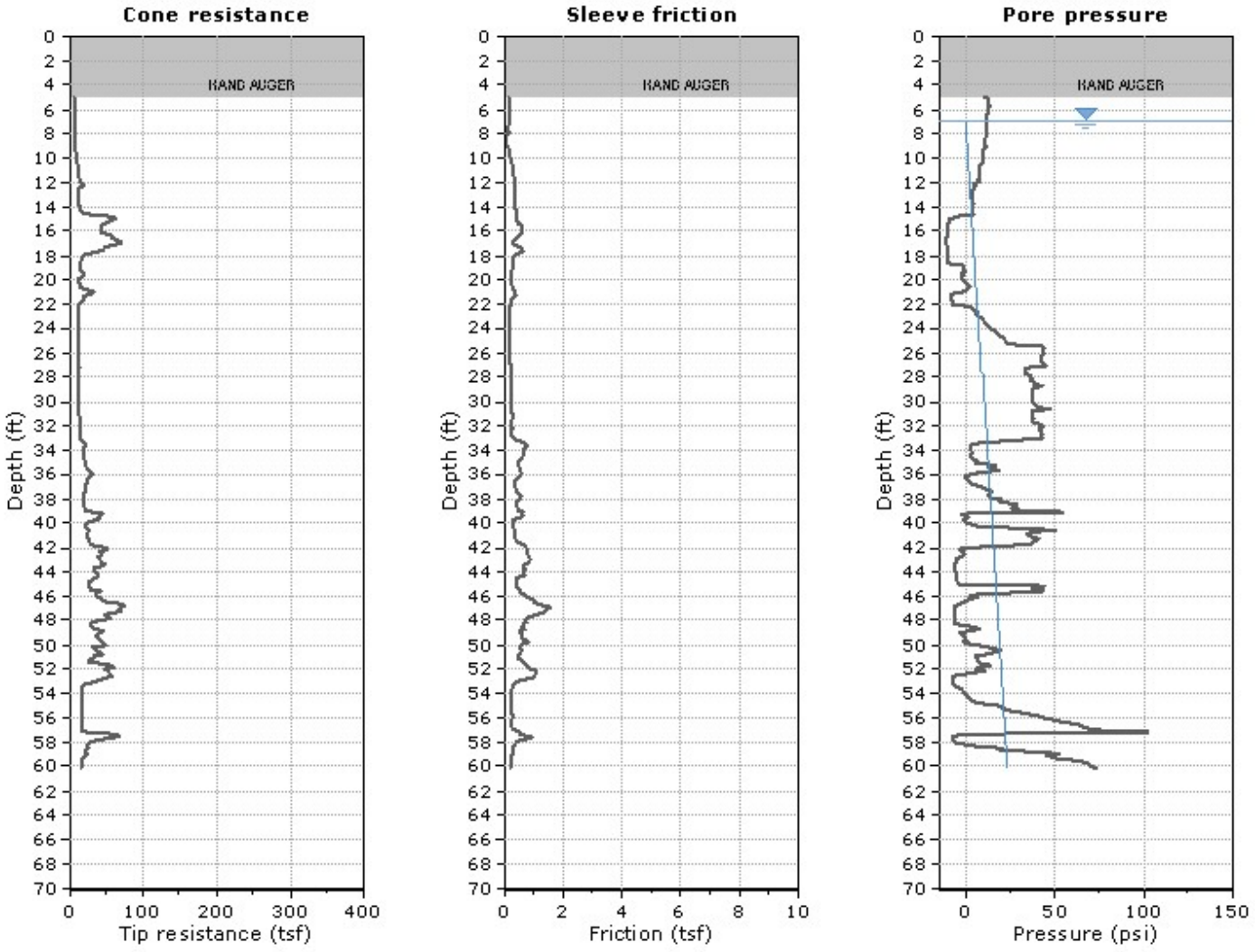
| SAMPLE ID | CT 18 ga | CT 12 ga | 2 mm (Uhlig) |
|---|---|---|---|
| WWTP10/A | >15 yrs | <34 yrs | ~9.5 yrs |
| treated | ~41 yrs | ~90 yrs | >44 yrs |
| WWTP11/A | ~14 yrs | <31 yrs | ~9 yrs |
| treated | <32 yrs | ~71 yrs | ~19 yrs |
| WWTP12/A | >8 yrs | >18 yrs | <9 yrs |
| treated | >19 yrs | ~43 yrs | <9 yrs |

| PARAMETER/ID | WWTP10/A | WWTP11/A | WWTP12/A |
|---|---|---|---|
| pH | Ø | Ø | Ø |
| Rs | Ø-4 | 1-6 | 8-10 |
| SO4 / Cl | Ø / 3 | Ø / 3 | Ø-3 |
| S= | 2 | Ø | Ø |
| Redox | Ø-4 | Ø-4 | Ø-4 |
| TOTALS | 2-13 | 1-13 | 8-17 |

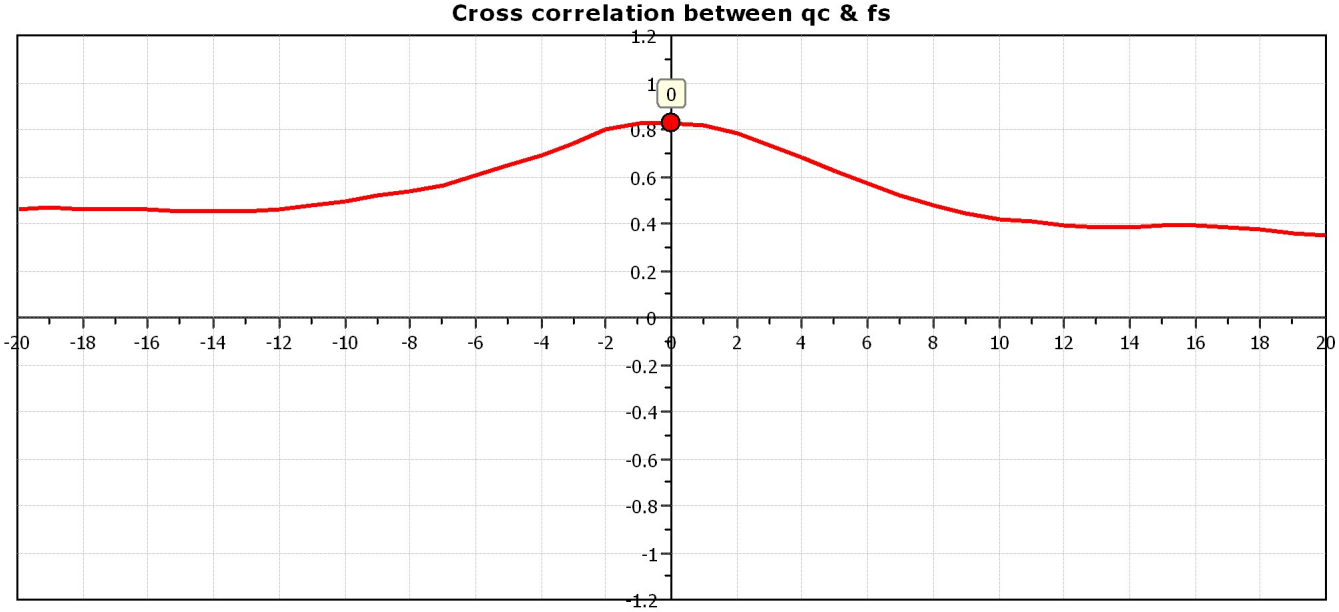
\\\\NOTES: Methods are from following sources: extractions by Cal Trans protocols as per Cal Test 417 (SO4), 422 (Cl), and 532/643 (pH & resistivity); &/or by ASTM Vol. 4.08 & ASTM Vol. 11.01 (=EPA Methods of Chemical Analysis, or Standard Methods); pH - ASTM G 51; Spec. Cond. - ASTM D 1125; resistivity - ASTM G 57; redox - Pt probe/ISE; sulfate - extraction Title 22, detection ASTM D 516 (=EPA 375.4); chloride - extraction Title 22, detection ASTM D 512 (=EPA 325.3); sulfides - extraction by Title 22, and detection EPA 376.2 (= SMEWW 4500-S D); cyanides - extraction by Title 22, and detection by ASTM D 4374 (=EPA 335.2).

# APPENDIX 4

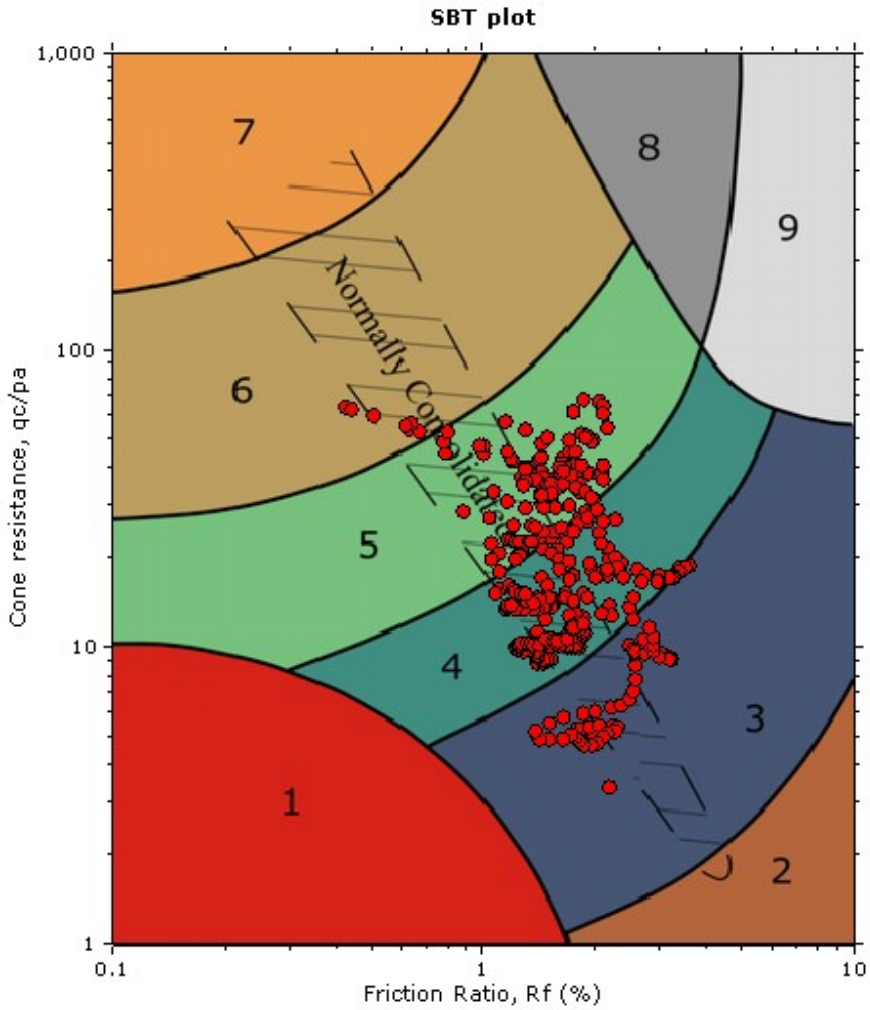
## CPT Analysis

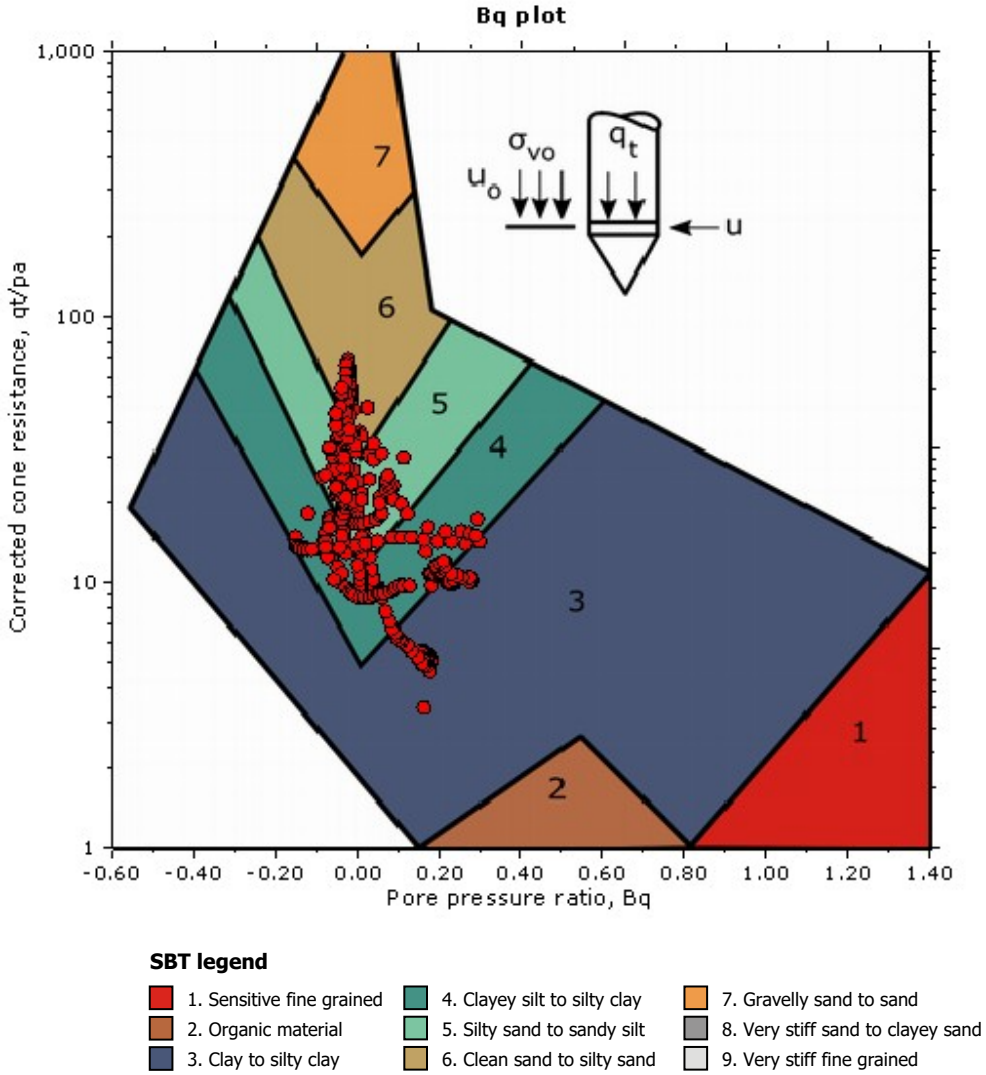



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



## SBT - Bq plots

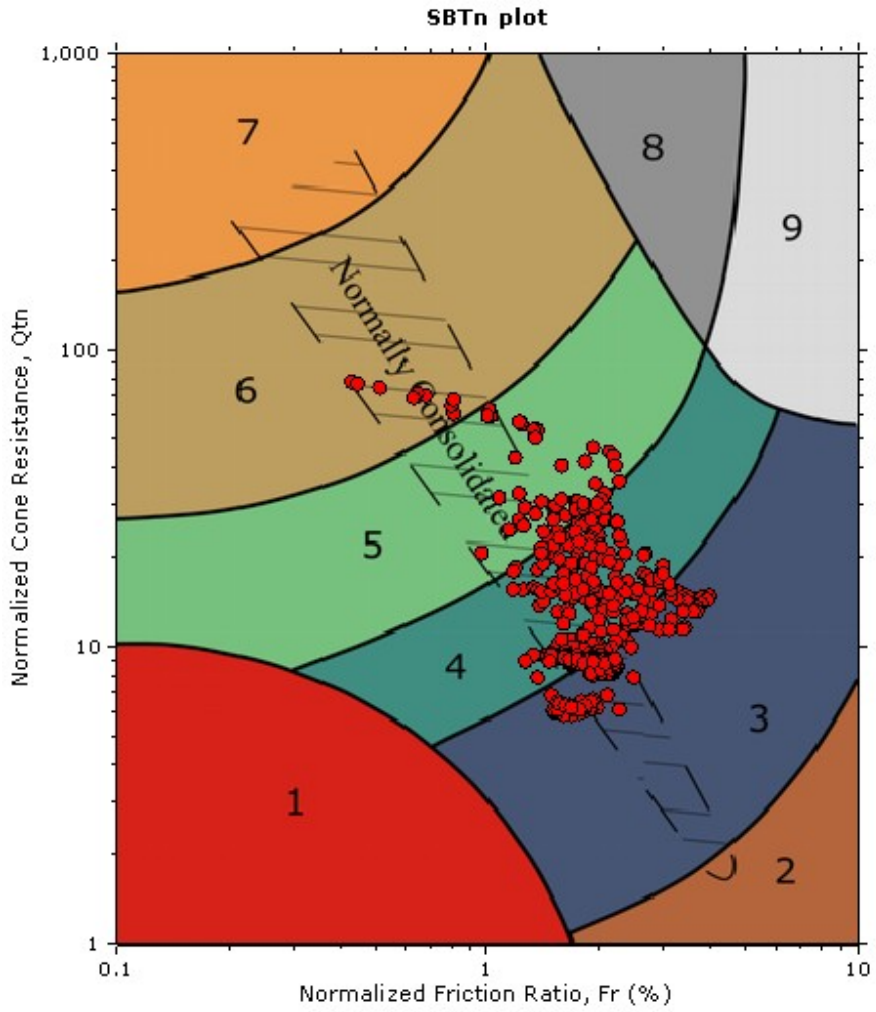


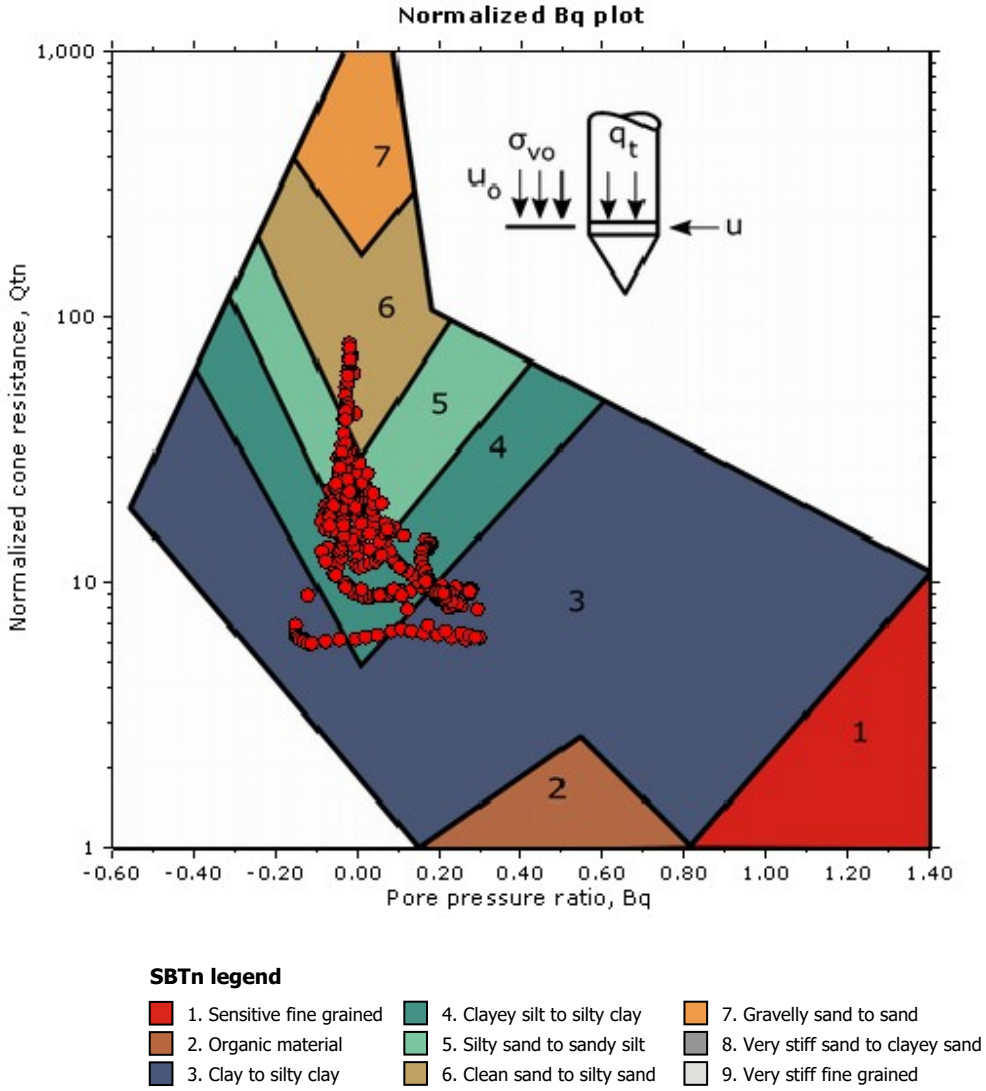




**SBT legend**

| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## SBT - Bq plots (normalized)

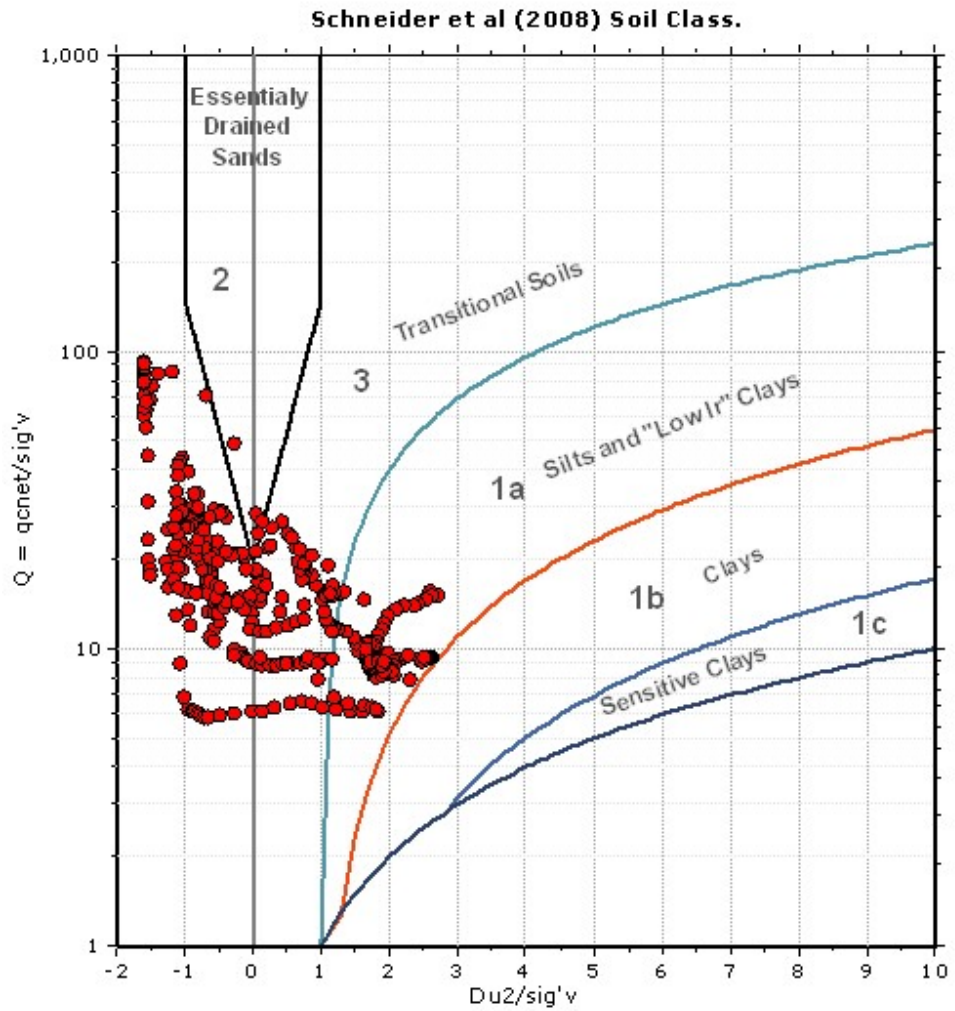


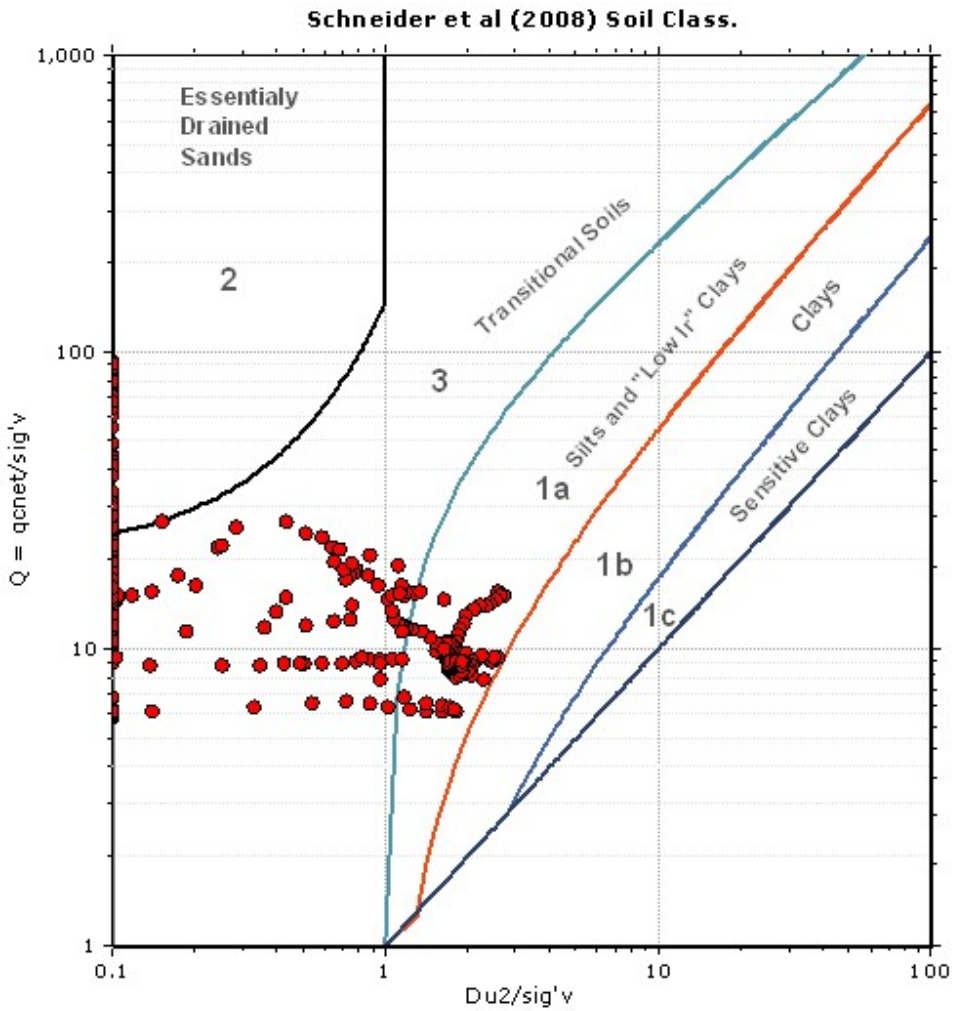



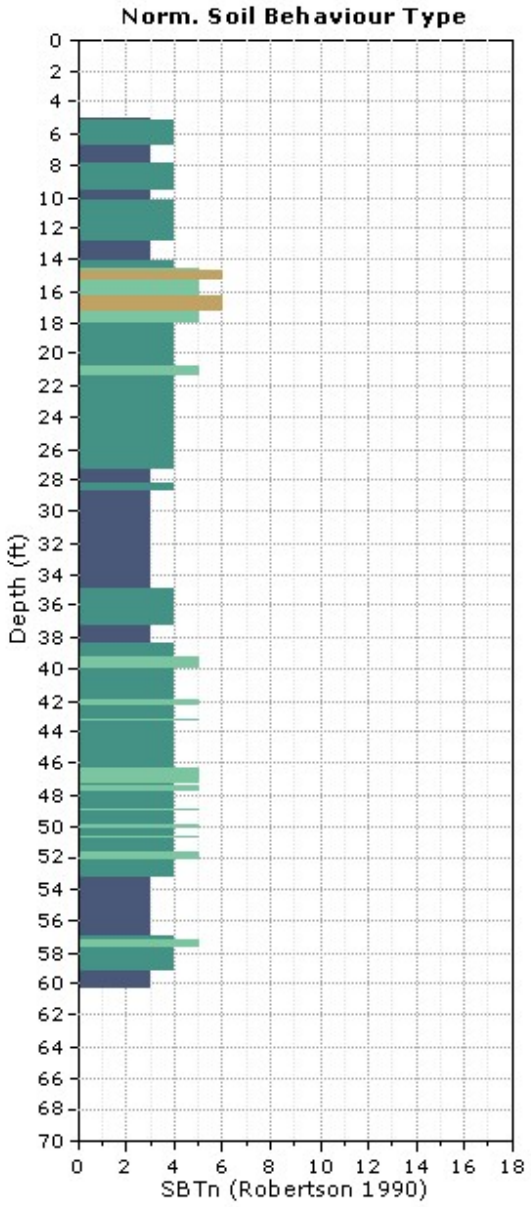

**SBTn legend**

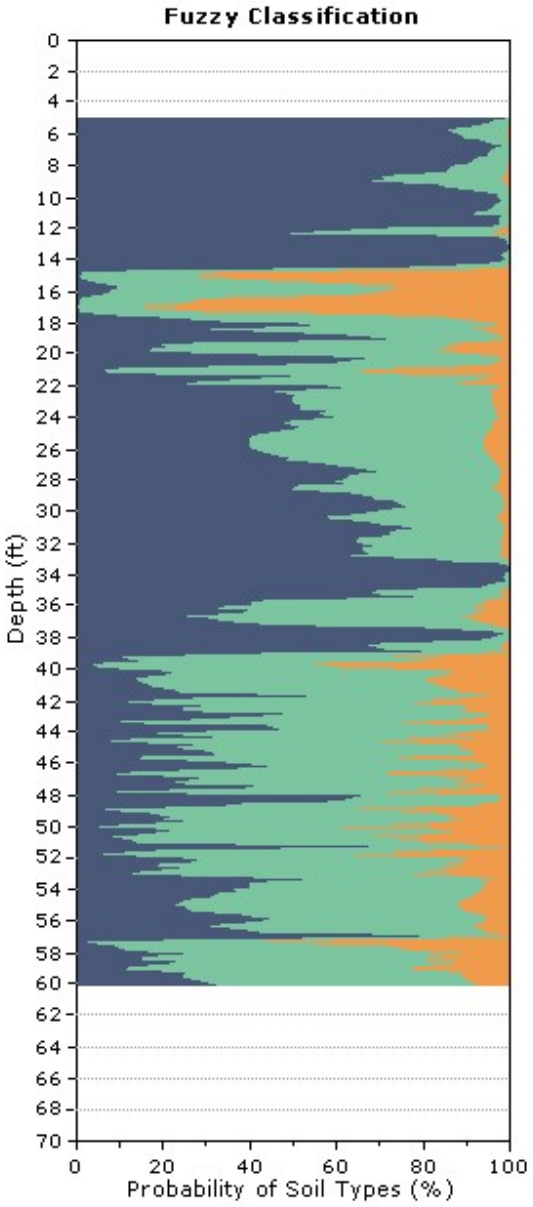
| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

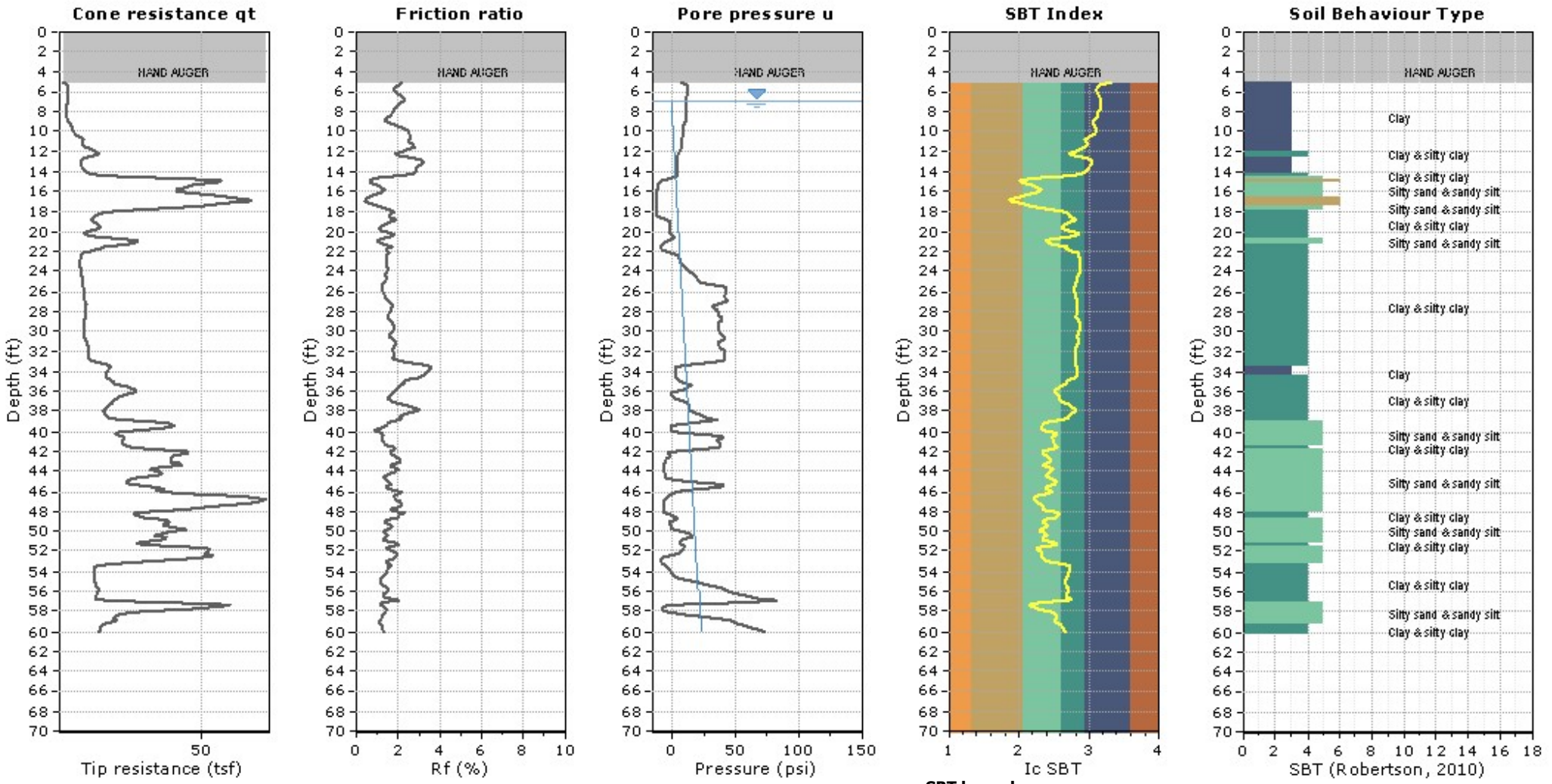
## Bq plots (Schneider)

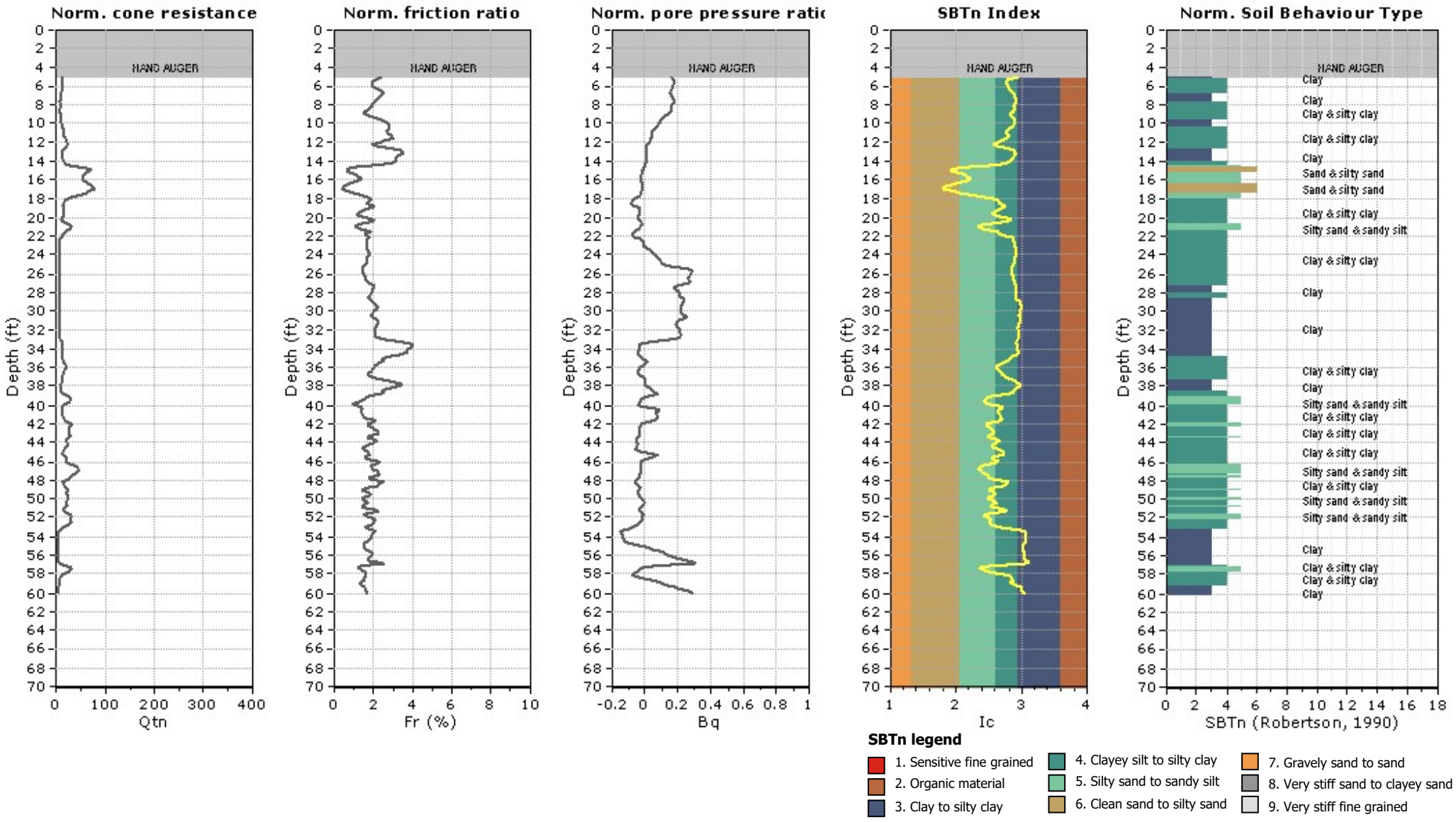


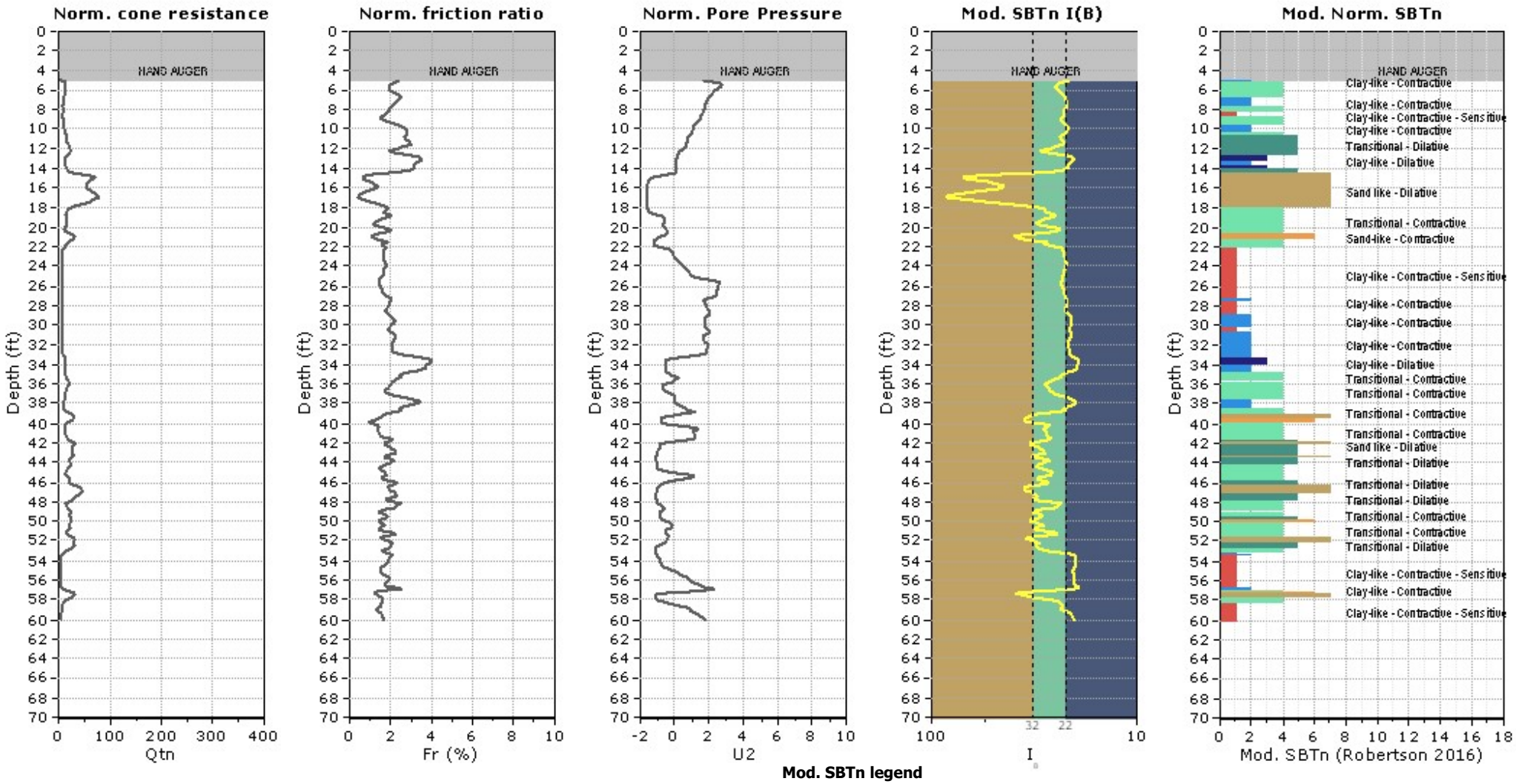




Norm. Soil Behaviour Type
Depth (ft)
SBTn (Robertson 1990)

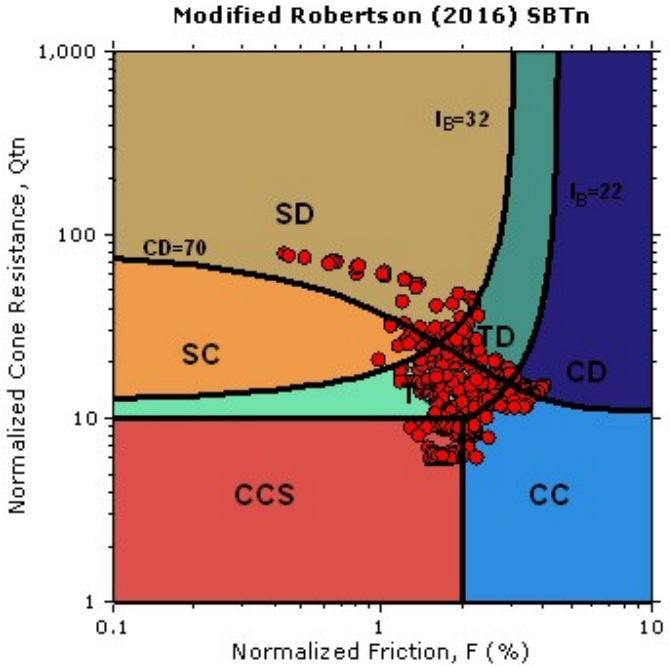

Fuzzy Classification
Depth (ft)
Probability of Soil Types (%)

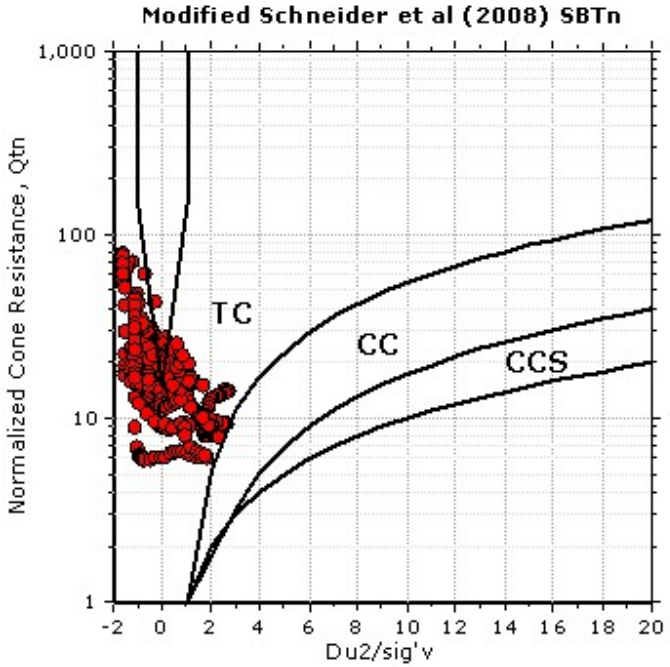

Cone resistance qt
Friction ratio
Pore pressure u
SBT Index
Soil Behaviour Type
HAND AUGER
Depth (ft)
Tip resistance (tsf)
Rf (%)
Pressure (psi)
Ic SBT
SBT (Robertson, 2010)
Clay
Clay & silty clay
Silty sand & sandy silt
SBT legend
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

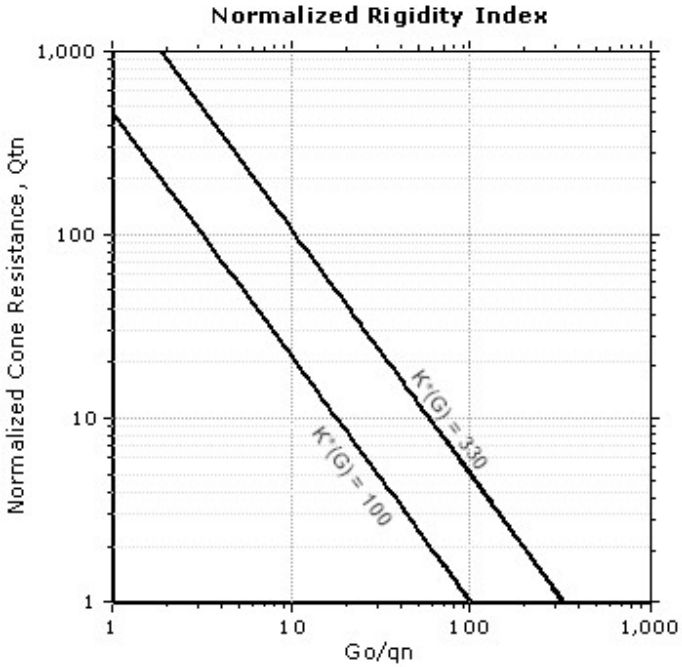

Norm. cone resistance
Norm. friction ratio
Norm. pore pressure ratio
SBTn Index
Norm. Soil Behaviour Type
HAND AUGER
Depth (ft)
Qtn
Fr (%)
Bq
Ic
SBTn (Robertson, 1990)
Clay
Clay & silty clay
Sand & silty sand
Silty sand & sandy silt
SBTn legend
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained


Norm. cone resistance
Norm. friction ratio
Norm. Pore Pressure
Mod. SBTn I(B)
Mod. Norm. SBTn
HAND AUGER
Depth (ft)
Qtn
Fr (%)
U2
I
Mod. SBTn (Robertson 2016)
Clay-like - Contractive
Clay-like - Contractive - Sensitive
Transitional - Dilative
Clay-like - Dilative
Sand like - Dilative
Transitional - Contractive
Sand-like - Contractive
Mod. SBTn legend
1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

## Updated SBTn plots

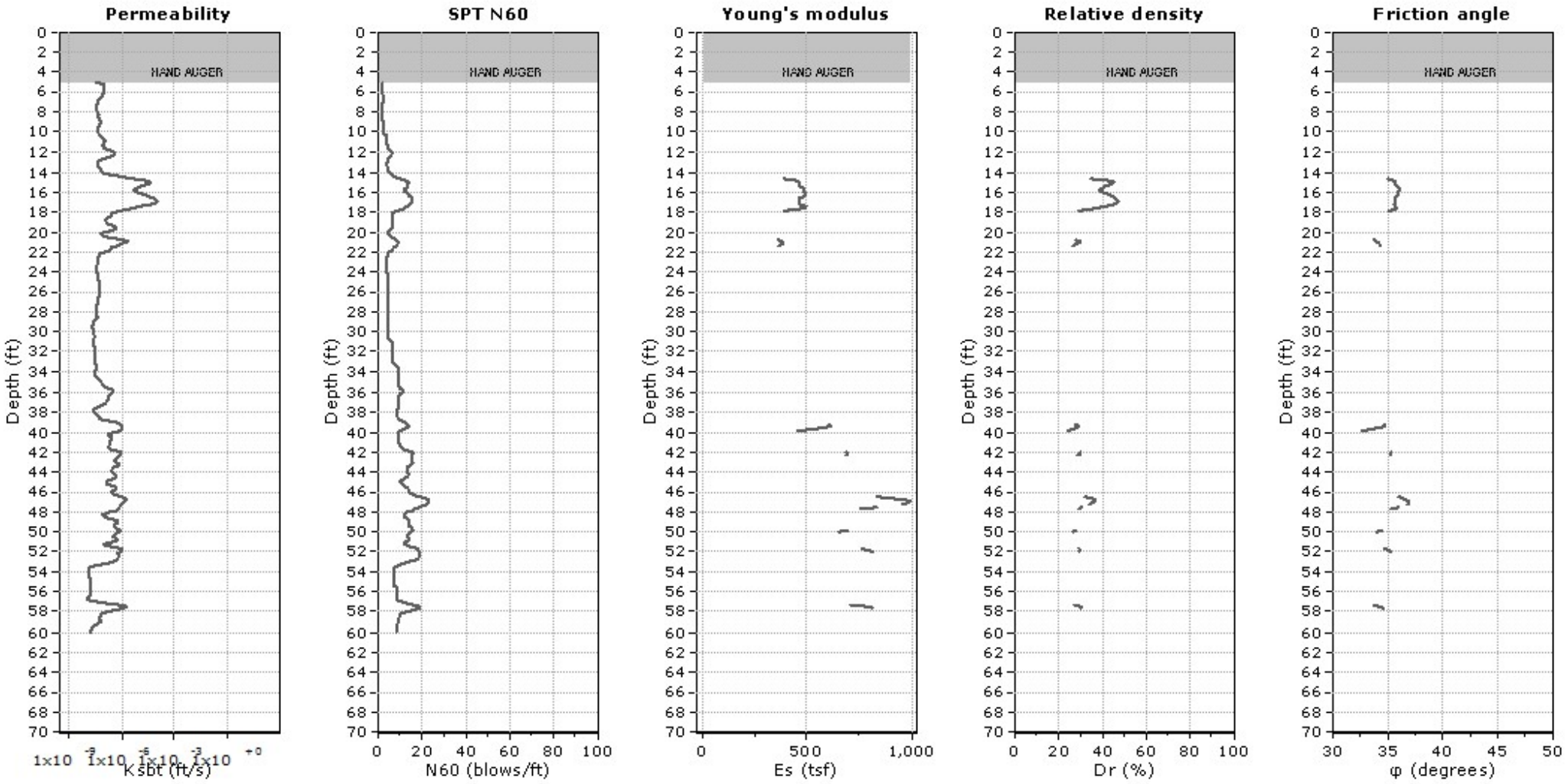


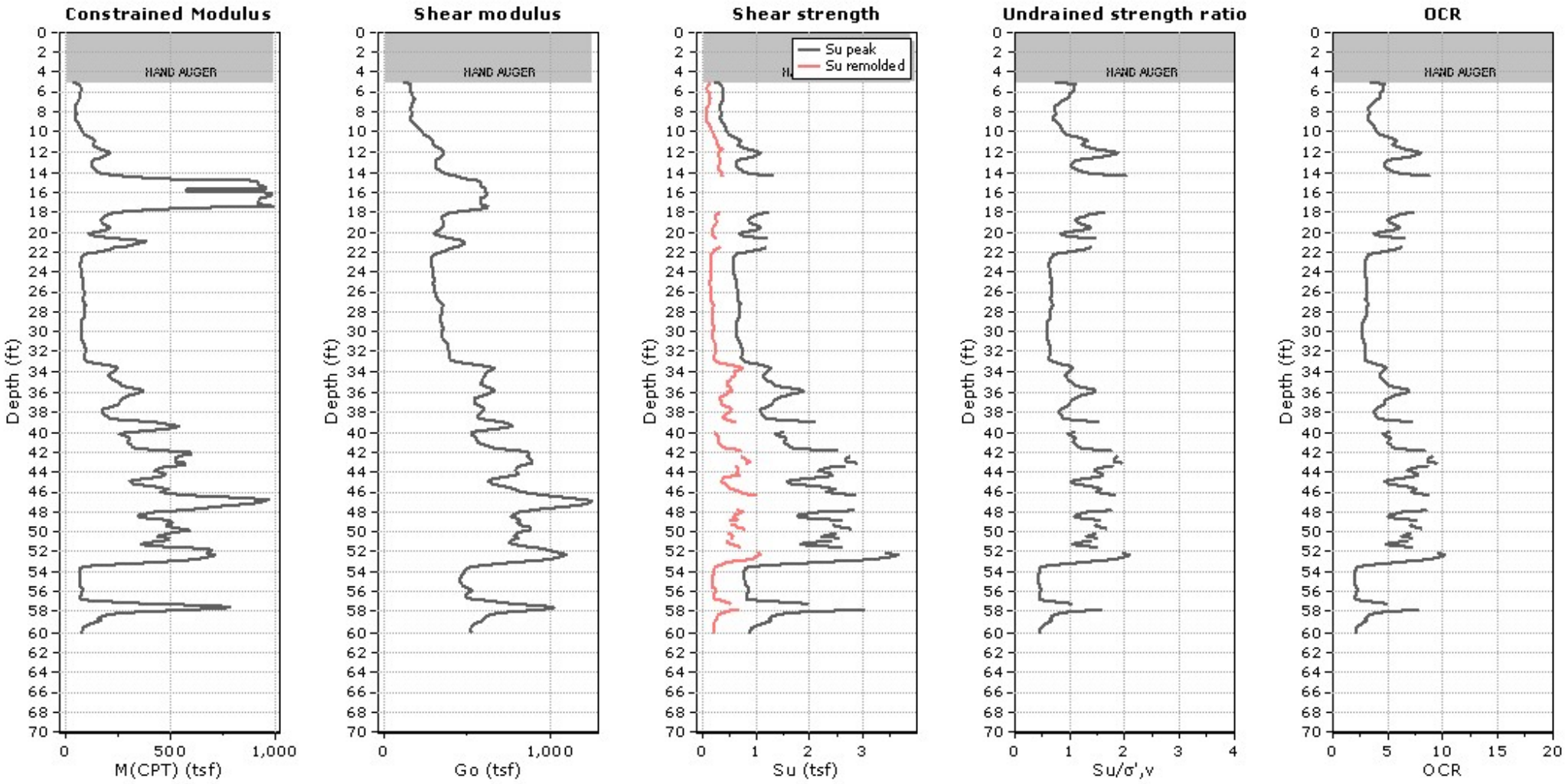

CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)



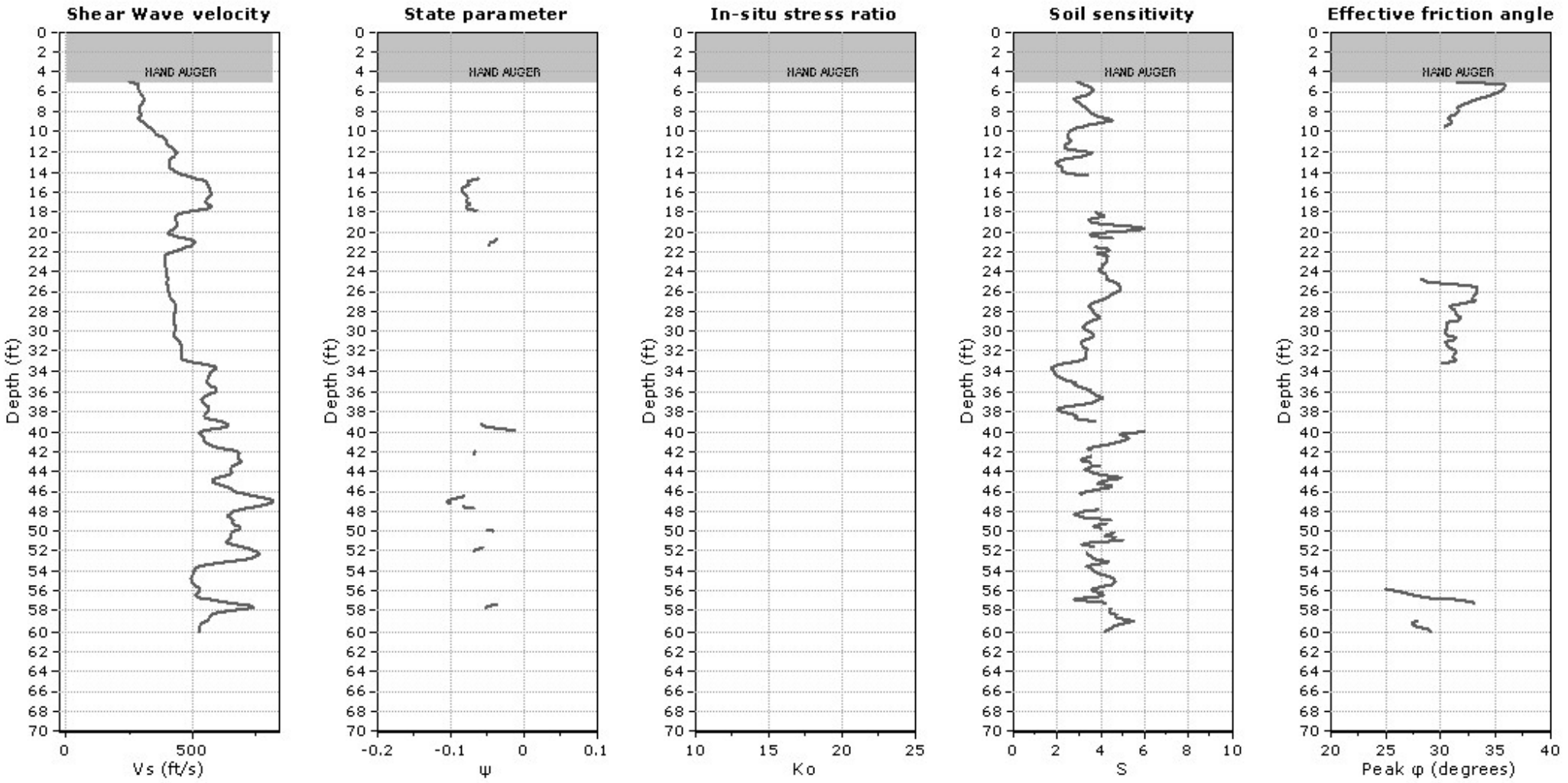

**Calculation parameters**

Permeability: Based on $SBT_n$
SPT $N_{60}$: Based on $I_c$ and $q_t$
Young's modulus: Based on variable alpha using $I_c$ (Robertson, 2009)
Relative density constant, $C_{Dr}$: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data




**Calculation parameters**

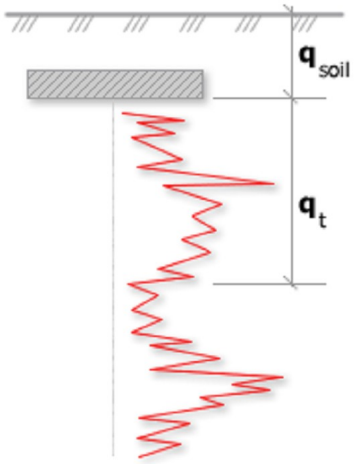
Constrained modulus: Based on variable alpha using $I_c$ and $Q_{tn}$ (Robertson, 2009)
Go: Based on variable alpha using $I_c$ (Robertson, 2009)
Undrained shear strength cone factor for clays, $N_{kt}$: 14
OCR factor for clays, $N_{kt}$: 0.33
User defined estimation data
Flat Dilatometer Test data




**Calculation parameters**

Soil Sensitivity factor, $N_S$: 7.00

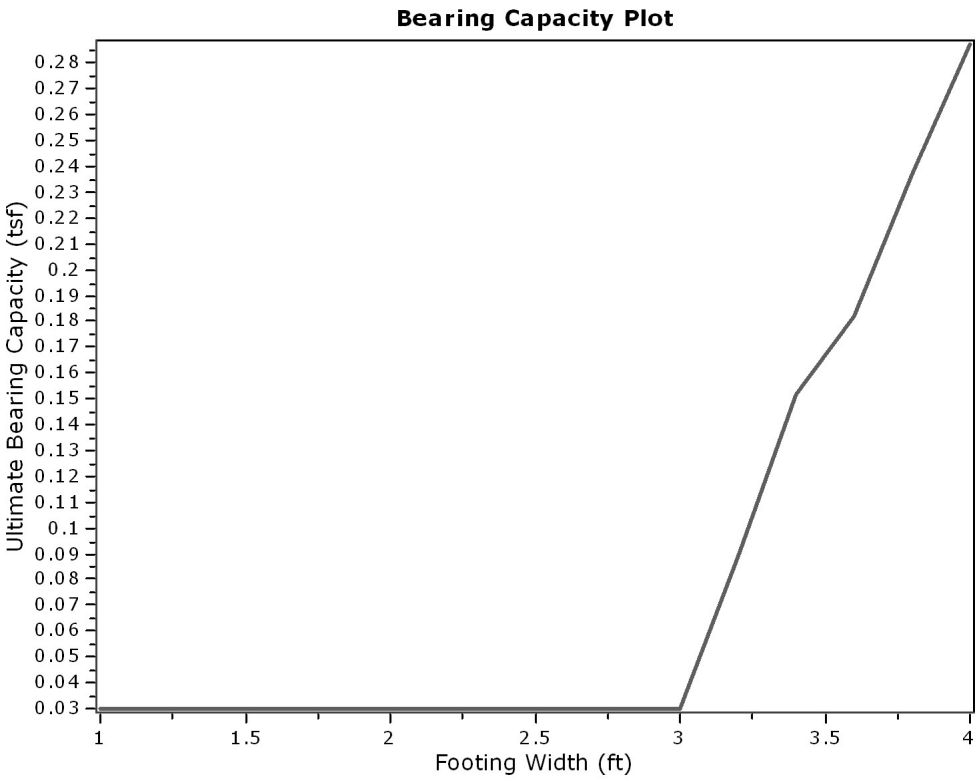
User defined estimation data




Bearing Capacity calculation is perfromed based on the formula:

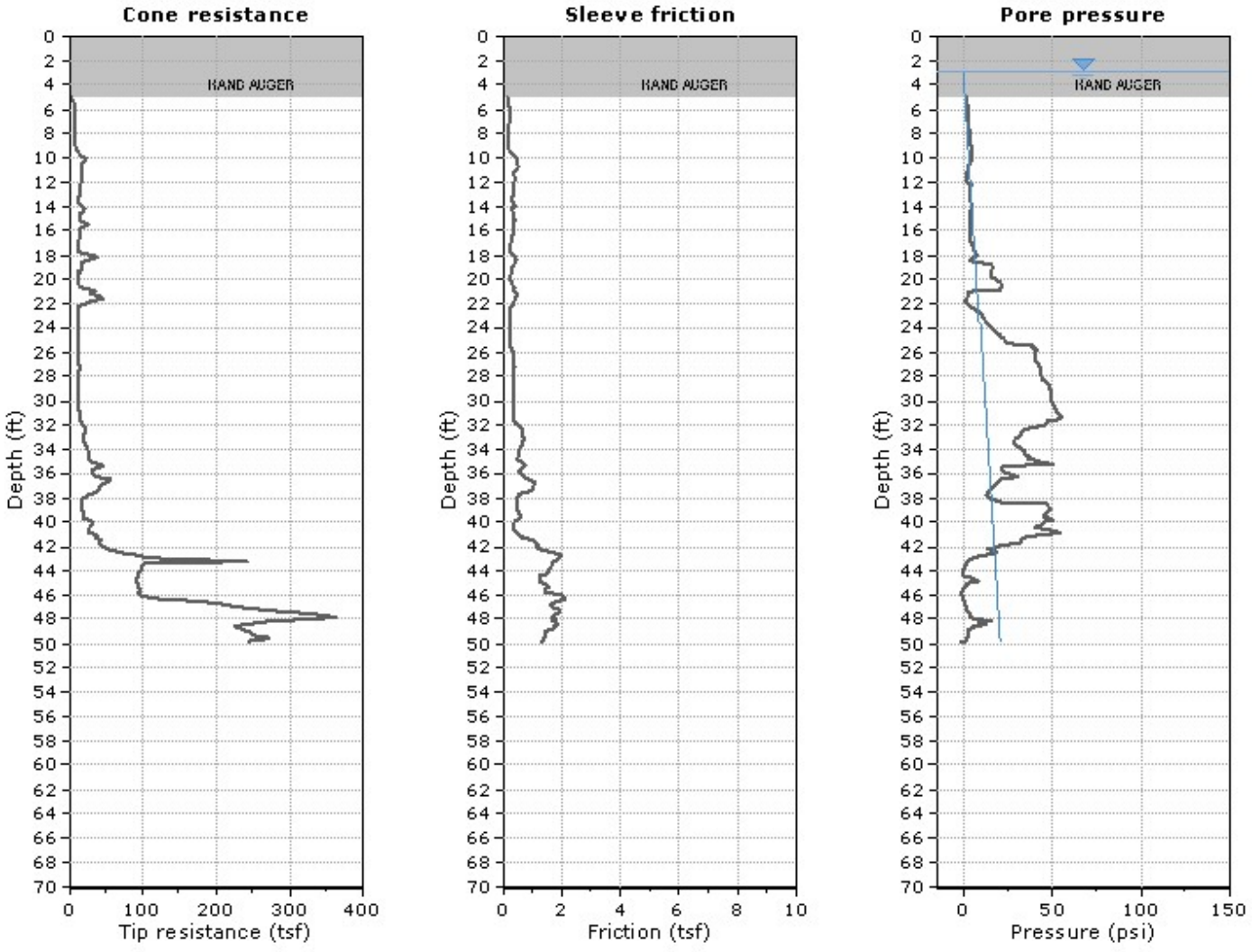
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
$R_k$: Bearing capacity factor
$q_t$: Average corrected cone resistance over calculation depth
$q_{soil}$: Pressure applied by soil above footing

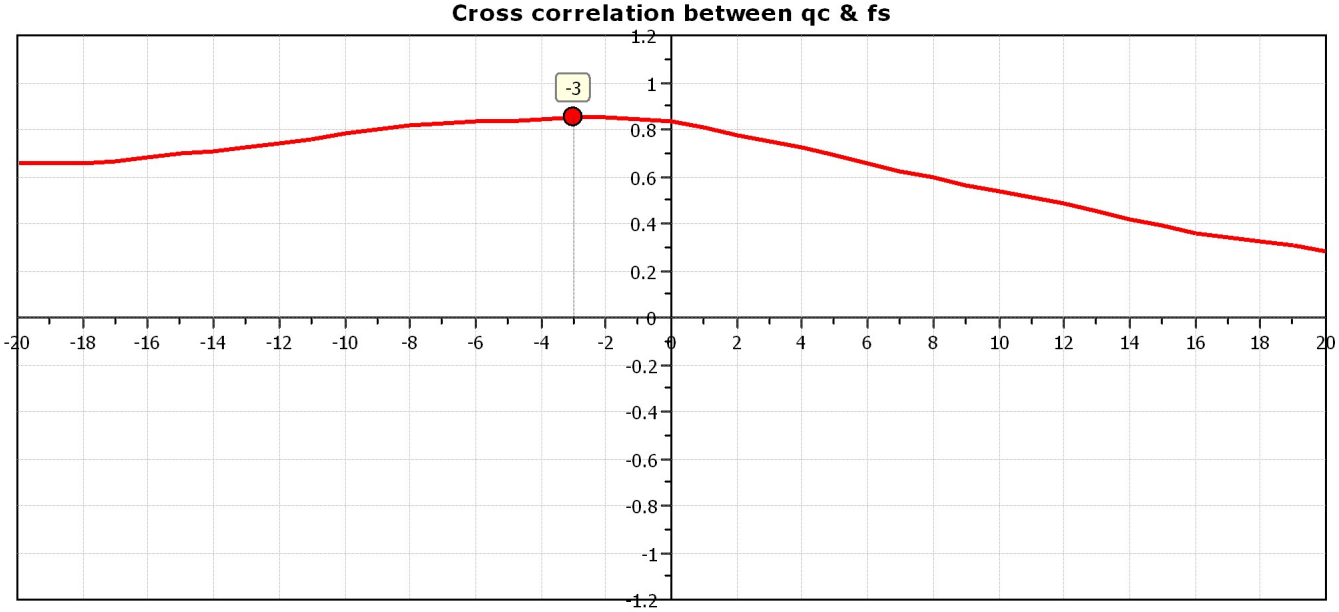



**:: Tabular results ::**

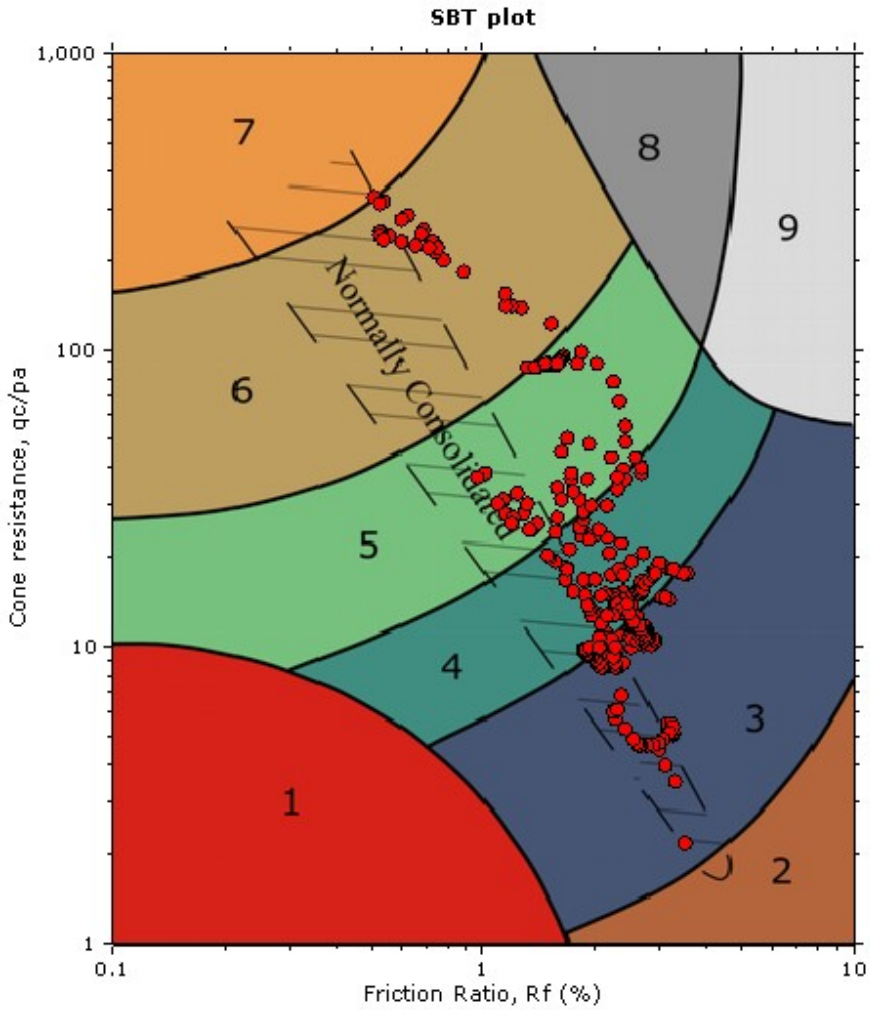
| No | B (ft) | Start Depth (ft) | End Depth (ft) | Ave. $q_t$ (tsf) | $R_k$ | Soil Press. (tsf) | Ult. bearing cap. (tsf) |
|---|---|---|---|---|---|---|---|
| 1 | 1.00 | 0.50 | 2.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 2 | 1.20 | 0.50 | 2.30 | 0.00 | 0.20 | 0.03 | 0.03 |
| 3 | 1.40 | 0.50 | 2.60 | 0.00 | 0.20 | 0.03 | 0.03 |
| 4 | 1.60 | 0.50 | 2.90 | 0.00 | 0.20 | 0.03 | 0.03 |
| 5 | 1.80 | 0.50 | 3.20 | 0.00 | 0.20 | 0.03 | 0.03 |
| 6 | 2.00 | 0.50 | 3.50 | 0.00 | 0.20 | 0.03 | 0.03 |
| 7 | 2.20 | 0.50 | 3.80 | 0.00 | 0.20 | 0.03 | 0.03 |
| 8 | 2.40 | 0.50 | 4.10 | 0.00 | 0.20 | 0.03 | 0.03 |
| 9 | 2.60 | 0.50 | 4.40 | 0.00 | 0.20 | 0.03 | 0.03 |
| 10 | 2.80 | 0.50 | 4.70 | 0.00 | 0.20 | 0.03 | 0.03 |
| 11 | 3.00 | 0.50 | 5.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 12 | 3.20 | 0.50 | 5.30 | 0.29 | 0.20 | 0.03 | 0.09 |
| 13 | 3.40 | 0.50 | 5.60 | 0.61 | 0.20 | 0.03 | 0.15 |
| 14 | 3.60 | 0.50 | 5.90 | 0.76 | 0.20 | 0.03 | 0.18 |
| 15 | 3.80 | 0.50 | 6.20 | 1.03 | 0.20 | 0.03 | 0.24 |
| 16 | 4.00 | 0.50 | 6.50 | 1.29 | 0.20 | 0.03 | 0.29 |

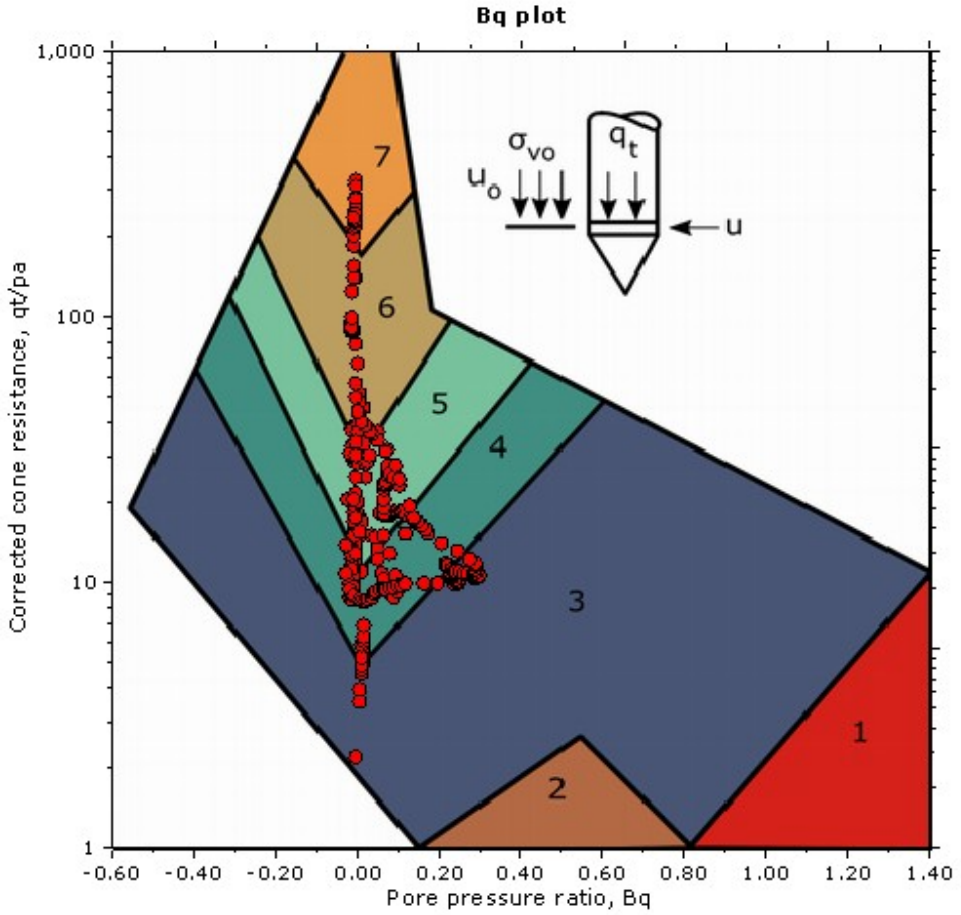



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



## SBT - Bq plots

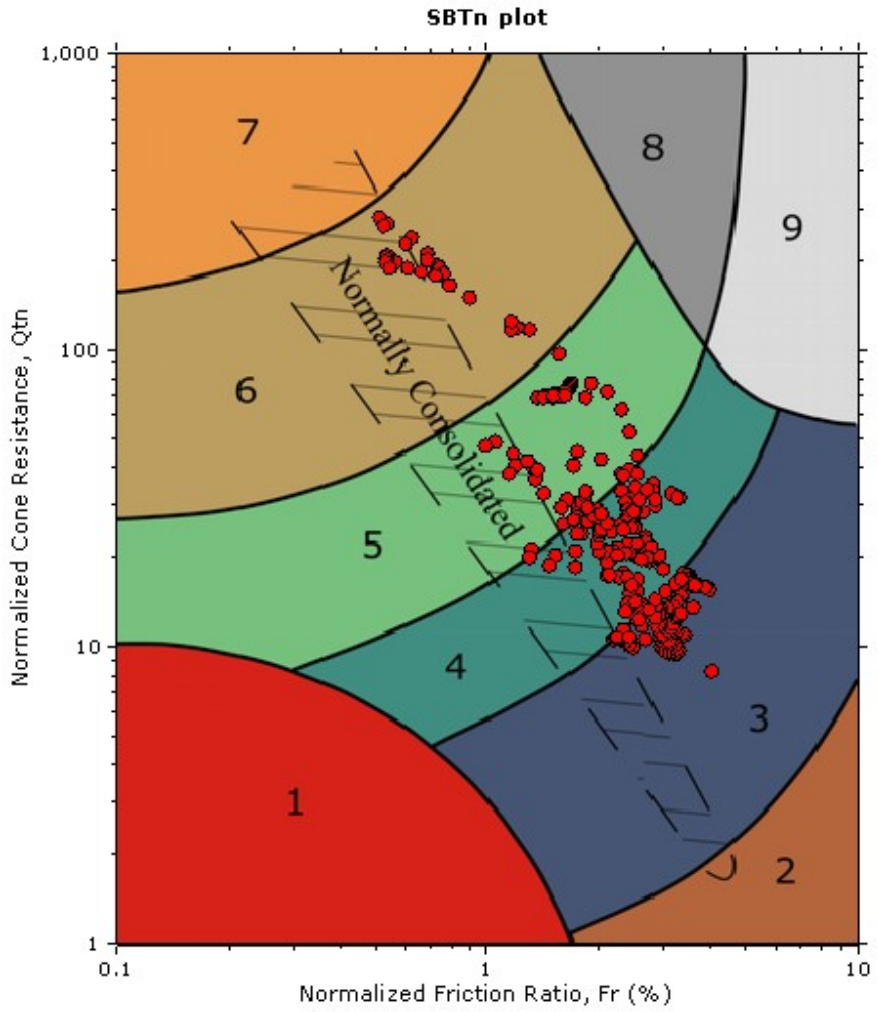


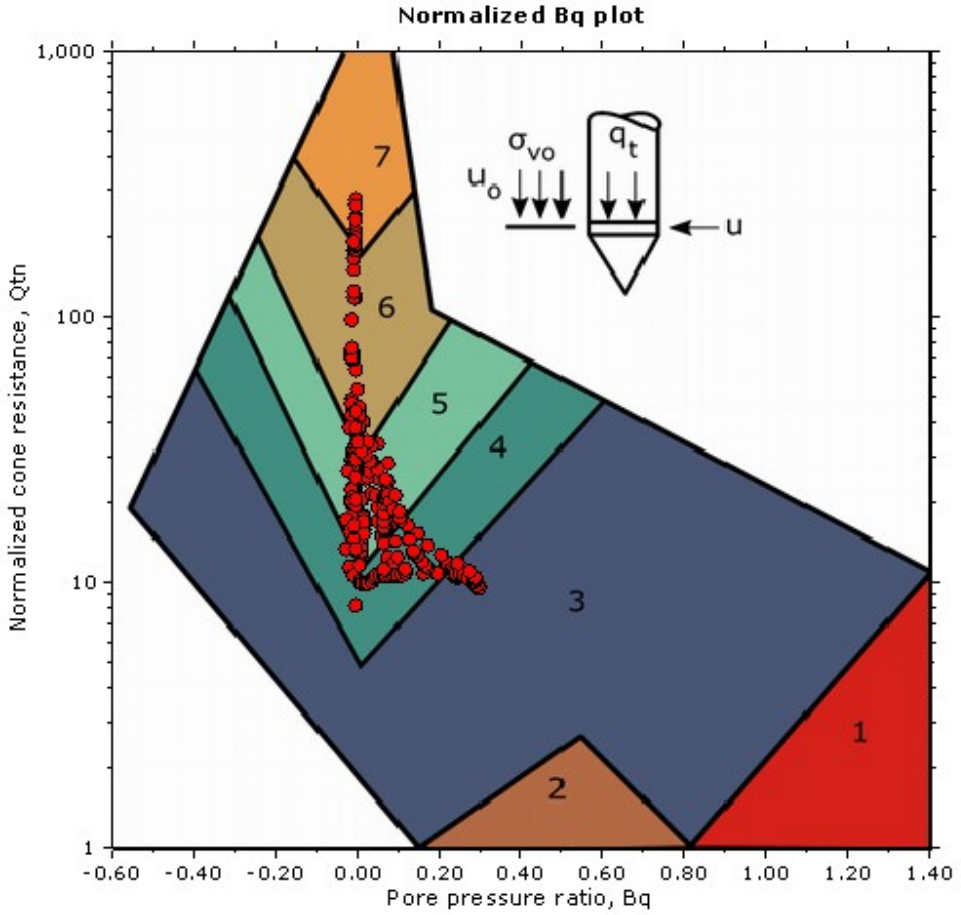




**SBT legend**

| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## SBT - Bq plots (normalized)

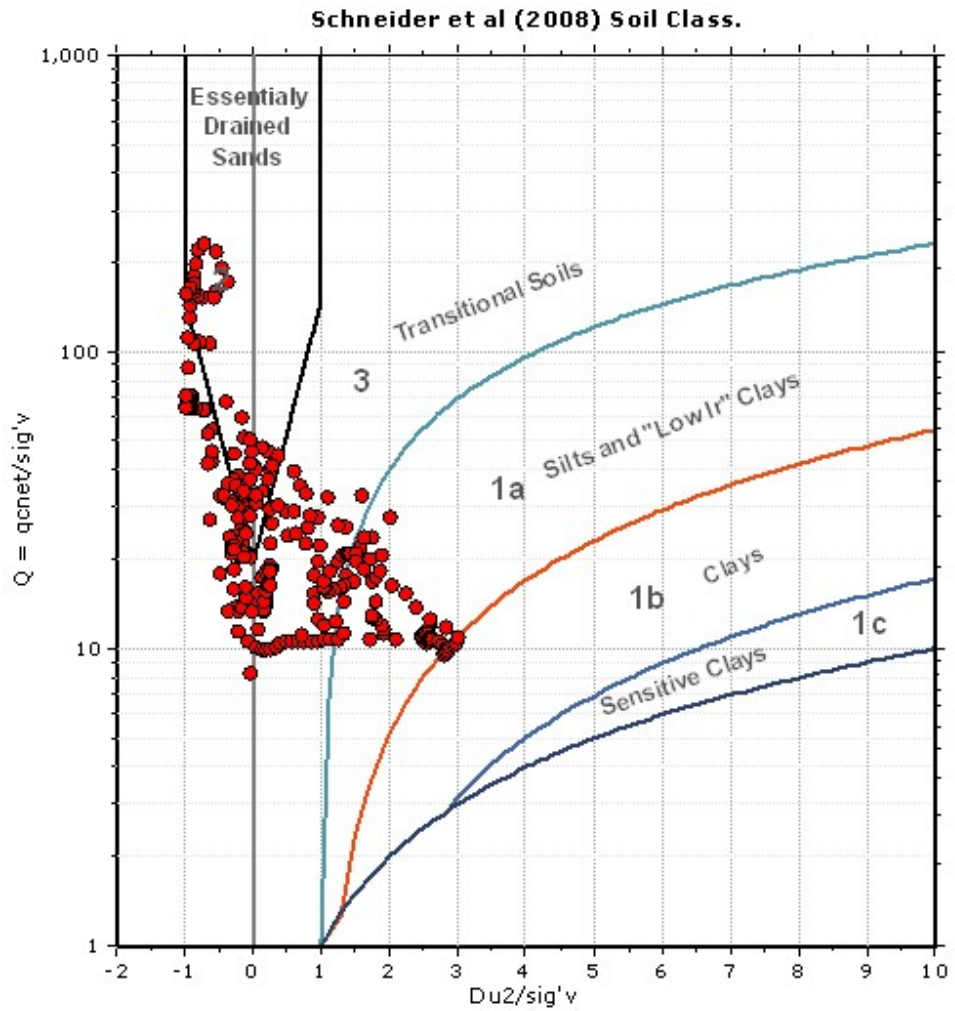


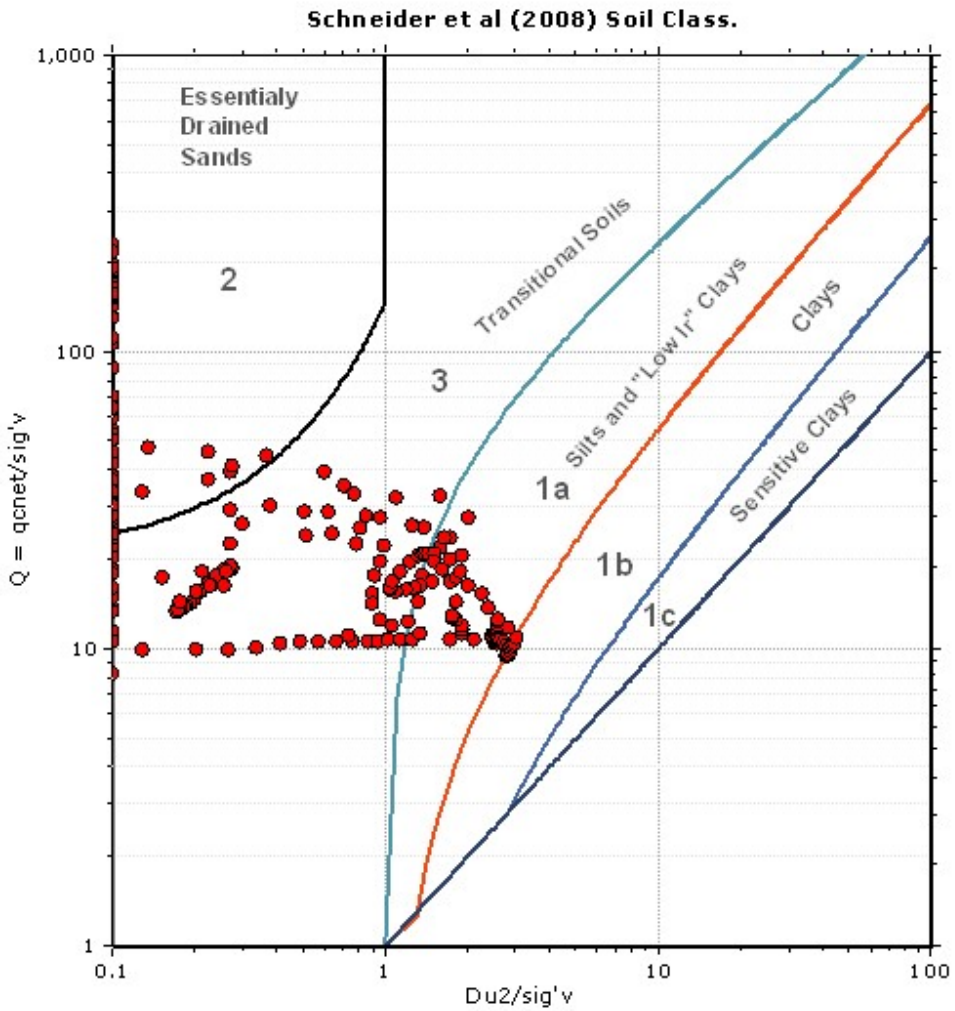



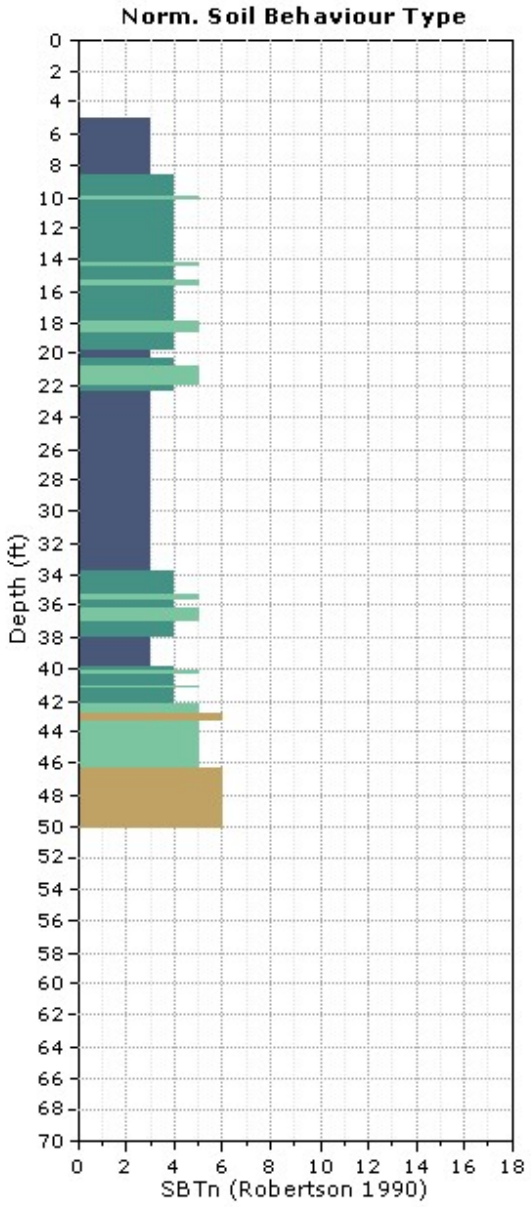

**SBTn legend**

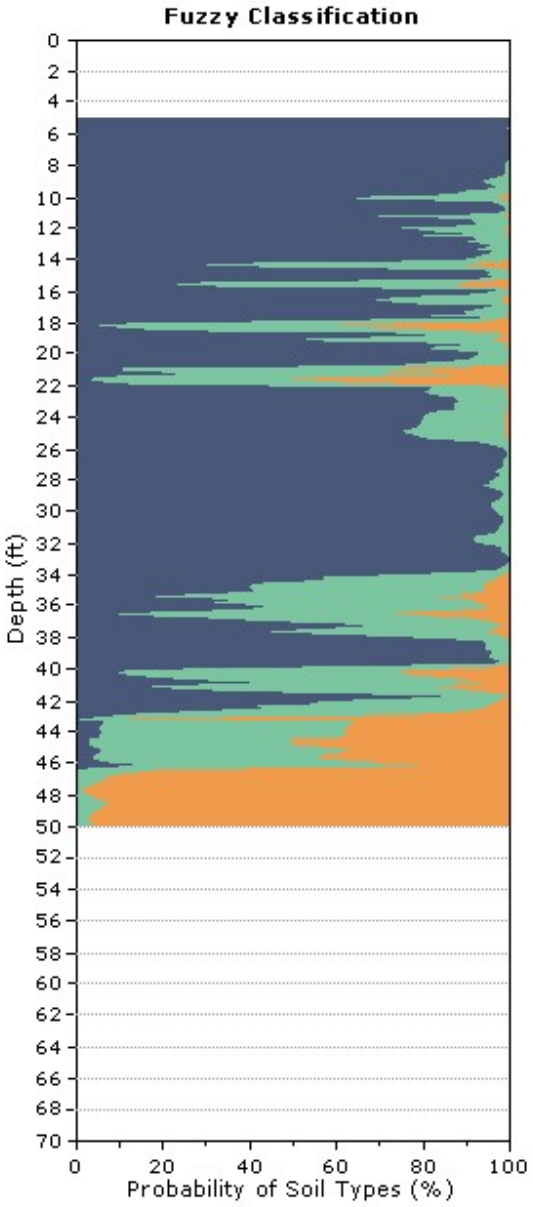
| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

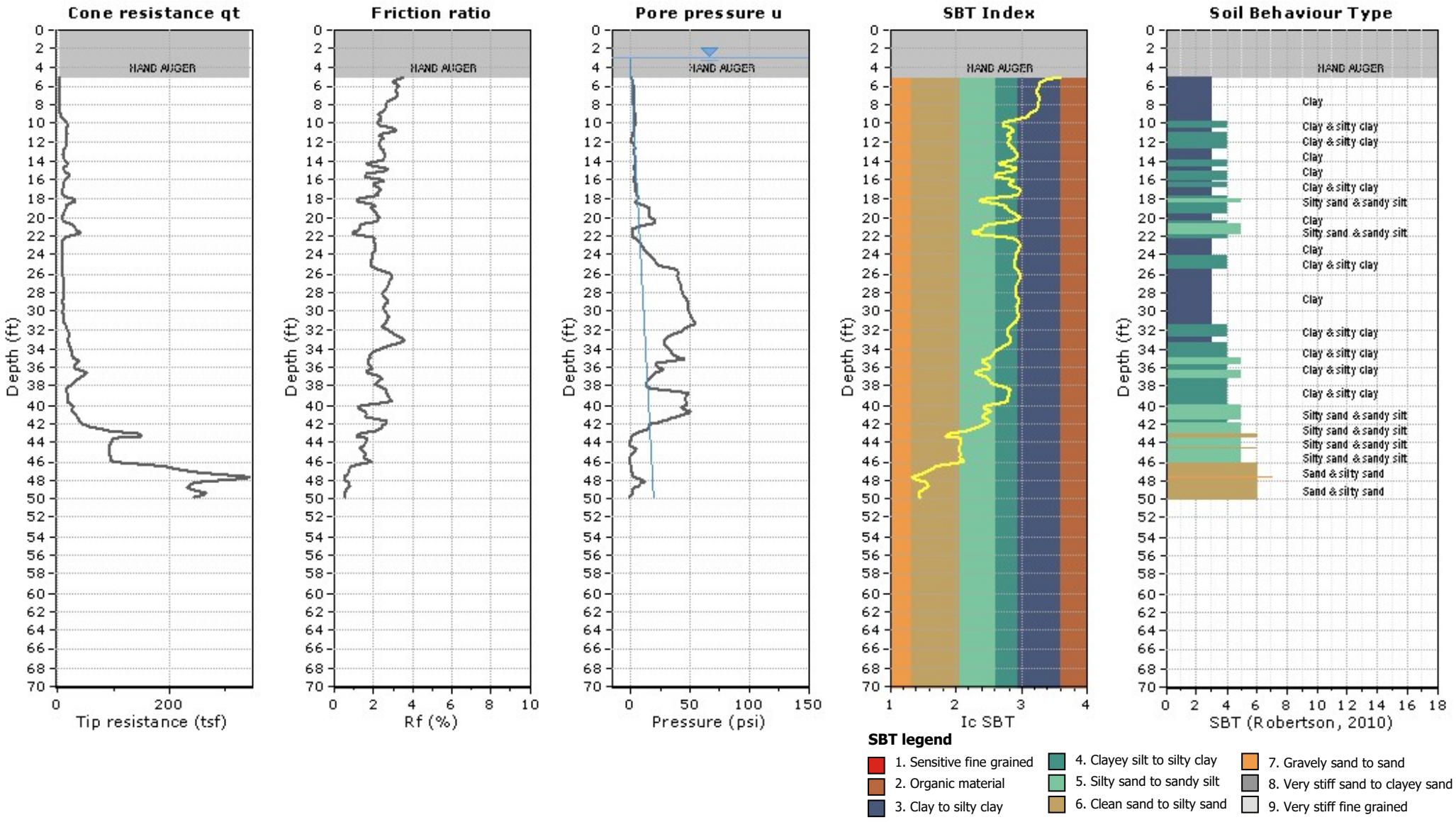
## Bq plots (Schneider)

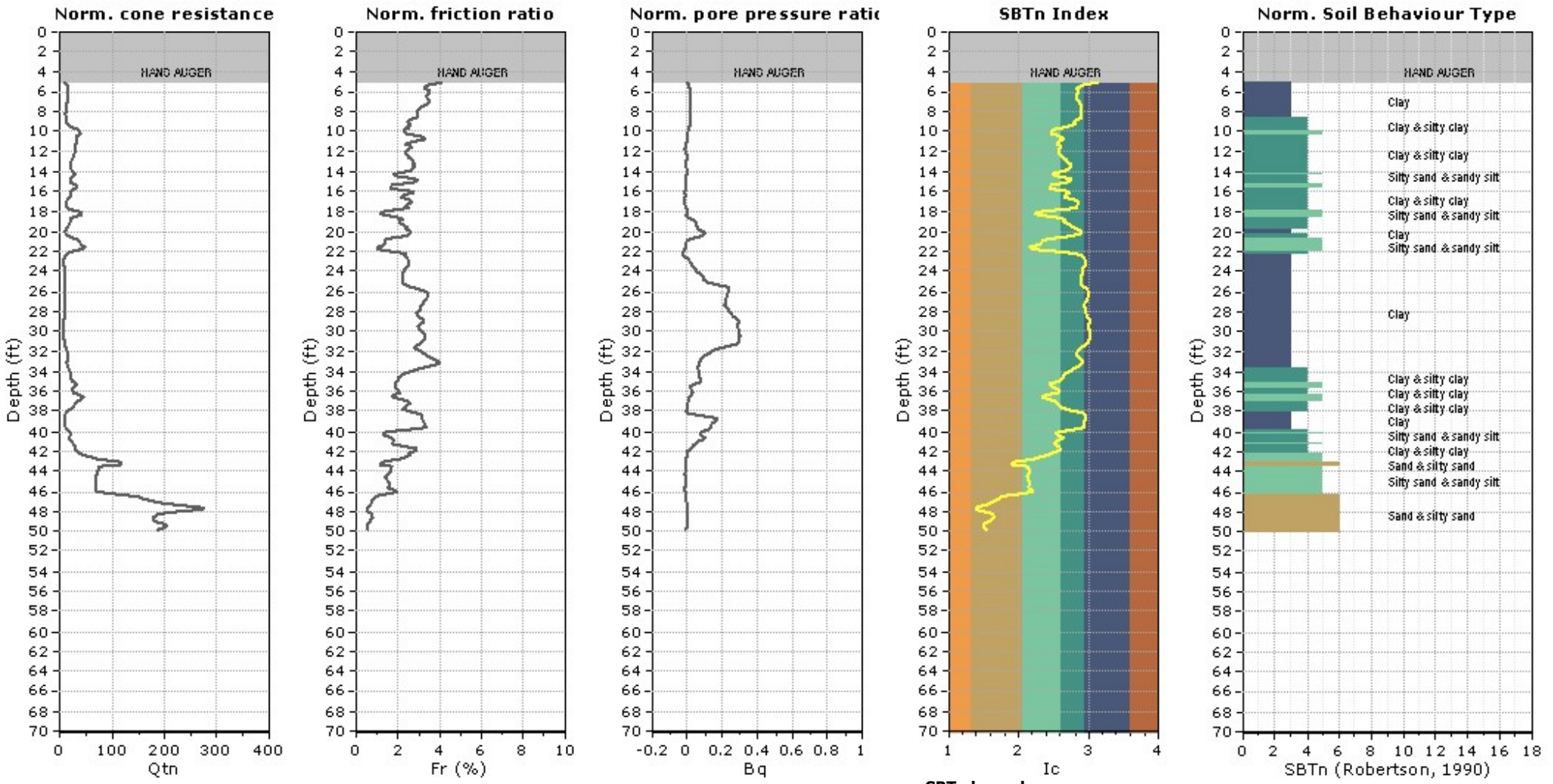



Norm. Soil Behaviour Type
Depth (ft)
SBTn (Robertson 1990)

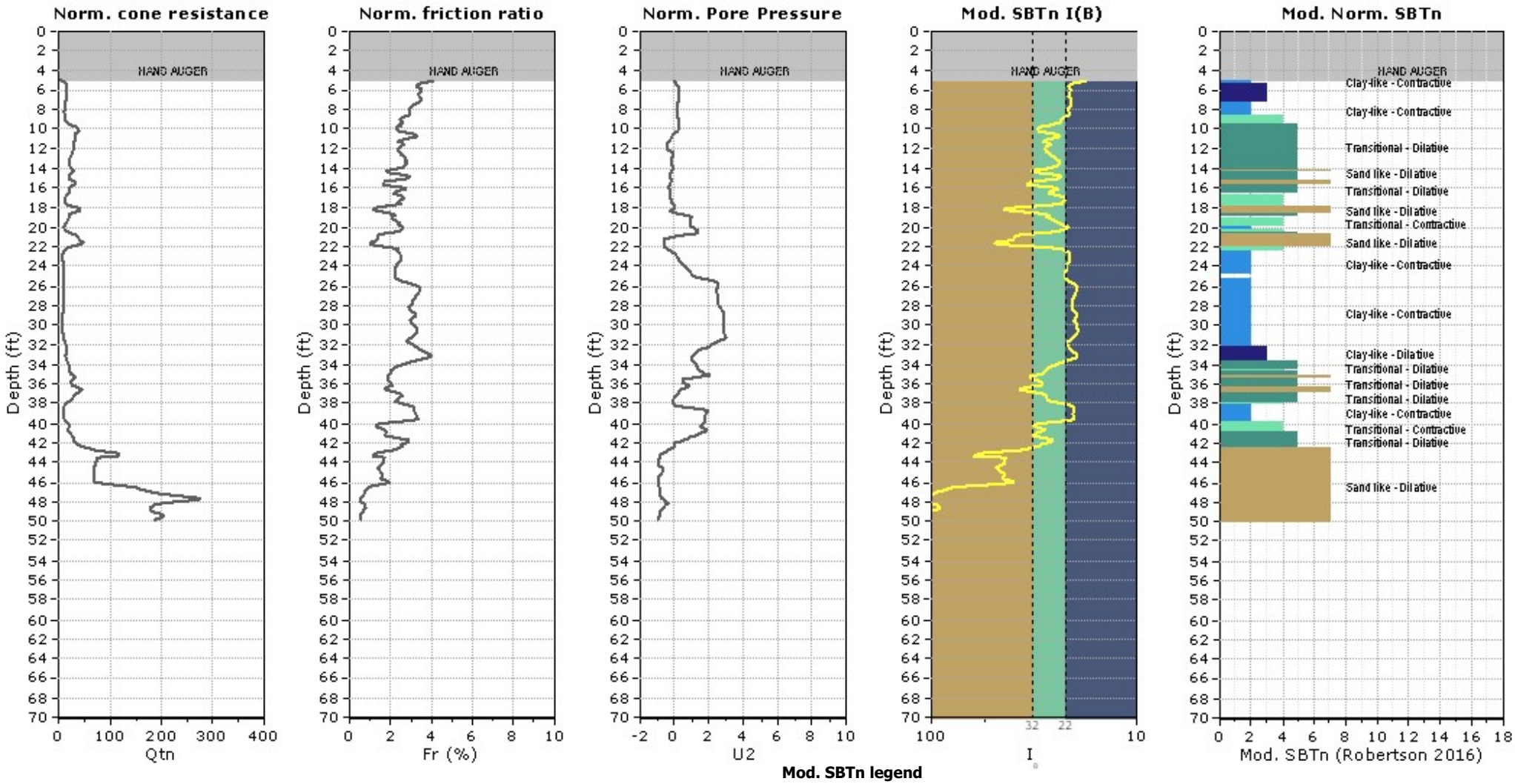

Fuzzy Classification
Depth (ft)
Probability of Soil Types (%)


Cone resistance qt
Friction ratio
Pore pressure u
SBT Index
Soil Behaviour Type
HAND AUGER
Depth (ft)
Tip resistance (tsf)
Rf (%)
Pressure (psi)
Ic SBT
SBT (Robertson, 2010)
Clay
Clay & silty clay
Silty sand & sandy silt
Sand & silty sand
SBT legend
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

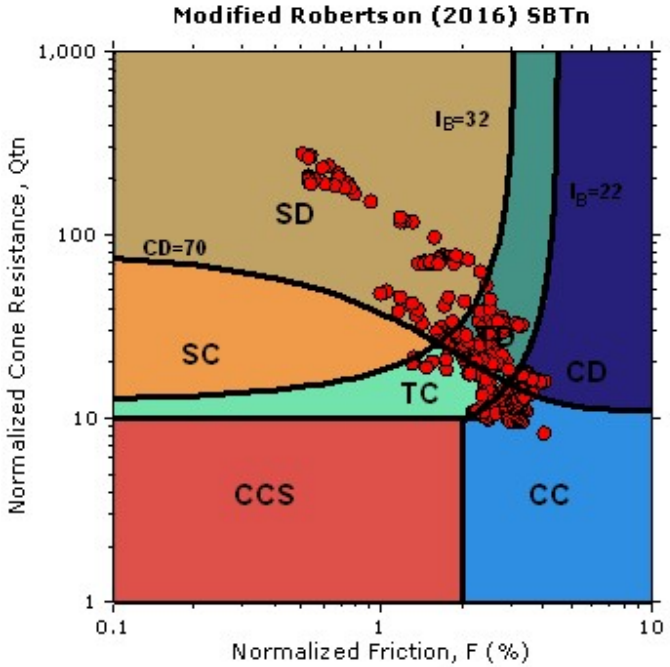

Norm. cone resistance
Norm. friction ratio
Norm. pore pressure ratio
SBTn Index
Norm. Soil Behaviour Type
HAND AUGER
Depth (ft)
Qtn
Fr (%)
Bq
Ic
SBTn (Robertson, 1990)
Clay
Clay & silty clay
Silty sand & sandy silt
Sand & silty sand
SBTn legend
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

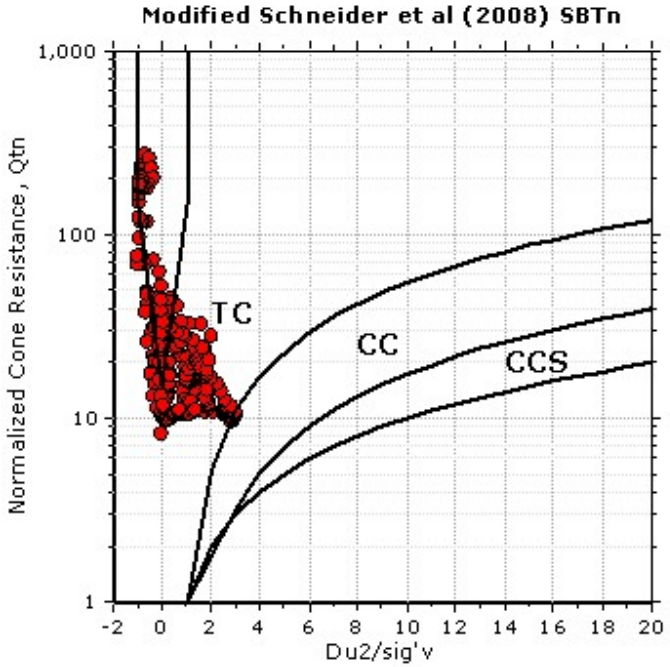
**CPT: CPT-02**
Total depth: 49.87 ft, Date: 4/25/2018
Surface Elevation: 10.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

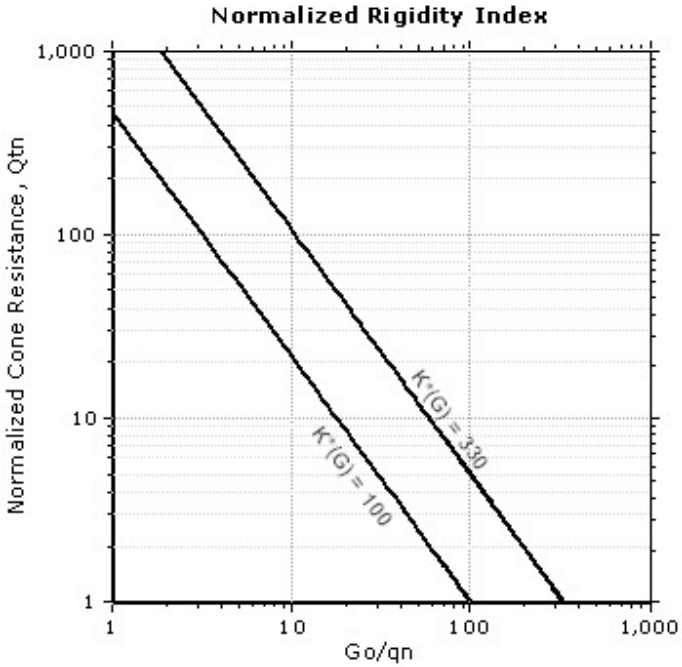
**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA



## Updated SBTn plots

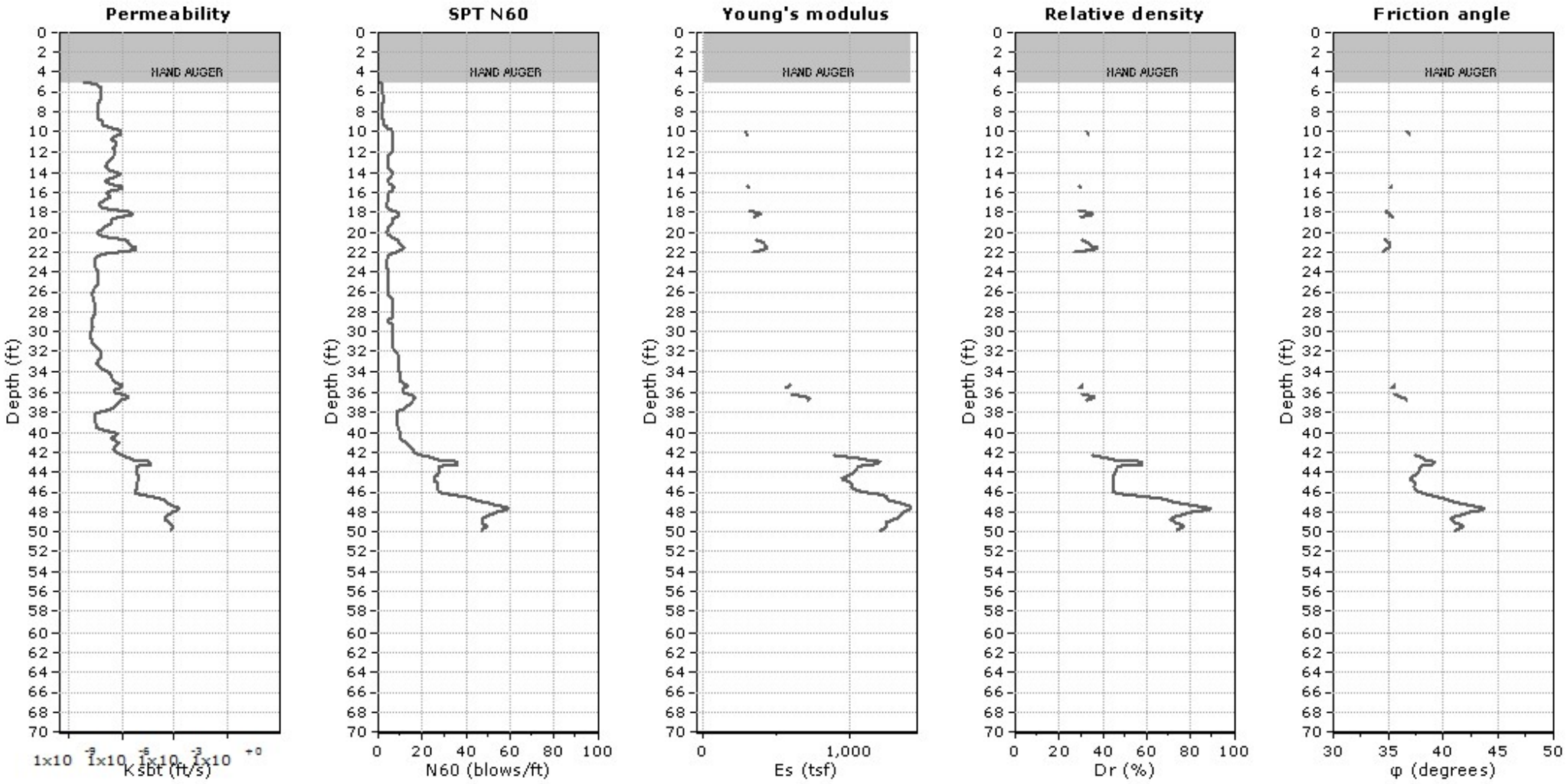


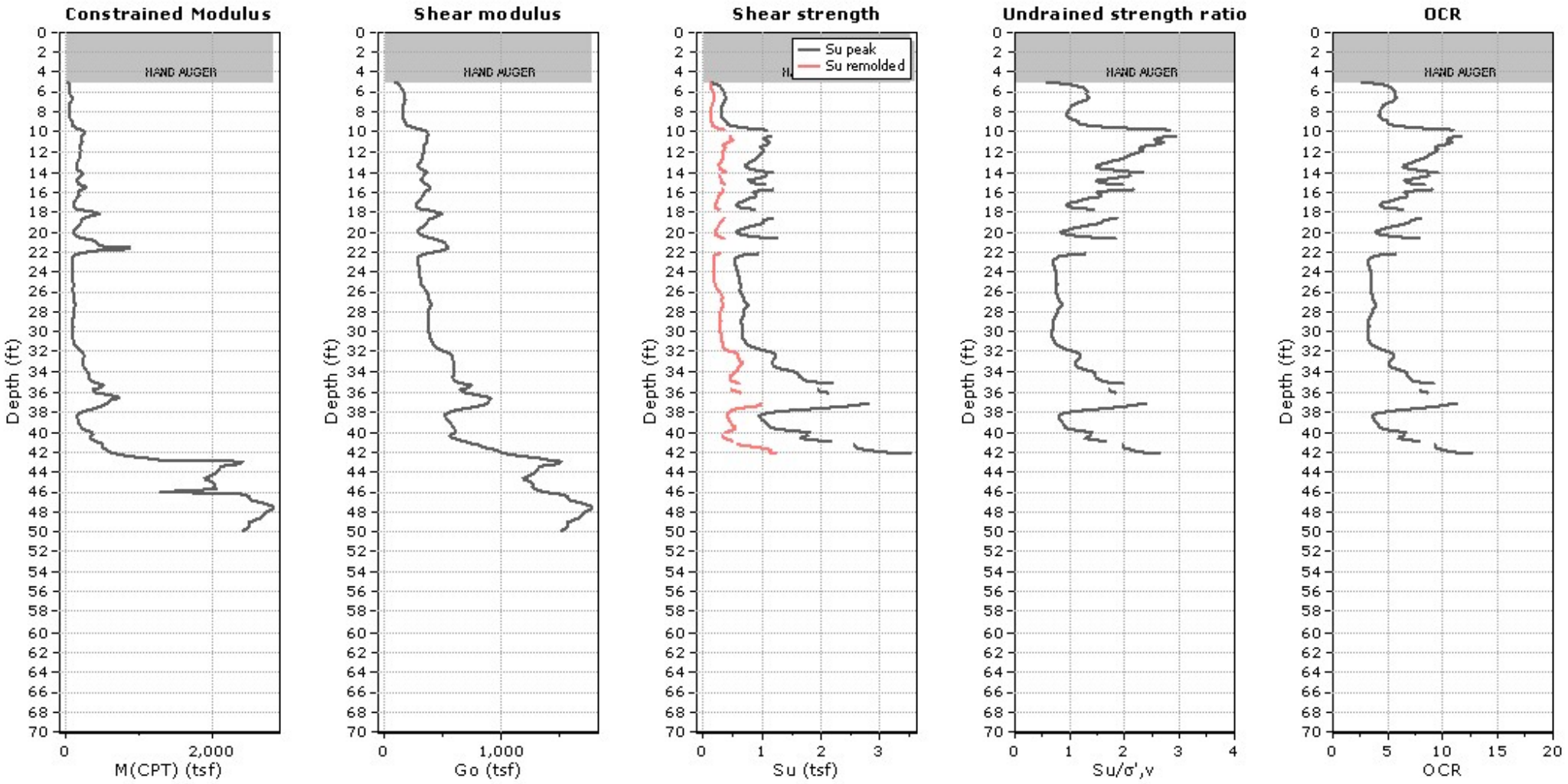

CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)



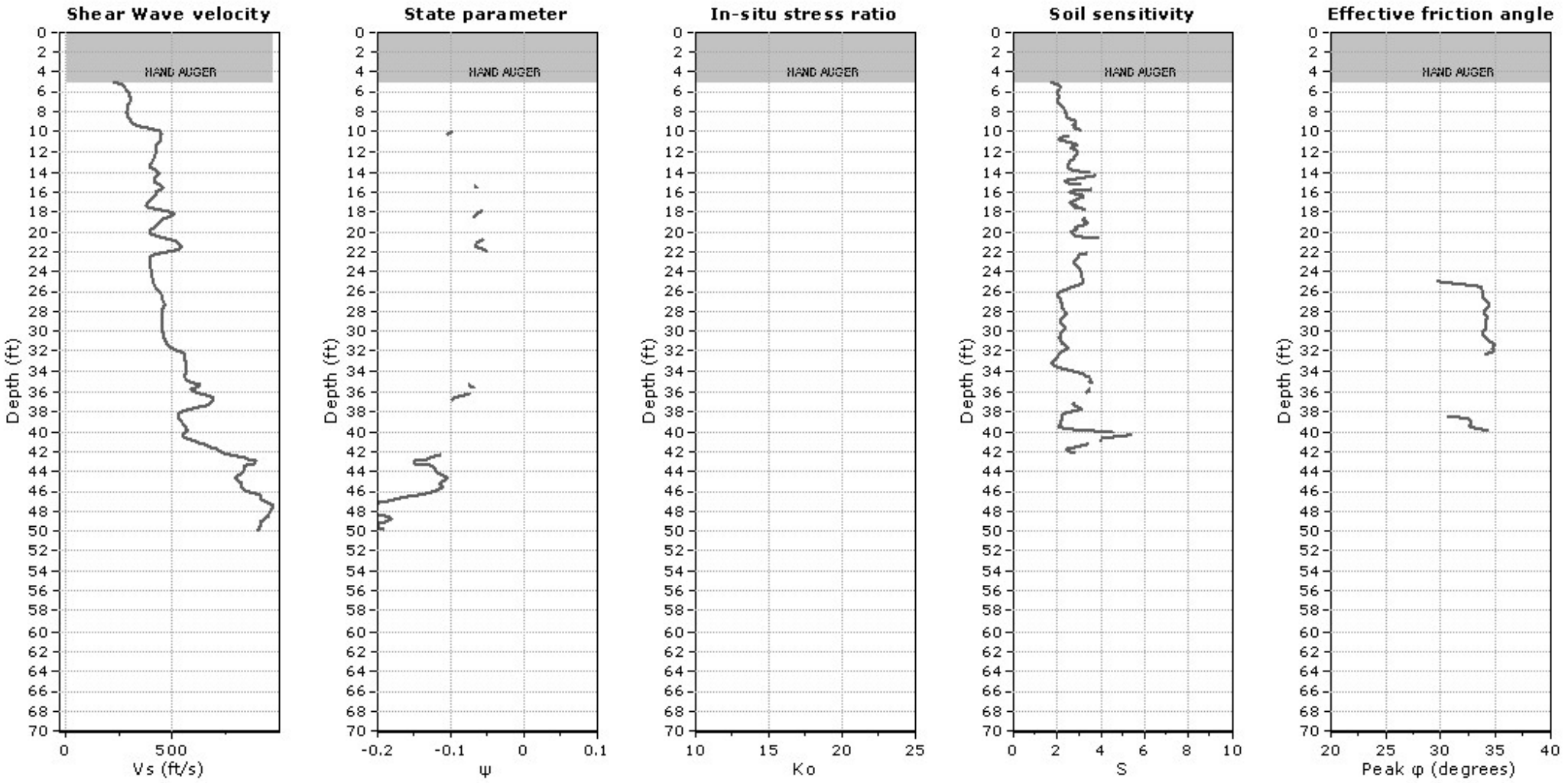

**Calculation parameters**

Permeability: Based on $SBT_n$
SPT $N_{60}$: Based on $I_c$ and $q_t$
Young's modulus: Based on variable alpha using $I_c$ (Robertson, 2009)
Relative density constant, $C_{Dr}$: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data




**Calculation parameters**

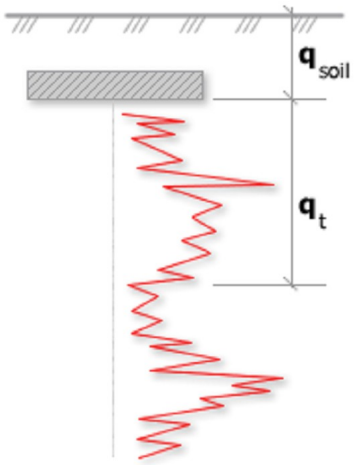
Constrained modulus: Based on variable alpha using $I_c$ and $Q_{tn}$ (Robertson, 2009)
Go: Based on variable alpha using $I_c$ (Robertson, 2009)
Undrained shear strength cone factor for clays, $N_{kt}$: 14
OCR factor for clays, $N_{kt}$: 0.33
User defined estimation data
Flat Dilatometer Test data




**Calculation parameters**

Soil Sensitivity factor, $N_S$: 7.00

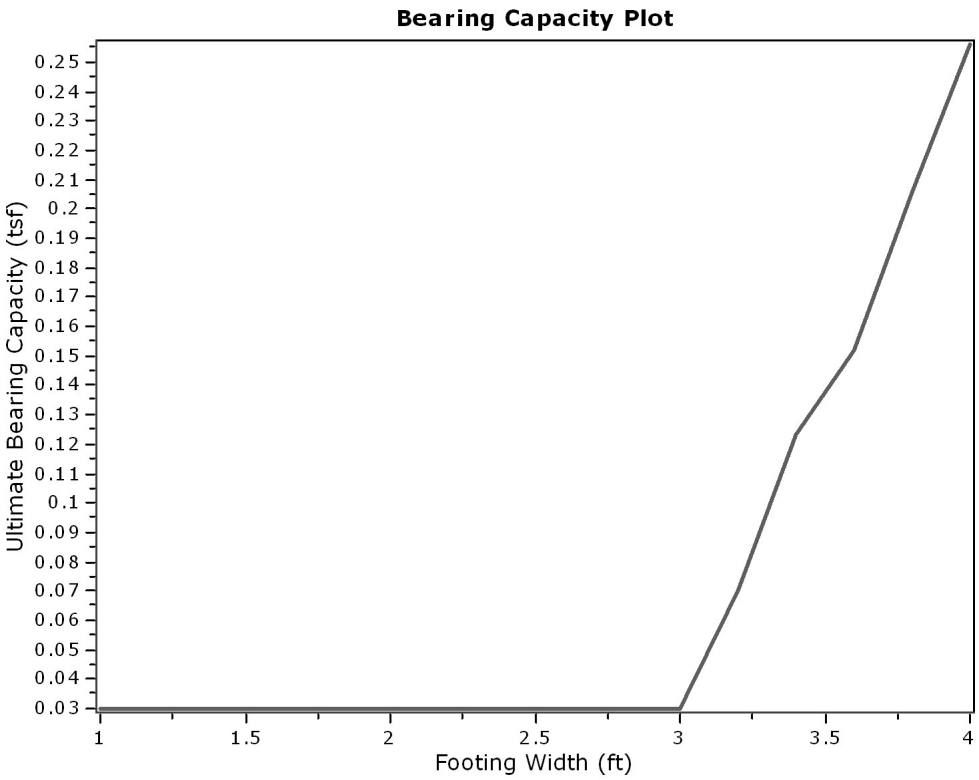
User defined estimation data




Bearing Capacity calculation is perfromed based on the formula:

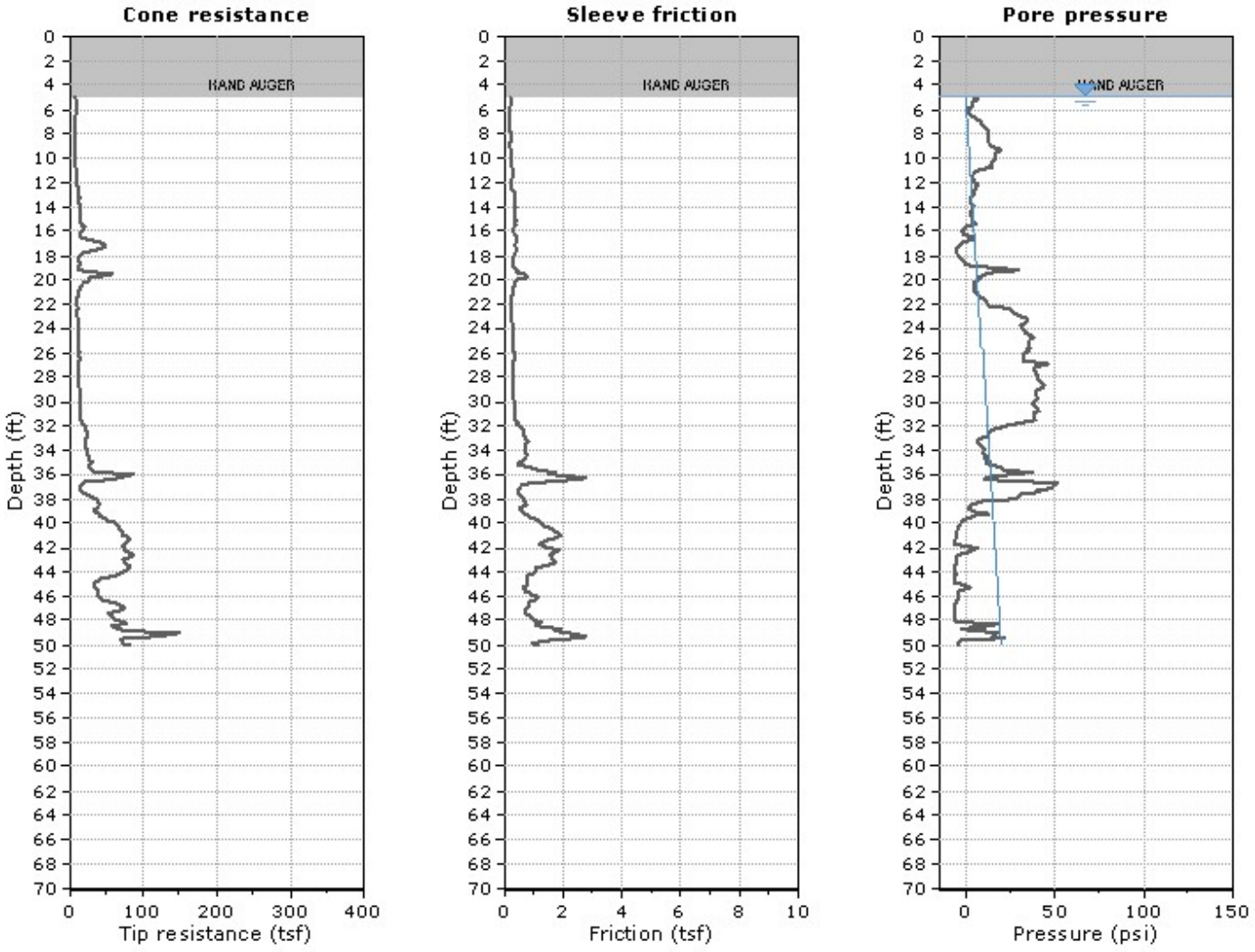
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
$R_k$: Bearing capacity factor
$q_t$: Average corrected cone resistance over calculation depth
$q_{soil}$: Pressure applied by soil above footing

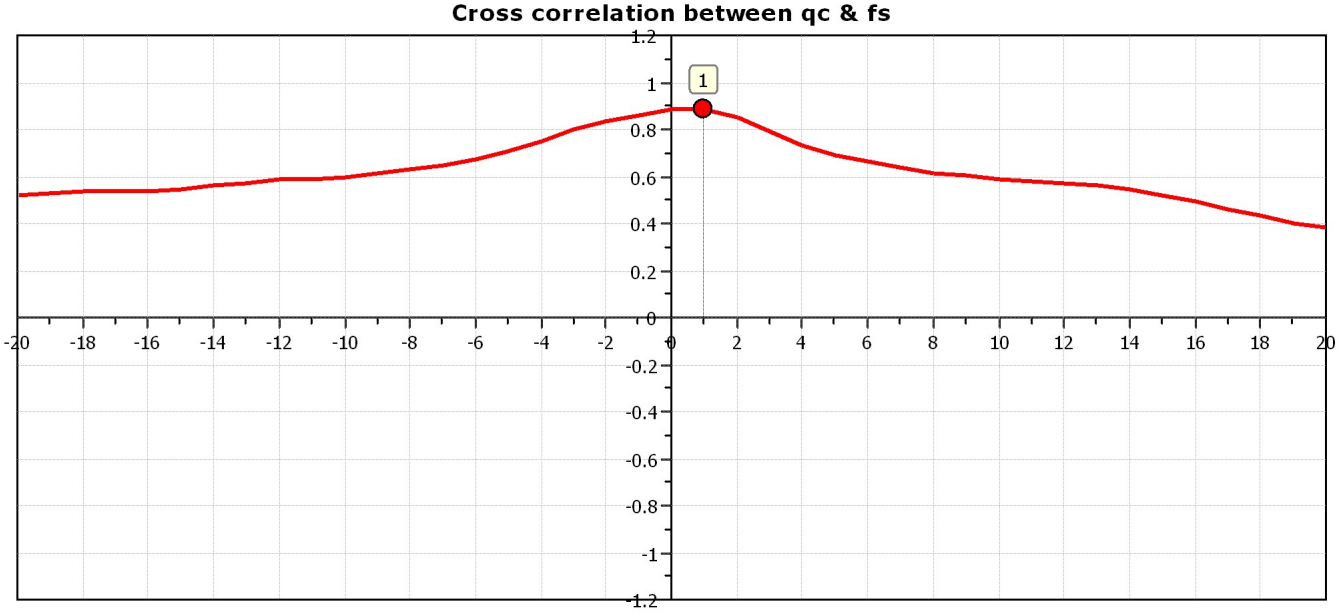



**:: Tabular results ::**

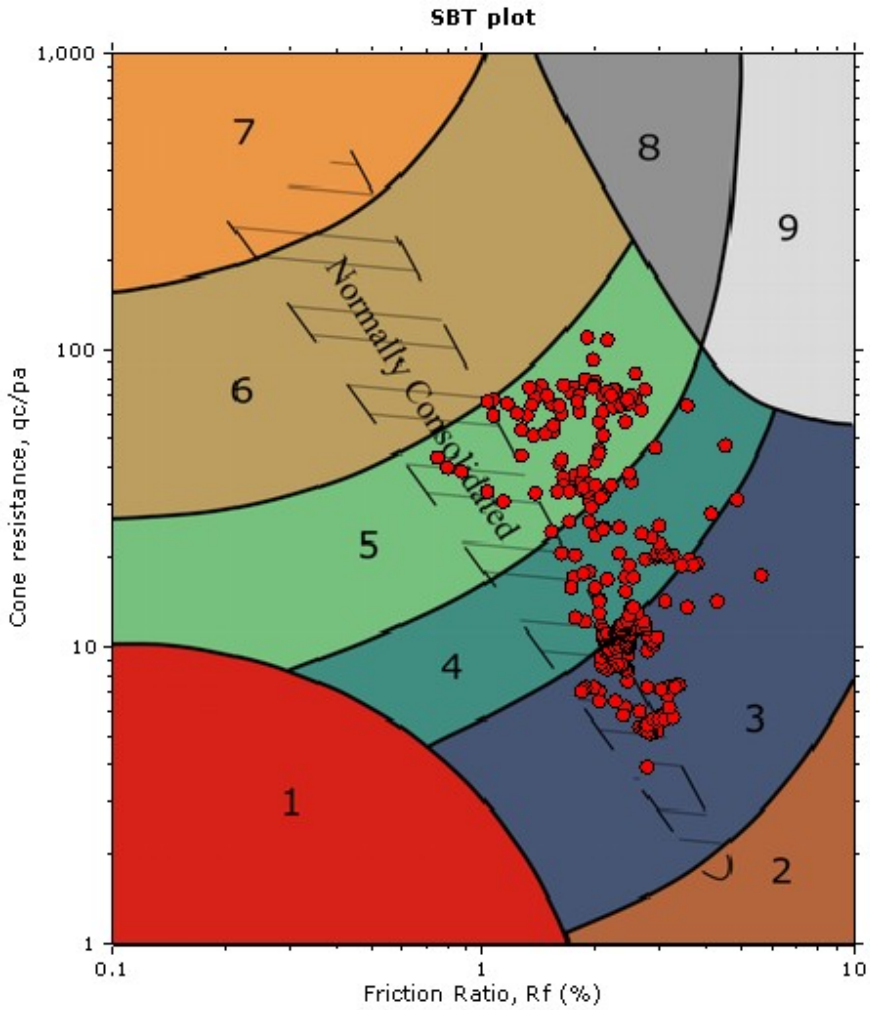
| No | B (ft) | Start Depth (ft) | End Depth (ft) | Ave. $q_t$ (tsf) | $R_k$ | Soil Press. (tsf) | Ult. bearing cap. (tsf) |
|---|---|---|---|---|---|---|---|
| 1 | 1.00 | 0.50 | 2.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 2 | 1.20 | 0.50 | 2.30 | 0.00 | 0.20 | 0.03 | 0.03 |
| 3 | 1.40 | 0.50 | 2.60 | 0.00 | 0.20 | 0.03 | 0.03 |
| 4 | 1.60 | 0.50 | 2.90 | 0.00 | 0.20 | 0.03 | 0.03 |
| 5 | 1.80 | 0.50 | 3.20 | 0.00 | 0.20 | 0.03 | 0.03 |
| 6 | 2.00 | 0.50 | 3.50 | 0.00 | 0.20 | 0.03 | 0.03 |
| 7 | 2.20 | 0.50 | 3.80 | 0.00 | 0.20 | 0.03 | 0.03 |
| 8 | 2.40 | 0.50 | 4.10 | 0.00 | 0.20 | 0.03 | 0.03 |
| 9 | 2.60 | 0.50 | 4.40 | 0.00 | 0.20 | 0.03 | 0.03 |
| 10 | 2.80 | 0.50 | 4.70 | 0.00 | 0.20 | 0.03 | 0.03 |
| 11 | 3.00 | 0.50 | 5.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 12 | 3.20 | 0.50 | 5.30 | 0.20 | 0.20 | 0.03 | 0.07 |
| 13 | 3.40 | 0.50 | 5.60 | 0.47 | 0.20 | 0.03 | 0.12 |
| 14 | 3.60 | 0.50 | 5.90 | 0.61 | 0.20 | 0.03 | 0.15 |
| 15 | 3.80 | 0.50 | 6.20 | 0.88 | 0.20 | 0.03 | 0.21 |
| 16 | 4.00 | 0.50 | 6.50 | 1.13 | 0.20 | 0.03 | 0.26 |

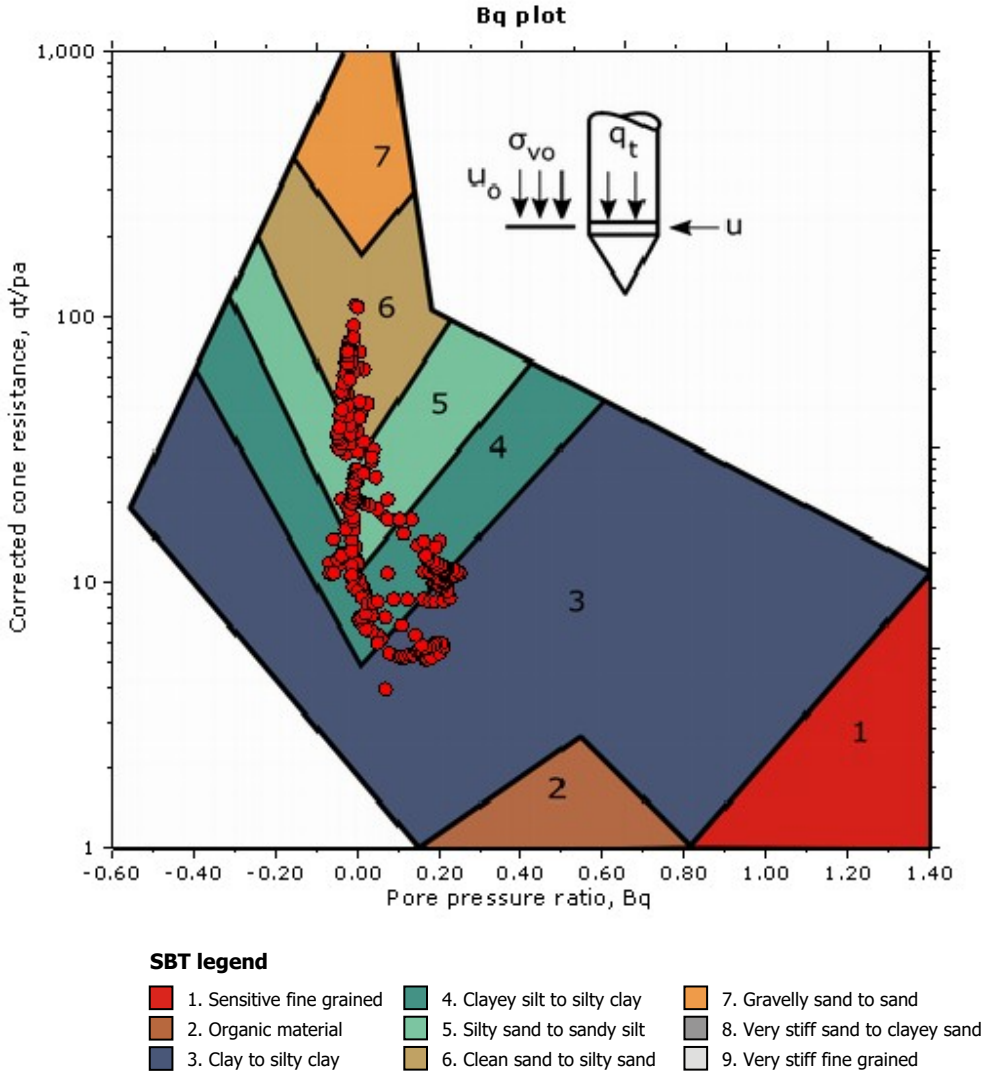



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



## SBT - Bq plots

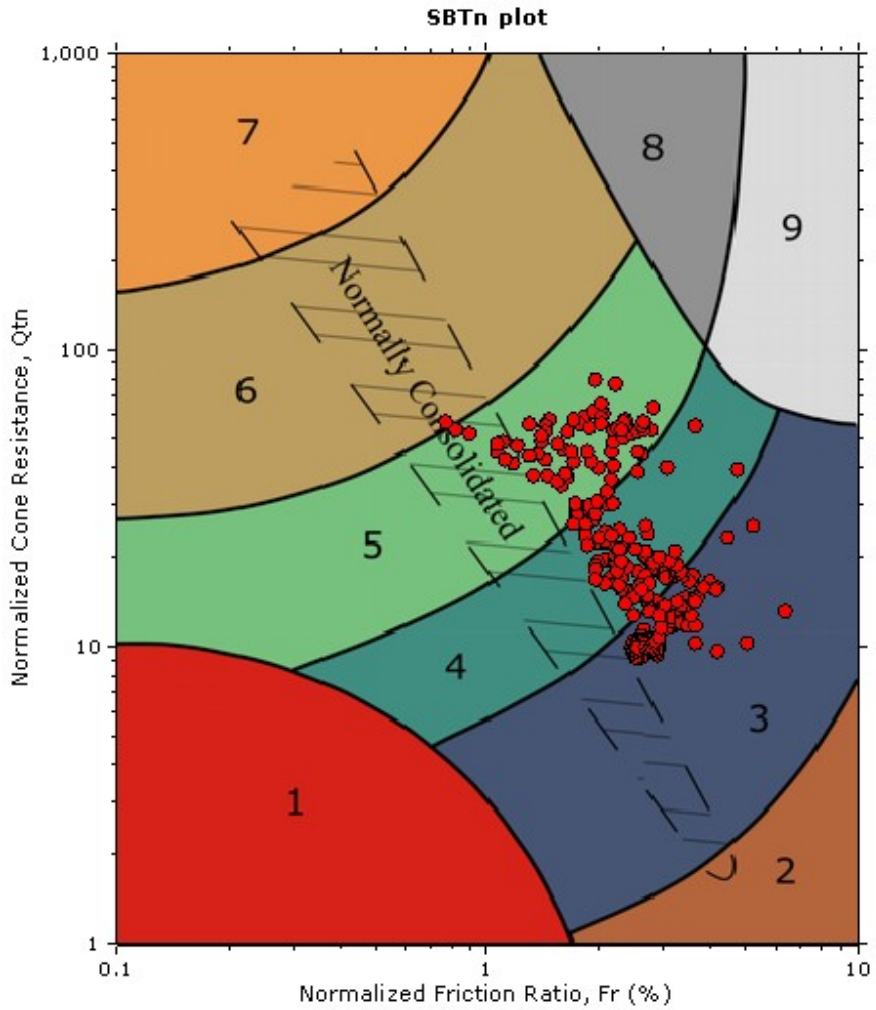


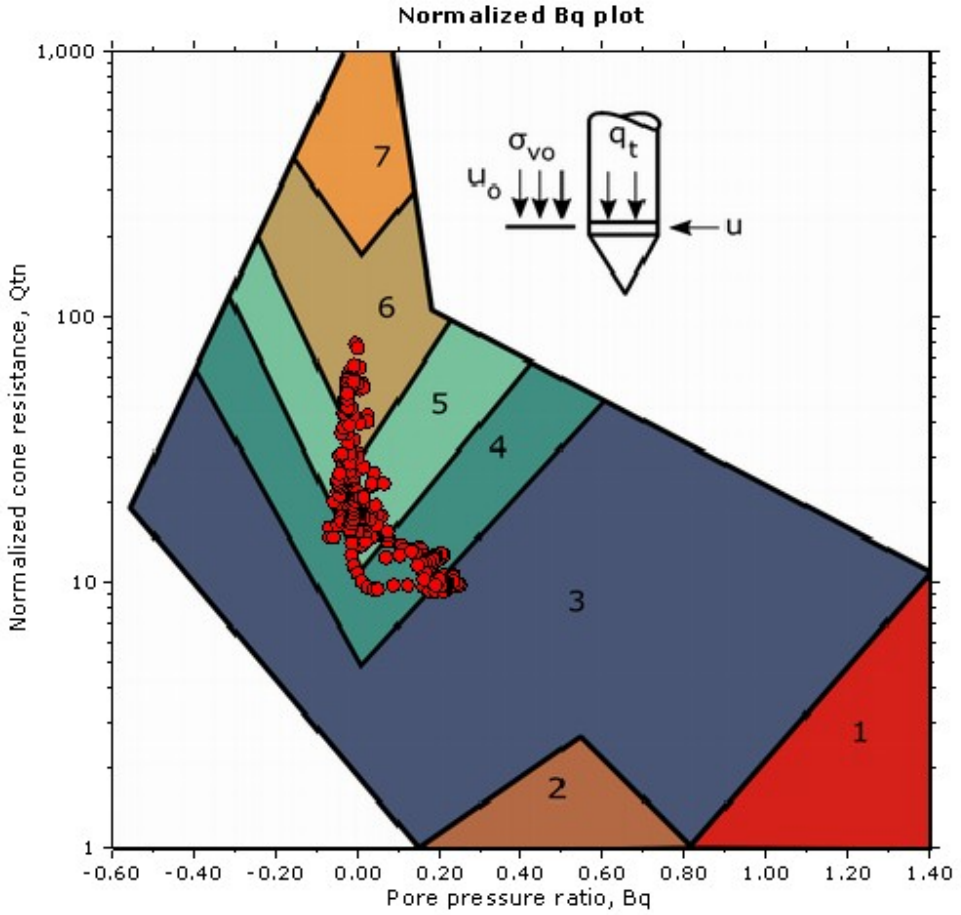




**SBT legend**

| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## SBT - Bq plots (normalized)

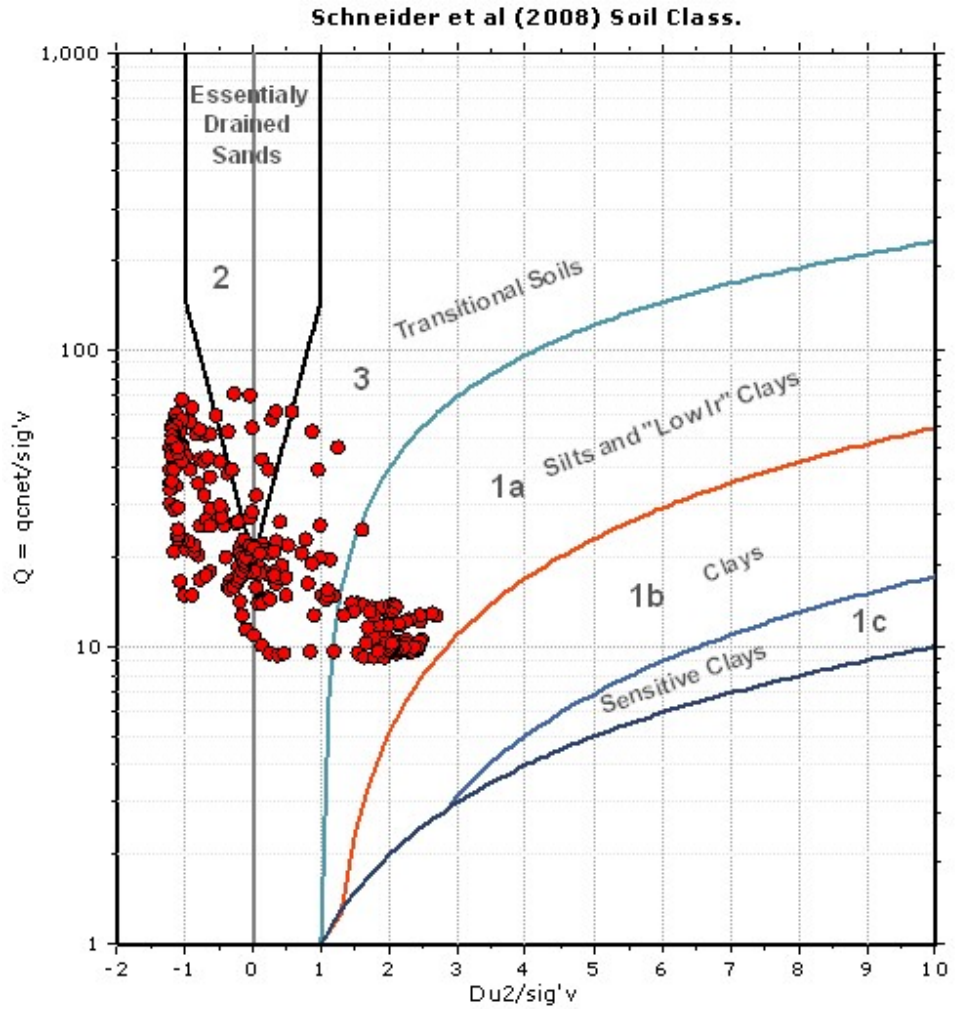


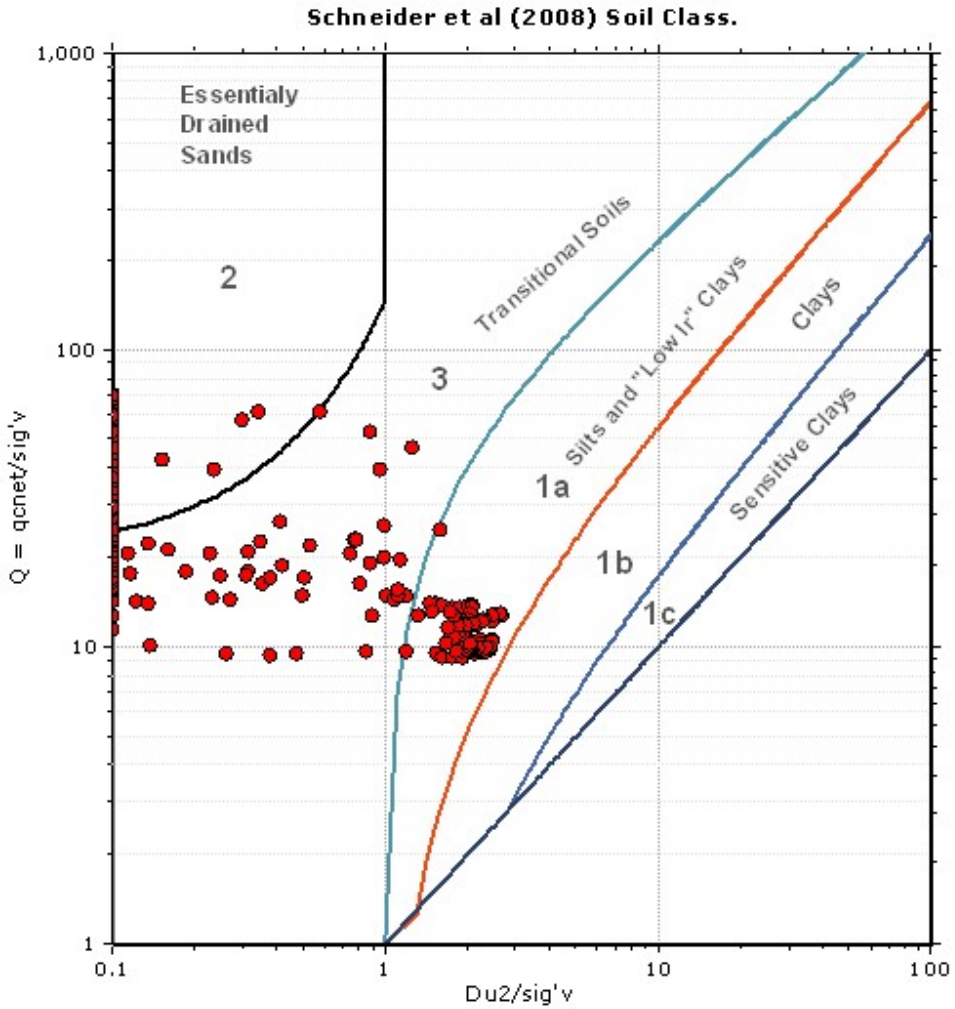



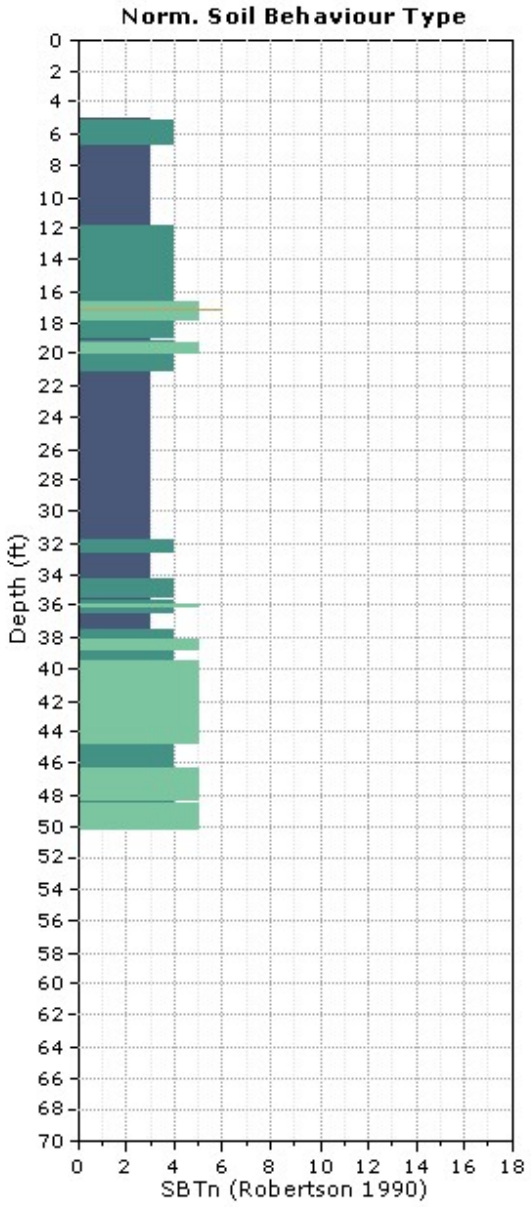

**SBTn legend**

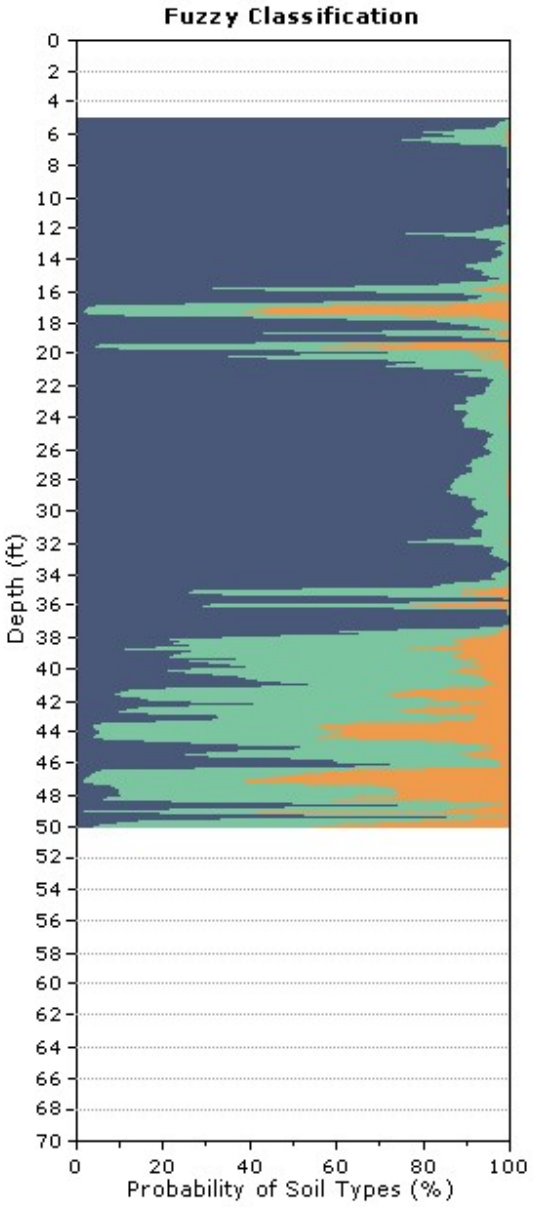
| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## Bq plots (Schneider)



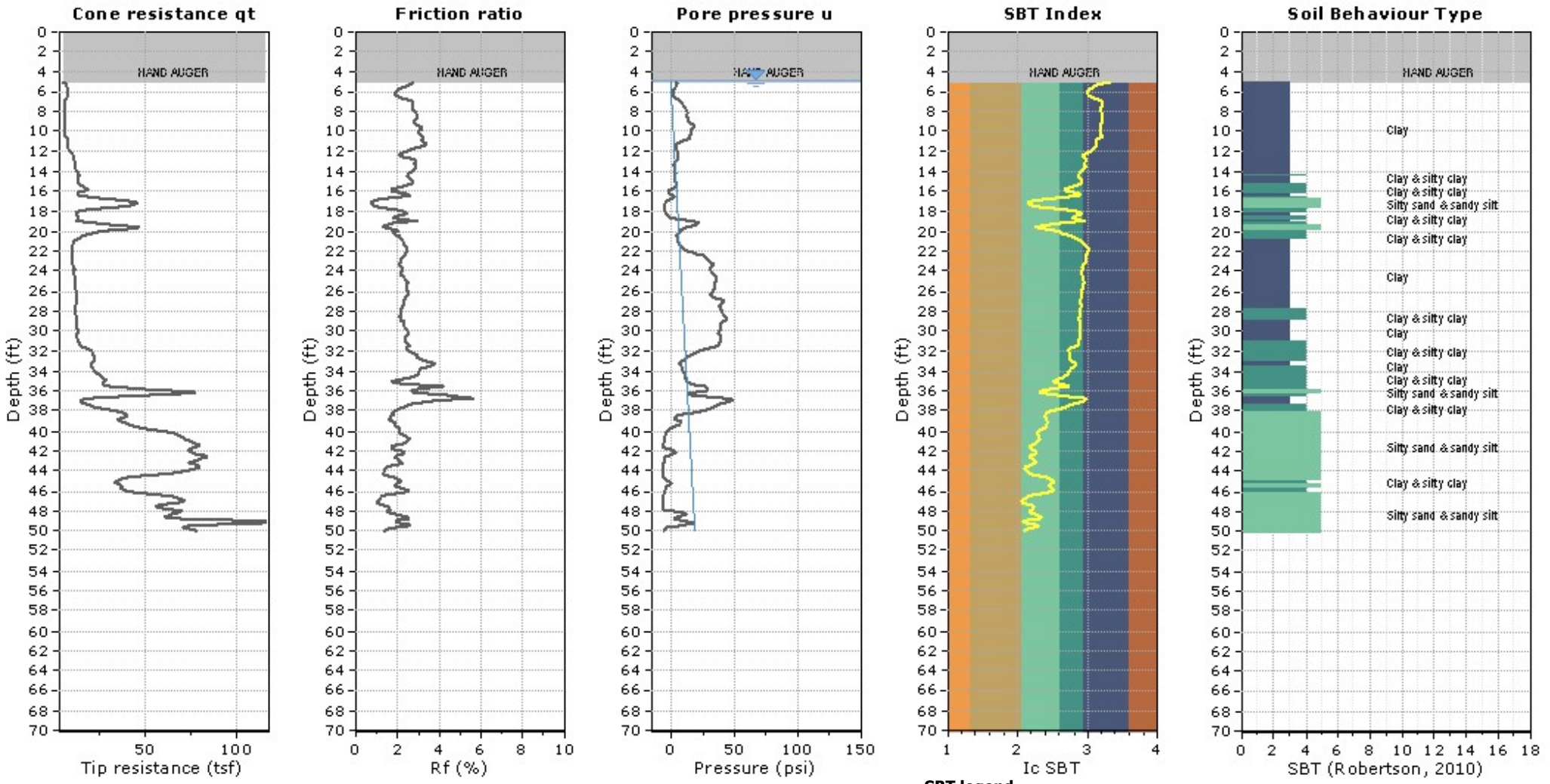



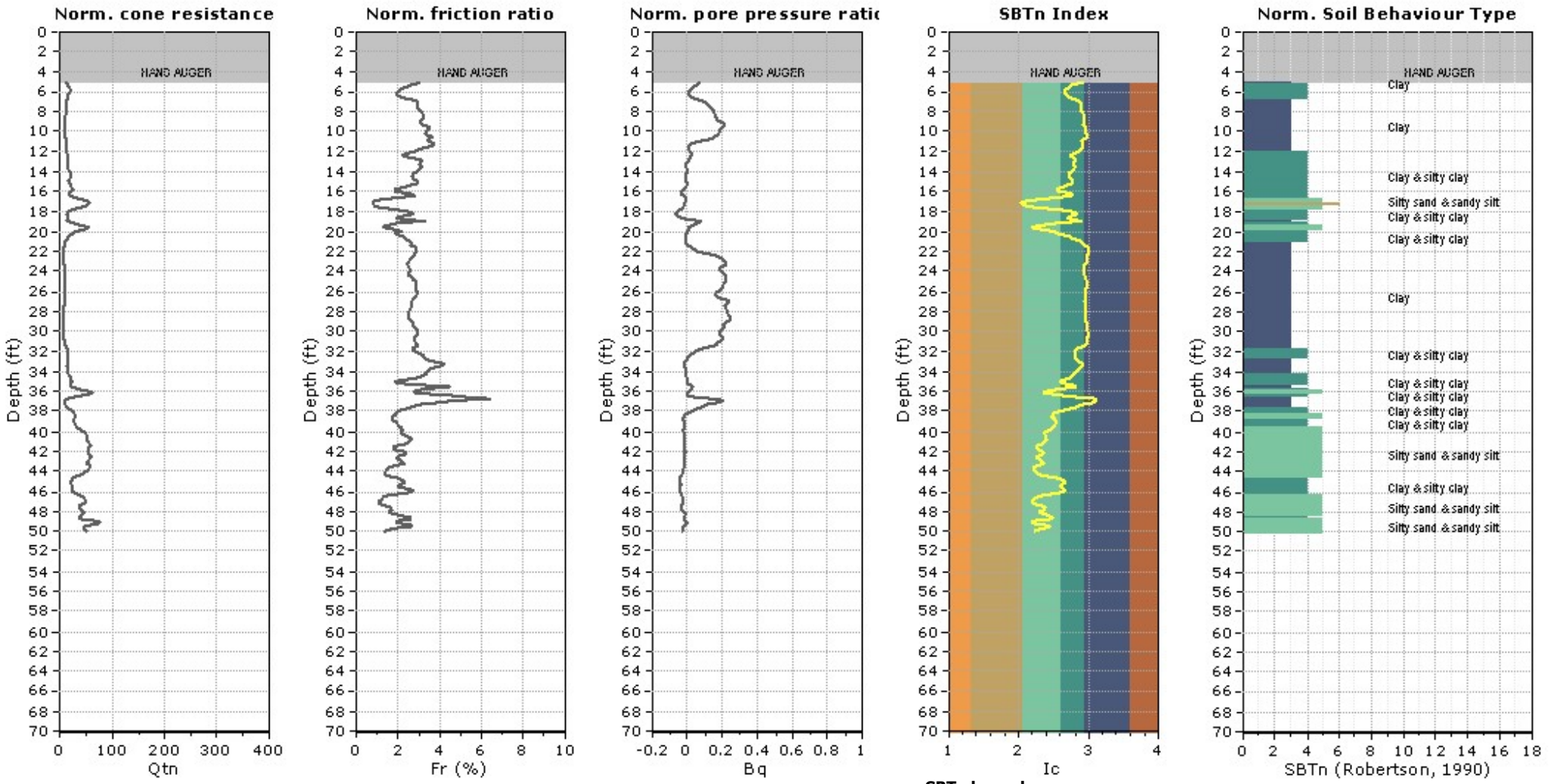

Norm. Soil Behaviour Type
Depth (ft)
SBTn (Robertson 1990)

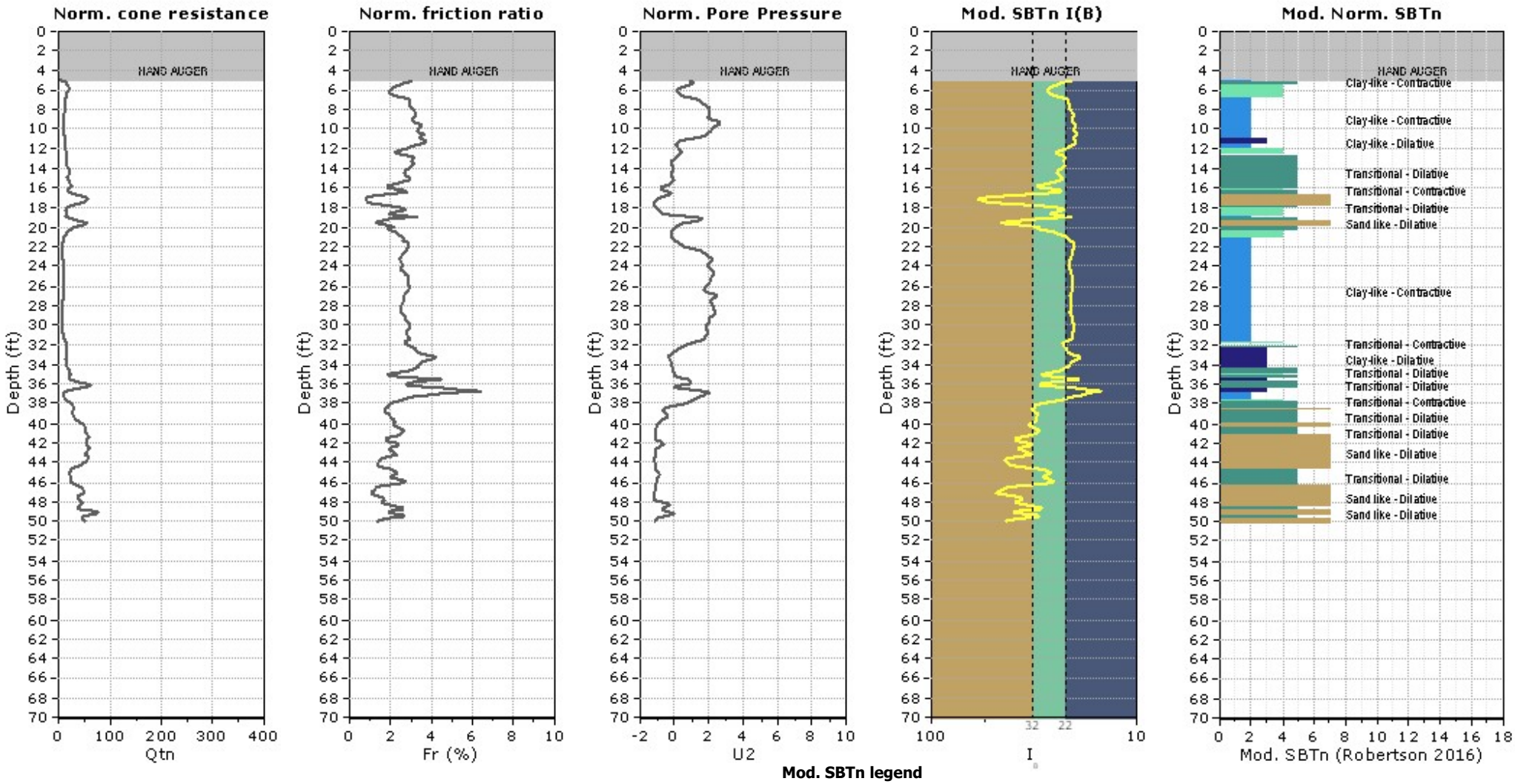

Fuzzy Classification
Depth (ft)
Probability of Soil Types (%)

**CPT: CPT-03**
Total depth: 50.03 ft, Date: 4/26/2018
Surface Elevation: 10.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

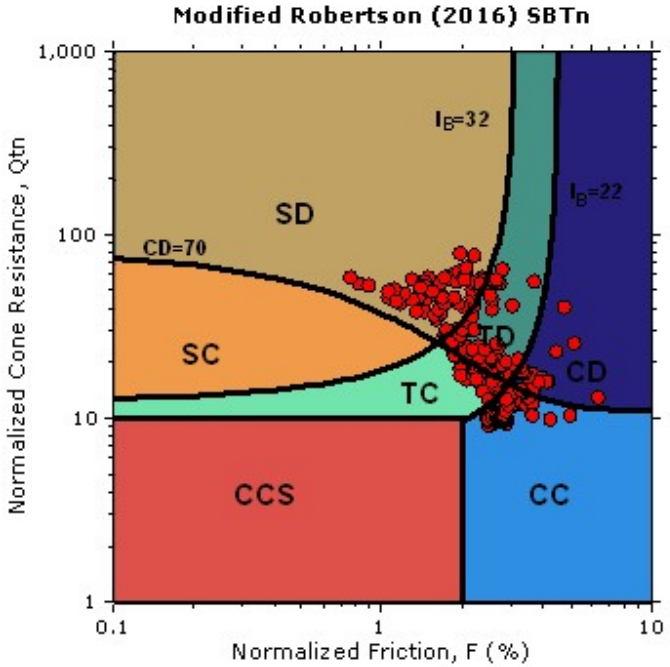
**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA

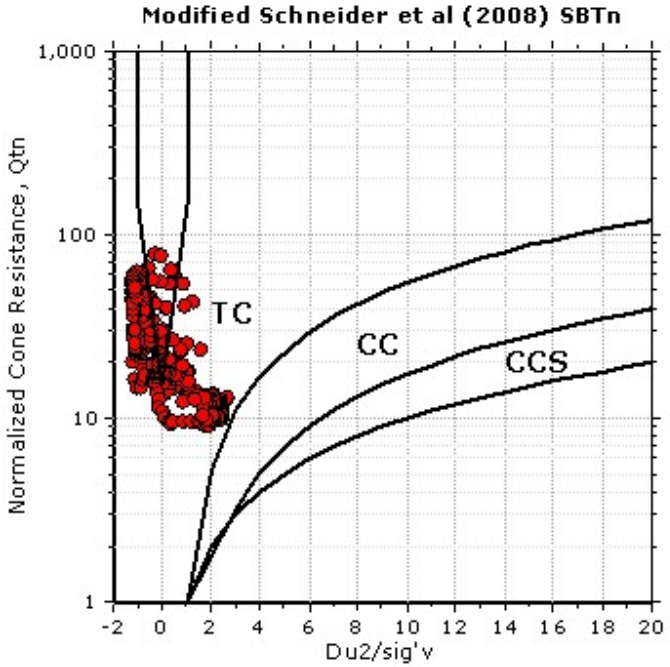


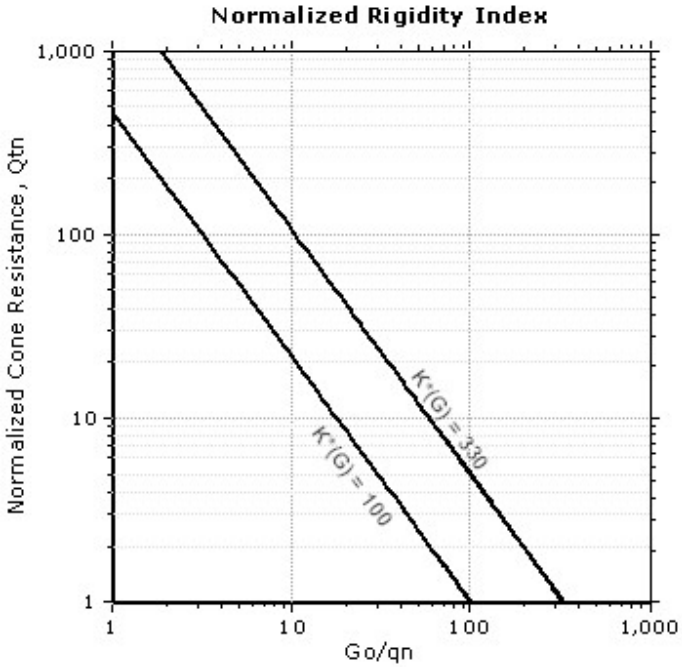

Norm. cone resistance
Norm. friction ratio
Norm. pore pressure ratio
SBTn Index
Norm. Soil Behaviour Type
HAND AUGER
Depth (ft)
Qtn
Fr (%)
Bq
Ic
SBTn (Robertson, 1990)
Clay
Clay & silty clay
Silty sand & sandy silt
SBTn legend
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained


Norm. cone resistance
Norm. friction ratio
Norm. Pore Pressure
Mod. SBTn I(B)
Mod. Norm. SBTn
HAND AUGER
Depth (ft)
Qtn
Fr (%)
U2
I
Mod. SBTn (Robertson 2016)
Clay-like - Contractive
Clay-like - Dilative
Transitional - Dilative
Transitional - Contractive
Sand like - Dilative
Mod. SBTn legend
1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

## Updated SBTn plots

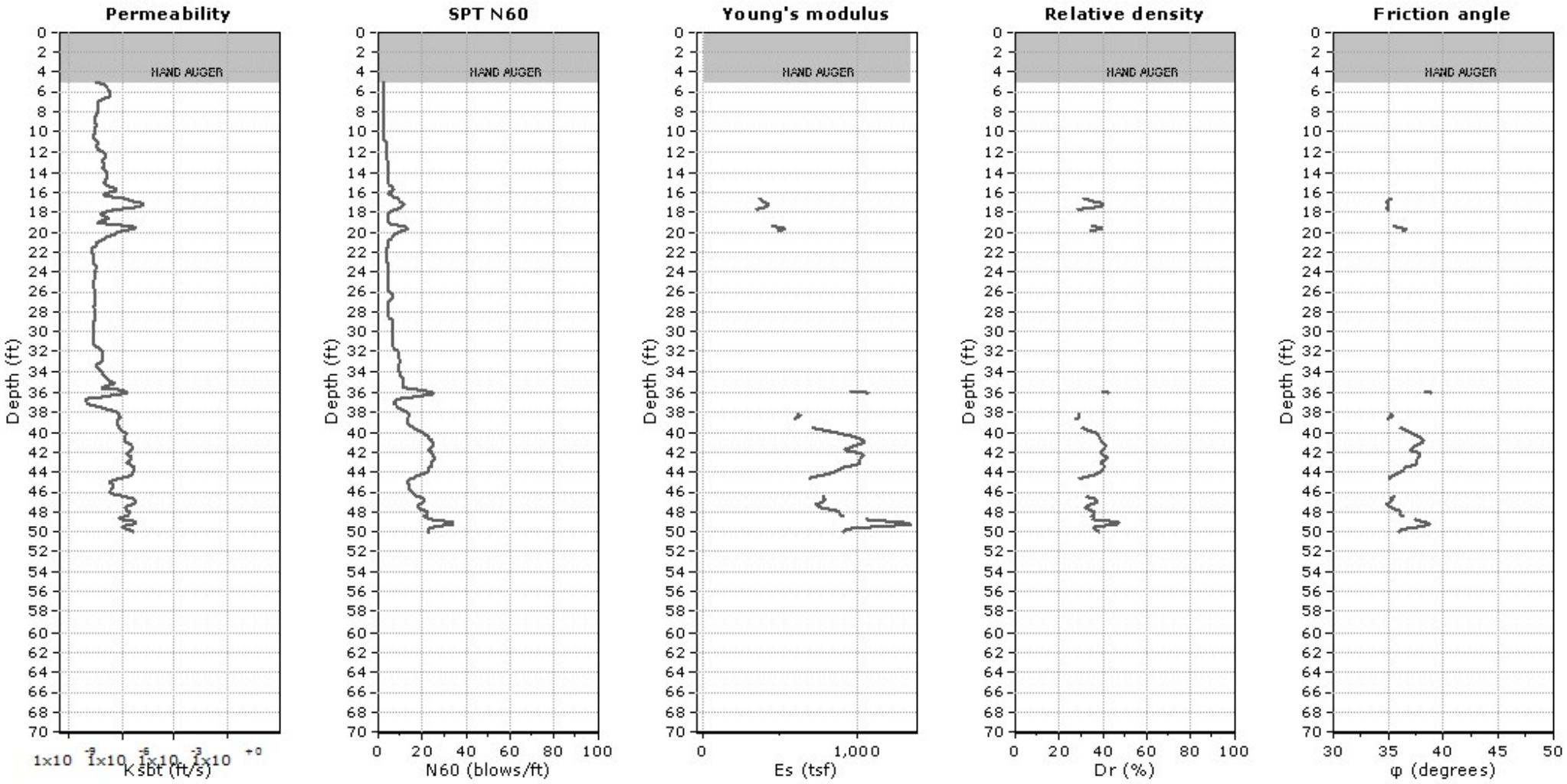


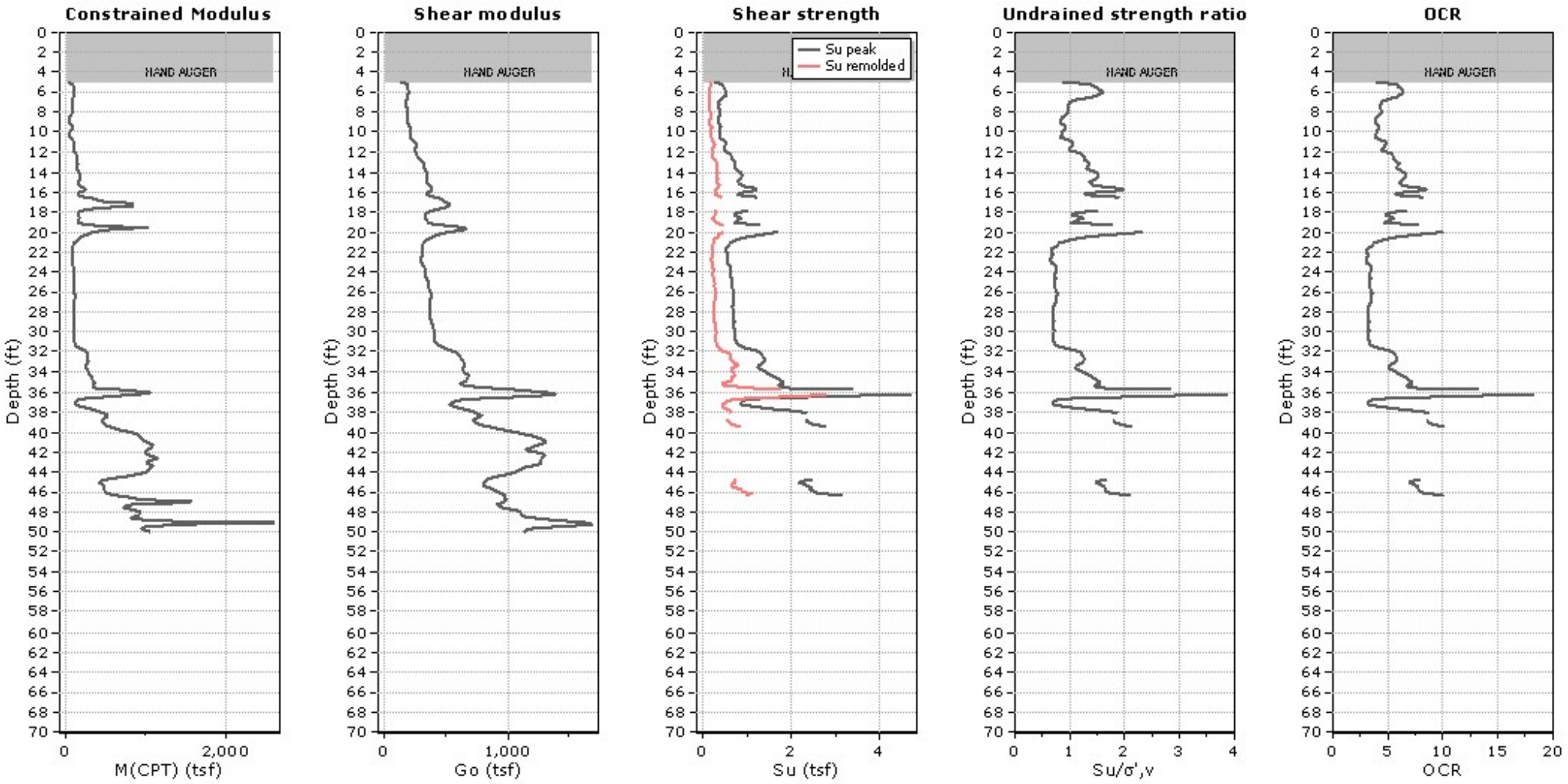

CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)



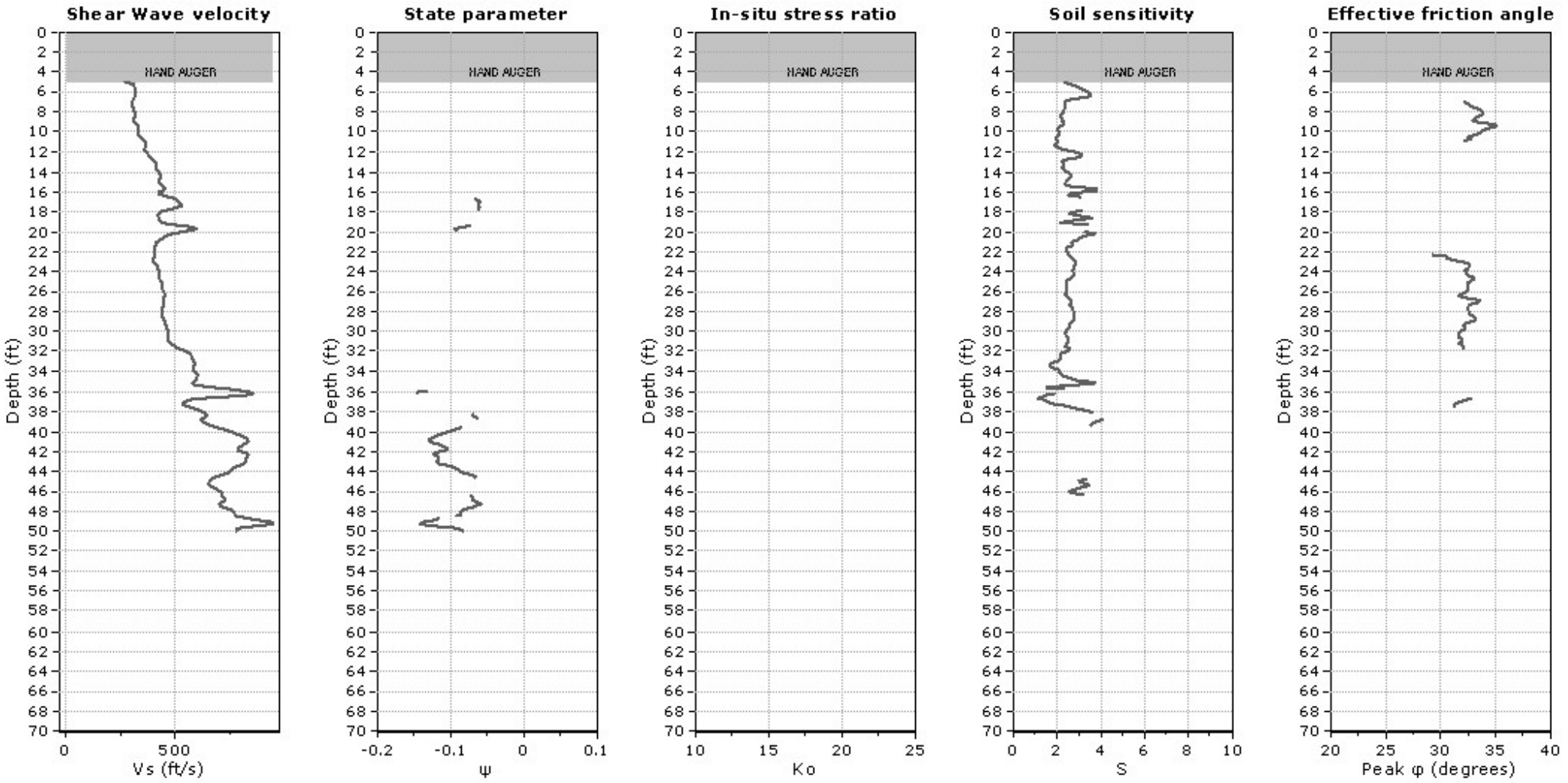

**Calculation parameters**

Permeability: Based on $SBT_n$
SPT $N_{60}$: Based on $I_c$ and $q_t$
Young's modulus: Based on variable alpha using $I_c$ (Robertson, 2009)
Relative density constant, $C_{Dr}$: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data




**Calculation parameters**

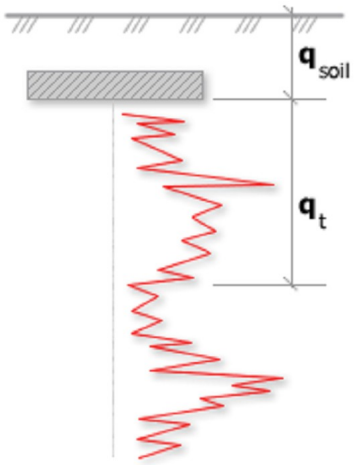
Constrained modulus: Based on variable alpha using $I_c$ and $Q_{tn}$ (Robertson, 2009)
Go: Based on variable alpha using $I_c$ (Robertson, 2009)
Undrained shear strength cone factor for clays, $N_{kt}$: 14
OCR factor for clays, $N_{kt}$: 0.33
User defined estimation data
Flat Dilatometer Test data




**Calculation parameters**

Soil Sensitivity factor, $N_S$: 7.00

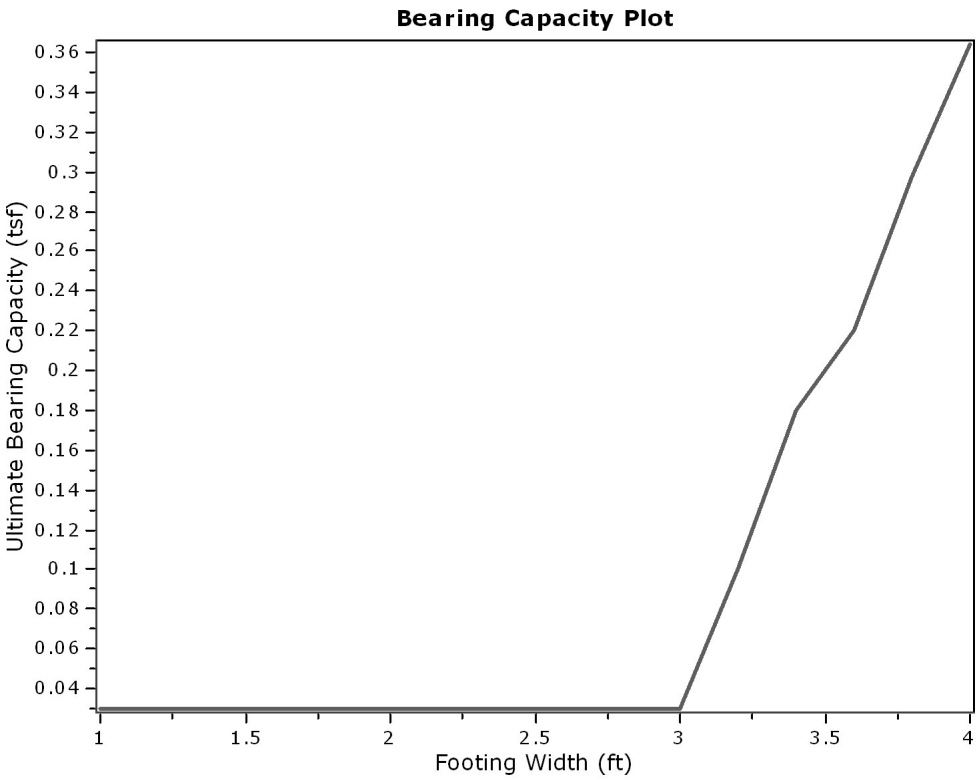
User defined estimation data




Bearing Capacity calculation is perfromed based on the formula:

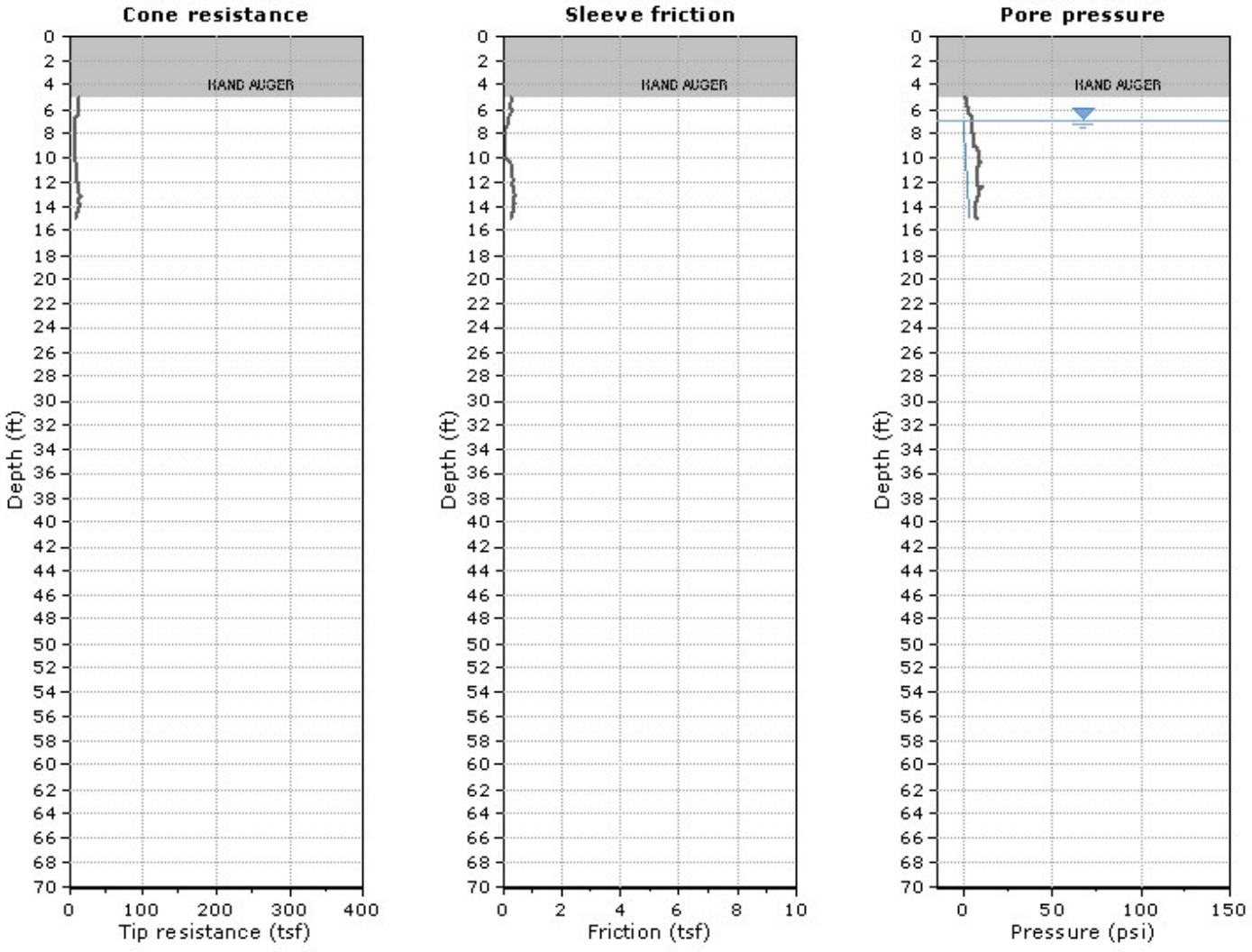
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
$R_k$: Bearing capacity factor
$q_t$: Average corrected cone resistance over calculation depth
$q_{soil}$: Pressure applied by soil above footing

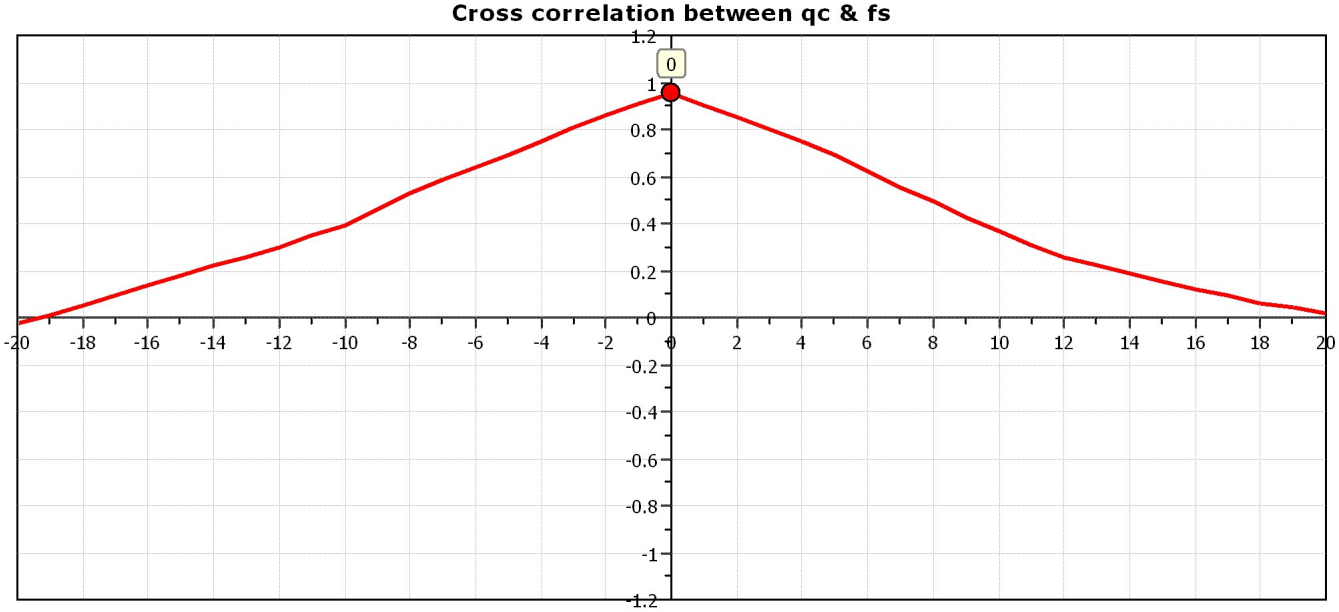



**:: Tabular results ::**

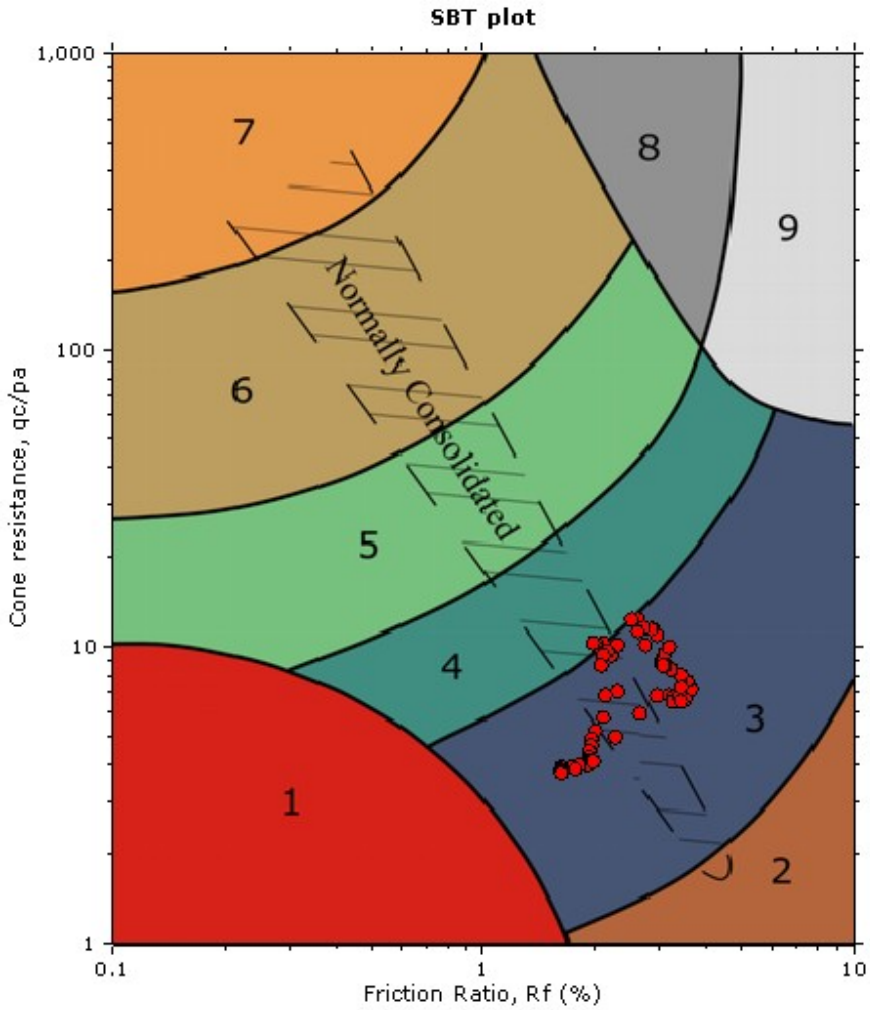
| No | B (ft) | Start Depth (ft) | End Depth (ft) | Ave. $q_t$ (tsf) | $R_k$ | Soil Press. (tsf) | Ult. bearing cap. (tsf) |
|---|---|---|---|---|---|---|---|
| 1 | 1.00 | 0.50 | 2.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 2 | 1.20 | 0.50 | 2.30 | 0.00 | 0.20 | 0.03 | 0.03 |
| 3 | 1.40 | 0.50 | 2.60 | 0.00 | 0.20 | 0.03 | 0.03 |
| 4 | 1.60 | 0.50 | 2.90 | 0.00 | 0.20 | 0.03 | 0.03 |
| 5 | 1.80 | 0.50 | 3.20 | 0.00 | 0.20 | 0.03 | 0.03 |
| 6 | 2.00 | 0.50 | 3.50 | 0.00 | 0.20 | 0.03 | 0.03 |
| 7 | 2.20 | 0.50 | 3.80 | 0.00 | 0.20 | 0.03 | 0.03 |
| 8 | 2.40 | 0.50 | 4.10 | 0.00 | 0.20 | 0.03 | 0.03 |
| 9 | 2.60 | 0.50 | 4.40 | 0.00 | 0.20 | 0.03 | 0.03 |
| 10 | 2.80 | 0.50 | 4.70 | 0.00 | 0.20 | 0.03 | 0.03 |
| 11 | 3.00 | 0.50 | 5.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 12 | 3.20 | 0.50 | 5.30 | 0.35 | 0.20 | 0.03 | 0.10 |
| 13 | 3.40 | 0.50 | 5.60 | 0.75 | 0.20 | 0.03 | 0.18 |
| 14 | 3.60 | 0.50 | 5.90 | 0.95 | 0.20 | 0.03 | 0.22 |
| 15 | 3.80 | 0.50 | 6.20 | 1.34 | 0.20 | 0.03 | 0.30 |
| 16 | 4.00 | 0.50 | 6.50 | 1.67 | 0.20 | 0.03 | 0.36 |

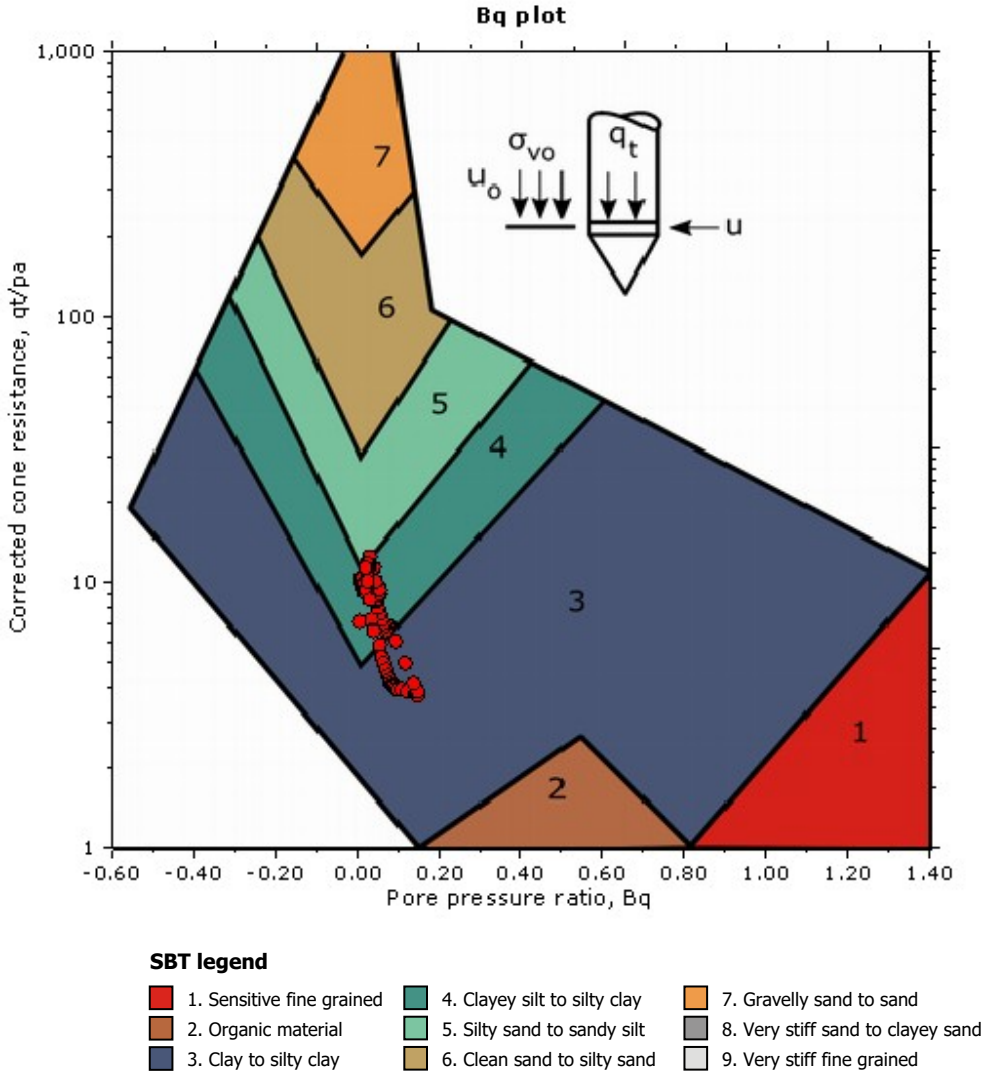



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



## SBT - Bq plots

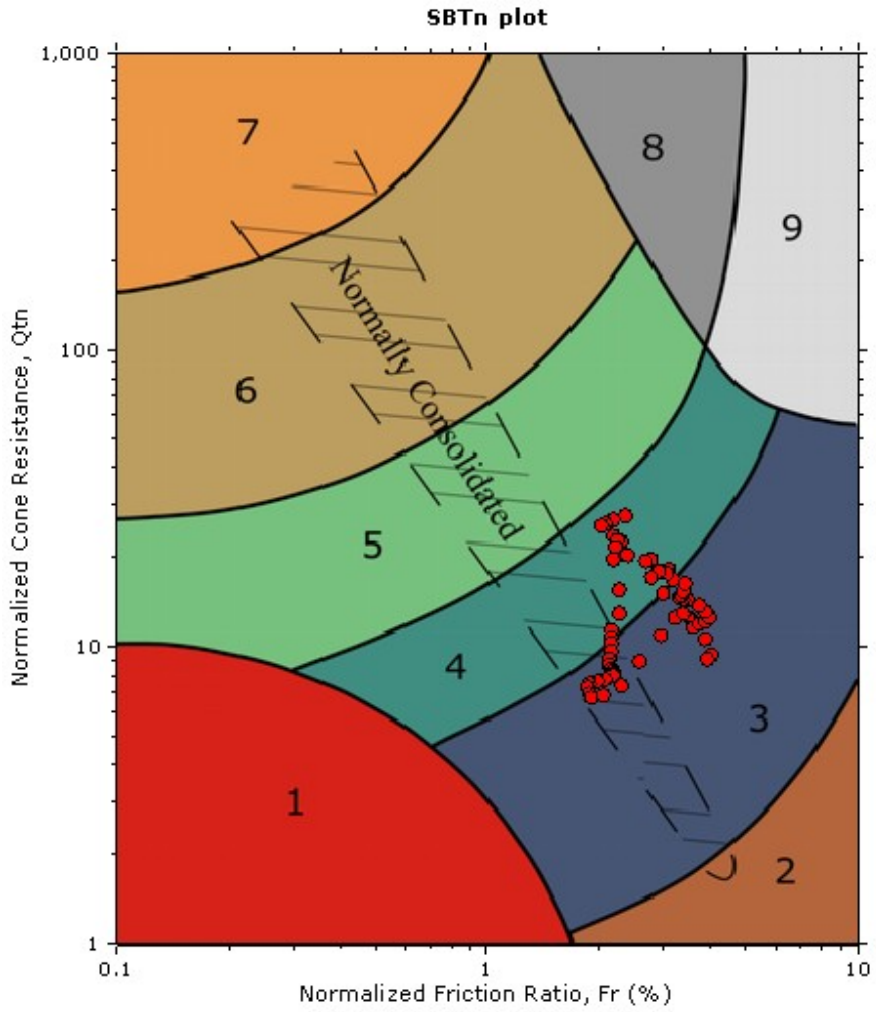


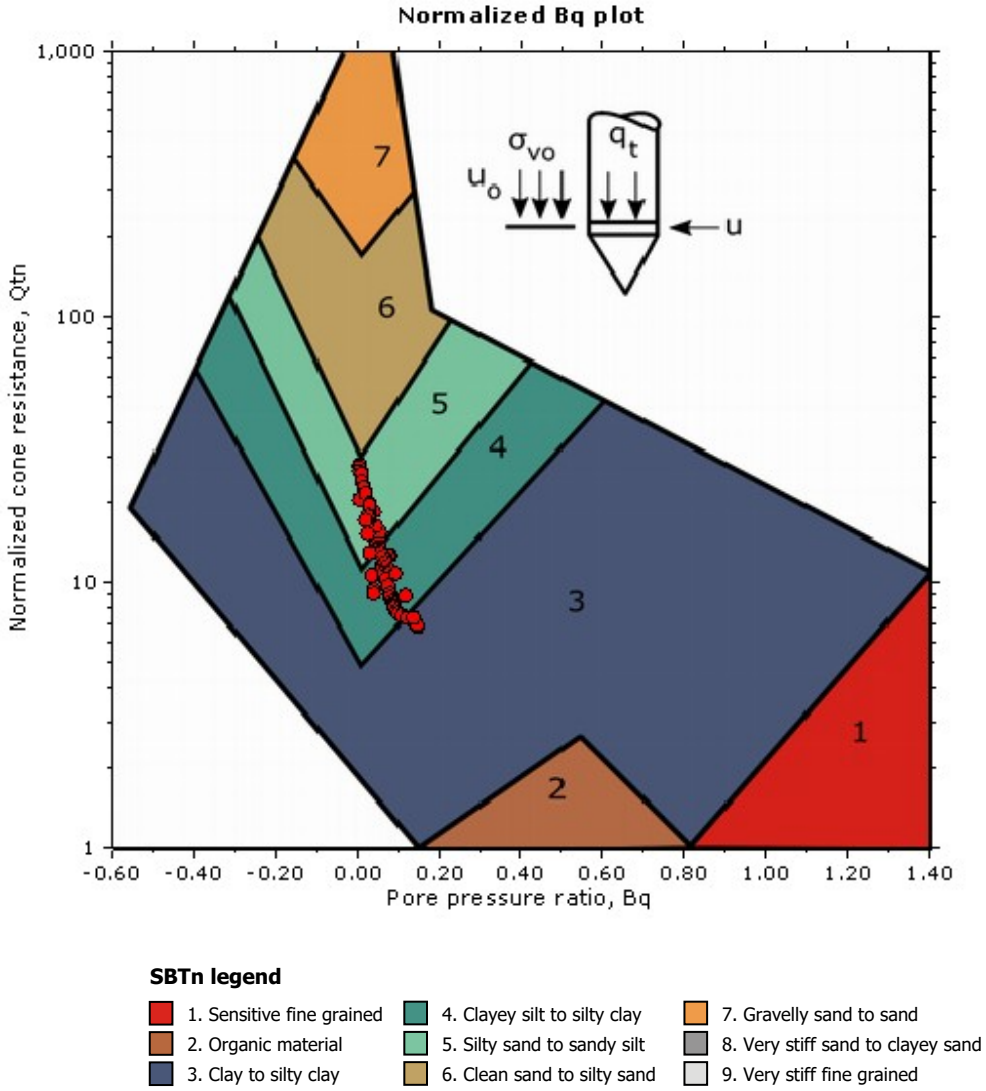




**SBT legend**

| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## SBT - Bq plots (normalized)

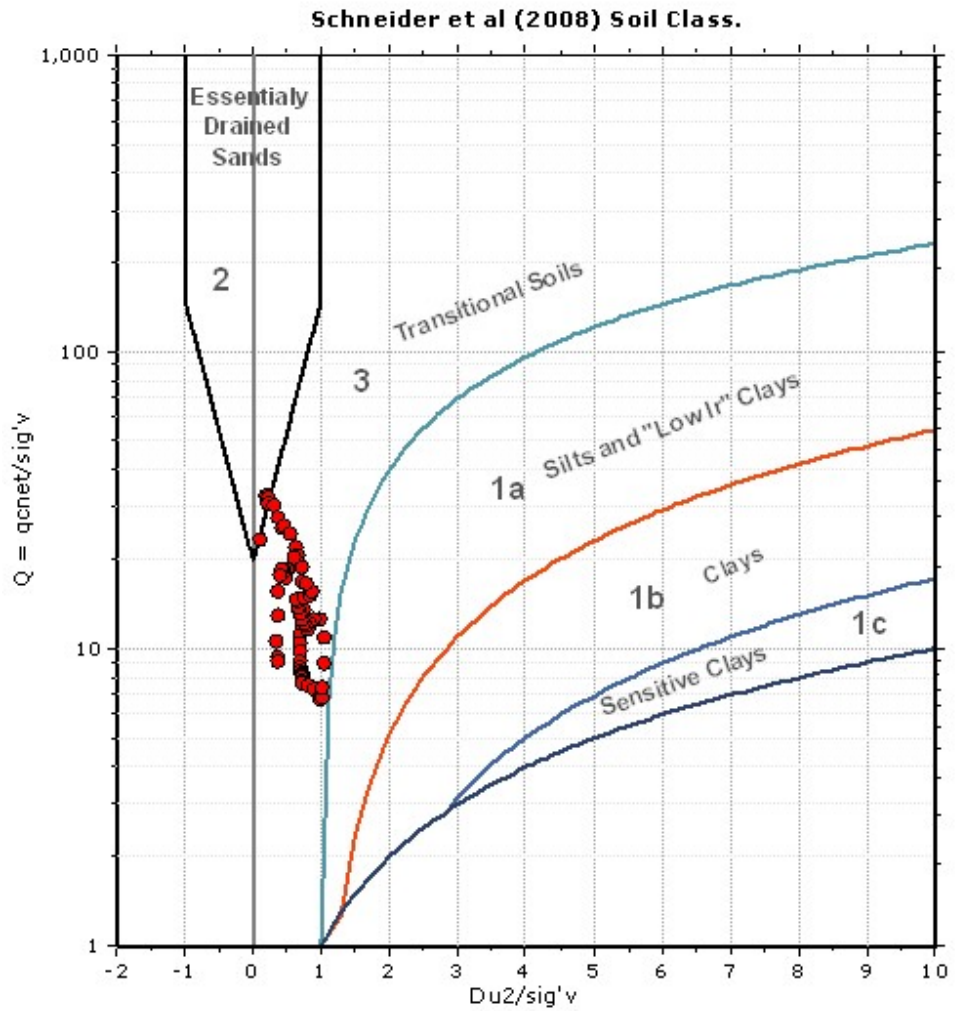


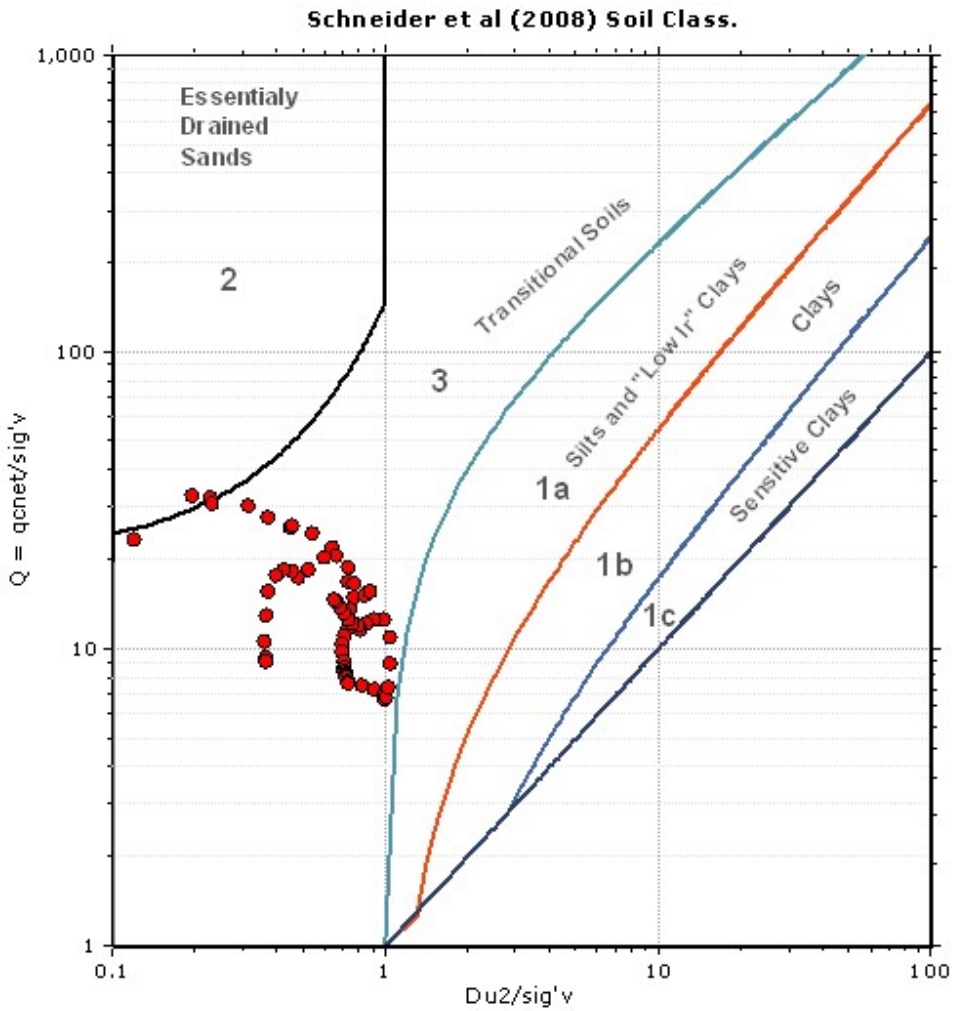



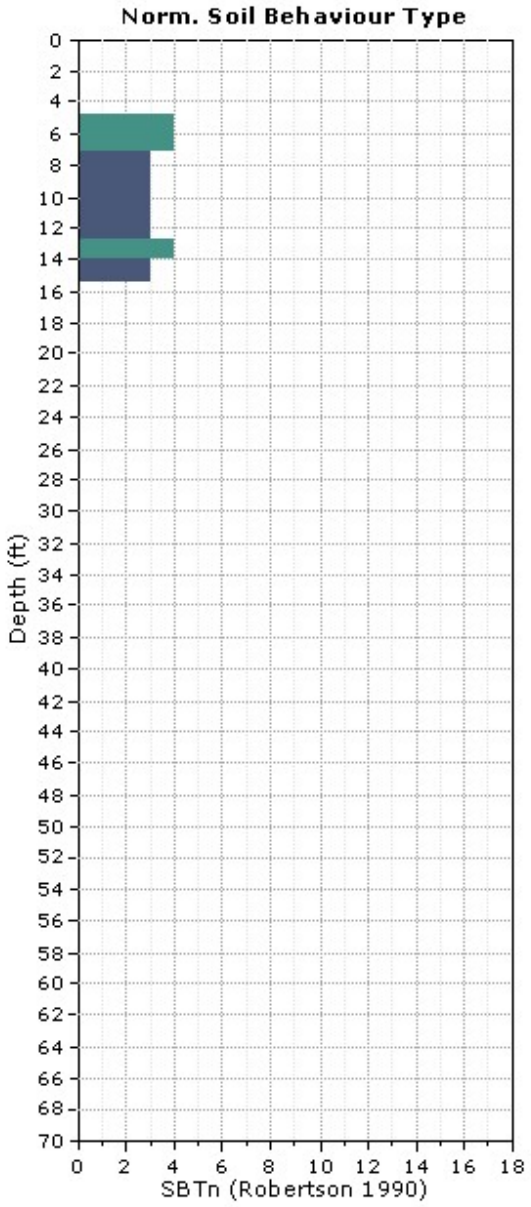

**SBTn legend**

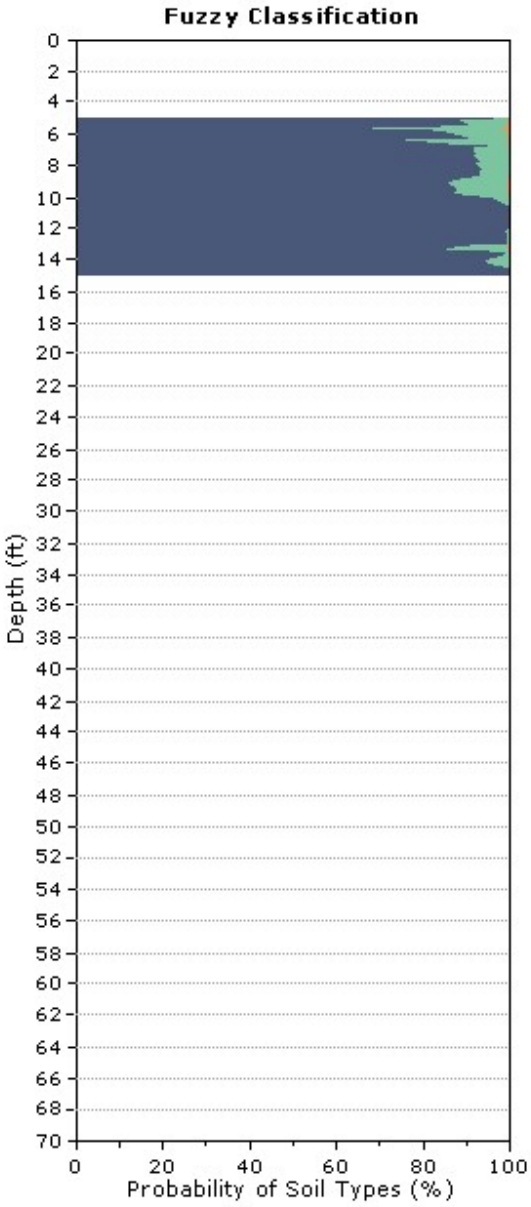
| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## Bq plots (Schneider)



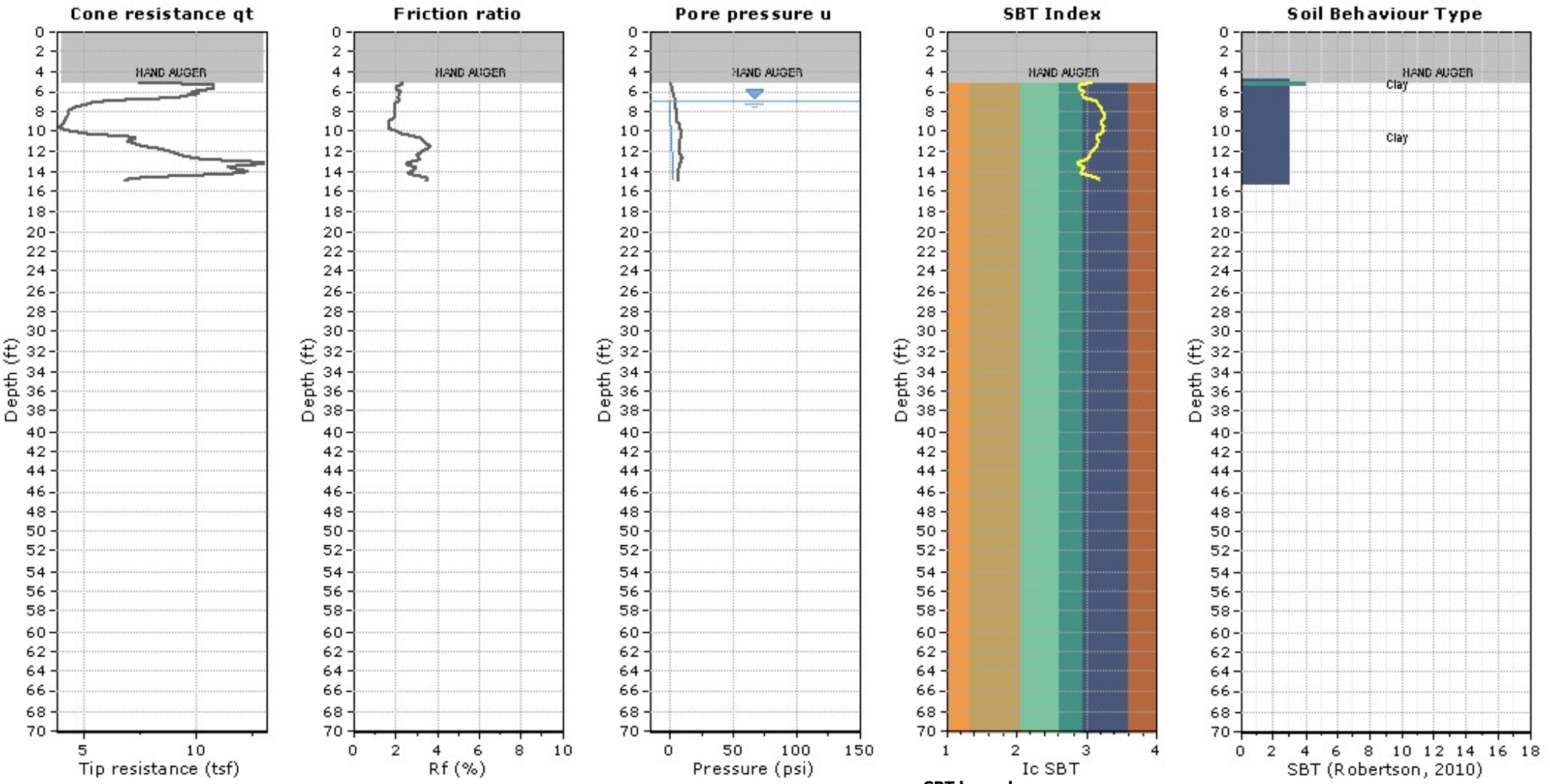



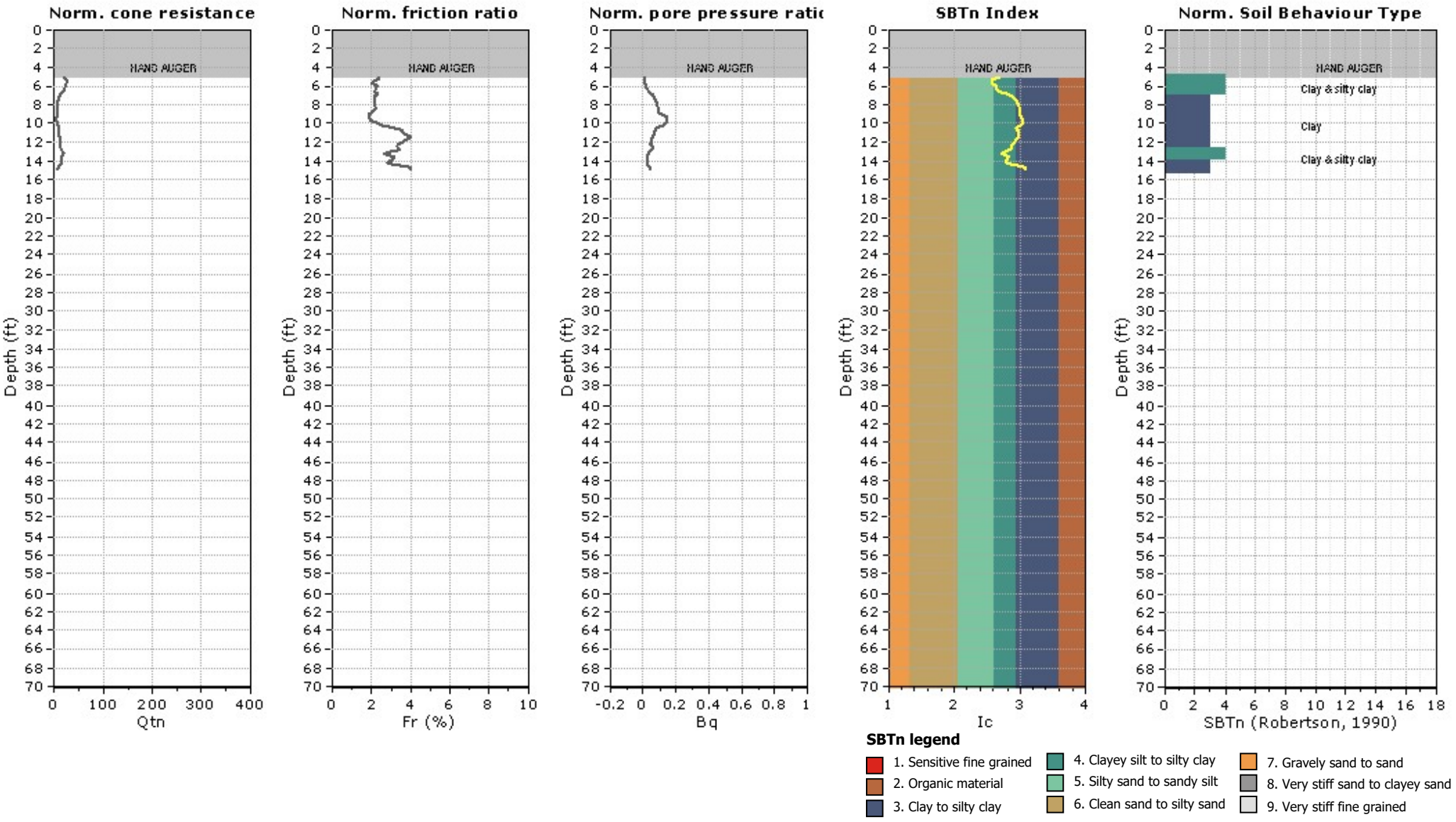

Norm. Soil Behaviour Type
Depth (ft)
SBTn (Robertson 1990)


Fuzzy Classification
Depth (ft)
Probability of Soil Types (%)

**CPT: CPT-04**
Total depth: 14.93 ft, Date: 4/25/2018
Surface Elevation: 10.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

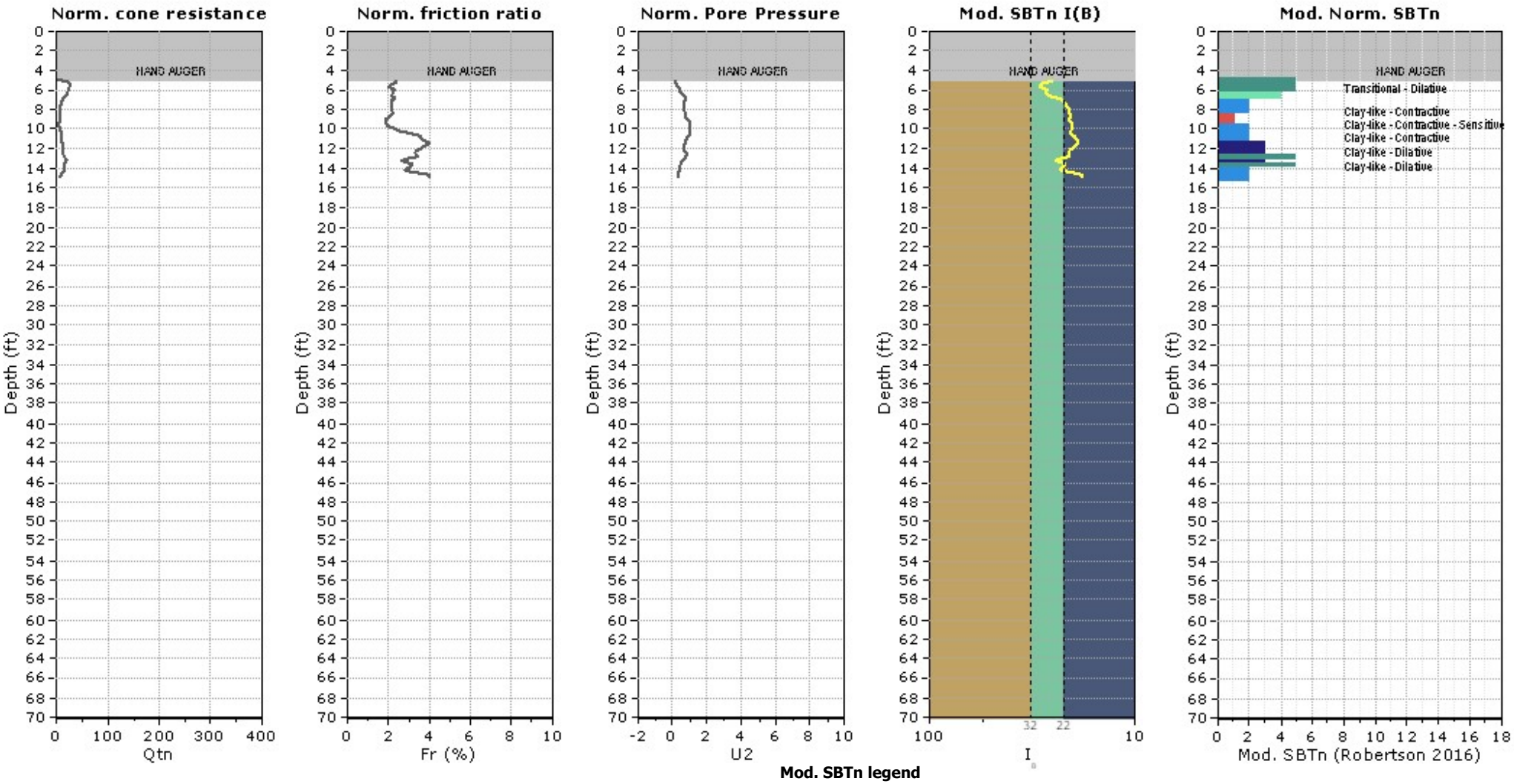
**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA



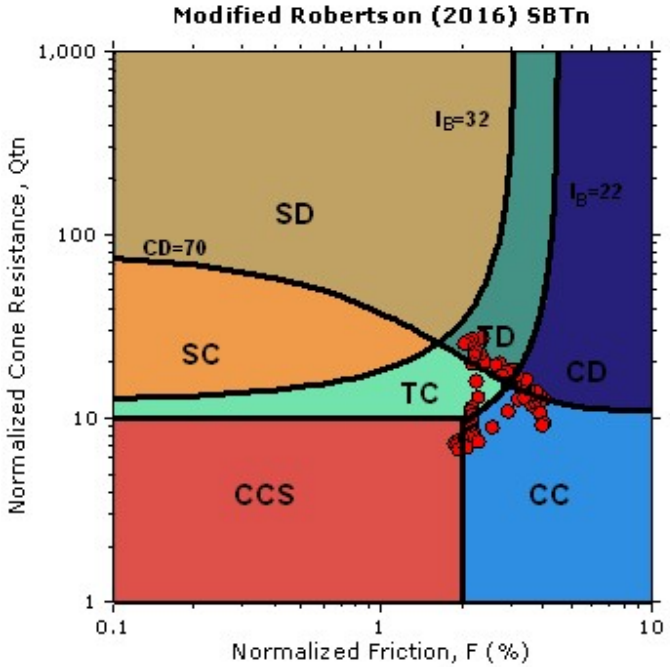

Norm. cone resistance
Norm. friction ratio
Norm. pore pressure ratio
SBTn Index
Norm. Soil Behaviour Type
HAND AUGER
Depth (ft)
Qtn
Fr (%)
Bq
Ic
SBTn (Robertson, 1990)
Clay & silty clay
Clay
Clay & silty clay
SBTn legend
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

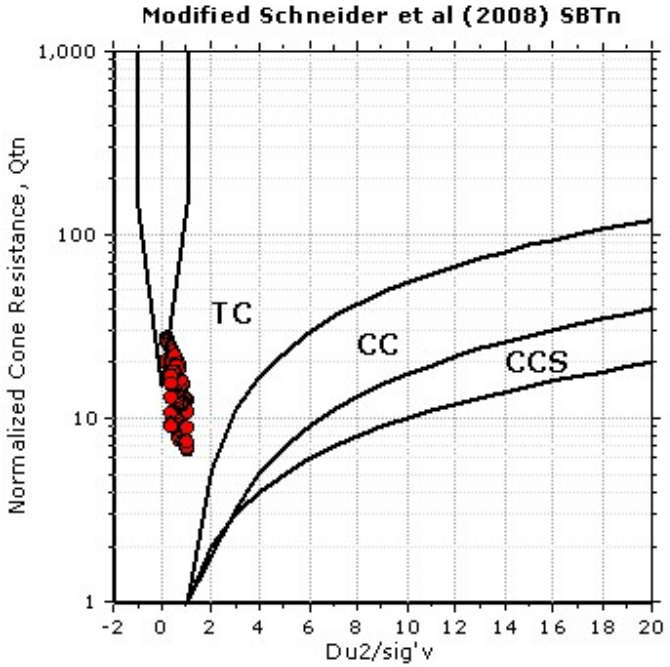
**CPT: CPT-04**
Total depth: 14.93 ft, Date: 4/25/2018
Surface Elevation: 10.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

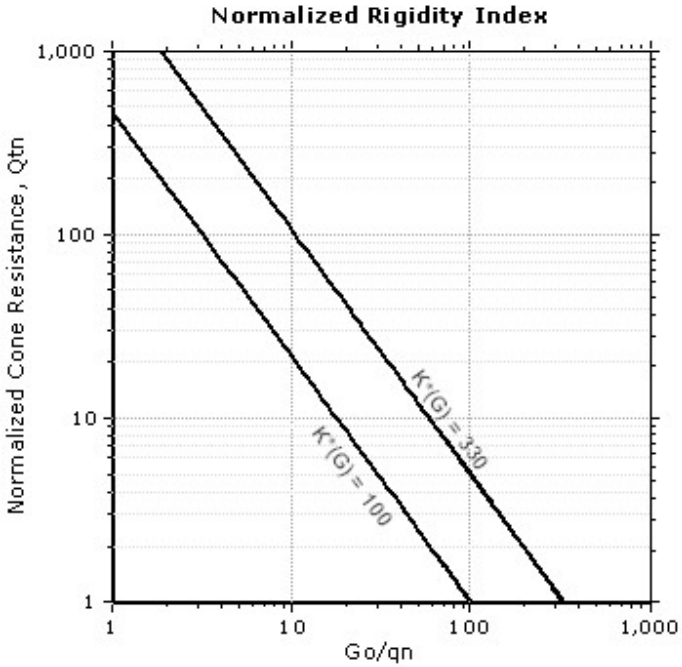
**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA



## Updated SBTn plots

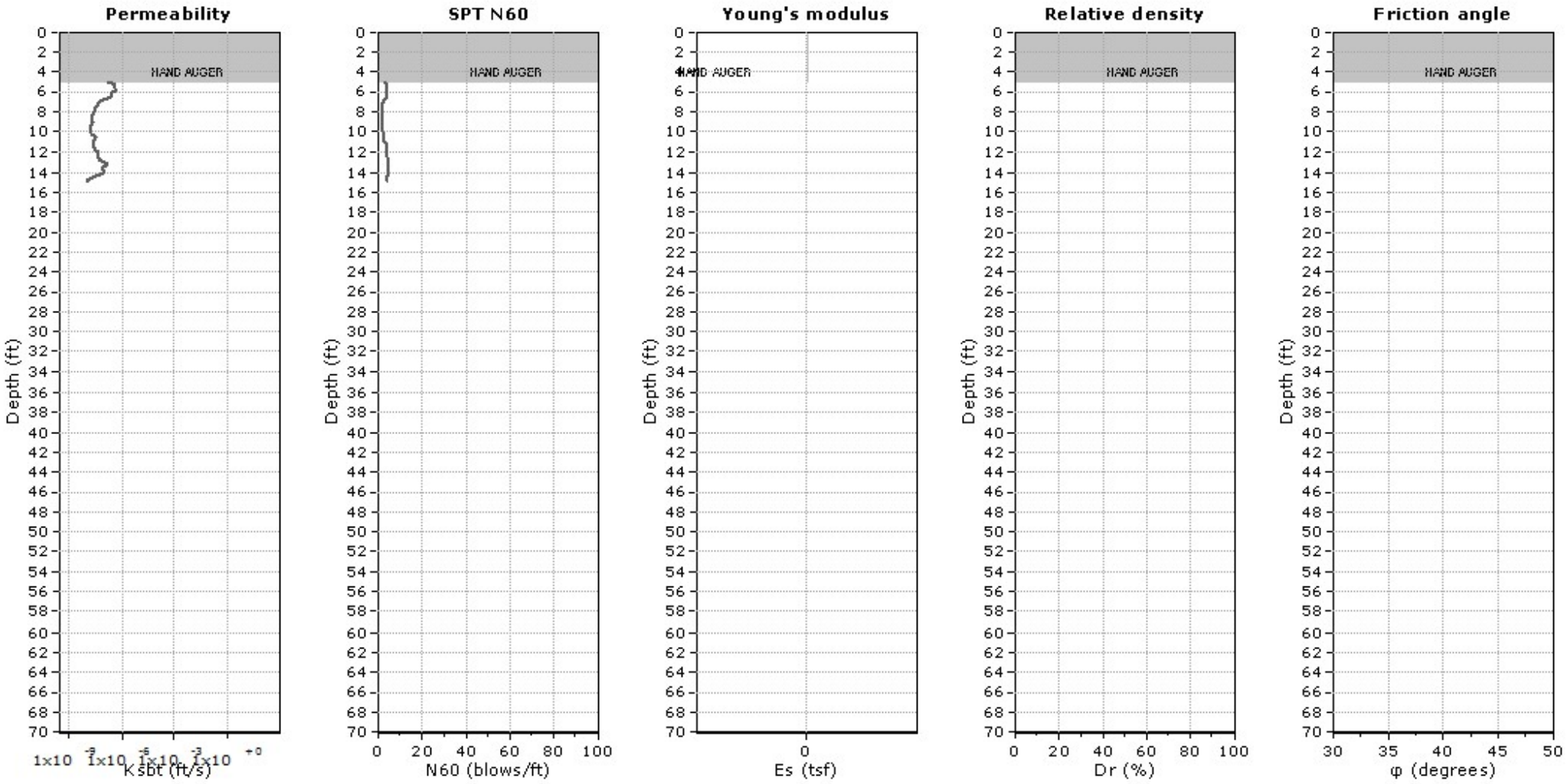


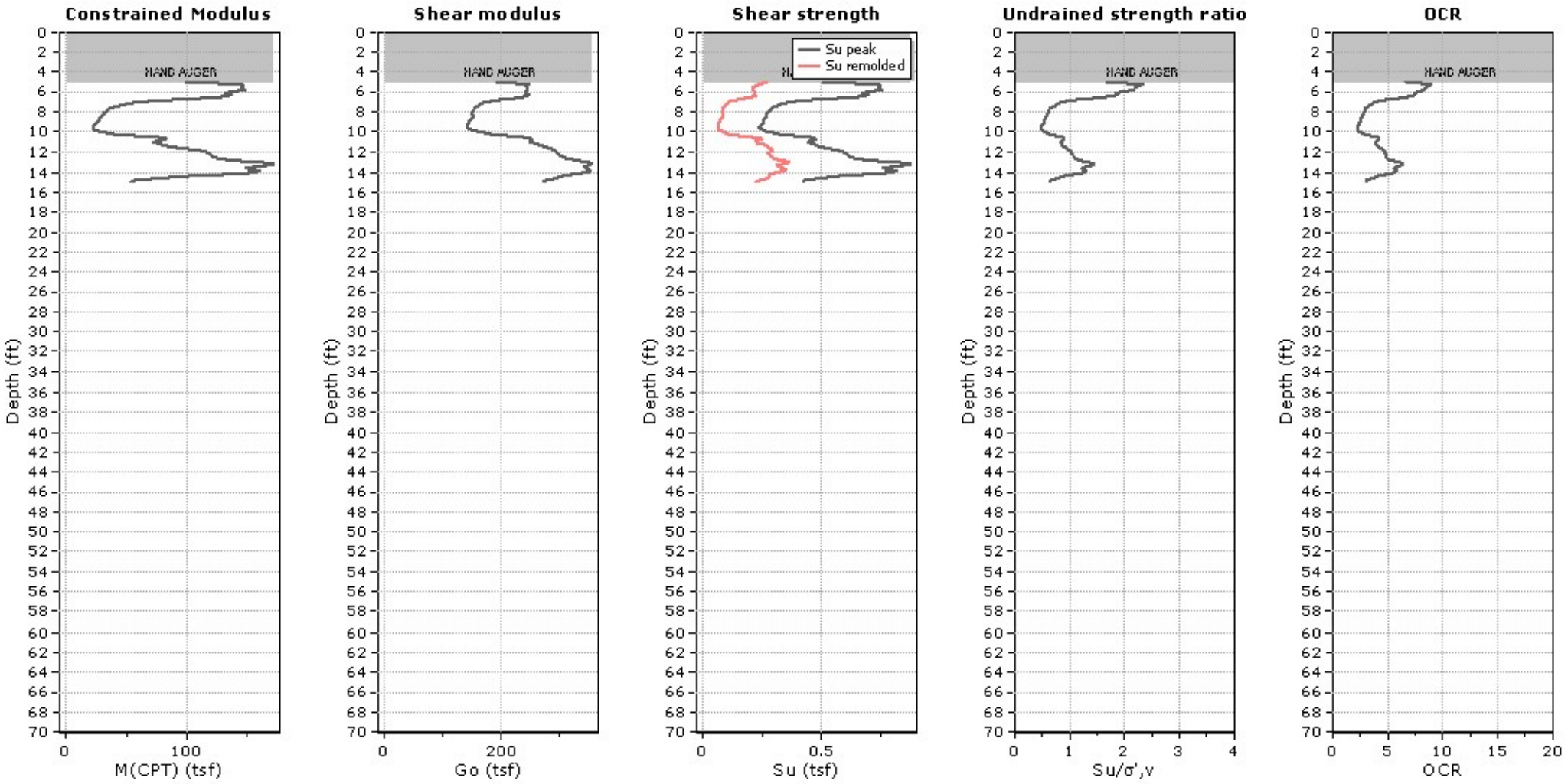

CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)



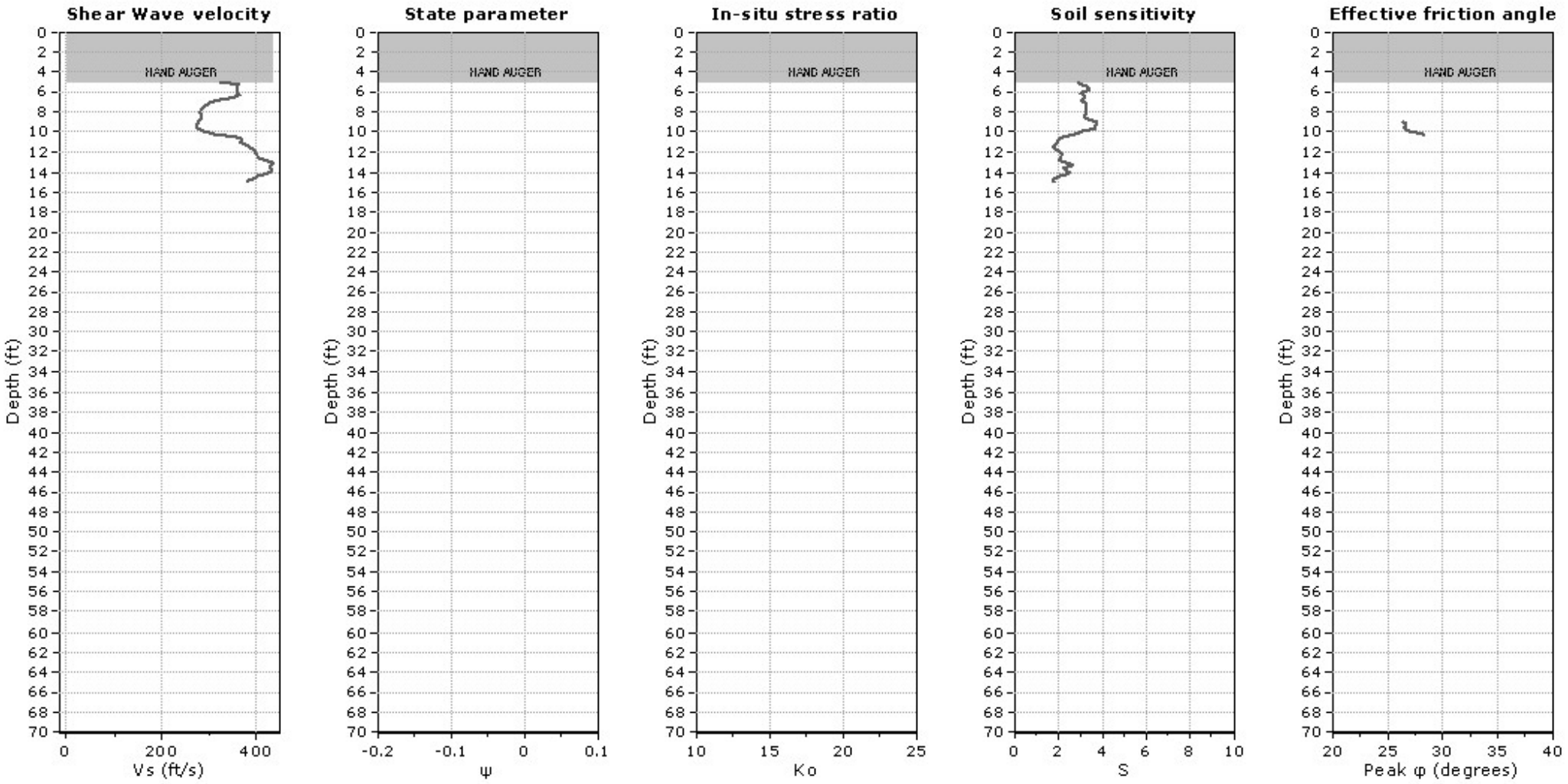

**Calculation parameters**

Permeability: Based on $SBT_n$
SPT $N_{60}$: Based on $I_c$ and $q_t$
Young's modulus: Based on variable alpha using $I_c$ (Robertson, 2009)
Relative density constant, $C_{Dr}$: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data




**Calculation parameters**

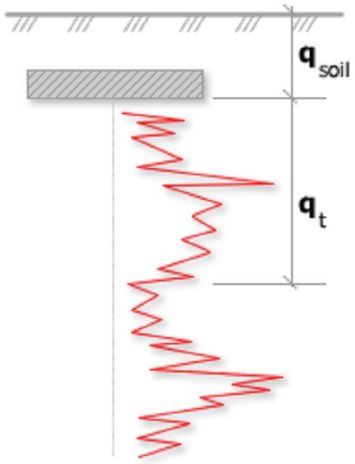
Constrained modulus: Based on variable alpha using $I_c$ and $Q_{tn}$ (Robertson, 2009)
Go: Based on variable alpha using $I_c$ (Robertson, 2009)
Undrained shear strength cone factor for clays, $N_{kt}$: 14
OCR factor for clays, $N_{kt}$: 0.33
User defined estimation data
Flat Dilatometer Test data




**Calculation parameters**

Soil Sensitivity factor, $N_S$: 7.00

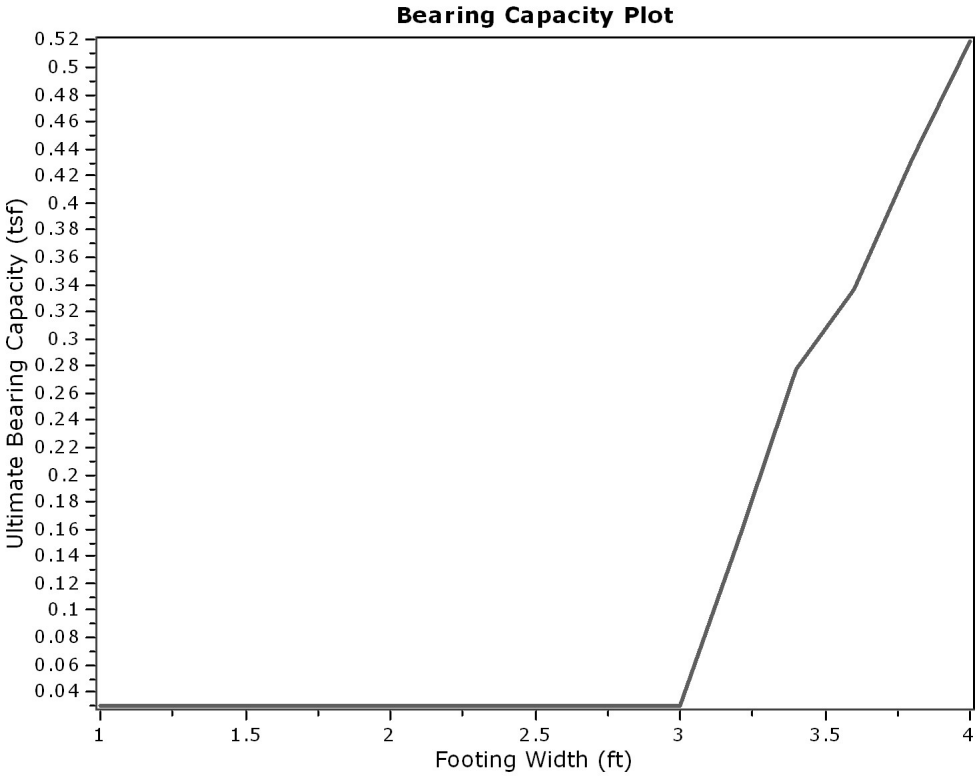
User defined estimation data




Bearing Capacity calculation is perfromed based on the formula:

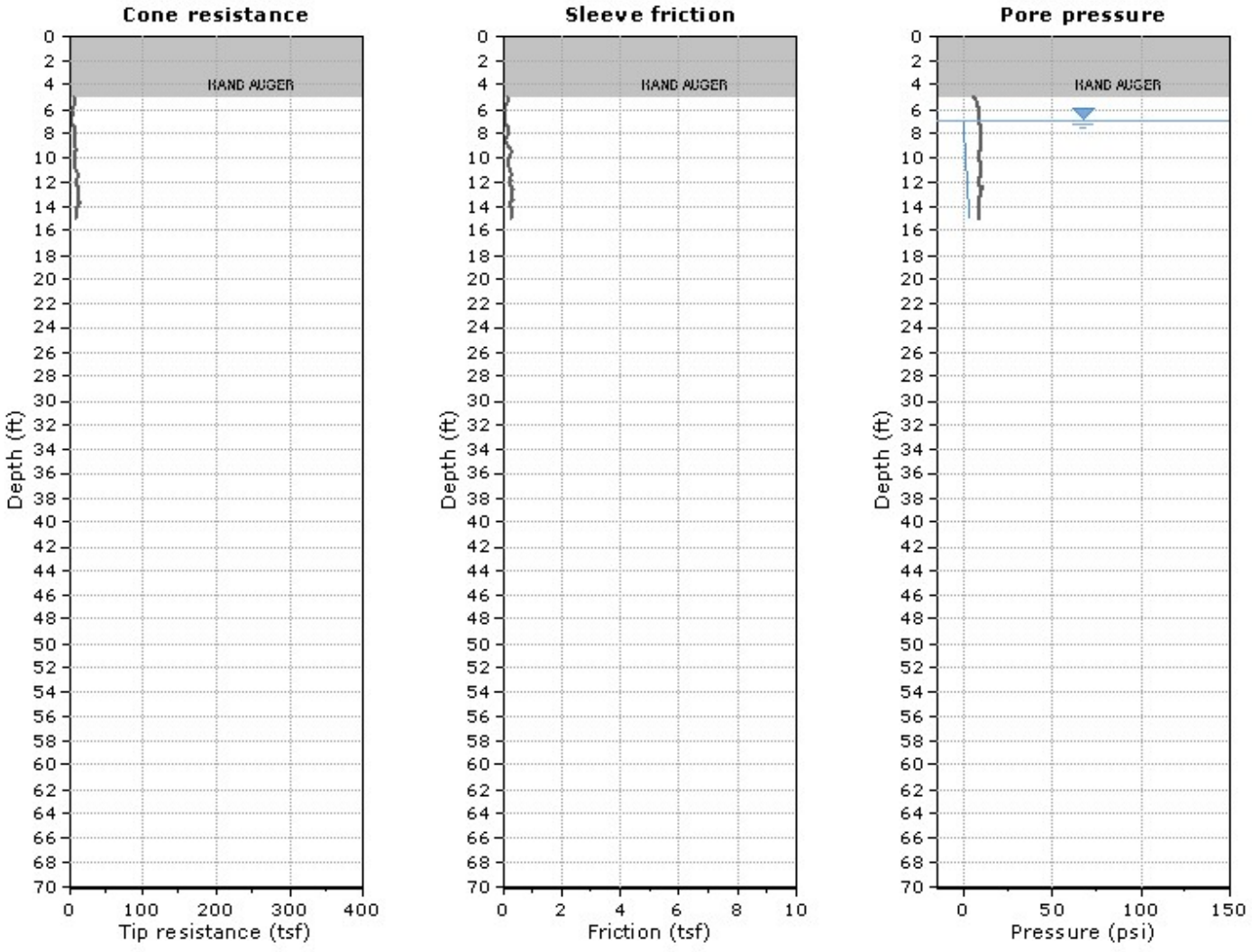
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
$R_k$: Bearing capacity factor
$q_t$: Average corrected cone resistance over calculation depth
$q_{soil}$: Pressure applied by soil above footing

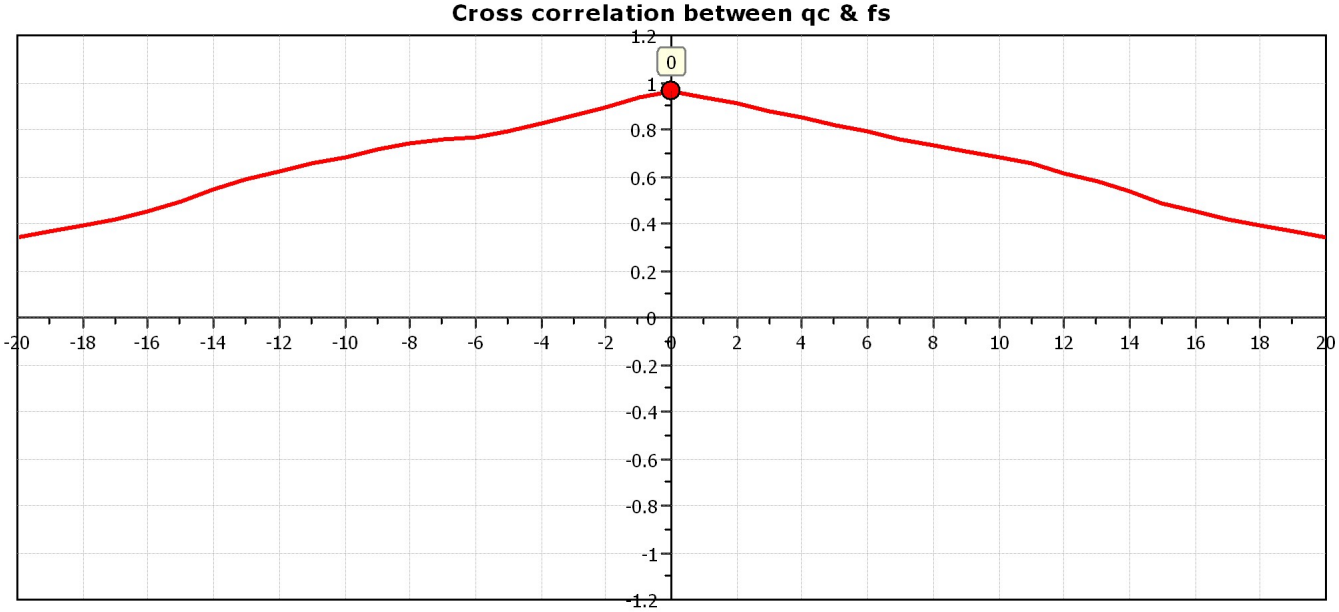



**:: Tabular results ::**

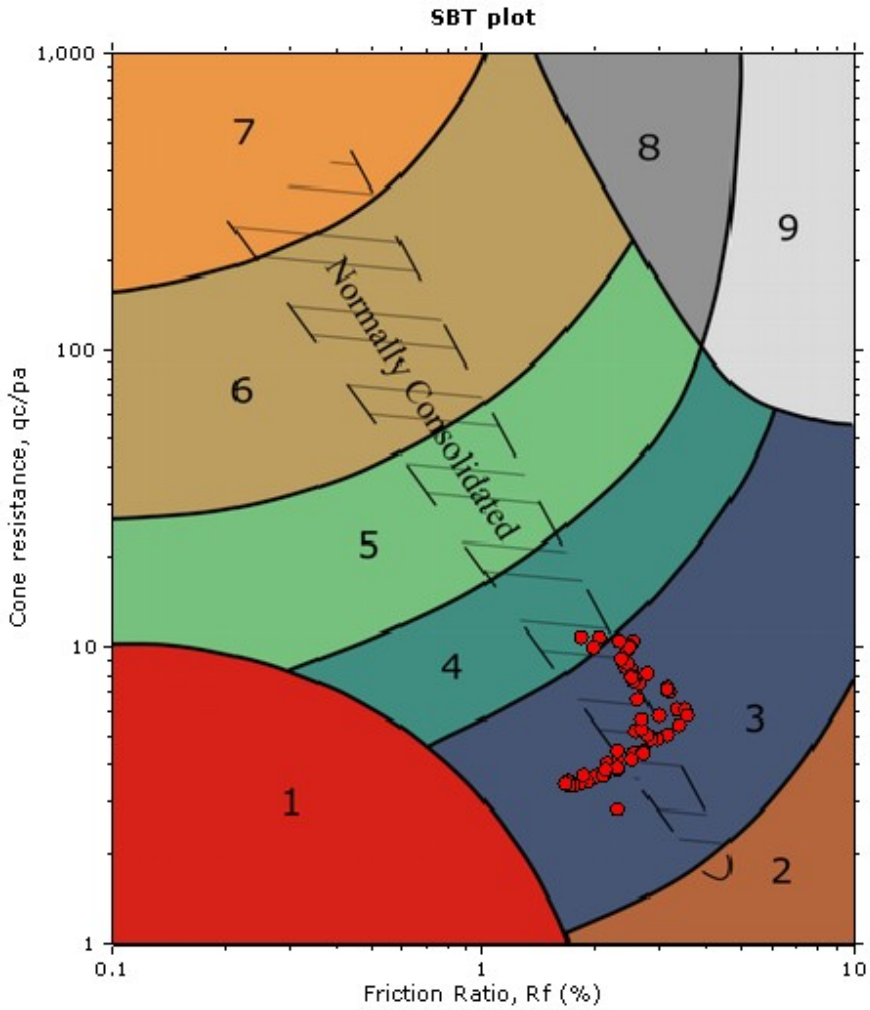
| No | B (ft) | Start Depth (ft) | End Depth (ft) | Ave. $q_t$ (tsf) | $R_k$ | Soil Press. (tsf) | Ult. bearing cap. (tsf) |
|---|---|---|---|---|---|---|---|
| 1 | 1.00 | 0.50 | 2.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 2 | 1.20 | 0.50 | 2.30 | 0.00 | 0.20 | 0.03 | 0.03 |
| 3 | 1.40 | 0.50 | 2.60 | 0.00 | 0.20 | 0.03 | 0.03 |
| 4 | 1.60 | 0.50 | 2.90 | 0.00 | 0.20 | 0.03 | 0.03 |
| 5 | 1.80 | 0.50 | 3.20 | 0.00 | 0.20 | 0.03 | 0.03 |
| 6 | 2.00 | 0.50 | 3.50 | 0.00 | 0.20 | 0.03 | 0.03 |
| 7 | 2.20 | 0.50 | 3.80 | 0.00 | 0.20 | 0.03 | 0.03 |
| 8 | 2.40 | 0.50 | 4.10 | 0.00 | 0.20 | 0.03 | 0.03 |
| 9 | 2.60 | 0.50 | 4.40 | 0.00 | 0.20 | 0.03 | 0.03 |
| 10 | 2.80 | 0.50 | 4.70 | 0.00 | 0.20 | 0.03 | 0.03 |
| 11 | 3.00 | 0.50 | 5.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 12 | 3.20 | 0.50 | 5.30 | 0.61 | 0.20 | 0.03 | 0.15 |
| 13 | 3.40 | 0.50 | 5.60 | 1.24 | 0.20 | 0.03 | 0.28 |
| 14 | 3.60 | 0.50 | 5.90 | 1.53 | 0.20 | 0.03 | 0.34 |
| 15 | 3.80 | 0.50 | 6.20 | 2.01 | 0.20 | 0.03 | 0.43 |
| 16 | 4.00 | 0.50 | 6.50 | 2.45 | 0.20 | 0.03 | 0.52 |

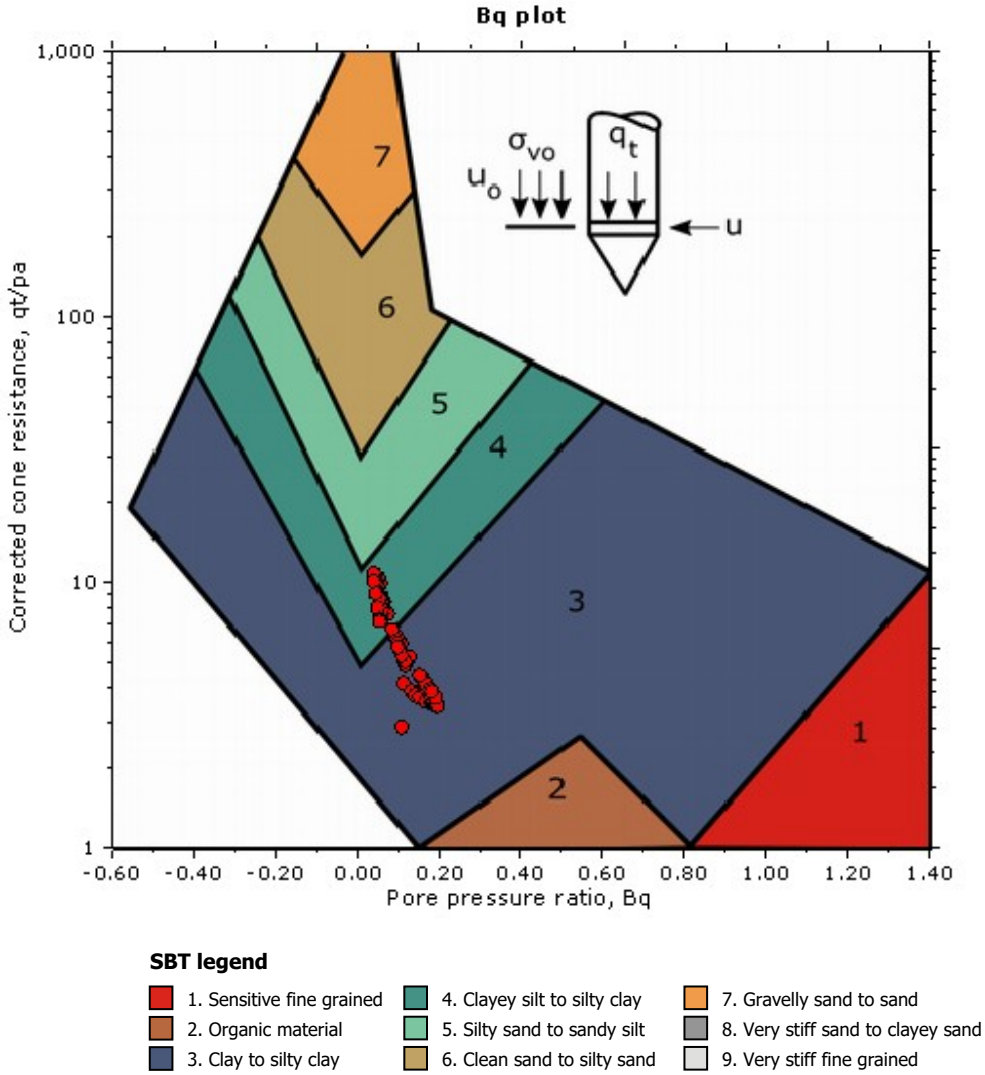



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



## SBT - Bq plots

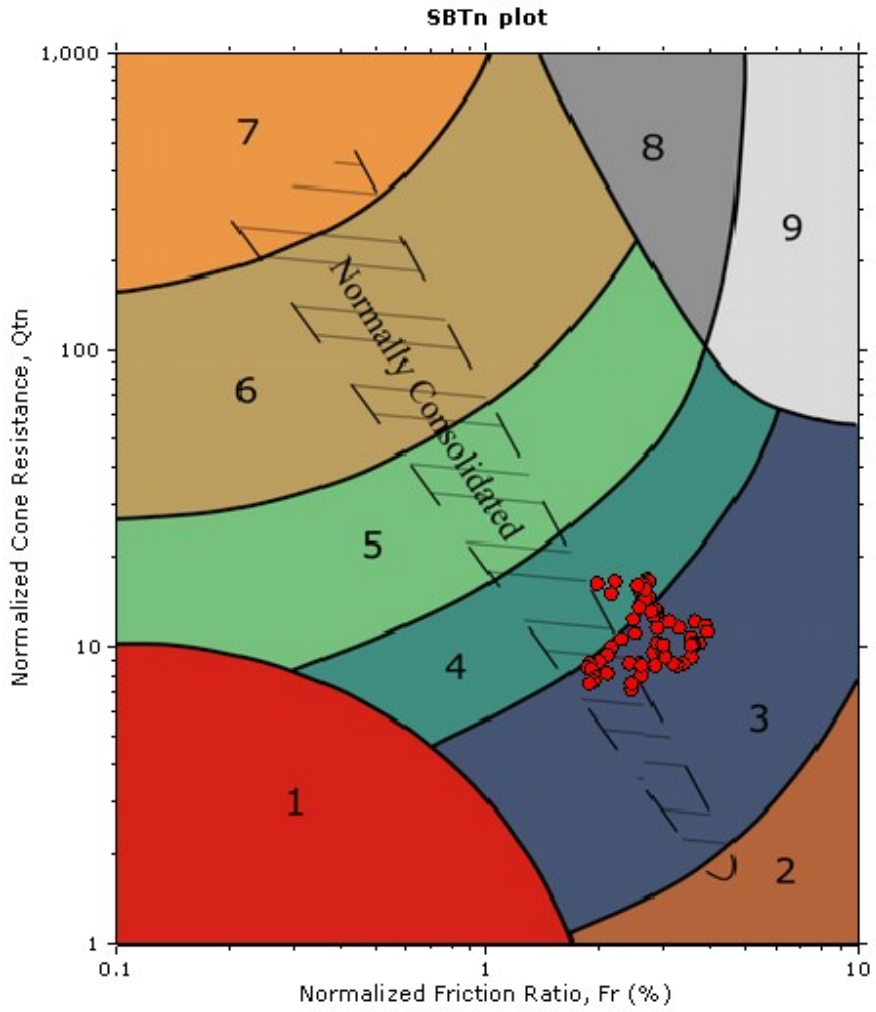


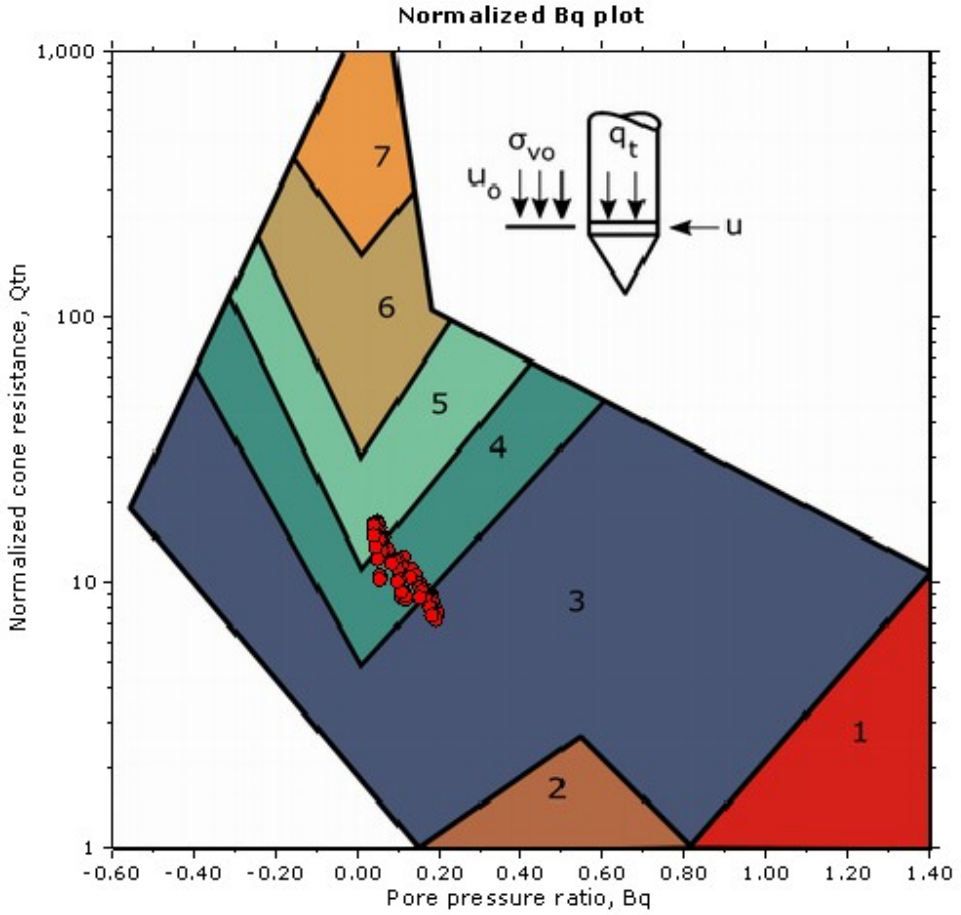




**SBT legend**

| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## SBT - Bq plots (normalized)

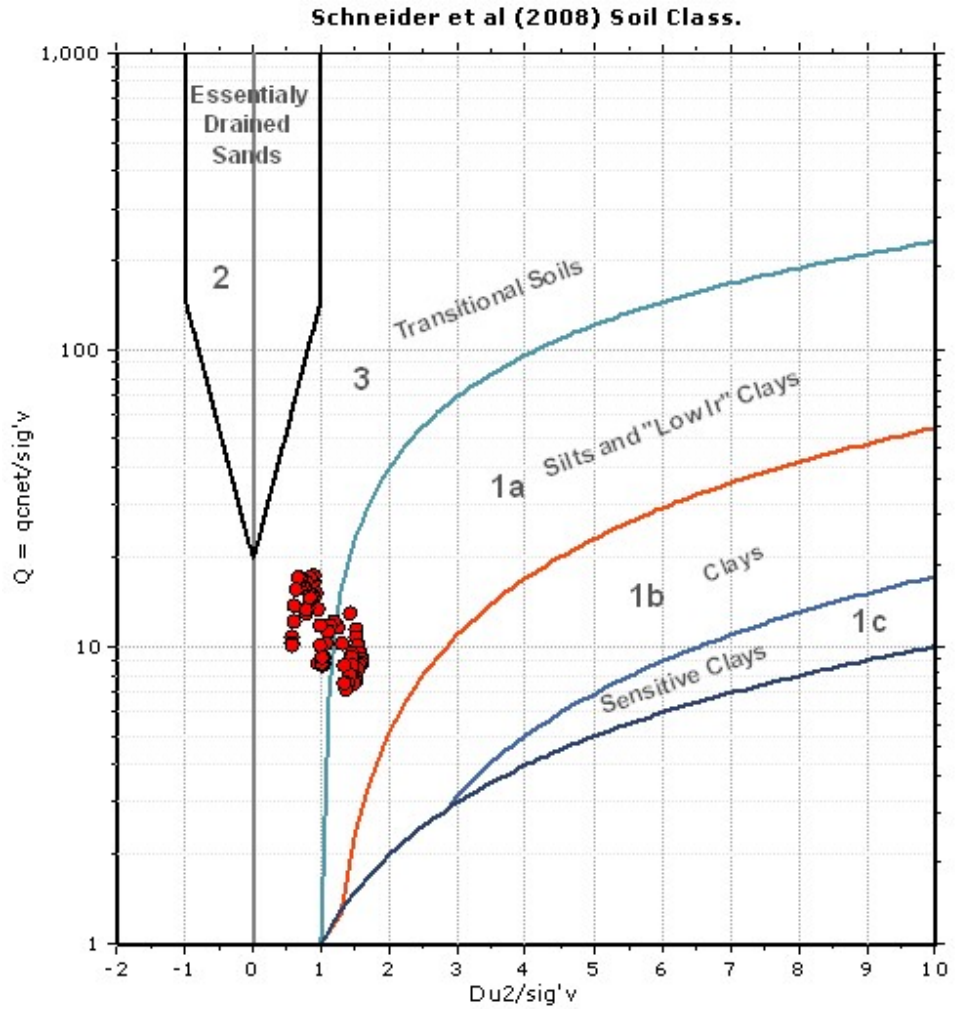


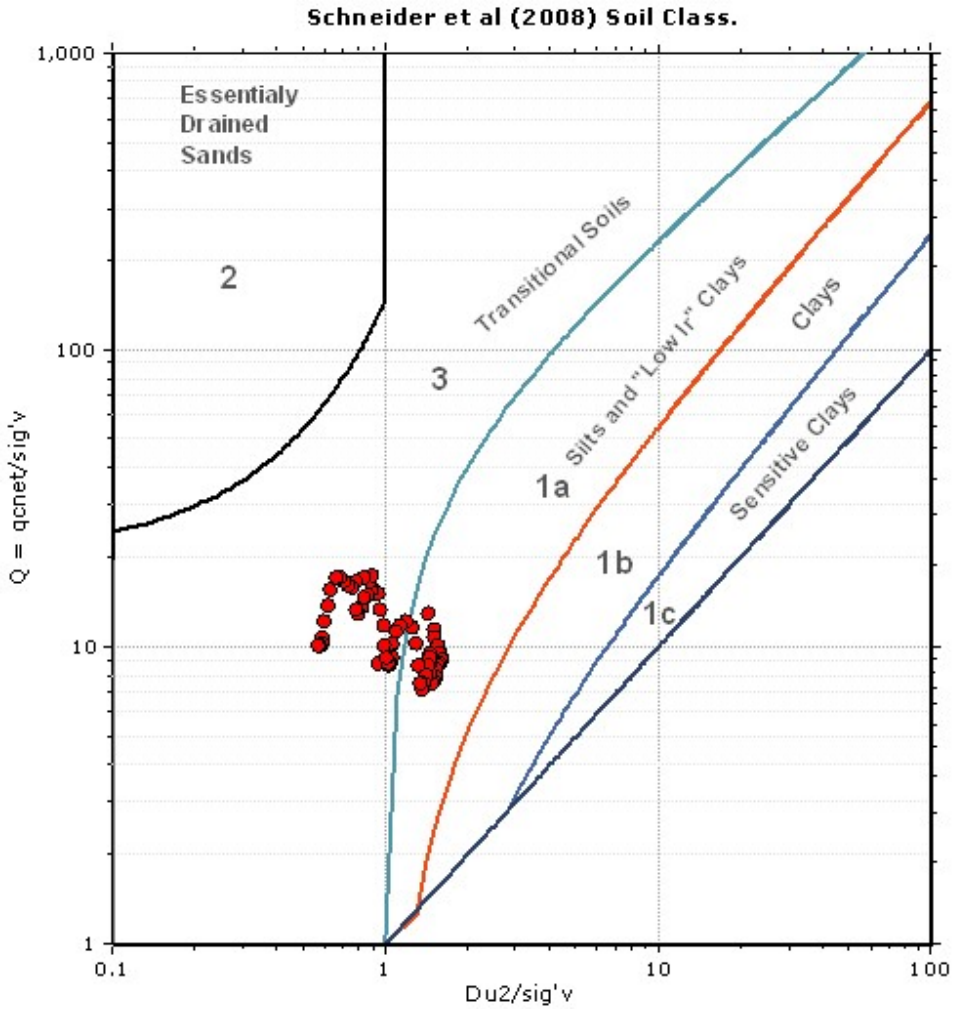



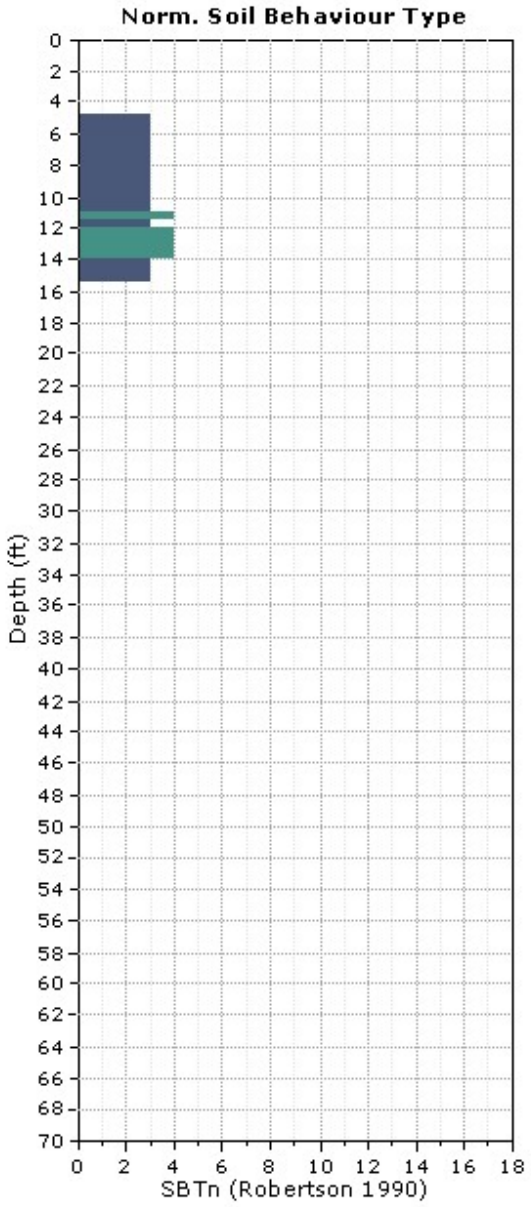

**SBTn legend**

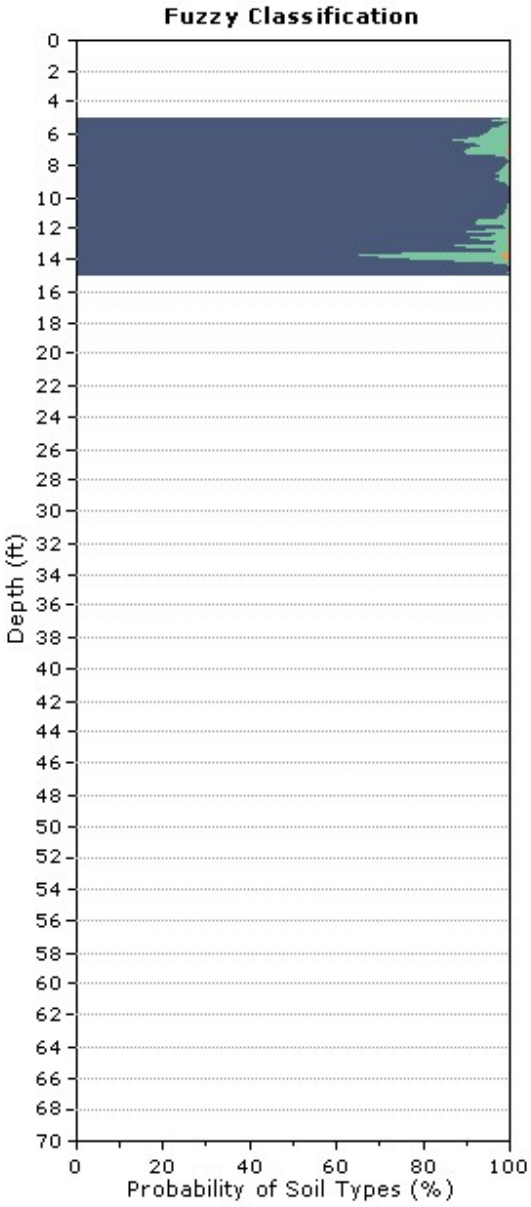
| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## Bq plots (Schneider)



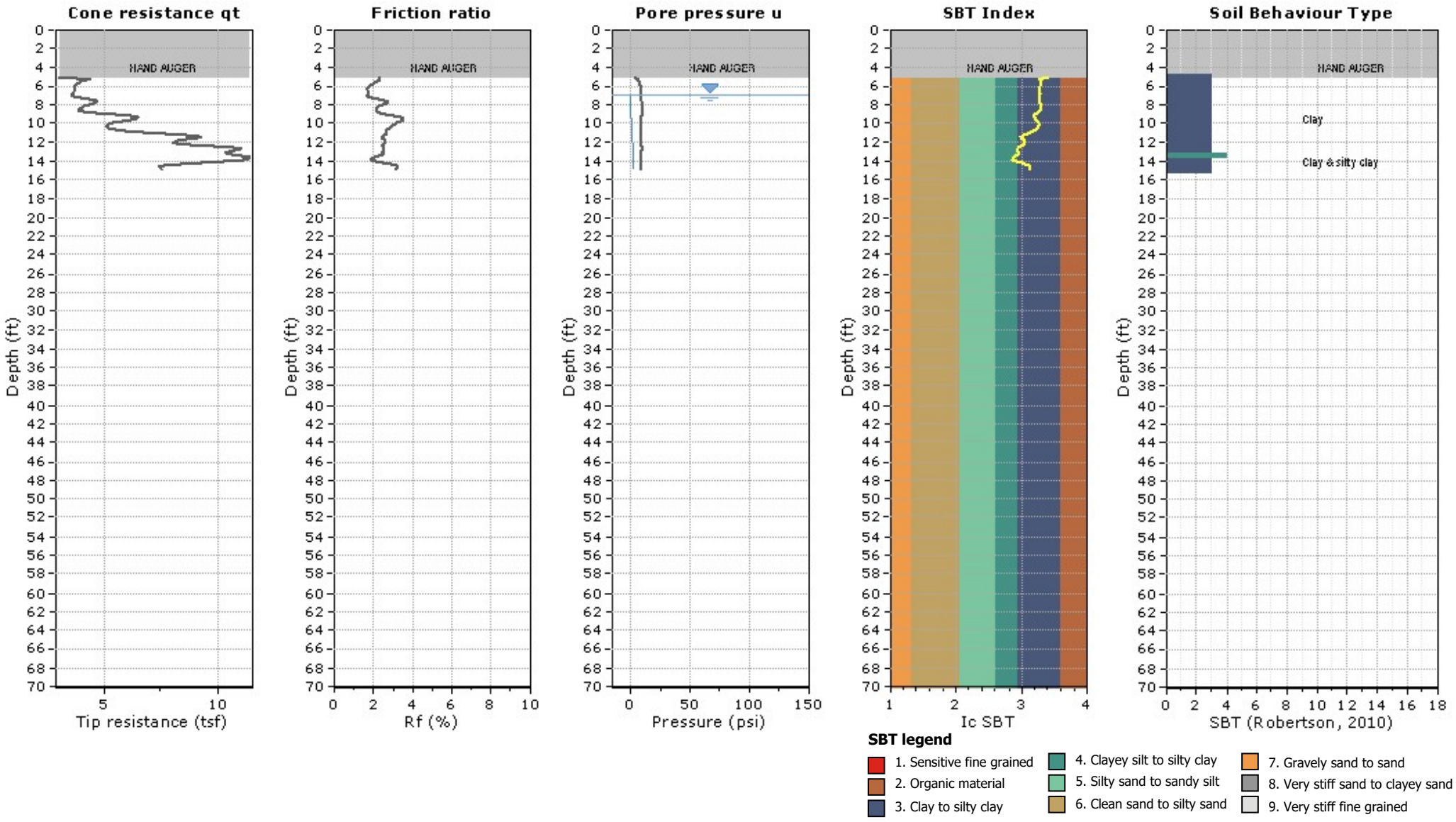




Norm. Soil Behaviour Type
Depth (ft)
SBTn (Robertson 1990)


Fuzzy Classification
Depth (ft)
Probability of Soil Types (%)

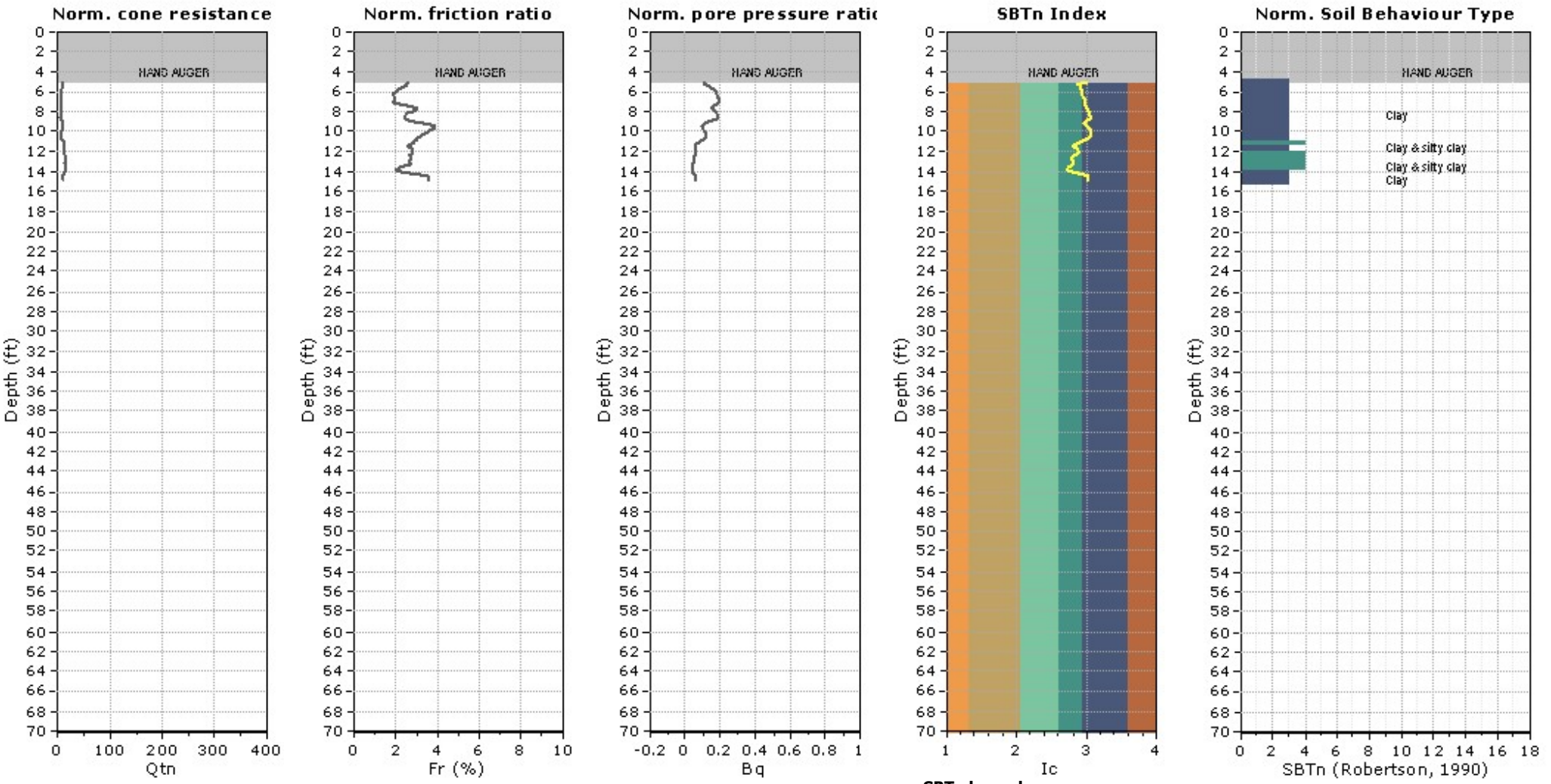
**CPT: CPT-05**
Total depth: 14.93 ft, Date: 4/25/2018
Surface Elevation: 10.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA



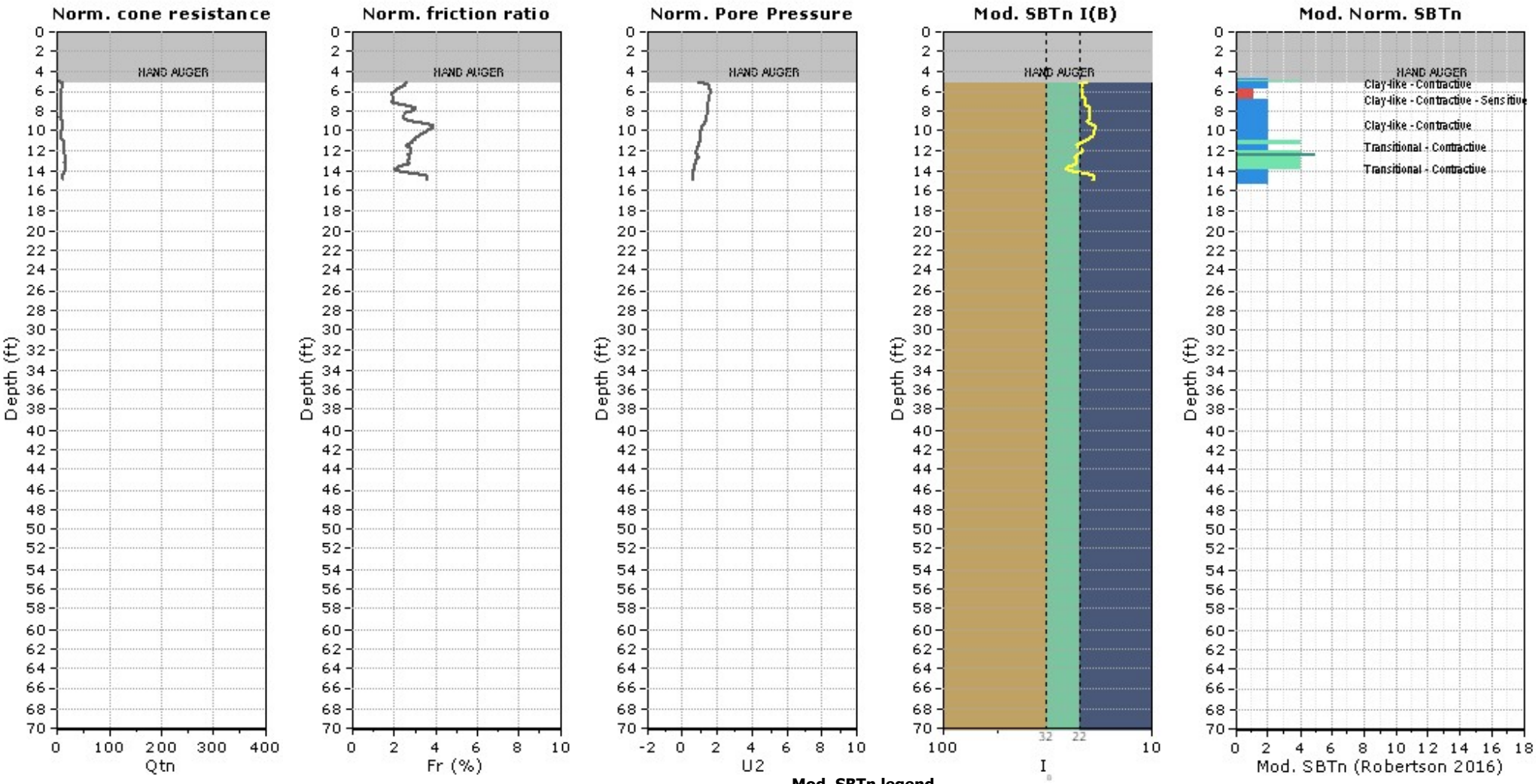
**CPT: CPT-05**
Total depth: 14.93 ft, Date: 4/25/2018
Surface Elevation: 10.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA

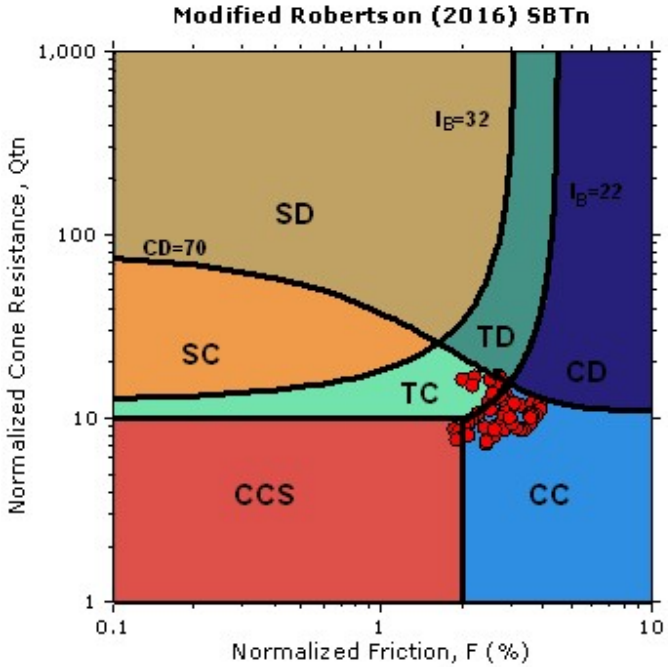


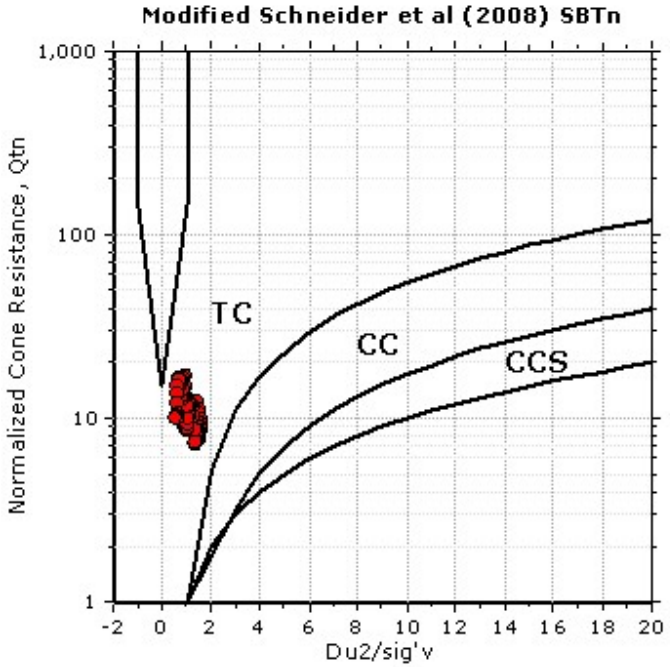
**CPT: CPT-05**
Total depth: 14.93 ft, Date: 4/25/2018
Surface Elevation: 10.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

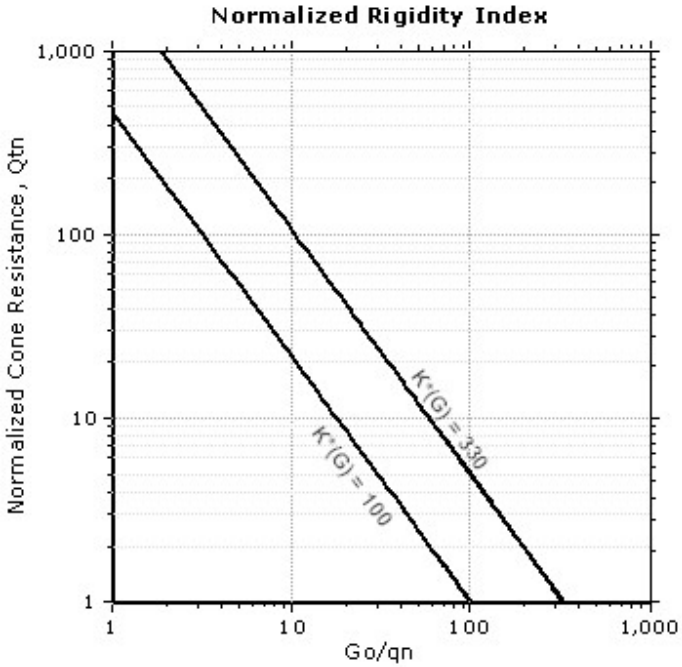
**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA



## Updated SBTn plots

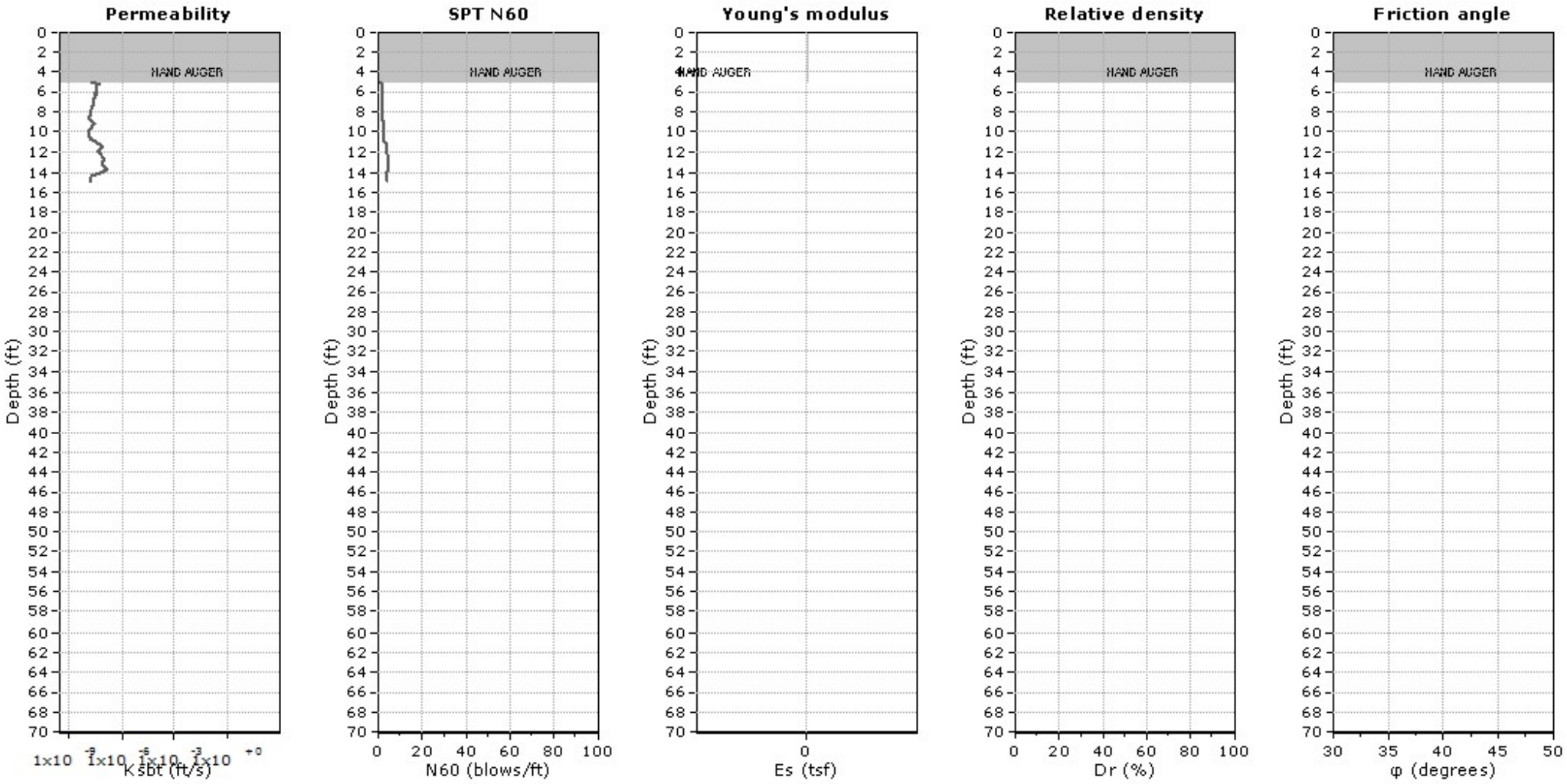


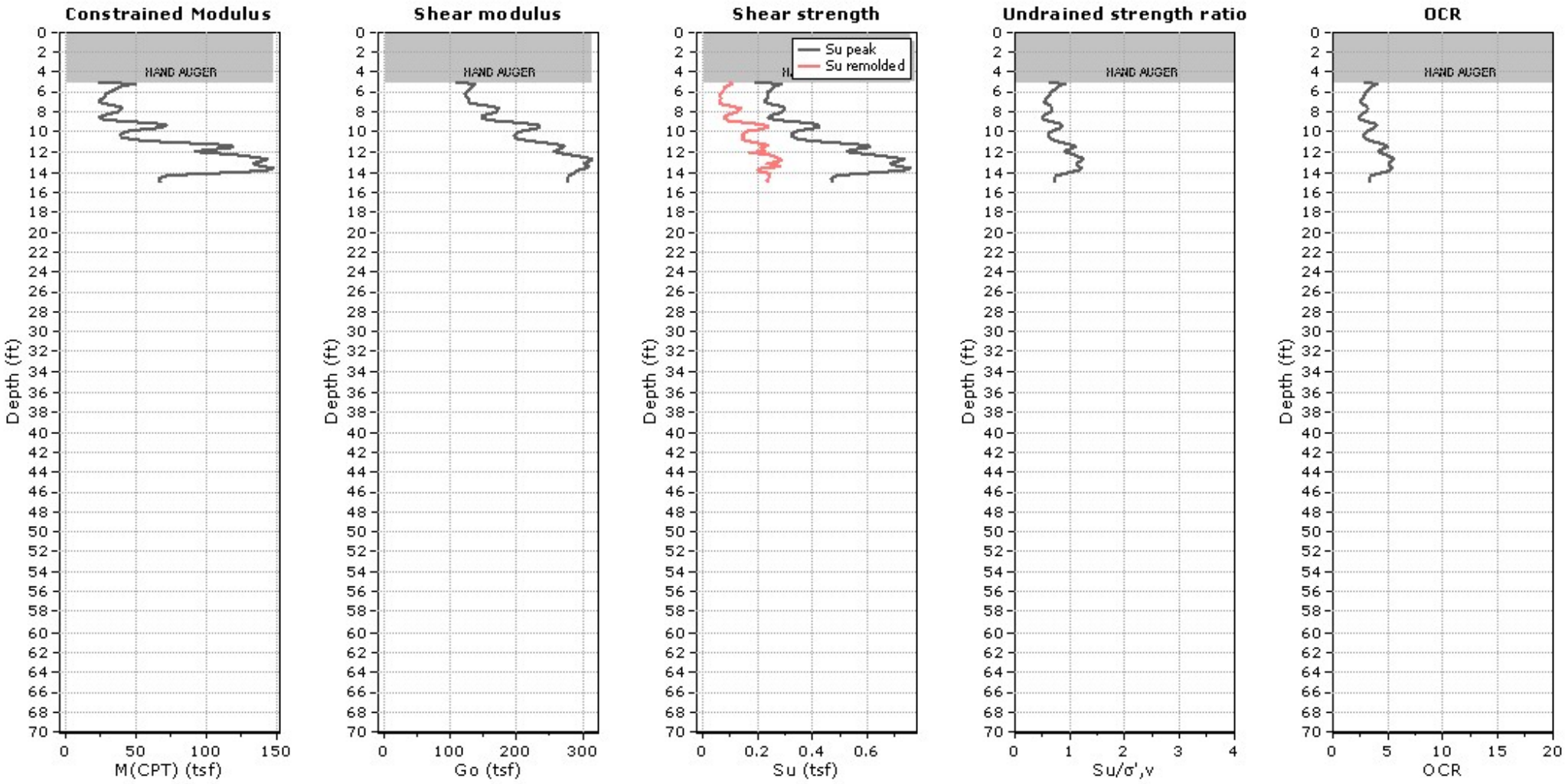

CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)



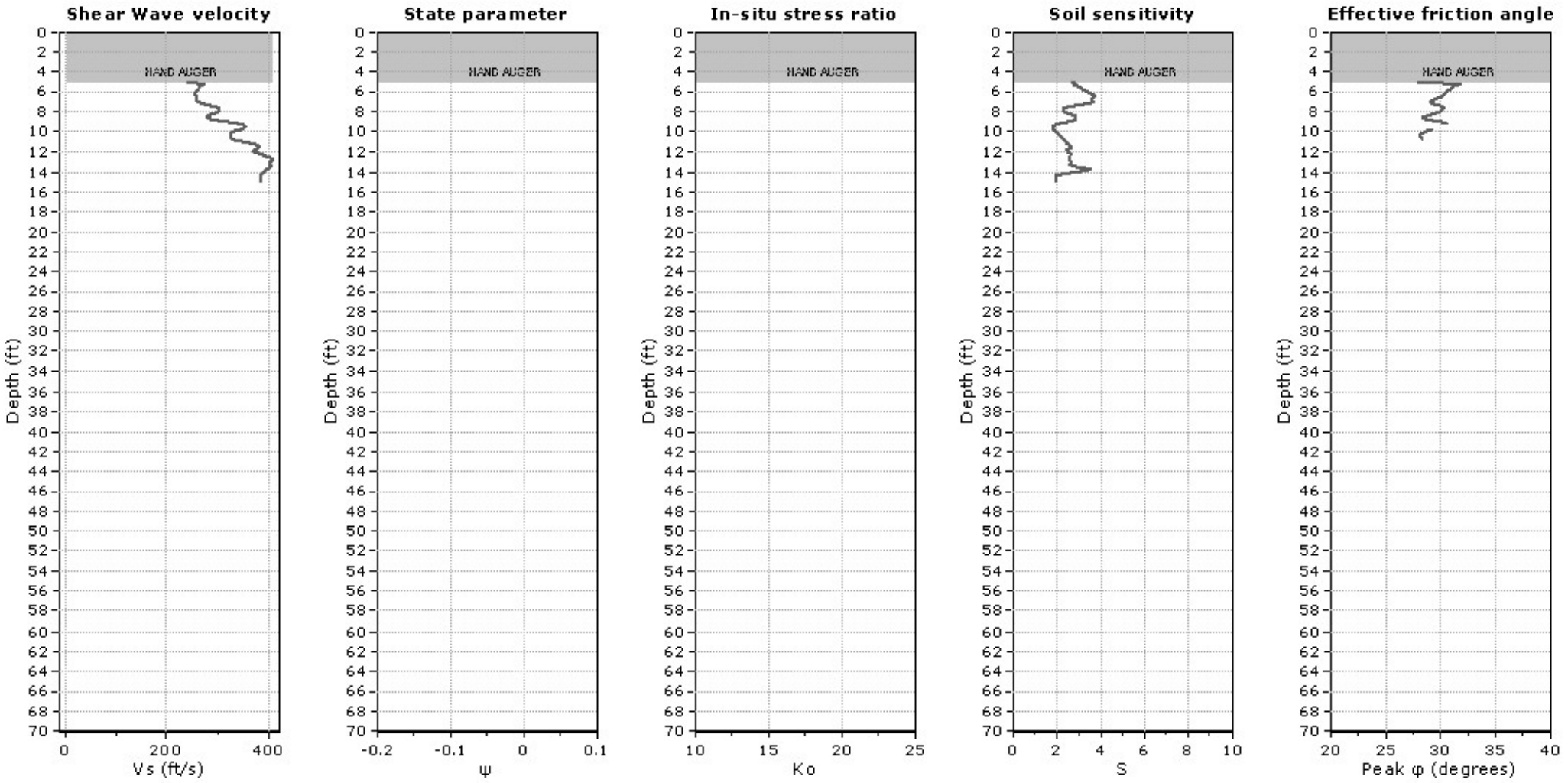

**Calculation parameters**

Permeability: Based on $SBT_n$
SPT $N_{60}$: Based on $I_c$ and $q_t$
Young's modulus: Based on variable alpha using $I_c$ (Robertson, 2009)
Relative density constant, $C_{Dr}$: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data




**Calculation parameters**

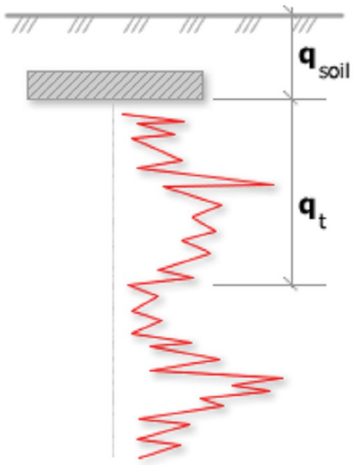
Constrained modulus: Based on variable alpha using $I_c$ and $Q_{tn}$ (Robertson, 2009)
Go: Based on variable alpha using $I_c$ (Robertson, 2009)
Undrained shear strength cone factor for clays, $N_{kt}$: 14
OCR factor for clays, $N_{kt}$: 0.33
User defined estimation data
Flat Dilatometer Test data




**Calculation parameters**

Soil Sensitivity factor, $N_S$: 7.00

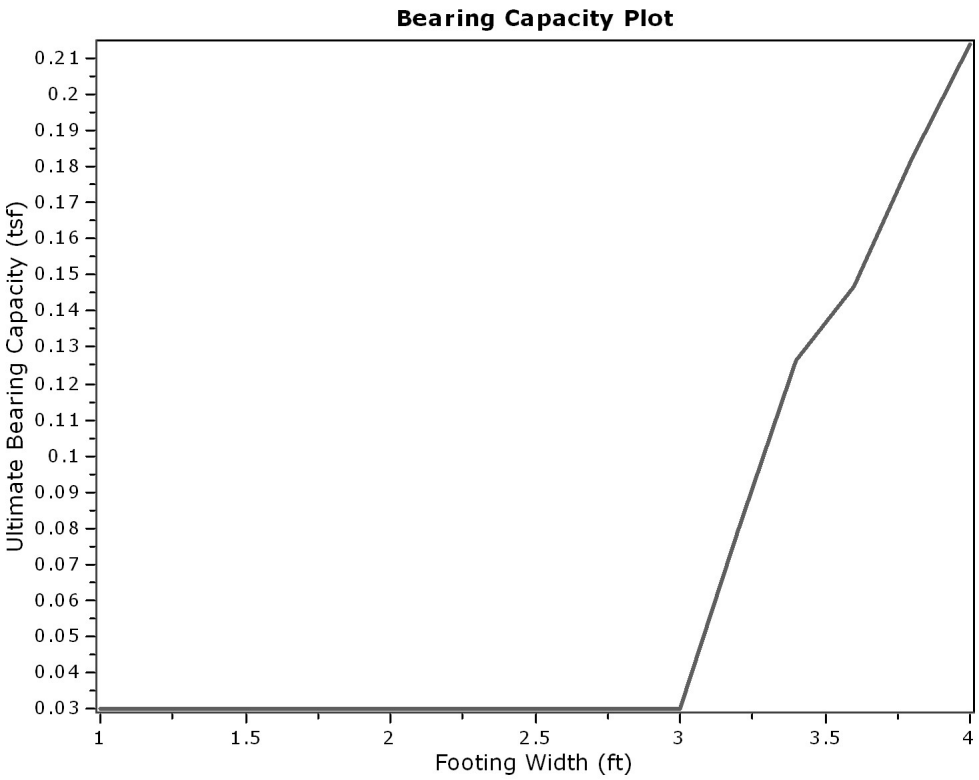
User defined estimation data




Bearing Capacity calculation is perfromed based on the formula:

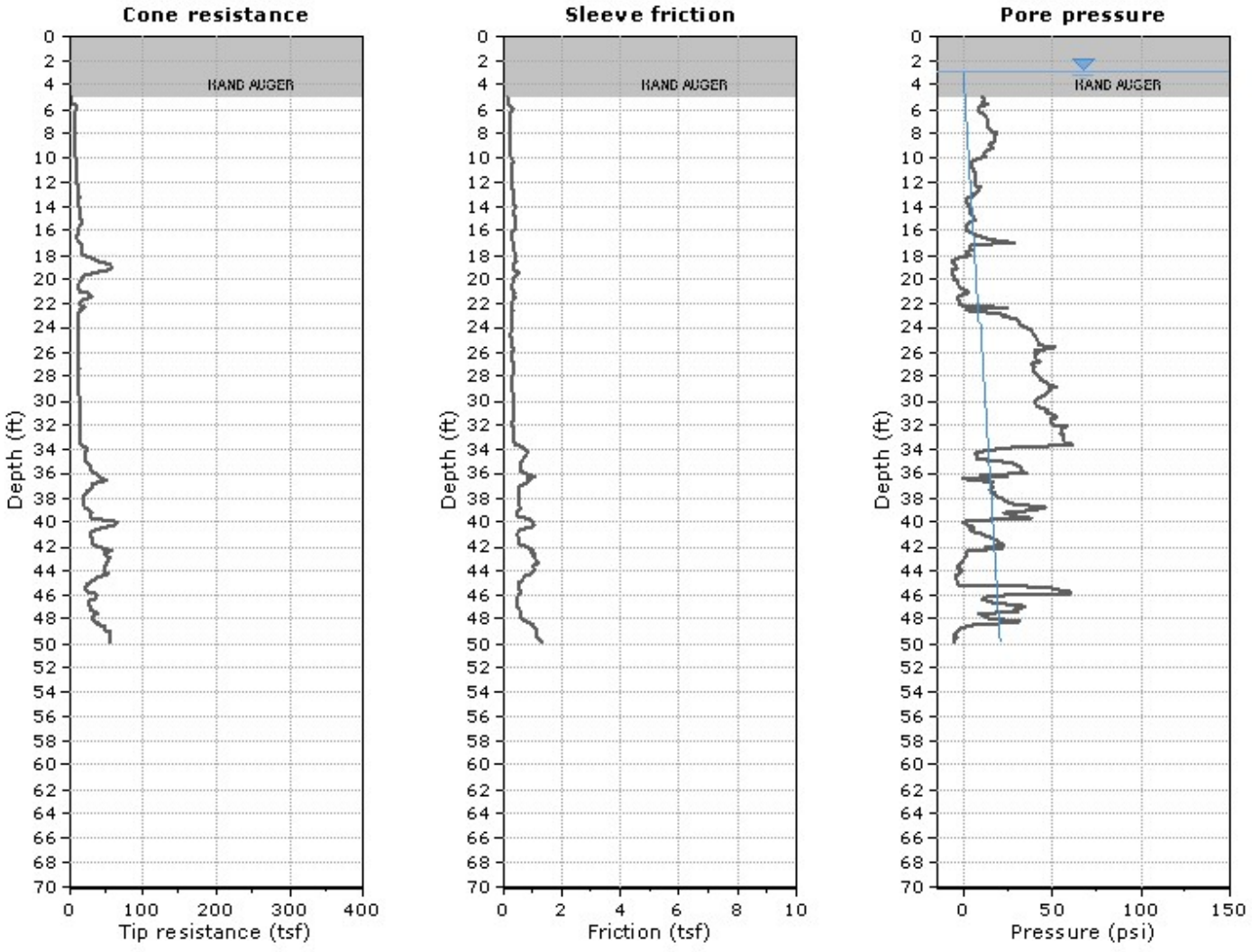
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
$R_k$: Bearing capacity factor
$q_t$: Average corrected cone resistance over calculation depth
$q_{soil}$: Pressure applied by soil above footing

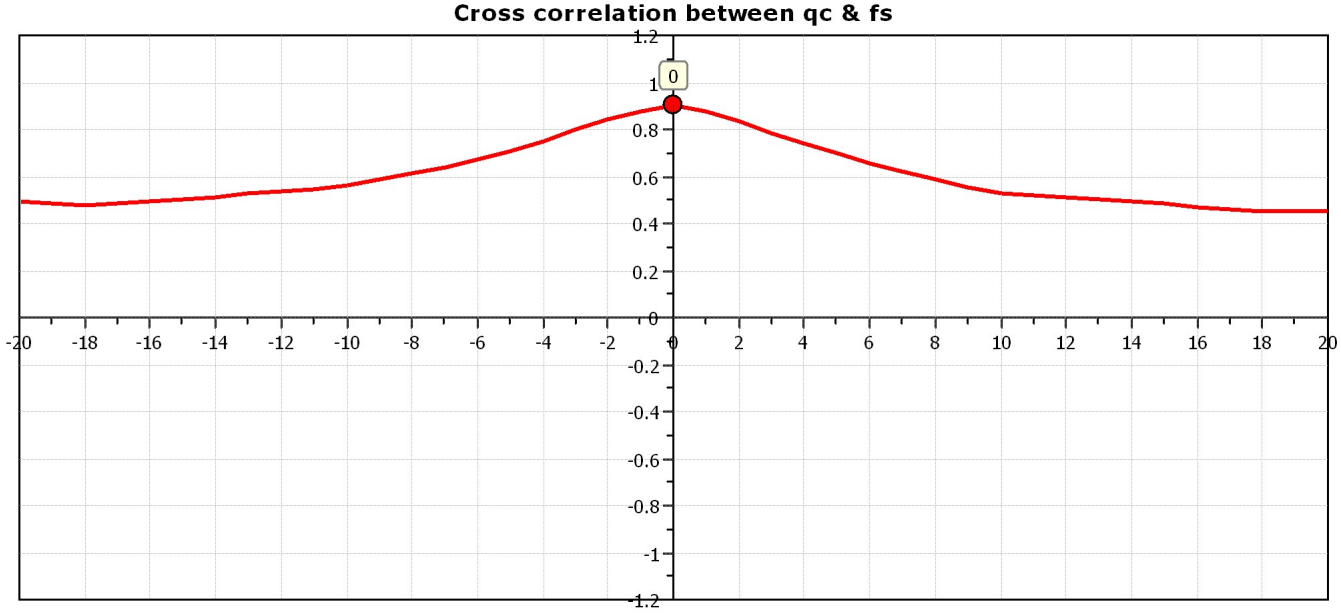



**:: Tabular results ::**

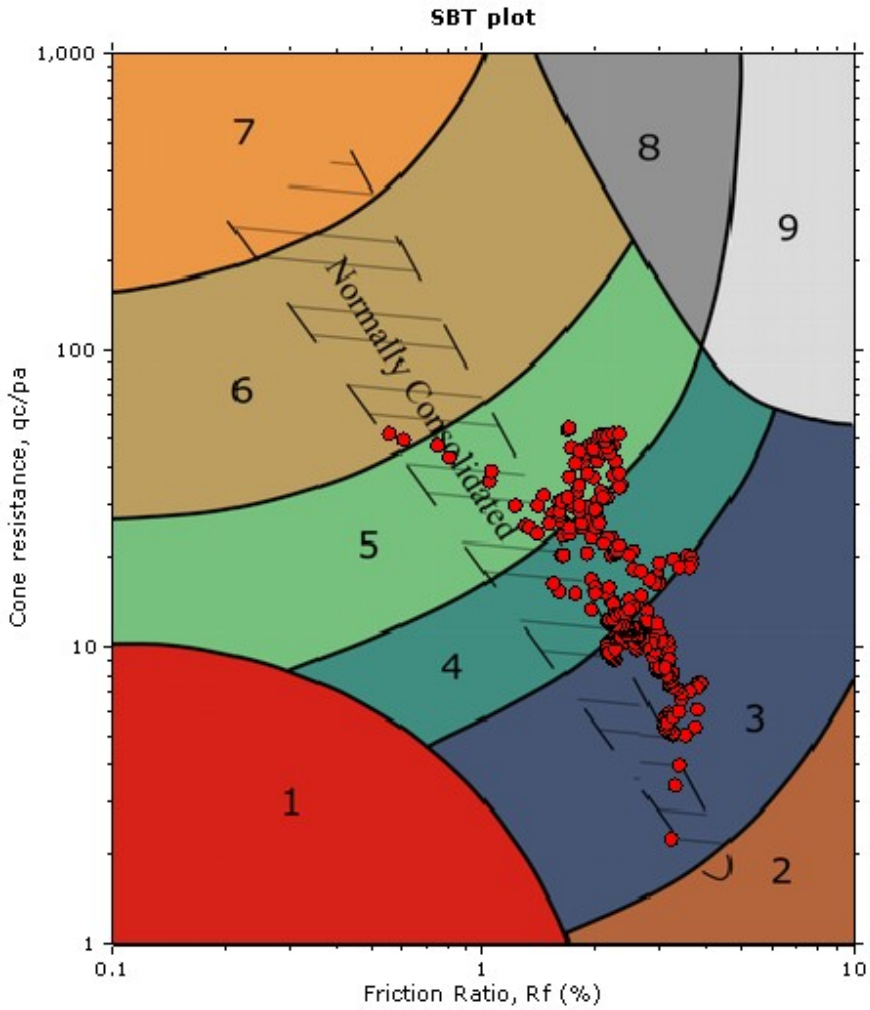
| No | B (ft) | Start Depth (ft) | End Depth (ft) | Ave. $q_t$ (tsf) | $R_k$ | Soil Press. (tsf) | Ult. bearing cap. (tsf) |
|---|---|---|---|---|---|---|---|
| 1 | 1.00 | 0.50 | 2.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 2 | 1.20 | 0.50 | 2.30 | 0.00 | 0.20 | 0.03 | 0.03 |
| 3 | 1.40 | 0.50 | 2.60 | 0.00 | 0.20 | 0.03 | 0.03 |
| 4 | 1.60 | 0.50 | 2.90 | 0.00 | 0.20 | 0.03 | 0.03 |
| 5 | 1.80 | 0.50 | 3.20 | 0.00 | 0.20 | 0.03 | 0.03 |
| 6 | 2.00 | 0.50 | 3.50 | 0.00 | 0.20 | 0.03 | 0.03 |
| 7 | 2.20 | 0.50 | 3.80 | 0.00 | 0.20 | 0.03 | 0.03 |
| 8 | 2.40 | 0.50 | 4.10 | 0.00 | 0.20 | 0.03 | 0.03 |
| 9 | 2.60 | 0.50 | 4.40 | 0.00 | 0.20 | 0.03 | 0.03 |
| 10 | 2.80 | 0.50 | 4.70 | 0.00 | 0.20 | 0.03 | 0.03 |
| 11 | 3.00 | 0.50 | 5.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 12 | 3.20 | 0.50 | 5.30 | 0.25 | 0.20 | 0.03 | 0.08 |
| 13 | 3.40 | 0.50 | 5.60 | 0.48 | 0.20 | 0.03 | 0.13 |
| 14 | 3.60 | 0.50 | 5.90 | 0.58 | 0.20 | 0.03 | 0.15 |
| 15 | 3.80 | 0.50 | 6.20 | 0.76 | 0.20 | 0.03 | 0.18 |
| 16 | 4.00 | 0.50 | 6.50 | 0.92 | 0.20 | 0.03 | 0.21 |

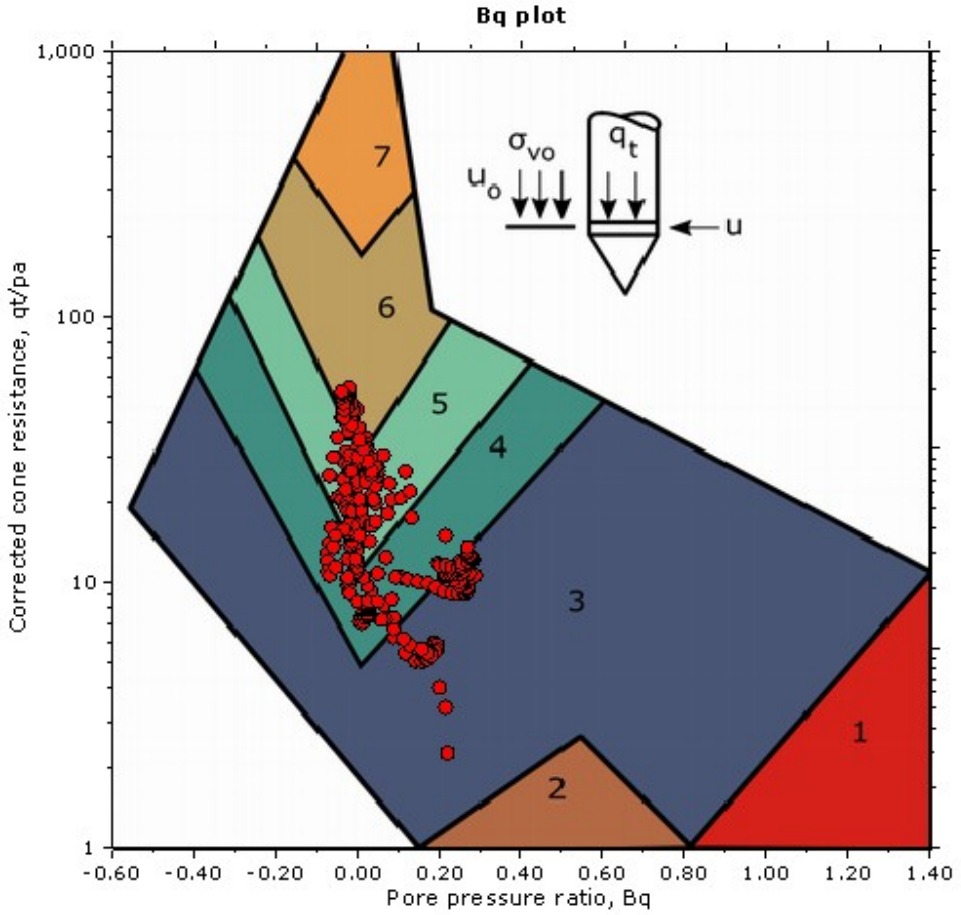



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



## SBT - Bq plots

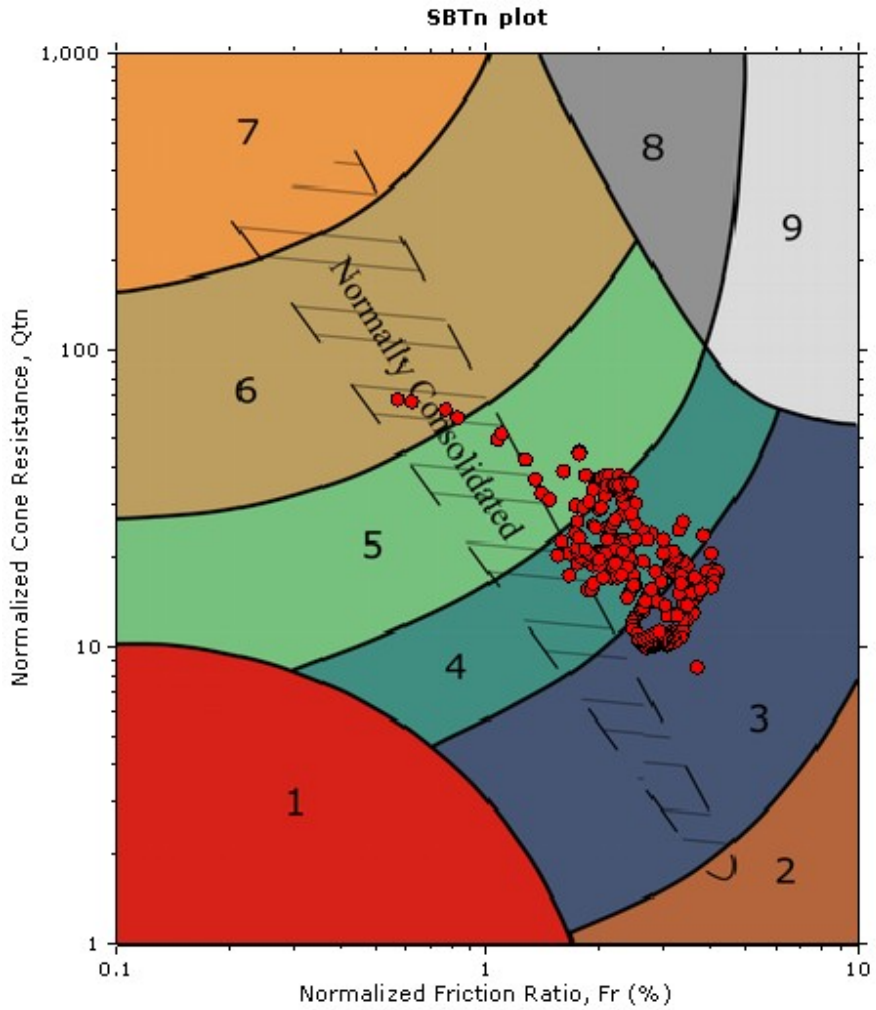


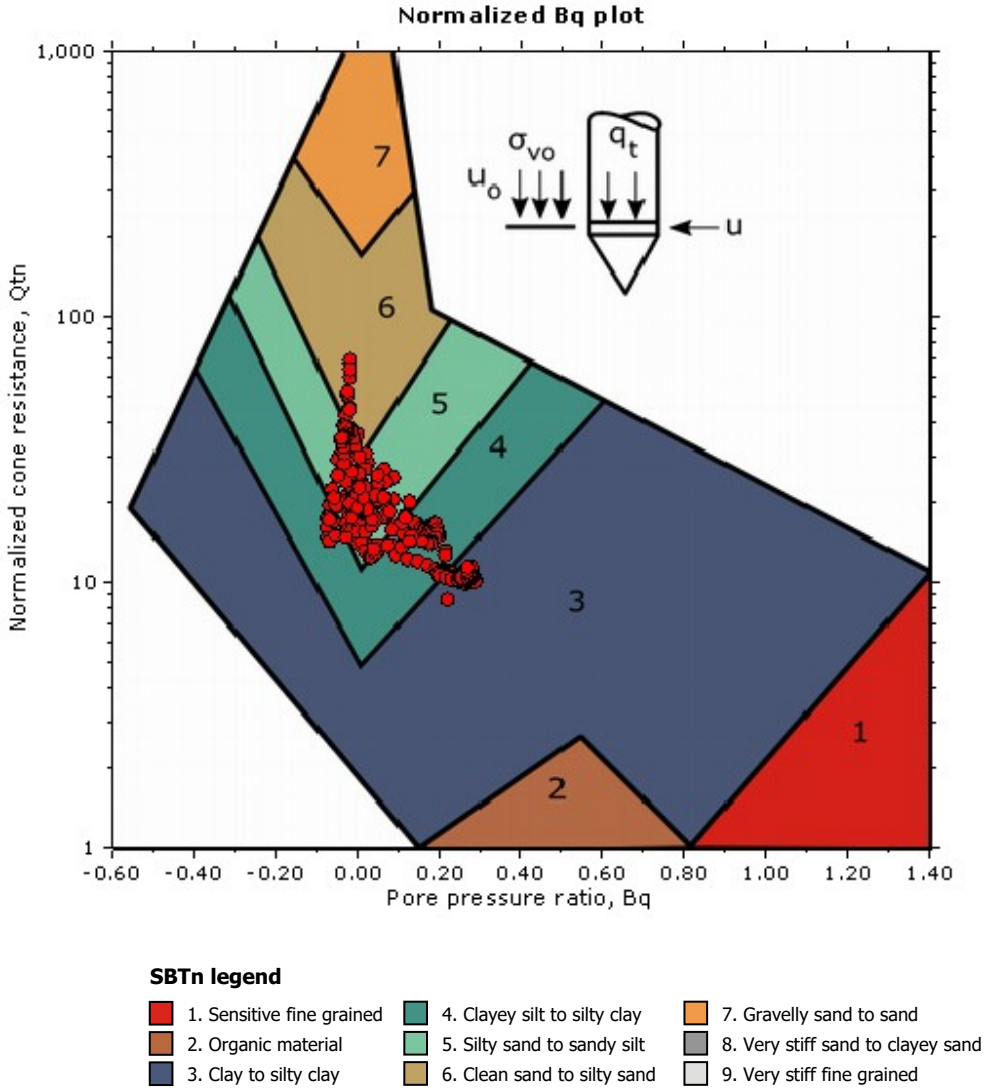




**SBT legend**

| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## SBT - Bq plots (normalized)

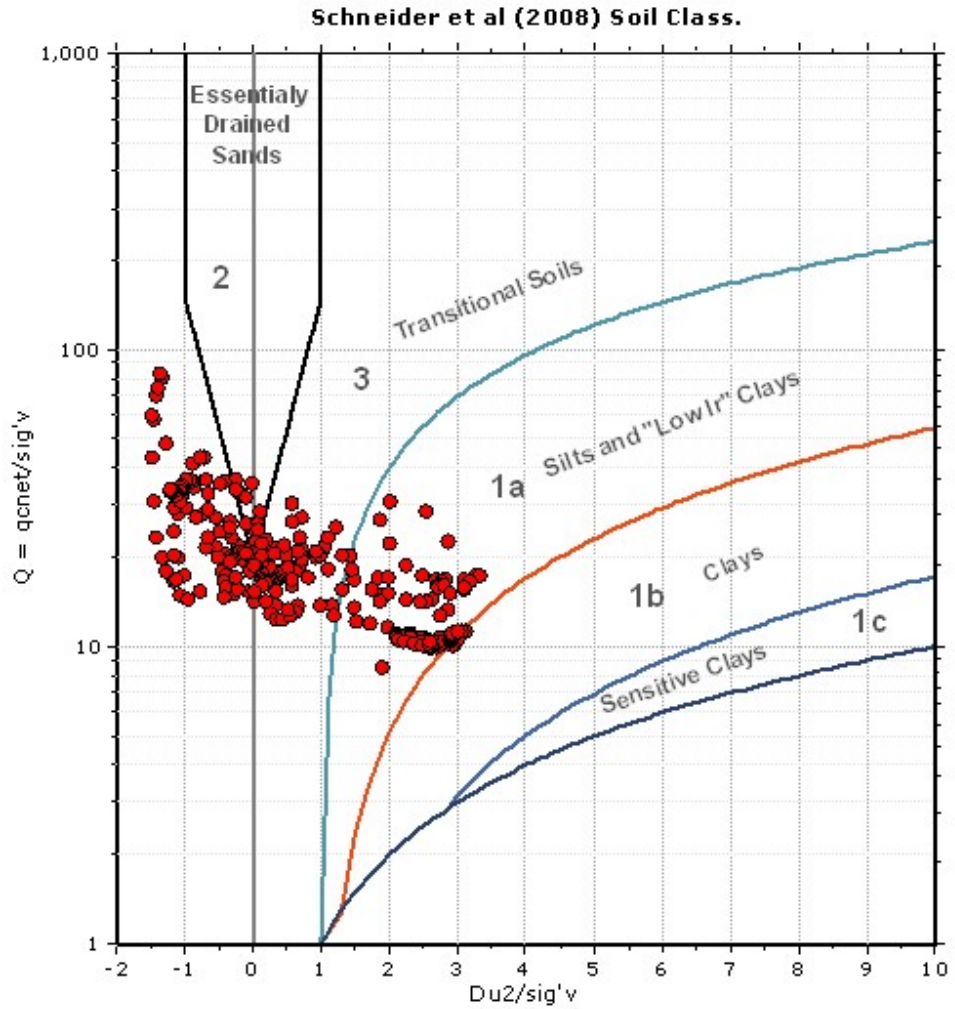


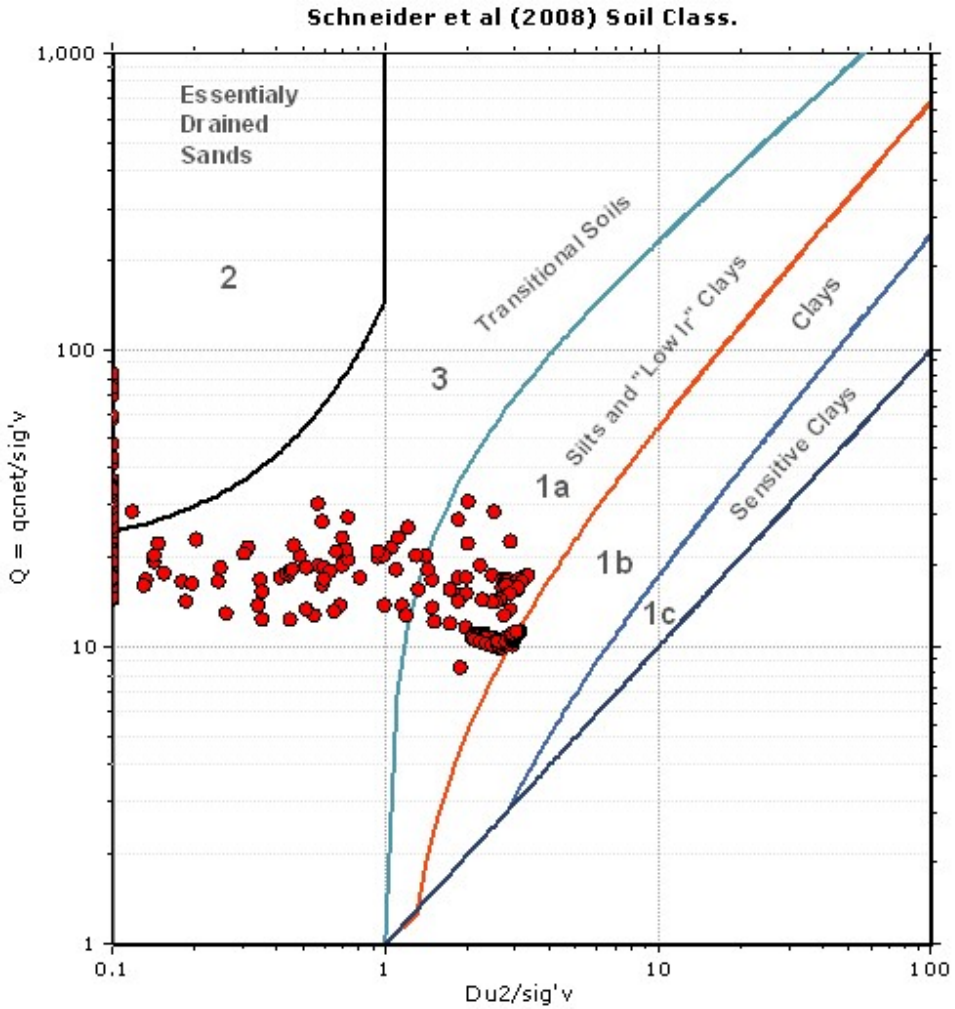



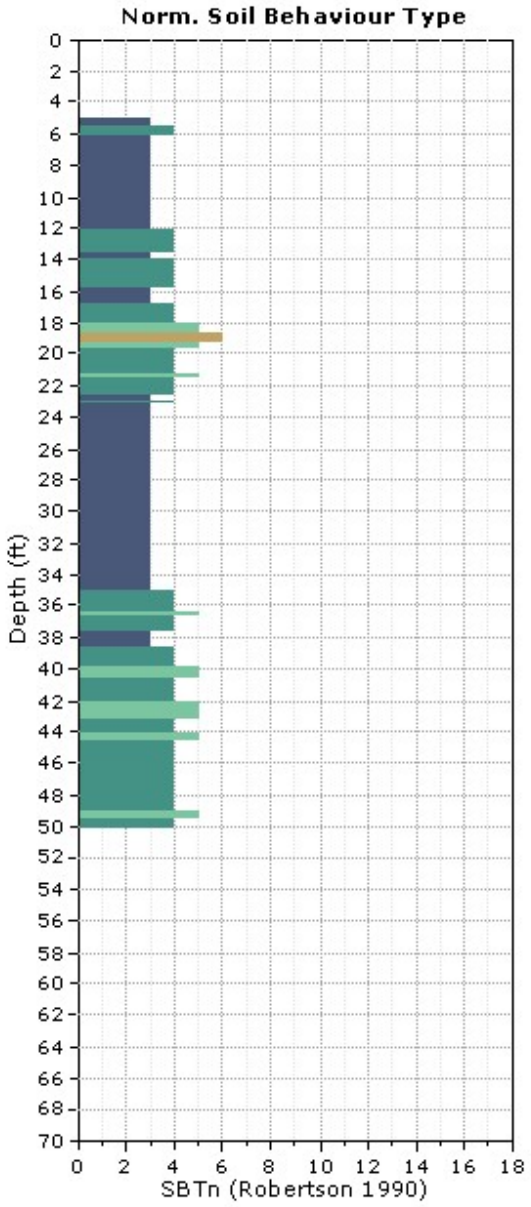

**SBTn legend**

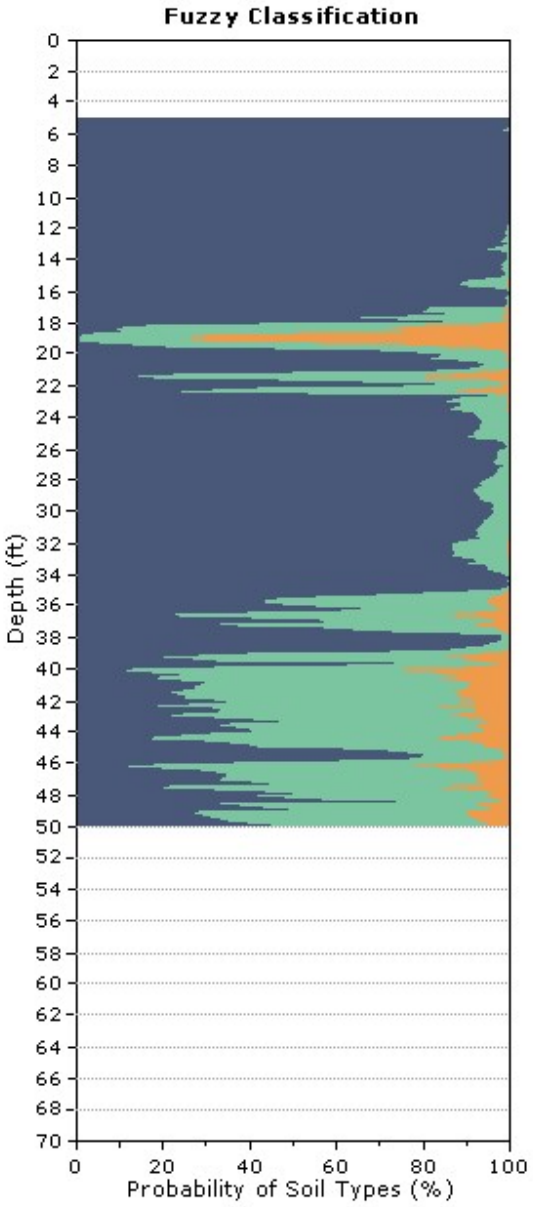
| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## Bq plots (Schneider)



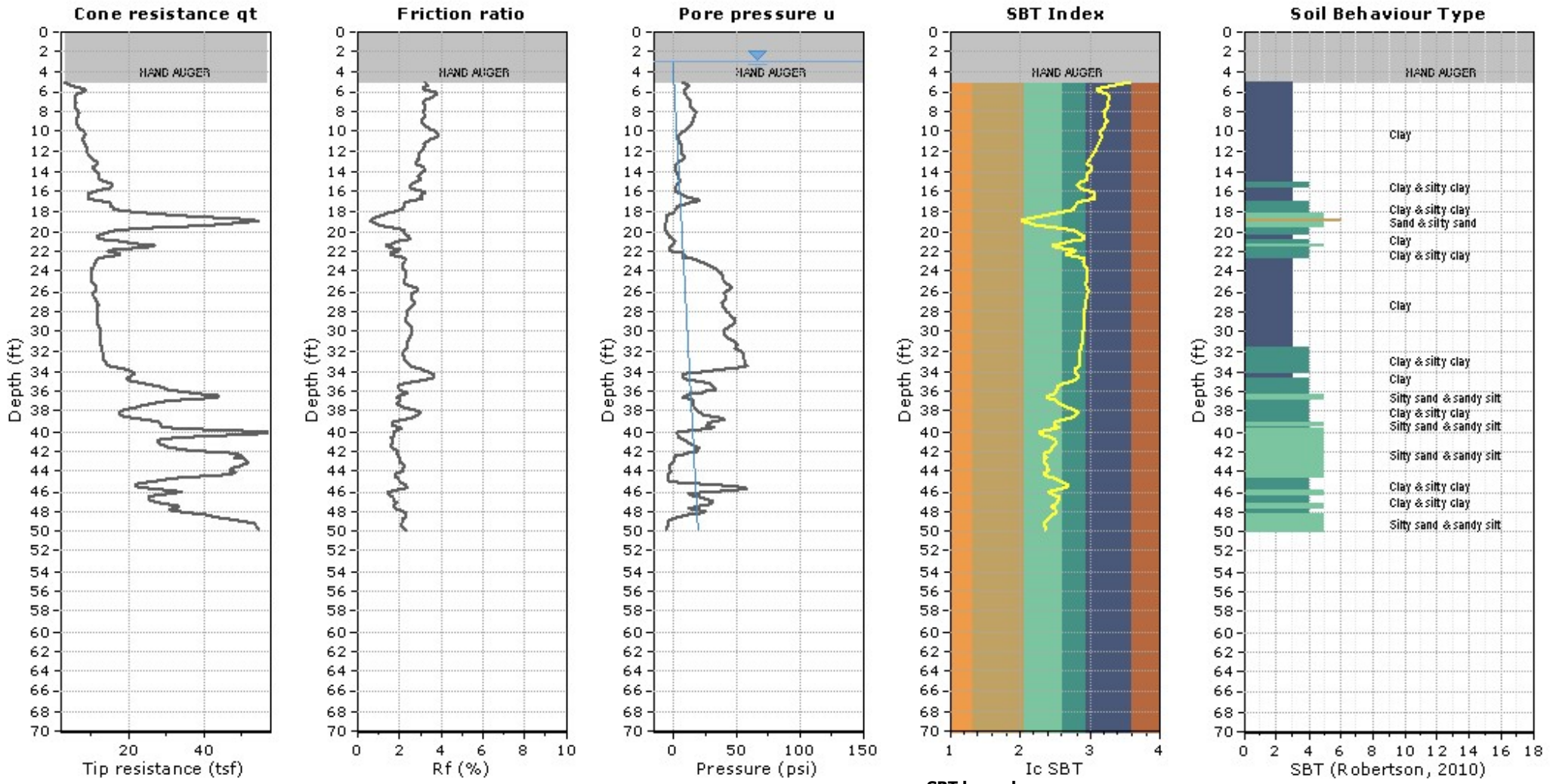



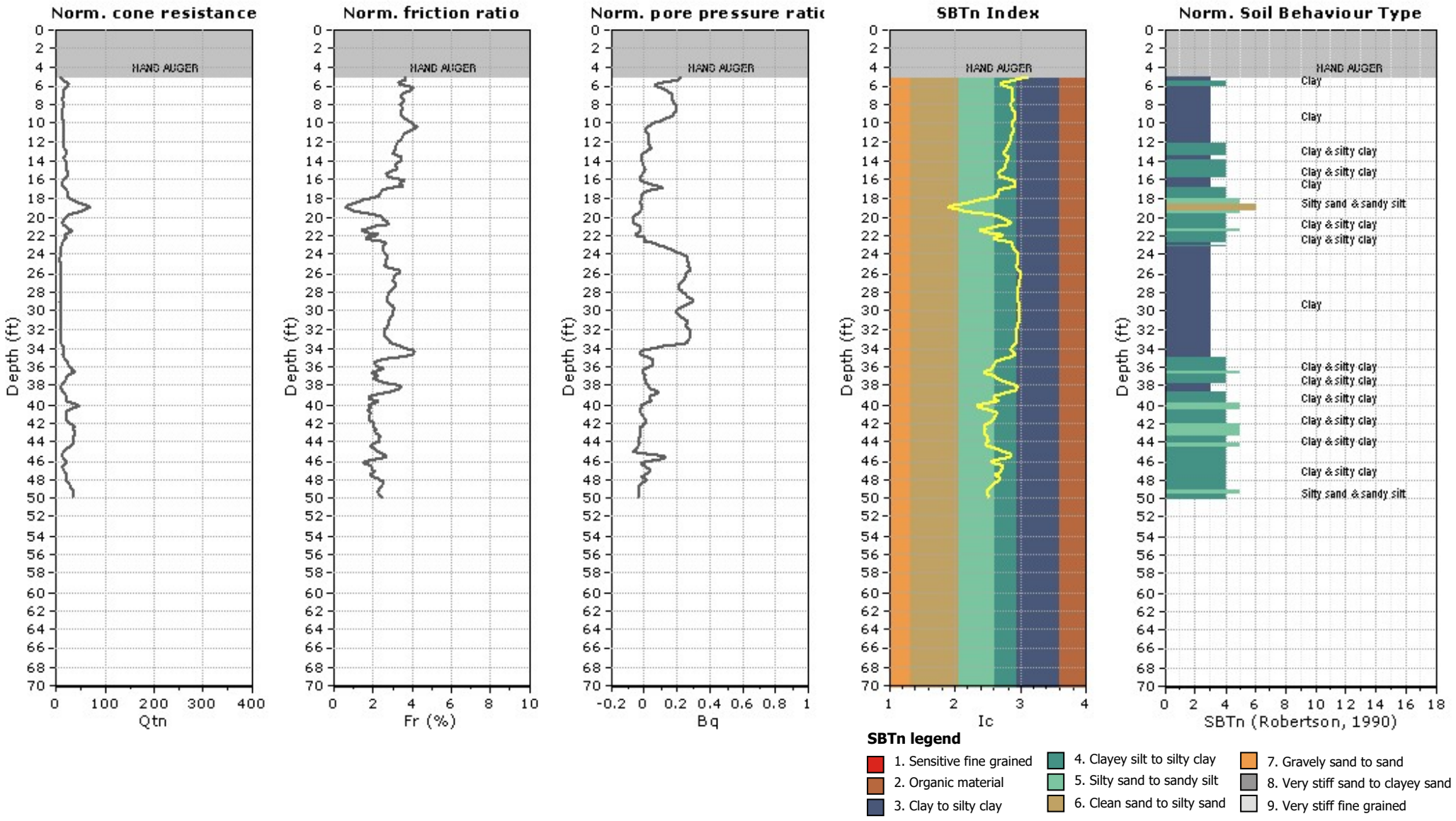

Norm. Soil Behaviour Type
Depth (ft)
SBTn (Robertson 1990)


Fuzzy Classification
Depth (ft)
Probability of Soil Types (%)

**CPT: CPT-06**
Total depth: 49.87 ft, Date: 4/26/2018
Surface Elevation: 10.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

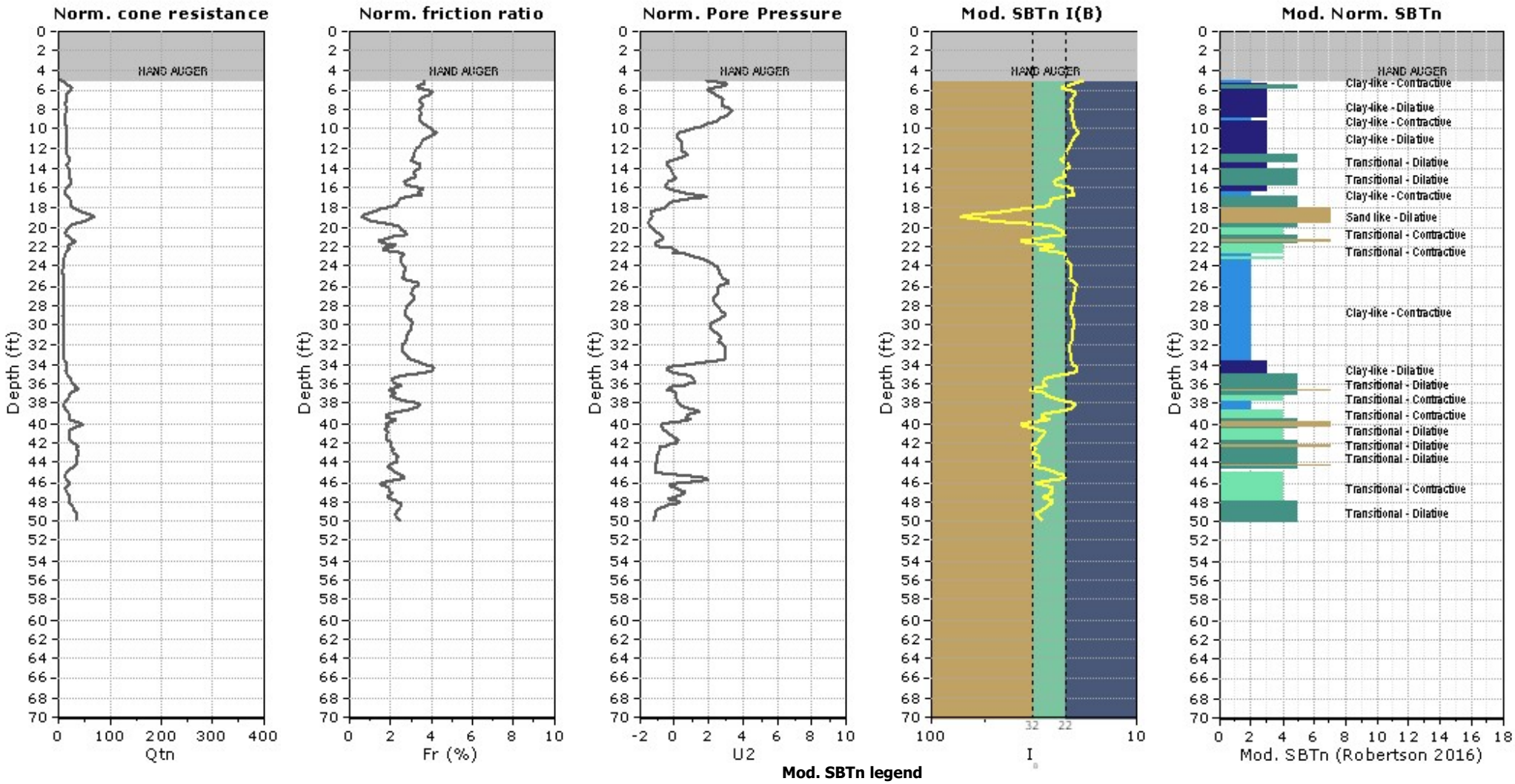
**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA



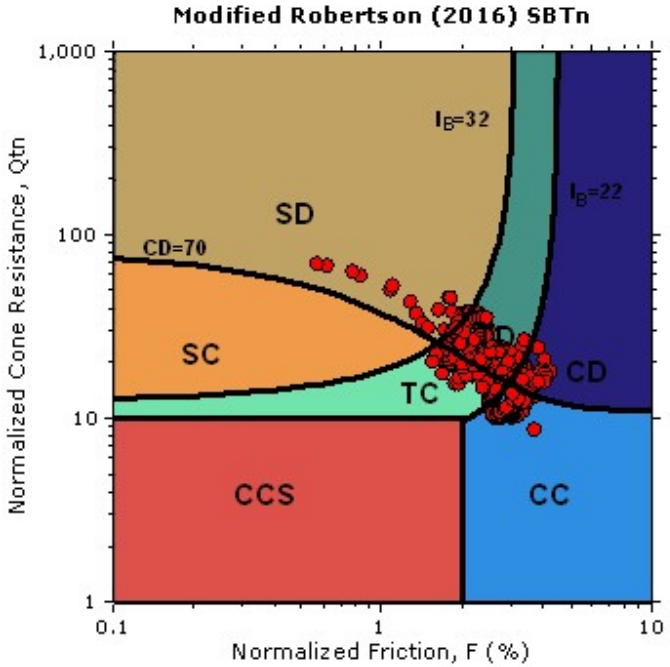

Norm. cone resistance
Norm. friction ratio
Norm. pore pressure ratio
SBTn Index
Norm. Soil Behaviour Type
HAND AUGER
Depth (ft)
Qtn
Fr (%)
Bq
Ic
SBTn (Robertson, 1990)
Clay
Clay & silty clay
Silty sand & sandy silt
SBTn legend
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

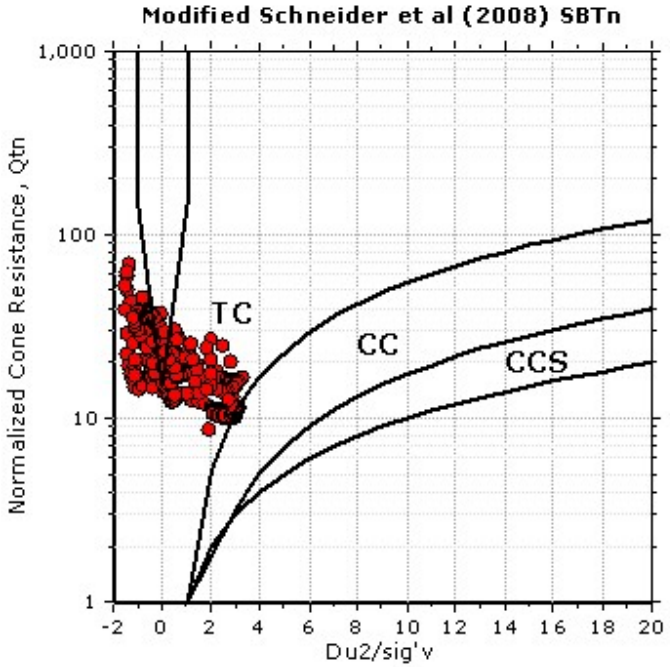
**CPT: CPT-06**
Total depth: 49.87 ft, Date: 4/26/2018
Surface Elevation: 10.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

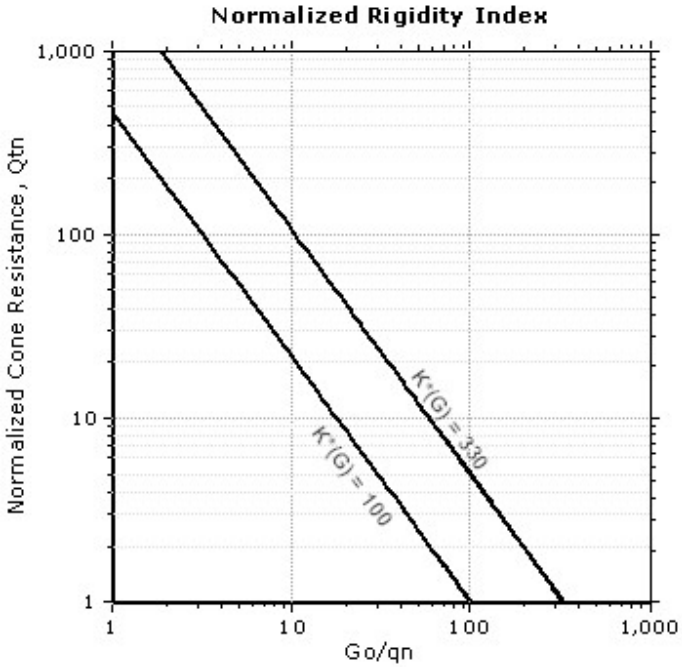
**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA



## Updated SBTn plots

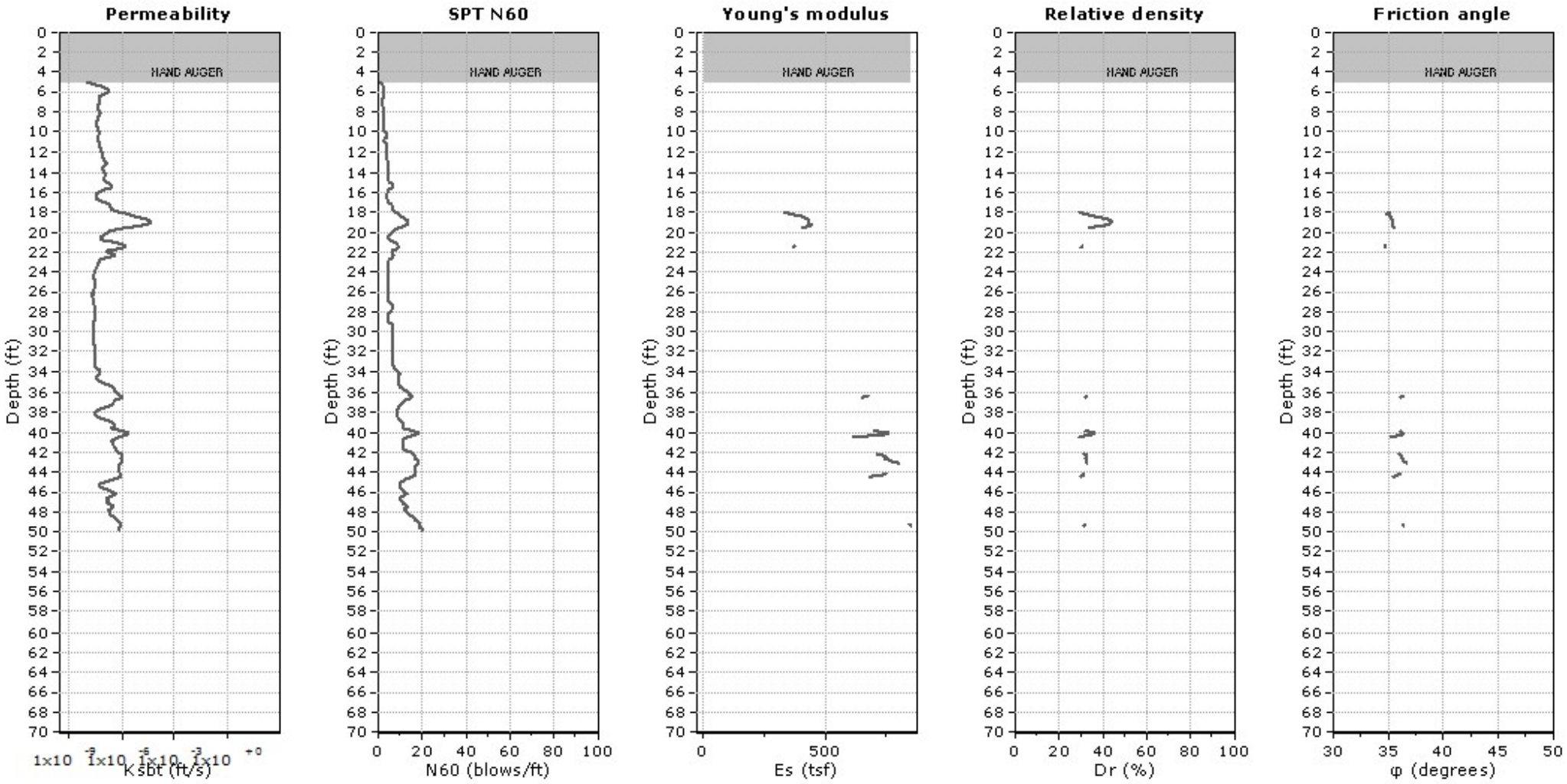


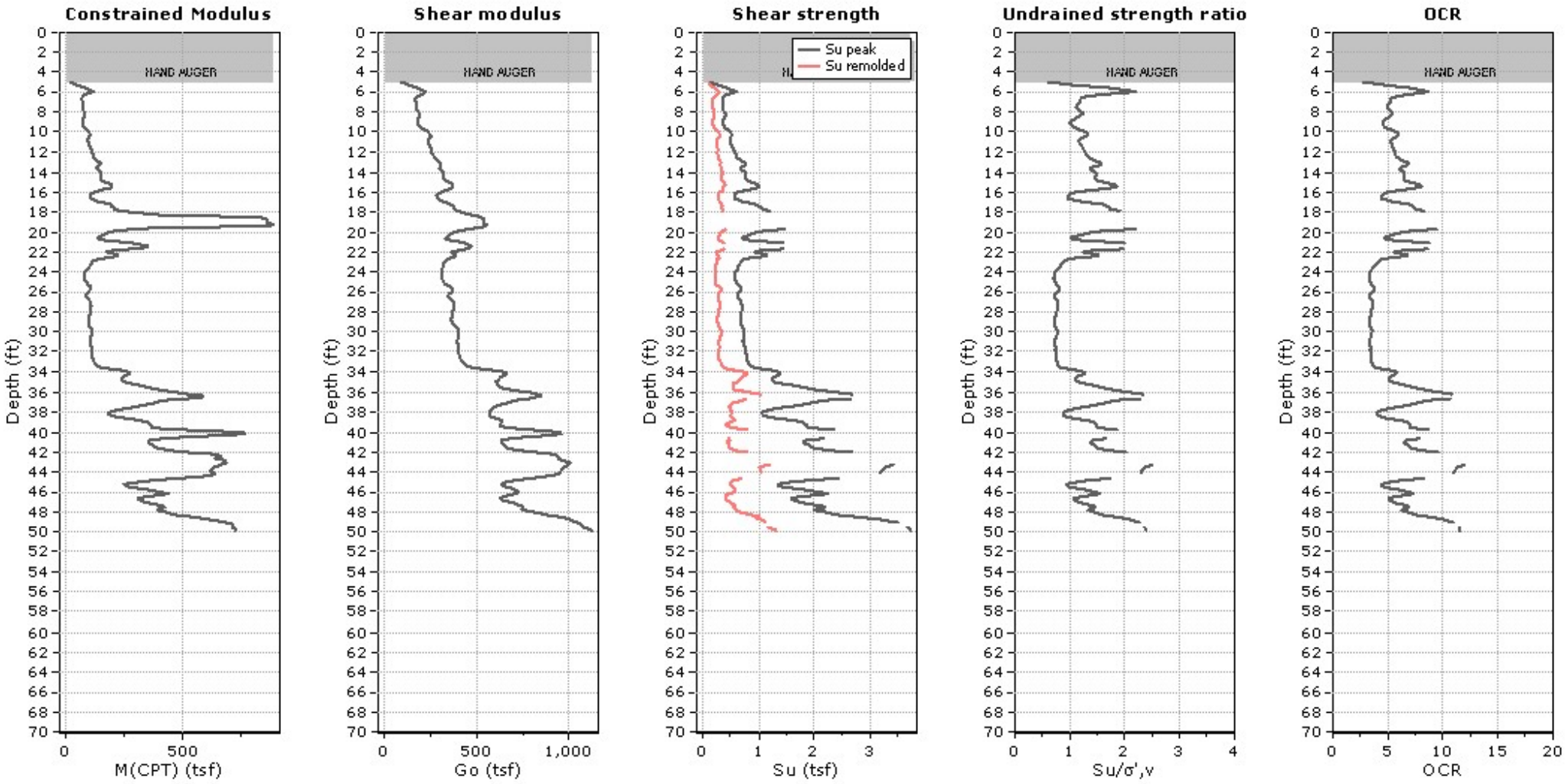

CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)



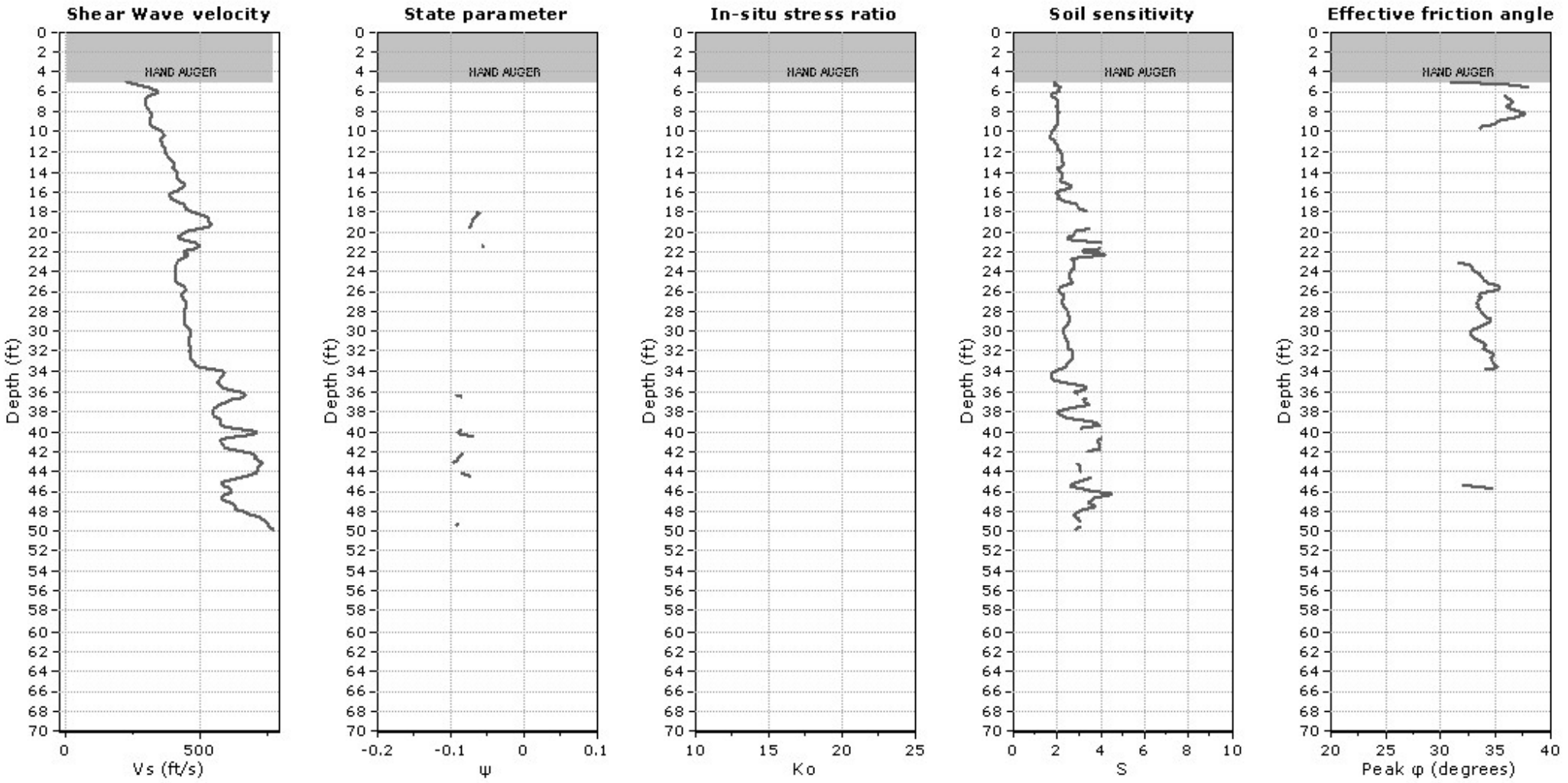

**Calculation parameters**

Permeability: Based on $SBT_n$
SPT $N_{60}$: Based on $I_c$ and $q_t$
Young's modulus: Based on variable alpha using $I_c$ (Robertson, 2009)
Relative density constant, $C_{Dr}$: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data




**Calculation parameters**

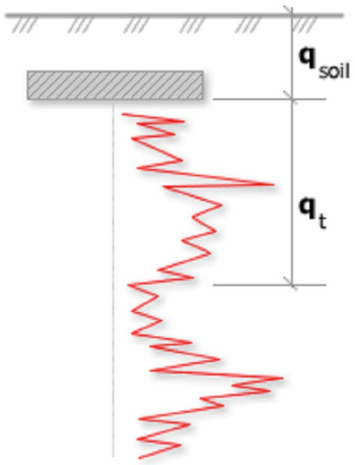
Constrained modulus: Based on variable alpha using $I_c$ and $Q_{tn}$ (Robertson, 2009)
Go: Based on variable alpha using $I_c$ (Robertson, 2009)
Undrained shear strength cone factor for clays, $N_{kt}$: 14
OCR factor for clays, $N_{kt}$: 0.33
User defined estimation data
Flat Dilatometer Test data




**Calculation parameters**

Soil Sensitivity factor, $N_S$: 7.00

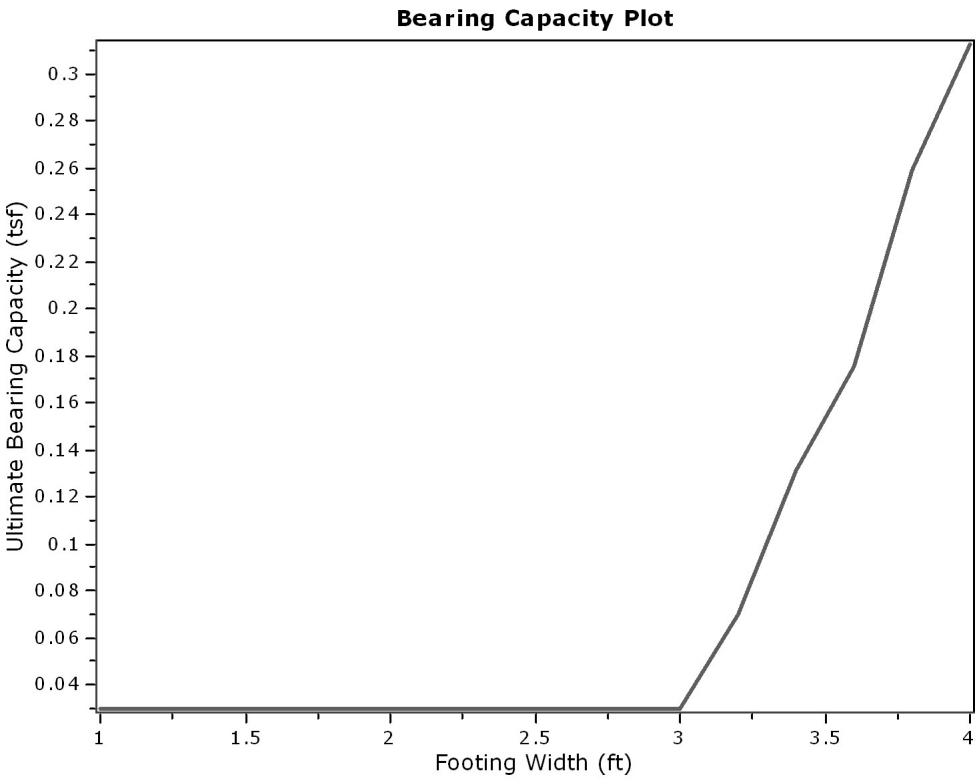
User defined estimation data




Bearing Capacity calculation is perfromed based on the formula:

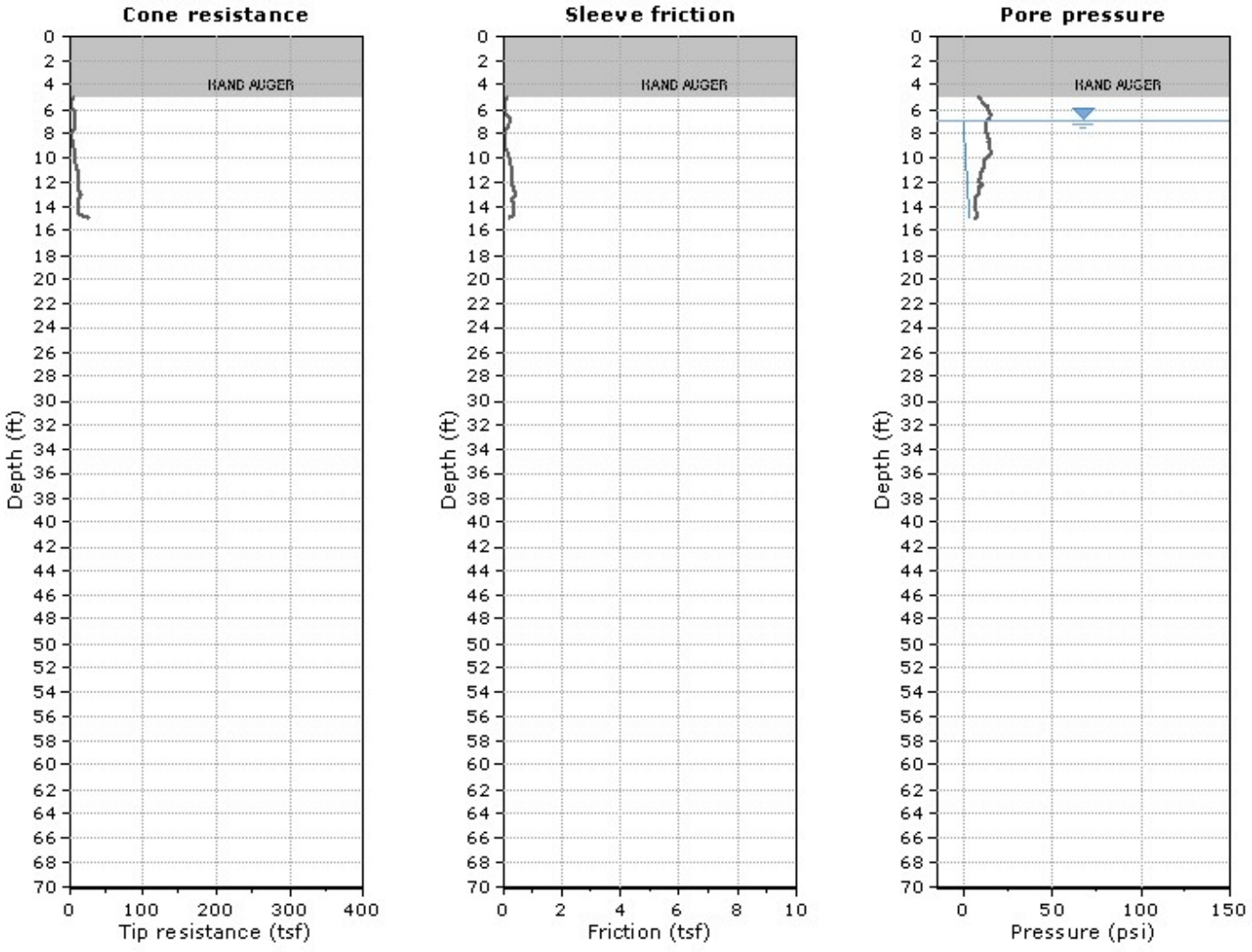
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
$R_k$: Bearing capacity factor
$q_t$: Average corrected cone resistance over calculation depth
$q_{soil}$: Pressure applied by soil above footing

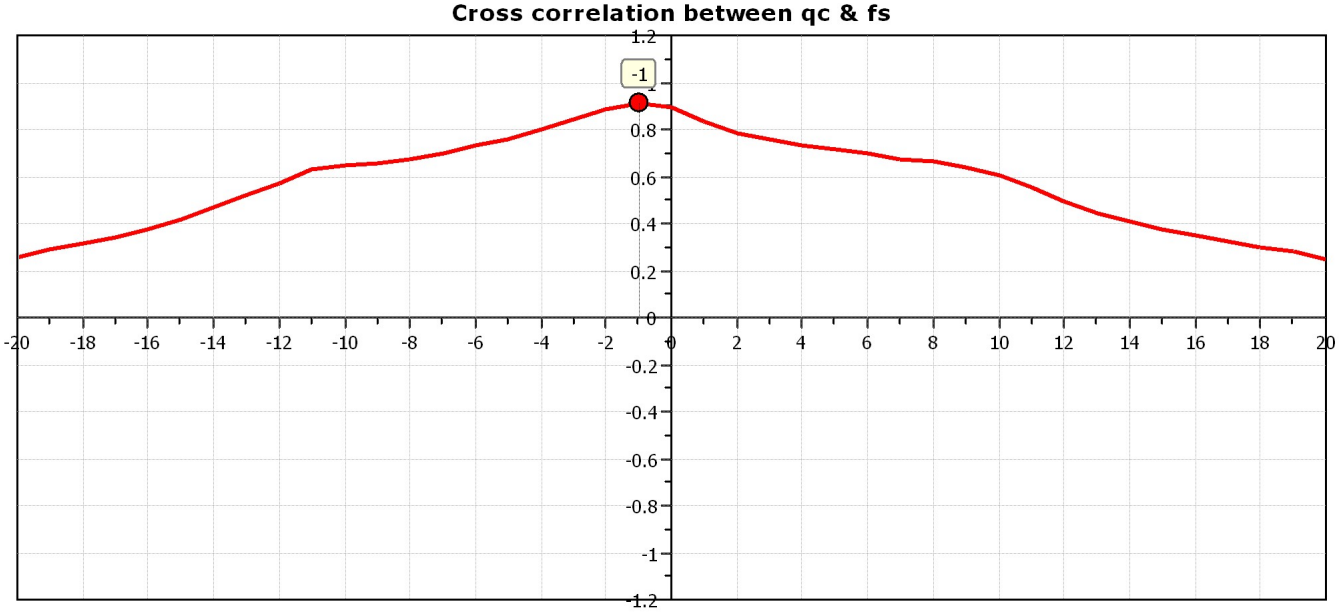



**:: Tabular results ::**

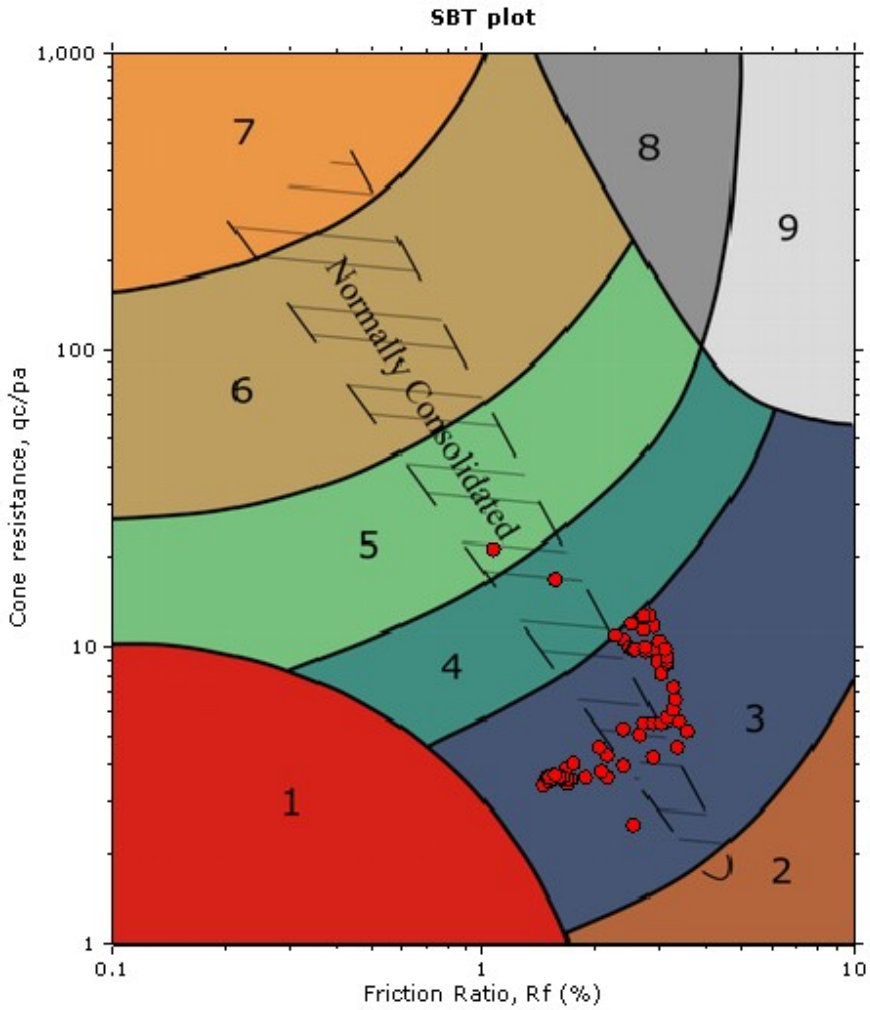
| No | B (ft) | Start Depth (ft) | End Depth (ft) | Ave. $q_t$ (tsf) | $R_k$ | Soil Press. (tsf) | Ult. bearing cap. (tsf) |
|---|---|---|---|---|---|---|---|
| 1 | 1.00 | 0.50 | 2.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 2 | 1.20 | 0.50 | 2.30 | 0.00 | 0.20 | 0.03 | 0.03 |
| 3 | 1.40 | 0.50 | 2.60 | 0.00 | 0.20 | 0.03 | 0.03 |
| 4 | 1.60 | 0.50 | 2.90 | 0.00 | 0.20 | 0.03 | 0.03 |
| 5 | 1.80 | 0.50 | 3.20 | 0.00 | 0.20 | 0.03 | 0.03 |
| 6 | 2.00 | 0.50 | 3.50 | 0.00 | 0.20 | 0.03 | 0.03 |
| 7 | 2.20 | 0.50 | 3.80 | 0.00 | 0.20 | 0.03 | 0.03 |
| 8 | 2.40 | 0.50 | 4.10 | 0.00 | 0.20 | 0.03 | 0.03 |
| 9 | 2.60 | 0.50 | 4.40 | 0.00 | 0.20 | 0.03 | 0.03 |
| 10 | 2.80 | 0.50 | 4.70 | 0.00 | 0.20 | 0.03 | 0.03 |
| 11 | 3.00 | 0.50 | 5.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 12 | 3.20 | 0.50 | 5.30 | 0.20 | 0.20 | 0.03 | 0.07 |
| 13 | 3.40 | 0.50 | 5.60 | 0.51 | 0.20 | 0.03 | 0.13 |
| 14 | 3.60 | 0.50 | 5.90 | 0.73 | 0.20 | 0.03 | 0.18 |
| 15 | 3.80 | 0.50 | 6.20 | 1.15 | 0.20 | 0.03 | 0.26 |
| 16 | 4.00 | 0.50 | 6.50 | 1.41 | 0.20 | 0.03 | 0.31 |

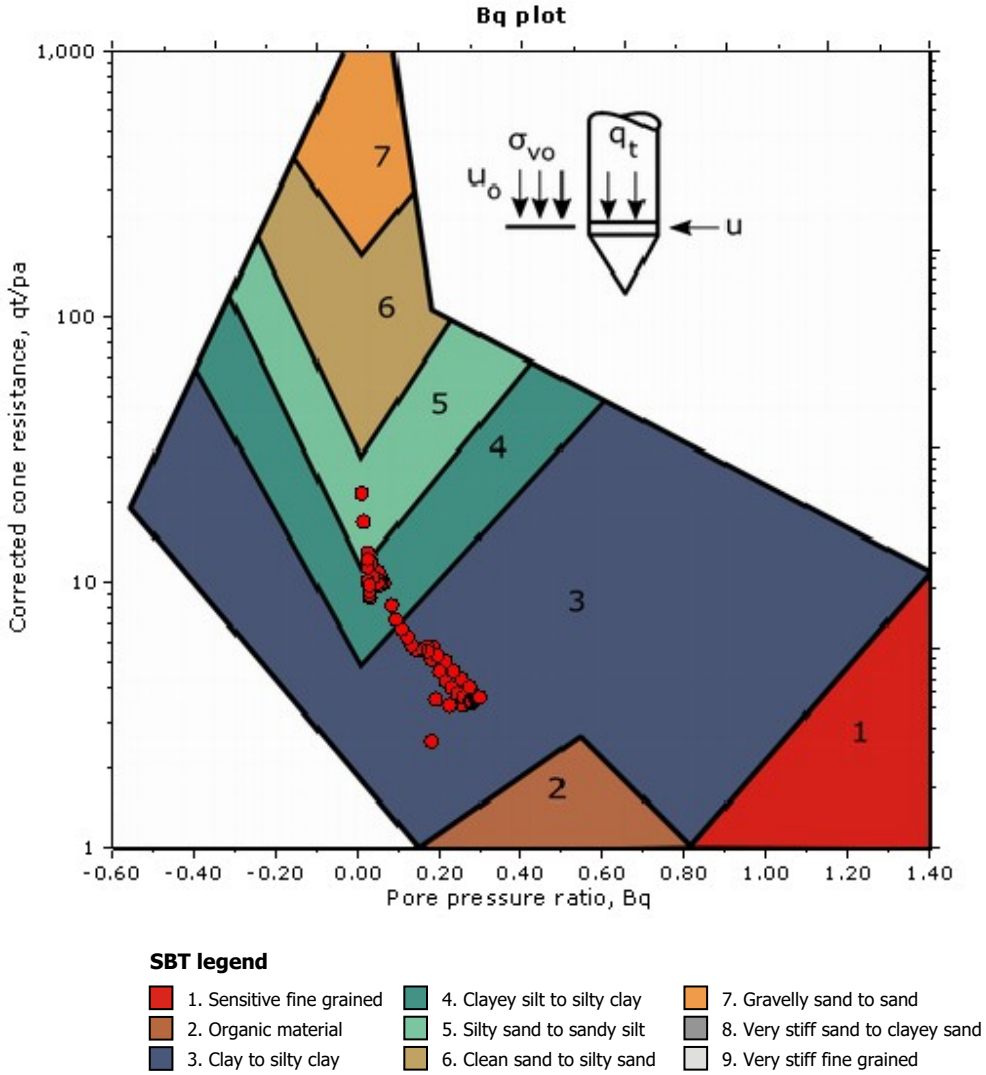



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



## SBT - Bq plots

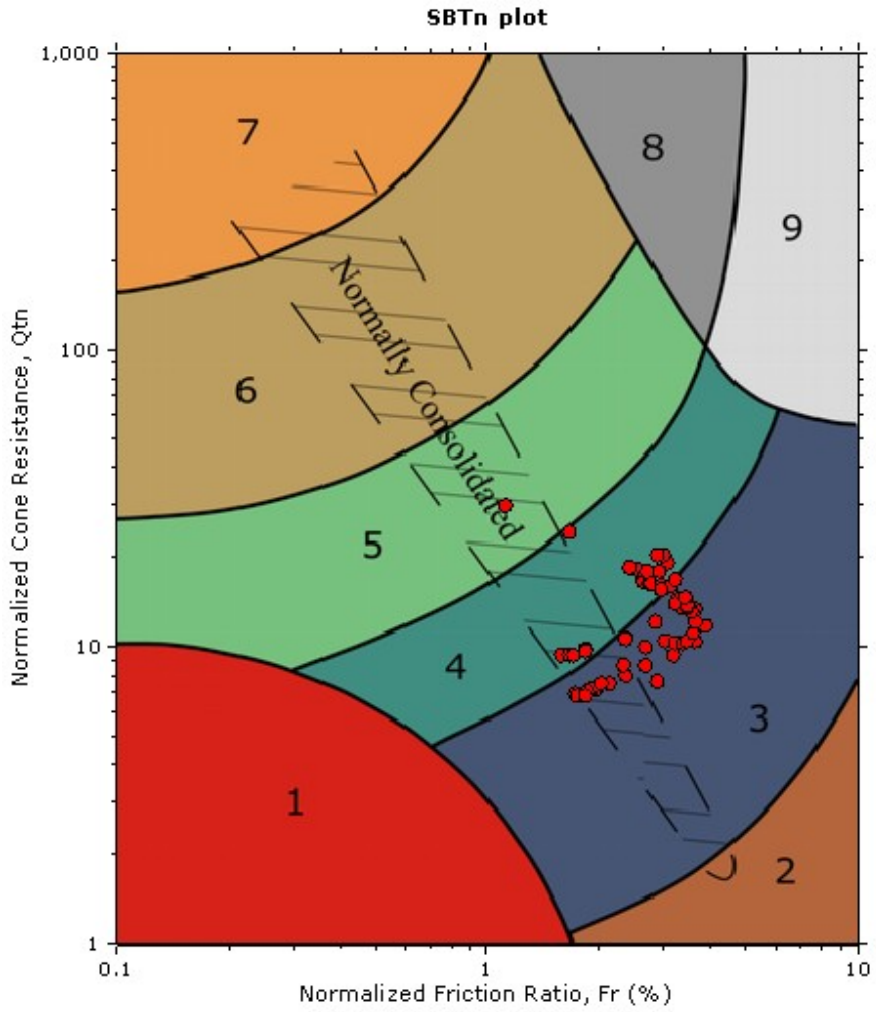


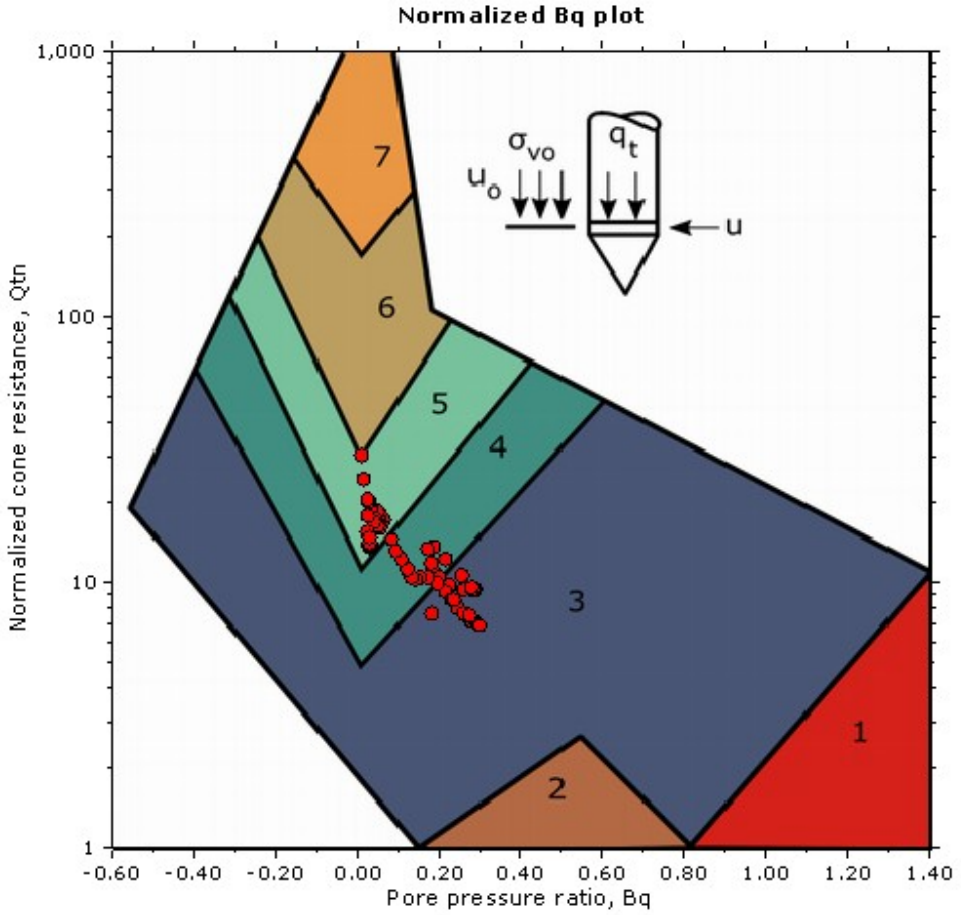




**SBT legend**

| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## SBT - Bq plots (normalized)

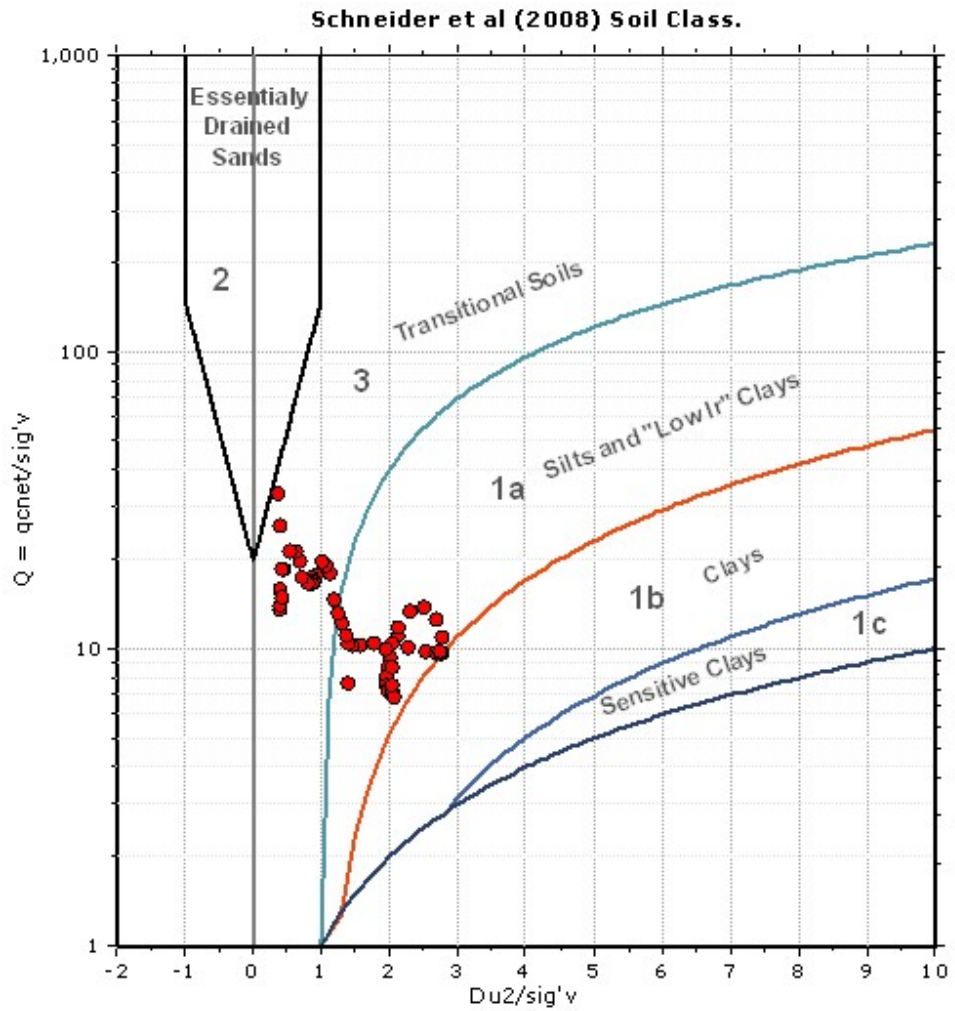


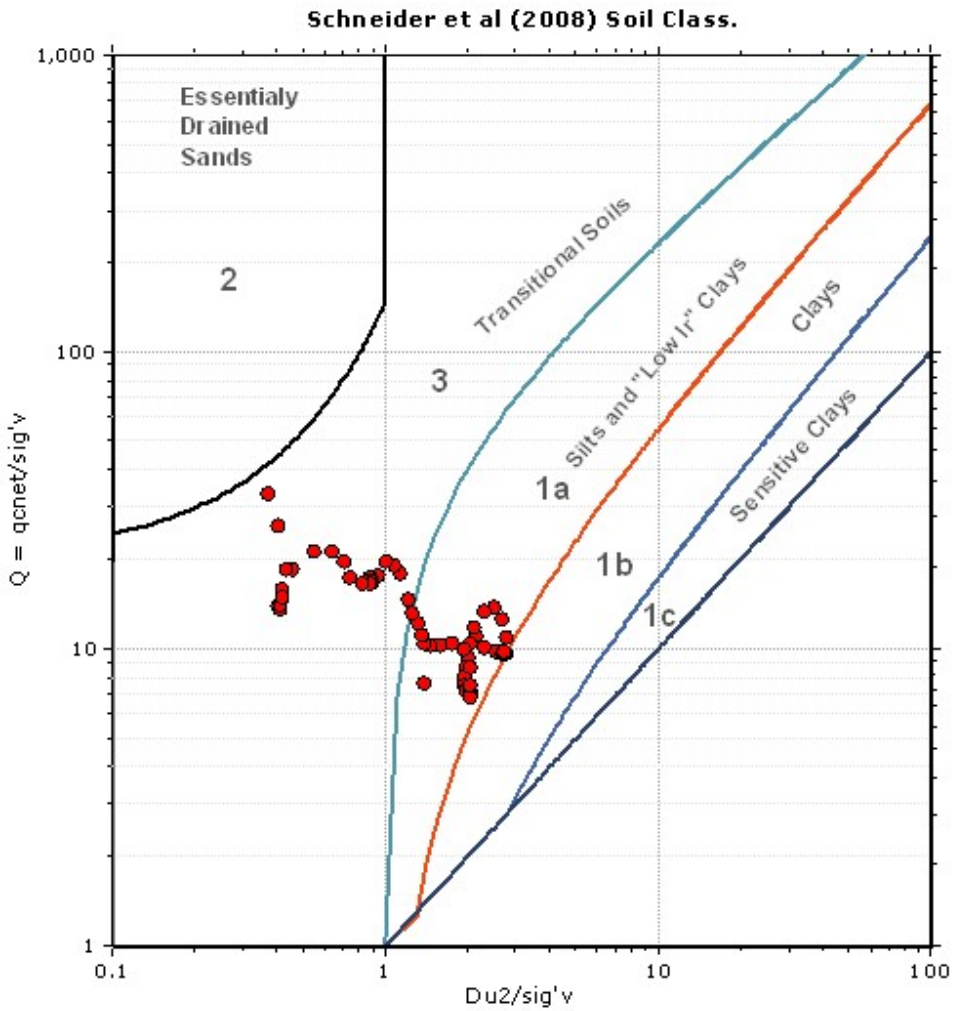



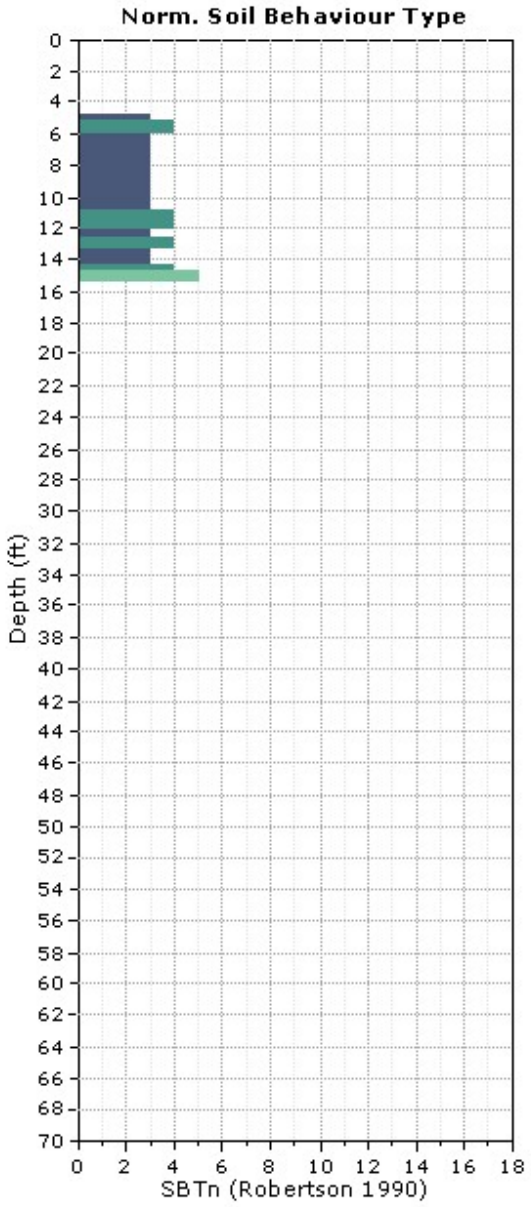

**SBTn legend**

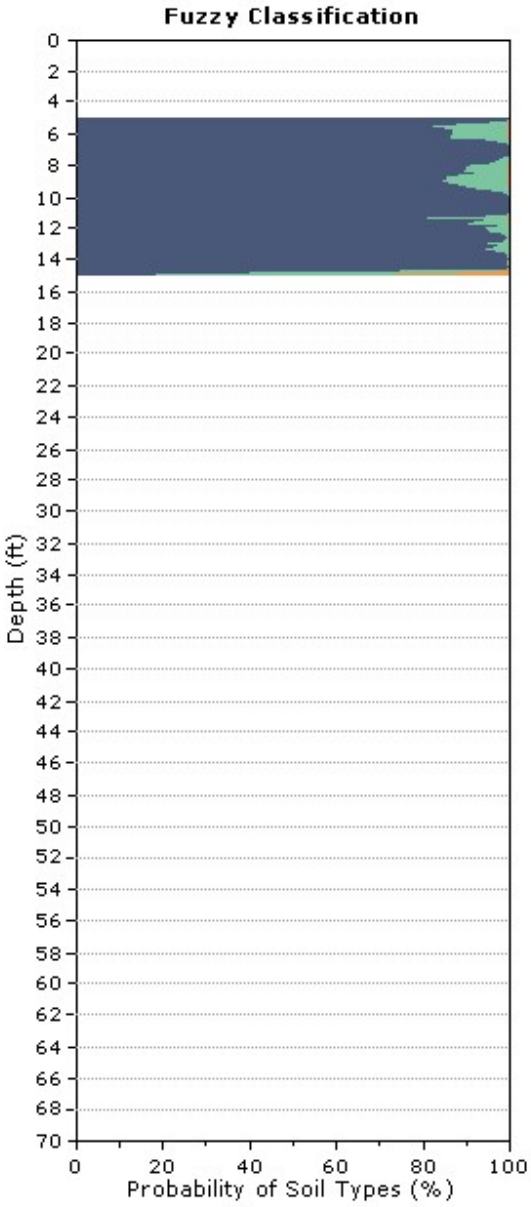
| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## Bq plots (Schneider)



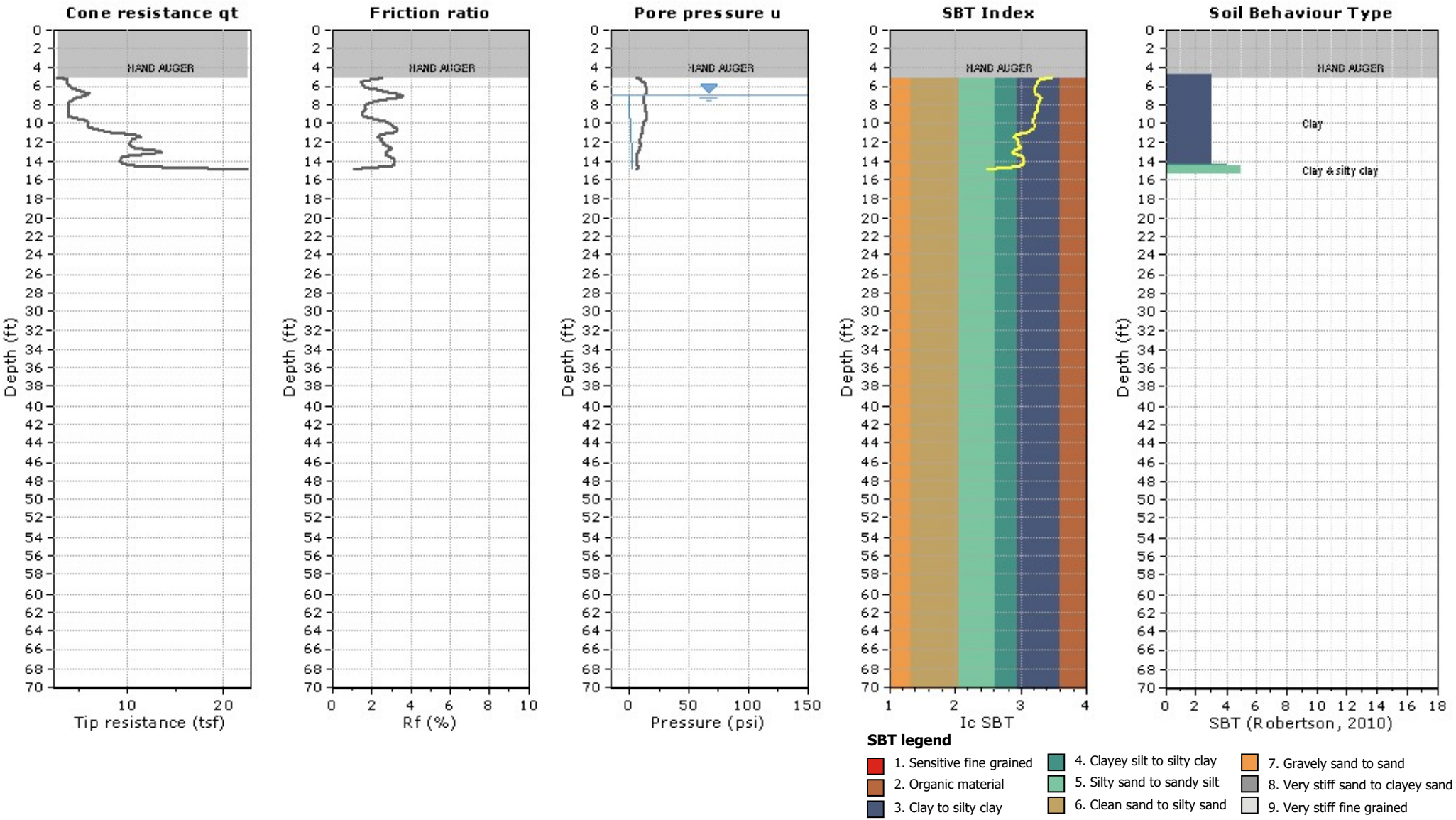




Norm. Soil Behaviour Type
Depth (ft)
SBTn (Robertson 1990)


Fuzzy Classification
Depth (ft)
Probability of Soil Types (%)

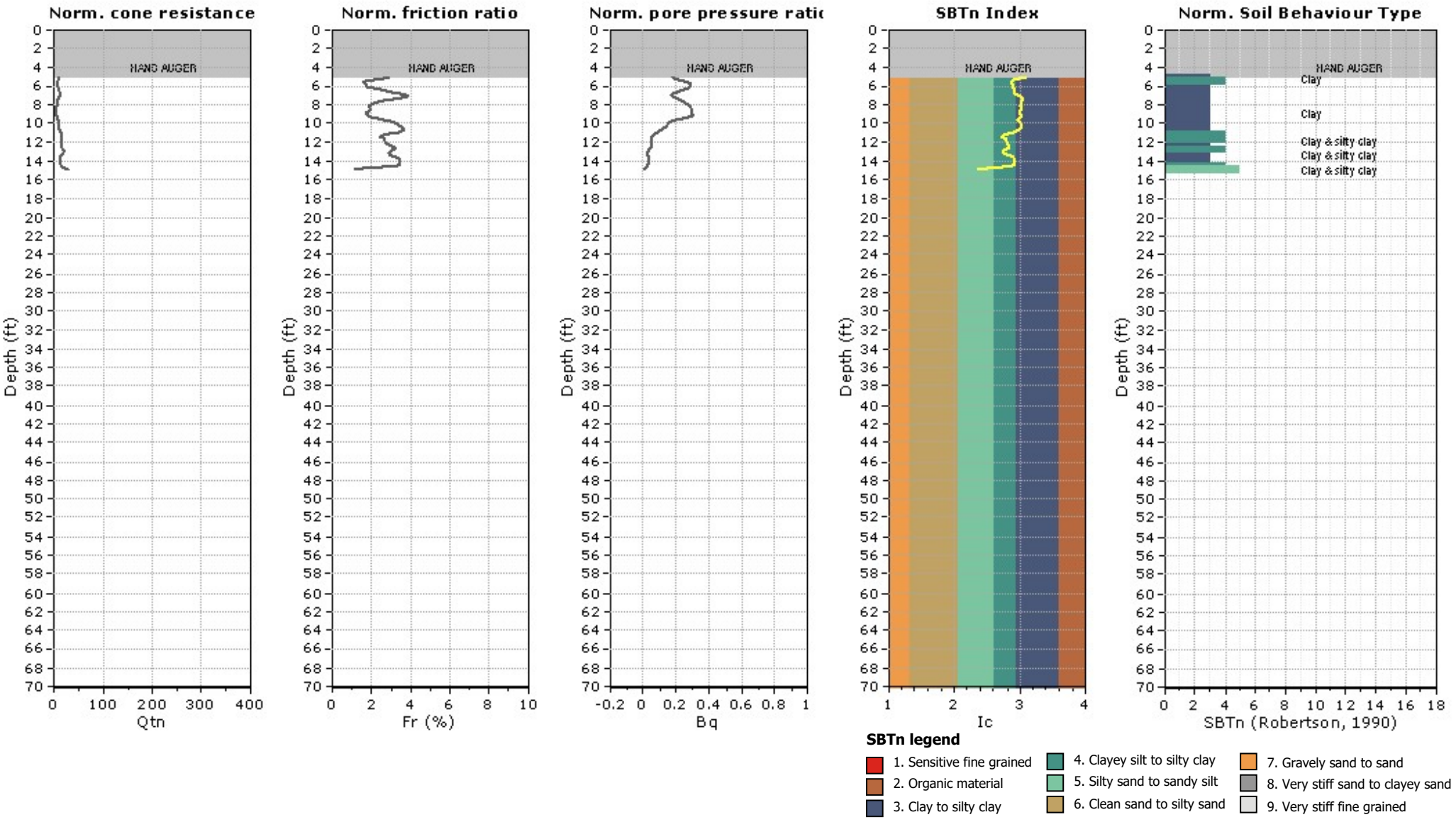
**CPT: CPT-07**
Total depth: 14.93 ft, Date: 4/25/2018
Surface Elevation: 10.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA



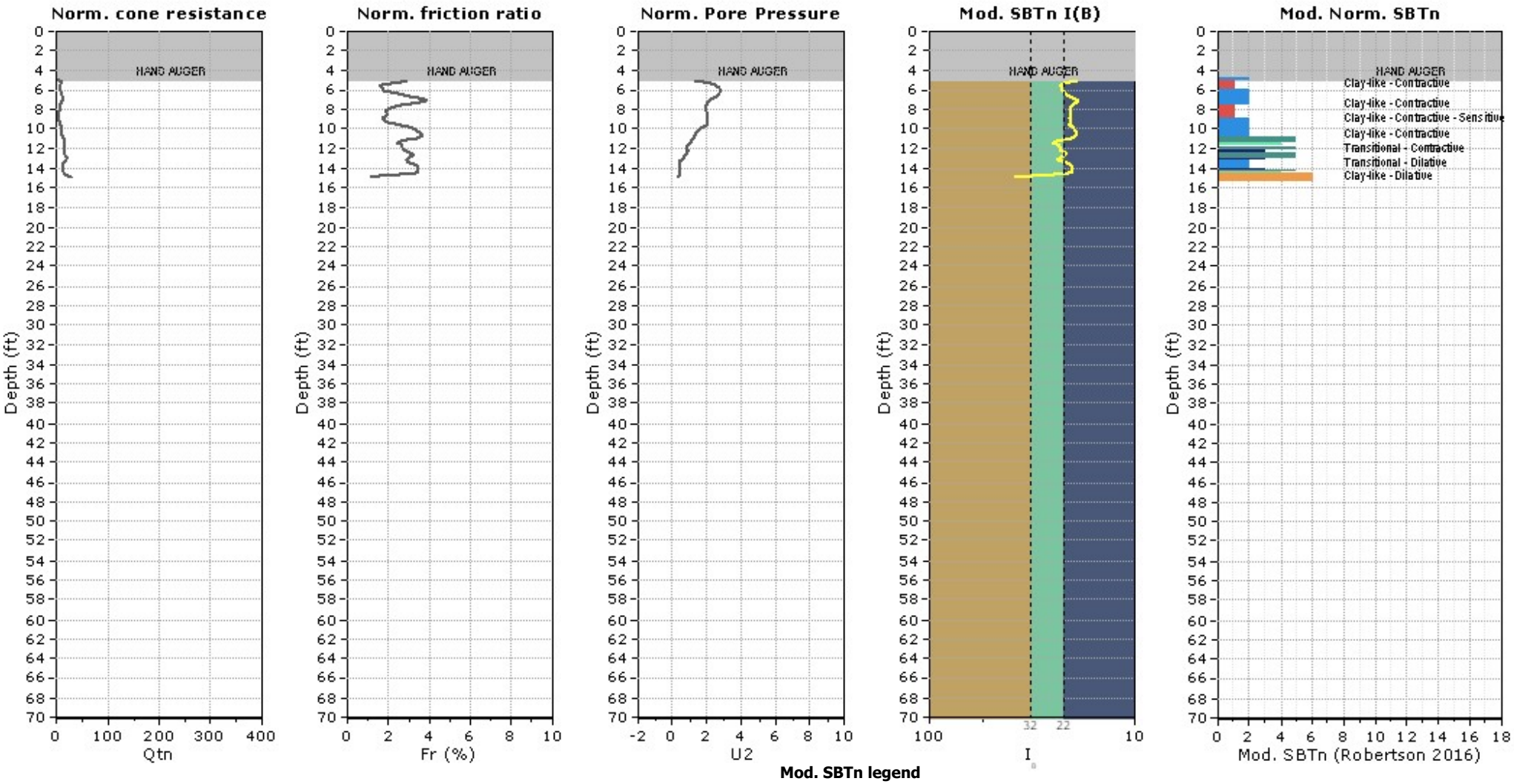
**CPT: CPT-07**
Total depth: 14.93 ft, Date: 4/25/2018
Surface Elevation: 10.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA

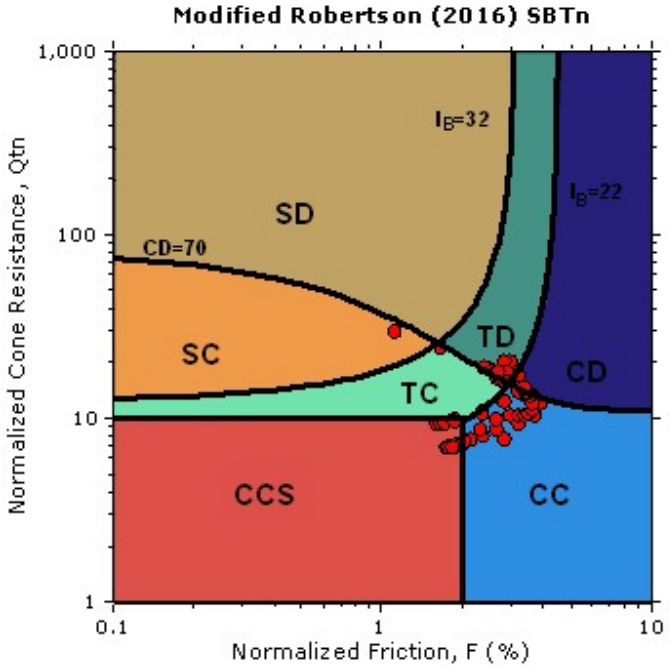


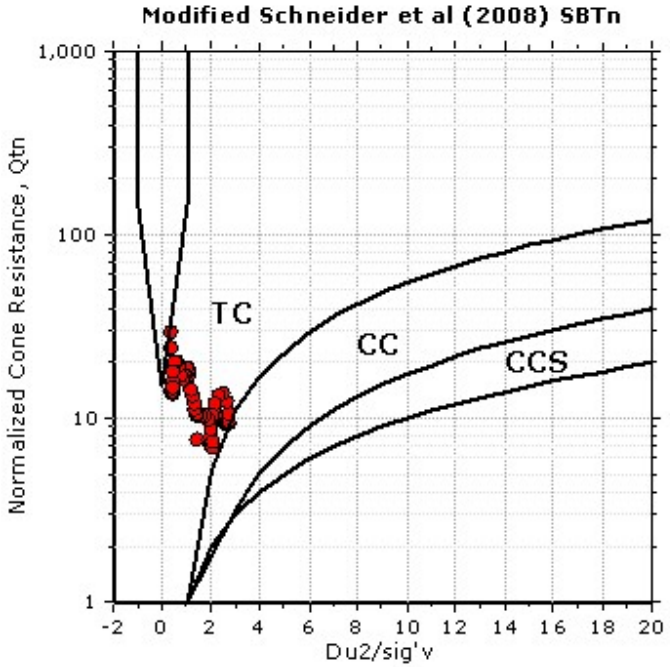
**CPT: CPT-07**
Total depth: 14.93 ft, Date: 4/25/2018
Surface Elevation: 10.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

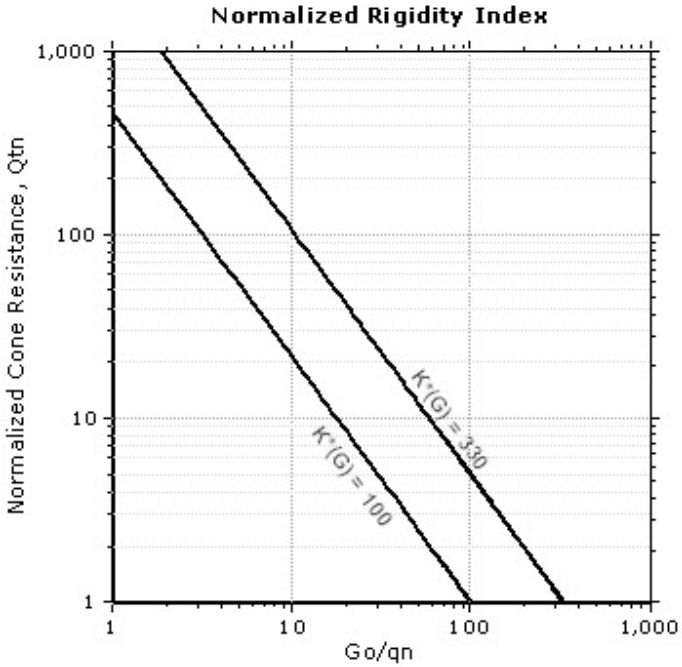
**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA



## Updated SBTn plots

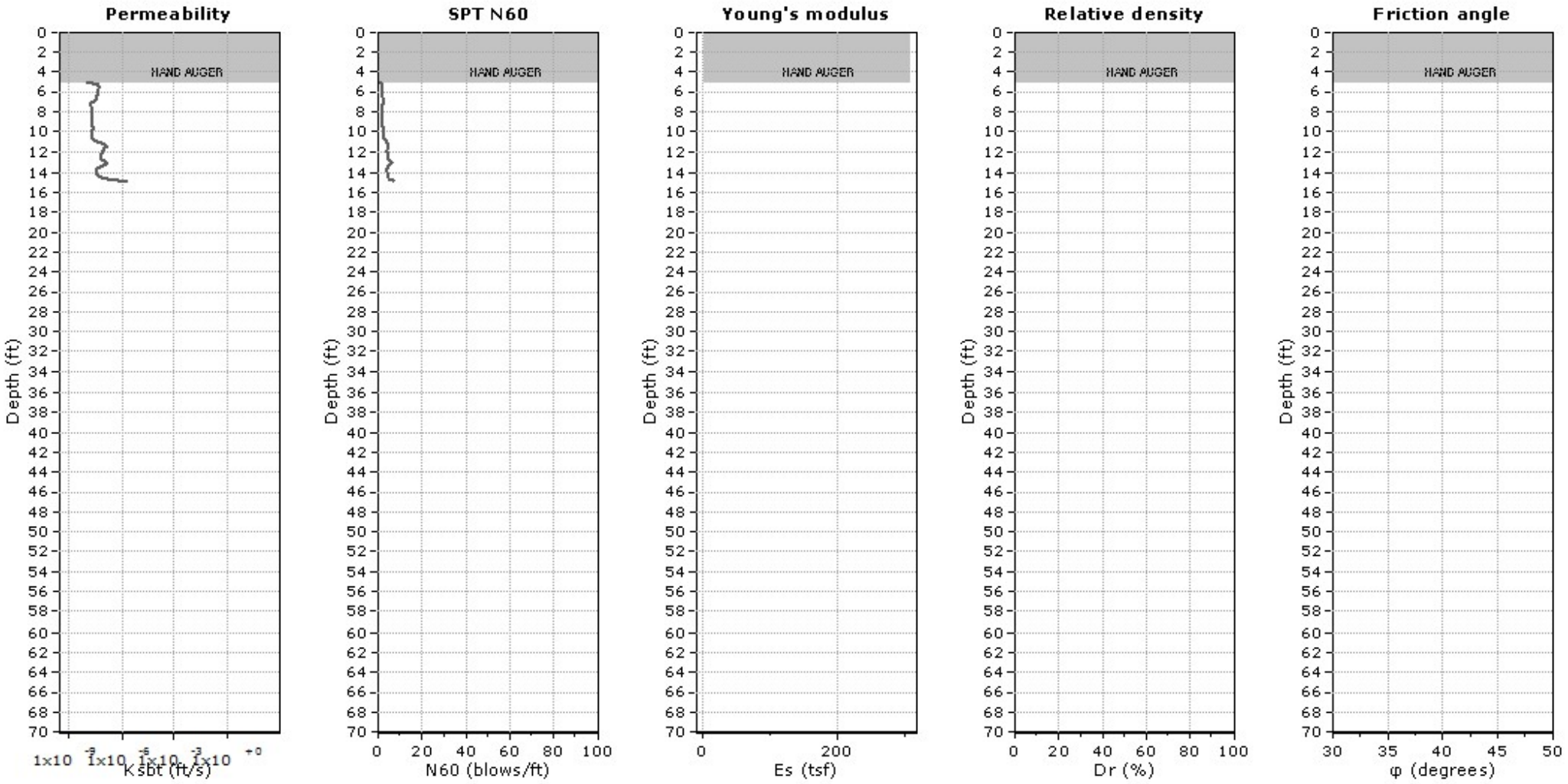


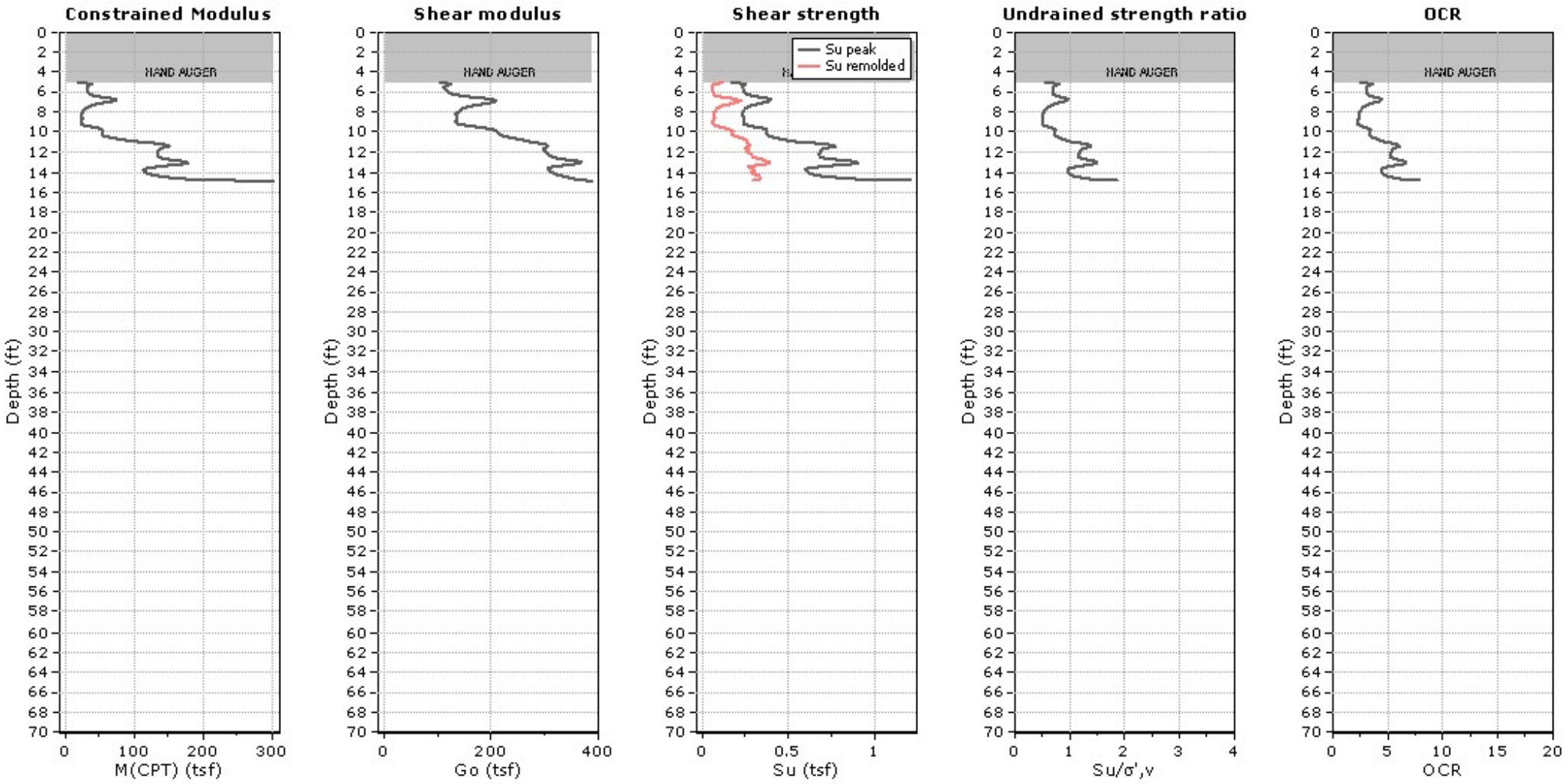

CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)



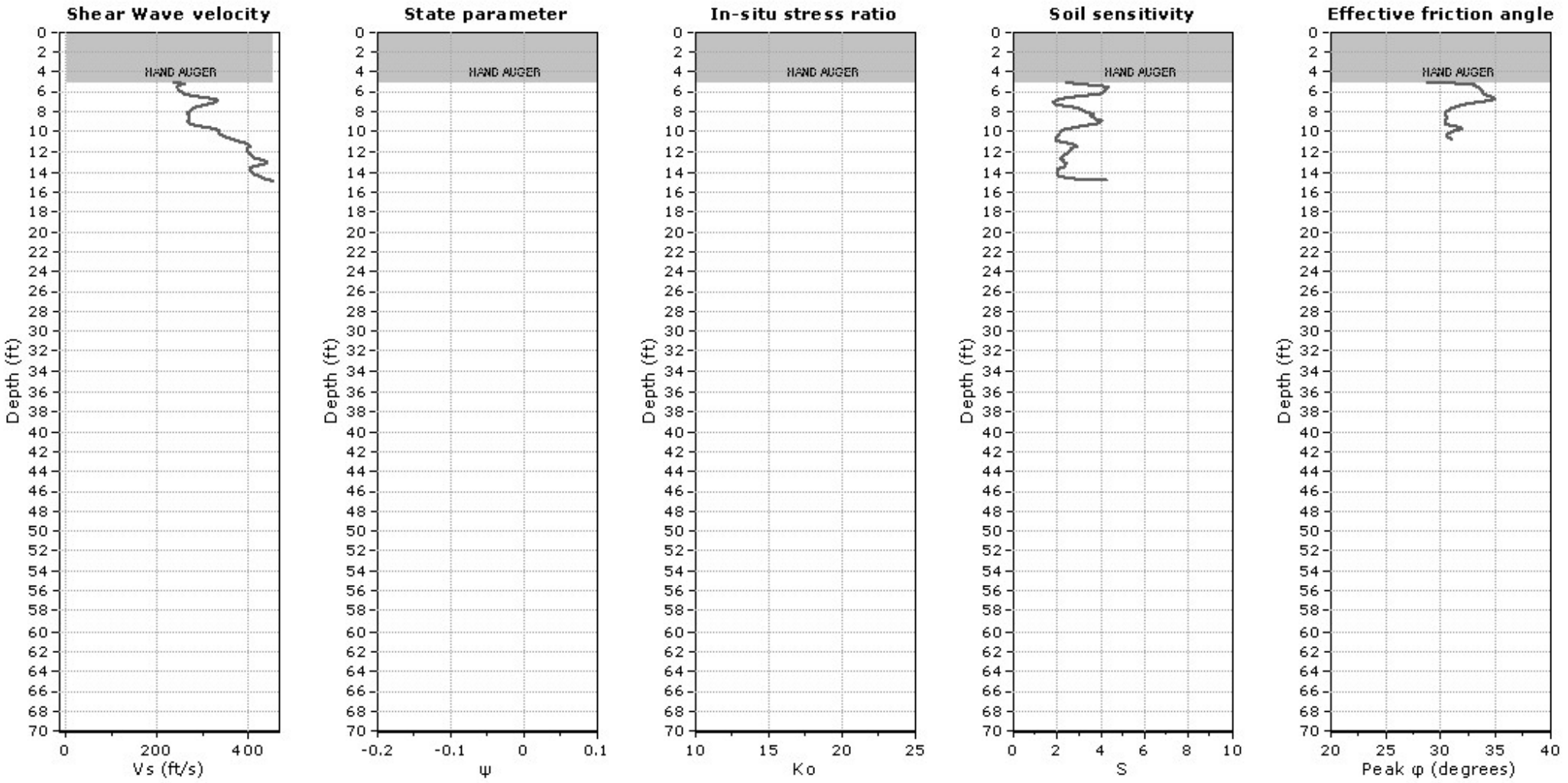

**Calculation parameters**

Permeability: Based on $SBT_n$
SPT $N_{60}$: Based on $I_c$ and $q_t$
Young's modulus: Based on variable alpha using $I_c$ (Robertson, 2009)
Relative density constant, $C_{Dr}$: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data




**Calculation parameters**

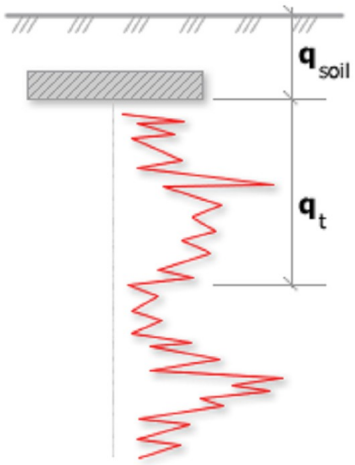
Constrained modulus: Based on variable alpha using $I_c$ and $Q_{tn}$ (Robertson, 2009)
Go: Based on variable alpha using $I_c$ (Robertson, 2009)
Undrained shear strength cone factor for clays, $N_{kt}$: 14
OCR factor for clays, $N_{kt}$: 0.33
User defined estimation data
Flat Dilatometer Test data




**Calculation parameters**

Soil Sensitivity factor, $N_S$: 7.00

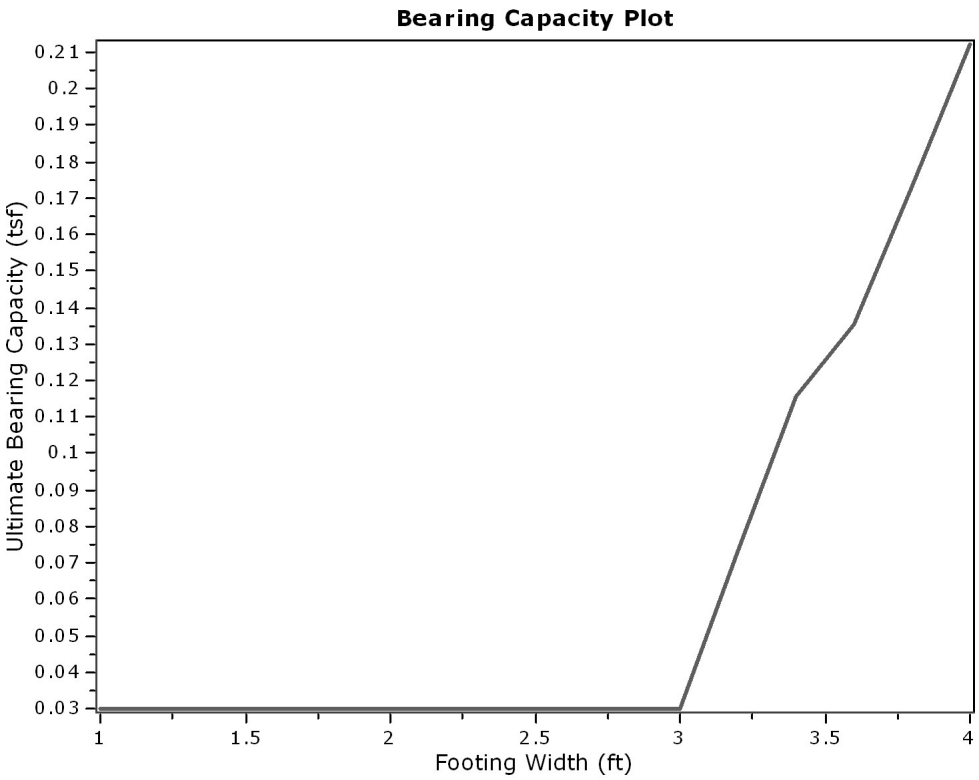
User defined estimation data




Bearing Capacity calculation is perfromed based on the formula:

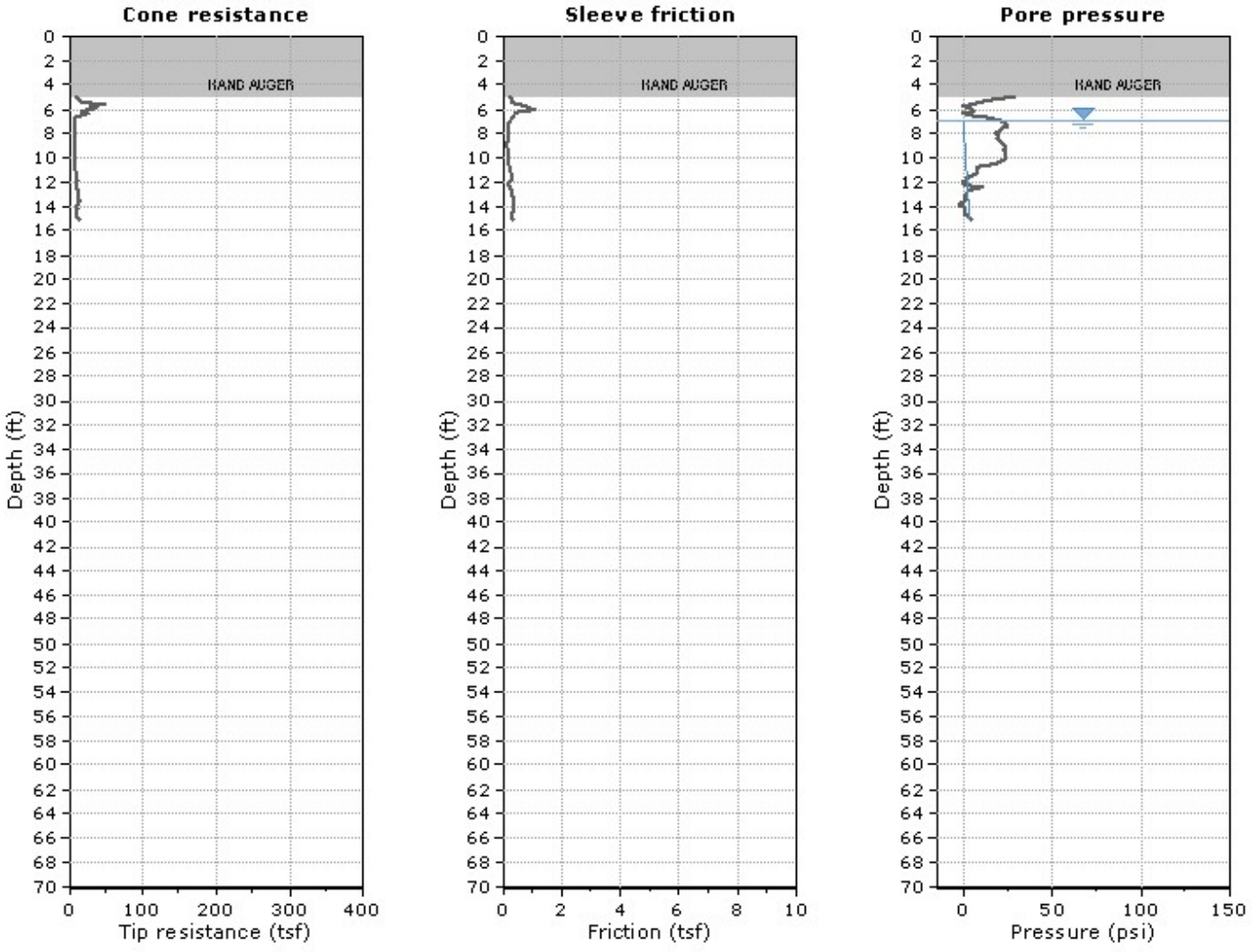
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
$R_k$: Bearing capacity factor
$q_t$: Average corrected cone resistance over calculation depth
$q_{soil}$: Pressure applied by soil above footing

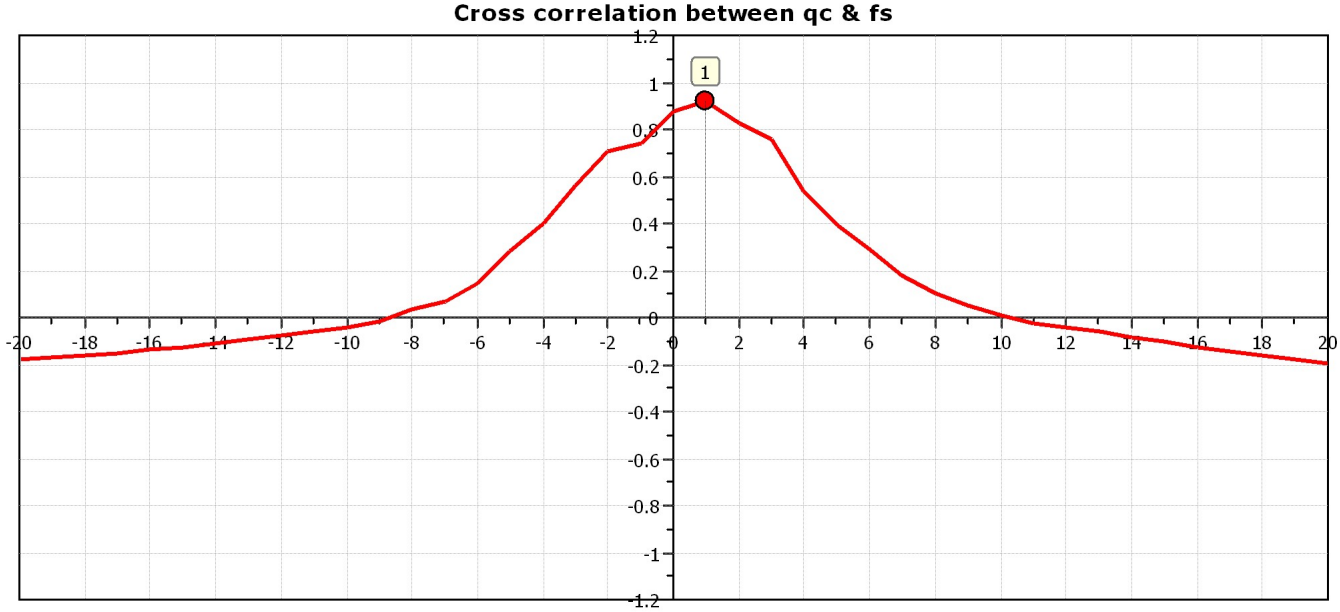



**:: Tabular results ::**

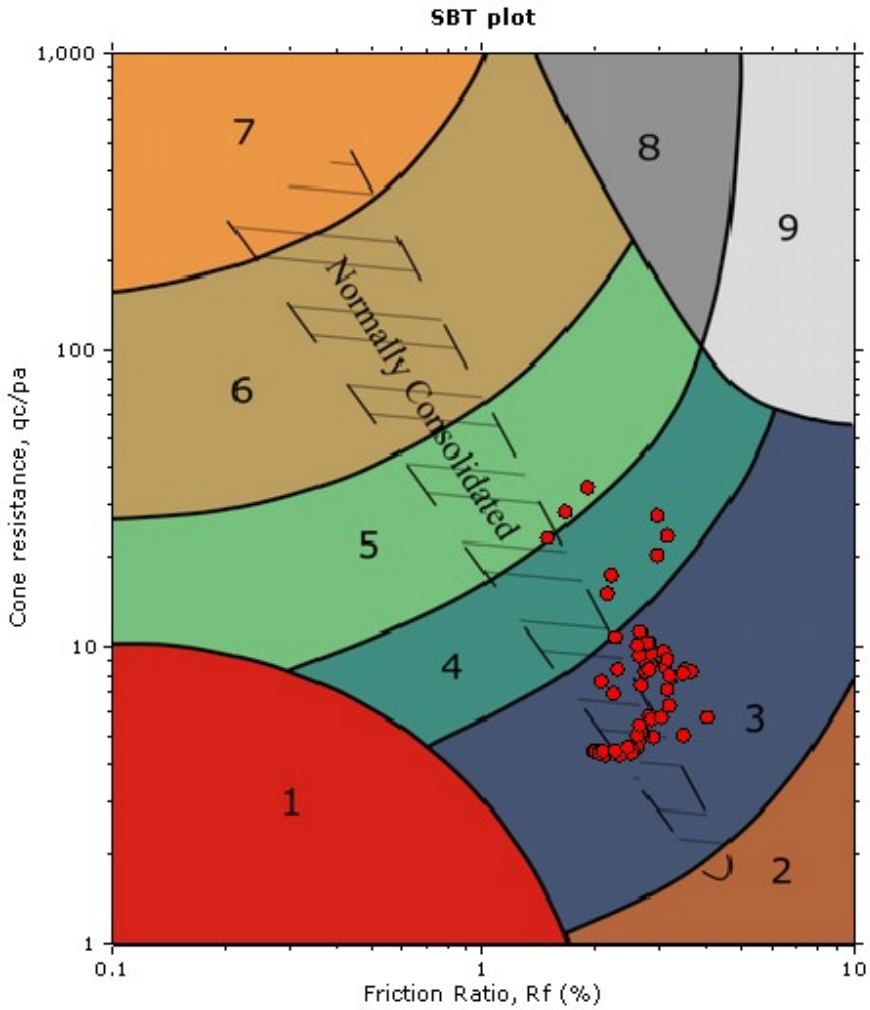
| No | B (ft) | Start Depth (ft) | End Depth (ft) | Ave. $q_t$ (tsf) | $R_k$ | Soil Press. (tsf) | Ult. bearing cap. (tsf) |
|---|---|---|---|---|---|---|---|
| 1 | 1.00 | 0.50 | 2.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 2 | 1.20 | 0.50 | 2.30 | 0.00 | 0.20 | 0.03 | 0.03 |
| 3 | 1.40 | 0.50 | 2.60 | 0.00 | 0.20 | 0.03 | 0.03 |
| 4 | 1.60 | 0.50 | 2.90 | 0.00 | 0.20 | 0.03 | 0.03 |
| 5 | 1.80 | 0.50 | 3.20 | 0.00 | 0.20 | 0.03 | 0.03 |
| 6 | 2.00 | 0.50 | 3.50 | 0.00 | 0.20 | 0.03 | 0.03 |
| 7 | 2.20 | 0.50 | 3.80 | 0.00 | 0.20 | 0.03 | 0.03 |
| 8 | 2.40 | 0.50 | 4.10 | 0.00 | 0.20 | 0.03 | 0.03 |
| 9 | 2.60 | 0.50 | 4.40 | 0.00 | 0.20 | 0.03 | 0.03 |
| 10 | 2.80 | 0.50 | 4.70 | 0.00 | 0.20 | 0.03 | 0.03 |
| 11 | 3.00 | 0.50 | 5.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 12 | 3.20 | 0.50 | 5.30 | 0.22 | 0.20 | 0.03 | 0.07 |
| 13 | 3.40 | 0.50 | 5.60 | 0.43 | 0.20 | 0.03 | 0.12 |
| 14 | 3.60 | 0.50 | 5.90 | 0.53 | 0.20 | 0.03 | 0.14 |
| 15 | 3.80 | 0.50 | 6.20 | 0.72 | 0.20 | 0.03 | 0.17 |
| 16 | 4.00 | 0.50 | 6.50 | 0.91 | 0.20 | 0.03 | 0.21 |

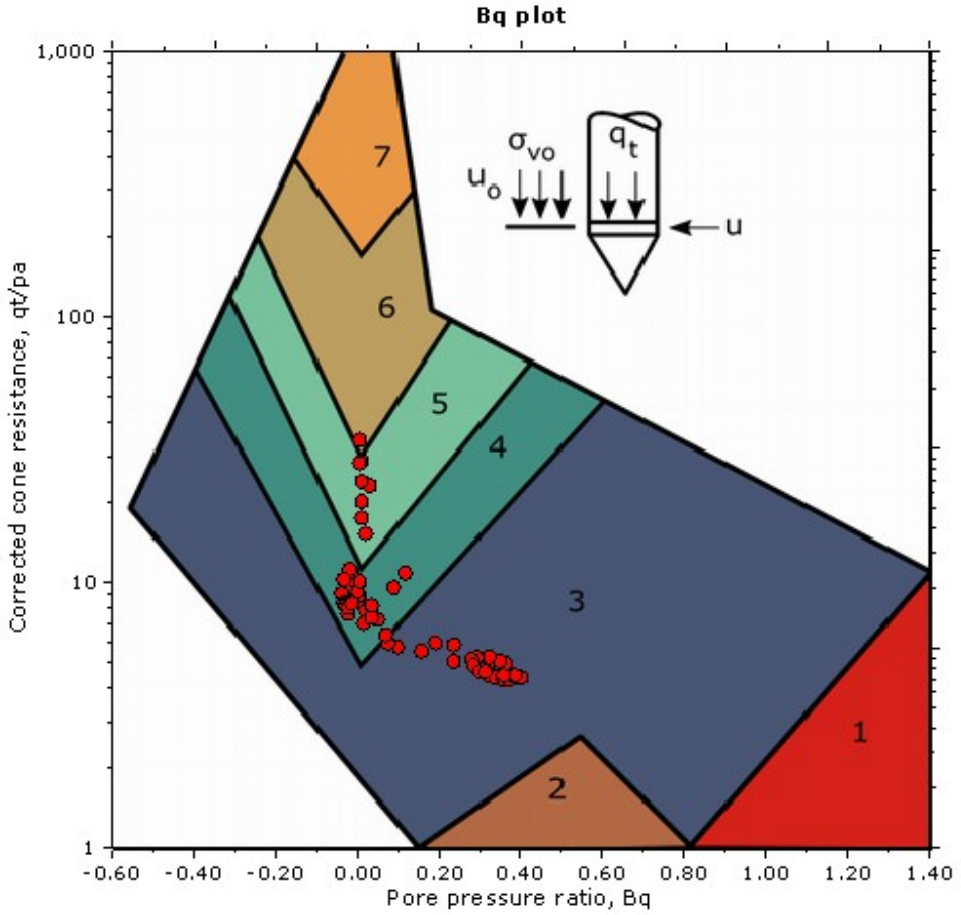



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



## SBT - Bq plots

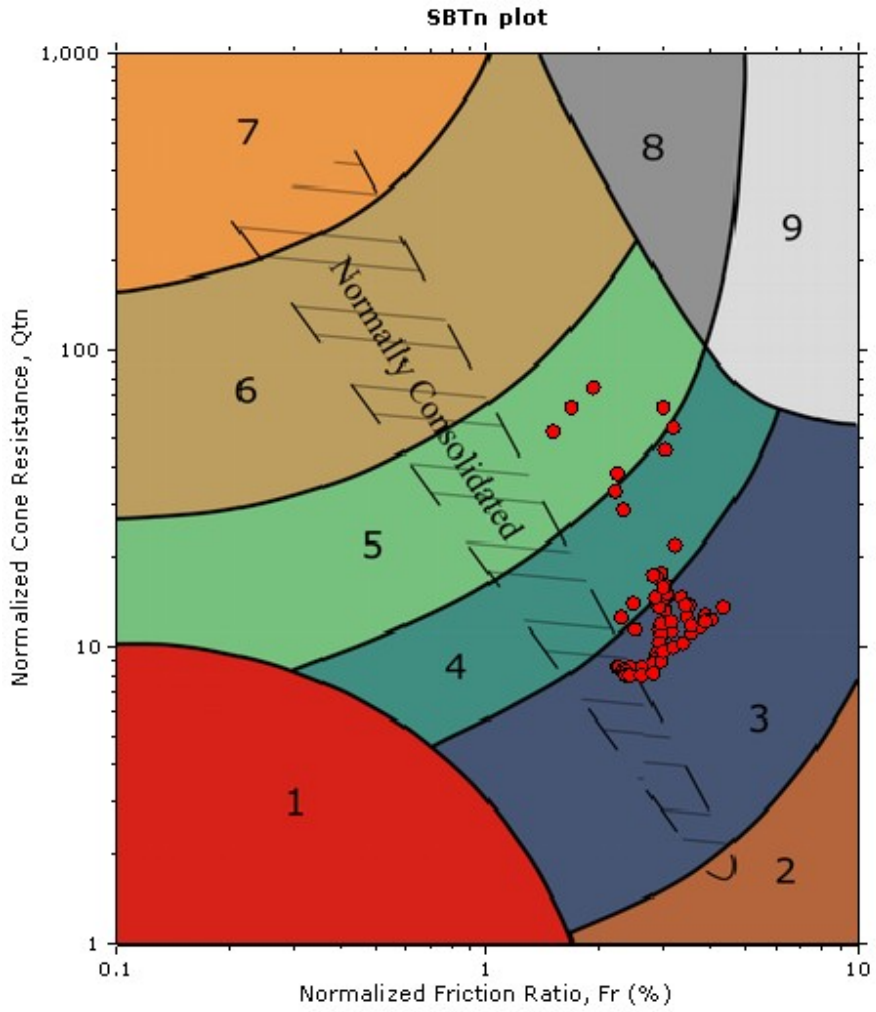


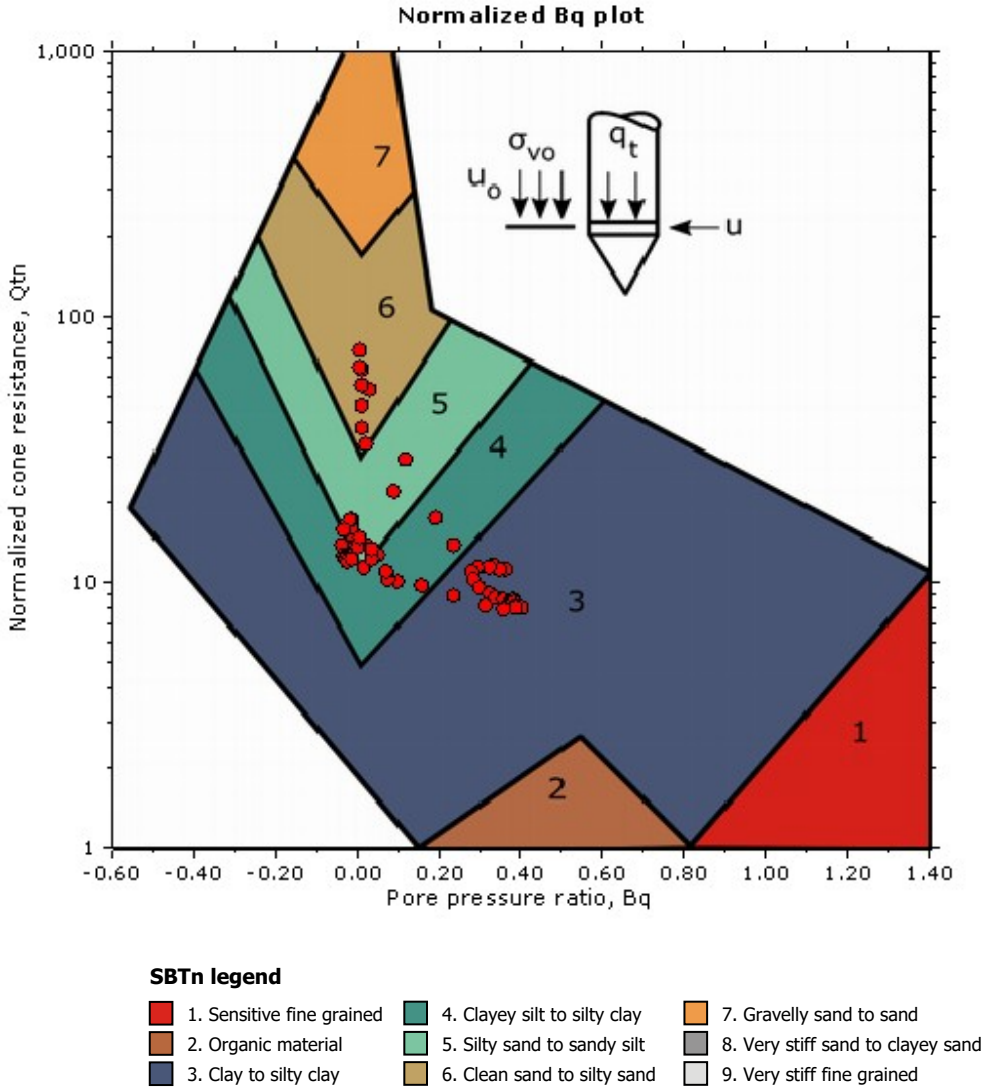




**SBT legend**

| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## SBT - Bq plots (normalized)

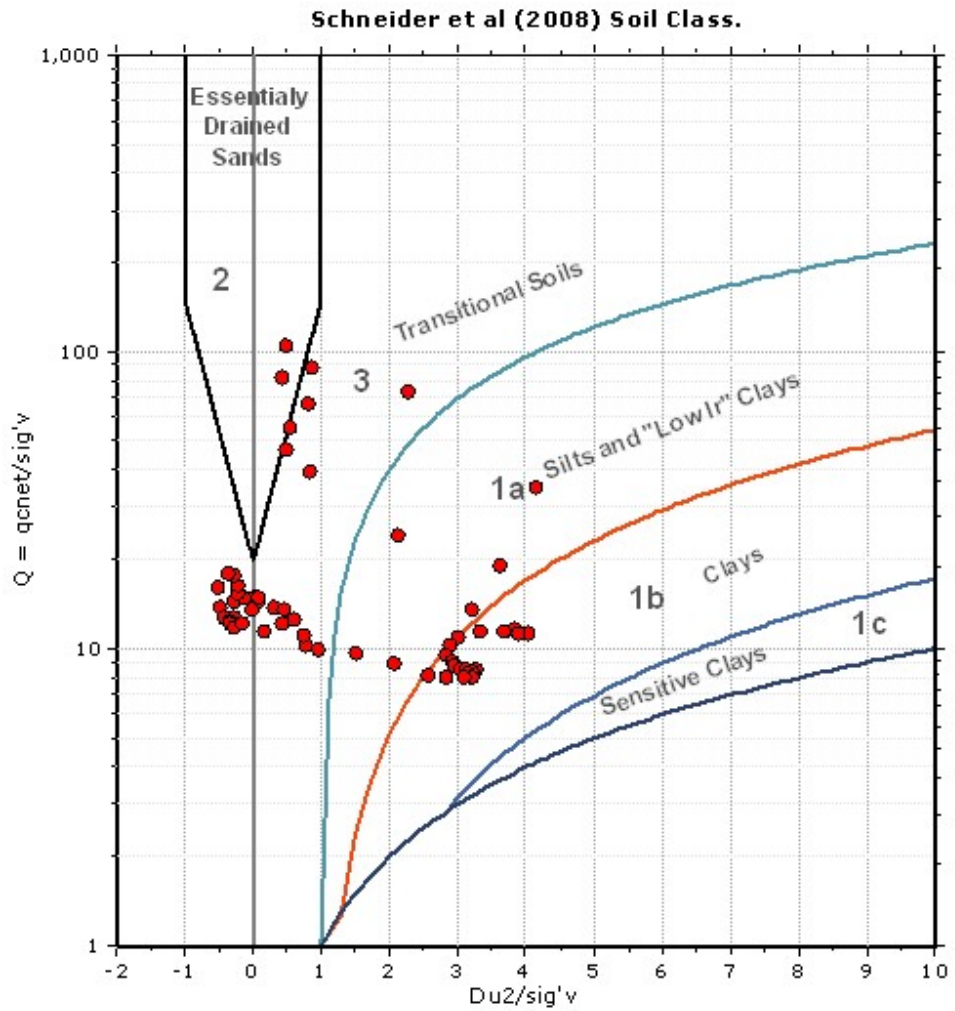


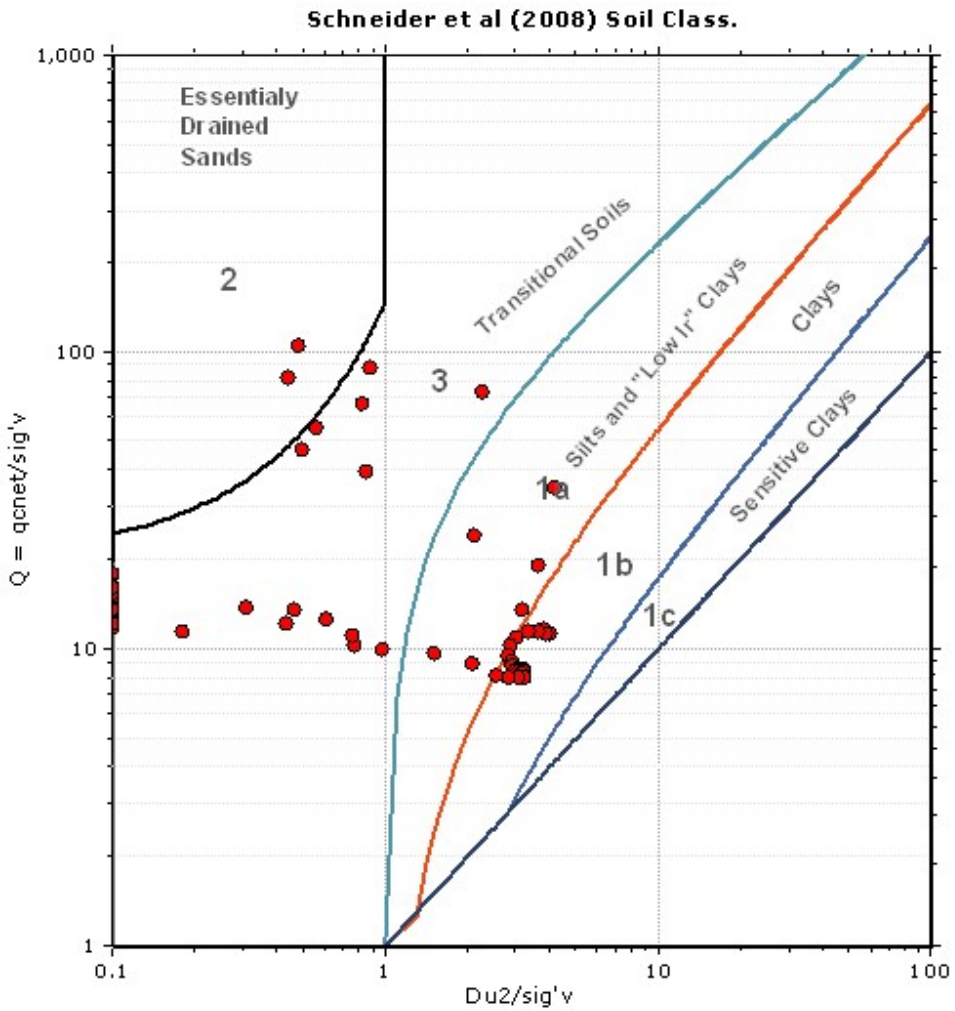



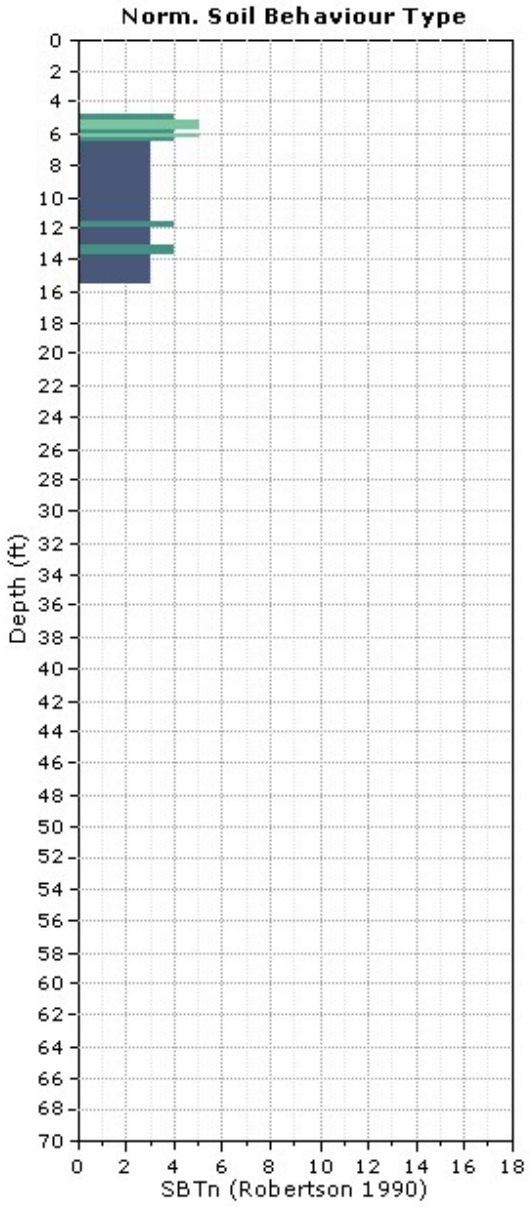

**SBTn legend**

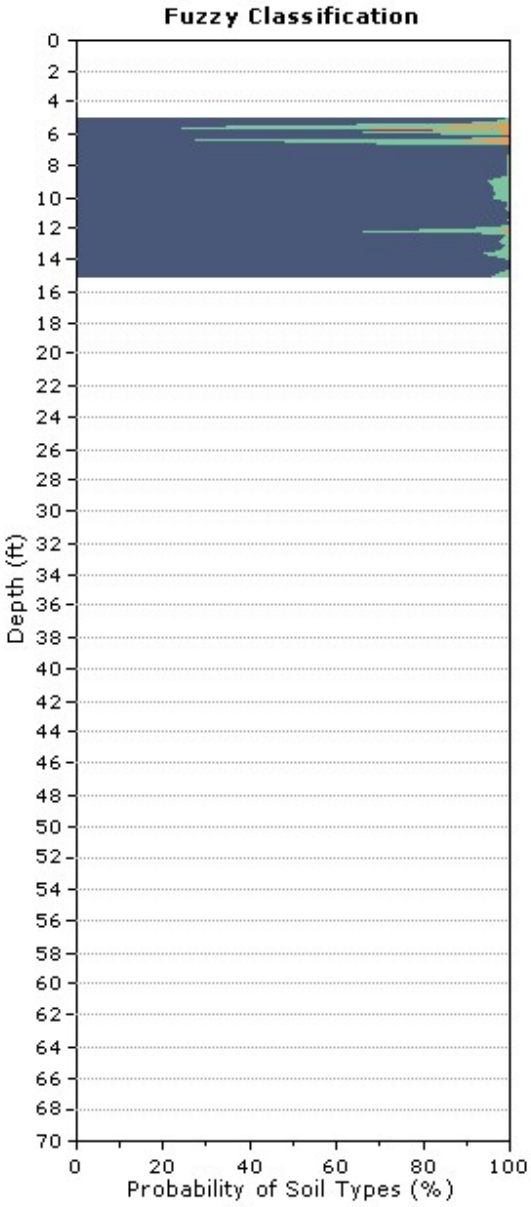
| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## Bq plots (Schneider)



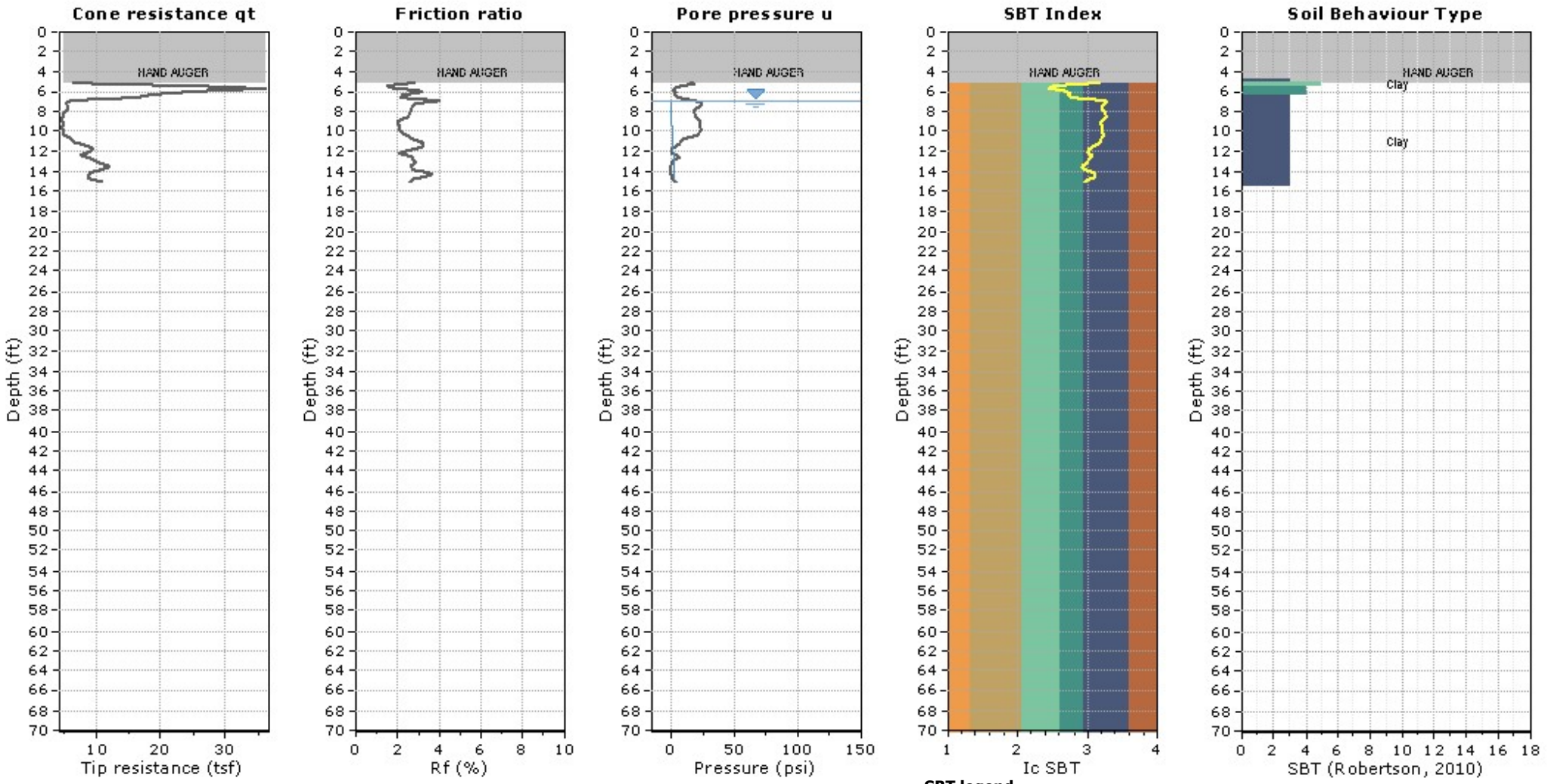



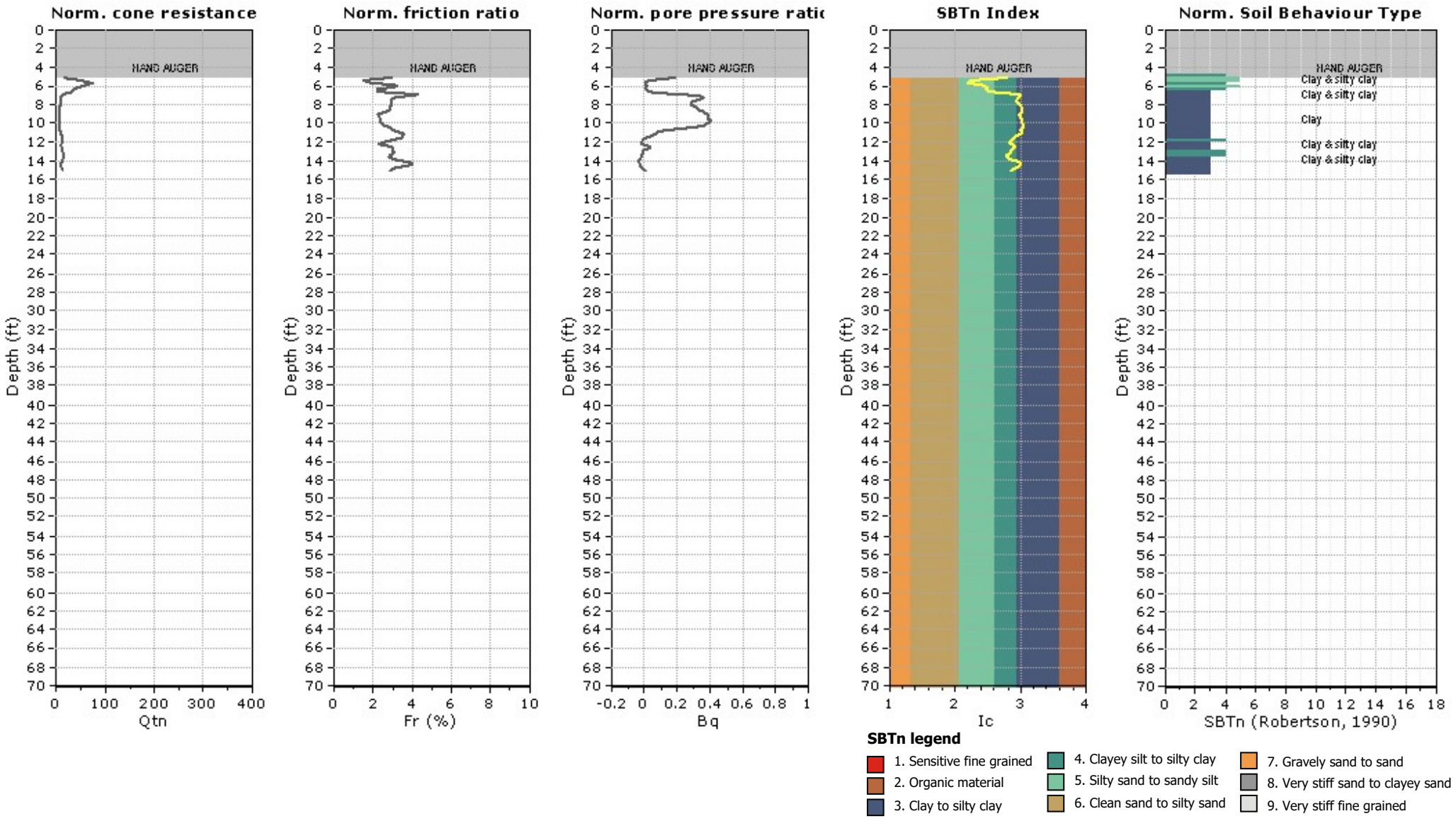

Norm. Soil Behaviour Type
Depth (ft)
SBTn (Robertson 1990)


Fuzzy Classification
Depth (ft)
Probability of Soil Types (%)

**CPT: CPT-08**
Total depth: 15.09 ft, Date: 4/25/2018
Surface Elevation: 10.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

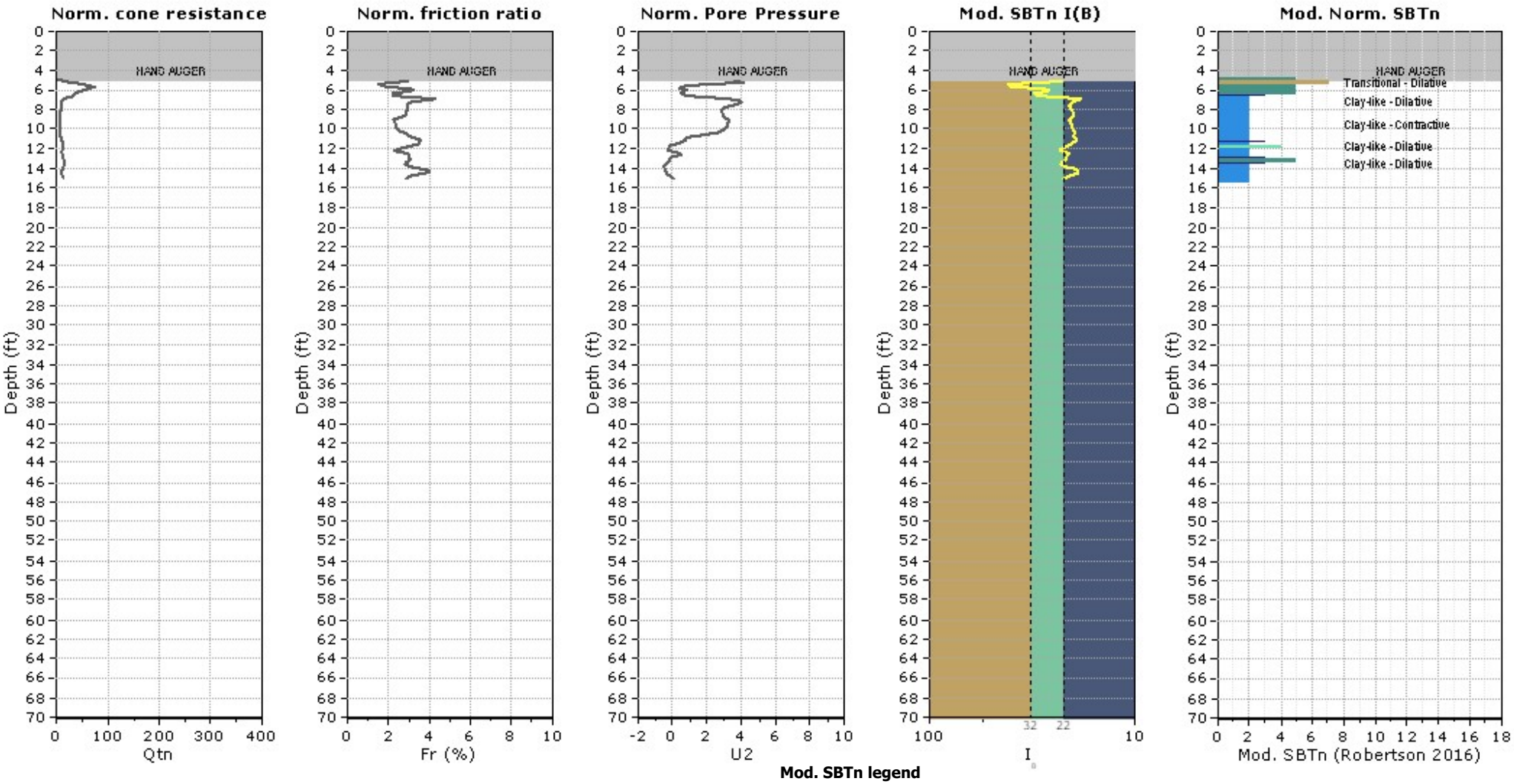
**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA



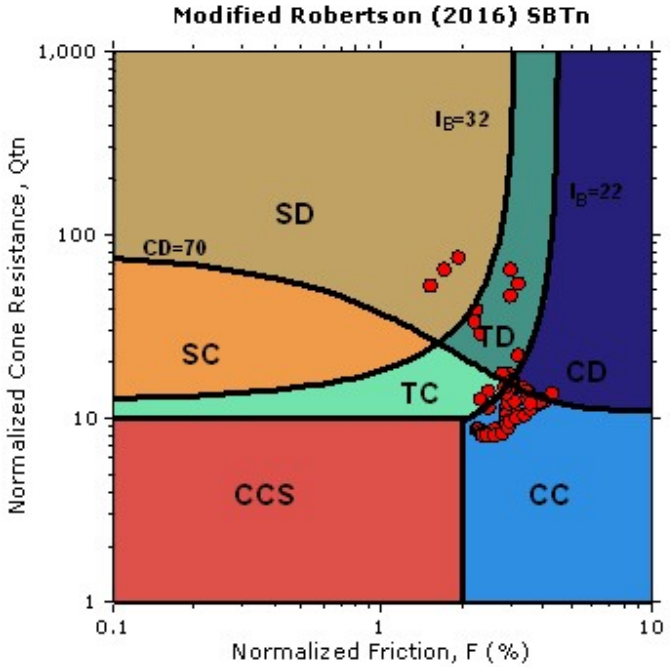

Norm. cone resistance
Norm. friction ratio
Norm. pore pressure ratio
SBTn Index
Norm. Soil Behaviour Type
HAND AUGER
Depth (ft)
Qtn
Fr (%)
Bq
Ic
SBTn (Robertson, 1990)
Clay & silty clay
Clay & silty clay
Clay
Clay & silty clay
Clay & silty clay
SBTn legend
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

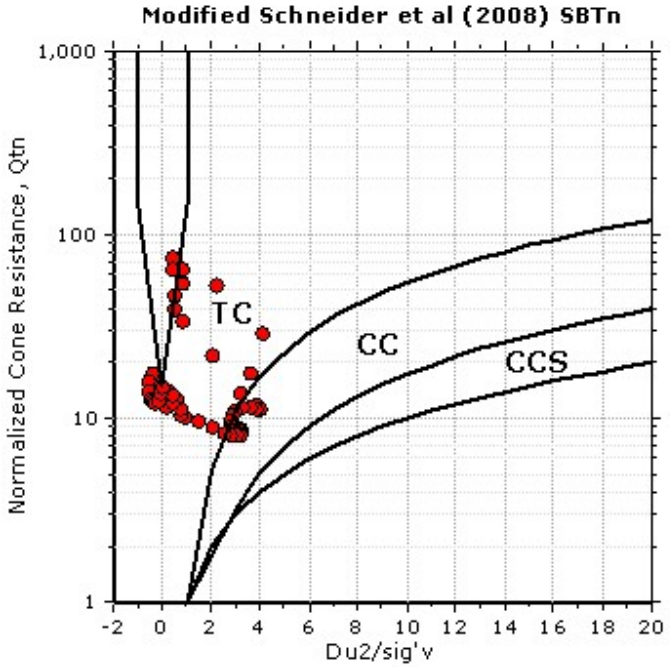
**CPT: CPT-08**
Total depth: 15.09 ft, Date: 4/25/2018
Surface Elevation: 10.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

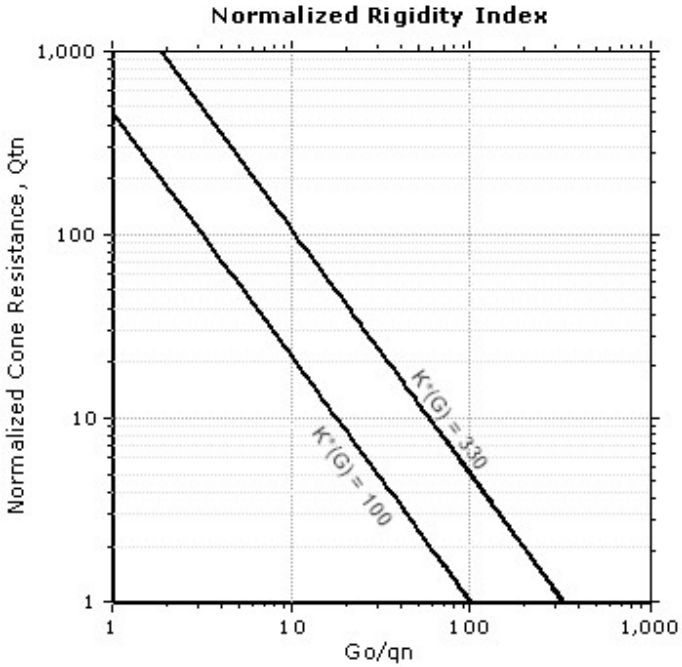
**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA



## Updated SBTn plots

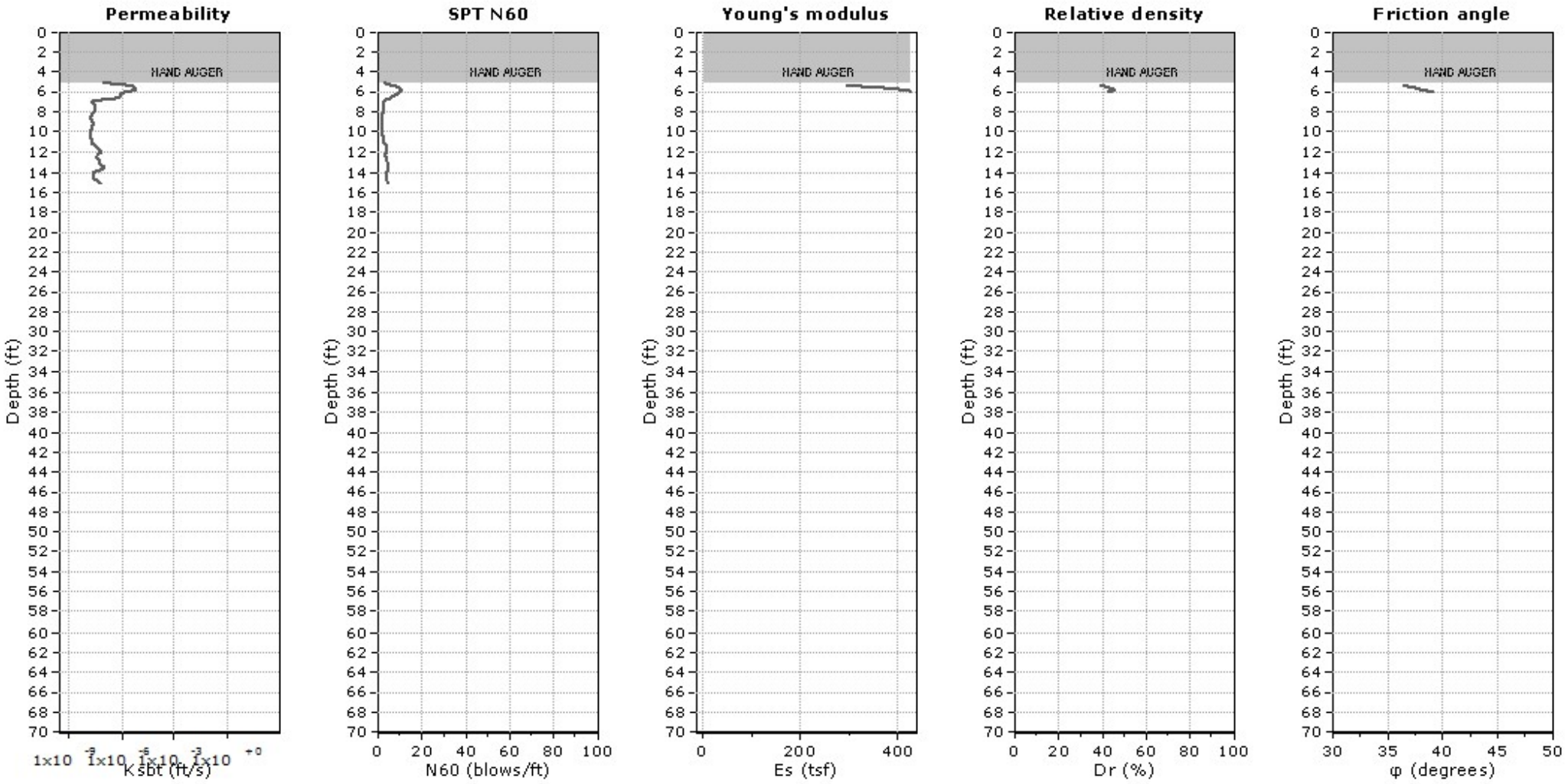


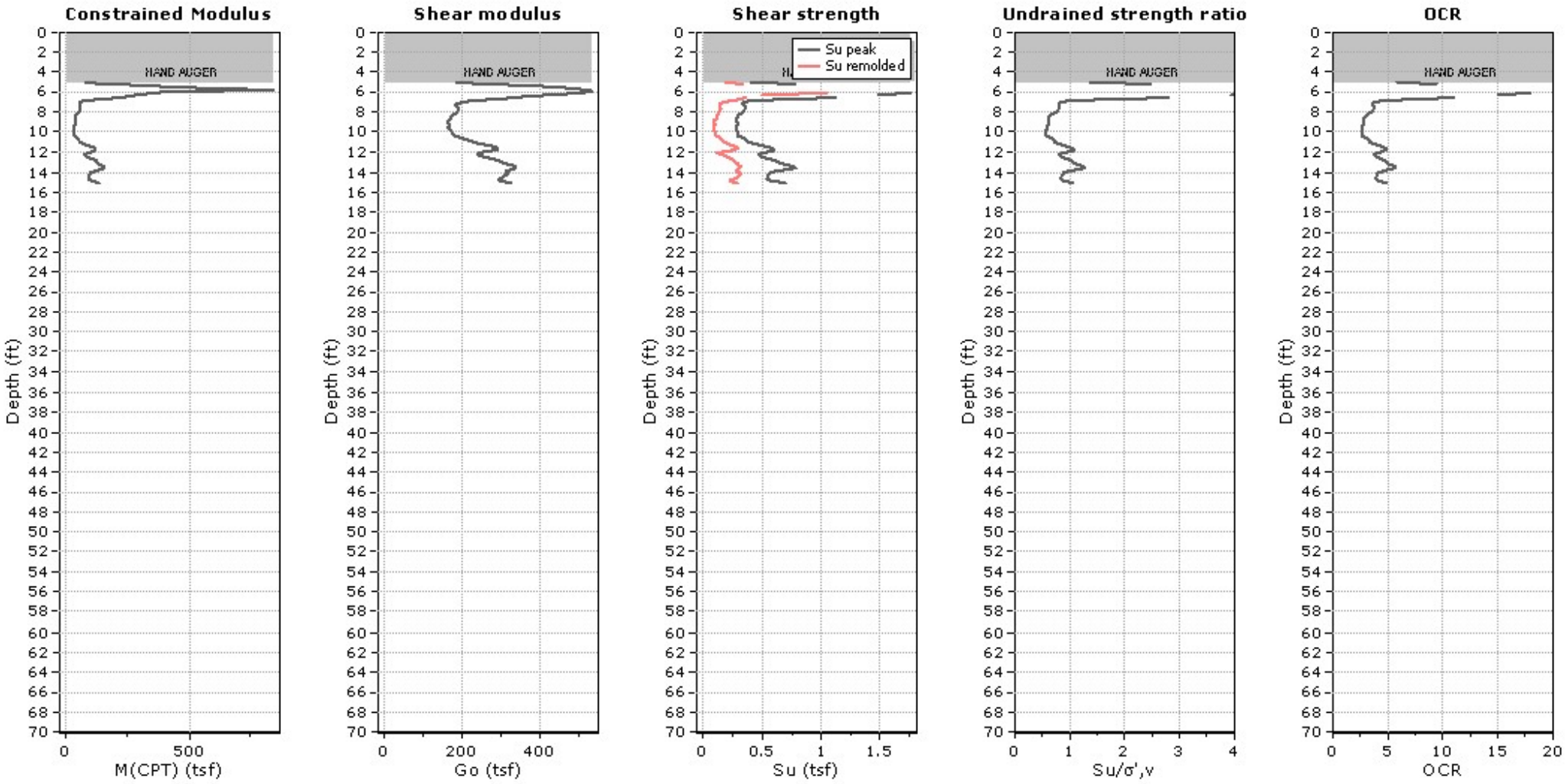

CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)



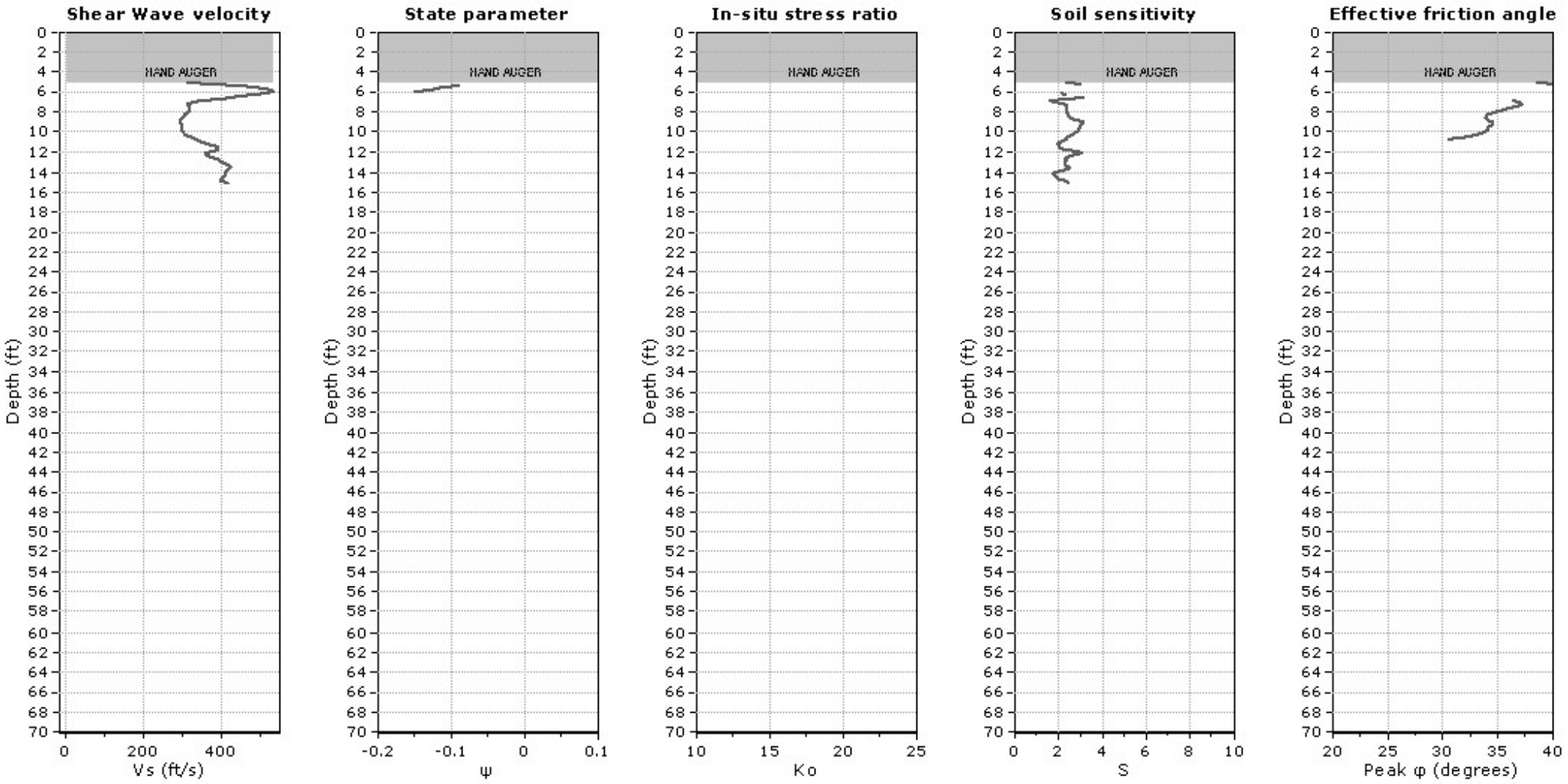

**Calculation parameters**

Permeability: Based on $SBT_n$
SPT $N_{60}$: Based on $I_c$ and $q_t$
Young's modulus: Based on variable alpha using $I_c$ (Robertson, 2009)
Relative density constant, $C_{Dr}$: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data




**Calculation parameters**

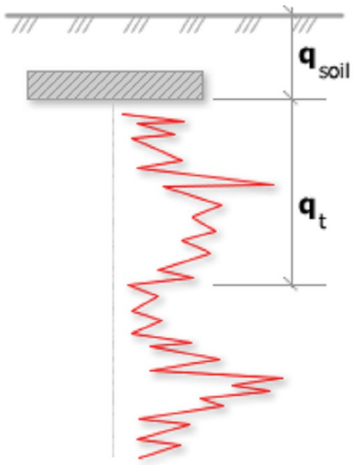
Constrained modulus: Based on variable alpha using $I_c$ and $Q_{tn}$ (Robertson, 2009)
Go: Based on variable alpha using $I_c$ (Robertson, 2009)
Undrained shear strength cone factor for clays, $N_{kt}$: 14
OCR factor for clays, $N_{kt}$: 0.33
User defined estimation data
Flat Dilatometer Test data




**Calculation parameters**

Soil Sensitivity factor, $N_S$: 7.00

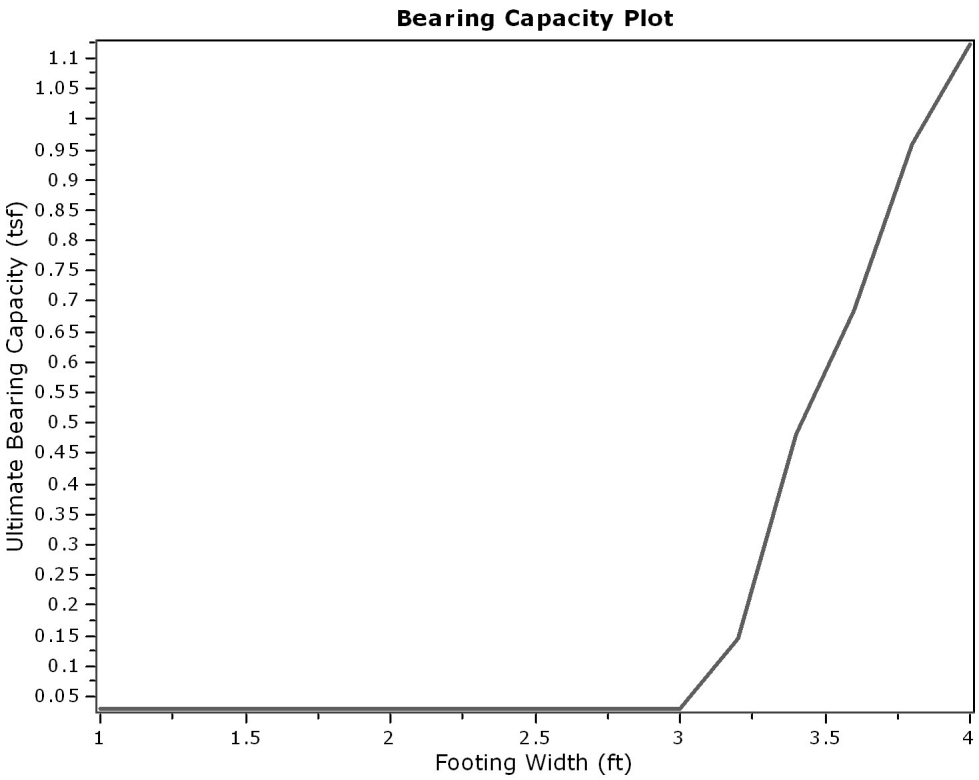
User defined estimation data




Bearing Capacity calculation is perfromed based on the formula:

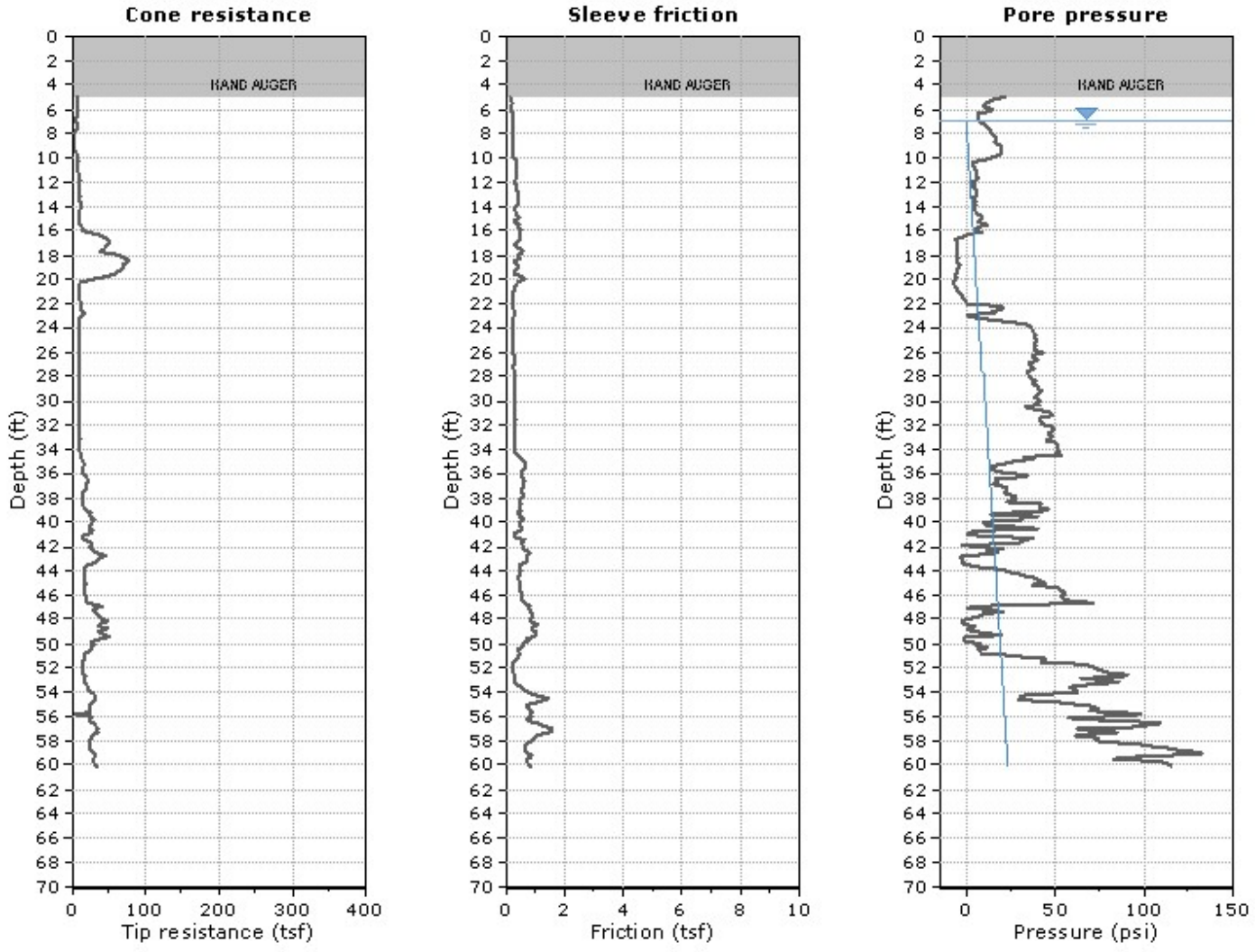
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
$R_k$: Bearing capacity factor
$q_t$: Average corrected cone resistance over calculation depth
$q_{soil}$: Pressure applied by soil above footing

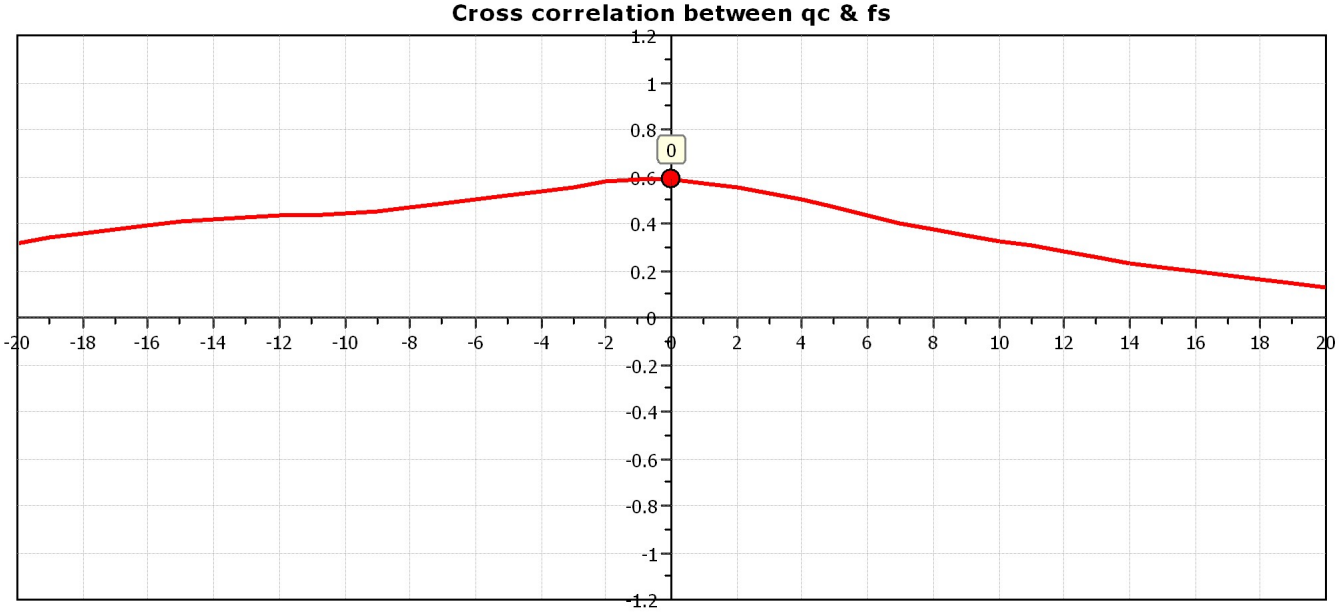



**:: Tabular results ::**

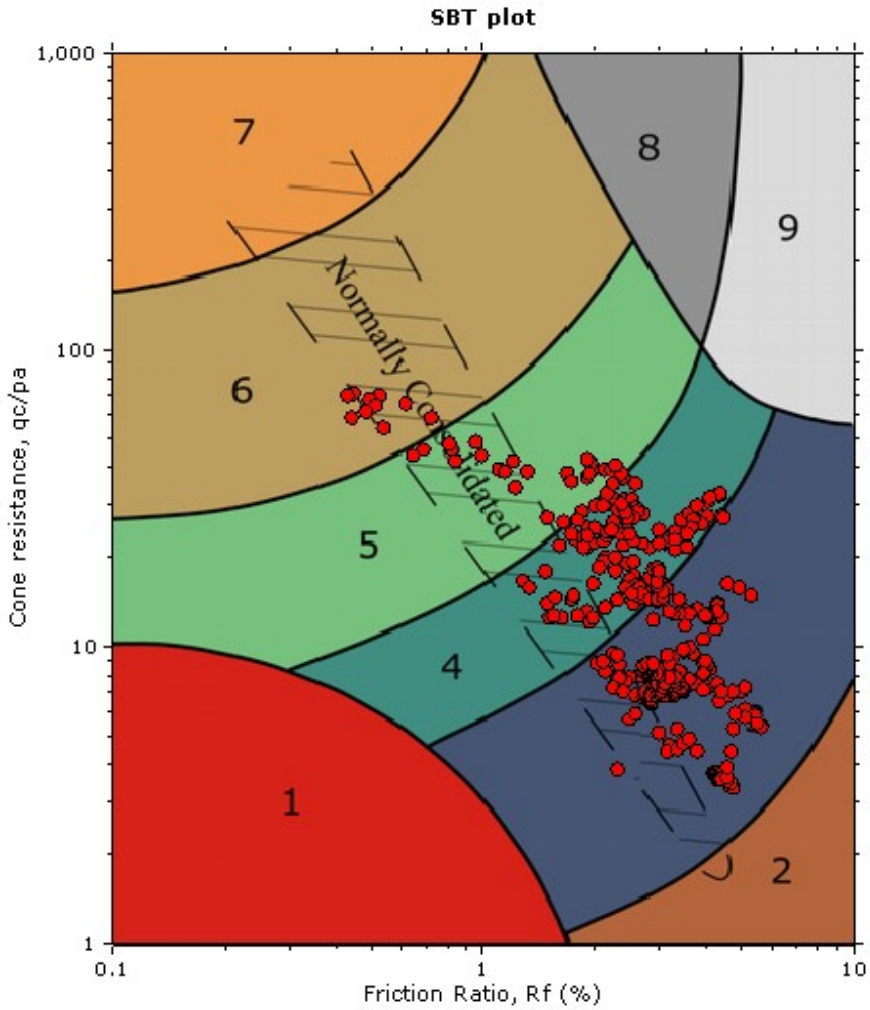
| No | B (ft) | Start Depth (ft) | End Depth (ft) | Ave. $q_t$ (tsf) | $R_k$ | Soil Press. (tsf) | Ult. bearing cap. (tsf) |
|---|---|---|---|---|---|---|---|
| 1 | 1.00 | 0.50 | 2.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 2 | 1.20 | 0.50 | 2.30 | 0.00 | 0.20 | 0.03 | 0.03 |
| 3 | 1.40 | 0.50 | 2.60 | 0.00 | 0.20 | 0.03 | 0.03 |
| 4 | 1.60 | 0.50 | 2.90 | 0.00 | 0.20 | 0.03 | 0.03 |
| 5 | 1.80 | 0.50 | 3.20 | 0.00 | 0.20 | 0.03 | 0.03 |
| 6 | 2.00 | 0.50 | 3.50 | 0.00 | 0.20 | 0.03 | 0.03 |
| 7 | 2.20 | 0.50 | 3.80 | 0.00 | 0.20 | 0.03 | 0.03 |
| 8 | 2.40 | 0.50 | 4.10 | 0.00 | 0.20 | 0.03 | 0.03 |
| 9 | 2.60 | 0.50 | 4.40 | 0.00 | 0.20 | 0.03 | 0.03 |
| 10 | 2.80 | 0.50 | 4.70 | 0.00 | 0.20 | 0.03 | 0.03 |
| 11 | 3.00 | 0.50 | 5.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 12 | 3.20 | 0.50 | 5.30 | 0.58 | 0.20 | 0.03 | 0.15 |
| 13 | 3.40 | 0.50 | 5.60 | 2.25 | 0.20 | 0.03 | 0.48 |
| 14 | 3.60 | 0.50 | 5.90 | 3.28 | 0.20 | 0.03 | 0.69 |
| 15 | 3.80 | 0.50 | 6.20 | 4.65 | 0.20 | 0.03 | 0.96 |
| 16 | 4.00 | 0.50 | 6.50 | 5.46 | 0.20 | 0.03 | 1.12 |

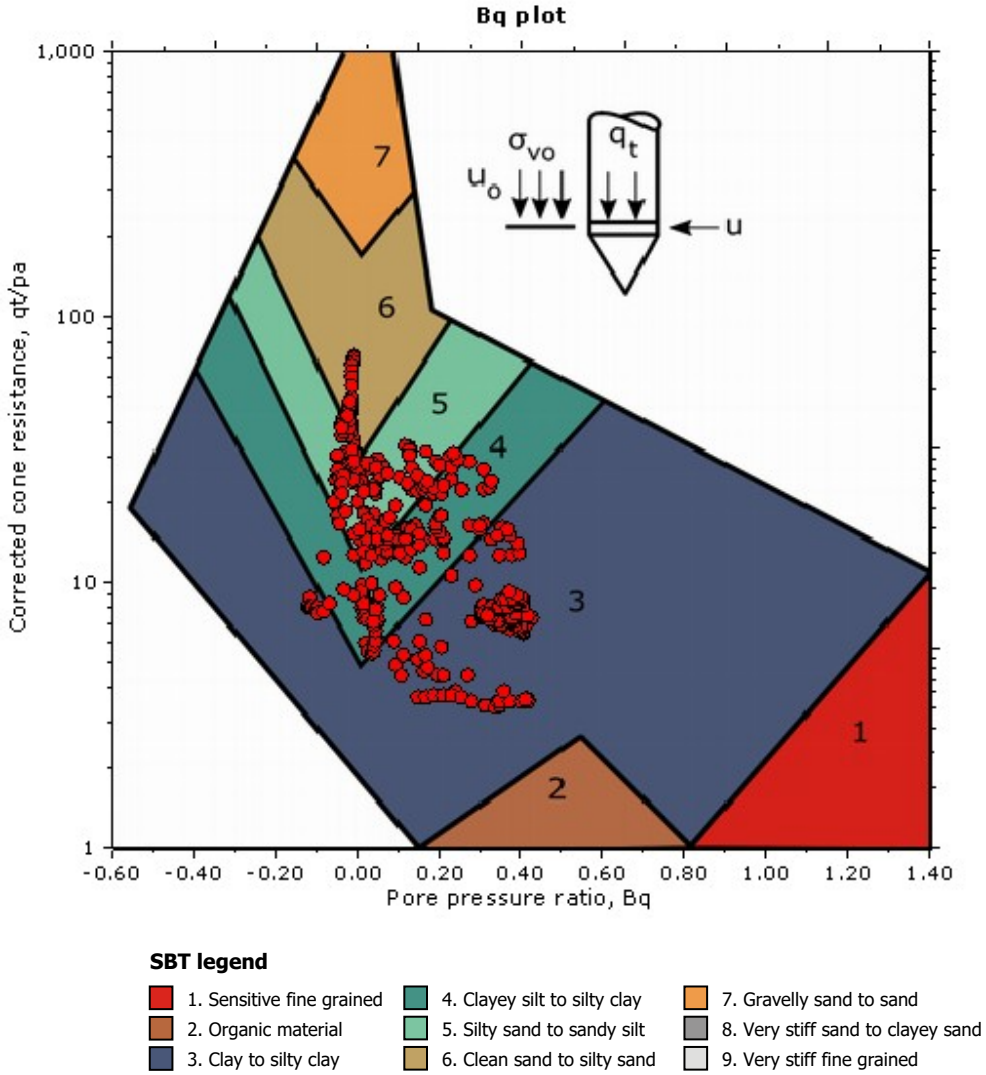



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



## SBT - Bq plots

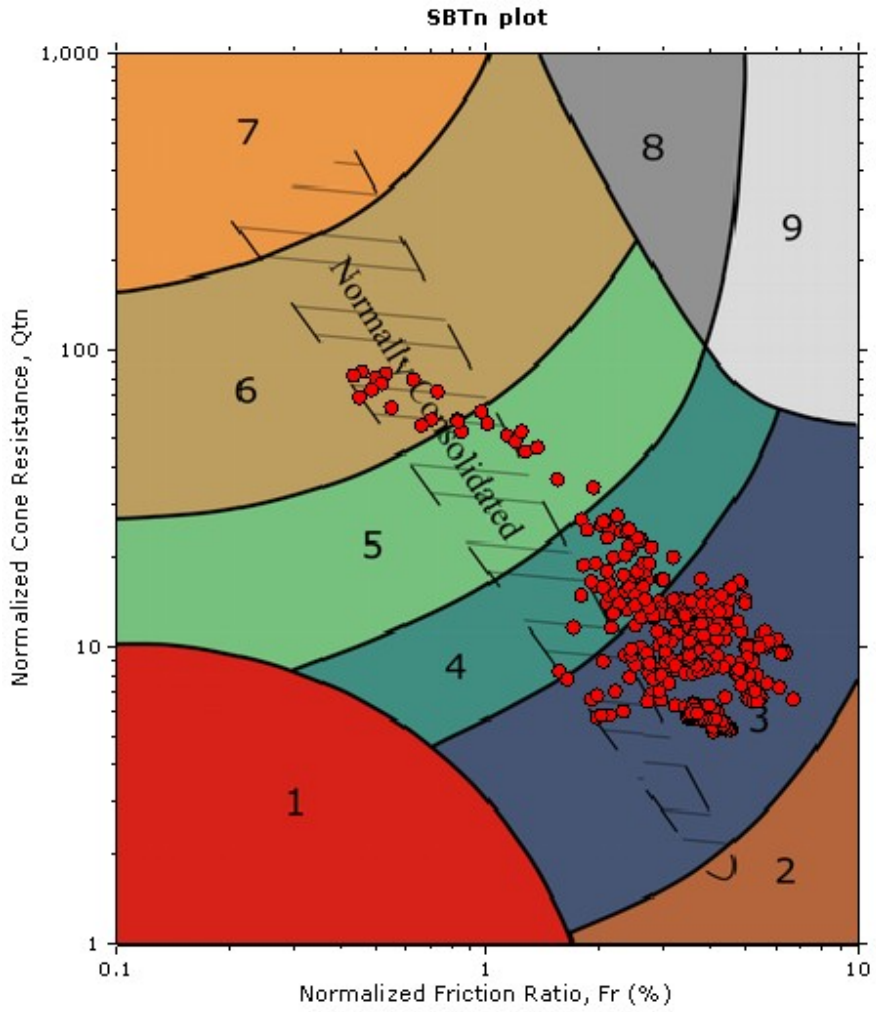


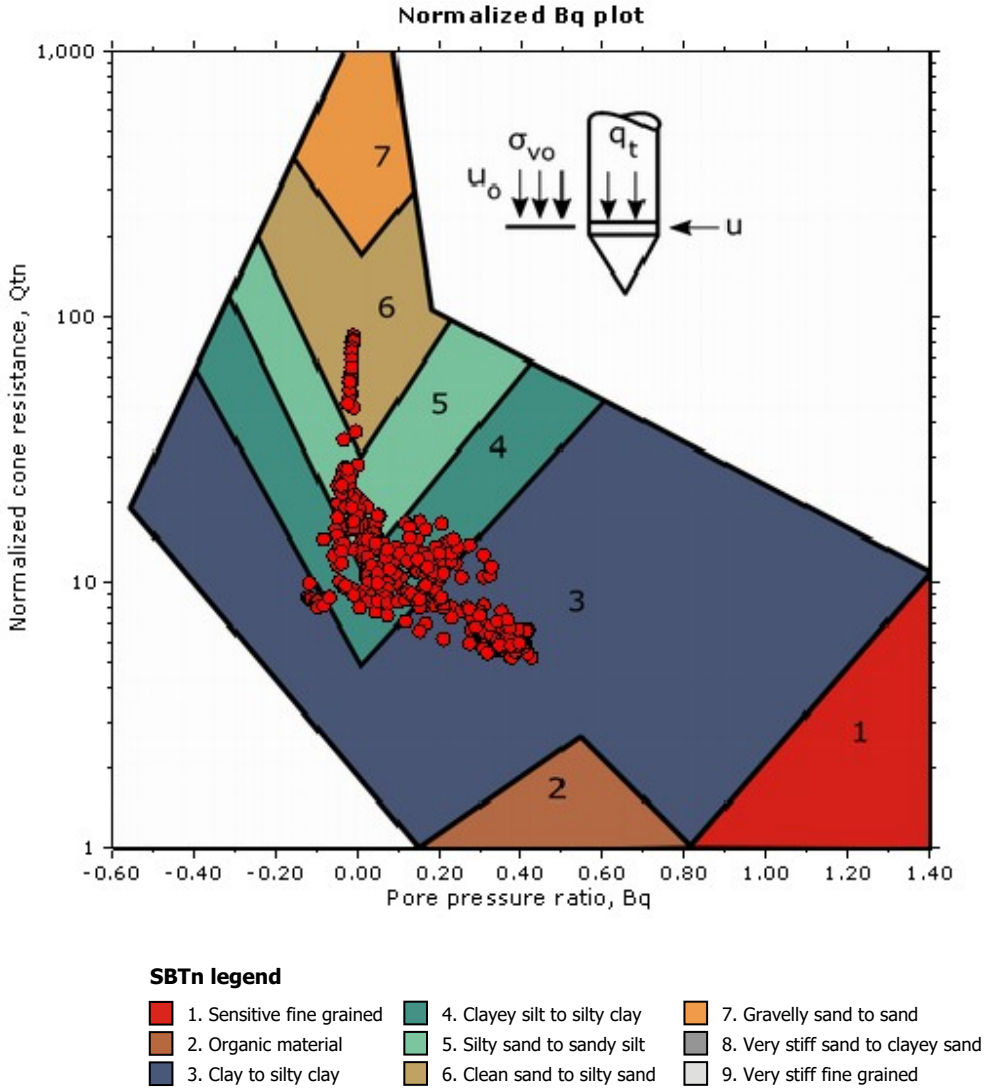




**SBT legend**

| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## SBT - Bq plots (normalized)

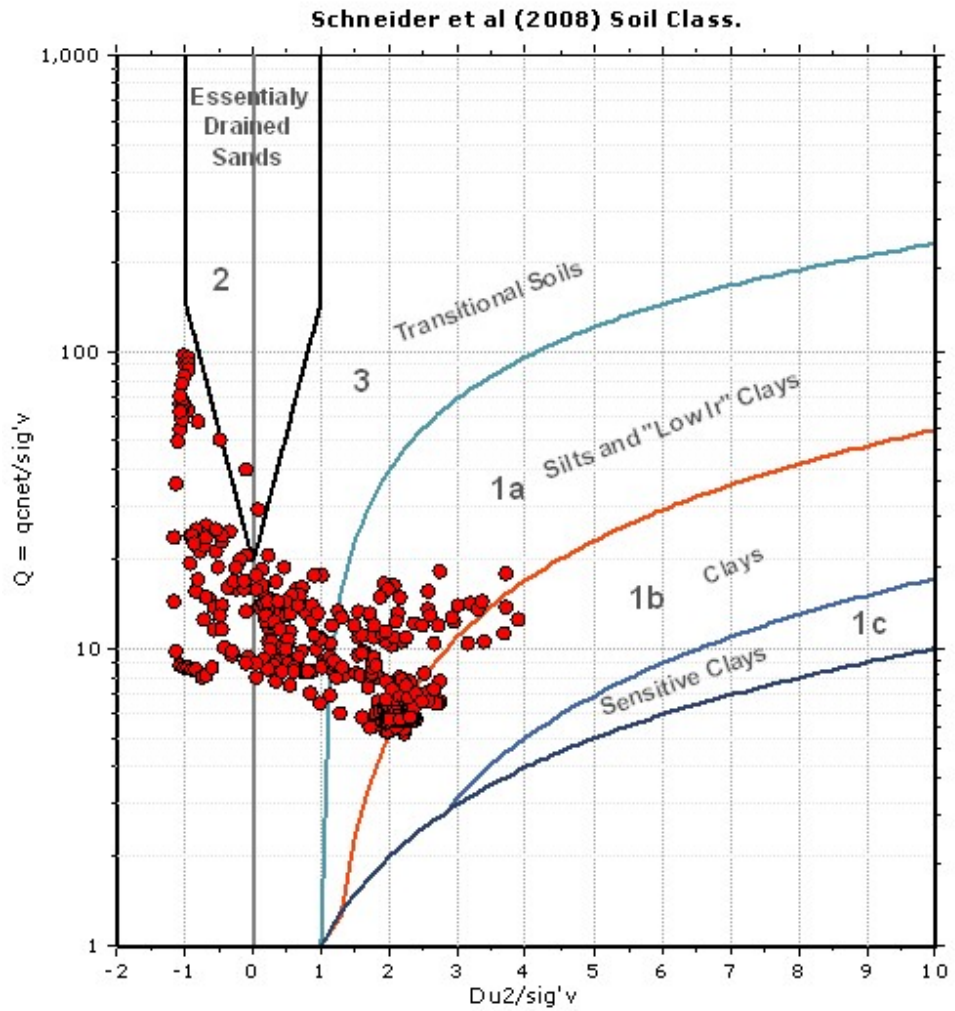


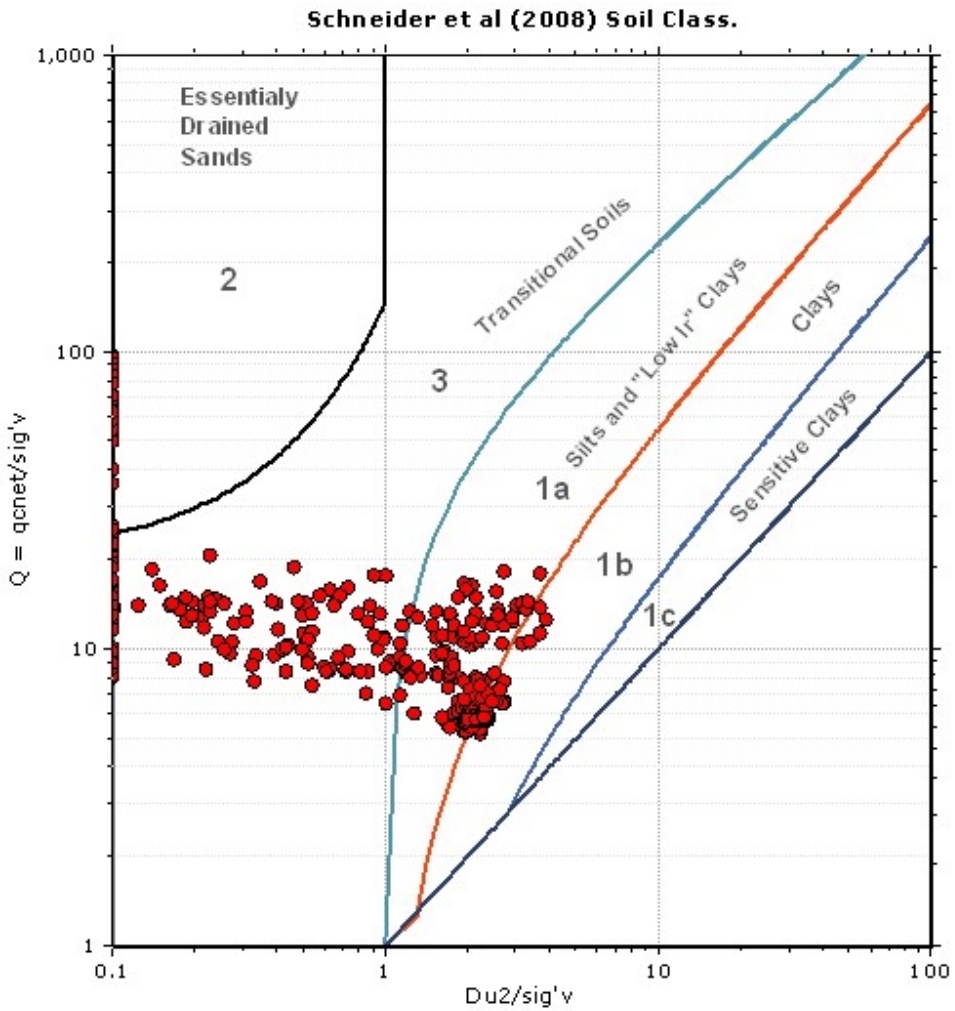



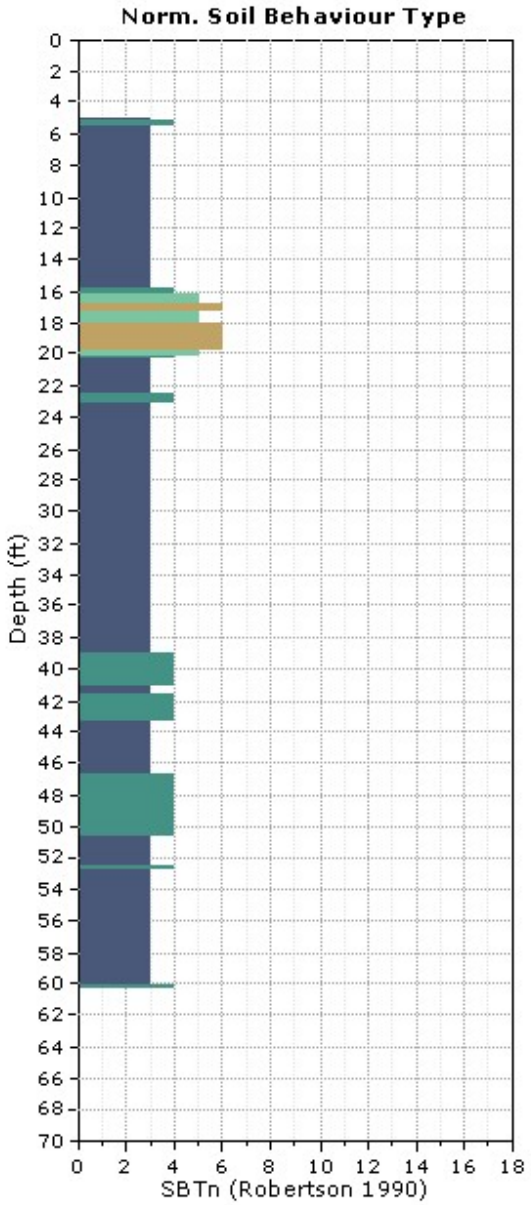

**SBTn legend**

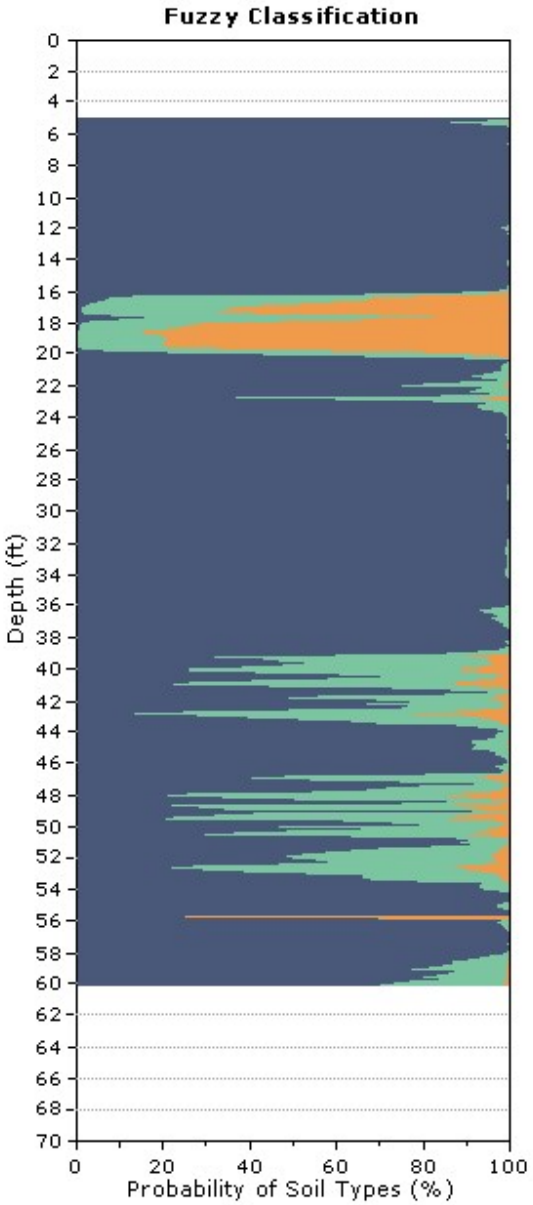
| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## Bq plots (Schneider)



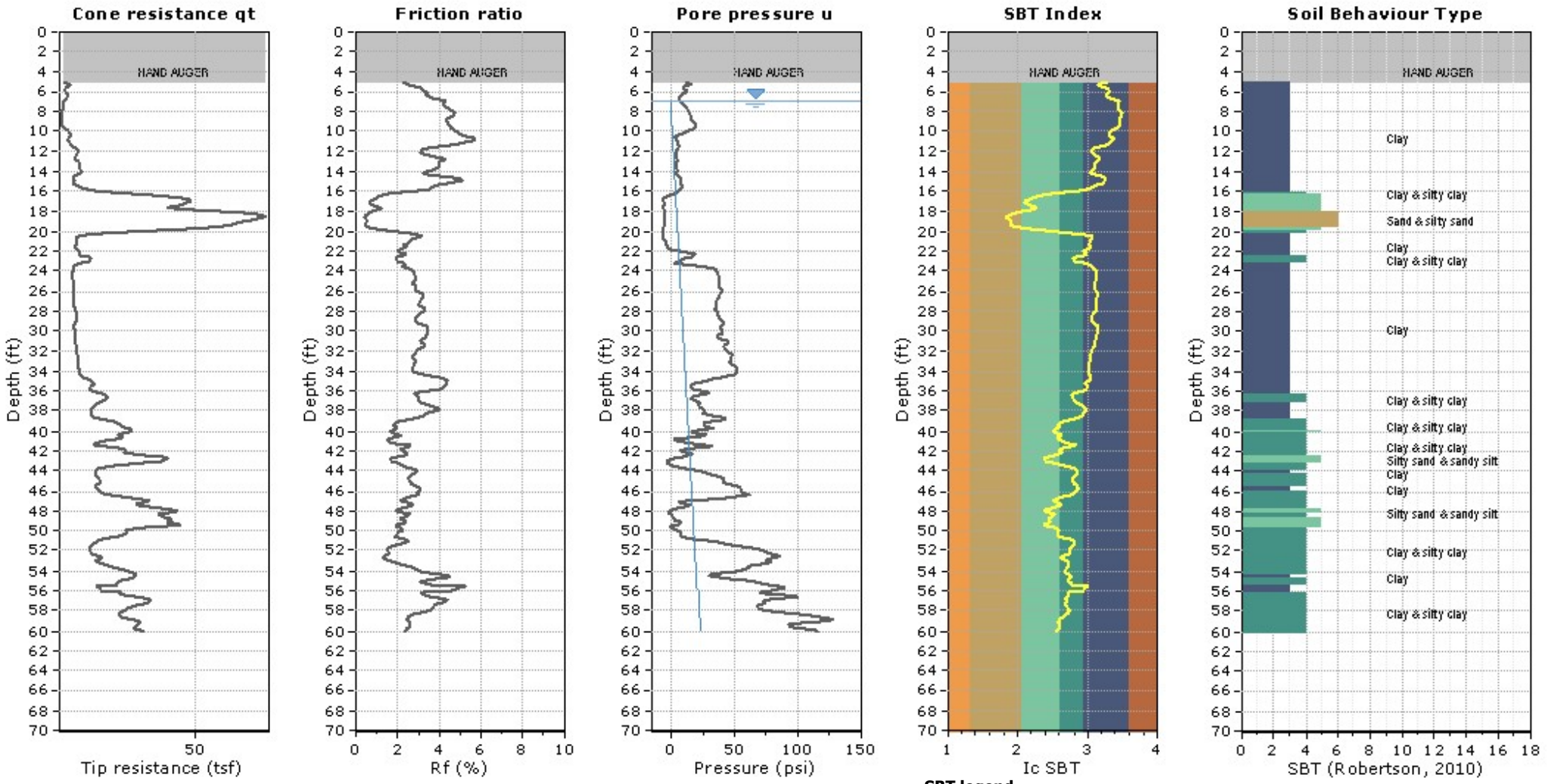



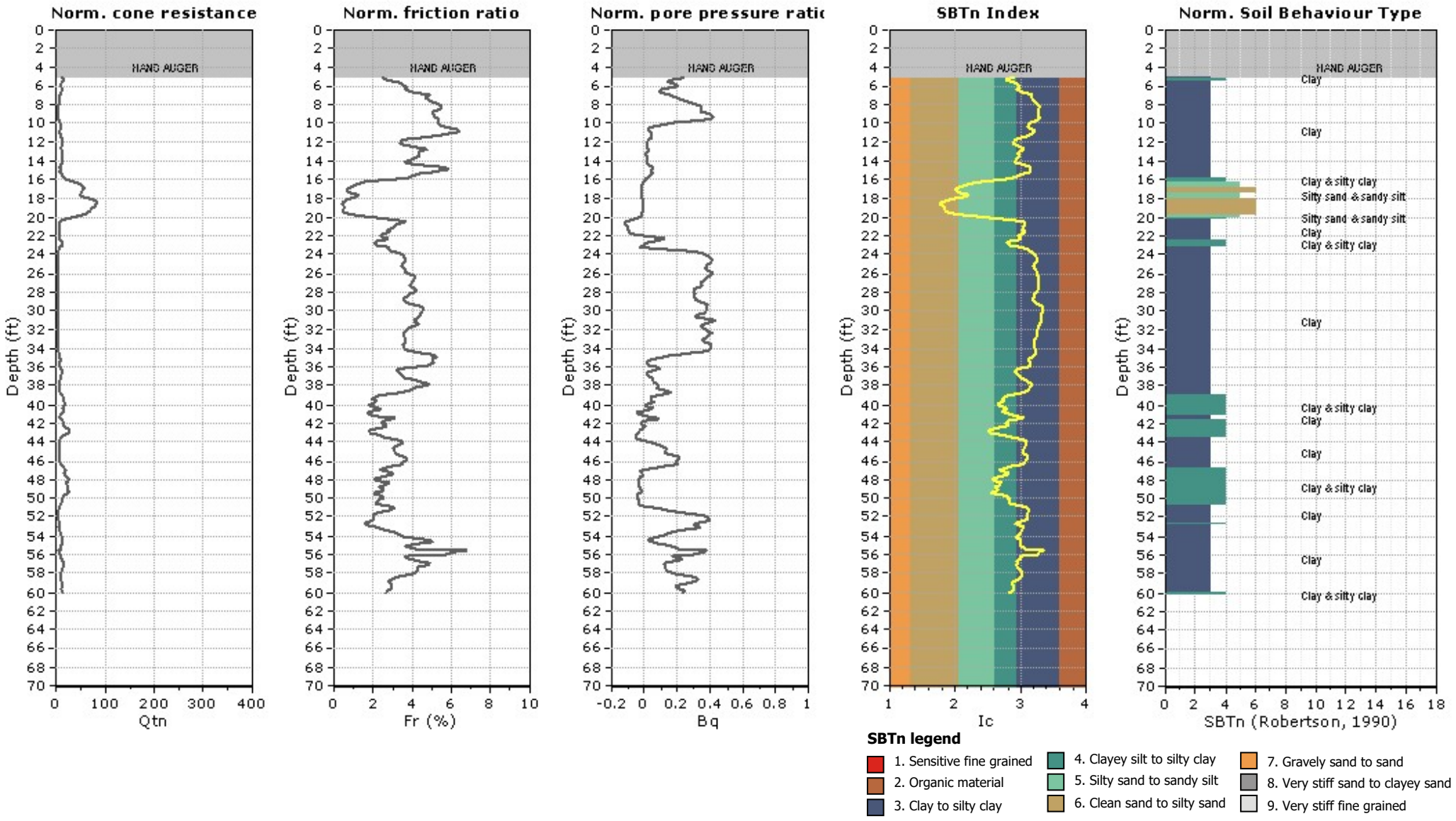

Norm. Soil Behaviour Type
Depth (ft)
SBTn (Robertson 1990)

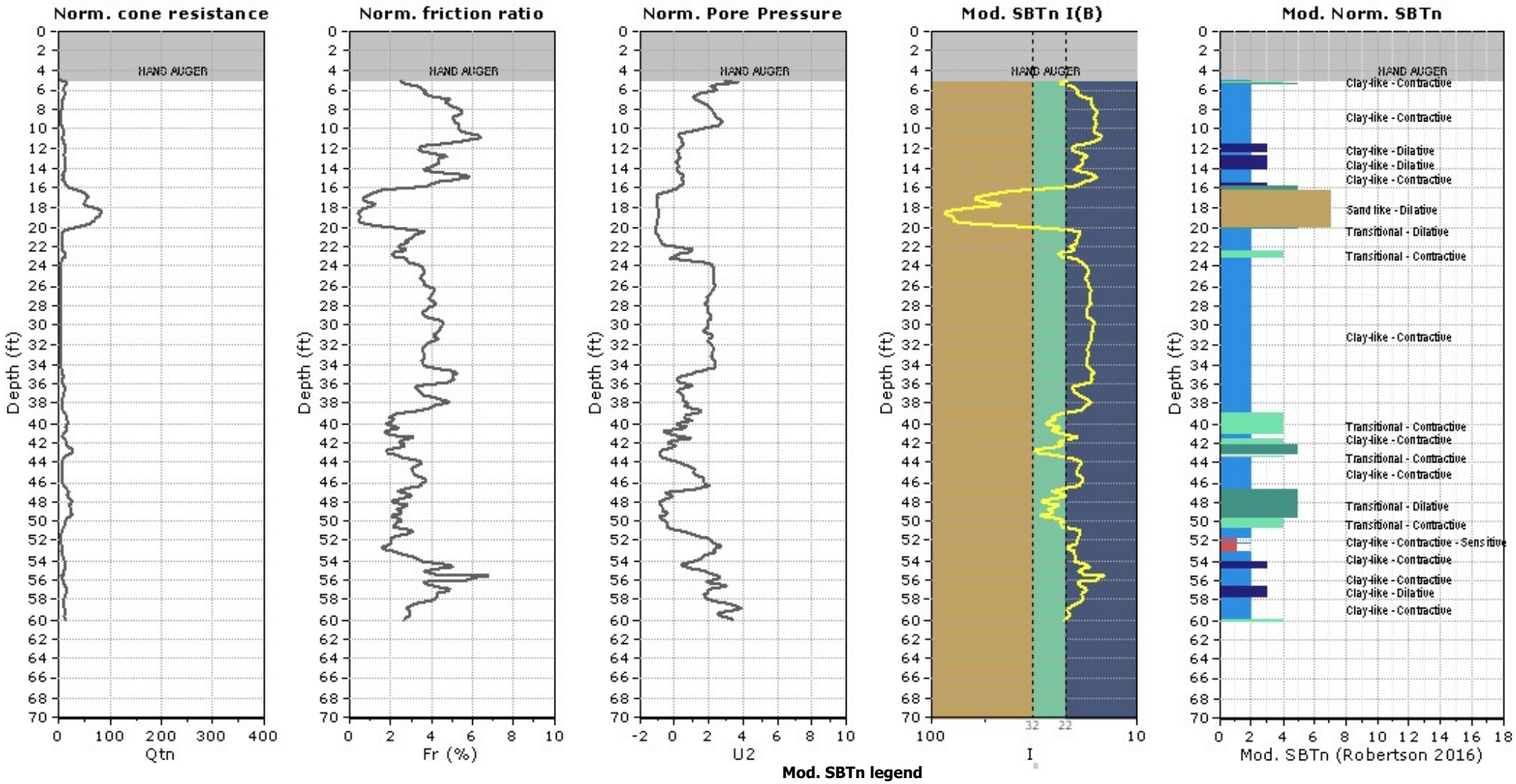

Fuzzy Classification
Depth (ft)
Probability of Soil Types (%)

**CPT: CPT-09**
Total depth: 60.04 ft, Date: 4/25/2018
Surface Elevation: 11.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

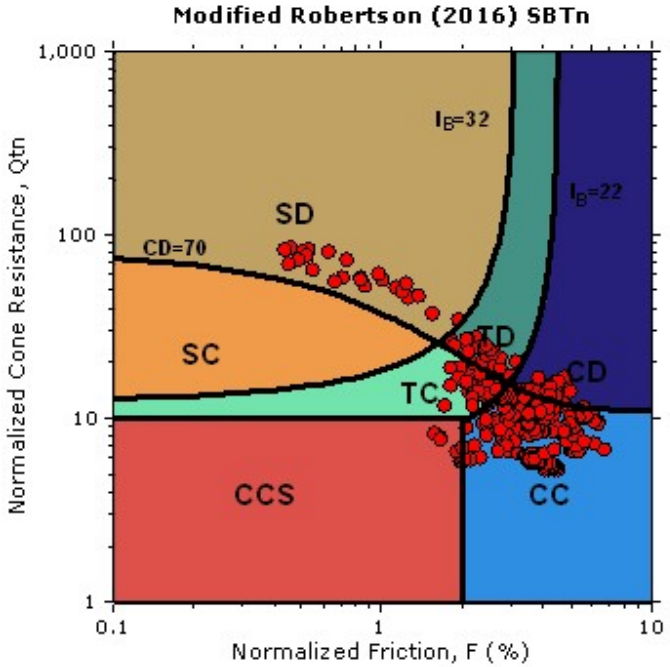
**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA

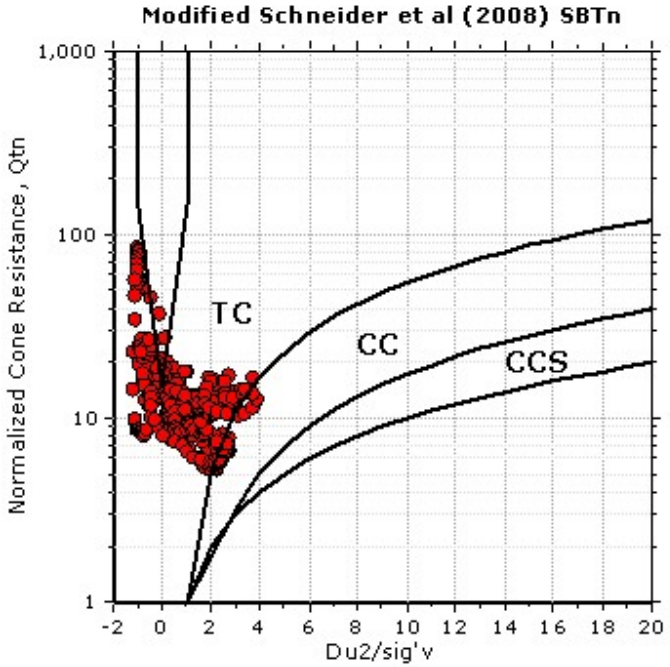


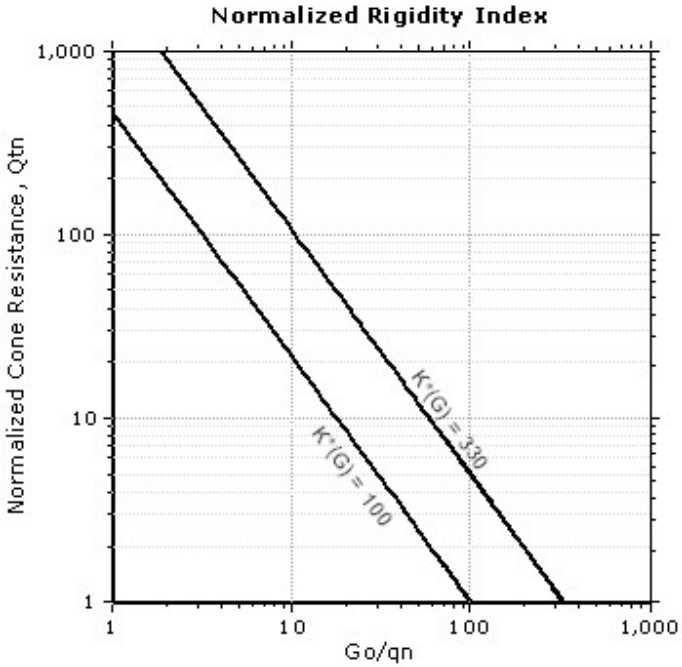

Norm. cone resistance
Norm. friction ratio
Norm. pore pressure ratio
SBTn Index
Norm. Soil Behaviour Type
HAND AUGER
Depth (ft)
Qtn
Fr (%)
Bq
Ic
SBTn (Robertson, 1990)
Clay
Clay & silty clay
Silty sand & sandy silt
SBTn legend
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained


Norm. cone resistance
Norm. friction ratio
Norm. Pore Pressure
Mod. SBTn I(B)
Mod. Norm. SBTn
HAND AUGER
Depth (ft)
Qtn
Fr (%)
U2
I
Mod. SBTn (Robertson 2016)
Clay-like - Contractive
Clay-like - Dilative
Sand like - Dilative
Transitional - Dilative
Transitional - Contractive
Clay-like - Contractive - Sensitive
Mod. SBTn legend
1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

## Updated SBTn plots

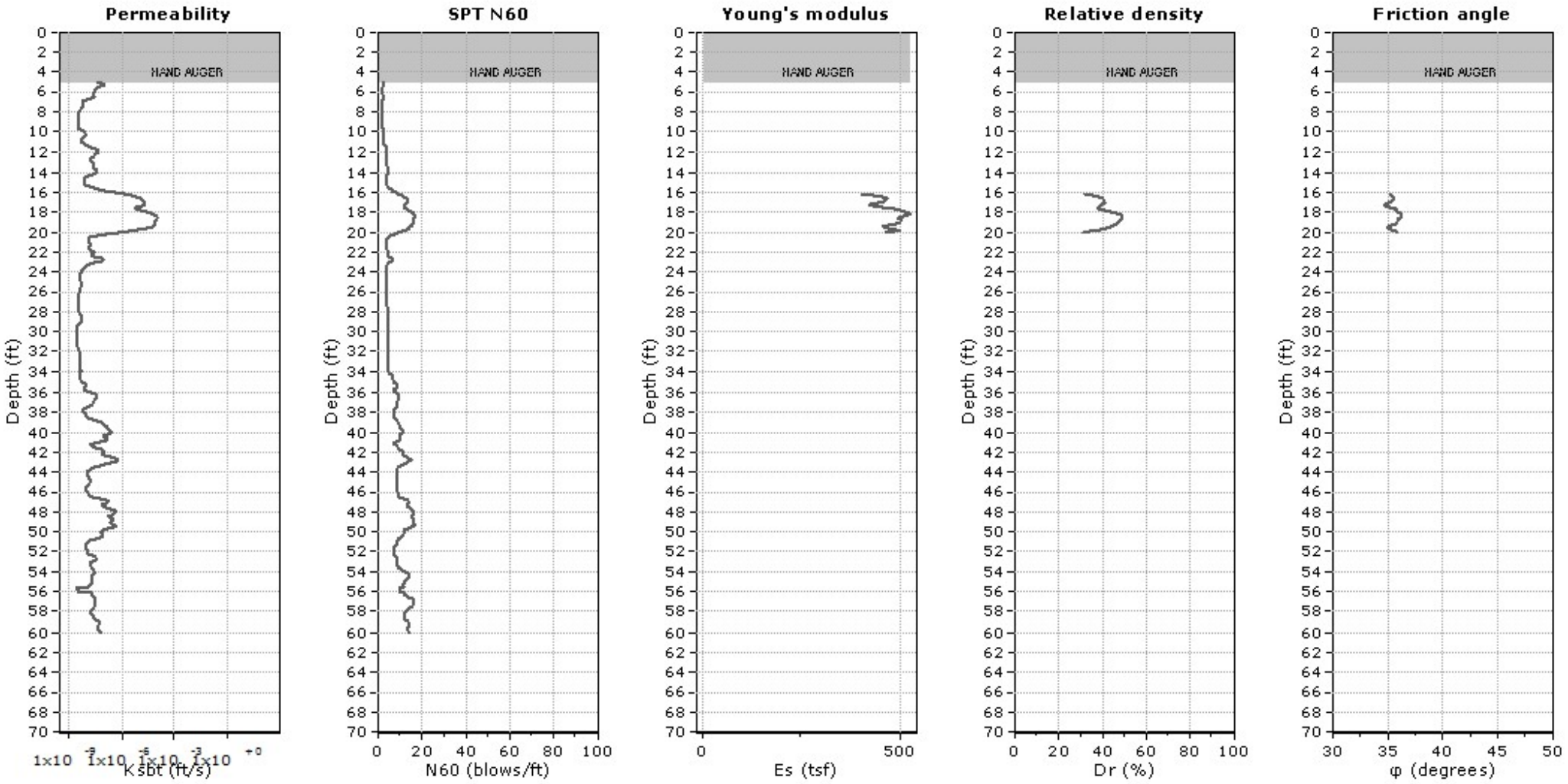


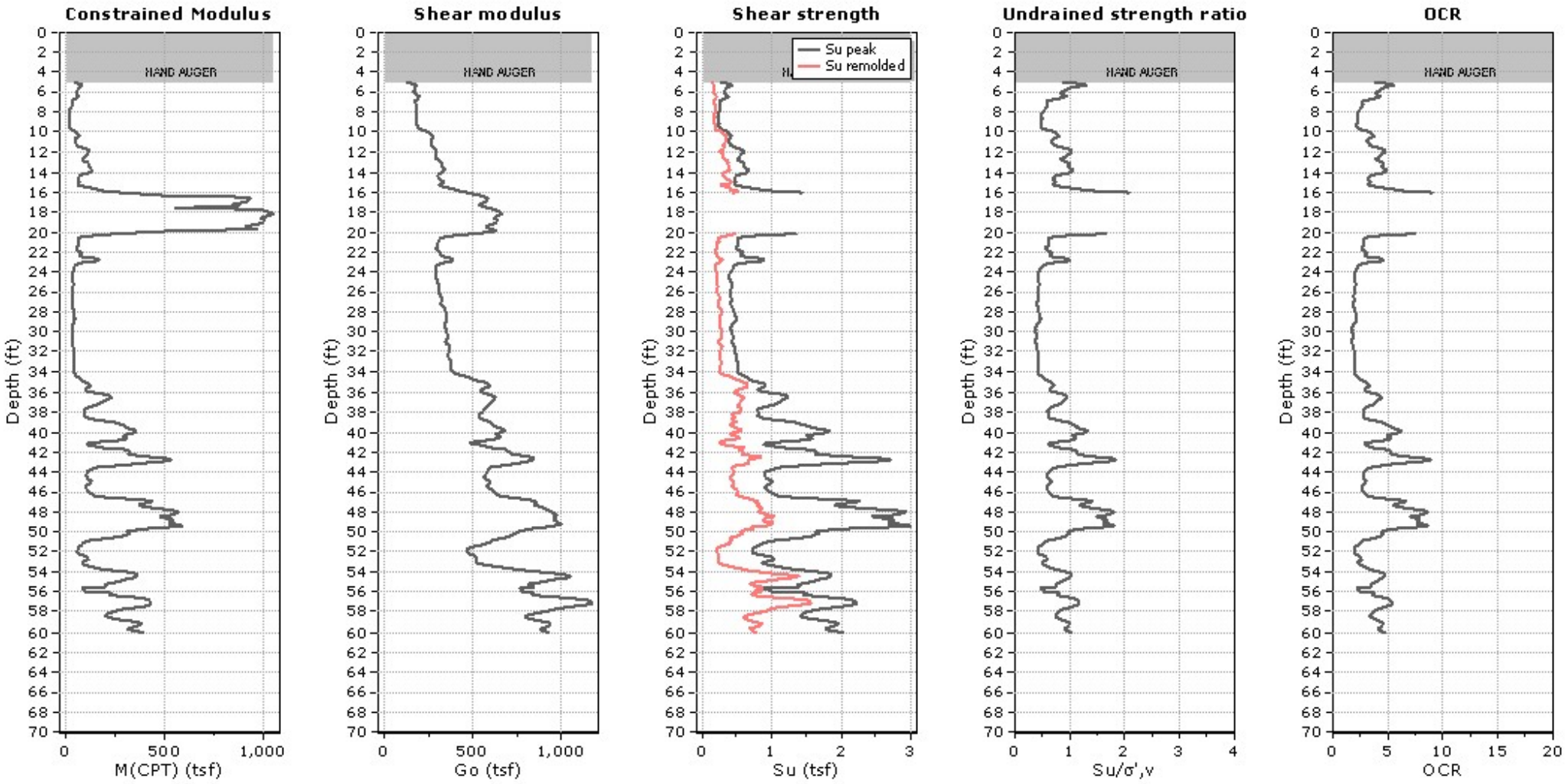

CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)



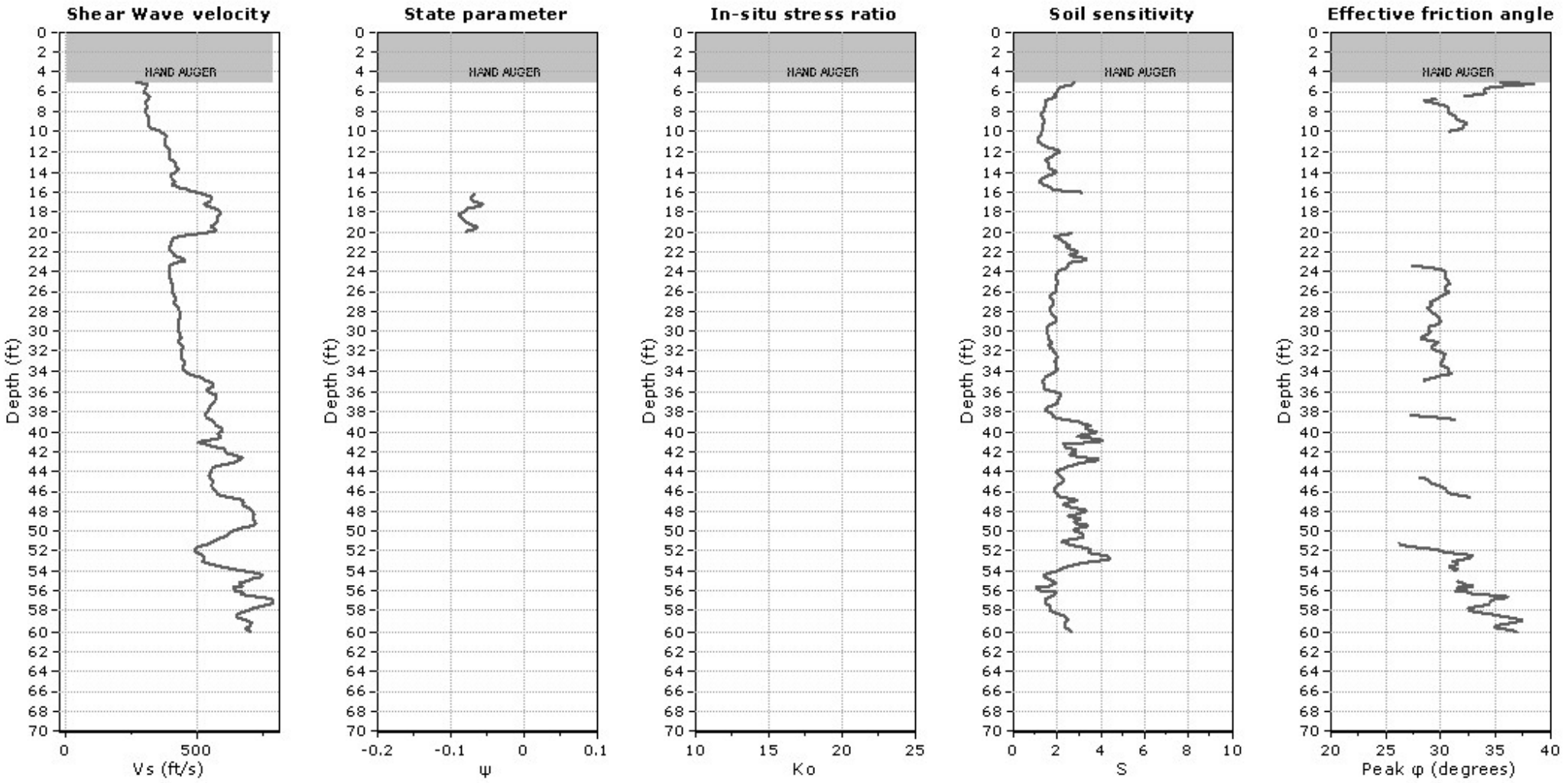

**Calculation parameters**

Permeability: Based on $SBT_n$
SPT $N_{60}$: Based on $I_c$ and $q_t$
Young's modulus: Based on variable alpha using $I_c$ (Robertson, 2009)
Relative density constant, $C_{Dr}$: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data




**Calculation parameters**

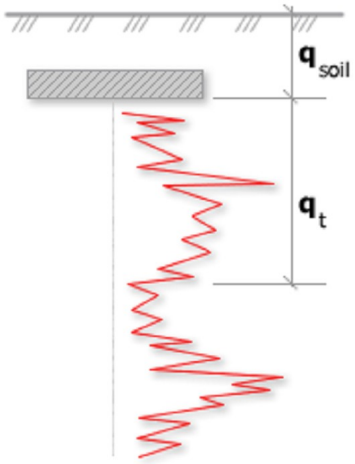
Constrained modulus: Based on variable alpha using $I_c$ and $Q_{tn}$ (Robertson, 2009)
Go: Based on variable alpha using $I_c$ (Robertson, 2009)
Undrained shear strength cone factor for clays, $N_{kt}$: 14
OCR factor for clays, $N_{kt}$: 0.33
User defined estimation data
Flat Dilatometer Test data




**Calculation parameters**

Soil Sensitivity factor, $N_S$: 7.00

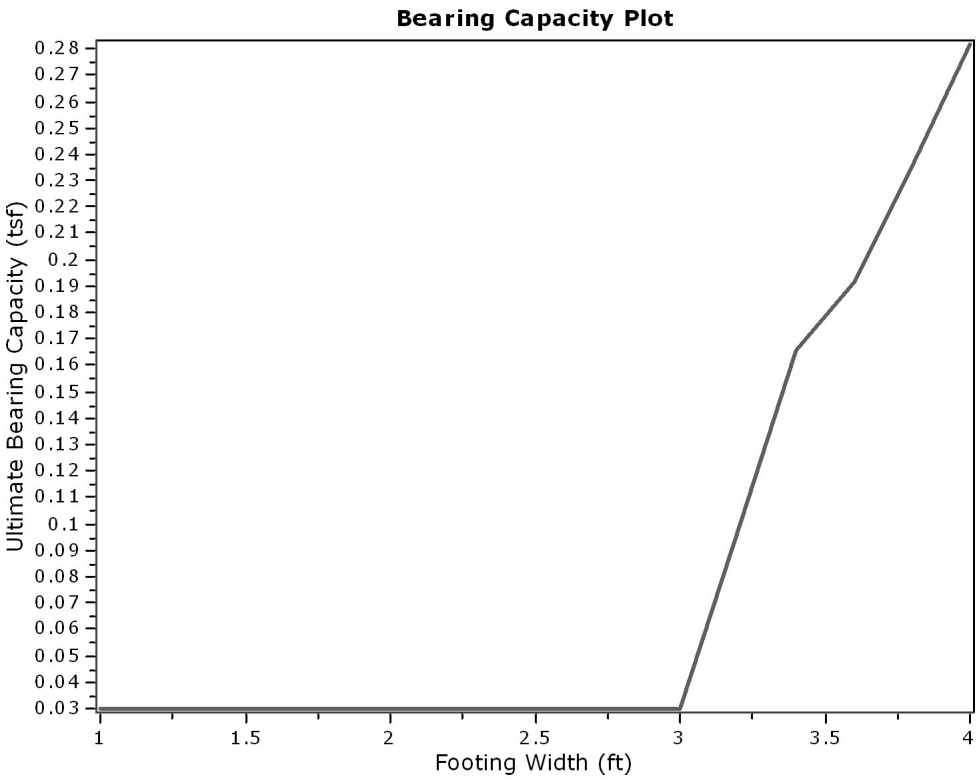
User defined estimation data




Bearing Capacity calculation is perfromed based on the formula:

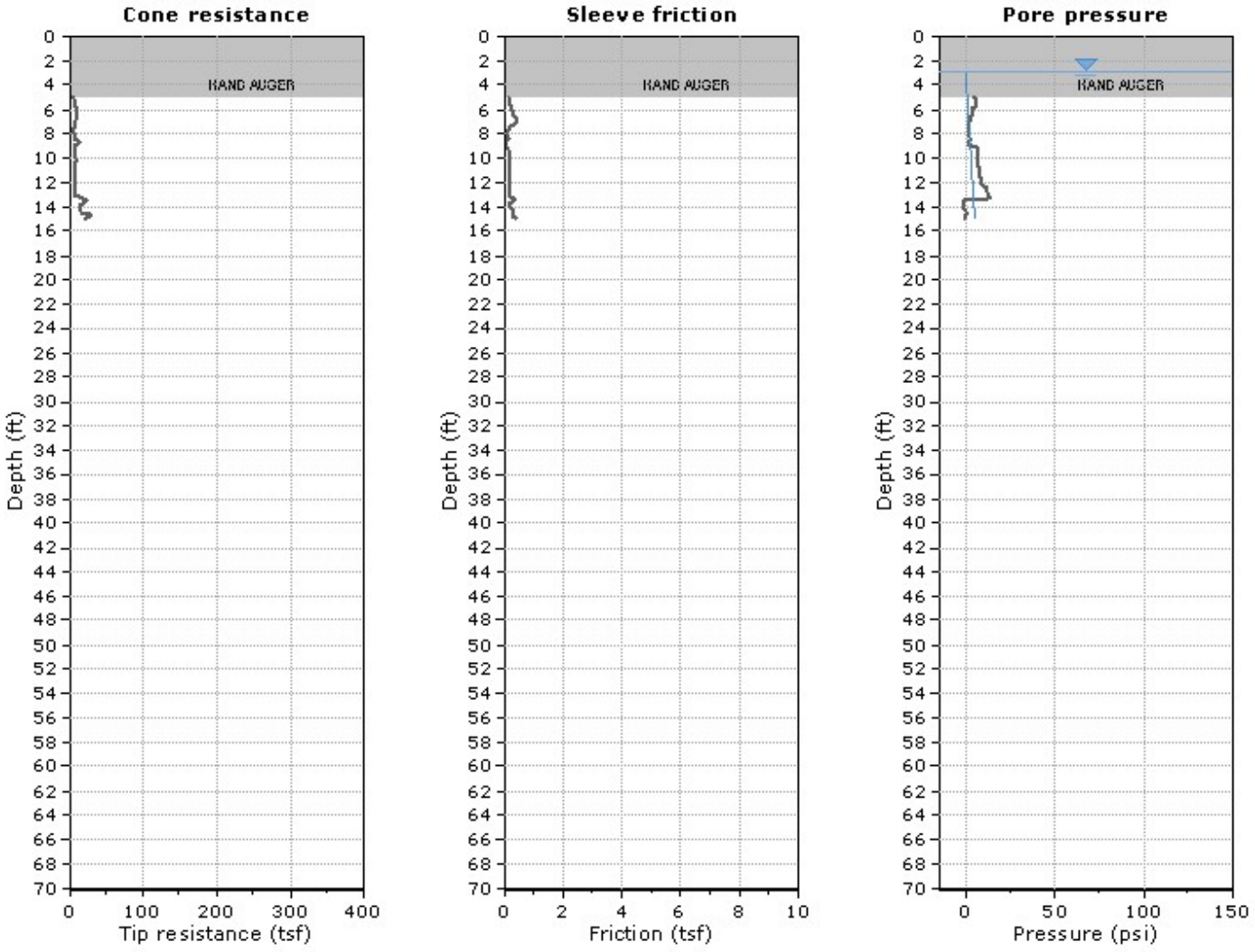
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
$R_k$: Bearing capacity factor
$q_t$: Average corrected cone resistance over calculation depth
$q_{soil}$: Pressure applied by soil above footing

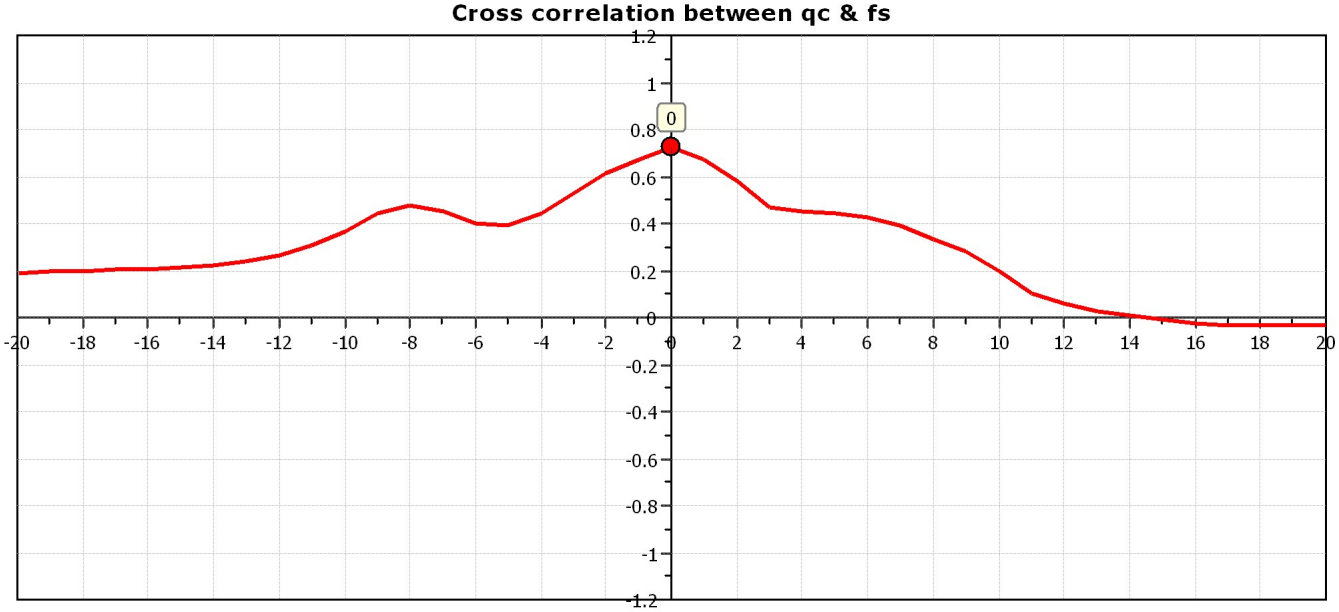



**:: Tabular results ::**

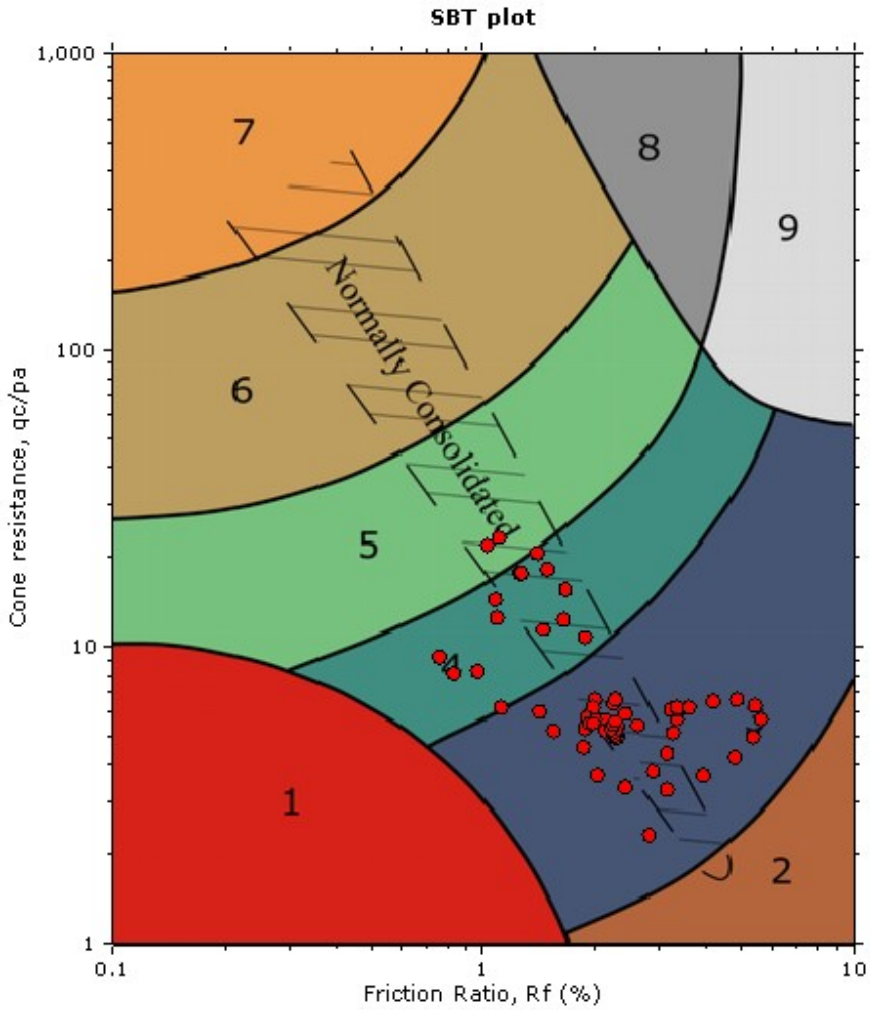
| No | B (ft) | Start Depth (ft) | End Depth (ft) | Ave. $q_t$ (tsf) | $R_k$ | Soil Press. (tsf) | Ult. bearing cap. (tsf) |
|---|---|---|---|---|---|---|---|
| 1 | 1.00 | 0.50 | 2.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 2 | 1.20 | 0.50 | 2.30 | 0.00 | 0.20 | 0.03 | 0.03 |
| 3 | 1.40 | 0.50 | 2.60 | 0.00 | 0.20 | 0.03 | 0.03 |
| 4 | 1.60 | 0.50 | 2.90 | 0.00 | 0.20 | 0.03 | 0.03 |
| 5 | 1.80 | 0.50 | 3.20 | 0.00 | 0.20 | 0.03 | 0.03 |
| 6 | 2.00 | 0.50 | 3.50 | 0.00 | 0.20 | 0.03 | 0.03 |
| 7 | 2.20 | 0.50 | 3.80 | 0.00 | 0.20 | 0.03 | 0.03 |
| 8 | 2.40 | 0.50 | 4.10 | 0.00 | 0.20 | 0.03 | 0.03 |
| 9 | 2.60 | 0.50 | 4.40 | 0.00 | 0.20 | 0.03 | 0.03 |
| 10 | 2.80 | 0.50 | 4.70 | 0.00 | 0.20 | 0.03 | 0.03 |
| 11 | 3.00 | 0.50 | 5.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 12 | 3.20 | 0.50 | 5.30 | 0.34 | 0.20 | 0.03 | 0.10 |
| 13 | 3.40 | 0.50 | 5.60 | 0.68 | 0.20 | 0.03 | 0.17 |
| 14 | 3.60 | 0.50 | 5.90 | 0.81 | 0.20 | 0.03 | 0.19 |
| 15 | 3.80 | 0.50 | 6.20 | 1.03 | 0.20 | 0.03 | 0.24 |
| 16 | 4.00 | 0.50 | 6.50 | 1.26 | 0.20 | 0.03 | 0.28 |

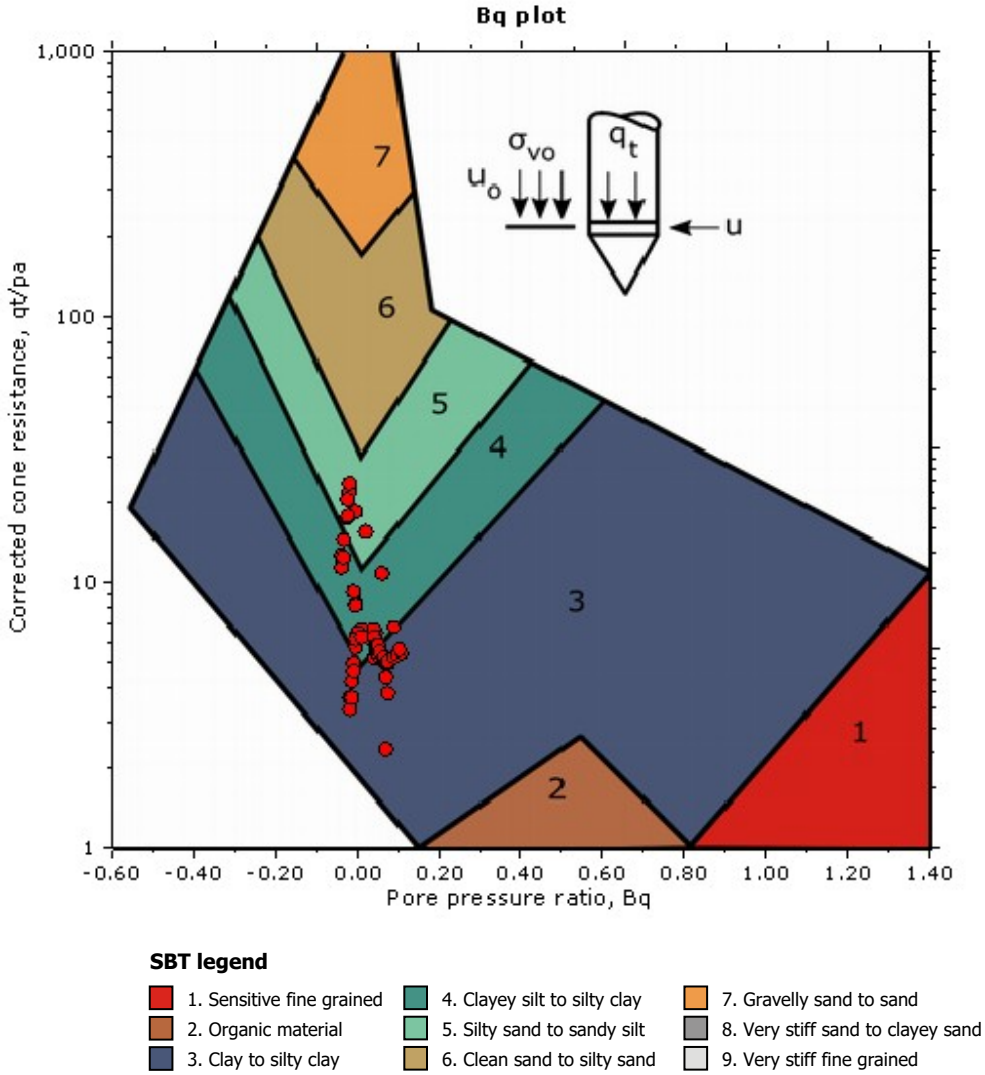



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



## SBT - Bq plots

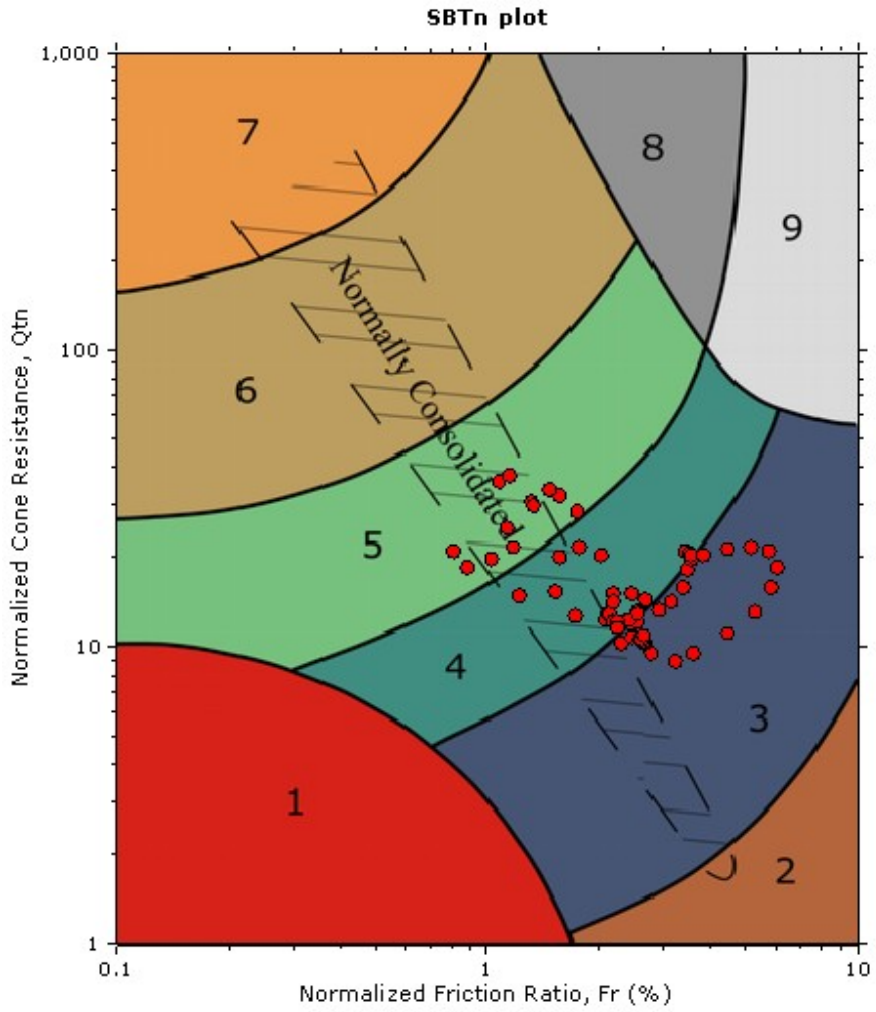


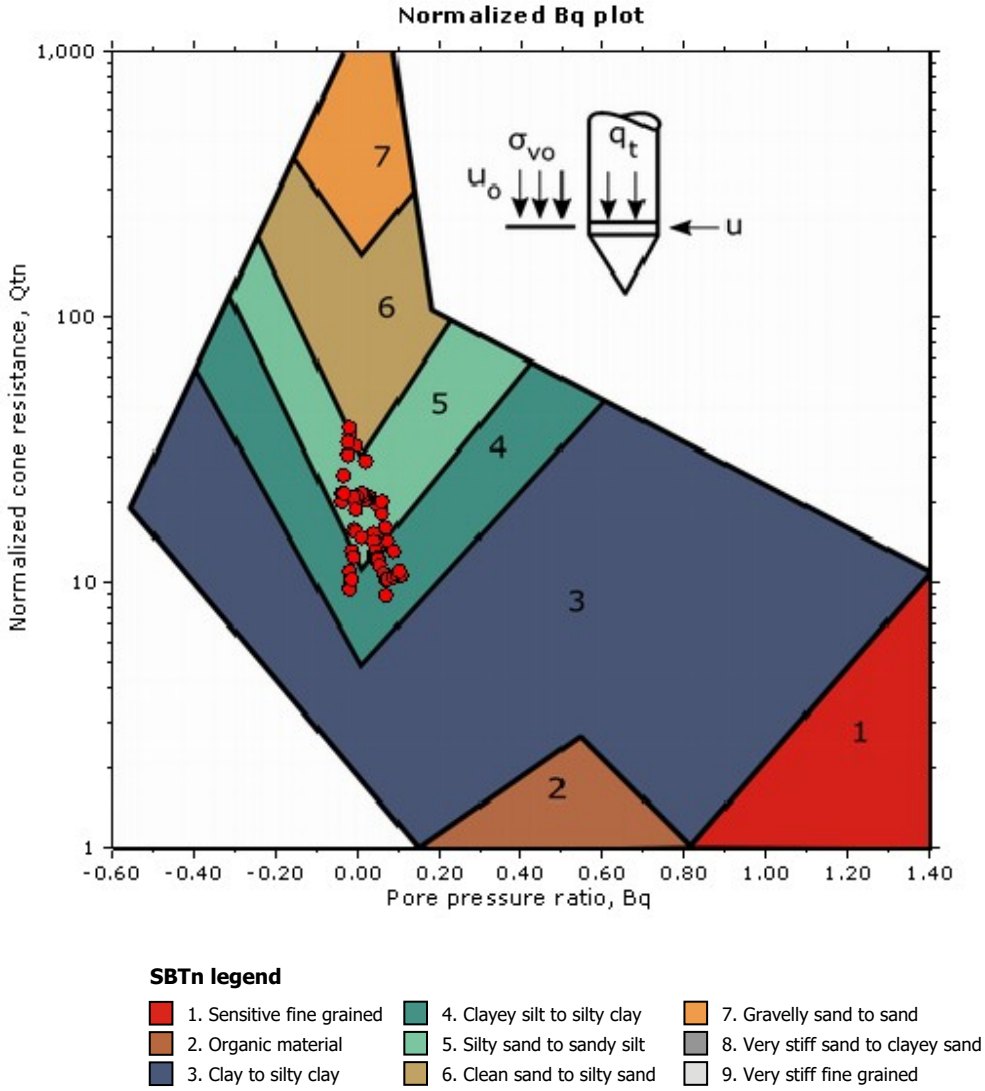




**SBT legend**

| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## SBT - Bq plots (normalized)

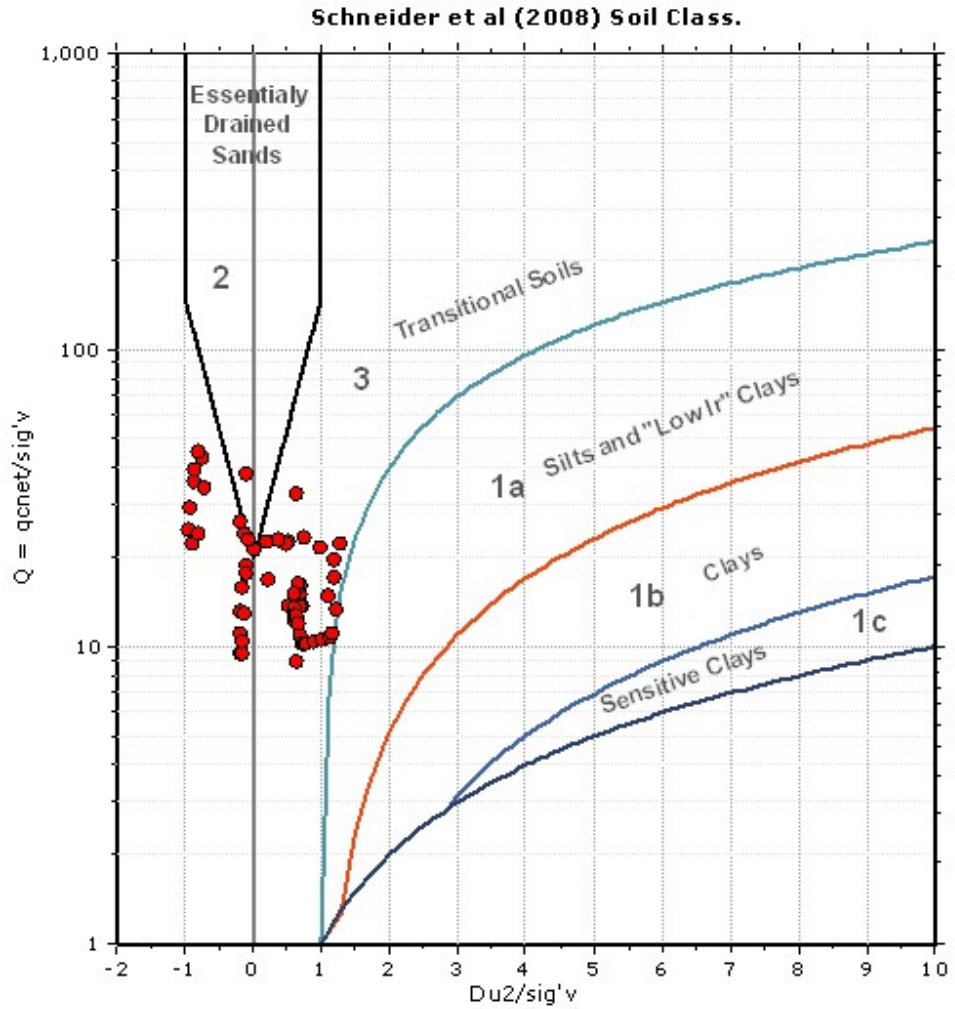


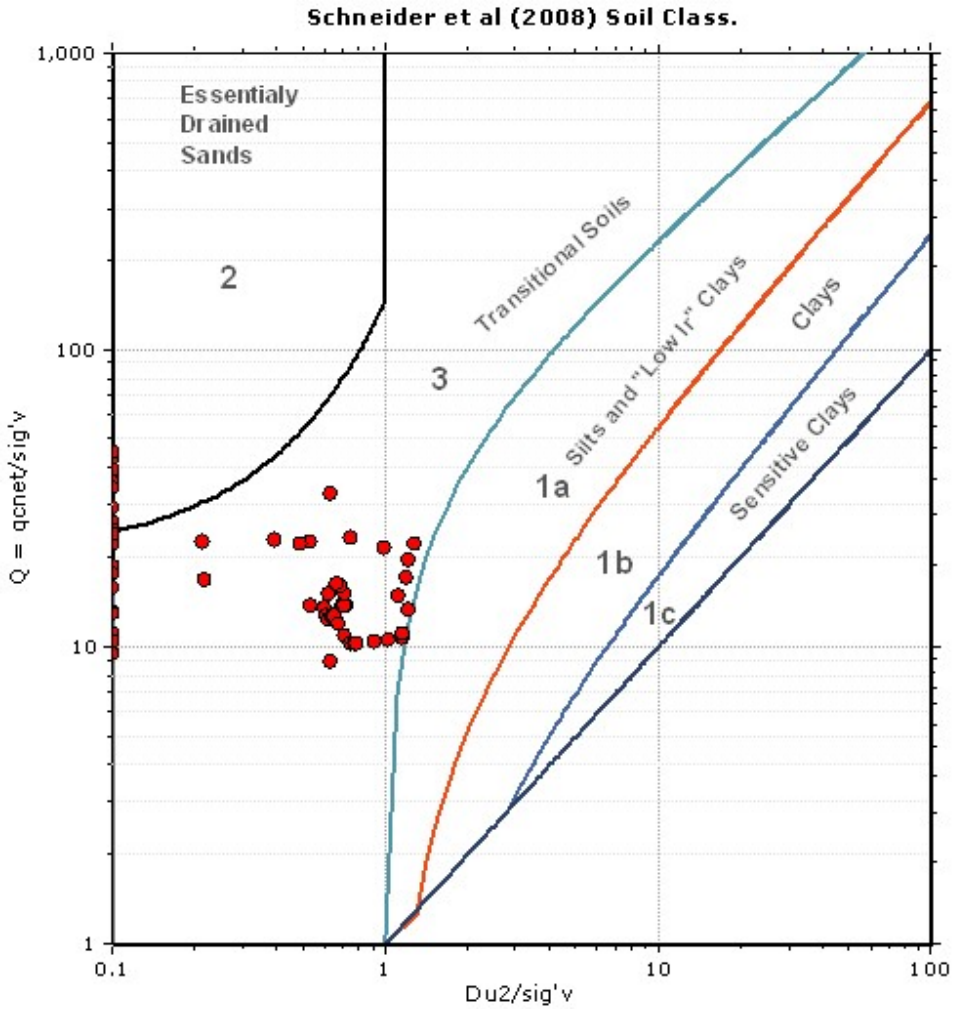



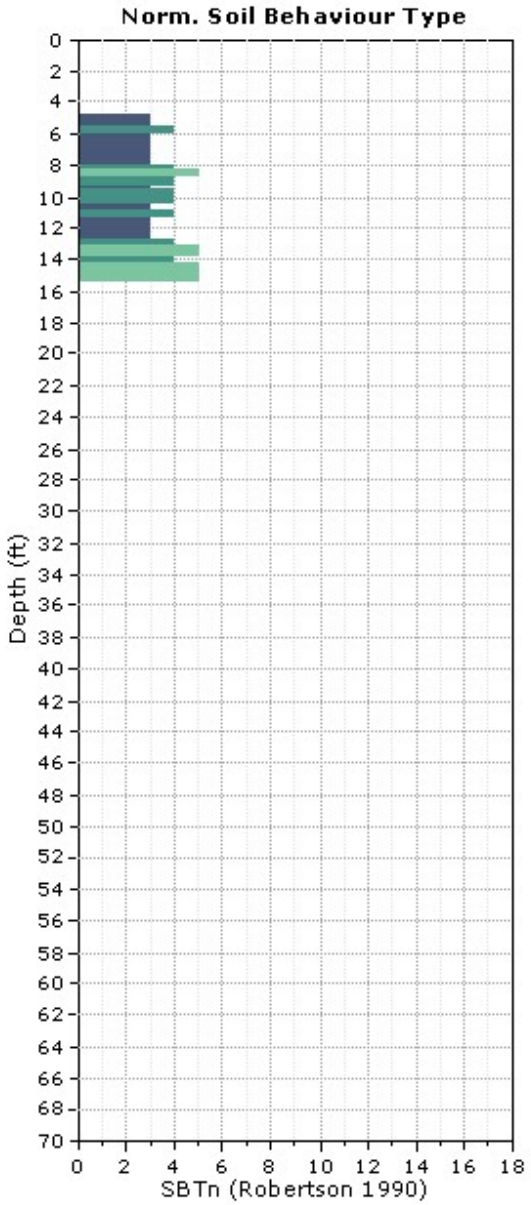

**SBTn legend**

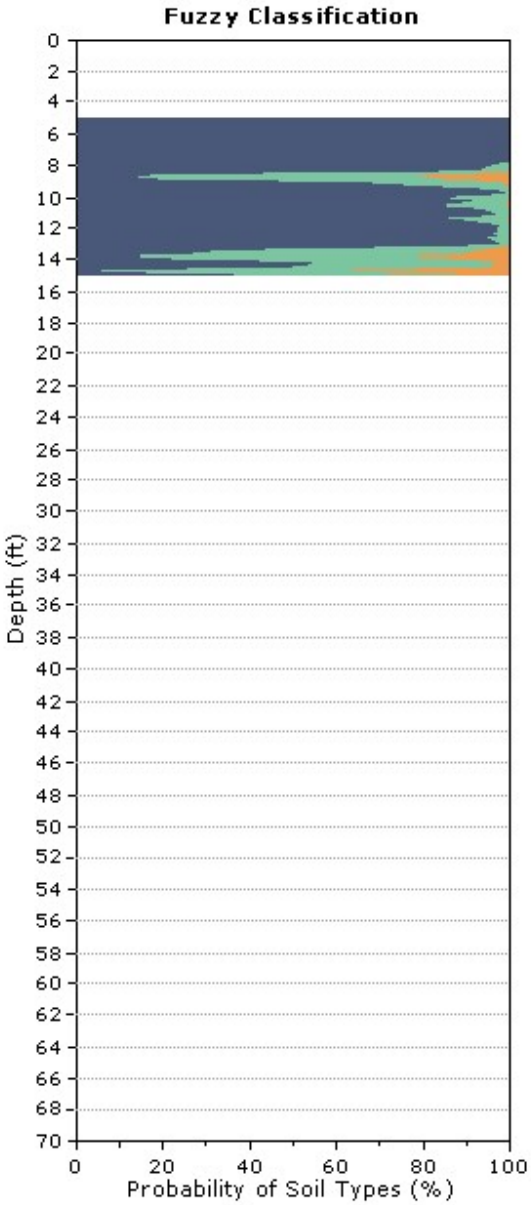
| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## Bq plots (Schneider)



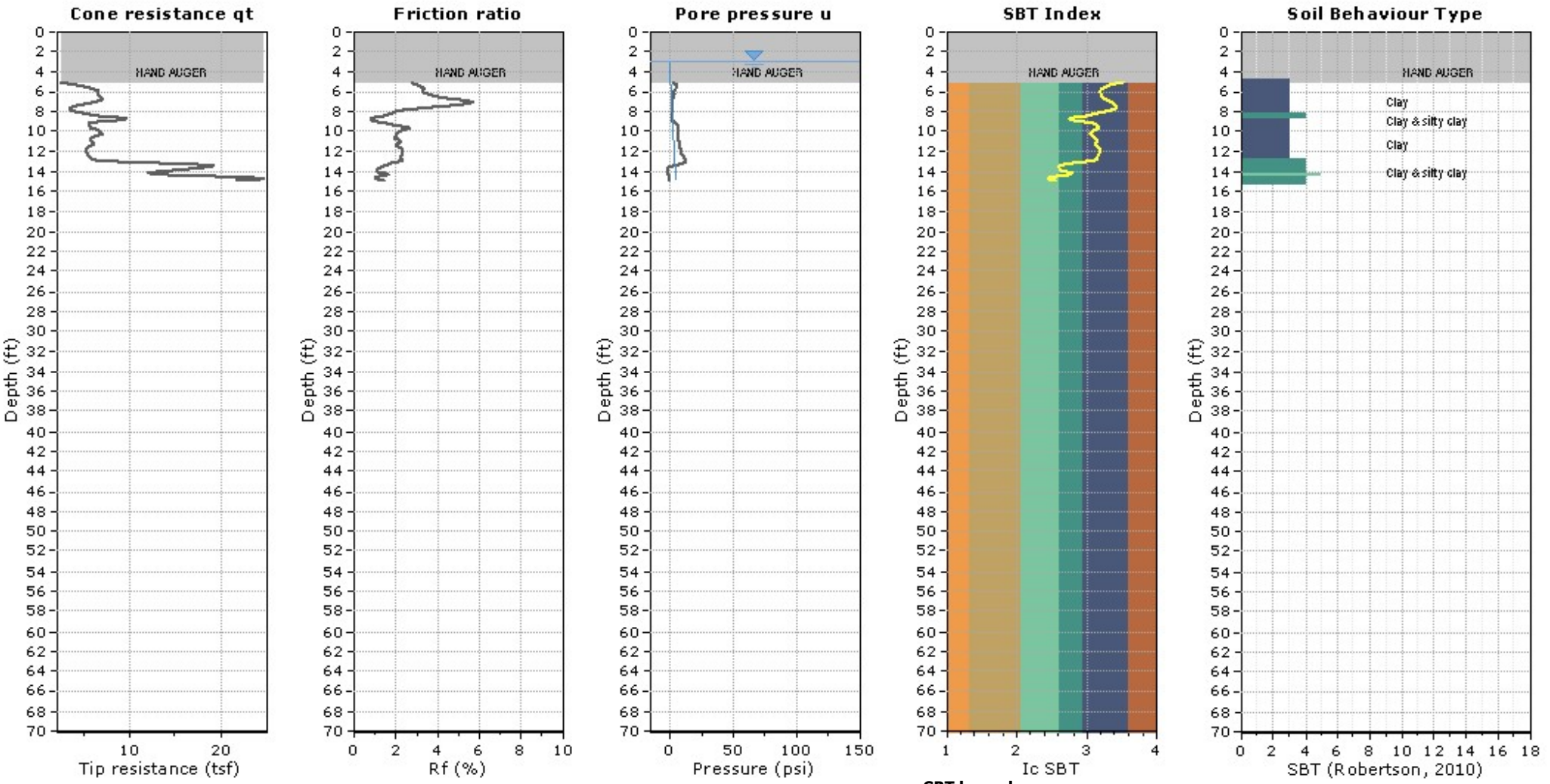




Norm. Soil Behaviour Type
Depth (ft)
SBTn (Robertson 1990)


Fuzzy Classification
Depth (ft)
Probability of Soil Types (%)

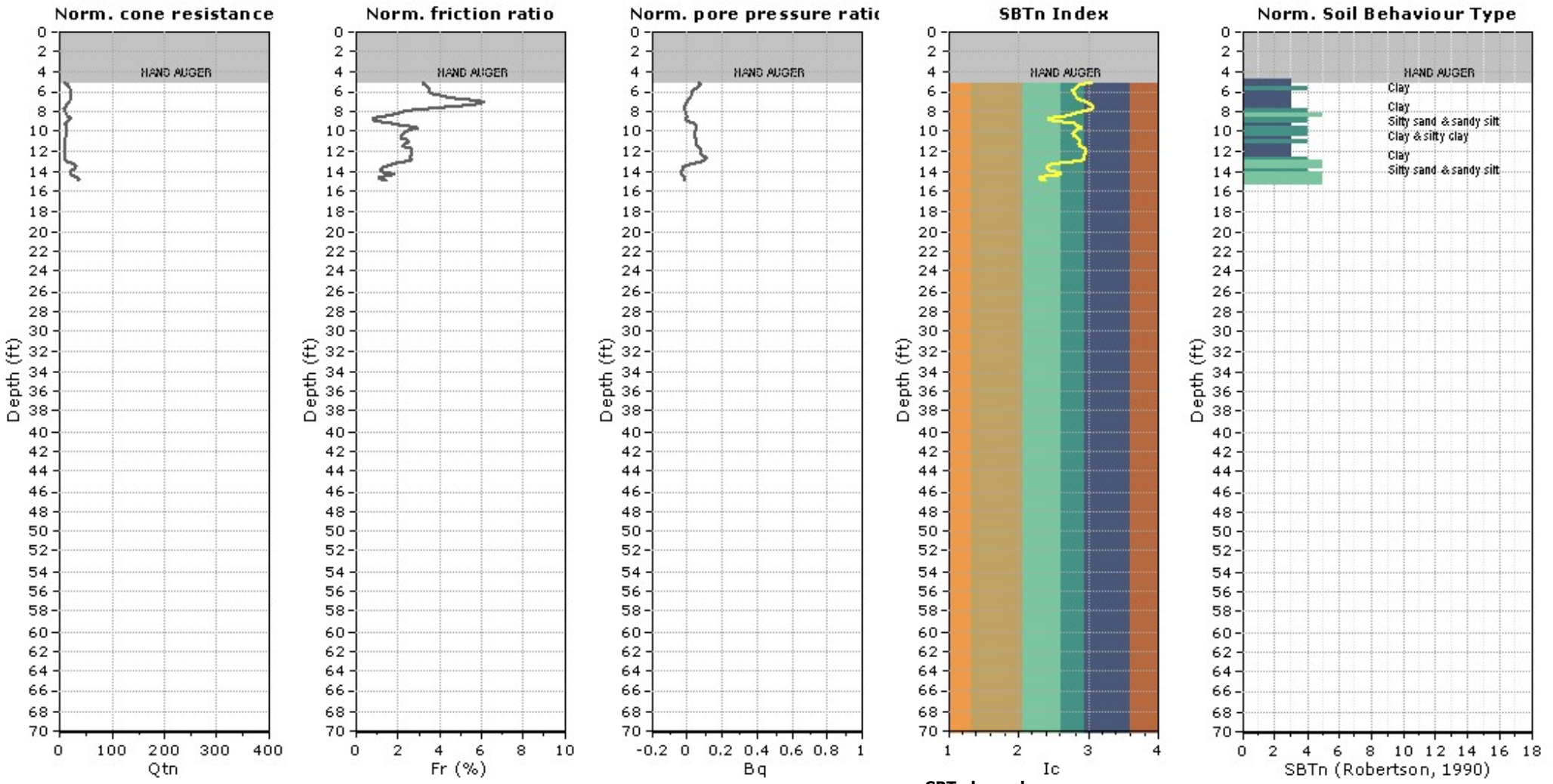
**CPT: CPT-10**
Total depth: 14.93 ft, Date: 4/26/2018
Surface Elevation: 10.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA



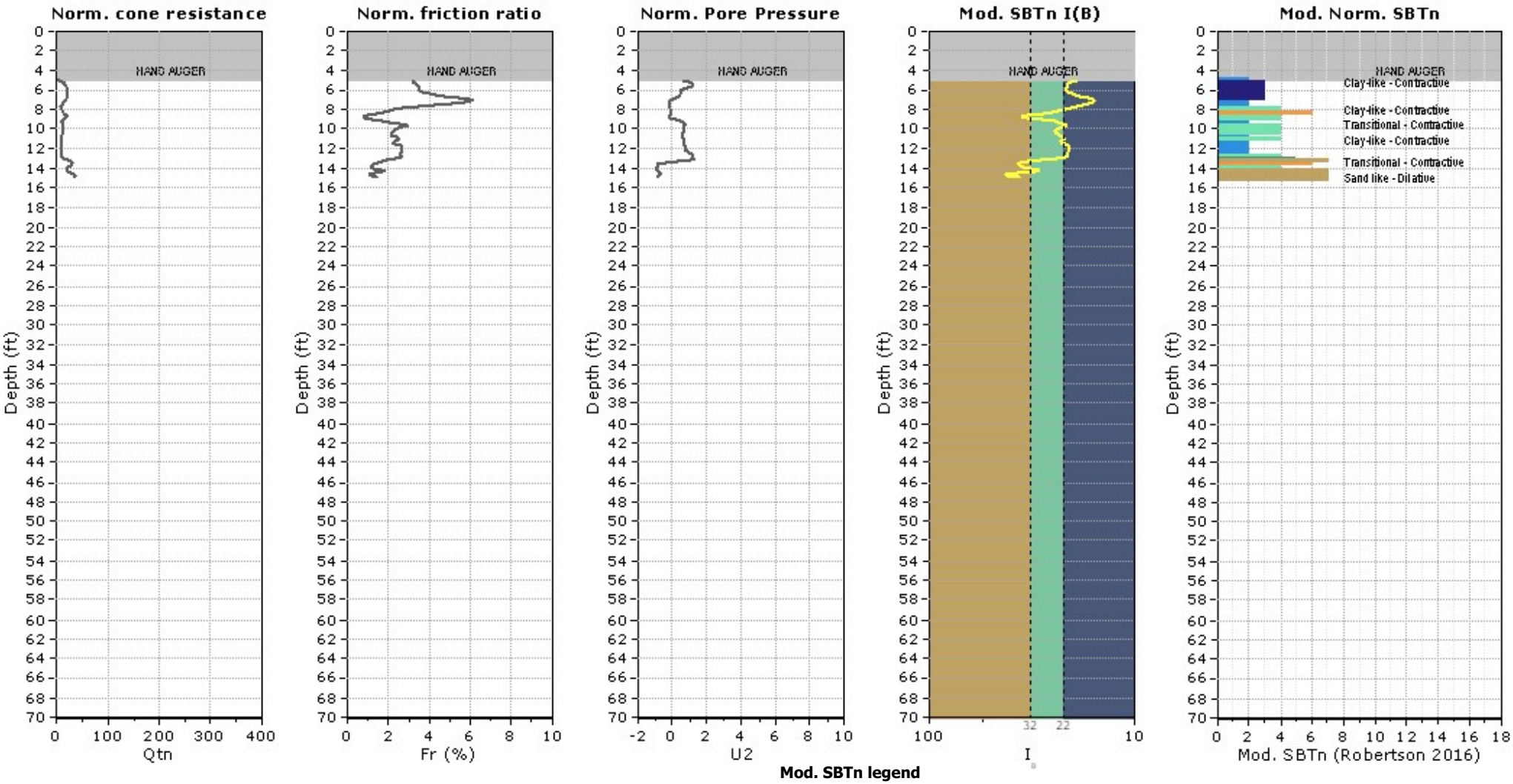
**CPT: CPT-10**
Total depth: 14.93 ft, Date: 4/26/2018
Surface Elevation: 10.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA

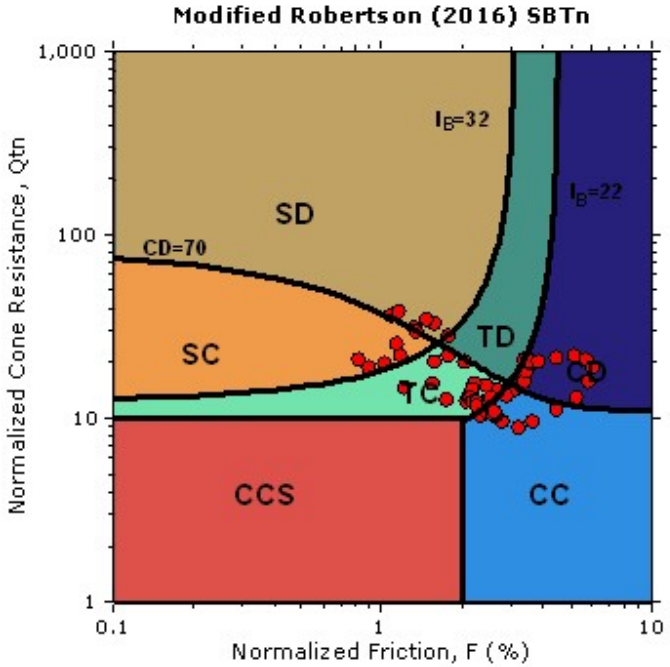


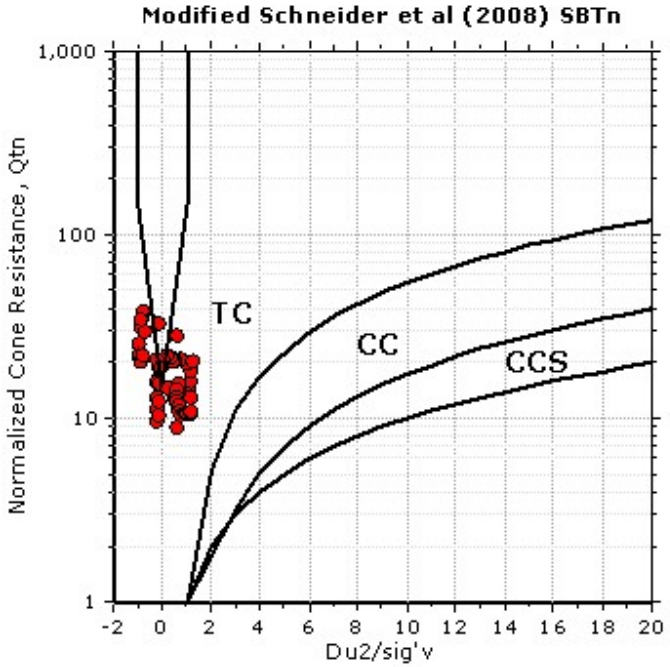
**CPT: CPT-10**
Total depth: 14.93 ft, Date: 4/26/2018
Surface Elevation: 10.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

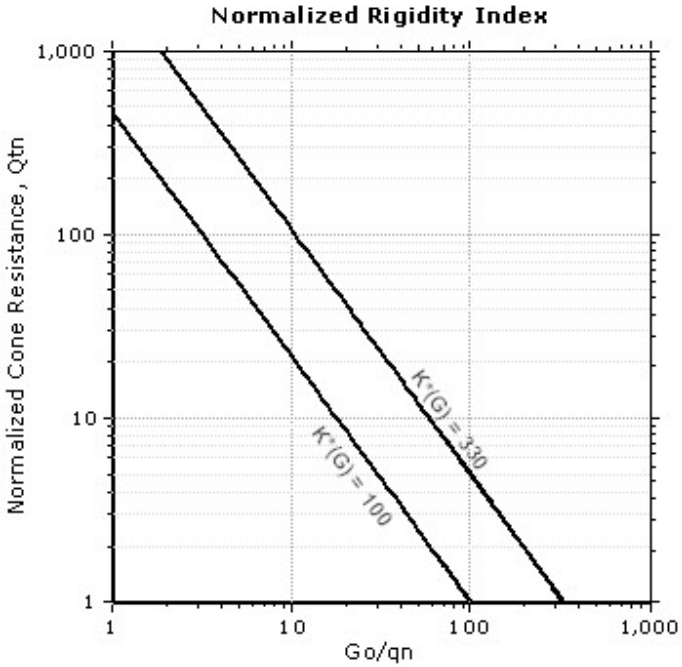
**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA



## Updated SBTn plots

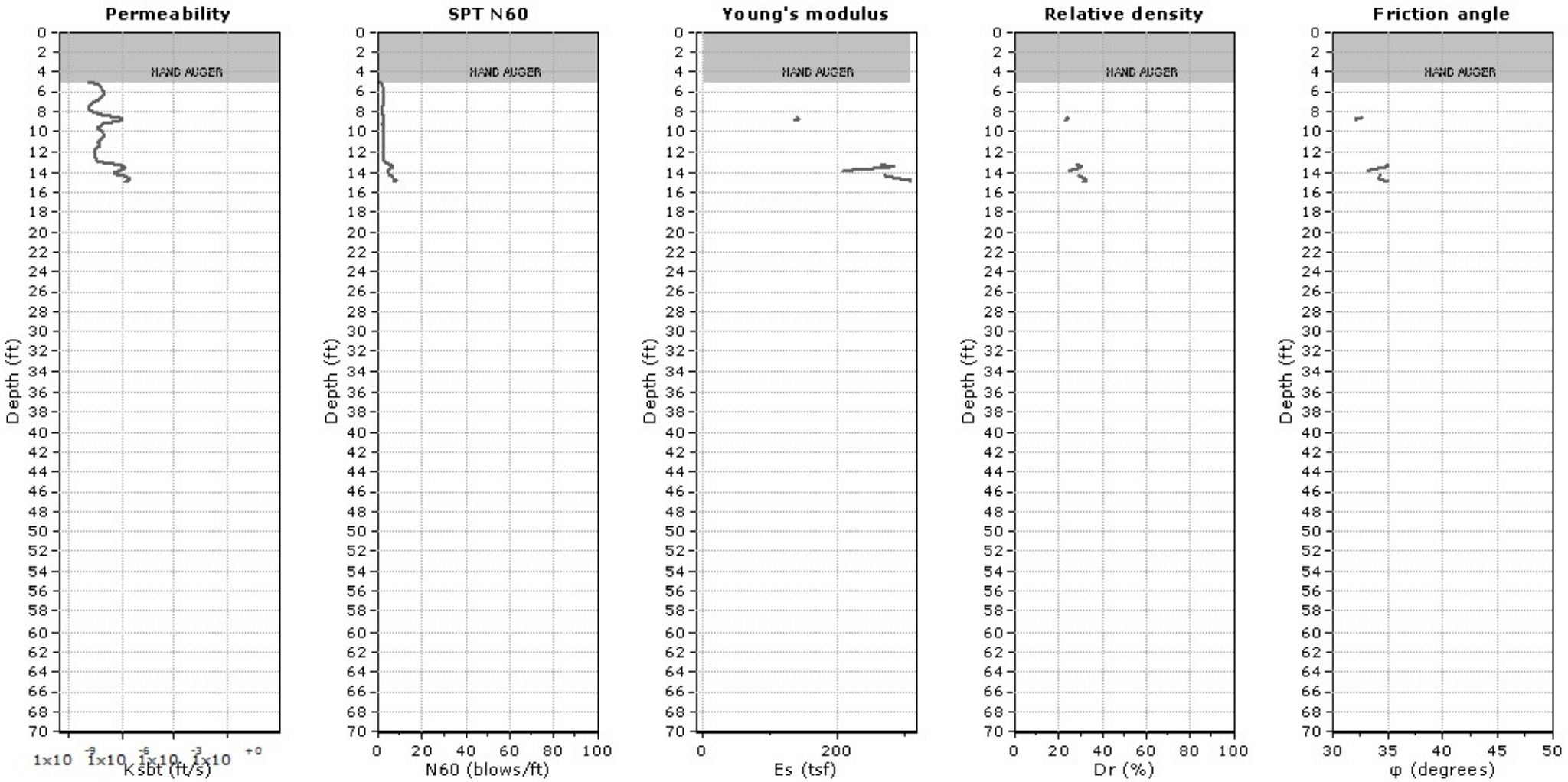


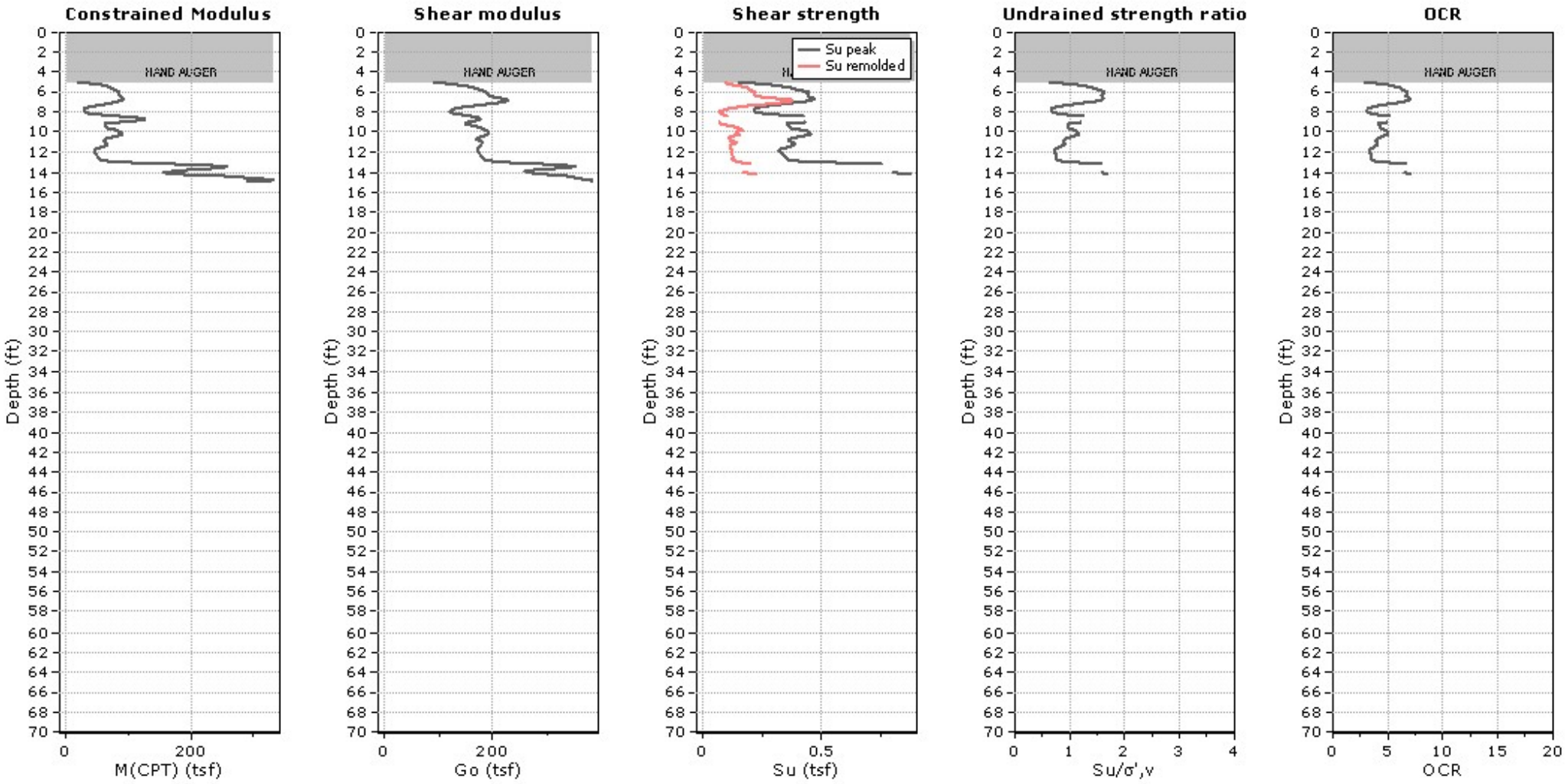

CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)



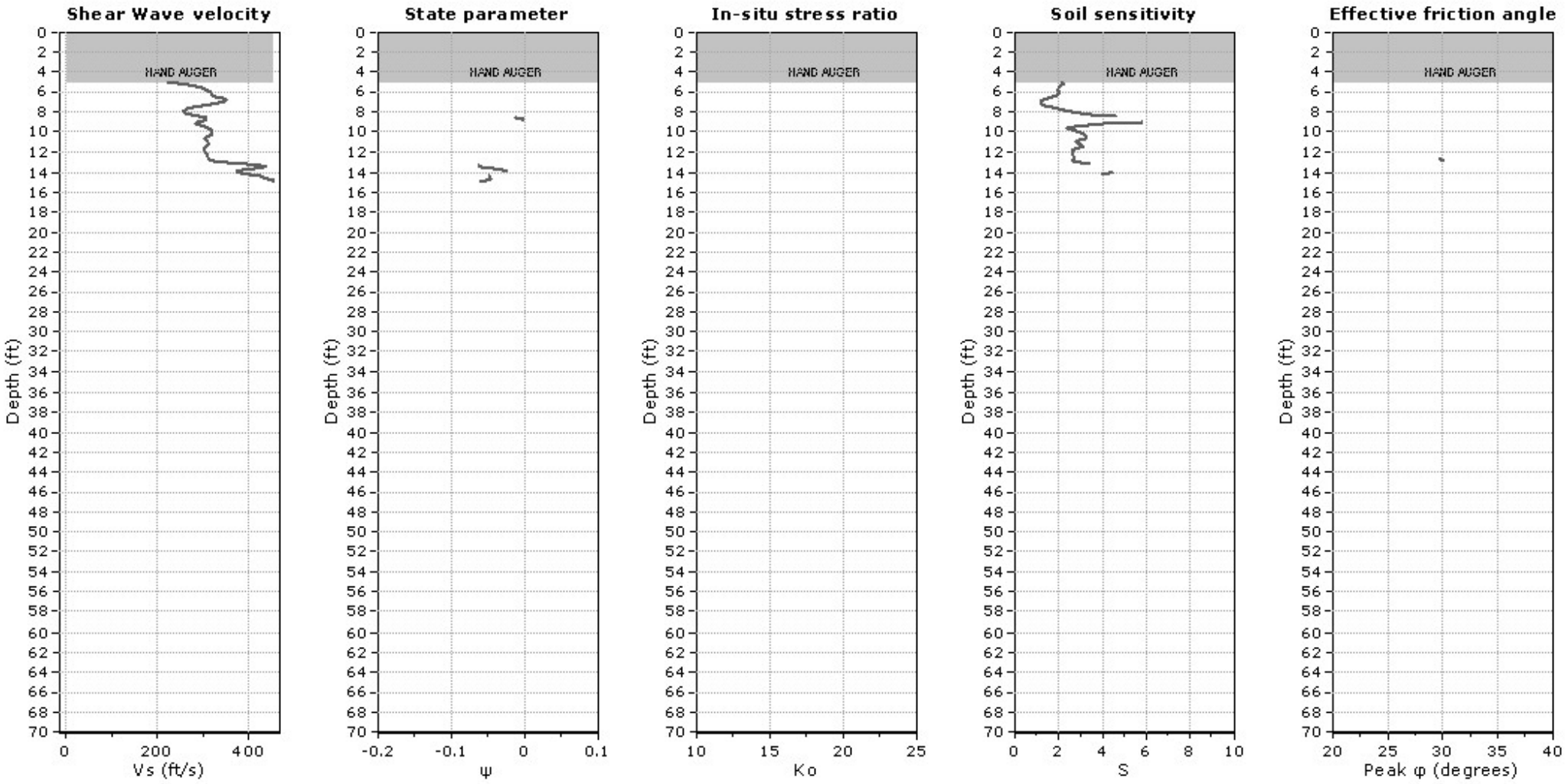

**Calculation parameters**

Permeability: Based on $SBT_n$
SPT $N_{60}$: Based on $I_c$ and $q_t$
Young's modulus: Based on variable alpha using $I_c$ (Robertson, 2009)
Relative density constant, $C_{Dr}$: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data




**Calculation parameters**

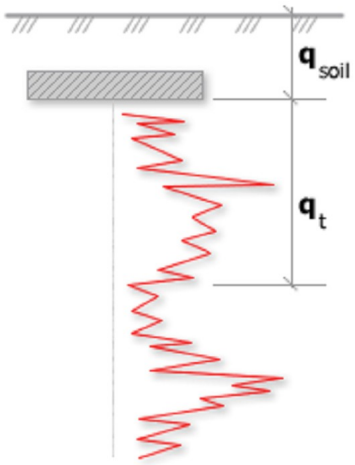
Constrained modulus: Based on variable alpha using $I_c$ and $Q_{tn}$ (Robertson, 2009)
Go: Based on variable alpha using $I_c$ (Robertson, 2009)
Undrained shear strength cone factor for clays, $N_{kt}$: 14
OCR factor for clays, $N_{kt}$: 0.33
User defined estimation data
Flat Dilatometer Test data




**Calculation parameters**

Soil Sensitivity factor, $N_S$: 7.00

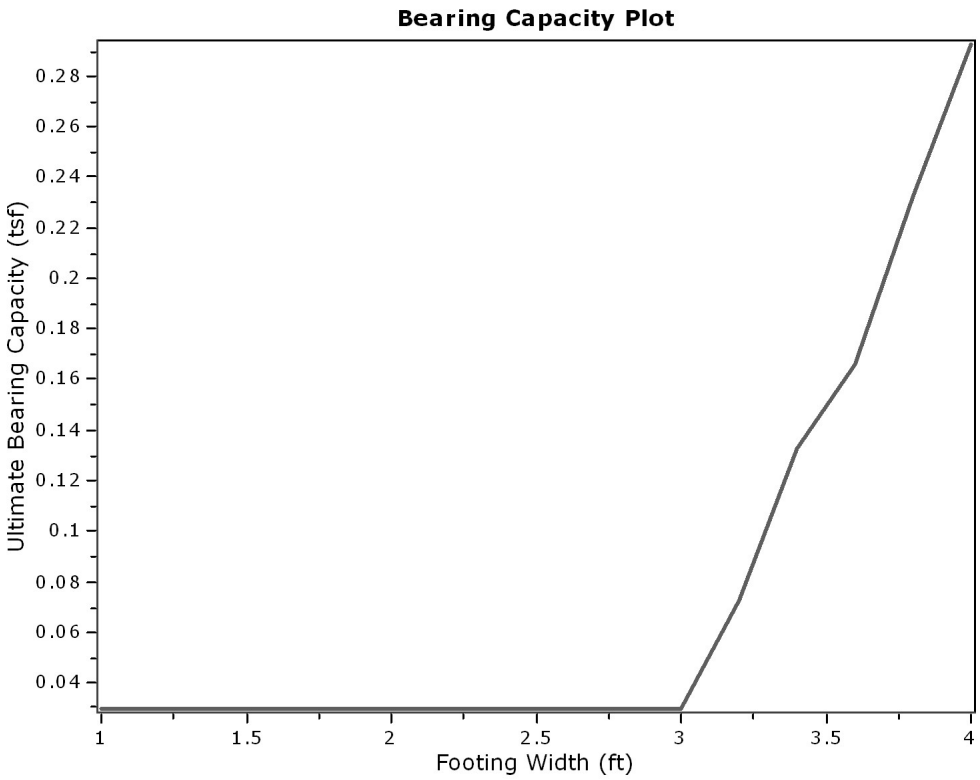
User defined estimation data




Bearing Capacity calculation is perfromed based on the formula:

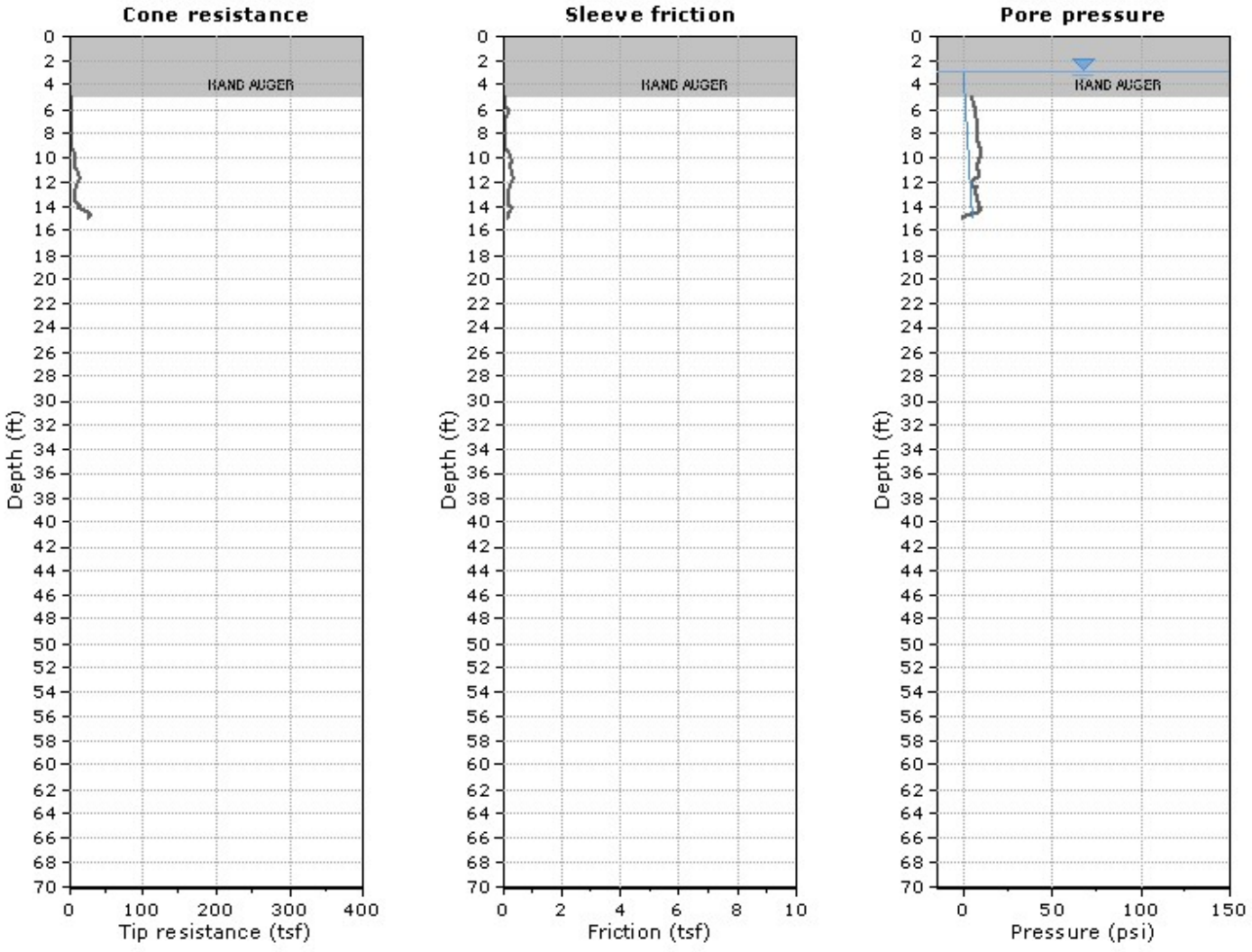
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
$R_k$: Bearing capacity factor
$q_t$: Average corrected cone resistance over calculation depth
$q_{soil}$: Pressure applied by soil above footing

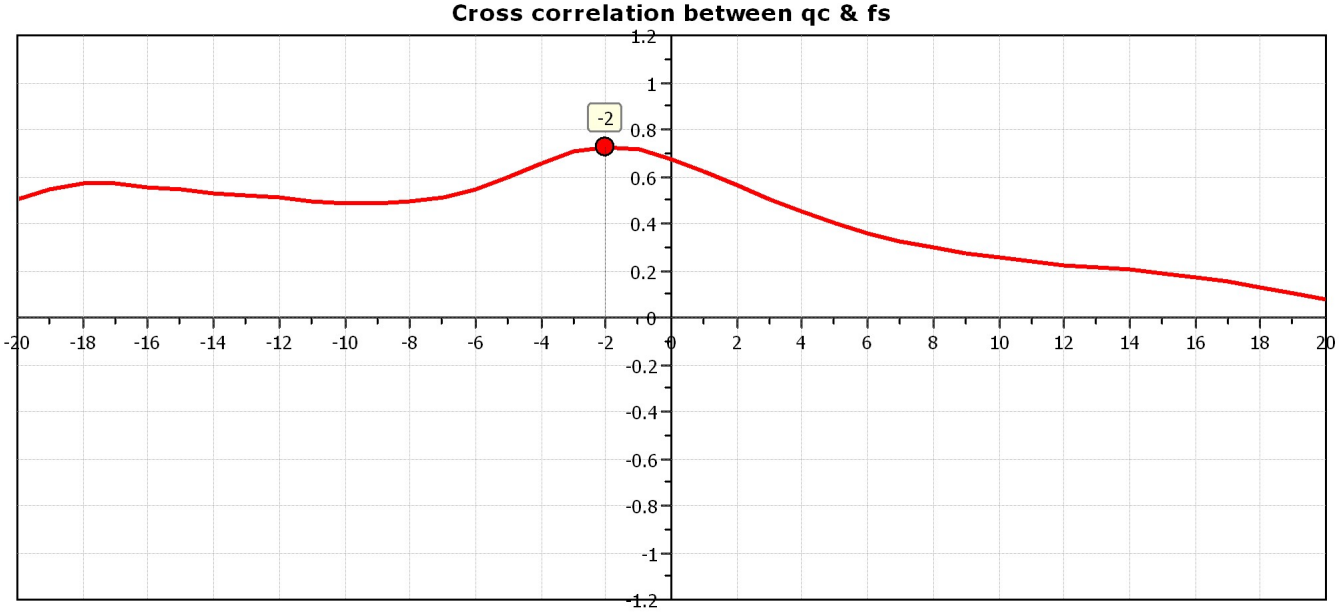



**:: Tabular results ::**

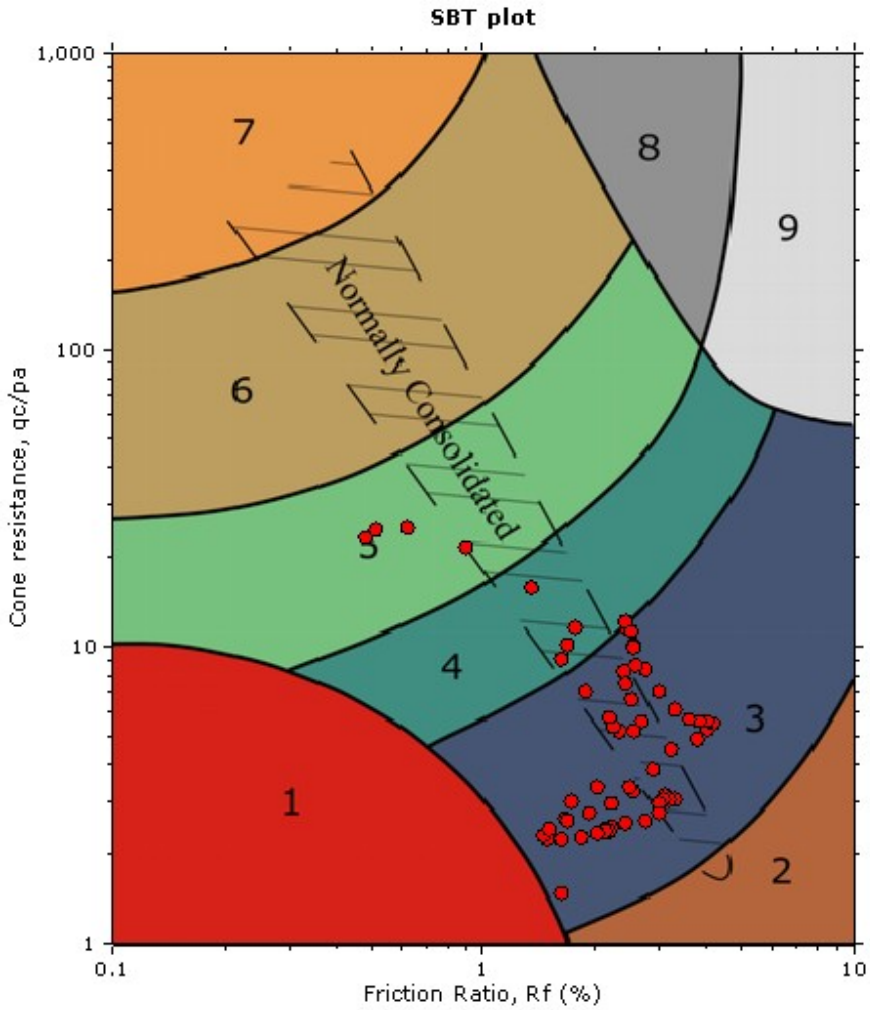
| No | B (ft) | Start Depth (ft) | End Depth (ft) | Ave. $q_t$ (tsf) | $R_k$ | Soil Press. (tsf) | Ult. bearing cap. (tsf) |
|---|---|---|---|---|---|---|---|
| 1 | 1.00 | 0.50 | 2.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 2 | 1.20 | 0.50 | 2.30 | 0.00 | 0.20 | 0.03 | 0.03 |
| 3 | 1.40 | 0.50 | 2.60 | 0.00 | 0.20 | 0.03 | 0.03 |
| 4 | 1.60 | 0.50 | 2.90 | 0.00 | 0.20 | 0.03 | 0.03 |
| 5 | 1.80 | 0.50 | 3.20 | 0.00 | 0.20 | 0.03 | 0.03 |
| 6 | 2.00 | 0.50 | 3.50 | 0.00 | 0.20 | 0.03 | 0.03 |
| 7 | 2.20 | 0.50 | 3.80 | 0.00 | 0.20 | 0.03 | 0.03 |
| 8 | 2.40 | 0.50 | 4.10 | 0.00 | 0.20 | 0.03 | 0.03 |
| 9 | 2.60 | 0.50 | 4.40 | 0.00 | 0.20 | 0.03 | 0.03 |
| 10 | 2.80 | 0.50 | 4.70 | 0.00 | 0.20 | 0.03 | 0.03 |
| 11 | 3.00 | 0.50 | 5.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 12 | 3.20 | 0.50 | 5.30 | 0.22 | 0.20 | 0.03 | 0.07 |
| 13 | 3.40 | 0.50 | 5.60 | 0.51 | 0.20 | 0.03 | 0.13 |
| 14 | 3.60 | 0.50 | 5.90 | 0.68 | 0.20 | 0.03 | 0.17 |
| 15 | 3.80 | 0.50 | 6.20 | 1.01 | 0.20 | 0.03 | 0.23 |
| 16 | 4.00 | 0.50 | 6.50 | 1.31 | 0.20 | 0.03 | 0.29 |

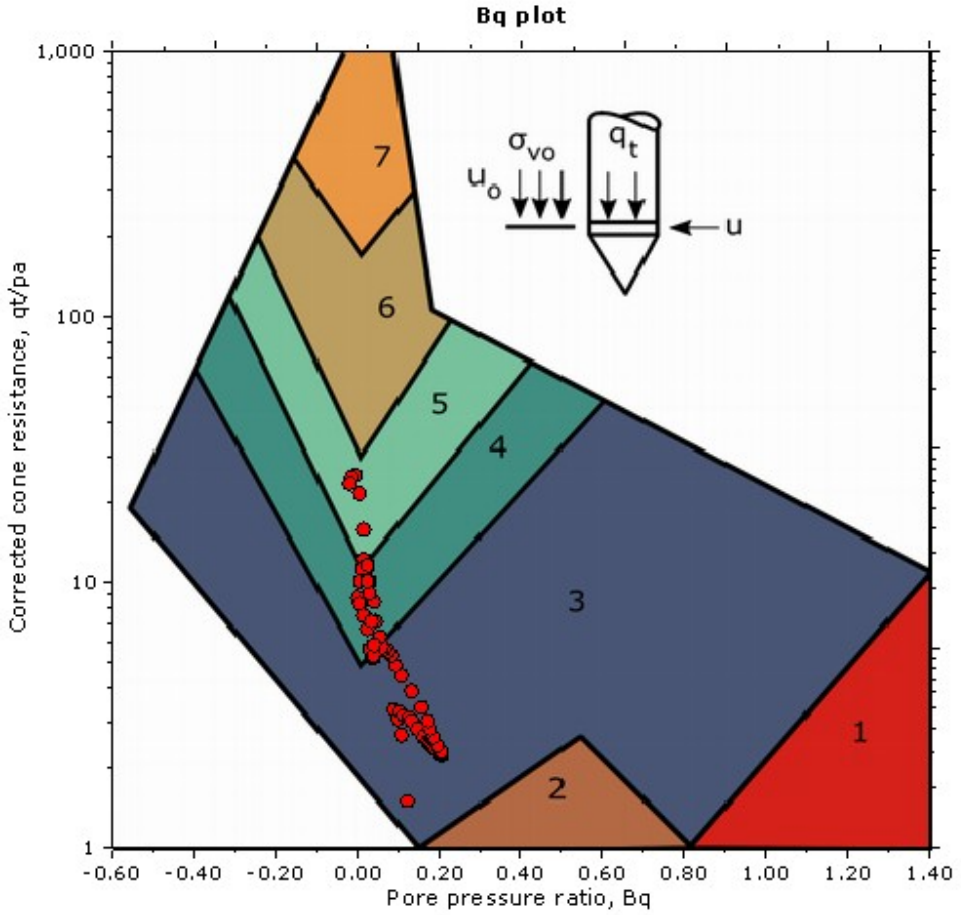



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



## SBT - Bq plots

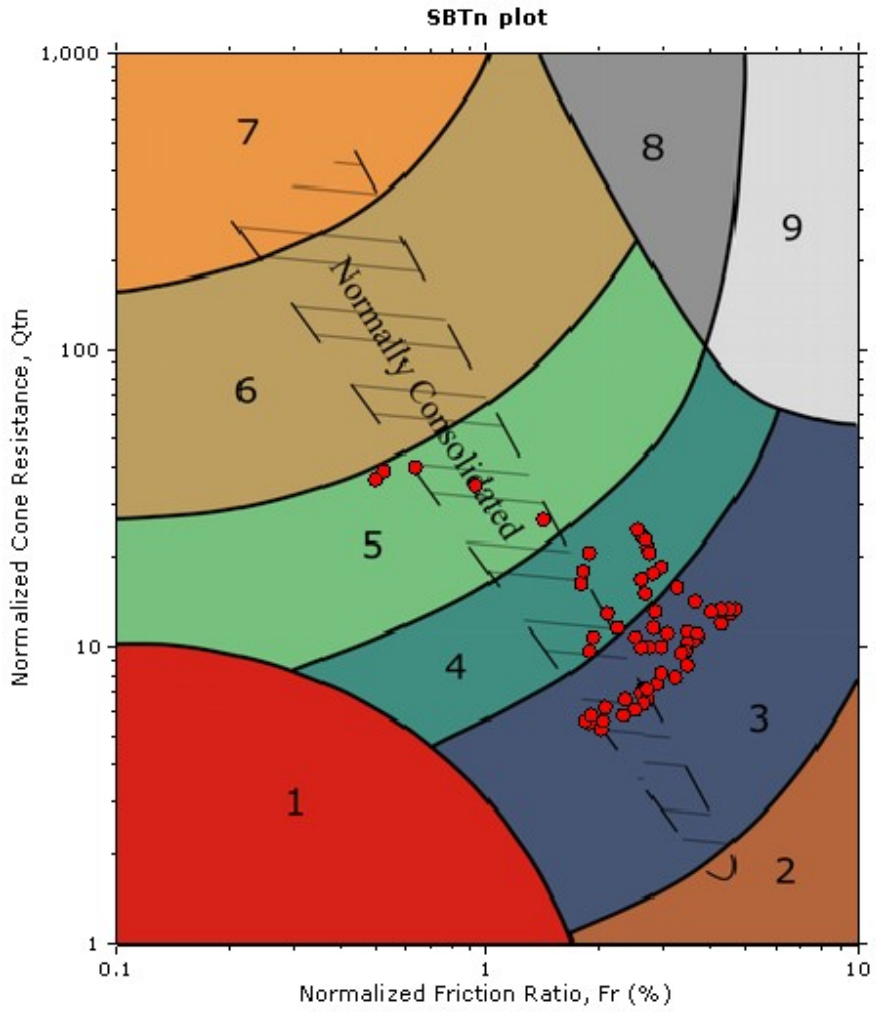


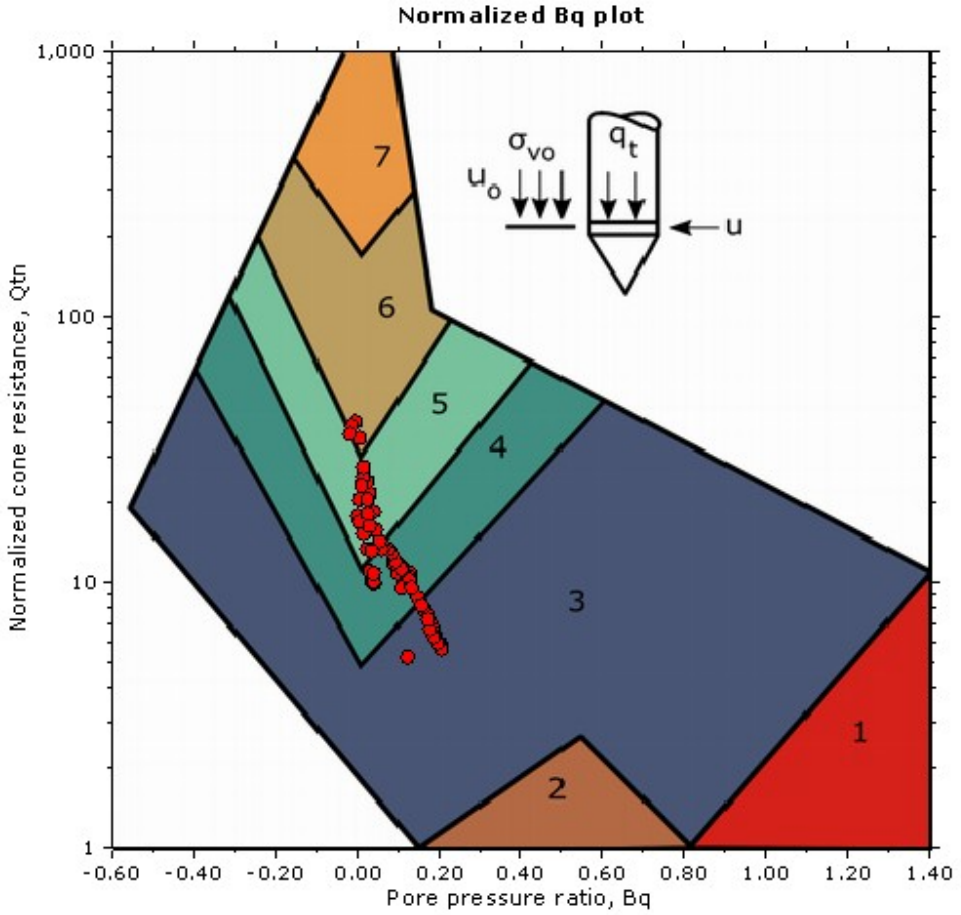




**SBT legend**

| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## SBT - Bq plots (normalized)

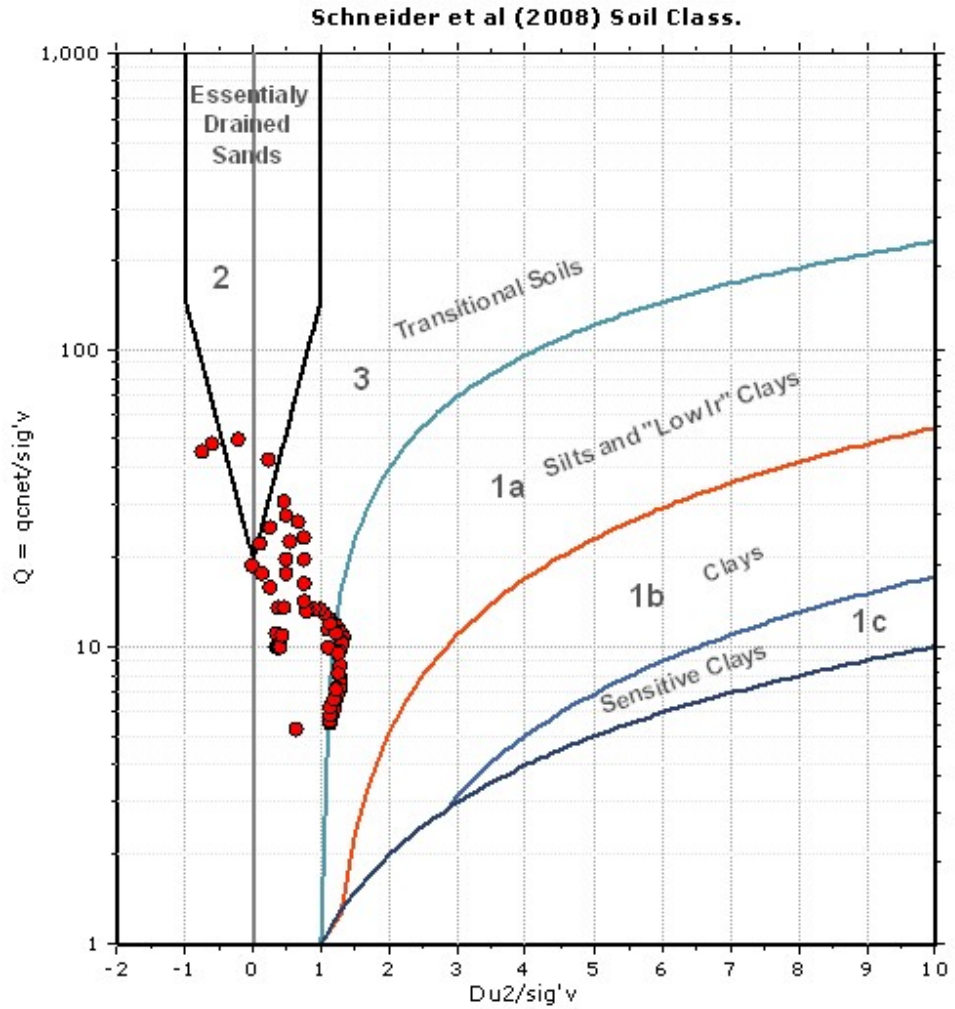


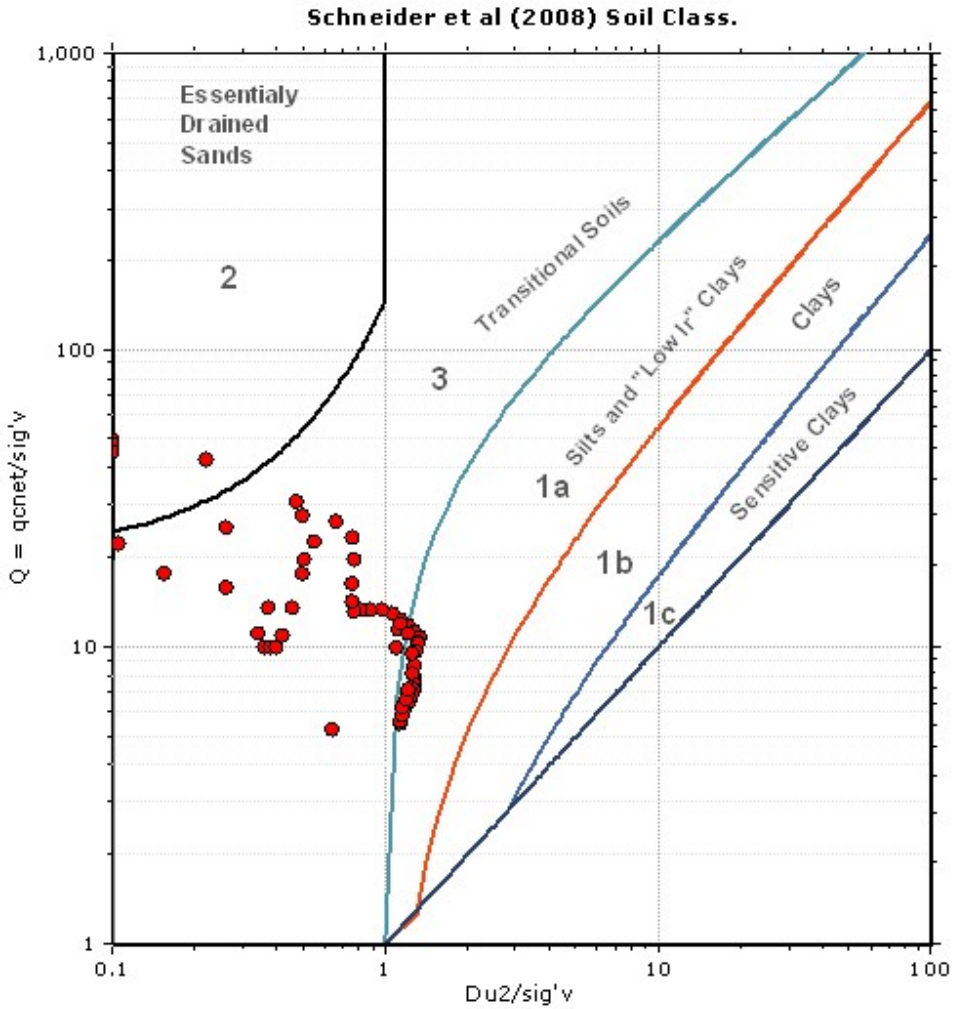



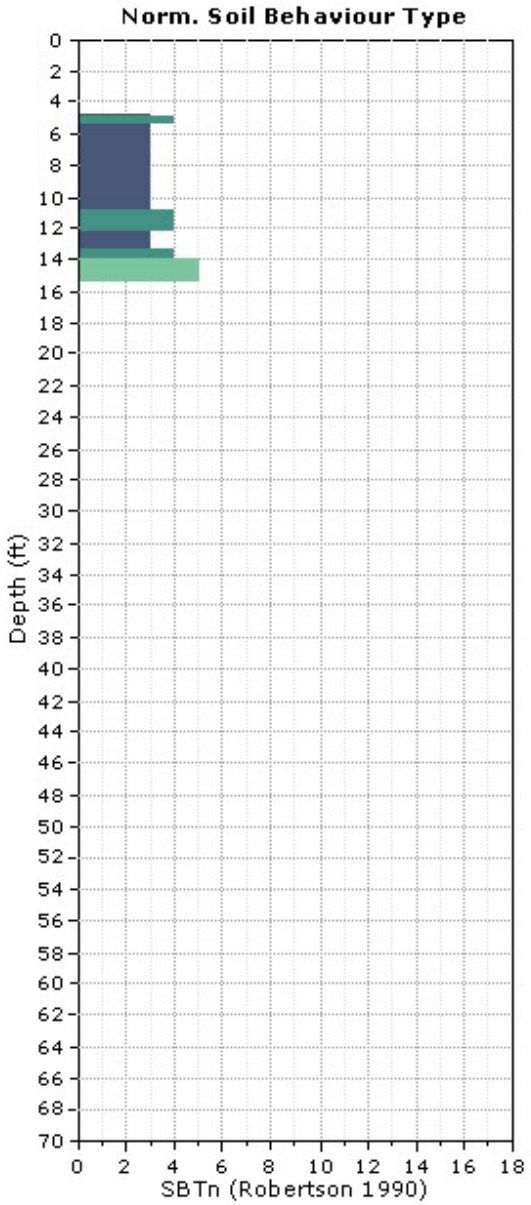

**SBTn legend**

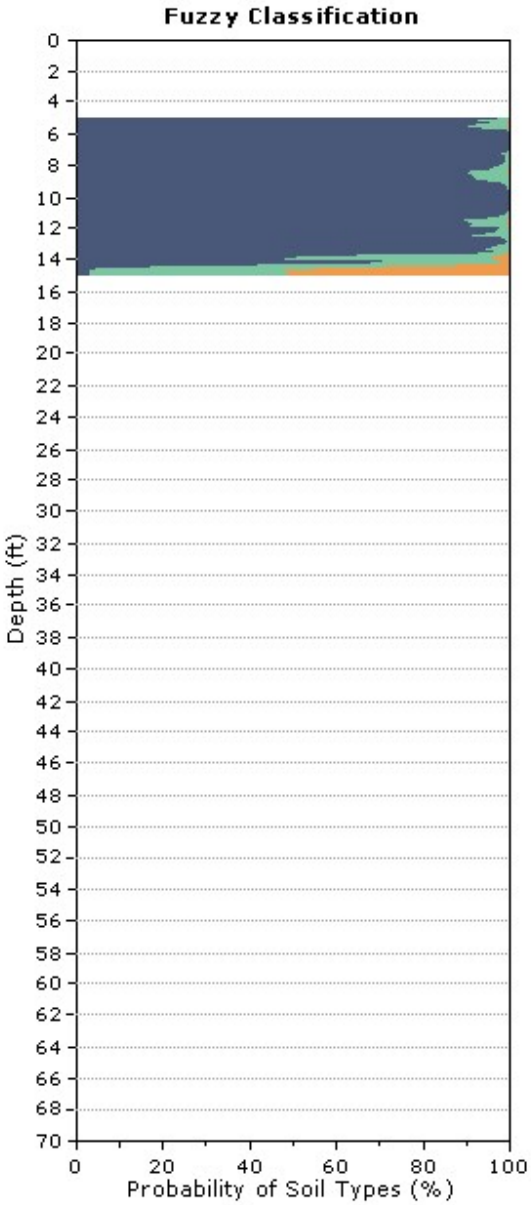
| | | |
|---|---|---|
| 1. Sensitive fine grained | 4. Clayey silt to silty clay | 7. Gravelly sand to sand |
| 2. Organic material | 5. Silty sand to sandy silt | 8. Very stiff sand to clayey sand |
| 3. Clay to silty clay | 6. Clean sand to silty sand | 9. Very stiff fine grained |

## Bq plots (Schneider)



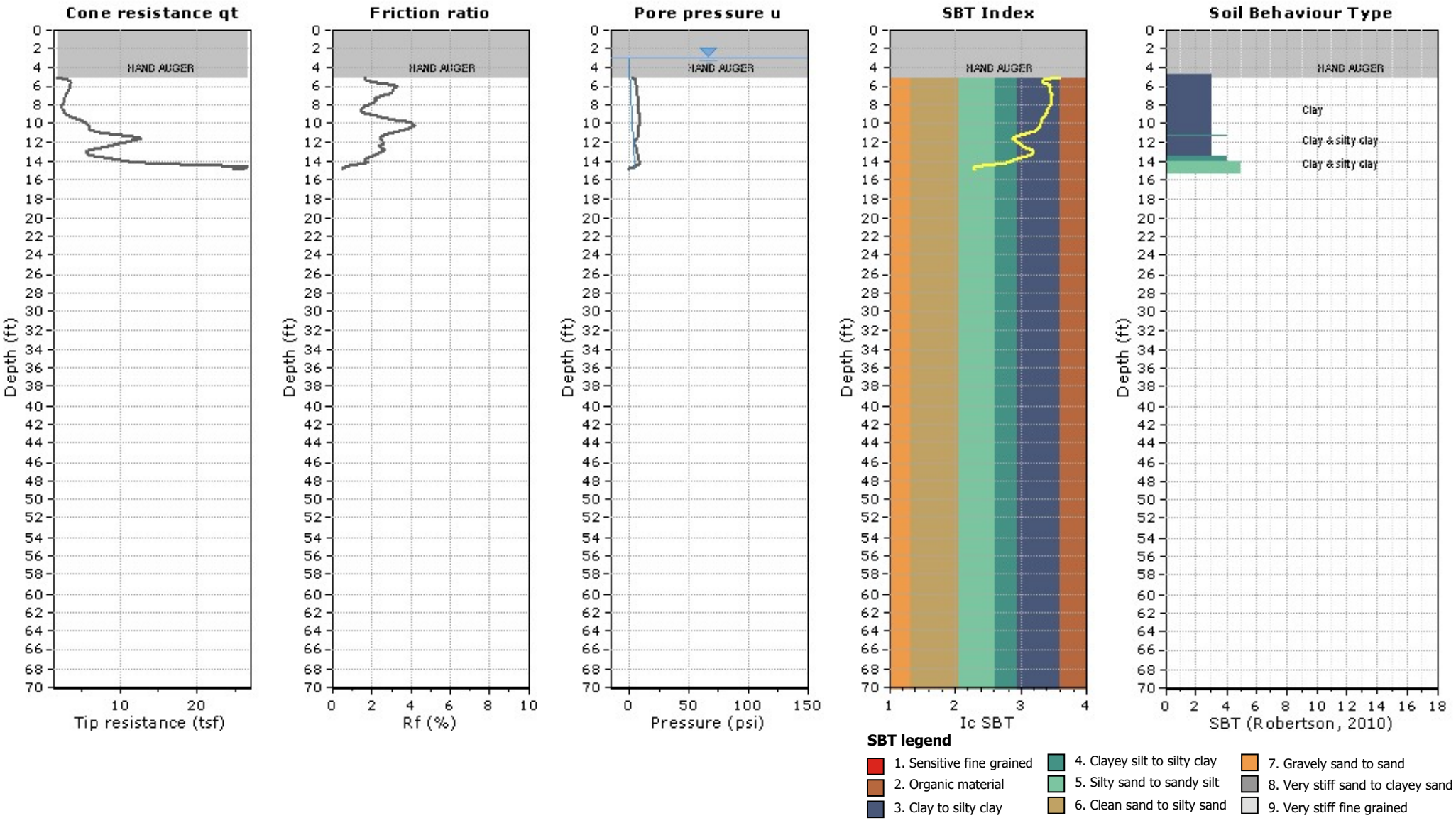




Norm. Soil Behaviour Type
Depth (ft)
SBTn (Robertson 1990)


Fuzzy Classification
Depth (ft)
Probability of Soil Types (%)

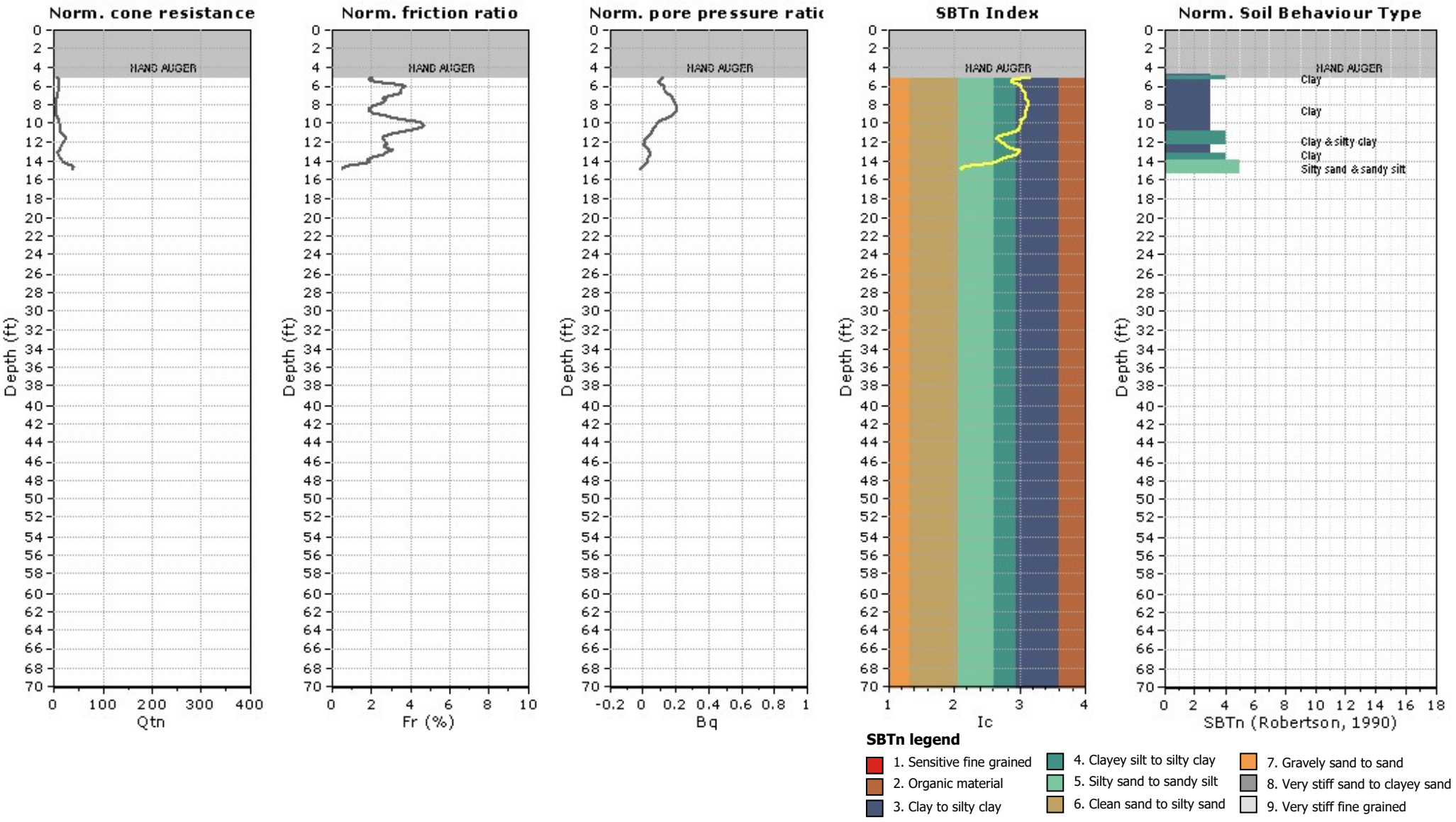
**CPT: CPT-11**
Total depth: 14.93 ft, Date: 4/26/2018
Surface Elevation: 11.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA



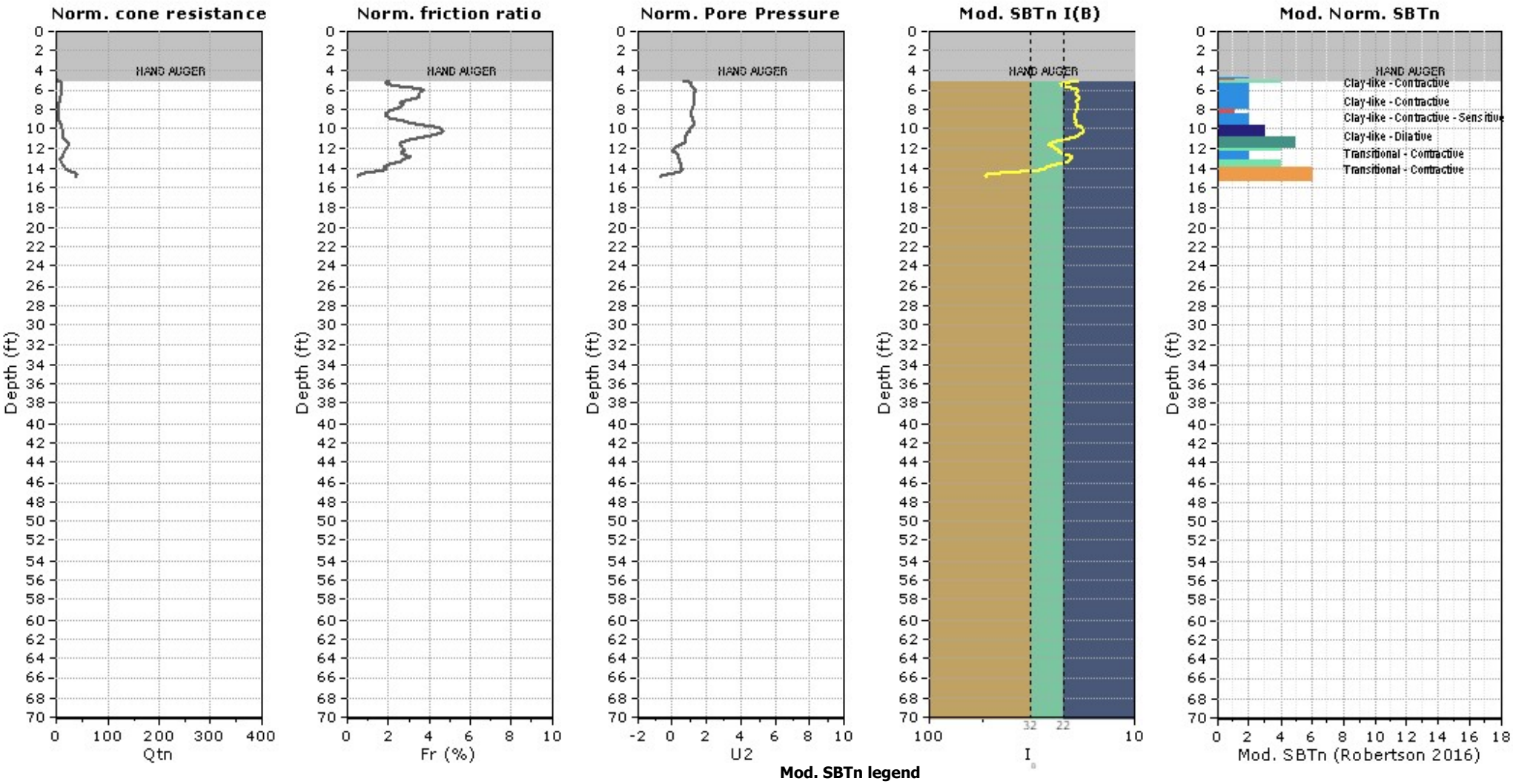
**CPT: CPT-11**
Total depth: 14.93 ft, Date: 4/26/2018
Surface Elevation: 11.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA

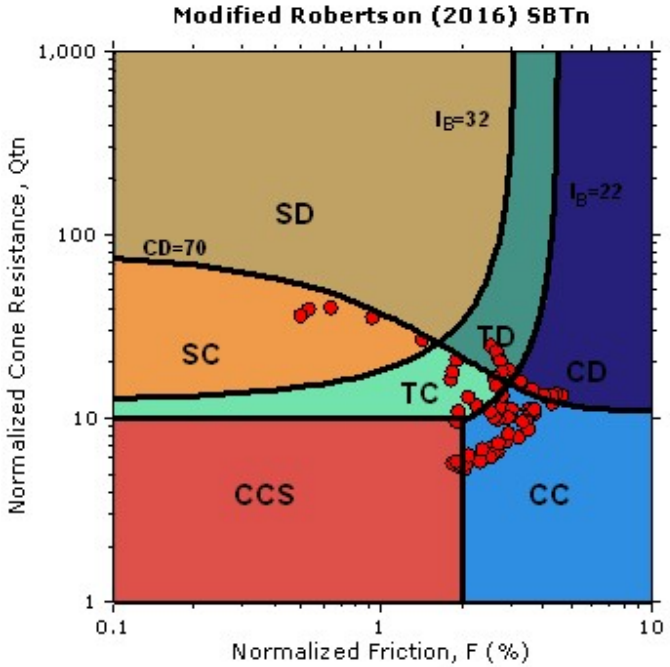


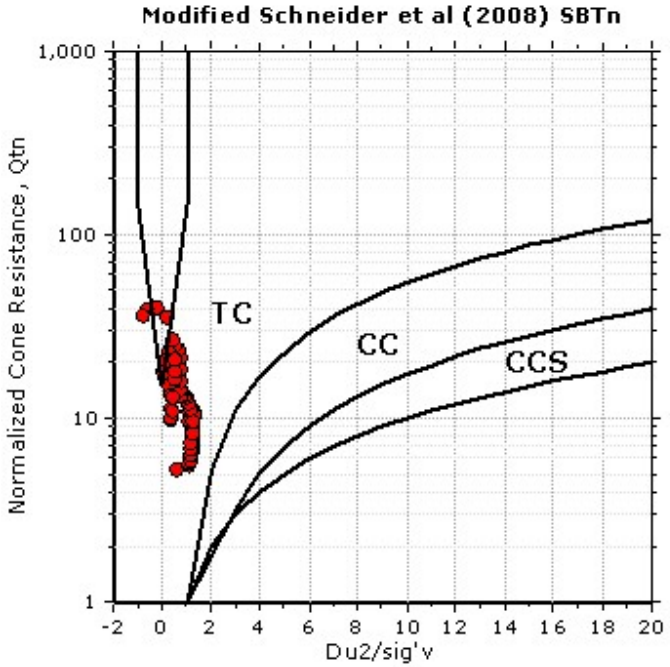
**CPT: CPT-11**
Total depth: 14.93 ft, Date: 4/26/2018
Surface Elevation: 11.00 ft
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: John/Aureliano

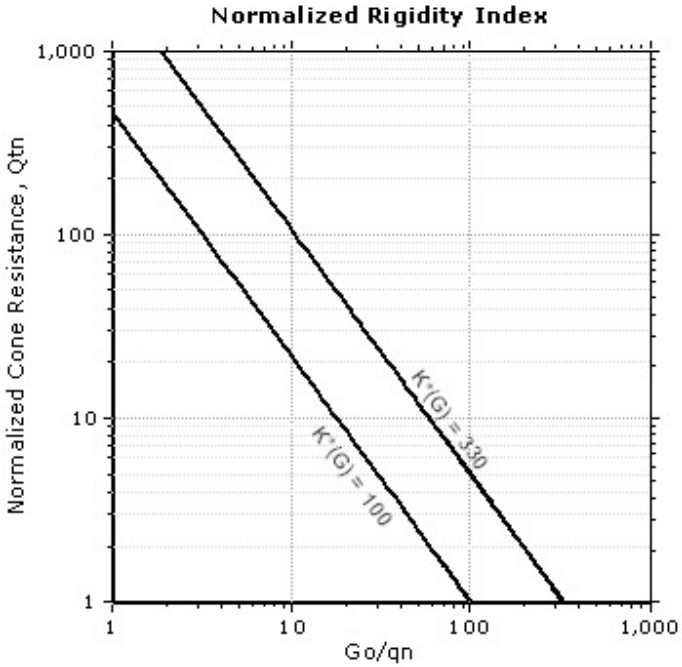
**Project:** LACO
**Location:** ARCATA WASTE WATER TREATMENT - ARCATA, CA



## Updated SBTn plots

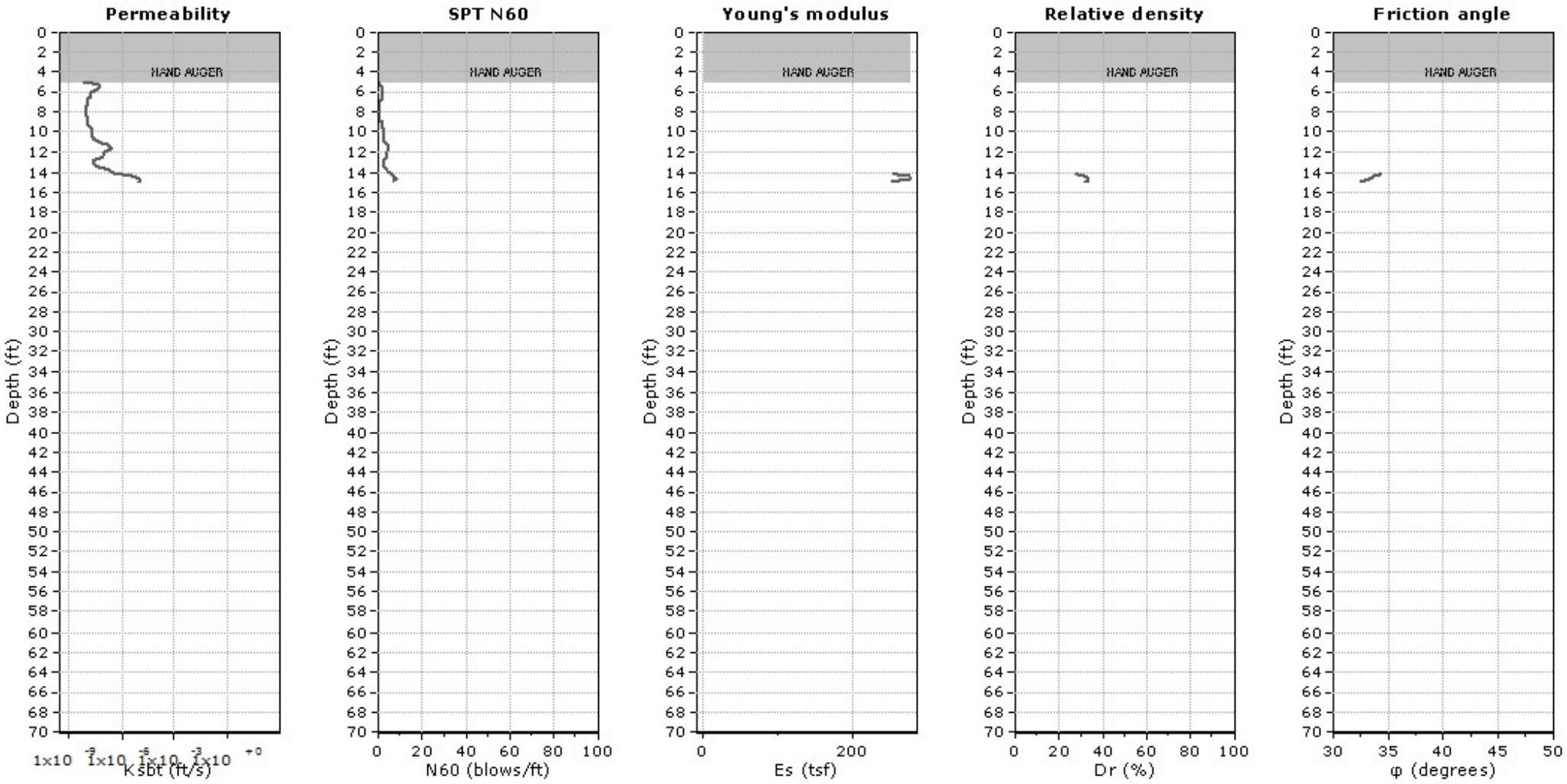


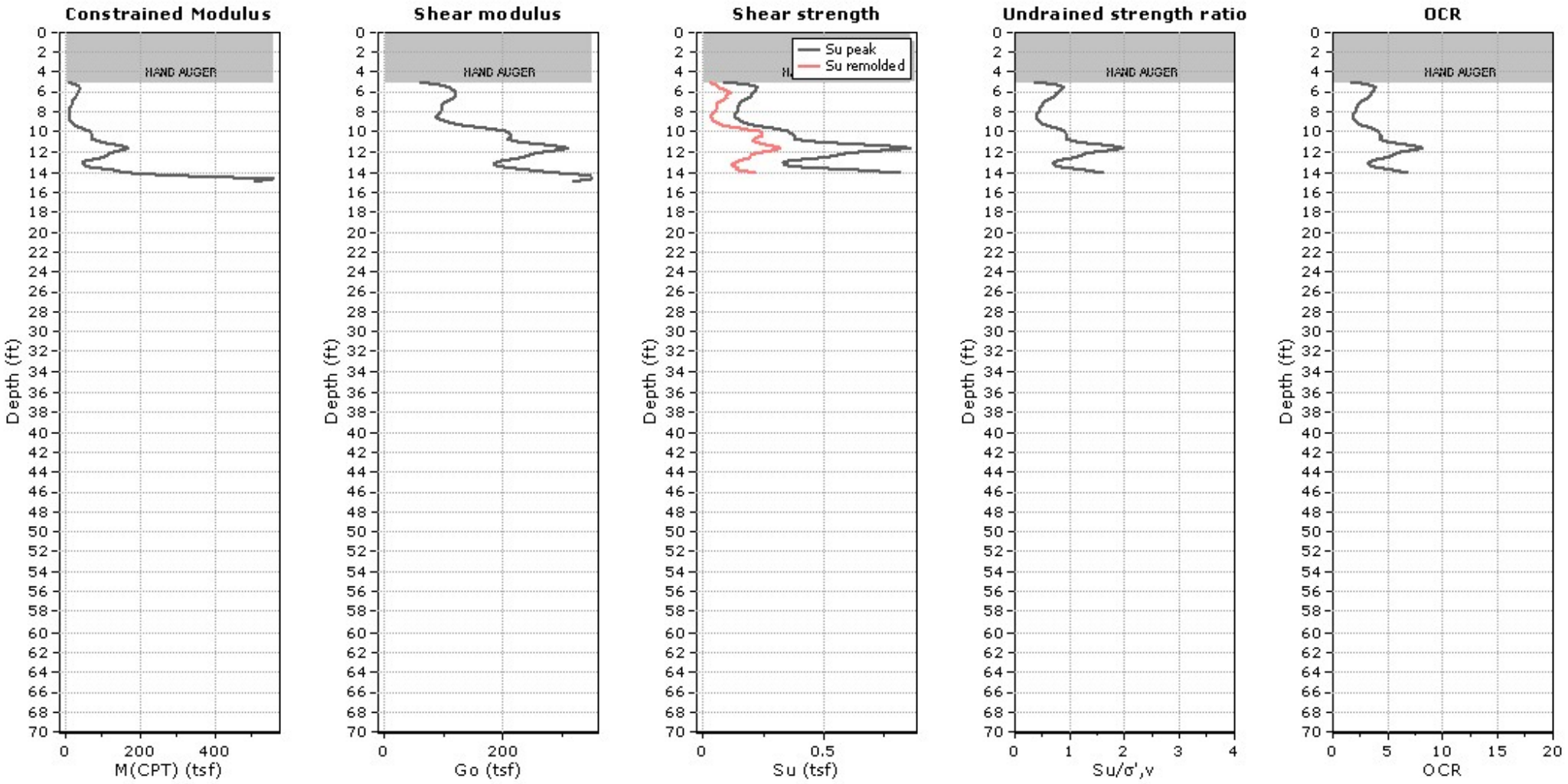

CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)



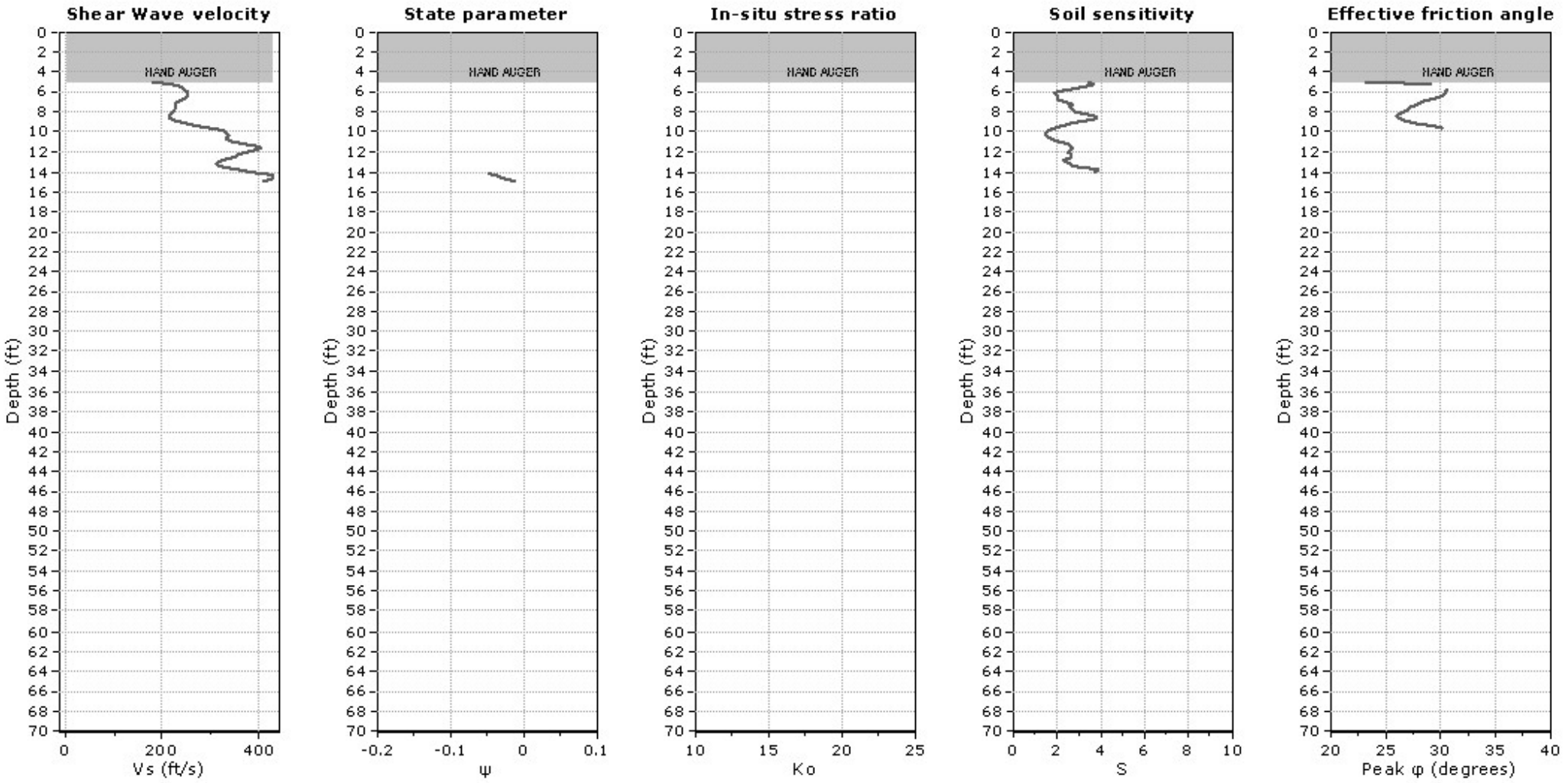

**Calculation parameters**

Permeability: Based on $SBT_n$
SPT $N_{60}$: Based on $I_c$ and $q_t$
Young's modulus: Based on variable alpha using $I_c$ (Robertson, 2009)
Relative density constant, $C_{Dr}$: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data




**Calculation parameters**

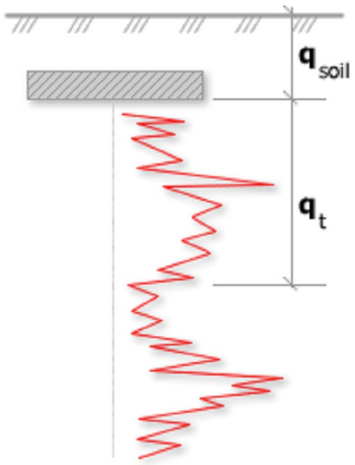
Constrained modulus: Based on variable alpha using $I_c$ and $Q_{tn}$ (Robertson, 2009)
Go: Based on variable alpha using $I_c$ (Robertson, 2009)
Undrained shear strength cone factor for clays, $N_{kt}$: 14
OCR factor for clays, $N_{kt}$: 0.33
User defined estimation data
Flat Dilatometer Test data




**Calculation parameters**

Soil Sensitivity factor, $N_S$: 7.00

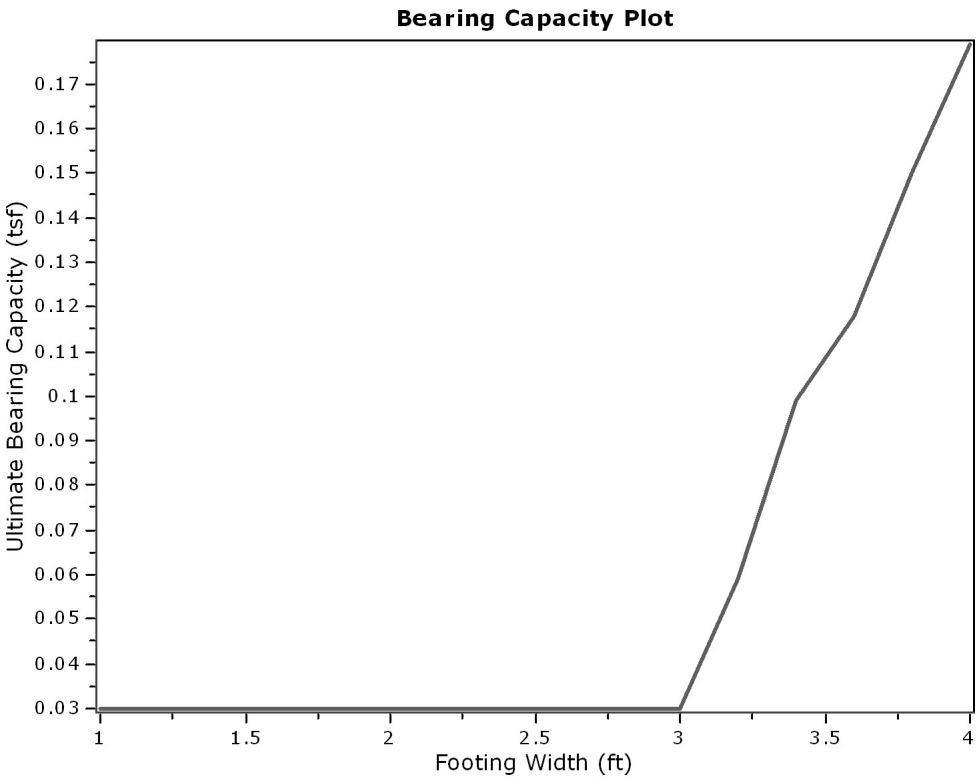
User defined estimation data




Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
$R_k$: Bearing capacity factor
$q_t$: Average corrected cone resistance over calculation depth
$q_{soil}$: Pressure applied by soil above footing




**:: Tabular results ::**

| No | B (ft) | Start Depth (ft) | End Depth (ft) | Ave. $q_t$ (tsf) | $R_k$ | Soil Press. (tsf) | Ult. bearing cap. (tsf) |
|---|---|---|---|---|---|---|---|
| 1 | 1.00 | 0.50 | 2.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 2 | 1.20 | 0.50 | 2.30 | 0.00 | 0.20 | 0.03 | 0.03 |
| 3 | 1.40 | 0.50 | 2.60 | 0.00 | 0.20 | 0.03 | 0.03 |
| 4 | 1.60 | 0.50 | 2.90 | 0.00 | 0.20 | 0.03 | 0.03 |
| 5 | 1.80 | 0.50 | 3.20 | 0.00 | 0.20 | 0.03 | 0.03 |
| 6 | 2.00 | 0.50 | 3.50 | 0.00 | 0.20 | 0.03 | 0.03 |
| 7 | 2.20 | 0.50 | 3.80 | 0.00 | 0.20 | 0.03 | 0.03 |
| 8 | 2.40 | 0.50 | 4.10 | 0.00 | 0.20 | 0.03 | 0.03 |
| 9 | 2.60 | 0.50 | 4.40 | 0.00 | 0.20 | 0.03 | 0.03 |
| 10 | 2.80 | 0.50 | 4.70 | 0.00 | 0.20 | 0.03 | 0.03 |
| 11 | 3.00 | 0.50 | 5.00 | 0.00 | 0.20 | 0.03 | 0.03 |
| 12 | 3.20 | 0.50 | 5.30 | 0.14 | 0.20 | 0.03 | 0.06 |
| 13 | 3.40 | 0.50 | 5.60 | 0.35 | 0.20 | 0.03 | 0.10 |
| 14 | 3.60 | 0.50 | 5.90 | 0.44 | 0.20 | 0.03 | 0.12 |
| 15 | 3.80 | 0.50 | 6.20 | 0.60 | 0.20 | 0.03 | 0.15 |
| 16 | 4.00 | 0.50 | 6.50 | 0.74 | 0.20 | 0.03 | 0.18 |

Presented below is a list of formulas used for the estimation of various soil properties. The formulas are presented in SI unit system and assume that all components are expressed in the same units.

**:: Unit Weight, g (kN/m³) ::**

$$g = g_w \cdot \left( 0.27 \cdot \log(R_f) + 0.36 \cdot \log(\frac{q_t}{p_a}) + 1.236 \right)$$

where $g_w$ = water unit weight

**:: Permeability, k (m/s) ::**

$I_c < 3.27$ and $I_c > 1.00$ then $k = 10^{0.952 - 3.04 \cdot I_c}$

$I_c \leq 4.00$ and $I_c > 3.27$ then $k = 10^{-4.52 - 1.37 \cdot I_c}$

**:: $N_{SPT}$ (blows per 30 cm) ::**

$$N_{60} = \left( \frac{q_c}{P_a} \right) \cdot \frac{1}{10^{1.1268 - 0.2817 \cdot I_c}}$$

$$N_{1(60)} = Q_{tn} \cdot \frac{1}{10^{1.1268 - 0.2817 \cdot I_c}}$$

**:: Young's Modulus, Es (MPa) ::**

$$(q_t - \sigma_v) \cdot 0.015 \cdot 10^{0.55 \cdot I_c + 1.68}$$

(applicable only to $I_c < I_{c\_cutoff}$)

**:: Relative Density, Dr (%) ::**

$$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}}$$ (applicable only to $SBT_n$: 5, 6, 7 and 8 or $I_c < I_{c\_cutoff}$)

**:: State Parameter, ψ ::**

$$\psi = 0.56 - 0.33 \cdot \log(Q_{tn,cs})$$

**:: Drained Friction Angle, φ (°) ::**

(applicable only to $SBT_n$: 5, 6, 7 and 8 or $I_c < I_{c\_cutoff}$)

**:: 1-D constrained modulus, M (MPa) ::**

If $I_c > 2.20$
α = 14 for $Q_{tn} > 14$
α = $Q_{tn}$ for $Q_{tn} \leq 14$
$M_{CPT} = \alpha \cdot (q_t - \sigma_v)$

If $I_c \geq 2.20$

**:: Small strain shear Modulus, Go (MPa) ::**

$$G_0 = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$$

**:: Shear Wave Velocity, Vs (m/s) ::**

$$V_s = \left( \frac{G_0}{\rho} \right)^{0.50}$$

**:: Undrained peak shear strength, Su (kPa) ::**

$N_{kt} = 10.50 + 7 \cdot \log(F_r)$ or user defined

$$S_u = \frac{(q_t - \sigma_v)}{N_{kt}}$$

(applicable only to $SBT_n$: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

**:: Remolded undrained shear strength, Su(rem) (kPa) ::**

$S_{u(rem)} = f_s$ (applicable only to $SBT_n$: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

**:: Overconsolidation Ratio, OCR ::**

$$k_{OCR} = \left[ \frac{Q_{tn}^{0.20}}{0.25 \cdot (10.50 \cdot +7 \cdot \log(F_r))} \right]^{1.25}$$ or user defined

$OCR = k_{OCR} \cdot Q_{tn}$

(applicable only to $SBT_n$: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

**:: In situ Stress Ratio, Ko ::**

$$K_O = (1 - \sin\varphi') \cdot OCR^{\sin\varphi'}$$

(applicable only to $SBT_n$: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

**:: Soil Sensitivity, $S_t$ ::**

$$S_t = \frac{N_S}{F_r}$$

(applicable only to $SBT_n$: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

**:: Peak Friction Angle, φ' (°) ::**

$$\varphi' = 29.5° \cdot B_q^{0.121} \cdot (0.256 + 0.336 \cdot B_q + \log Q_t)$$

(applicable for $0.10 < B_q < 1.00$)

**References**


• Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012

• Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

# APPENDIX 5

## Site-Specific Ground Motion Analysis

# SITE-SPECIFIC GROUND MOTION ANALYSIS

## A5.1. Introduction

This report presents the results of a site-specific seismic ground motion analysis performed by LACO Associates (LACO) for Carollo Engineers, Inc. to support design of wastewater treatment plant (WWTP) improvements at the Arcata Wastewater Treatment Plant, located at 601 South G Street, Arcata, California. Site coordinates are 40.8556°, -124.0901°.

Section 1613A of the 2016 California Building Code (CBC) mandates that structures be designed and constructed to resist earthquake damages in pursuant to ASCE 7-10 and modifications included in Section 1613 (ASCE, 2013; CBC, 2016). According to 1616A.13 ASCE 7, Section 11.4.7, buildings that are assigned to Seismic Design Category E or F require a ground motion hazard analysis in accordance with ASCE 7 Chapter 21 as modified by Section 1803A.6. Seismic Design Category E is mandated for planned structures that are classified as Risk Category III, have a characteristic mapped acceleration parameter $S_1$ greater than or equal to 0.75 times the acceleration of gravity (0.75g). Projects designated in Seismic Design Category E are not required to perform a site response analysis per Section 11.4.7 and Chapter 21 of ASCE 7-10, however this site response analysis has been prepared at the request of Carollo Engineers, Inc. Specifically, the request was for a spectra that provides *a smoothed, elastic horizontal and vertical design seismic response for the specific project site. The ground motion represented by the spectra shall be based on the geologic, tectonic, seismic recurrence information, and foundation material properties associated with the specific site. The response spectra shall consider deep foundation and the influence of foundation embedded in competent strata. The spectra shall be representative of motions which can be generated by known faults which can affect this site. The ground motion representation shall be an equal hazards spectra having a 2 percent probability of being exceeded in 50 years based on the 2016 California Building Code. Horizontal response spectra curves shall be provided for ½, 2, and 5 percent damping. A vertical response spectra curve shall be provided for 5 percent damping only. The response spectra shall have a curve extended to a period of 5 seconds for 2 and 5 percent damping and 10 seconds for ½ percent damping.*

The objective of this Section is to present the site-specific seismic response analysis and design parameters that may be used in foundation design for the wastewater treatment plant planned improvements.

## A5.2. Evaluation of Historical Seismicity

Historical earthquakes within the local region were analyzed using geospatial seismicity data obtained from the Northern California Earthquake Data Center (NCEDC, 2017). Two earthquake catalogs were used: the Berkeley Seismological Laboratory (BSL) Berkeley Digital Seismic Network (BDSN) Catalog provided earthquake data from 1910 to 2003, and the United States Geological Survey (USGS) Northern California Seismic Network (NCSN) Catalog provided data from 1967 to present.

Historic seismicity for the city of Arcata, California is presented in Figure A3-1. Earthquakes with a Richter magnitude of less than 5 were eliminated from the analysis. Site proximity to Aqluist-Priolo zones is illustrated in Figure A3-2. Nearby historic earthquake events are presented in Table A3-1.

*Table A3-1. Local Historic Seismic Events*

| Source | Magnitude | Distance (mi) | Year |
|---|---|---|---|
| Ferndale Fault | 5.3 | 23.70 | 1975 |
| Little Salmon (Offshore) | 5.2 | 12.36 | 1979 |
| Little Salmon (Offshore) | 7.2 | 31.70 | 1980 |
| Mendocino | 5.6 | 34.02 | 1987 |
| Little Salmon (Offshore) | 5.4 | 13.78 | 1994 |
| Little Salmon (Offshore) | 5.2 | 24.42 | 2002 |
| Grogan Fault | 5.4 | 31.13 | 2008 |
| Bear River Fault Zone | 6.5 | 35.00 | 2010 |
| Grogan Fault | 5.6 | 25.28 | 2012 |

Distances to site were estimated using Google™ Earth

## A5.3. Evaluation of Potential Seismic Risk

The potential seismic risk, was evaluated using EZ-FRISK™ software (Fugro, 2011). The software models seismic sources and earthquake recurrence based on the USGS source model used to update the National Seismic Hazard Maps (USGS, 2008). Specifically, earthquake ruptures are modeled using Gutenberg-Richter and characteristic magnitude-frequency distributions based on fault slip rate, geometry, dip angle, and depth. Magnitudes are modeled from previous earthquake events or from magnitude estimates (Ellsworth 2003; Hanks and Bakun 2002). Earthquake recurrence is based on earthquake rupture, magnitude estimates, and fault slip rates. Background seismicity is addressed to compensate for regions with minimal historical seismicity and is spread over the seismic model region using uniform background zones. Using EZ-FRISK™, earthquake hazard risk was evaluated for faults within a 120-mile radius of the Site. Potential sources, respective magnitudes, distances to the Site, and seismic parameters are presented in Table A3-2.

*Table A3-2. Summary of Nearby Seismic Sources*

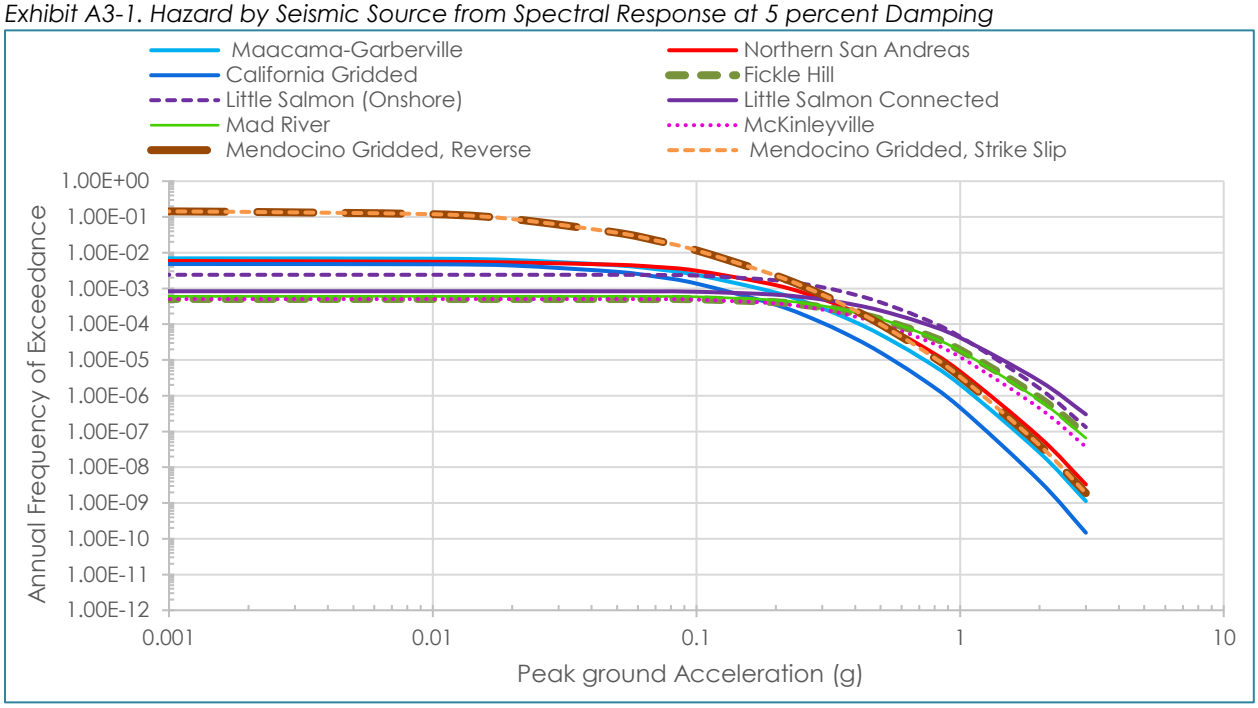
| Source | Maximum Magnitude | Distance (km) | Site Lies | Dip Angle (degree) | Mechanism | Length (km) | Slip Rate[1] (mm/year) |
|---|---|---|---|---|---|---|---|
| Maacama-Garberville | 7.4 | 65.94 | N | 90 | Strike Slip | 221 | 9 |
| Northern San Andreas | 8.05 | 72.94 | N | 90 | Strike Slip | 325 | – |
| California Gridded | 7 | 0 | Above | 90 | SS \| R | – | – |
| Bartlett Springs | 7.3 | 82.33 | NW | 90 | Strike Slip | 174 | 6.00 |
| Battle Creek | 6.7 | 168.43 | W | 75 | Normal | 29 | 0.5 |
| Big Lagoon-Bald Mtn | 7.5 | 23.66 | SW | 35 | Reverse | 90 | 0.5 |
| Cedar Mtn-Mahogany Mtn | 7.1 | 197.6 | W | 60 | Normal | 78 | 1 |

| Source | Maximum Magnitude | Distance (km) | Site Lies | Dip Angle (degree) | Mechanism | Length (km) | Slip Rate[1] (mm/year) |
|---|---|---|---|---|---|---|---|
| Fickle Hill | 7.1 | 2.91 | SW | 35 | Reverse | 32 | 0.6 |
| Great Valley 1 | 6.8 | 193.74 | NW | 15 | Reverse | 44 | 0.1 |
| Little Salmon (Offshore) | 7.3 | 10.34 | E | 30 | Reverse | 34 | 5 |
| Little Salmon (Onshore) | 7.1 | 9.3 | N | 30 | Reverse | 46 | 1 |
| Little Salmon Connected | 7.5 | 9.35 | Above | 30 | Reverse | 46 | 1 |
| Mad River | 7.2 | 4.53 | SW | 35 | Reverse | 42 | 0.7 |
| McKinleyville | 7.2 | 6.24 | SW | 35 | Reverse | 42 | 0.7 |
| Mendocino Gridded, Reverse | 7.3 | 7.05 | N | 90 | Reverse | 174 | <5.00 |
| Mendocino Gridded, Strike Slip | 7.3 | 7.05 | N | 90 | Reverse | 174 | >5.00 |
| Shear 1 Gridded | 7.6 | 183.21 | NW | 90 | Strike Slip | – | – |
| Shear 2 Gridded | 7.6 | 141.45 | SW | 90 | Strike Slip | – | – |
| Table Bluff | 7.2 | 16.69 | NE | 45 | Reverse | 49 | 0.6 |
| Trinidad | 7.5 | 11.42 | SW | 35 | Reverse | 88 | 0.7 |

[1] Length and Slip Rate values from USGS 2008 National Seismic Hazard Maps – Source Parameters; other values from Risk Engineering, 2011. Magnitudes provided are in moment magnitude.
km–kilometer
mm–milometer
Mtn–Mountain

As shown in Table A3-2, the fault systems that demonstrate the most significant seismic hazard for the Site include Mendocino Gridded, Maacama-Garberville, Northern San Andreas, California Gridded, Little Salmon, Mad River, McKinleyville, and Fickle Hill. Peak ground accelerations (PGAs) for fault rupture at the Site, evaluated using EZ-FRISK™, are shown in Exhibit A3-1.

*Exhibit A3-1. Hazard by Seismic Source from Spectral Response at 5 percent Damping*




As shown in Exhibit A3-1, the Mendocino Gridded fault yields the highest annual frequency of exceedance, however, the Little Salmon fault yields the greatest PGA compared to the other faults. On this basis, in addition to the proximity of the Little Salmon Fault to the Site, we used the Little Salmon fault in our seismic hazard analysis.

## A5.4. Seismic Hazard Analysis

Our analysis included development of the following:

- Risk-Targeted Maximum Considered Earthquake ($MCE_R$) ground motions based on probabilistic and deterministic response spectra;
- Deterministic Lower Limit on $MCE_R$ Response Spectrum from Figure 21.2-1 of ASCE 7-10; and
- Design Response Spectrum from Figure 11.4-1 of ASCE 7-10. Design acceleration parameters are developed specifically for Site Class F based on ASCE 7-10 Section 21.4.

Earthquake intensity was calculated using the maximum rotated spectral response with 5 percent damping using the 2008 USGS fault model for California, and 2008 Next Generation Attenuation (NGA) relations (based on the 2008 USGS National Seismic Hazard Maps for the Western United States) per CBC Chapter 18A Section 1803A.6 (USGS, 2008). Three attenuation equations were utilized to provide mean values for the computed probabilistic and deterministic horizontal response spectra. These attenuation equations are by Boore and Atkinson (2008) NGA USGS 2008, Chiou and Youngs (2007) NGA USGS 2008, and Campbell and Bozorgnia (2008) NGA USGS 2008. Three attenuation equations were also utilized to provide mean values for the computed probabilistic and deterministic vertical response spectra. These attenuation equations are by Ambraseys et al (2005), Campbell and Bozorgnia (2003) uncorrolated vertical, and Sabetta and Pugliese (1996) vertical.

The NGA relations utilize the average shear wave velocity in the top 100 feet, the depths to shear wave velocities of 1,000 meters (m) ($Z_1$) and 2,500 m ($Z_{2.5}$). The average shear wave velocity is based on site-specific geotechnical data from five cone penetration tests (CPT) at the direction of a LACO geologist. CPT depths and respective shear wave velocities are presented in Table A3-3.

*Table A3-3. Geotechnical Boring Data*

| Depth Range (feet) | Shear Wave Velocity in Borings (feet per second) | | | | |
|---|---|---|---|---|---|
| | CPT1 | CPT2 | CPT3 | CPT6 | CPT9 |
| 0-5 | 300 | 300 | 350 | 350 | 315 |
| 5-10 | 300 | 300 | 350 | 350 | 315 |
| 10-15 | 400 | 420 | 400 | 400 | 390 |
| 15-20 | 500 | 420 | 480 | 450 | 500 |
| 20-25 | 400 | 420 | 400 | 450 | 400 |
| 25-30 | 400 | 420 | 400 | 450 | 400 |
| 30-35 | 450 | 540 | 550 | 450 | 430 |
| 35-40 | 520 | 540 | 650 | 600 | 510 |
| 40-45 | 600 | 750 | 750 | 600 | 580 |
| 45-50 | 650 | 850 | --- | 650 | 600 |
| 50-55 | 600 | --- | --- | --- | 600 |
| 55-60 | 600 | --- | --- | --- | 650 |

Average shear wave velocity ($V_s$) for the top 100 feet is 137 m/s (449 ft/s). It was computed using Equation A3-1 (Section 20.4 of ASCE 7-10) and individual thicknesses and shear wave velocities in Table A3-3.

$$\bar{v}_s = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{v_{si}}}$$ Equation A3-1

where

$\bar{v}_s$ = average shear wave velocity

$d_i$ = Thickness of layer $i$

$v_{si}$ = Average shear wave velocity in layer $i$

Accordingly, $Z_1$ was estimated at 350 m using Figure 2.5 from Abrahamson and Silva (2008) and Chiou and Youngs (2008); and $Z_{2.5}$ was set to a default value of 2 kilometers (km) based on Section 6.3.5 of Campbell and Bozorgnia (2008). Variation of $Z_{2.5}$ to 1 km and 3 km did not have an effect on probabilistic or deterministic spectral acceleration values.

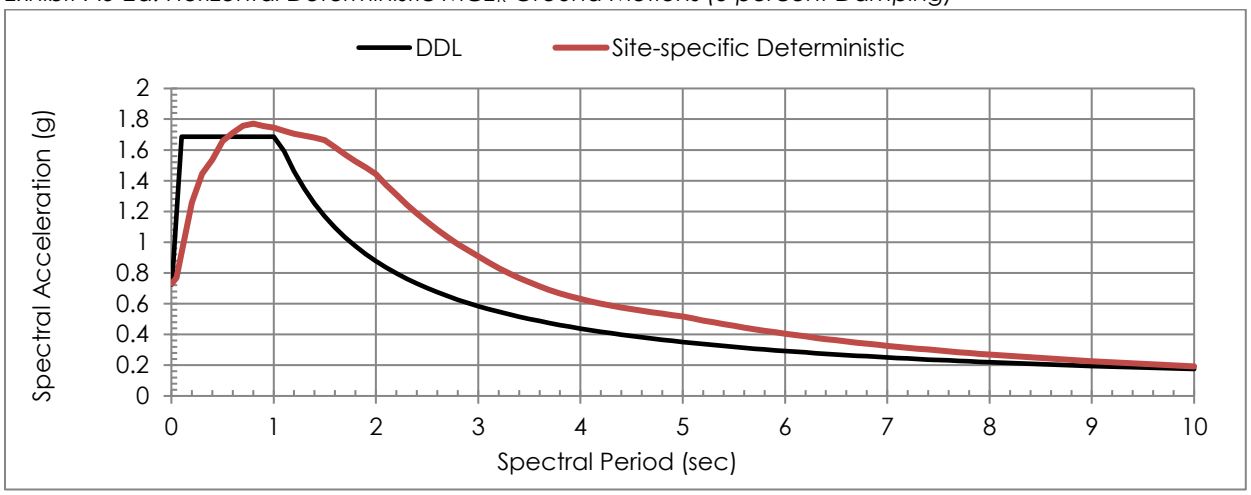
## A5.5. Results

This Section describes the seismic model results and data processing to meet the requirements of ASCE 7-10 and CBC. Site-specific characteristics, probabilistic and deterministic spectra, and design spectra are presented in this Section.

Probabilistic spectra was computed using a probability of exceedance of 2 percent in 50 years (a return period of 2,475 years) in accordance with Method 1 described in 21.2 of ASCE 7-10. The probabilistic analysis

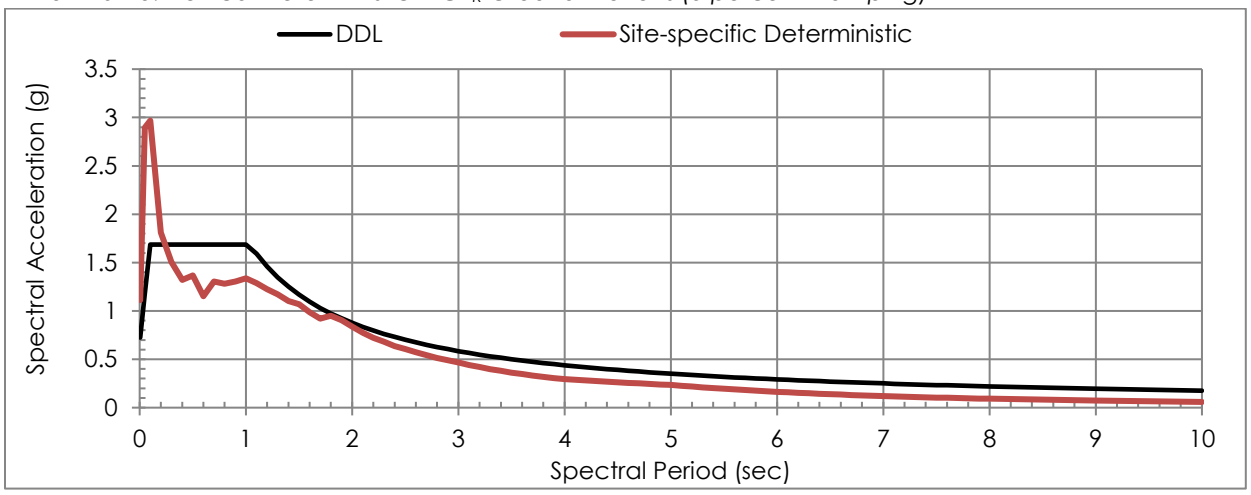
included seismic sources within a 200 km radius of the Site (the greatest contributors are illustrated in Table A3-2). Deterministic spectra were computed using the 84th percentile of spectral accelerations based on ASCE 7-10 requirements from Section 21.2.1.2. The deterministic analysis included the Little Salmon seismic source (located approximately 11 miles southwest of the Site). Probabilistic and deterministic spectra presented in these results utilize 5 percent damping. The resulting site-specific deterministic spectra was compared to the deterministic lower limit (DDL) described in Figure 21.2-1 of ASCE 7-10. The results for horizontal deterministic $MCE_R$ ground motions are presented in Exhibit A3-2a and the results for vertical deterministic $MCE_R$ ground motions are presented in Exhibit A3-2b. The DDL is used to provide a lower bound on computed spectra to ensure that designs based on deterministic spectra are sufficiently conservative.

*Exhibit A3-2a. Horizontal Deterministic $MCE_R$ Ground Motions (5 percent Damping)*




As shown in Exhibit A3-2a, site-specific deterministic spectra are greater than the DDL spectra for periods greater than 0.5 seconds, but the DDL is greater than site-specific deterministic spectra for periods less than 0.5 seconds. Therefore, the site-specific deterministic spectra require adjustment to include the DDL values according to ASCE 7-10 Section 21.2.2.

*Exhibit A3-2b. Vertical Deterministic $MCE_R$ Ground Motions (5 percent Damping)*

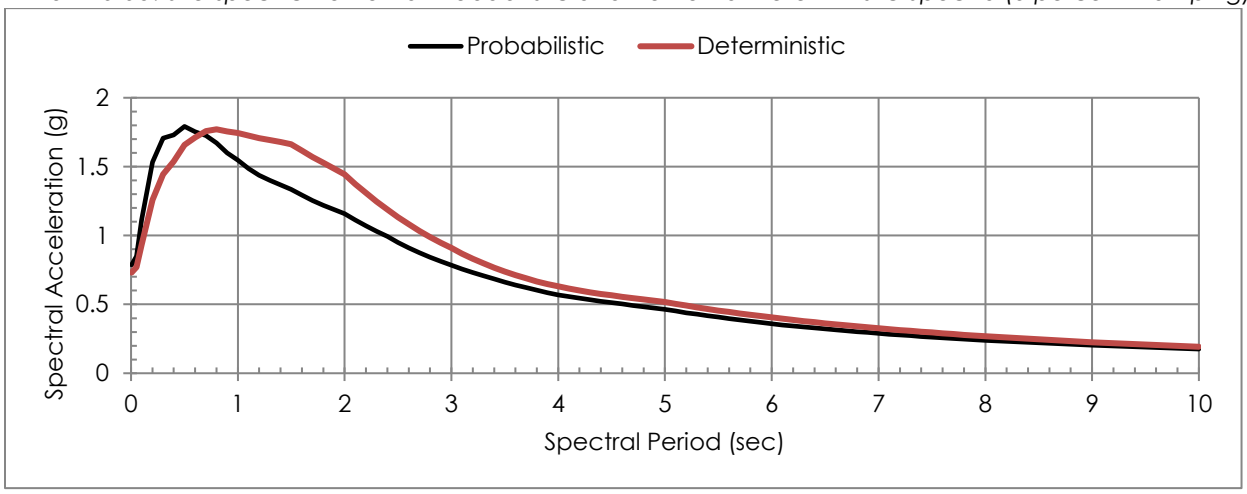


As illustrated in Exhibit A3-2b, site-specific deterministic spectra are greater than the DDL spectra for periods less than 0.2 seconds, but the DDL is greater than site-specific deterministic spectra for periods greater than 0.2 seconds. Therefore, the site-specific deterministic spectra require adjustment to include the DDL values according to ASCE 7-10 Section 21.2.2.

The lesser of the probabilistic and deterministic response spectra establishes the site-specific $MCE_R$ response based on ASCE 7-10 Section 21.2.3. Horizontal probabilistic and deterministic spectra and vertical probabilistic and deterministic spectra are compared in Exhibit A3-3a and A3-3b, respectively.

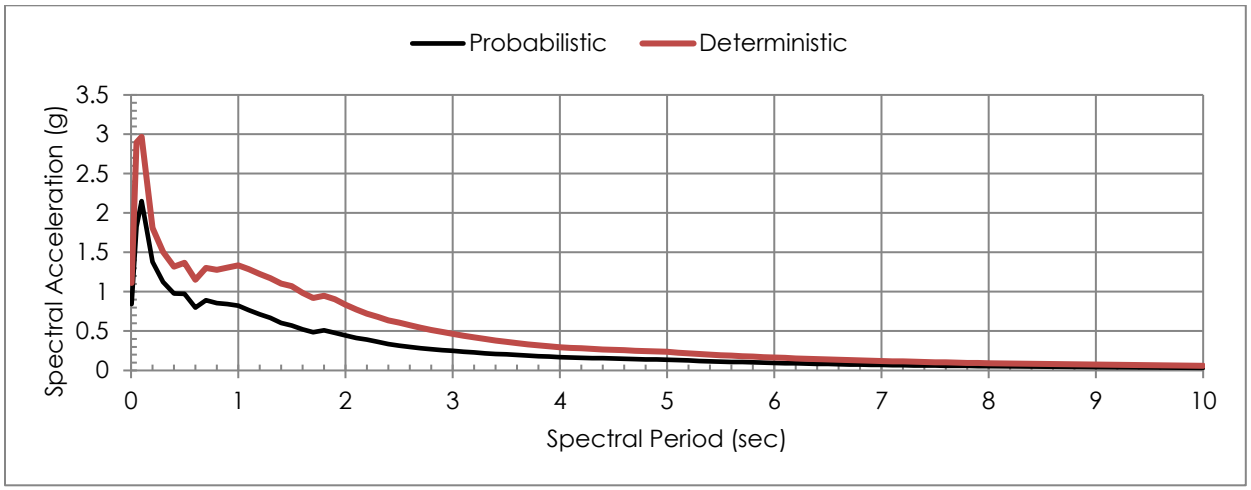
Both of the horizontal probabilistic and horizontal deterministic spectra are in the direction of the maximum horizontal response. Both of the vertical probabilistic and vertical deterministic spectra are in the direction of the maximum vertical response. In addition, mapped risk coefficients $C_{RS}$ and $C_{R1}$ were used to adjust the probabilistic spectral response spectra based on the requirements in ASCE 7-10 Section 21.2.1.1. The value for $C_{RS}$ and $C_{R1}$ are 0.894 and 0.886, respectively, are based on the U.S. Seismic Design Maps (USGS, 2017).

*Exhibit A3-3a. Site-specific Horizontal Probabilistic and Horizontal Deterministic Spectra (5 percent Damping)*




As shown in Exhibit A3-3a, the probabilistic spectra are higher than the deterministic spectra for the periods less than 0.7 seconds, but the probabilistic spectra are lower than the deterministic spectra for the periods greater than 0.7 seconds and are therefore modified to include the component of the deterministic spectra based on ASCE 7-10 Section 21.2.3.

*Exhibit A3-3b. Site-specific Vertical Probabilistic and Vertical Deterministic Spectra (5 percent Damping)*

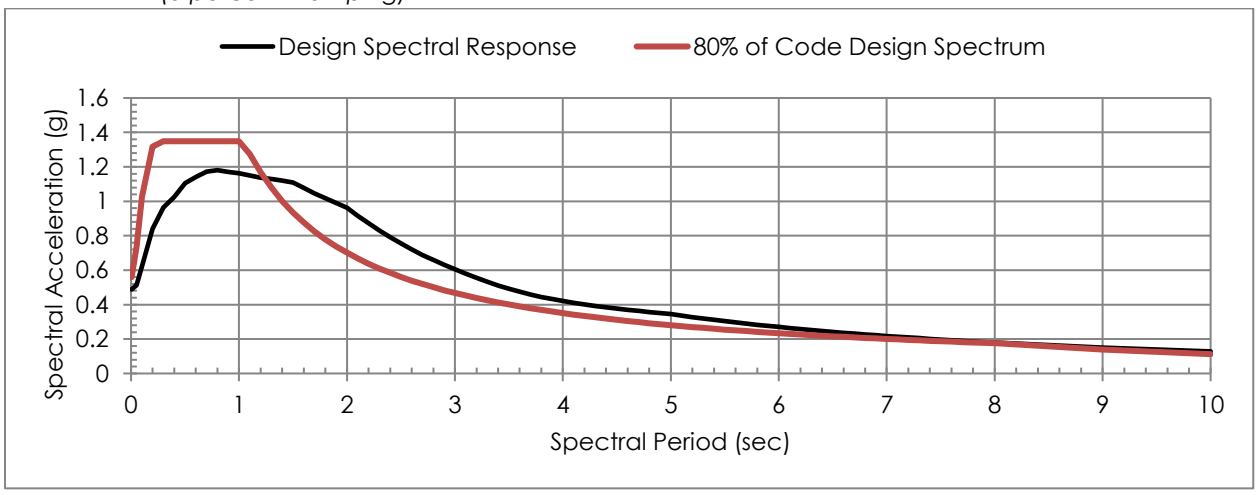



As shown in Exhibit A3-3b, the probabilistic spectra are lower than the deterministic spectra and are therefore the controlling site-specific spectra based on ASCE 7-10 Section 21.2.3.

The design spectral response acceleration is calculated as two-thirds of the controlling site-specific spectra based on ASCE 7-10 Section 21.3. ASCE 7-10 mandates that the design spectral response be greater than 80 percent of the code design spectra developed using the methods in ASCE 7-10 Section 11.4.5. Site Class E was selected based on the average shear wave velocity from the CPT logs. Therefore, Site Class E tabular values for site coefficients $F_a$ and $F_v$ were used to develop the code design spectra.

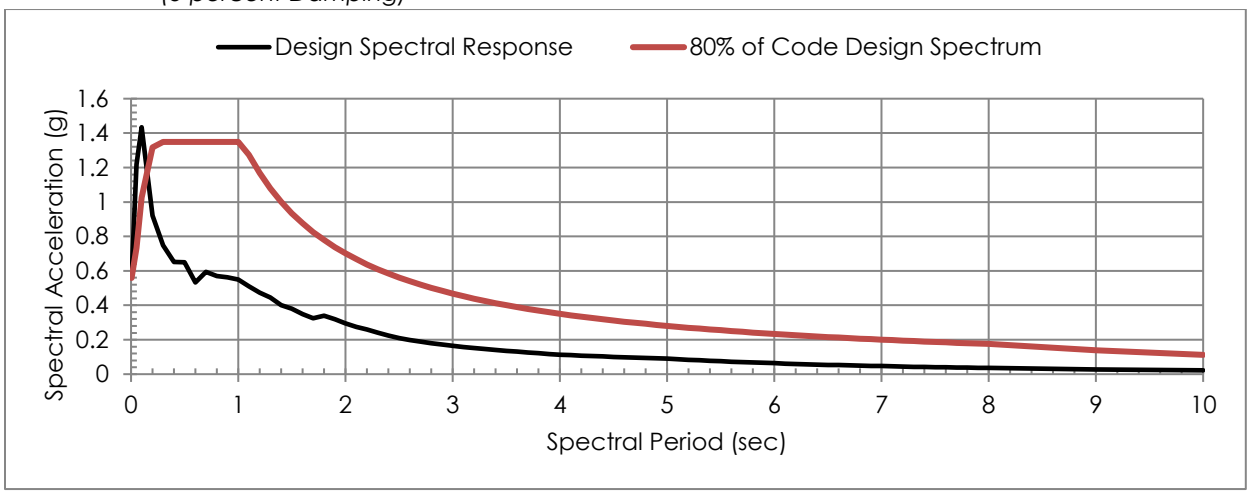
The final design spectra was obtained by taking the maximum value of the design spectral response and 80 percent of code design spectra based on the requirements in ASCE 7-10 Section 21.3. The two horizontal spectra are compared in Exhibit A3-4a and the two vertical spectra are compared in Exhibit A3-4b.

*Exhibit A3-4a. Horizontal Design Spectral Response and 80 percent of Code Design Spectrum (5 percent Damping)*




The horizontal design spectral response are not higher than 80 percent of code design spectra, and are therefore modified to include the component of 80 percent of code design spectra.

*Exhibit A3-4b. Vertical Design Spectral Response and 80 percent of Code Design Spectrum (5 percent Damping)*




The vertical design spectral response are not higher than 80 percent of code design spectra, and are therefore modified to include the component of 80 percent of code design spectra.

The $MCE_R$ response spectrum is created by multiplying the modified design spectra by 1.5 based on ASCE 7-10 Section 11.4.6.

The horizontal design spectrum results for 5 percent dampening are presented in Exhibit A3-5a. Both the horizontal $MCE_R$ and horizontal design spectrum contain the influences of the 80 percent of code design spectra value near the spectral period of 2.0 seconds based on the requirements in ASCE 7-10 Section 21.3. The horizontal $MCE_R$ and horizontal design spectrum are tabulated in Table A3-4.

*Exhibit A3-5a. Horizontal $MCE_R$ and Horizontal Design Spectrum (5 percent Damping)*

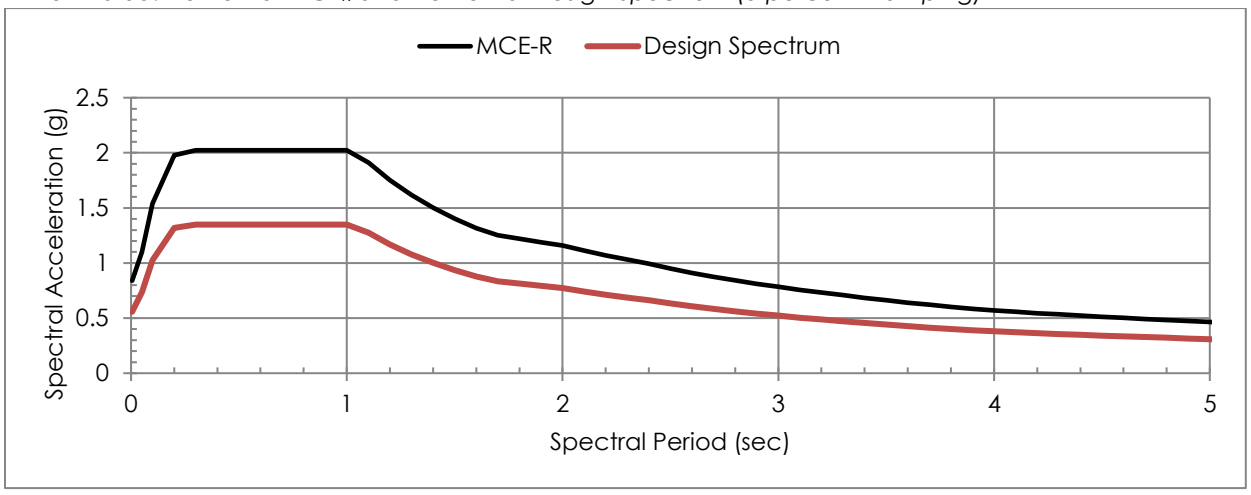


*Table A3-4a. Horizontal* $MCE_R$ Spectrum and Horizontal Design Spectrum

| Period (sec) | $MCE_R$ Spectrum | Design Spectrum |
|---|---|---|
| PGA (0.005) | 0.8384 | 0.5590 |
| 0.1 | 1.5389 | 1.0260 |
| 0.2 | 1.9768 | 1.3179 |
| 0.4 | 2.0232 | 1.3488 |
| 0.6 | 2.0232 | 1.3488 |
| 0.8 | 2.0232 | 1.3488 |
| 1.0 | 2.0232 | 1.3488 |
| 2.0 | 1.158 | 0.7720 |
| 3.0 | 0.7839 | 0.5226 |
| 4.0 | 0.5693 | 0.3795 |

Horizontal response spectra curves for 1/2 percent, and 2 percent dampening based off of the horizontal $MCE_R$ and horizontal design spectrum are presented below in Exhibit A3-5b, and A3-5c.

*Exhibit A3-5b. Horizontal Response Spectra for ½ percent Damping*

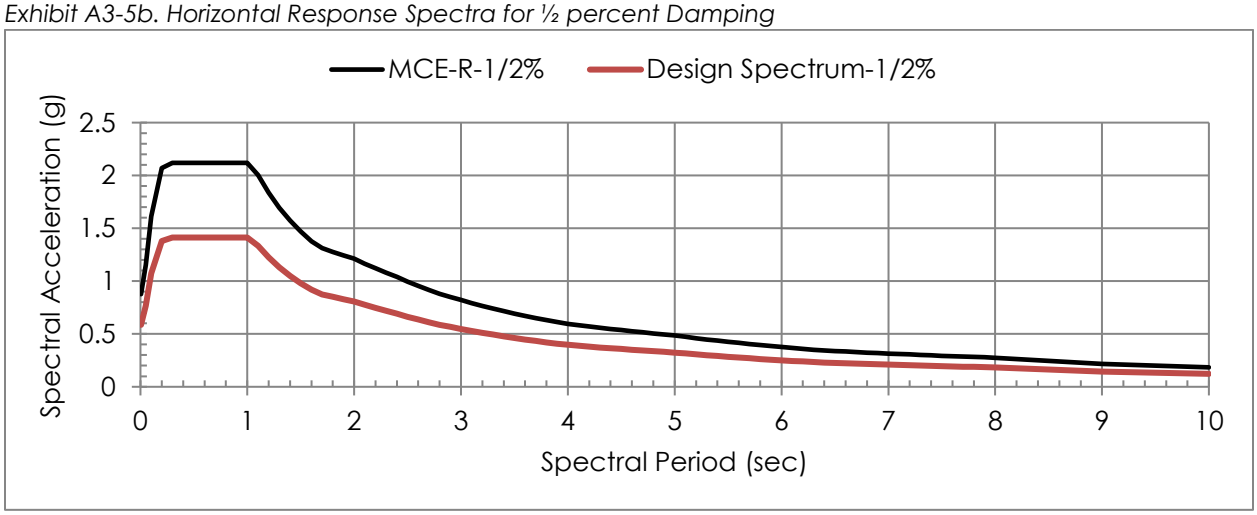
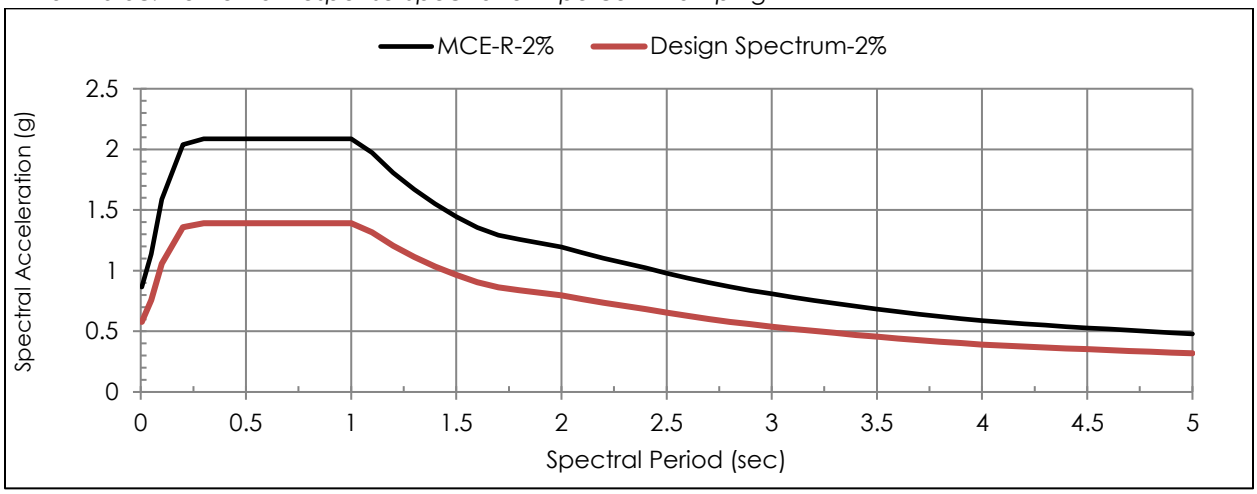


*Exhibit A3-5c. Horizontal Response Spectra for 2 percent Damping*




The vertical design spectrum results for 5 percent dampening are presented in Exhibit A3-6. Both the vertical $MCE_R$ and vertical design spectrum contain the influences of the 80 percent of code design spectra value near the spectral period of 2.0 seconds based on the requirements in ASCE 7-10 Section 21.3. The vertical $MCE_R$ and vertical design spectrum are tabulated in Table A3-4b.

*Exhibit A3-6. Vertical $MCE_R$ and Design Spectrum*, 5 percent damping

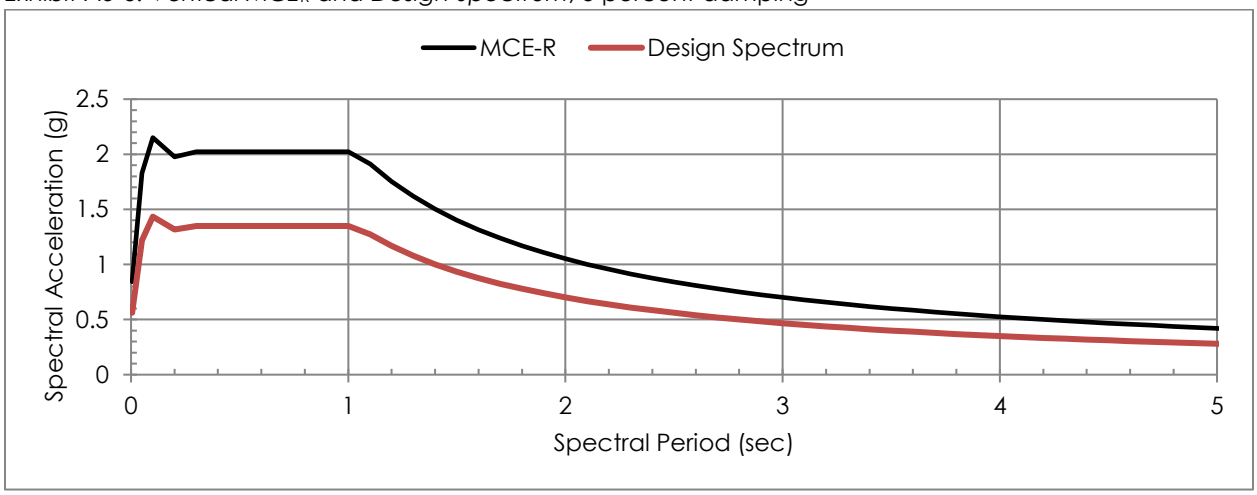


*Table A3-4b. Vertical* $MCE_R$ Spectrum and Vertical Design Spectrum

| Period (sec) | $MCE_R$ Spectrum | Design Spectrum |
|---|---|---|
| PGA (0.005) | 0.8432 | 0.5621 |
| 0.1 | 2.151 | 1.4340 |
| 0.2 | 1.9768 | 1.3179 |
| 0.4 | 2.0232 | 1.3488 |
| 0.6 | 2.0232 | 1.3488 |
| 0.8 | 2.0232 | 1.3488 |
| 1.0 | 2.0232 | 1.3488 |
| 2.0 | 1.0518 | 0.7012 |
| 3.0 | 0.7012 | 0.4675 |
| 4.0 | 0.5259 | 0.3506 |

## A5.6. Seismic Design Parameters

Based on the results of our ground motion analysis, we recommend using the seismic design factors presented in Table A3-5.

*Table A3-5. Summary of Seismic Design Factors per ASCE 21.4: Design Acceleration Parameters*

| | $S_{MS}$ (g) | $S_{M1}$ (g) | $S_{DS}$ (g) | $S_{D1}$ (g) |
|---|---|---|---|---|
| Horizontal | 2.0232 | 2.3160 | 1.3488 | 1.5440 |
| Vertical | 2.0232 | 2.1036 | 1.3488 | 1.4024 |

(g) acceleration of gravity

where

$S_{MS}$ = Maximum considered earthquake spectral response acceleration, 5 percent damped, at 0.2 second (in percent g).

$S_{M1}$ = Maximum considered earthquake spectral response acceleration, 5 percent damped, at 1.0 second period (in percent g).

$S_{DS}$ = Design spectral response acceleration, 5 percent damped, at 0.2 second period (in percent g).

$S_{D1}$ = Design spectral response acceleration, 5 percent damped, at 1.0 second period (in percent g).

Peak ground accelerations were computed for the geometric mean horizontal component of the spectral response per ASCE 7-10 Section 11.8.3 and are summarized in Table A3-7.

*Table A3-7.* $MCE_G$ *(g) Peak Ground Acceleration Adjusted for Site Class Effects*

| Intensity Type | Probabilistic | Deterministic | 80 percent of Equation 11.8-1 |
|---|---|---|---|
| Geometric Mean Horizontal Component of Spectral Response | 0.61 | 0.56 | 0.81 |

Based on ASCE 7-10 Section 21.5.3, the site-specific $MCE_G$ peak ground acceleration should be taken as the lesser of the probabilistic or deterministic geometric mean peak ground acceleration, but shall not be taken

less than 80% of $PGA_M$ determined from Equation 11.8-1. Use the deterministic value of 0.81g from the geometric mean horizontal component for $MCE_G$ (PGA) and an earthquake magnitude of M7.3, located 4.23 miles from Site, for design.

## A5.7. References

American Society of Civil Engineers (ASCE), 2013. Minimum Design Loads for Buildings and Other Structures: ASCE Standard 7-10.

Boore, D.M. and Atkinson, G.M., 2008. Ground-Motion Prediction Equations for the Average Horizontal Component of PGA, PGV, and 5 percent-Damped PSA at Spectral Periods between 0.01 s and 10.0 s. Earthquake Spectra, Vol 24.

Campbell, K.W. and Bozorgnia, Y., 2008. NGA Ground Motion Model for the Geometric Mean Horizontal Component of PGA, PGV, PGD and 5 percent Damped Linear Elastic Response Spectra for Periods Ranging from 0.01s to 10 s. Earthquake Spectra, Vol 24.

Chiou, B.S.-J, and Youngs, R.R., 2008. An NGA Model for the Average Horizontal Component of Peak Ground Motion and Response Spectra. Earthquake Spectra, Vol 24.

California Building Standards Commission, California Building Code (CBC), 2016. California Code of Regulations, Title 24, Part 2, Volumes 1 and 2.

Ellsworth, W., 2003. Appendix D—Magnitude and area data for strike slip earthquakes, in Working Group on California Earthquake Probabilities, Earthquake probabilities in the San Francisco Bay region—2002–2031. U.S. Geological Survey Open-File Report.

Fugro Consultants, Inc., 2011. EZ-FRISK ™-Software for Earthquake Ground Motion Estimation (Version 7.62) (computer software).

Hanks, T.C. and Bakun, W.H., 2002. A bilinear source-scaling model for M-log A observations of continental earthquakes. Bulletin of the Seismological Society of America.

Kirar et al., 2016. Correlation Between Shear Wave Velocity (Vs) and SPT Resistance (N) for Roorkee Region. Bablu Kirar, B.K. Maheshwari, Pradeep Muley. Springer International Publishing Switzerland.

United States Geological Survey (USGS), 2008. Documentation for the 2008 Update of the United States National Seismic Hazard Maps, United States Department of the Interior - Geological Survey. Authors: Petersen, M.D., Frankel, A.D., Harmsen, S.C., Mueller, C.S., Haller, K.M., Wheeler, R.L., Wesson, R.L., Zeng, Y., Boyd, O.S., Perkins, D.M., Luco, N., Field, E.H., Wills, C.J., and Rukstales, K.S. Open-File Report 2008–1128.

United States Geological Survey (USGS), 2017. U.S. Seismic Design Maps. Earthquake Hazards Program. Accessed on July 1, 2017. https://earthquake.usgs.gov/designmaps/us/application.php.

University of California, Berkeley-Berkeley Seismological Laboratory, Northern California Earthquake Data Center (NCEDC). http://ncedc.org/ncedc/catalog-search.html. Accessed on July 1, 2017.

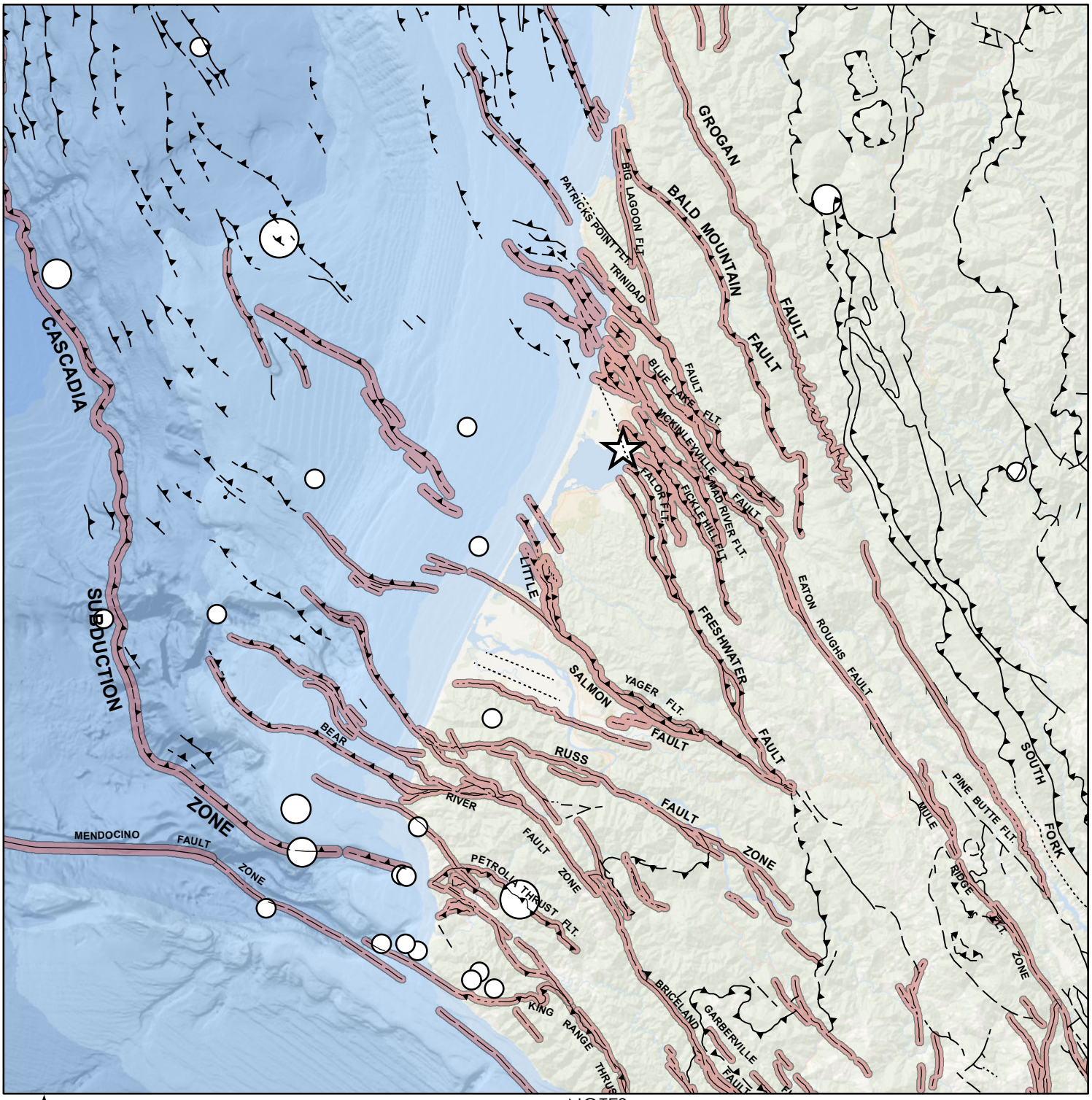
# FIGURES

**Figure A5-1 Historical Seismicity Map**

**Figure A5-2 Alquist-Priolo Zones Map**

| LACO | PROJECT | Wastewater Treatment Plant Improvements | BY | JRG | FIGURE |
|---|---|---|---|---|---|
| EUREKA • UKIAH • SANTA ROSA | CLIENT | Carollo Engineers, Inc. | CHECK | BMW | A5-1 |
| 1-800-515-5054 www.lacoassociates.com | LOCATION | Gearheart Marsh, Arcata, CA 95521 | DATE | 8/09/2018 | JOB NO. 7986.01 |
| | | Historical Seismicity Map | | | |

REUSE OF DOCUMENTS: This document and the ideas and design incorporated herein, as an instrument of professional service, is the property of LACO Associates and shall not be reused in whole or part for any other project without LACO Associates express written authorization.




Arcata Waste Water Treatment Facility

Magnitude

- 5.0
- 6.0
- 7.0

NOTES:
1. IMAGE TAKEN FROM GOOGLE EARTH WITH KML FROM USGS EARTHQUAKE CATALOG
2. ALL LOCATIONS ARE APPROXIMATE

N

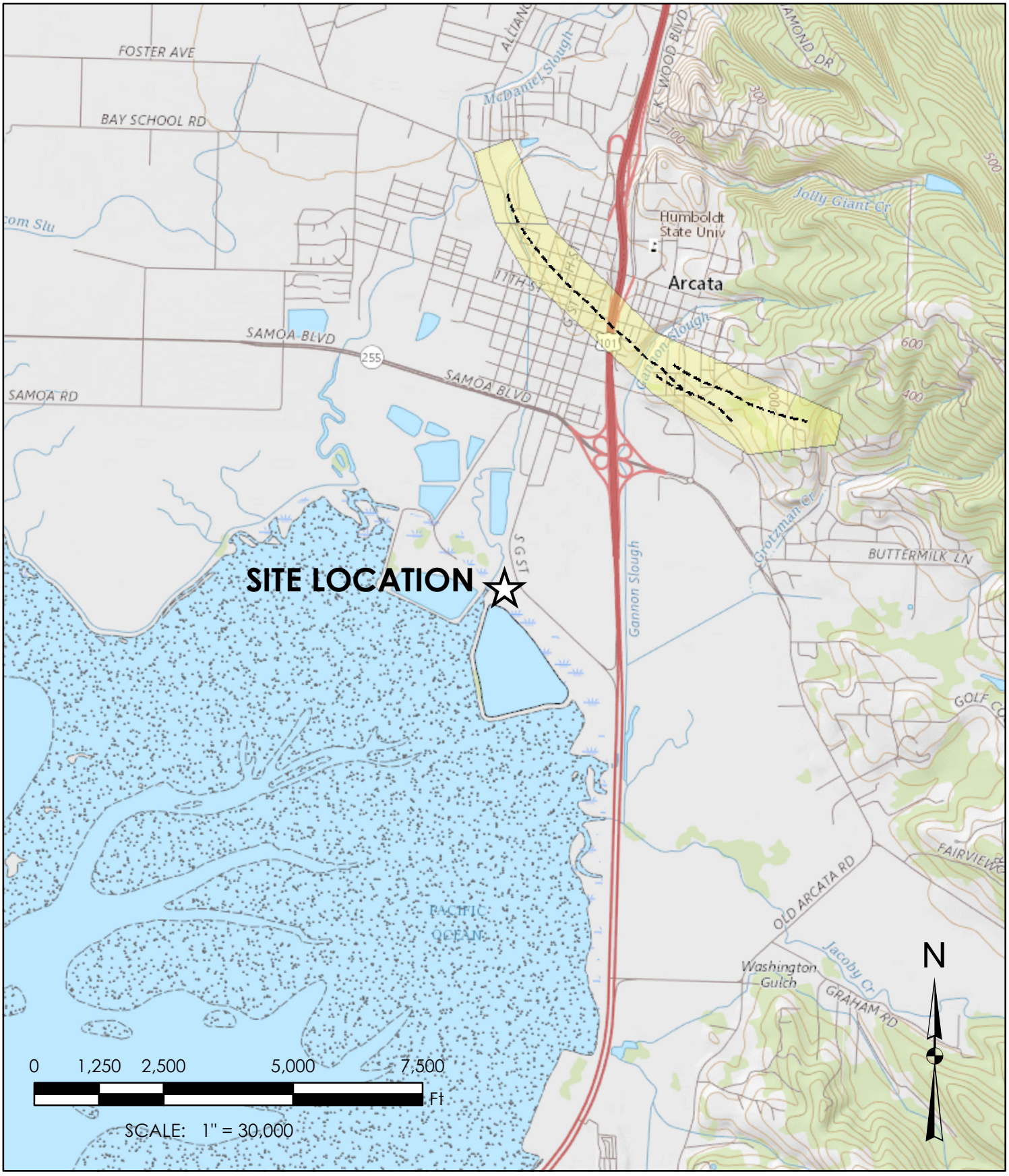
0 37,500 75,000 150,000 225,000 Ft

SCALE: 1" = 700,000

Date: 8/14/2018 Time: 11:11:50 AM
Path: P:\7900\7986 Carollo Engineers\7986.01 Arcata Wastewater Treatment Facility Design\12 Figures_Maps\Site Specific GIS\Figure A4-1.mxd

| LACO<br>EUREKA • UKIAH • SANTA ROSA<br>1-800-515-5054 www.lacoassociates.com | PROJECT Wastewater Treatment Plant Improvements | BY JRG | FIGURE A5-2 |
|---|---|---|---|
| | CLIENT Carollo Engineers, Inc. | CHECK BMW | |
| | LOCATION Gearheart Marsh, Arcata, CA 95521 | DATE 8/09/2018 | JOB NO. 7986.01 |
| | Alquist-Priolo Zone Map | | |

REUSE OF DOCUMENTS: This document and the ideas and design incorporated herein, as an instrument of professional service, is the property of LACO Associates and shall not be reused in whole or part for any other project without LACO Associates express written authorization.




Date: 8/14/2018 Time: 10:55:34 AM
Path: P:\7900\7986 Carollo Engineers\7986.01 Arcata Wastewater Treatment Facility Design\12 Figures_Maps\Fault map Earthquakes\Figure A4-2.mxd

# APPENDIX A5-1

## Tabular Seismic Response Spectra Data

## Horizontal Damping Tabular Spectrum Data

| T | MCE-R at 0% Damping | Design at 0% Damping | MCE-R at 0.05% Damping | Design Spectrum at 0.5% Damping | MCE-R at 2% Damping | Design Spectrum at 2% Damping | MCE-R at 5% Damping | Design-Spectrum at 5% Damping |
|---|---|---|---|---|---|---|---|---|
| 0.005 | 0.883 | 0.588 | 0.878 | 0.585 | 0.865 | 0.577 | 0.838 | 0.559 |
| 0.050 | 1.159 | 0.773 | 1.153 | 0.769 | 1.136 | 0.757 | 1.101 | 0.734 |
| 0.100 | 1.620 | 1.080 | 1.612 | 1.075 | 1.588 | 1.058 | 1.539 | 1.026 |
| 0.200 | 2.081 | 1.387 | 2.070 | 1.380 | 2.039 | 1.359 | 1.977 | 1.318 |
| 0.300 | 2.130 | 1.420 | 2.119 | 1.413 | 2.087 | 1.391 | 2.023 | 1.349 |
| 0.400 | 2.130 | 1.420 | 2.119 | 1.413 | 2.087 | 1.391 | 2.023 | 1.349 |
| 0.500 | 2.130 | 1.420 | 2.119 | 1.413 | 2.087 | 1.391 | 2.023 | 1.349 |
| 0.600 | 2.130 | 1.420 | 2.119 | 1.413 | 2.087 | 1.391 | 2.023 | 1.349 |
| 0.700 | 2.130 | 1.420 | 2.119 | 1.413 | 2.087 | 1.391 | 2.023 | 1.349 |
| 0.800 | 2.130 | 1.420 | 2.119 | 1.413 | 2.087 | 1.391 | 2.023 | 1.349 |
| 0.900 | 2.130 | 1.420 | 2.119 | 1.413 | 2.087 | 1.391 | 2.023 | 1.349 |
| 1.000 | 2.130 | 1.420 | 2.119 | 1.413 | 2.087 | 1.391 | 2.023 | 1.349 |
| 1.100 | 2.013 | 1.342 | 2.003 | 1.335 | 1.973 | 1.315 | 1.912 | 1.275 |
| 1.200 | 1.845 | 1.230 | 1.836 | 1.224 | 1.808 | 1.206 | 1.753 | 1.169 |
| 1.300 | 1.703 | 1.136 | 1.695 | 1.130 | 1.669 | 1.113 | 1.618 | 1.079 |
| 1.400 | 1.582 | 1.054 | 1.574 | 1.049 | 1.550 | 1.033 | 1.503 | 1.002 |
| 1.500 | 1.476 | 0.984 | 1.469 | 0.979 | 1.447 | 0.964 | 1.402 | 0.935 |
| 1.600 | 1.384 | 0.923 | 1.377 | 0.918 | 1.356 | 0.904 | 1.315 | 0.876 |
| 1.700 | 1.319 | 0.879 | 1.312 | 0.875 | 1.293 | 0.862 | 1.253 | 0.835 |
| 1.800 | 1.283 | 0.855 | 1.277 | 0.851 | 1.257 | 0.838 | 1.219 | 0.813 |
| 1.900 | 1.251 | 0.834 | 1.244 | 0.830 | 1.226 | 0.817 | 1.188 | 0.792 |
| 2.000 | 1.219 | 0.813 | 1.213 | 0.809 | 1.195 | 0.796 | 1.158 | 0.772 |
| 2.100 | 1.171 | 0.780 | 1.165 | 0.776 | 1.147 | 0.765 | 1.112 | 0.741 |
| 2.200 | 1.126 | 0.751 | 1.121 | 0.747 | 1.104 | 0.736 | 1.070 | 0.713 |
| 2.300 | 1.084 | 0.723 | 1.079 | 0.719 | 1.063 | 0.708 | 1.030 | 0.687 |
| 2.400 | 1.045 | 0.696 | 1.040 | 0.693 | 1.024 | 0.683 | 0.992 | 0.662 |
| 2.500 | 1.000 | 0.666 | 0.995 | 0.663 | 0.980 | 0.653 | 0.950 | 0.633 |
| 2.600 | 0.959 | 0.639 | 0.954 | 0.636 | 0.940 | 0.626 | 0.911 | 0.607 |
| 2.700 | 0.920 | 0.614 | 0.916 | 0.611 | 0.902 | 0.601 | 0.874 | 0.583 |
| 2.800 | 0.886 | 0.590 | 0.881 | 0.588 | 0.868 | 0.579 | 0.841 | 0.561 |
| 2.900 | 0.854 | 0.569 | 0.850 | 0.566 | 0.837 | 0.558 | 0.811 | 0.541 |
| 3.000 | 0.825 | 0.550 | 0.821 | 0.547 | 0.809 | 0.539 | 0.784 | 0.523 |
| 3.100 | 0.796 | 0.531 | 0.792 | 0.528 | 0.780 | 0.520 | 0.756 | 0.504 |
| 3.200 | 0.770 | 0.513 | 0.766 | 0.510 | 0.754 | 0.503 | 0.731 | 0.487 |
| 3.300 | 0.745 | 0.497 | 0.741 | 0.494 | 0.730 | 0.487 | 0.708 | 0.472 |
| 3.400 | 0.720 | 0.480 | 0.716 | 0.478 | 0.706 | 0.470 | 0.684 | 0.456 |

## Horizontal Damping Tabular Spectrum Data

| T | MCE-R at 0% Damping | Design at 0% Damping | MCE-R at 0.05% Damping | Design Spectrum at 0.5% Damping | MCE-R at 2% Damping | Design Spectrum at 2% Damping | MCE-R at 5% Damping | Design-Spectrum at 5% Damping |
|---|---|---|---|---|---|---|---|---|
| 3.500 | 0.696 | 0.464 | 0.693 | 0.462 | 0.682 | 0.455 | 0.662 | 0.441 |
| 3.600 | 0.675 | 0.450 | 0.671 | 0.447 | 0.661 | 0.441 | 0.641 | 0.427 |
| 3.700 | 0.654 | 0.436 | 0.650 | 0.434 | 0.641 | 0.427 | 0.621 | 0.414 |
| 3.800 | 0.634 | 0.423 | 0.631 | 0.421 | 0.621 | 0.414 | 0.602 | 0.402 |
| 3.900 | 0.616 | 0.411 | 0.613 | 0.409 | 0.604 | 0.403 | 0.585 | 0.390 |
| 4.000 | 0.599 | 0.400 | 0.596 | 0.398 | 0.587 | 0.392 | 0.569 | 0.380 |
| 4.100 | 0.586 | 0.391 | 0.583 | 0.389 | 0.574 | 0.383 | 0.557 | 0.371 |
| 4.200 | 0.574 | 0.382 | 0.571 | 0.380 | 0.562 | 0.375 | 0.545 | 0.363 |
| 4.300 | 0.562 | 0.374 | 0.559 | 0.373 | 0.550 | 0.367 | 0.533 | 0.356 |
| 4.400 | 0.550 | 0.367 | 0.547 | 0.365 | 0.539 | 0.359 | 0.523 | 0.348 |
| 4.500 | 0.539 | 0.360 | 0.537 | 0.358 | 0.529 | 0.352 | 0.512 | 0.342 |
| 4.600 | 0.529 | 0.353 | 0.527 | 0.351 | 0.519 | 0.346 | 0.503 | 0.335 |
| 4.700 | 0.519 | 0.346 | 0.516 | 0.344 | 0.508 | 0.339 | 0.493 | 0.328 |
| 4.800 | 0.508 | 0.339 | 0.505 | 0.337 | 0.498 | 0.332 | 0.483 | 0.322 |
| 4.900 | 0.498 | 0.332 | 0.496 | 0.330 | 0.488 | 0.325 | 0.473 | 0.315 |
| 5.000 | 0.489 | 0.326 | 0.486 | 0.324 | 0.479 | 0.319 | 0.464 | 0.309 |
| 5.100 | 0.475 | 0.317 | 0.473 | 0.315 | 0.465 | 0.310 | 0.451 | 0.301 |
| 5.200 | 0.462 | 0.308 | 0.460 | 0.307 | 0.453 | 0.302 | 0.439 | 0.293 |
| 5.300 | 0.450 | 0.300 | 0.448 | 0.299 | 0.441 | 0.294 | 0.428 | 0.285 |
| 5.400 | 0.439 | 0.293 | 0.437 | 0.291 | 0.430 | 0.287 | 0.417 | 0.278 |
| 5.500 | 0.429 | 0.286 | 0.426 | 0.284 | 0.420 | 0.280 | 0.407 | 0.271 |
| 5.600 | 0.418 | 0.279 | 0.416 | 0.277 | 0.410 | 0.273 | 0.397 | 0.265 |
| 5.700 | 0.407 | 0.271 | 0.405 | 0.270 | 0.399 | 0.266 | 0.387 | 0.258 |
| 5.800 | 0.397 | 0.265 | 0.395 | 0.263 | 0.389 | 0.259 | 0.377 | 0.251 |
| 5.900 | 0.387 | 0.258 | 0.385 | 0.257 | 0.379 | 0.253 | 0.368 | 0.245 |
| 6.000 | 0.378 | 0.252 | 0.376 | 0.251 | 0.371 | 0.247 | 0.359 | 0.239 |
| 6.100 | 0.369 | 0.246 | 0.367 | 0.245 | 0.362 | 0.241 | 0.351 | 0.234 |
| 6.200 | 0.361 | 0.241 | 0.359 | 0.239 | 0.354 | 0.236 | 0.343 | 0.229 |
| 6.300 | 0.353 | 0.235 | 0.351 | 0.234 | 0.346 | 0.231 | 0.335 | 0.223 |
| 6.400 | 0.346 | 0.231 | 0.344 | 0.230 | 0.339 | 0.226 | 0.329 | 0.219 |
| 6.500 | 0.341 | 0.227 | 0.339 | 0.226 | 0.334 | 0.223 | 0.324 | 0.216 |
| 6.600 | 0.336 | 0.224 | 0.334 | 0.223 | 0.329 | 0.219 | 0.319 | 0.212 |
| 6.700 | 0.330 | 0.220 | 0.329 | 0.219 | 0.324 | 0.216 | 0.314 | 0.209 |
| 6.800 | 0.326 | 0.217 | 0.324 | 0.216 | 0.319 | 0.213 | 0.309 | 0.206 |
| 6.900 | 0.321 | 0.214 | 0.319 | 0.213 | 0.314 | 0.210 | 0.305 | 0.203 |
| 7.000 | 0.316 | 0.211 | 0.315 | 0.210 | 0.310 | 0.207 | 0.301 | 0.200 |

## Horizontal Damping Tabular Spectrum Data

| T | MCE-R at 0% Damping | Design at 0% Damping | MCE-R at 0.05% Damping | Design Spectrum at 0.5% Damping | MCE-R at 2% Damping | Design Spectrum at 2% Damping | MCE-R at 5% Damping | Design-Spectrum at 5% Damping |
|---|---|---|---|---|---|---|---|---|
| 7.100 | 0.312 | 0.208 | 0.310 | 0.207 | 0.306 | 0.204 | 0.296 | 0.198 |
| 7.200 | 0.308 | 0.205 | 0.306 | 0.204 | 0.301 | 0.201 | 0.292 | 0.195 |
| 7.300 | 0.303 | 0.202 | 0.302 | 0.201 | 0.297 | 0.198 | 0.288 | 0.192 |
| 7.400 | 0.299 | 0.199 | 0.298 | 0.198 | 0.293 | 0.195 | 0.284 | 0.190 |
| 7.500 | 0.295 | 0.197 | 0.294 | 0.196 | 0.289 | 0.193 | 0.280 | 0.187 |
| 7.600 | 0.291 | 0.194 | 0.290 | 0.193 | 0.286 | 0.190 | 0.277 | 0.185 |
| 7.700 | 0.288 | 0.192 | 0.286 | 0.191 | 0.282 | 0.188 | 0.273 | 0.182 |
| 7.800 | 0.284 | 0.189 | 0.282 | 0.188 | 0.278 | 0.185 | 0.270 | 0.180 |
| 7.900 | 0.280 | 0.187 | 0.279 | 0.186 | 0.275 | 0.183 | 0.266 | 0.178 |
| 8.000 | 0.277 | 0.185 | 0.275 | 0.184 | 0.271 | 0.181 | 0.263 | 0.175 |
| 9.000 | 0.219 | 0.146 | 0.218 | 0.145 | 0.214 | 0.143 | 0.208 | 0.139 |
| 10.000 | 0.123 | 0.184 | 0.123 | 0.181 | 0.121 | 0.176 | 0.117 | |

| Vertical Damping Tabular Spectrum Data | | | | |
|---|---|---|---|---|
| T | MCE-R at 0% Damping | Design at 0% Damping | MCE-R at 5% Damping | Design at 5% Damping |
| 0.005 | 0.888 | 0.592 | 0.843 | 0.562 |
| 0.050 | 1.924 | 1.283 | 1.828 | 1.219 |
| 0.100 | 2.264 | 1.509 | 2.151 | 1.434 |
| 0.200 | 2.081 | 1.387 | 1.977 | 1.318 |
| 0.300 | 2.130 | 1.420 | 2.023 | 1.349 |
| 0.400 | 2.130 | 1.420 | 2.023 | 1.349 |
| 0.500 | 2.130 | 1.420 | 2.023 | 1.349 |
| 0.600 | 2.130 | 1.420 | 2.023 | 1.349 |
| 0.700 | 2.130 | 1.420 | 2.023 | 1.349 |
| 0.800 | 2.130 | 1.420 | 2.023 | 1.349 |
| 0.900 | 2.130 | 1.420 | 2.023 | 1.349 |
| 1.000 | 2.130 | 1.420 | 2.023 | 1.349 |
| 1.100 | 2.013 | 1.342 | 1.912 | 1.275 |
| 1.200 | 1.845 | 1.230 | 1.753 | 1.169 |
| 1.300 | 1.703 | 1.136 | 1.618 | 1.079 |
| 1.400 | 1.582 | 1.054 | 1.503 | 1.002 |
| 1.500 | 1.476 | 0.984 | 1.402 | 0.935 |
| 1.600 | 1.384 | 0.923 | 1.315 | 0.876 |
| 1.700 | 1.303 | 0.868 | 1.237 | 0.825 |
| 1.800 | 1.230 | 0.820 | 1.169 | 0.779 |
| 1.900 | 1.165 | 0.777 | 1.107 | 0.738 |
| 2.000 | 1.107 | 0.738 | 1.052 | 0.701 |
| 2.100 | 1.054 | 0.703 | 1.002 | 0.668 |
| 2.200 | 1.007 | 0.671 | 0.956 | 0.637 |
| 2.300 | 0.963 | 0.642 | 0.915 | 0.610 |
| 2.400 | 0.923 | 0.615 | 0.876 | 0.584 |
| 2.500 | 0.886 | 0.590 | 0.841 | 0.561 |
| 2.600 | 0.852 | 0.568 | 0.809 | 0.539 |
| 2.700 | 0.820 | 0.547 | 0.779 | 0.519 |
| 2.800 | 0.791 | 0.527 | 0.751 | 0.501 |
| 2.900 | 0.764 | 0.509 | 0.725 | 0.484 |
| 3.000 | 0.738 | 0.492 | 0.701 | 0.467 |
| 3.100 | 0.714 | 0.476 | 0.679 | 0.452 |
| 3.200 | 0.692 | 0.461 | 0.657 | 0.438 |
| 3.300 | 0.671 | 0.447 | 0.637 | 0.425 |
| 3.400 | 0.651 | 0.434 | 0.619 | 0.412 |
| 3.500 | 0.633 | 0.422 | 0.601 | 0.401 |

| Vertical Damping Tabular Spectrum Data | | | | |
|---|---|---|---|---|
| T | MCE-R at 0% Damping | Design at 0% Damping | MCE-R at 5% Damping | Design at 5% Damping |
| 3.600 | 0.615 | 0.410 | 0.584 | 0.390 |
| 3.700 | 0.598 | 0.399 | 0.569 | 0.379 |
| 3.800 | 0.583 | 0.388 | 0.554 | 0.369 |
| 3.900 | 0.568 | 0.379 | 0.539 | 0.360 |
| 4.000 | 0.554 | 0.369 | 0.526 | 0.351 |
| 4.100 | 0.540 | 0.360 | 0.513 | 0.342 |
| 4.200 | 0.527 | 0.351 | 0.501 | 0.334 |
| 4.300 | 0.515 | 0.343 | 0.489 | 0.326 |
| 4.400 | 0.503 | 0.336 | 0.478 | 0.319 |
| 4.500 | 0.492 | 0.328 | 0.467 | 0.312 |
| 4.600 | 0.481 | 0.321 | 0.457 | 0.305 |
| 4.700 | 0.471 | 0.314 | 0.448 | 0.298 |
| 4.800 | 0.461 | 0.308 | 0.438 | 0.292 |
| 4.900 | 0.452 | 0.301 | 0.429 | 0.286 |
| 5.000 | 0.443 | 0.295 | 0.421 | 0.280 |
| 5.100 | 0.434 | 0.289 | 0.412 | 0.275 |
| 5.200 | 0.426 | 0.284 | 0.405 | 0.270 |
| 5.300 | 0.418 | 0.279 | 0.397 | 0.265 |
| 5.400 | 0.410 | 0.273 | 0.390 | 0.260 |
| 5.500 | 0.403 | 0.268 | 0.382 | 0.255 |
| 5.600 | 0.395 | 0.264 | 0.376 | 0.250 |
| 5.700 | 0.388 | 0.259 | 0.369 | 0.246 |
| 5.800 | 0.382 | 0.255 | 0.363 | 0.242 |
| 5.900 | 0.375 | 0.250 | 0.357 | 0.238 |
| 6.000 | 0.369 | 0.246 | 0.351 | 0.234 |
| 6.100 | 0.363 | 0.242 | 0.345 | 0.230 |
| 6.200 | 0.357 | 0.238 | 0.339 | 0.226 |
| 6.300 | 0.351 | 0.234 | 0.334 | 0.223 |
| 6.400 | 0.346 | 0.231 | 0.329 | 0.219 |
| 6.500 | 0.341 | 0.227 | 0.324 | 0.216 |
| 6.600 | 0.336 | 0.224 | 0.319 | 0.212 |
| 6.700 | 0.330 | 0.220 | 0.314 | 0.209 |
| 6.800 | 0.326 | 0.217 | 0.309 | 0.206 |
| 6.900 | 0.321 | 0.214 | 0.305 | 0.203 |
| 7.000 | 0.316 | 0.211 | 0.301 | 0.200 |
| 7.100 | 0.312 | 0.208 | 0.296 | 0.198 |
| 7.200 | 0.308 | 0.205 | 0.292 | 0.195 |

| Vertical Damping Tabular Spectrum Data | | | | |
|---|---|---|---|---|
| **T** | **MCE-R at 0% Damping** | **Design at 0% Damping** | **MCE-R at 5% Damping** | **Design at 5% Damping** |
| 7.300 | 0.303 | 0.202 | 0.288 | 0.192 |
| 7.400 | 0.299 | 0.199 | 0.284 | 0.190 |
| 7.500 | 0.295 | 0.197 | 0.280 | 0.187 |
| 7.600 | 0.291 | 0.194 | 0.277 | 0.185 |
| 7.700 | 0.288 | 0.192 | 0.273 | 0.182 |
| 7.800 | 0.284 | 0.189 | 0.270 | 0.180 |
| 7.900 | 0.280 | 0.187 | 0.266 | 0.178 |
| 8.000 | 0.277 | 0.185 | 0.263 | 0.175 |
| 9.000 | 0.219 | 0.146 | 0.208 | 0.139 |
| 10.000 | 0.177 | 0.118 | 0.168 | 0.112 |

| Vertical Tabular Spectrum Data | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Deterministic** | **Sa = 2/3 Deter** | **$C_R$** | **Probabilistic** | **T** | **Design** | **80% Design** | **Design** | **MCE-R** | **DDL** | **Min Prob/Deter** |
| 1.111 | 0.562 | 0.754 | 0.843 | 0.005 | 0.699 | 0.559 | 0.562 | 0.843 | 0.725 | 0.843 |
| 2.895 | 1.219 | 1.634 | 1.828 | 0.050 | 0.918 | 0.734 | 1.219 | 1.828 | 1.180 | 1.828 |
| 2.968 | 1.434 | 1.923 | 2.151 | 0.100 | 1.161 | *1.026* | 1.434 | 2.151 | 1.686 | 2.151 |
| 1.811 | 0.921 | 1.235 | 1.381 | 0.200 | 1.647 | 1.318 | 1.318 | 1.977 | 1.686 | 1.381 |
| 1.505 | 0.749 | 0.999 | 1.123 | 0.300 | 1.686 | 1.349 | 1.349 | 2.023 | 1.686 | 1.123 |
| 1.320 | 0.651 | 0.870 | 0.977 | 0.400 | 1.686 | 1.349 | 1.349 | 2.023 | 1.686 | 0.977 |
| 1.366 | 0.650 | 0.867 | 0.974 | 0.500 | 1.686 | 1.349 | 1.349 | 2.023 | 1.686 | 0.974 |
| 1.153 | 0.532 | 0.711 | 0.799 | 0.600 | 1.686 | 1.349 | 1.349 | 2.023 | 1.686 | 0.799 |
| 1.304 | 0.595 | 0.794 | 0.892 | 0.700 | 1.686 | 1.349 | 1.349 | 2.023 | 1.686 | 0.892 |
| 1.280 | 0.570 | 0.761 | 0.856 | 0.800 | 1.686 | 1.349 | 1.349 | 2.023 | 1.686 | 0.856 |
| 1.305 | 0.563 | 0.751 | 0.844 | 0.900 | 1.686 | 1.349 | 1.349 | 2.023 | 1.686 | 0.844 |
| 1.336 | 0.549 | 0.729 | 0.823 | 1.000 | 1.686 | 1.349 | 1.349 | 2.023 | 1.686 | 0.823 |
| 1.287 | 0.511 | 0.685 | 0.767 | 1.100 | 1.594 | 1.275 | 1.275 | 1.912 | 1.594 | 0.767 |
| 1.225 | 0.474 | 0.636 | 0.711 | 1.200 | 1.461 | 1.169 | 1.169 | 1.753 | 1.461 | 0.711 |
| 1.172 | 0.446 | 0.598 | 0.669 | 1.300 | 1.348 | 1.079 | 1.079 | 1.618 | 1.348 | 0.669 |
| 1.102 | 0.401 | 0.538 | 0.602 | 1.400 | 1.252 | 1.002 | 1.002 | 1.503 | 1.252 | 0.602 |
| 1.070 | 0.380 | 0.509 | 0.570 | 1.500 | 1.169 | 0.935 | 0.935 | 1.402 | 1.169 | 0.570 |
| 0.986 | 0.349 | 0.468 | 0.523 | 1.600 | 1.096 | 0.877 | 0.877 | 1.315 | 1.096 | 0.523 |
| 0.919 | 0.325 | 0.435 | 0.487 | 1.700 | 1.031 | 0.825 | 0.825 | 1.237 | 1.031 | 0.487 |
| 0.949 | 0.339 | 0.454 | 0.508 | 1.800 | 0.974 | 0.779 | 0.779 | 1.169 | 0.974 | 0.508 |
| 0.904 | 0.318 | 0.427 | 0.477 | 1.900 | 0.923 | 0.738 | 0.738 | 1.107 | 0.923 | 0.477 |
| 0.837 | 0.296 | 0.396 | 0.443 | 2.000 | 0.877 | 0.701 | 0.701 | 1.052 | 0.877 | 0.443 |
| 0.774 | 0.274 | 0.368 | 0.412 | 2.100 | 0.835 | 0.668 | 0.668 | 1.002 | 0.835 | 0.412 |
| 0.721 | 0.260 | 0.349 | 0.390 | 2.200 | 0.797 | 0.637 | 0.637 | 0.956 | 0.797 | 0.390 |
| 0.682 | 0.241 | 0.323 | 0.362 | 2.300 | 0.762 | 0.610 | 0.610 | 0.915 | 0.762 | 0.362 |
| 0.637 | 0.224 | 0.300 | 0.336 | 2.400 | 0.730 | 0.584 | 0.584 | 0.877 | 0.730 | 0.336 |
| 0.607 | 0.209 | 0.280 | 0.313 | 2.500 | 0.701 | 0.561 | 0.561 | 0.841 | 0.701 | 0.313 |
| 0.573 | 0.199 | 0.266 | 0.298 | 2.600 | 0.674 | 0.539 | 0.539 | 0.809 | 0.674 | 0.298 |
| 0.543 | 0.189 | 0.253 | 0.284 | 2.700 | 0.649 | 0.519 | 0.519 | 0.779 | 0.649 | 0.284 |
| 0.515 | 0.180 | 0.242 | 0.271 | 2.800 | 0.626 | 0.501 | 0.501 | 0.751 | 0.626 | 0.271 |
| 0.490 | 0.173 | 0.231 | 0.259 | 2.900 | 0.604 | 0.484 | 0.484 | 0.725 | 0.604 | 0.259 |
| 0.467 | 0.165 | 0.222 | 0.248 | 3.000 | 0.584 | 0.467 | 0.467 | 0.701 | 0.584 | 0.248 |
| 0.442 | 0.158 | 0.212 | 0.237 | 3.100 | 0.565 | 0.452 | 0.452 | 0.679 | 0.565 | 0.237 |
| 0.419 | 0.152 | 0.203 | 0.228 | 3.200 | 0.548 | 0.438 | 0.438 | 0.657 | 0.548 | 0.228 |
| 0.399 | 0.146 | 0.196 | 0.219 | 3.300 | 0.531 | 0.425 | 0.425 | 0.637 | 0.531 | 0.219 |
| 0.380 | 0.140 | 0.188 | 0.211 | 3.400 | 0.516 | 0.412 | 0.412 | 0.619 | 0.516 | 0.211 |
| 0.363 | 0.136 | 0.182 | 0.203 | 3.500 | 0.501 | 0.401 | 0.401 | 0.601 | 0.501 | 0.203 |
| 0.347 | 0.131 | 0.175 | 0.196 | 3.600 | 0.487 | 0.390 | 0.390 | 0.584 | 0.487 | 0.196 |
| 0.332 | 0.126 | 0.169 | 0.189 | 3.700 | 0.474 | 0.379 | 0.379 | 0.569 | 0.474 | 0.189 |

| Vertical Tabular Spectrum Data | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Deterministic** | **Sa = 2/3 Deter** | **$C_R$** | **Probabilistic** | **T** | **Design** | **80% Design** | **Design** | **MCE-R** | **DDL** | **Min Prob/Deter** |
| 0.319 | 0.121 | 0.163 | 0.182 | 3.800 | 0.461 | 0.369 | 0.369 | 0.554 | 0.461 | 0.182 |
| 0.306 | 0.117 | 0.157 | 0.176 | 3.900 | 0.449 | 0.360 | 0.360 | 0.539 | 0.449 | 0.176 |
| 0.294 | 0.113 | 0.152 | 0.170 | 4.000 | 0.438 | 0.351 | 0.351 | 0.526 | 0.438 | 0.170 |
| 0.287 | 0.111 | 0.148 | 0.166 | 4.100 | 0.428 | 0.342 | 0.342 | 0.513 | 0.428 | 0.166 |
| 0.280 | 0.108 | 0.145 | 0.162 | 4.200 | 0.417 | 0.334 | 0.334 | 0.501 | 0.417 | 0.162 |
| 0.274 | 0.105 | 0.141 | 0.158 | 4.300 | 0.408 | 0.326 | 0.326 | 0.489 | 0.408 | 0.158 |
| 0.268 | 0.103 | 0.138 | 0.154 | 4.400 | 0.398 | 0.319 | 0.319 | 0.478 | 0.398 | 0.154 |
| 0.262 | 0.101 | 0.135 | 0.151 | 4.500 | 0.390 | 0.312 | 0.312 | 0.467 | 0.390 | 0.151 |
| 0.256 | 0.098 | 0.132 | 0.147 | 4.600 | 0.381 | 0.305 | 0.305 | 0.457 | 0.381 | 0.147 |
| 0.251 | 0.096 | 0.129 | 0.144 | 4.700 | 0.373 | 0.298 | 0.298 | 0.448 | 0.373 | 0.144 |
| 0.245 | 0.094 | 0.126 | 0.141 | 4.800 | 0.365 | 0.292 | 0.292 | 0.438 | 0.365 | 0.141 |
| 0.240 | 0.092 | 0.124 | 0.138 | 4.900 | 0.358 | 0.286 | 0.286 | 0.429 | 0.358 | 0.138 |
| 0.236 | 0.090 | 0.121 | 0.136 | 5.000 | 0.351 | 0.280 | 0.280 | 0.421 | 0.351 | 0.136 |
| 0.226 | 0.087 | 0.117 | 0.131 | 5.100 | 0.344 | 0.275 | 0.275 | 0.412 | 0.344 | 0.131 |
| 0.218 | 0.084 | 0.112 | 0.126 | 5.200 | 0.337 | 0.270 | 0.270 | 0.405 | 0.337 | 0.126 |
| 0.210 | 0.081 | 0.108 | 0.121 | 5.300 | 0.331 | 0.265 | 0.265 | 0.397 | 0.331 | 0.121 |
| 0.202 | 0.078 | 0.105 | 0.117 | 5.400 | 0.325 | 0.260 | 0.260 | 0.390 | 0.325 | 0.117 |
| 0.195 | 0.075 | 0.101 | 0.113 | 5.500 | 0.319 | 0.255 | 0.255 | 0.382 | 0.319 | 0.113 |
| 0.188 | 0.073 | 0.098 | 0.109 | 5.600 | 0.313 | 0.250 | 0.250 | 0.376 | 0.313 | 0.109 |
| 0.181 | 0.070 | 0.094 | 0.106 | 5.700 | 0.308 | 0.246 | 0.246 | 0.369 | 0.308 | 0.106 |
| 0.175 | 0.068 | 0.091 | 0.102 | 5.800 | 0.302 | 0.242 | 0.242 | 0.363 | 0.302 | 0.102 |
| 0.169 | 0.066 | 0.088 | 0.099 | 5.900 | 0.297 | 0.238 | 0.238 | 0.357 | 0.297 | 0.099 |
| 0.164 | 0.064 | 0.085 | 0.096 | 6.000 | 0.292 | 0.234 | 0.234 | 0.351 | 0.292 | 0.096 |
| 0.158 | 0.062 | 0.083 | 0.092 | 6.100 | 0.287 | 0.230 | 0.230 | 0.345 | 0.287 | 0.092 |
| 0.153 | 0.060 | 0.080 | 0.089 | 6.200 | 0.283 | 0.226 | 0.226 | 0.339 | 0.283 | 0.089 |
| 0.148 | 0.058 | 0.077 | 0.086 | 6.300 | 0.278 | 0.223 | 0.223 | 0.334 | 0.278 | 0.086 |
| 0.144 | 0.056 | 0.075 | 0.084 | 6.400 | 0.274 | 0.219 | 0.219 | 0.329 | 0.274 | 0.084 |
| 0.139 | 0.054 | 0.073 | 0.081 | 6.500 | 0.270 | 0.216 | 0.216 | 0.324 | 0.270 | 0.081 |
| 0.135 | 0.053 | 0.070 | 0.079 | 6.600 | 0.266 | 0.212 | 0.212 | 0.319 | 0.266 | 0.079 |
| 0.131 | 0.051 | 0.068 | 0.077 | 6.700 | 0.262 | 0.209 | 0.209 | 0.314 | 0.262 | 0.077 |
| 0.127 | 0.050 | 0.066 | 0.074 | 6.800 | 0.258 | 0.206 | 0.206 | 0.309 | 0.258 | 0.074 |
| 0.124 | 0.048 | 0.065 | 0.072 | 6.900 | 0.254 | 0.203 | 0.203 | 0.305 | 0.254 | 0.072 |
| 0.120 | 0.047 | 0.063 | 0.070 | 7.000 | 0.250 | 0.200 | 0.200 | 0.301 | 0.250 | 0.070 |
| 0.117 | 0.046 | 0.061 | 0.068 | 7.100 | 0.247 | 0.198 | 0.198 | 0.296 | 0.247 | 0.068 |
| 0.114 | 0.044 | 0.059 | 0.066 | 7.200 | 0.243 | 0.195 | 0.195 | 0.292 | 0.243 | 0.066 |
| 0.111 | 0.043 | 0.058 | 0.065 | 7.300 | 0.240 | 0.192 | 0.192 | 0.288 | 0.240 | 0.065 |
| 0.108 | 0.042 | 0.056 | 0.063 | 7.400 | 0.237 | 0.190 | 0.190 | 0.284 | 0.237 | 0.063 |
| 0.105 | 0.041 | 0.055 | 0.061 | 7.500 | 0.234 | 0.187 | 0.187 | 0.280 | 0.234 | 0.061 |
| 0.102 | 0.040 | 0.053 | 0.059 | 7.600 | 0.231 | 0.185 | 0.185 | 0.277 | 0.231 | 0.059 |

| Vertical Tabular Spectrum Data | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Deterministic** | **Sa = 2/3 Deter** | **$C_R$** | **Probabilistic** | **T** | **Design** | **80% Design** | **Design** | **MCE-R** | **DDL** | **Min Prob/Deter** |
| 0.099 | 0.039 | 0.052 | 0.058 | 7.700 | 0.228 | 0.182 | 0.182 | 0.273 | 0.228 | 0.058 |
| 0.097 | 0.038 | 0.050 | 0.056 | 7.800 | 0.225 | 0.180 | 0.180 | 0.270 | 0.225 | 0.056 |
| 0.094 | 0.037 | 0.049 | 0.055 | 7.900 | 0.222 | 0.178 | 0.178 | 0.266 | 0.222 | 0.055 |
| 0.092 | 0.036 | 0.048 | 0.054 | 8.000 | 0.219 | 0.175 | 0.175 | 0.263 | 0.219 | 0.054 |
| 0.073 | 0.028 | 0.037 | 0.042 | 9.000 | 0.173 | 0.139 | 0.139 | 0.208 | 0.195 | 0.042 |
| 0.059 | 0.022 | 0.030 | 0.033 | 10.000 | 0.140 | 0.112 | 0.112 | 0.168 | 0.175 | 0.033 |

| Horizontal Tabular Spectrum Data | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Deterministic | Sa = 2/3 Deter | CR | Probabilistic | T | Design | 80% Design | Design | MCE-R | DDL | Min Prob/Deter |
| 0.732 | 0.488 | 0.704 | 0.788 | 0.005 | 0.699 | 0.559 | 0.559 | 0.838 | 0.725 | 0.732 |
| 0.770 | 0.513 | 0.759 | 0.849 | 0.050 | 0.918 | 0.734 | 0.734 | 1.101 | 1.180 | 0.770 |
| 0.933 | 0.622 | 0.996 | 1.114 | 0.100 | 1.161 | *1.026* | 1.026 | 1.539 | 1.686 | 0.933 |
| 1.258 | 0.839 | 1.370 | 1.532 | 0.200 | 1.647 | 1.318 | 1.318 | 1.977 | 1.686 | 1.258 |
| 1.445 | 0.963 | 1.518 | 1.706 | 0.300 | 1.686 | 1.349 | 1.349 | 2.023 | 1.686 | 1.445 |
| 1.537 | 1.025 | 1.540 | 1.730 | 0.400 | 1.686 | 1.349 | 1.349 | 2.023 | 1.686 | 1.537 |
| 1.658 | 1.105 | 1.595 | 1.792 | 0.500 | 1.686 | 1.349 | 1.349 | 2.023 | 1.686 | 1.658 |
| 1.712 | 1.141 | 1.560 | 1.753 | 0.600 | 1.686 | 1.349 | 1.349 | 2.023 | 1.686 | 1.712 |
| 1.758 | 1.151 | 1.536 | 1.726 | 0.700 | 1.686 | 1.349 | 1.349 | 2.023 | 1.686 | 1.726 |
| 1.771 | 1.115 | 1.488 | 1.672 | 0.800 | 1.686 | 1.349 | 1.349 | 2.023 | 1.686 | 1.672 |
| 1.756 | 1.067 | 1.424 | 1.600 | 0.900 | 1.686 | 1.349 | 1.349 | 2.023 | 1.686 | 1.600 |
| 1.745 | 1.031 | 1.371 | 1.547 | 1.000 | 1.686 | 1.349 | 1.349 | 2.023 | 1.686 | 1.547 |
| 1.725 | 0.991 | 1.329 | 1.487 | 1.100 | 1.594 | 1.275 | 1.275 | 1.912 | 1.594 | 1.487 |
| 1.706 | 0.959 | 1.286 | 1.438 | 1.200 | 1.461 | 1.169 | 1.169 | 1.753 | 1.461 | 1.438 |
| 1.693 | 0.933 | 1.252 | 1.400 | 1.300 | 1.348 | 1.079 | 1.079 | 1.618 | 1.348 | 1.400 |
| 1.680 | 0.911 | 1.222 | 1.367 | 1.400 | 1.252 | 1.002 | 1.002 | 1.503 | 1.252 | 1.367 |
| 1.663 | 0.890 | 1.193 | 1.335 | 1.500 | 1.169 | 0.935 | 0.935 | 1.402 | 1.169 | 1.335 |
| 1.617 | 0.862 | 1.156 | 1.293 | 1.600 | 1.096 | 0.877 | 0.877 | 1.315 | 1.096 | 1.293 |
| 1.570 | 0.835 | 1.120 | 1.253 | 1.700 | 1.031 | 0.825 | 0.835 | 1.253 | 1.031 | 1.253 |
| 1.527 | 0.813 | 1.090 | 1.219 | 1.800 | 0.974 | 0.779 | 0.813 | 1.219 | 0.974 | 1.219 |
| 1.486 | 0.792 | 1.062 | 1.188 | 1.900 | 0.923 | 0.738 | 0.792 | 1.188 | 0.923 | 1.188 |
| 1.444 | 0.772 | 1.035 | 1.158 | 2.000 | 0.877 | 0.701 | 0.772 | 1.158 | 0.877 | 1.158 |
| 1.373 | 0.741 | 0.994 | 1.112 | 2.100 | 0.835 | 0.668 | 0.741 | 1.112 | 0.835 | 1.112 |
| 1.309 | 0.713 | 0.957 | 1.070 | 2.200 | 0.797 | 0.637 | 0.713 | 1.070 | 0.797 | 1.070 |
| 1.246 | 0.687 | 0.921 | 1.030 | 2.300 | 0.762 | 0.610 | 0.687 | 1.030 | 0.762 | 1.030 |
| 1.188 | 0.662 | 0.887 | 0.993 | 2.400 | 0.730 | 0.584 | 0.662 | 0.993 | 0.730 | 0.993 |
| 1.133 | 0.633 | 0.849 | 0.950 | 2.500 | 0.701 | 0.561 | 0.633 | 0.950 | 0.701 | 0.950 |
| 1.081 | 0.607 | 0.814 | 0.911 | 2.600 | 0.674 | 0.539 | 0.607 | 0.911 | 0.674 | 0.911 |
| 1.032 | 0.583 | 0.782 | 0.874 | 2.700 | 0.649 | 0.519 | 0.583 | 0.874 | 0.649 | 0.874 |
| 0.988 | 0.561 | 0.752 | 0.841 | 2.800 | 0.626 | 0.501 | 0.561 | 0.841 | 0.626 | 0.841 |
| 0.947 | 0.541 | 0.725 | 0.811 | 2.900 | 0.604 | 0.484 | 0.541 | 0.811 | 0.604 | 0.811 |
| 0.909 | 0.523 | 0.701 | 0.784 | 3.000 | 0.584 | 0.467 | 0.523 | 0.784 | 0.584 | 0.784 |
| 0.869 | 0.504 | 0.676 | 0.756 | 3.100 | 0.565 | 0.452 | 0.504 | 0.756 | 0.565 | 0.756 |
| 0.832 | 0.487 | 0.654 | 0.731 | 3.200 | 0.548 | 0.438 | 0.487 | 0.731 | 0.548 | 0.731 |
| 0.798 | 0.472 | 0.633 | 0.708 | 3.300 | 0.531 | 0.425 | 0.472 | 0.708 | 0.531 | 0.708 |
| 0.767 | 0.456 | 0.611 | 0.684 | 3.400 | 0.516 | 0.412 | 0.456 | 0.684 | 0.516 | 0.684 |
| 0.739 | 0.441 | 0.591 | 0.662 | 3.500 | 0.501 | 0.401 | 0.441 | 0.662 | 0.501 | 0.662 |
| 0.713 | 0.427 | 0.573 | 0.641 | 3.600 | 0.487 | 0.390 | 0.427 | 0.641 | 0.487 | 0.641 |
| 0.688 | 0.414 | 0.555 | 0.621 | 3.700 | 0.474 | 0.379 | 0.414 | 0.621 | 0.474 | 0.621 |
| 0.666 | 0.402 | 0.539 | 0.602 | 3.800 | 0.461 | 0.369 | 0.402 | 0.602 | 0.461 | 0.602 |
| 0.648 | 0.390 | 0.523 | 0.585 | 3.900 | 0.449 | 0.360 | 0.390 | 0.585 | 0.449 | 0.585 |
| 0.631 | 0.380 | 0.509 | 0.569 | 4.000 | 0.438 | 0.351 | 0.380 | 0.569 | 0.438 | 0.569 |

| Horizontal Tabular Spectrum Data | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Deterministic | Sa = 2/3 Deter | CR | Probabilistic | T | Design | 80% Design | Design | MCE-R | DDL | Min Prob/Deter |
| 0.616 | 0.371 | 0.498 | 0.557 | 4.100 | 0.428 | 0.342 | 0.371 | 0.557 | 0.428 | 0.557 |
| 0.601 | 0.363 | 0.487 | 0.545 | 4.200 | 0.417 | 0.334 | 0.363 | 0.545 | 0.417 | 0.545 |
| 0.587 | 0.356 | 0.477 | 0.534 | 4.300 | 0.408 | 0.326 | 0.356 | 0.534 | 0.408 | 0.534 |
| 0.576 | 0.348 | 0.467 | 0.523 | 4.400 | 0.398 | 0.319 | 0.348 | 0.523 | 0.398 | 0.523 |
| 0.565 | 0.342 | 0.458 | 0.512 | 4.500 | 0.390 | 0.312 | 0.342 | 0.512 | 0.390 | 0.512 |
| 0.555 | 0.335 | 0.449 | 0.503 | 4.600 | 0.381 | 0.305 | 0.335 | 0.503 | 0.381 | 0.503 |
| 0.545 | 0.328 | 0.440 | 0.493 | 4.700 | 0.373 | 0.298 | 0.328 | 0.493 | 0.373 | 0.493 |
| 0.535 | 0.322 | 0.431 | 0.483 | 4.800 | 0.365 | 0.292 | 0.322 | 0.483 | 0.365 | 0.483 |
| 0.526 | 0.315 | 0.423 | 0.473 | 4.900 | 0.358 | 0.286 | 0.315 | 0.473 | 0.358 | 0.473 |
| 0.517 | 0.309 | 0.415 | 0.464 | 5.000 | 0.351 | 0.280 | 0.309 | 0.464 | 0.351 | 0.464 |
| 0.503 | 0.301 | 0.403 | 0.451 | 5.100 | 0.344 | 0.275 | 0.301 | 0.451 | 0.344 | 0.451 |
| 0.491 | 0.293 | 0.393 | 0.439 | 5.200 | 0.337 | 0.270 | 0.293 | 0.439 | 0.337 | 0.439 |
| 0.479 | 0.285 | 0.383 | 0.428 | 5.300 | 0.331 | 0.265 | 0.285 | 0.428 | 0.331 | 0.428 |
| 0.467 | 0.278 | 0.373 | 0.417 | 5.400 | 0.325 | 0.260 | 0.278 | 0.417 | 0.325 | 0.417 |
| 0.456 | 0.271 | 0.364 | 0.407 | 5.500 | 0.319 | 0.255 | 0.271 | 0.407 | 0.319 | 0.407 |
| 0.445 | 0.265 | 0.355 | 0.397 | 5.600 | 0.313 | 0.250 | 0.265 | 0.397 | 0.313 | 0.397 |
| 0.434 | 0.258 | 0.346 | 0.387 | 5.700 | 0.308 | 0.246 | 0.258 | 0.387 | 0.308 | 0.387 |
| 0.424 | 0.251 | 0.337 | 0.377 | 5.800 | 0.302 | 0.242 | 0.251 | 0.377 | 0.302 | 0.377 |
| 0.414 | 0.245 | 0.329 | 0.368 | 5.900 | 0.297 | 0.238 | 0.245 | 0.368 | 0.297 | 0.368 |
| 0.405 | 0.239 | 0.321 | 0.359 | 6.000 | 0.292 | 0.234 | 0.239 | 0.359 | 0.292 | 0.359 |
| 0.396 | 0.234 | 0.314 | 0.351 | 6.100 | 0.287 | 0.230 | 0.234 | 0.351 | 0.287 | 0.351 |
| 0.387 | 0.229 | 0.306 | 0.343 | 6.200 | 0.283 | 0.226 | 0.229 | 0.343 | 0.283 | 0.343 |
| 0.378 | 0.223 | 0.300 | 0.335 | 6.300 | 0.278 | 0.223 | 0.223 | 0.335 | 0.278 | 0.335 |
| 0.370 | 0.219 | 0.293 | 0.328 | 6.400 | 0.274 | 0.219 | 0.219 | 0.329 | 0.274 | 0.328 |
| 0.362 | 0.214 | 0.287 | 0.321 | 6.500 | 0.270 | 0.216 | 0.216 | 0.324 | 0.270 | 0.321 |
| 0.355 | 0.210 | 0.281 | 0.315 | 6.600 | 0.266 | 0.212 | 0.212 | 0.319 | 0.266 | 0.315 |
| 0.347 | 0.206 | 0.276 | 0.308 | 6.700 | 0.262 | 0.209 | 0.209 | 0.314 | 0.262 | 0.308 |
| 0.340 | 0.202 | 0.270 | 0.302 | 6.800 | 0.258 | 0.206 | 0.206 | 0.309 | 0.258 | 0.302 |
| 0.333 | 0.197 | 0.265 | 0.296 | 6.900 | 0.254 | 0.203 | 0.203 | 0.305 | 0.254 | 0.296 |
| 0.326 | 0.193 | 0.259 | 0.290 | 7.000 | 0.250 | 0.200 | 0.200 | 0.301 | 0.250 | 0.290 |
| 0.320 | 0.189 | 0.254 | 0.284 | 7.100 | 0.247 | 0.198 | 0.198 | 0.296 | 0.247 | 0.284 |
| 0.314 | 0.185 | 0.249 | 0.278 | 7.200 | 0.243 | 0.195 | 0.195 | 0.292 | 0.243 | 0.278 |
| 0.307 | 0.182 | 0.244 | 0.273 | 7.300 | 0.240 | 0.192 | 0.192 | 0.288 | 0.240 | 0.273 |
| 0.302 | 0.178 | 0.239 | 0.267 | 7.400 | 0.237 | 0.190 | 0.190 | 0.284 | 0.237 | 0.267 |
| 0.296 | 0.175 | 0.235 | 0.262 | 7.500 | 0.234 | 0.187 | 0.187 | 0.280 | 0.234 | 0.262 |
| 0.290 | 0.171 | 0.230 | 0.257 | 7.600 | 0.231 | 0.185 | 0.185 | 0.277 | 0.231 | 0.257 |
| 0.284 | 0.168 | 0.225 | 0.252 | 7.700 | 0.228 | 0.182 | 0.182 | 0.273 | 0.228 | 0.252 |
| 0.279 | 0.165 | 0.221 | 0.248 | 7.800 | 0.225 | 0.180 | 0.180 | 0.270 | 0.225 | 0.248 |
| 0.274 | 0.162 | 0.217 | 0.243 | 7.900 | 0.222 | 0.178 | 0.178 | 0.266 | 0.222 | 0.243 |
| 0.268 | 0.159 | 0.213 | 0.239 | 8.000 | 0.219 | 0.175 | 0.175 | 0.263 | 0.219 | 0.239 |
| 0.225 | 0.136 | 0.182 | 0.204 | 9.000 | 0.173 | 0.139 | 0.139 | 0.208 | 0.195 | 0.204 |
| 0.192 | 0.117 | 0.157 | 0.176 | 10.000 | 0.140 | 0.112 | 0.117 | 0.176 | 0.175 | 0.176 |

# APPENDIX 6

## Liquefaction Assessment Results by use of SPT Data

GEOLOGISMIKI Geotechnical Software

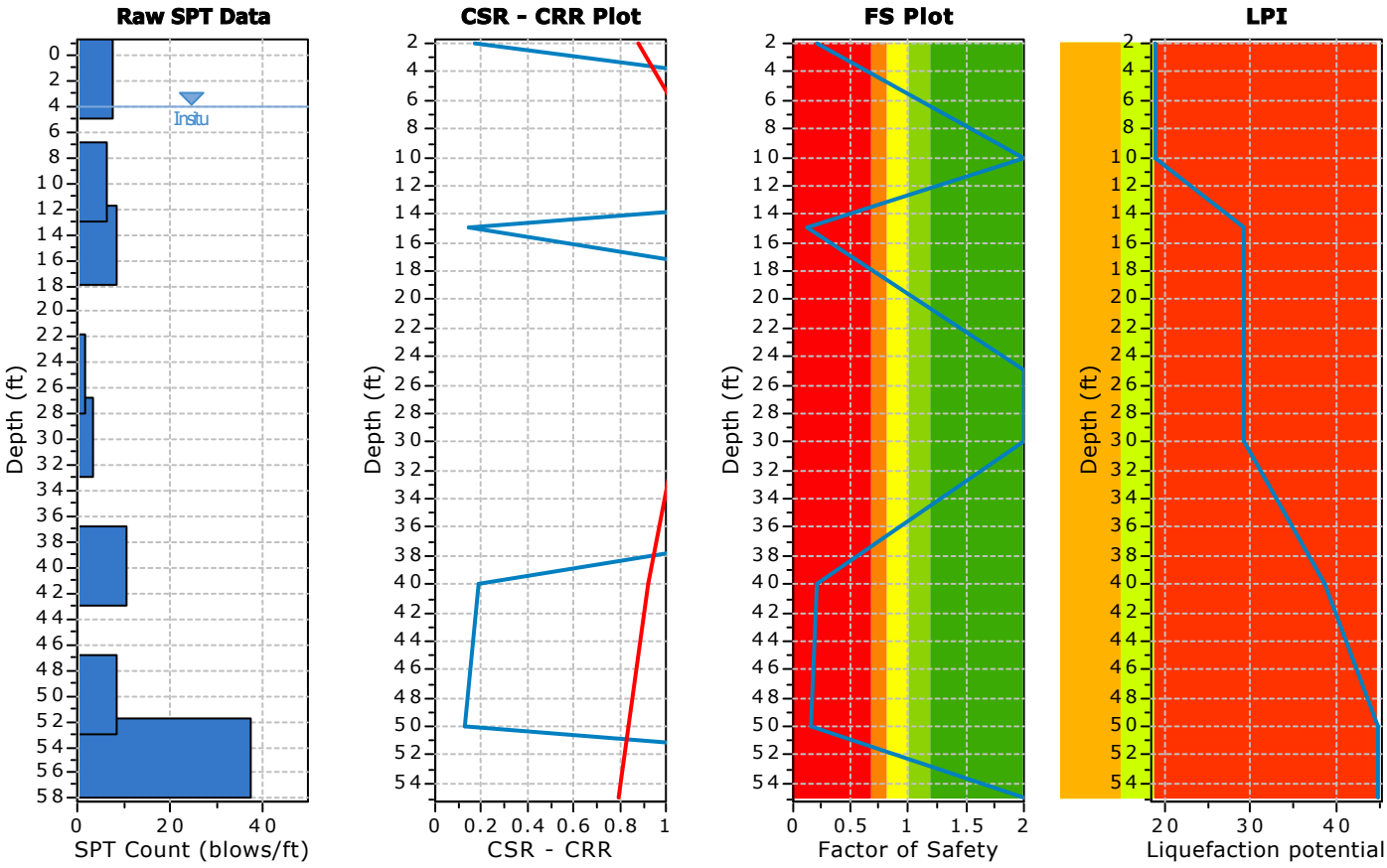
# SPT BASED LIQUEFACTION ANALYSIS REPORT

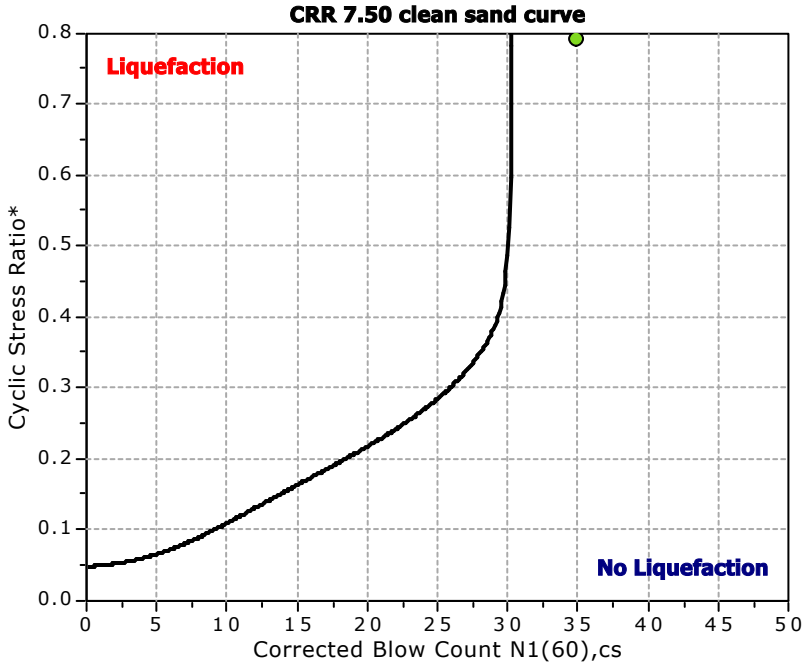
**Project title : Arcata Wastewater Treatment Facility Improvements Project** **SPT Name: GBH-2**

**Location : 736 F Street, Arcata, California**

**:: Input parameters and analysis properties ::**

| | | | |
|---|---|---|---|
| Analysis method: | NCEER 1998 | G.W.T. (in-situ): | 4.00 ft |
| Fines correction method: | NCEER 1998 | G.W.T. (earthq.): | 0.00 ft |
| Sampling method: | Standard Sampler | Earthquake magnitude $M_w$: | 7.30 |
| Borehole diameter: | 65mm to 115mm | Peak ground acceleration: | 0.81 g |
| Rod length: | 3.30 ft | Eq. external load: | 0.00 tsf |
| Hammer energy ratio: | 1.00 | | |



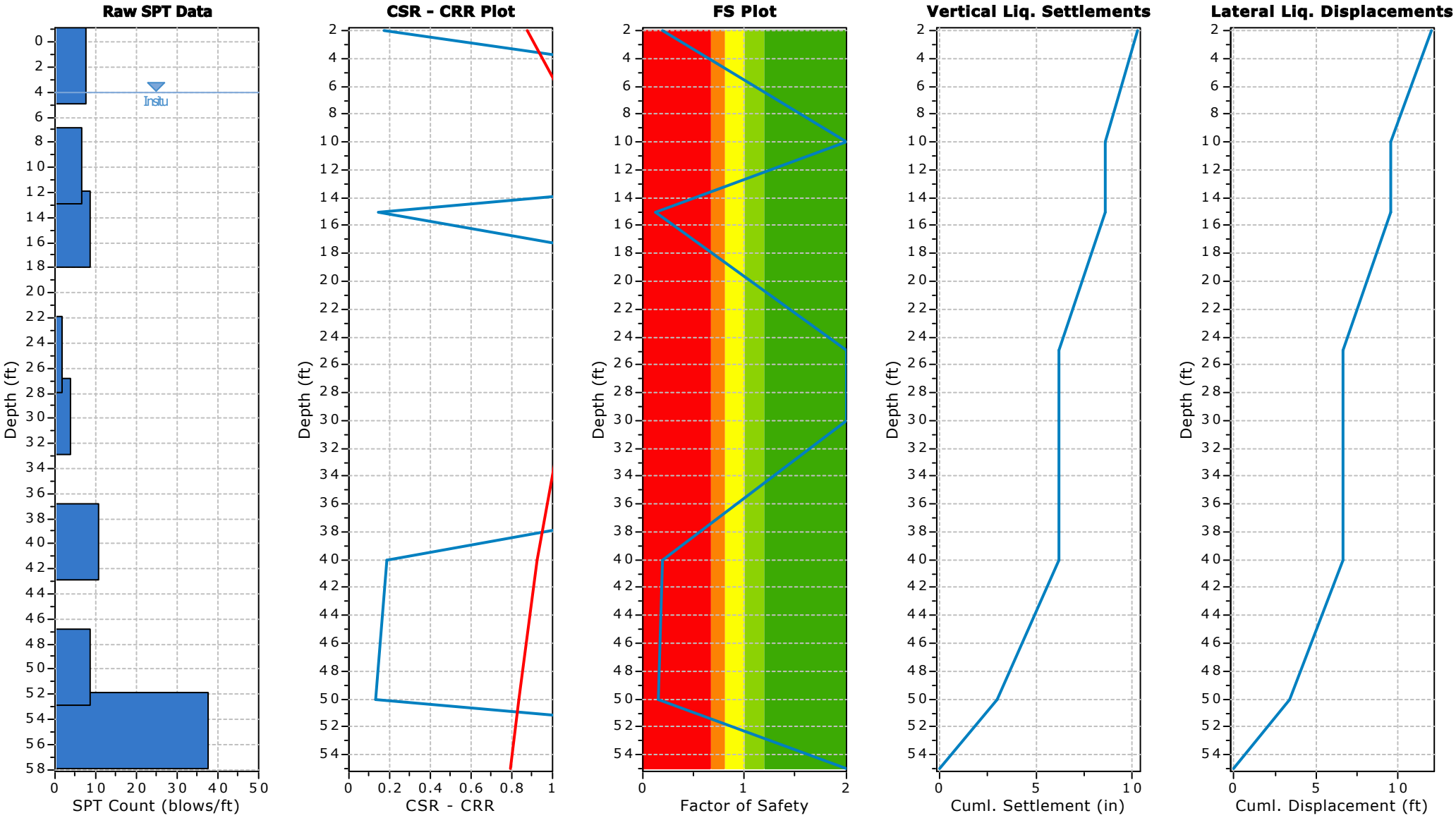

**F.S. color scheme**

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk

## :: Overall Liquefaction Assessment Analysis Plots ::



**:: Field input data ::**

| Test Depth (ft) | SPT Field Value (blows) | Fines Content (%) | Unit Weight (pcf) | Infl. Thickness (ft) | Can Liquefy |
|---|---|---|---|---|---|
| 2.00 | 8 | 28.00 | 141.00 | 5.00 | Yes |
| 10.00 | 7 | 89.00 | 97.00 | 10.00 | No |
| 15.00 | 9 | 14.00 | 112.00 | 6.00 | Yes |
| 25.00 | 2 | 93.30 | 112.00 | 7.00 | No |
| 30.00 | 4 | 93.30 | 112.00 | 7.00 | No |
| 40.00 | 11 | 30.00 | 125.00 | 10.00 | Yes |
| 50.00 | 9 | 18.00 | 127.00 | 7.00 | Yes |
| 55.00 | 38 | 18.00 | 127.00 | 3.50 | Yes |

**Abbreviations**

Depth: Depth at which test was performed (ft)
SPT Field Value: Number of blows per foot
Fines Content: Fines content at test depth (%)
Unit Weight: Unit weight at test depth (pcf)
Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

**:: Cyclic Resistance Ratio (CRR) calculation data ::**

| Depth (ft) | SPT Field Value | Unit Weight (pcf) | $\sigma_v$ (tsf) | $u_o$ (tsf) | $\sigma'_{vo}$ (tsf) | $C_N$ | $C_E$ | $C_B$ | $C_R$ | $C_S$ | $(N_1)_{60}$ | Fines Content (%) | α | β | $(N_1)_{60cs}$ | $CRR_{7.5}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.00 | 8 | 141.00 | 0.14 | 0.00 | 0.14 | 1.65 | 1.00 | 1.00 | 0.75 | 1.00 | 10 | 28.00 | 4.56 | 1.14 | 16 | 0.174 |
| 10.00 | 7 | 97.00 | 0.53 | 0.19 | 0.34 | 1.44 | 1.00 | 1.00 | 0.85 | 1.00 | 9 | 89.00 | 5.00 | 1.20 | 16 | 4.000 |
| 15.00 | 9 | 112.00 | 0.81 | 0.34 | 0.47 | 1.34 | 1.00 | 1.00 | 0.85 | 1.00 | 10 | 14.00 | 2.20 | 1.04 | 13 | 0.142 |
| 25.00 | 2 | 112.00 | 1.37 | 0.66 | 0.71 | 1.17 | 1.00 | 1.00 | 0.95 | 1.00 | 2 | 93.30 | 5.00 | 1.20 | 7 | 4.000 |
| 30.00 | 4 | 112.00 | 1.65 | 0.81 | 0.84 | 1.10 | 1.00 | 1.00 | 1.00 | 1.00 | 4 | 93.30 | 5.00 | 1.20 | 10 | 4.000 |
| 40.00 | 11 | 125.00 | 2.27 | 1.12 | 1.15 | 0.96 | 1.00 | 1.00 | 1.00 | 1.00 | 11 | 30.00 | 4.71 | 1.15 | 17 | 0.185 |
| 50.00 | 9 | 127.00 | 2.91 | 1.44 | 1.47 | 0.85 | 1.00 | 1.00 | 1.00 | 1.00 | 8 | 18.00 | 3.23 | 1.07 | 12 | 0.131 |
| 55.00 | 38 | 127.00 | 3.23 | 1.59 | 1.64 | 0.80 | 1.00 | 1.00 | 1.00 | 1.00 | 30 | 18.00 | 3.23 | 1.07 | 35 | 4.000 |

**Abbreviations**

$\sigma_v$: Total stress during SPT test (tsf)
$u_o$: Water pore pressure during SPT test (tsf)
$\sigma'_{vo}$: Effective overburden pressure during SPT test (tsf)
$C_N$: Overburden corretion factor
$C_E$: Energy correction factor
$C_B$: Borehole diameter correction factor
$C_R$: Rod length correction factor
$C_S$: Liner correction factor
$N_{1(60)}$: Corrected $N_{SPT}$ to a 60% energy ratio
α, β: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cyclic resistance ratio for M=7.5

**:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::**

| Depth (ft) | Unit Weight (pcf) | $\sigma_{v,eq}$ (tsf) | $u_{o,eq}$ (tsf) | $\sigma'_{vo,eq}$ (tsf) | $r_d$ | α | CSR | MSF | $CSR_{eq,M=7.5}$ | $K_{sigma}$ | $CSR^*$ | FS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.00 | 141.00 | 0.14 | 0.06 | 0.08 | 1.00 | 1.00 | 0.942 | 1.07 | 0.879 | 1.00 | 0.879 | 0.198 | 🔴 |
| 10.00 | 97.00 | 0.53 | 0.31 | 0.22 | 0.98 | 1.00 | 1.257 | 1.07 | 1.173 | 1.00 | 1.173 | 2.000 | 🟢 |
| 15.00 | 112.00 | 0.81 | 0.47 | 0.34 | 0.97 | 1.00 | 1.210 | 1.07 | 1.129 | 1.00 | 1.129 | 0.126 | 🔴 |
| 25.00 | 112.00 | 1.37 | 0.78 | 0.59 | 0.94 | 1.00 | 1.153 | 1.07 | 1.076 | 1.00 | 1.076 | 2.000 | 🟢 |
| 30.00 | 112.00 | 1.65 | 0.94 | 0.71 | 0.92 | 1.00 | 1.121 | 1.07 | 1.046 | 1.00 | 1.046 | 2.000 | 🟢 |
| 40.00 | 125.00 | 2.27 | 1.25 | 1.03 | 0.85 | 1.00 | 0.993 | 1.07 | 0.927 | 1.00 | 0.927 | 0.199 | 🔴 |

**:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::**

| Depth (ft) | Unit Weight (pcf) | $\sigma_{v,eq}$ (tsf) | $u_{o,eq}$ (tsf) | $\sigma'_{vo,eq}$ (tsf) | $r_d$ | $\alpha$ | CSR | MSF | $CSR_{eq,M=7.5}$ | $K_{sigma}$ | $CSR^*$ | FS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 50.00 | 127.00 | 2.91 | 1.56 | 1.35 | 0.75 | 1.00 | 0.855 | 1.07 | 0.798 | 0.95 | 0.837 | 0.156 | 🔴 |
| 55.00 | 127.00 | 3.23 | 1.72 | 1.51 | 0.70 | 1.00 | 0.791 | 1.07 | 0.738 | 0.93 | 0.793 | 2.000 | 🟢 |

**Abbreviations**

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
$r_d$ : Nonlinear shear mass factor
$\alpha$: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
$K_{sigma}$: Effective overburden stress factor
$CSR^*$: CSR fully adjusted
FS: Calculated factor of safety against soil liquefaction

**:: Liquefaction potential according to Iwasaki ::**

| Depth (ft) | FS | F | wz | Thickness (ft) | $I_L$ |
|---|---|---|---|---|---|
| 2.00 | 0.198 | 0.80 | 9.70 | 8.00 | 18.96 |
| 10.00 | 2.000 | 0.00 | 8.48 | 8.00 | 0.00 |
| 15.00 | 0.126 | 0.87 | 7.71 | 5.00 | 10.28 |
| 25.00 | 2.000 | 0.00 | 6.19 | 10.00 | 0.00 |
| 30.00 | 2.000 | 0.00 | 5.43 | 5.00 | 0.00 |
| 40.00 | 0.199 | 0.80 | 3.90 | 10.00 | 9.53 |
| 50.00 | 0.156 | 0.84 | 2.38 | 10.00 | 6.12 |
| 55.00 | 2.000 | 0.00 | 1.62 | 5.00 | 0.00 |

**Overall potential $I_L$ : 44.89**

$I_L$ = 0.00 - No liquefaction
$I_L$ between 0.00 and 5 - Liquefaction not probable
$I_L$ between 5 and 15 - Liquefaction probable
$I_L$ > 15 - Liquefaction certain

**:: Vertical settlements estimation for saturated sands ::**

| Depth (ft) | $D_{50}$ (in) | $q_c/N$ | $e_v$ (%) | $\Delta h$ (ft) | s (in) |
|---|---|---|---|---|---|
| 2.00 | 0.00 | 5.00 | 2.81 | 5.00 | 1.684 |
| 10.00 | 0.00 | 5.00 | 0.00 | 10.00 | 0.000 |
| 15.00 | 0.00 | 5.00 | 3.33 | 6.00 | 2.395 |
| 25.00 | 0.00 | 5.00 | 0.00 | 7.00 | 0.000 |
| 30.00 | 0.00 | 5.00 | 0.00 | 7.00 | 0.000 |
| 40.00 | 0.00 | 5.00 | 2.67 | 10.00 | 3.204 |
| 50.00 | 0.00 | 5.00 | 3.55 | 7.00 | 2.984 |
| 55.00 | 0.00 | 5.00 | 0.00 | 3.50 | 0.000 |

**:: Vertical settlements estimation for saturated sands ::**

| Depth (ft) | $D_{50}$ (in) | $q_c/N$ | $e_v$ (%) | $\Delta h$ (ft) | s (in) |
|---|---|---|---|---|---|

**Cumulative settlements: 10.266**

**Abbreviations**

$D_{50}$: Median grain size (in)
$q_c/N$: Ratio of cone resistance to SPT
$e_v$: Post liquefaction volumetric strain (%)
$\Delta h$: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

**:: Lateral displacements estimation for saturated sands ::**

| Depth (ft) | $(N_1)_{60}$ | $D_r$ (%) | $\gamma_{max}$ (%) | $d_z$ (ft) | LDI | LD (ft) |
|---|---|---|---|---|---|---|
| 2.00 | 10 | 44.27 | 51.20 | 5.00 | 2.560 | 2.43 |
| 10.00 | 9 | 42.00 | 0.00 | 10.00 | 0.000 | 0.00 |
| 15.00 | 10 | 44.27 | 51.20 | 6.00 | 3.072 | 2.92 |
| 25.00 | 2 | 19.80 | 0.00 | 7.00 | 0.000 | 0.00 |
| 30.00 | 4 | 28.00 | 0.00 | 7.00 | 0.000 | 0.00 |
| 40.00 | 11 | 46.43 | 34.10 | 10.00 | 3.410 | 3.24 |
| 50.00 | 8 | 39.60 | 51.20 | 7.00 | 3.584 | 3.41 |
| 55.00 | 30 | 76.68 | 0.00 | 3.50 | 0.000 | 0.00 |

**Cumulative lateral displacements: 12.01**

**Abbreviations**

$D_r$: Relative density (%)
$\gamma_{max}$: Maximum amplitude of cyclic shear strain (%)
$d_z$: Soil layer thickness (ft)
LDI: Lateral displacement index (ft)
LD: Actual estimated displacement (ft)

GEOLOGISMIKI Geotechnical Software

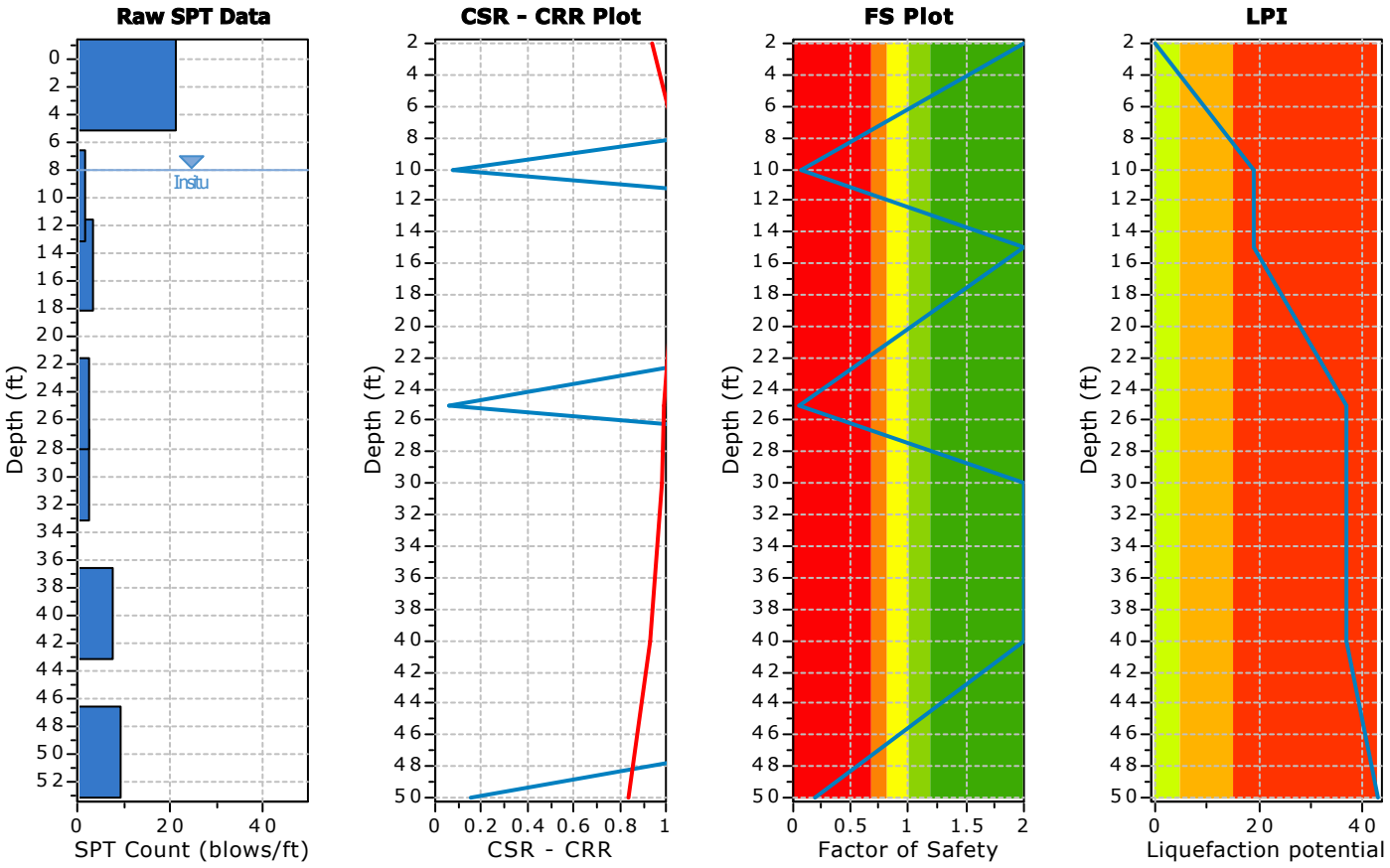
# SPT BASED LIQUEFACTION ANALYSIS REPORT

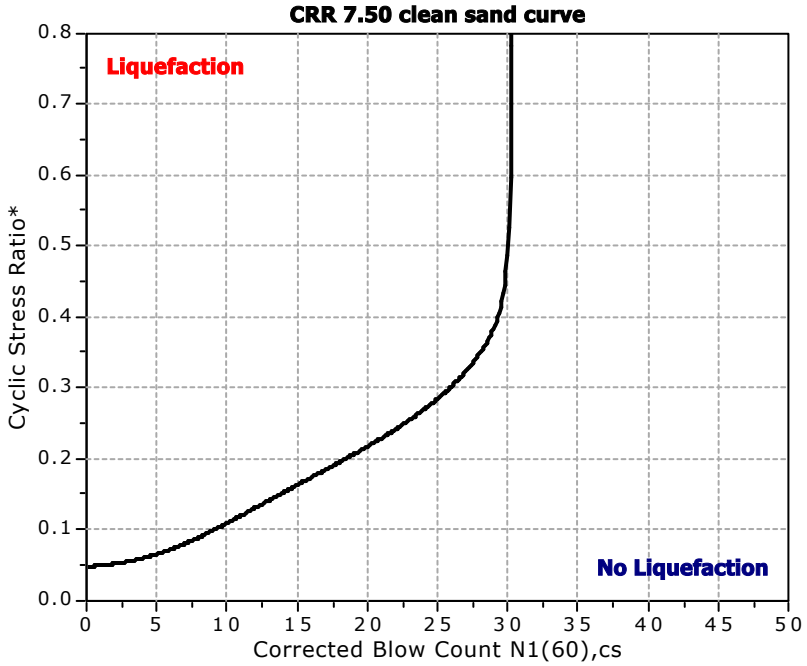
**Project title : Arcata Wastewater Treatment Facility Improvements Project** **SPT Name: GBH-5**

**Location : 736 F Street, Arcata, California**

**:: Input parameters and analysis properties ::**

| | | | |
|---|---|---|---|
| Analysis method: | NCEER 1998 | G.W.T. (in-situ): | 8.00 ft |
| Fines correction method: | NCEER 1998 | G.W.T. (earthq.): | 0.00 ft |
| Sampling method: | Standard Sampler | Earthquake magnitude $M_w$: | 7.30 |
| Borehole diameter: | 65mm to 115mm | Peak ground acceleration: | 0.81 g |
| Rod length: | 3.30 ft | Eq. external load: | 0.00 tsf |
| Hammer energy ratio: | 1.00 | | |



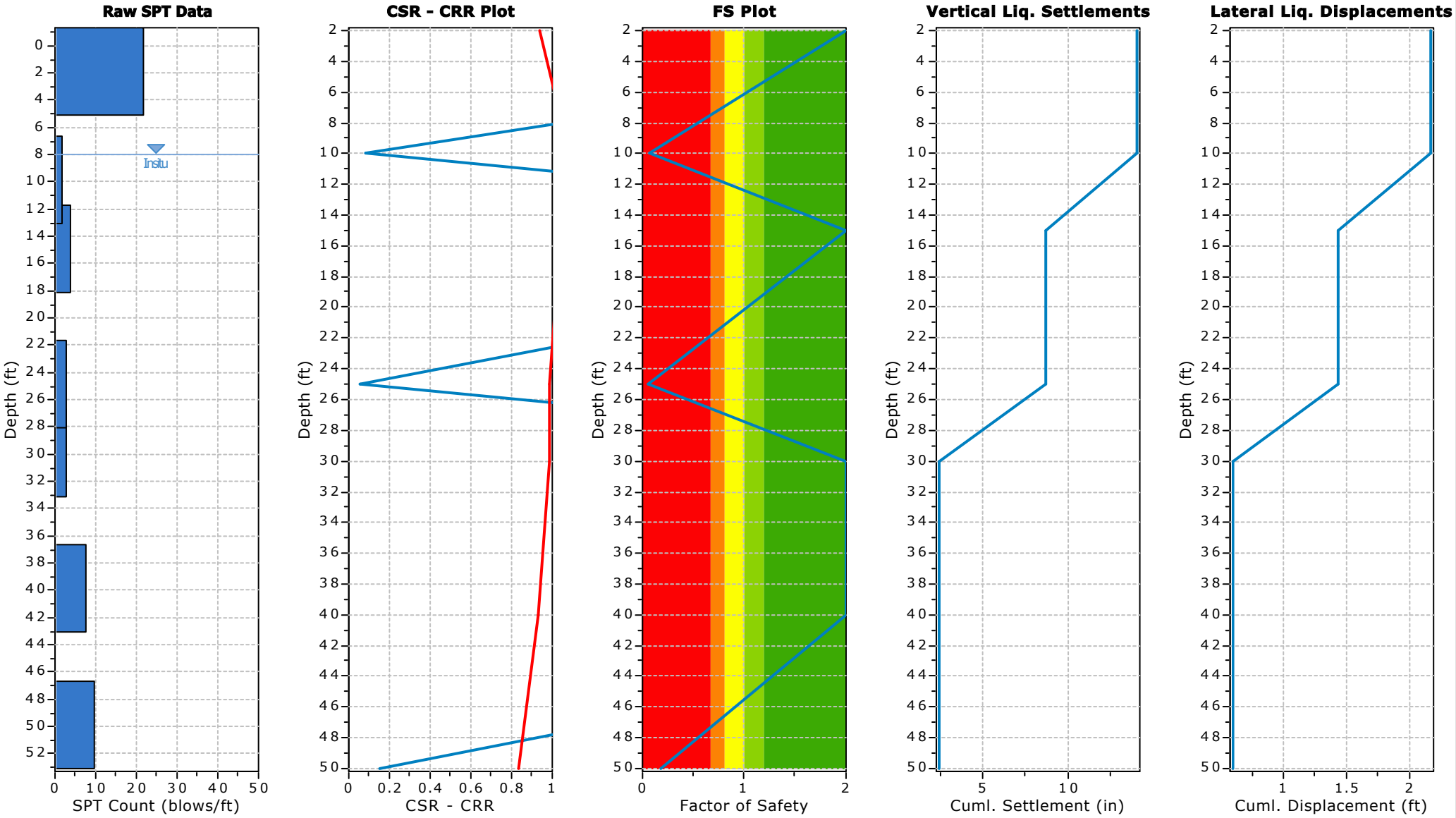

**F.S. color scheme**

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

**LPI color scheme**

- Very high risk
- High risk
- Low risk

## :: Overall Liquefaction Assessment Analysis Plots ::



**:: Field input data ::**

| Test Depth (ft) | SPT Field Value (blows) | Fines Content (%) | Unit Weight (pcf) | Infl. Thickness (ft) | Can Liquefy |
|---|---|---|---|---|---|
| 2.00 | 22 | 28.00 | 131.00 | 5.00 | Yes |
| 10.00 | 2 | 95.00 | 108.00 | 8.00 | Yes |
| 15.00 | 4 | 97.50 | 120.00 | 8.00 | No |
| 25.00 | 3 | 7.10 | 121.00 | 9.00 | Yes |
| 30.00 | 3 | 95.50 | 104.00 | 5.00 | No |
| 40.00 | 8 | 90.00 | 108.00 | 10.00 | No |
| 50.00 | 10 | 30.00 | 129.00 | 6.50 | Yes |

**Abbreviations**

Depth: Depth at which test was performed (ft)
SPT Field Value: Number of blows per foot
Fines Content: Fines content at test depth (%)
Unit Weight: Unit weight at test depth (pcf)
Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

**:: Cyclic Resistance Ratio (CRR) calculation data ::**

| Depth (ft) | SPT Field Value | Unit Weight (pcf) | $\sigma_v$ (tsf) | $u_o$ (tsf) | $\sigma'_{vo}$ (tsf) | $C_N$ | $C_E$ | $C_B$ | $C_R$ | $C_S$ | $(N_1)_{60}$ | Fines Content (%) | $\alpha$ | $\beta$ | $(N_1)_{60cs}$ | $CRR_{7.5}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.00 | 22 | 131.00 | 0.13 | 0.00 | 0.13 | 1.66 | 1.00 | 1.00 | 0.75 | 1.00 | 27 | 28.00 | 4.56 | 1.14 | 35 | 4.000 |
| 10.00 | 2 | 108.00 | 0.56 | 0.06 | 0.50 | 1.31 | 1.00 | 1.00 | 0.85 | 1.00 | 2 | 95.00 | 5.00 | 1.20 | 7 | 0.081 |
| 15.00 | 4 | 120.00 | 0.86 | 0.22 | 0.64 | 1.22 | 1.00 | 1.00 | 0.85 | 1.00 | 4 | 97.50 | 5.00 | 1.20 | 10 | 4.000 |
| 25.00 | 3 | 121.00 | 1.47 | 0.53 | 0.94 | 1.05 | 1.00 | 1.00 | 0.95 | 1.00 | 3 | 7.10 | 0.13 | 1.01 | 3 | 0.056 |
| 30.00 | 3 | 104.00 | 1.73 | 0.69 | 1.04 | 1.01 | 1.00 | 1.00 | 1.00 | 1.00 | 3 | 95.50 | 5.00 | 1.20 | 9 | 4.000 |
| 40.00 | 8 | 108.00 | 2.27 | 1.00 | 1.27 | 0.92 | 1.00 | 1.00 | 1.00 | 1.00 | 7 | 90.00 | 5.00 | 1.20 | 13 | 4.000 |
| 50.00 | 10 | 129.00 | 2.91 | 1.31 | 1.60 | 0.81 | 1.00 | 1.00 | 1.00 | 1.00 | 8 | 30.00 | 4.71 | 1.15 | 14 | 0.153 |

**Abbreviations**

$\sigma_v$: Total stress during SPT test (tsf)
$u_o$: Water pore pressure during SPT test (tsf)
$\sigma'_{vo}$: Effective overburden pressure during SPT test (tsf)
$C_N$: Overburden corretion factor
$C_E$: Energy correction factor
$C_B$: Borehole diameter correction factor
$C_R$: Rod length correction factor
$C_S$: Liner correction factor
$N_{1(60)}$: Corrected $N_{SPT}$ to a 60% energy ratio
$\alpha$, $\beta$: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cyclic resistance ratio for M=7.5

**:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::**

| Depth (ft) | Unit Weight (pcf) | $\sigma_{v,eq}$ (tsf) | $u_{o,eq}$ (tsf) | $\sigma'_{vo,eq}$ (tsf) | $r_d$ | $\alpha$ | CSR | MSF | $CSR_{eq,M=7.5}$ | $K_{sigma}$ | CSR* | FS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.00 | 131.00 | 0.13 | 0.06 | 0.07 | 1.00 | 1.00 | 1.003 | 1.07 | 0.936 | 1.00 | 0.936 | 2.000 | ● |
| 10.00 | 108.00 | 0.56 | 0.31 | 0.25 | 0.98 | 1.00 | 1.156 | 1.07 | 1.079 | 1.00 | 1.079 | 0.075 | ● |
| 15.00 | 120.00 | 0.86 | 0.47 | 0.40 | 0.97 | 1.00 | 1.114 | 1.07 | 1.040 | 1.00 | 1.040 | 2.000 | ● |
| 25.00 | 121.00 | 1.47 | 0.78 | 0.69 | 0.94 | 1.00 | 1.058 | 1.07 | 0.988 | 1.00 | 0.988 | 0.057 | ● |
| 30.00 | 104.00 | 1.73 | 0.94 | 0.79 | 0.92 | 1.00 | 1.057 | 1.07 | 0.987 | 1.00 | 0.987 | 2.000 | ● |
| 40.00 | 108.00 | 2.27 | 1.25 | 1.02 | 0.85 | 1.00 | 0.996 | 1.07 | 0.930 | 1.00 | 0.930 | 2.000 | ● |
| 50.00 | 129.00 | 2.91 | 1.56 | 1.35 | 0.75 | 1.00 | 0.853 | 1.07 | 0.796 | 0.95 | 0.837 | 0.183 | ● |

**:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::**

| Depth (ft) | Unit Weight (pcf) | $\sigma_{v,eq}$ (tsf) | $u_{b,eq}$ (tsf) | $\sigma'_{vo,eq}$ (tsf) | $r_d$ | $\alpha$ | CSR | MSF | $CSR_{eq,M=7.5}$ | $K_{sigma}$ | $CSR^*$ | FS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

**Abbreviations**

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{b,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
$r_d$ : Nonlinear shear mass factor
$\alpha$: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
$K_{sigma}$: Effective overburden stress factor
$CSR^*$: CSR fully adjusted
FS: Calculated factor of safety against soil liquefaction

**:: Liquefaction potential according to Iwasaki ::**

| Depth (ft) | FS | F | wz | Thickness (ft) | $I_L$ |
|---|---|---|---|---|---|
| 2.00 | 2.000 | 0.00 | 9.70 | 8.00 | 0.00 |
| 10.00 | 0.075 | 0.93 | 8.48 | 8.00 | 19.12 |
| 15.00 | 2.000 | 0.00 | 7.71 | 5.00 | 0.00 |
| 25.00 | 0.057 | 0.94 | 6.19 | 10.00 | 17.80 |
| 30.00 | 2.000 | 0.00 | 5.43 | 5.00 | 0.00 |
| 40.00 | 2.000 | 0.00 | 3.90 | 10.00 | 0.00 |
| 50.00 | 0.183 | 0.82 | 2.38 | 10.00 | 5.93 |

**Overall potential $I_L$ : 42.85**

$I_L$ = 0.00 - No liquefaction
$I_L$ between 0.00 and 5 - Liquefaction not probable
$I_L$ between 5 and 15 - Liquefaction probable
$I_L$ > 15 - Liquefaction certain

**:: Vertical settlements estimation for saturated sands ::**

| Depth (ft) | $D_{50}$ (in) | $q_c/N$ | $e_v$ (%) | $\Delta h$ (ft) | s (in) |
|---|---|---|---|---|---|
| 2.00 | 0.00 | 5.00 | 0.00 | 5.00 | 0.000 |
| 10.00 | 0.00 | 5.00 | 5.53 | 8.00 | 5.306 |
| 15.00 | 0.00 | 5.00 | 0.00 | 8.00 | 0.000 |
| 25.00 | 0.00 | 5.00 | 5.80 | 9.00 | 6.264 |
| 30.00 | 0.00 | 5.00 | 0.00 | 5.00 | 0.000 |
| 40.00 | 0.00 | 5.00 | 0.00 | 10.00 | 0.000 |
| 50.00 | 0.00 | 5.00 | 3.13 | 6.50 | 2.442 |

**Cumulative settlements: 14.011**

**Abbreviations**

$D_{50}$: Median grain size (in)
$q_c/N$: Ratio of cone resistance to SPT
$e_v$: Post liquefaction volumetric strain (%)
$\Delta h$: Thickness of soil layer to be considered (ft)
s: Estimated settlement (in)

**:: Lateral displacements estimation for saturated sands ::**

| Depth (ft) | $(N_1)_{60}$ | $D_r$ (%) | $\gamma_{max}$ (%) | $d_z$ (ft) | LDI | LD (ft) |
|---|---|---|---|---|---|---|
| 2.00 | 27 | 72.75 | 0.00 | 5.00 | 0.000 | 0.00 |
| 10.00 | 2 | 19.80 | 51.20 | 8.00 | 4.096 | 0.74 |
| 15.00 | 4 | 28.00 | 0.00 | 8.00 | 0.000 | 0.00 |
| 25.00 | 3 | 24.25 | 51.20 | 9.00 | 4.608 | 0.83 |
| 30.00 | 3 | 24.25 | 0.00 | 5.00 | 0.000 | 0.00 |
| 40.00 | 7 | 37.04 | 0.00 | 10.00 | 0.000 | 0.00 |
| 50.00 | 8 | 39.60 | 51.20 | 6.50 | 3.328 | 0.60 |

**Cumulative lateral displacements: 2.17**

**Abbreviations**

$D_r$: Relative density (%)
$\gamma_{max}$: Maximum amplitude of cyclic shear strain (%)
$d_z$: Soil layer thickness (ft)
LDI: Lateral displacement index (ft)
LD: Actual estimated displacement (ft)

## References


- Ronald D. Andrus, Hossein Hayati, Nisha P. Mohanan, 2009. Correcting Liquefaction Resistance for Aged Sands Using Measured to Estimated Velocity Ratio, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 135, No. 6, June 1

- Boulanger, R.W. and Idriss, I. M., 2014. CPT AND SPT BASED LIQUEFACTION TRIGGERING PROCEDURES. DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING COLLEGE OF ENGINEERING UNIVERSITY OF CALIFORNIA AT DAVIS

- Dipl.-Ing. Heinz J. Priebe, Vibro Replacement to Prevent Earthquake Induced Liquefaction, Proceedings of the Geotechnique-Colloquium at Darmstadt, Germany, on March 19th, 1998 (also published in Ground Engineering, September 1998), Technical paper 12-57E

- Robertson, P.K. and Cabal, K.L., 2007, Guide to Cone Penetration Testing for Geotechnical Engineering. Available at no cost at http://www.geologismiki.gr/

- Youd, T.L., Idriss, I.M., Andrus, R.D., Arango, I., Castro, G., Christian, J.T., Dobry, R., Finn, W.D.L., Harder, L.F., Hynes, M.E., Ishihara, K., Koester, J., Liao, S., Marcuson III, W.F., Martin, G.R., Mitchell, J.K., Moriwaki, Y., Power, M.S., Robertson, P.K., Seed, R., and Stokoe, K.H., Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshop on Evaluation of Liquefaction Resistance of Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 127, October, pp 817-833

- Zhang, G., Robertson. P.K., Brachman, R., 2002, Estimating Liquefaction Induced Ground Settlements from the CPT, Canadian Geotechnical Journal, 39: pp 1168-1180

- Zhang, G., Robertson. P.K., Brachman, R., 2004, Estimating Liquefaction Induced Lateral Displacements using the SPT and CPT, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 130, No. 8, 861-871

- Pradel, D., 1998, Procedure to Evaluate Earthquake-Induced Settlements in Dry Sandy Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 124, No. 4, 364-368

- R. Kayen, R. E. S. Moss, E. M. Thompson, R. B. Seed, K. O. Cetin, A. Der Kiureghian, Y. Tanaka, K. Tokimatsu, 2013. Shear-Wave Velocity–Based Probabilistic and Deterministic Assessment of Seismic Soil Liquefaction Potential, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 139, No. 3, March 1

# APPENDIX 7

## Liquefaction Assessment Results by use of CPT Data

# TABLE OF CONTENTS


**CPT-1 results**
Summary data report 1
Vertical settlements summary report 8
Lateral displacements summary report 9

**CPT-2 results**
Summary data report 10
Vertical settlements summary report 17
Lateral displacements summary report 18

**CPT-3 results**
Summary data report 19
Vertical settlements summary report 26
Lateral displacements summary report 27

**CPT-6 results**
Summary data report 28
Vertical settlements summary report 35

**CPT-9 results**
Summary data report 36
Vertical settlements summary report 43

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

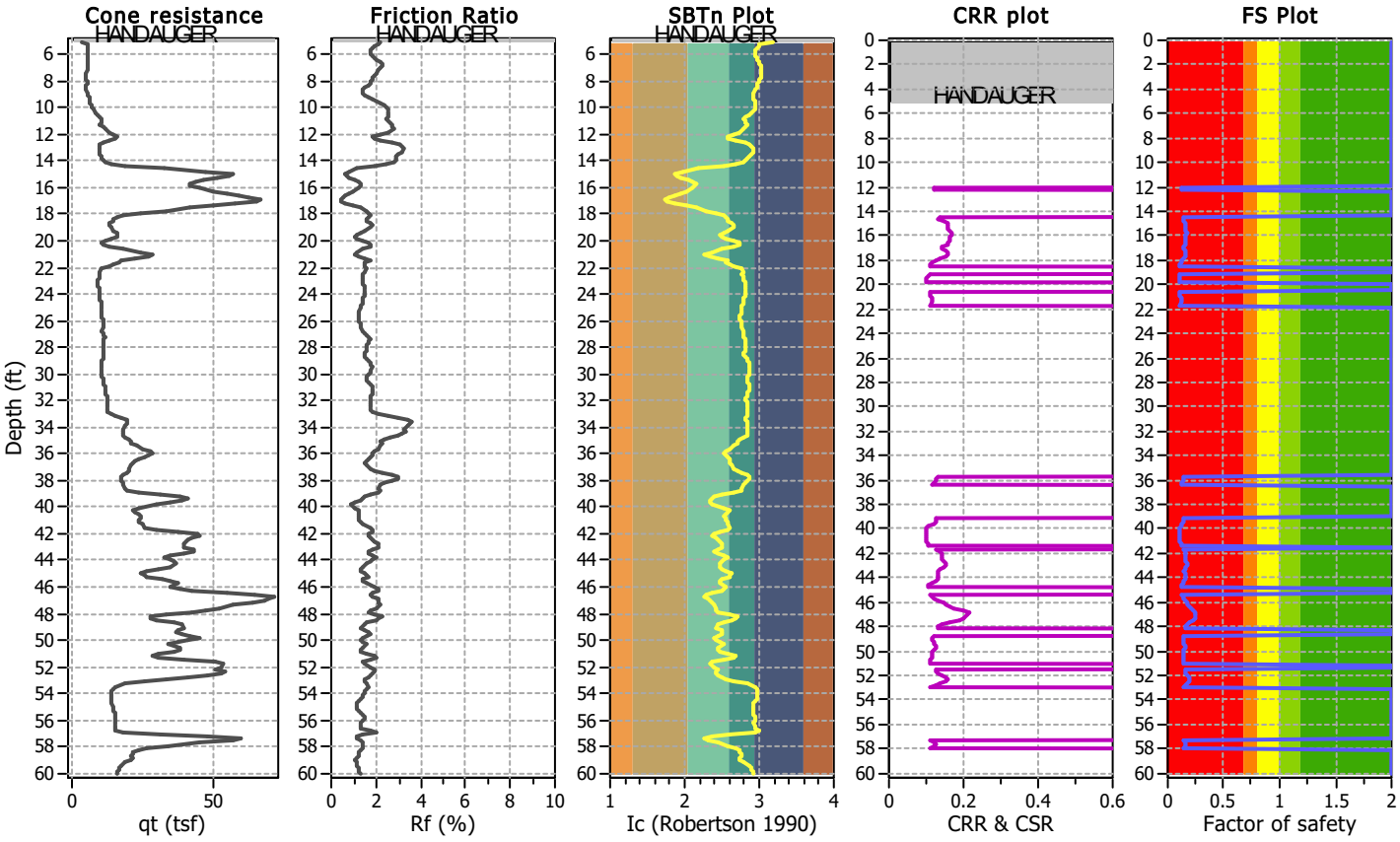
# LIQUEFACTION ANALYSIS REPORT

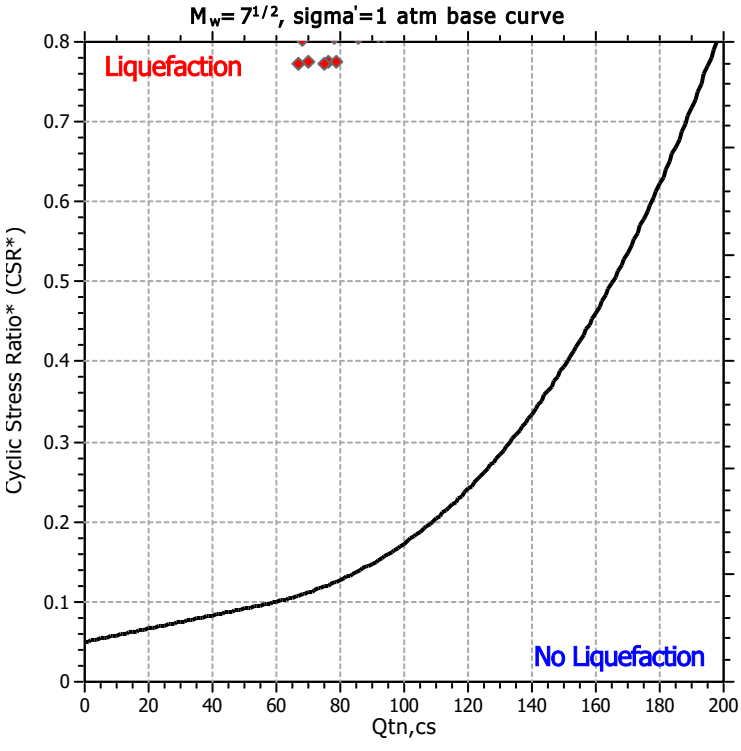
**Project title : AWWTF Improvements Project** **Location : 736 F Street, Arcata, California**

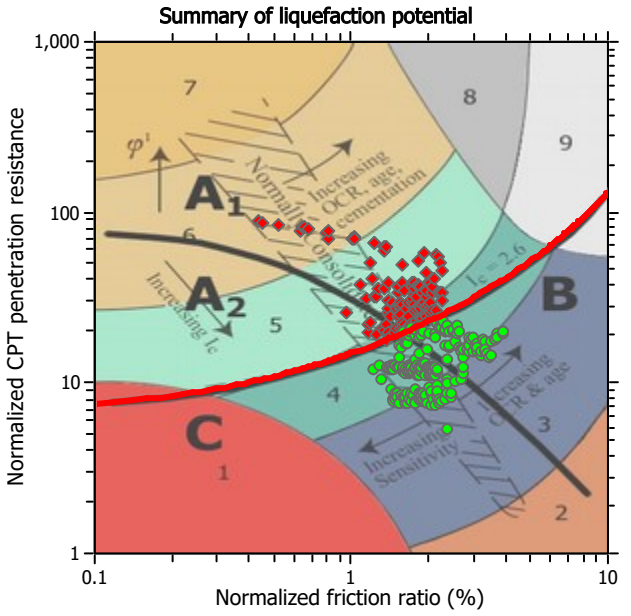
**CPT file : CPT-1**

**Input parameters and analysis data**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Analysis method:** | **NCEER (1998)** | **G.W.T. (in-situ):** | **5.00 ft** | **Use fill:** | **Yes** | **Clay like behavior applied:** | **Sands only** |
| **Fines correction method:** | **NCEER (1998)** | **G.W.T. (earthq.):** | **0.00 ft** | **Fill height:** | **5.00 ft** | **Limit depth applie:** | **No** |
| **Points to test:** | **Based on Ic value** | **Average results interv:** | **3** | **Fill weight:** | **141.00 lb/ft³** | **Limit depth:** | **N/A** |
| **Earthquake magnitude $M_w$:** | **7.30** | **Ic cut-off value:** | **2.60** | **Trans. detect. applied:** | **No** | **MSF method:** | **Method based** |
| **Peak ground acceleration:** | **0.81** | **Unit weight calculatior** | **Based on SBT** | **$K_o$ applied:** | **Yes** | | |

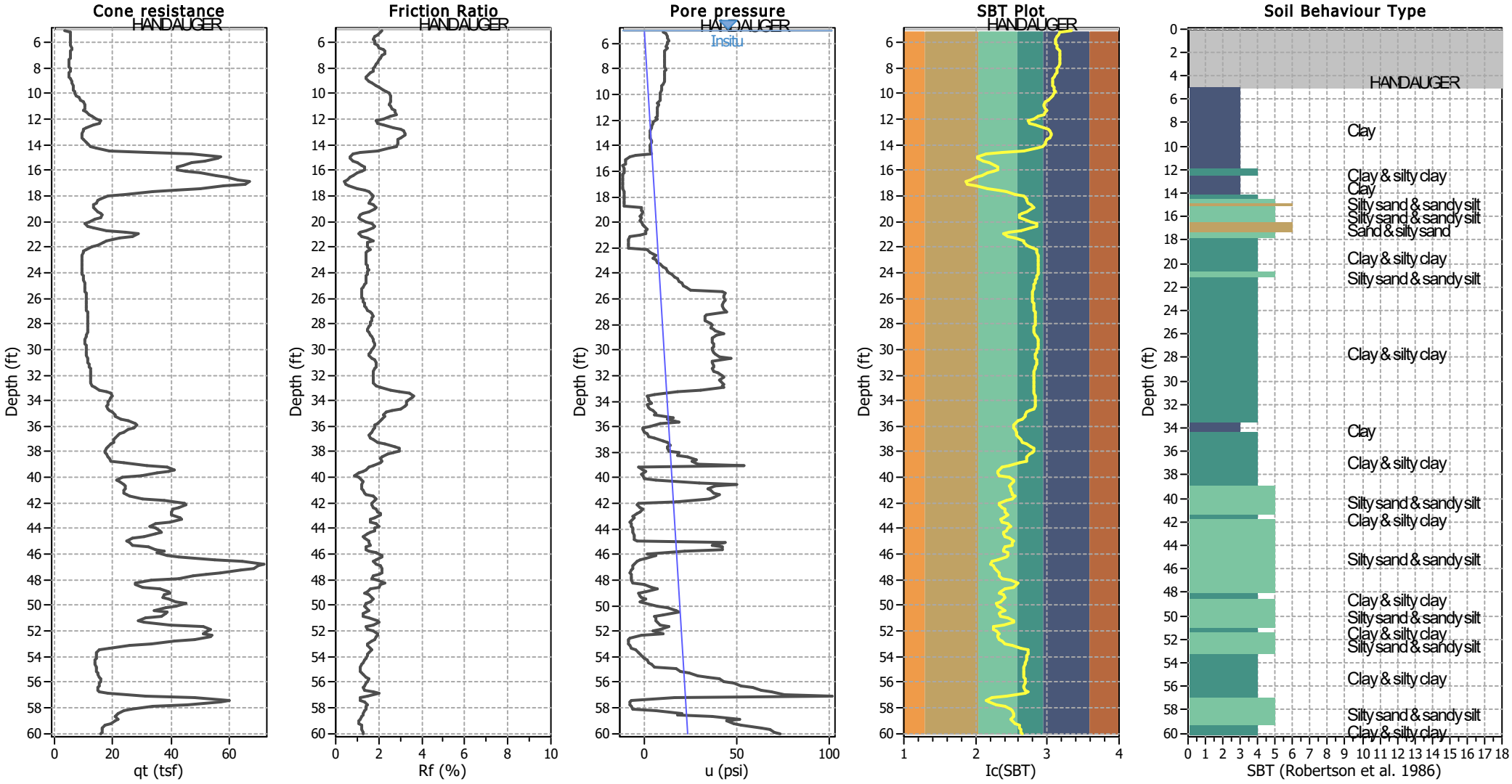



Zone $A_1$: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone $A_2$: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

# CPT basic interpretation plots



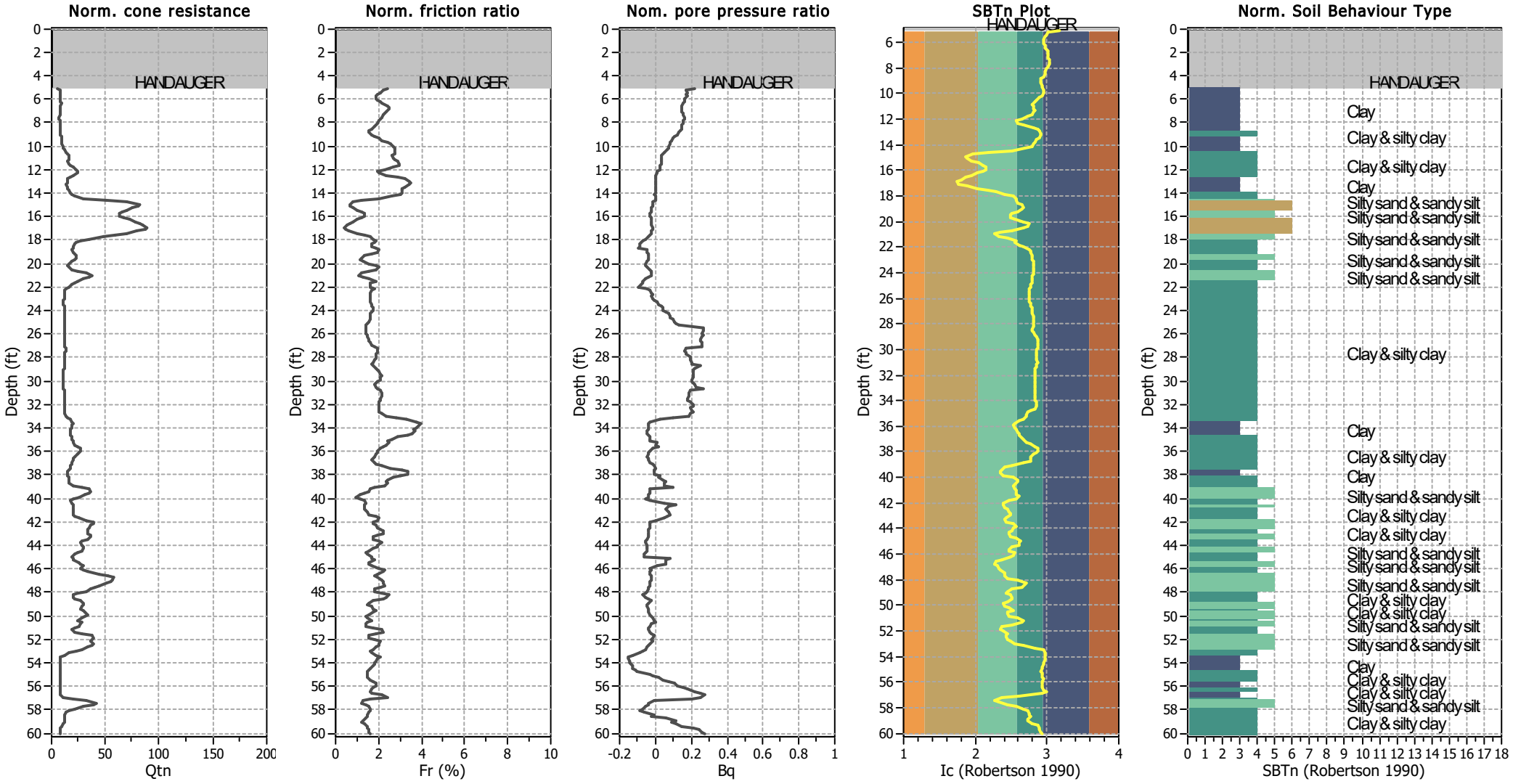

## Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

**SBT legend**

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

## CPT basic interpretation plots (normalized)



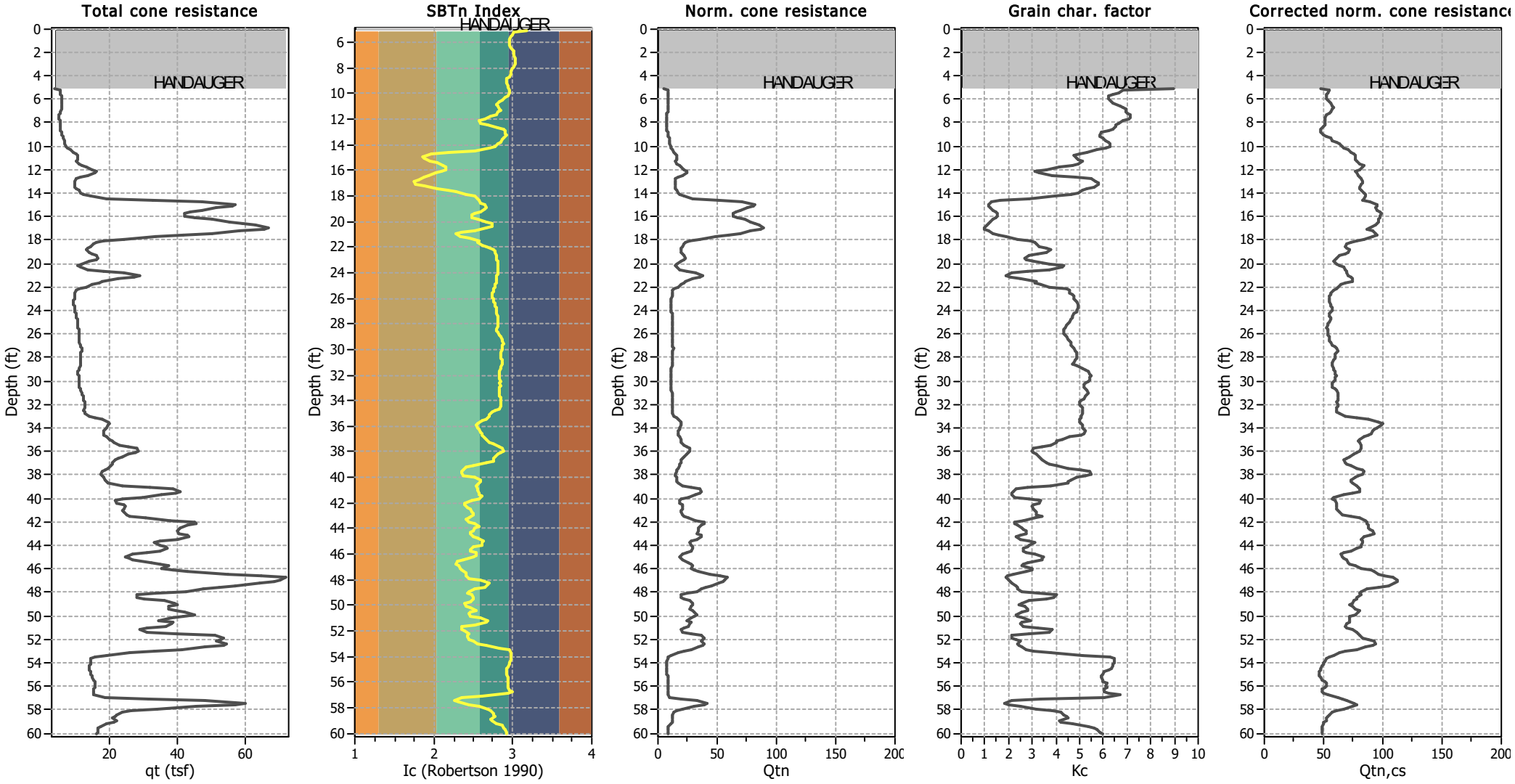

### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

**SBTn legend**

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

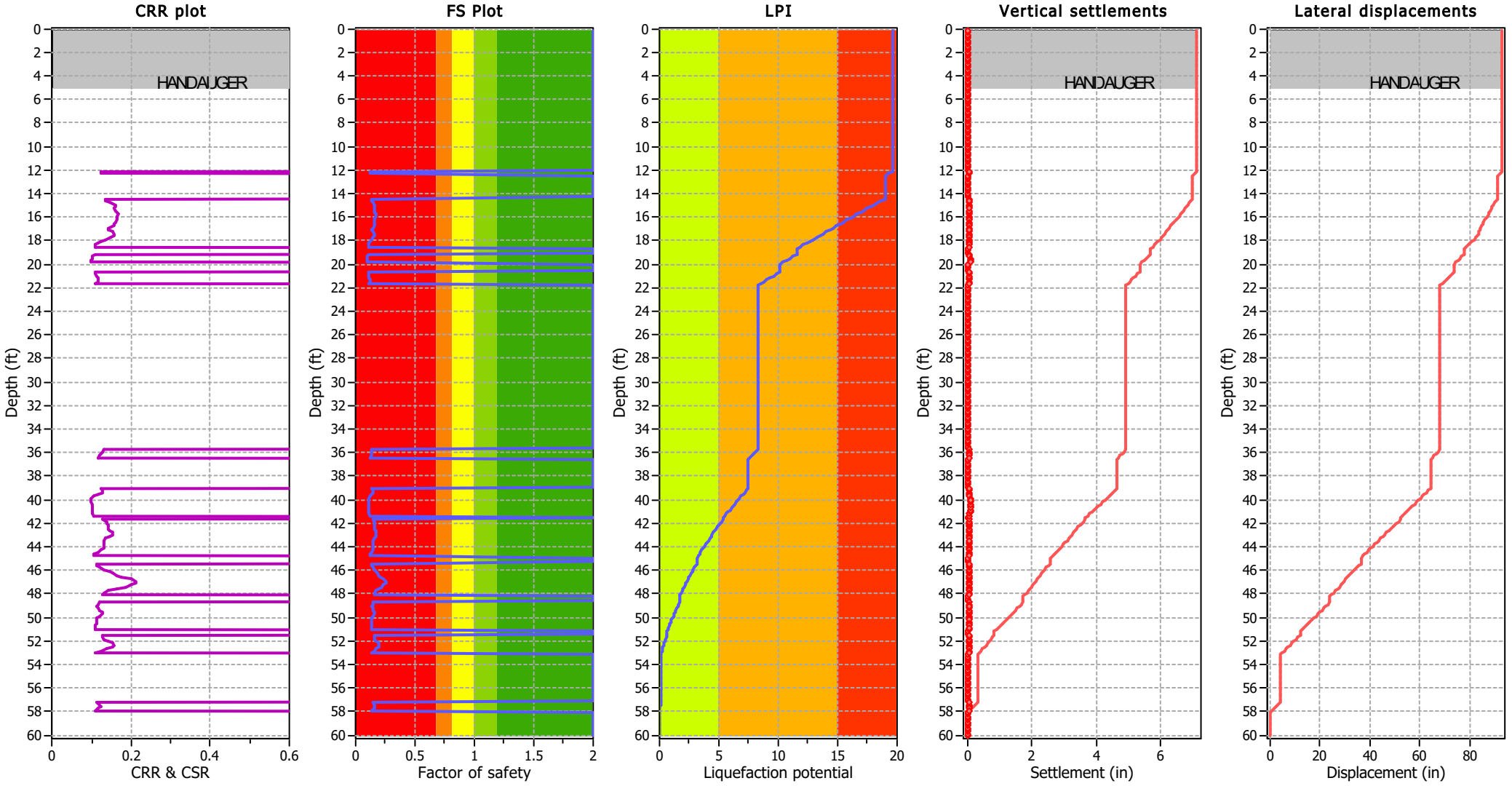
## Liquefaction analysis overall plots (intermediate results)




### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

# Liquefaction analysis overall plots




## Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

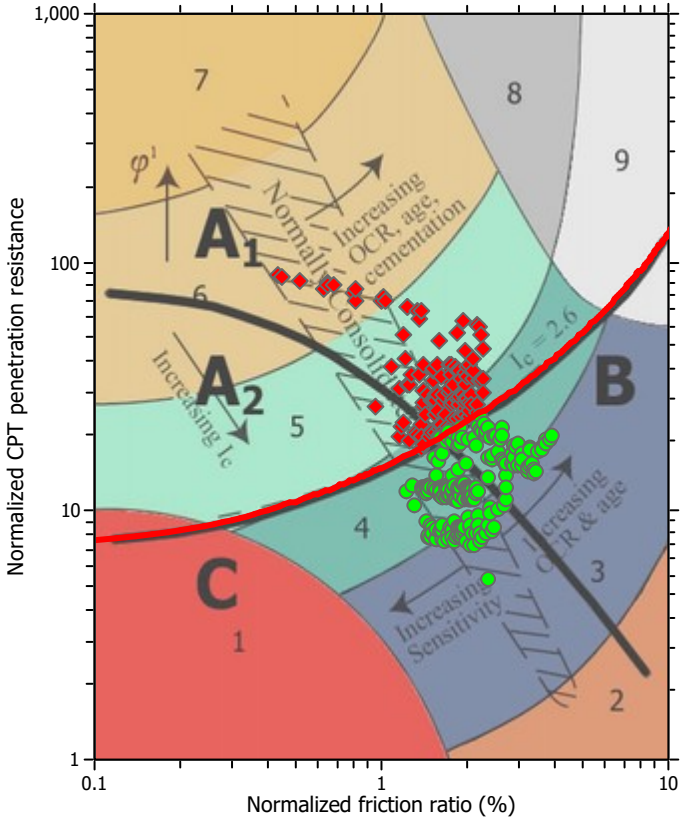
**F.S. color scheme**

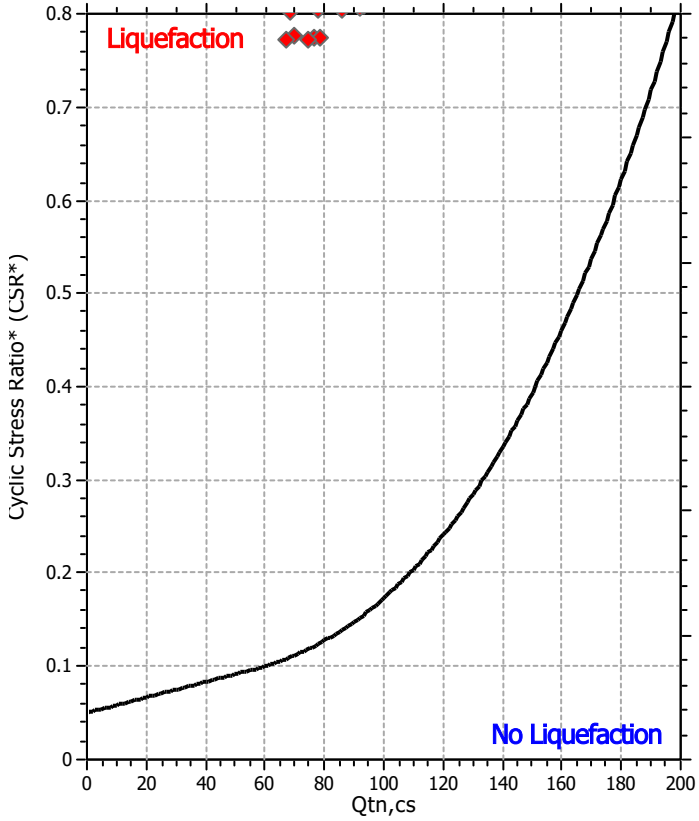
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

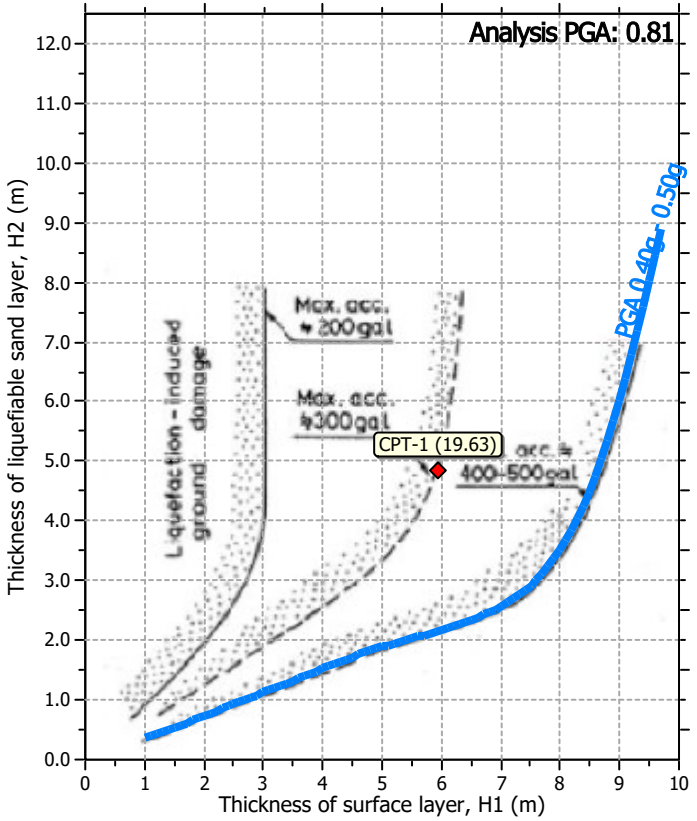
**LPI color scheme**

- Very high risk
- High risk
- Low risk

## Liquefaction analysis summary plots



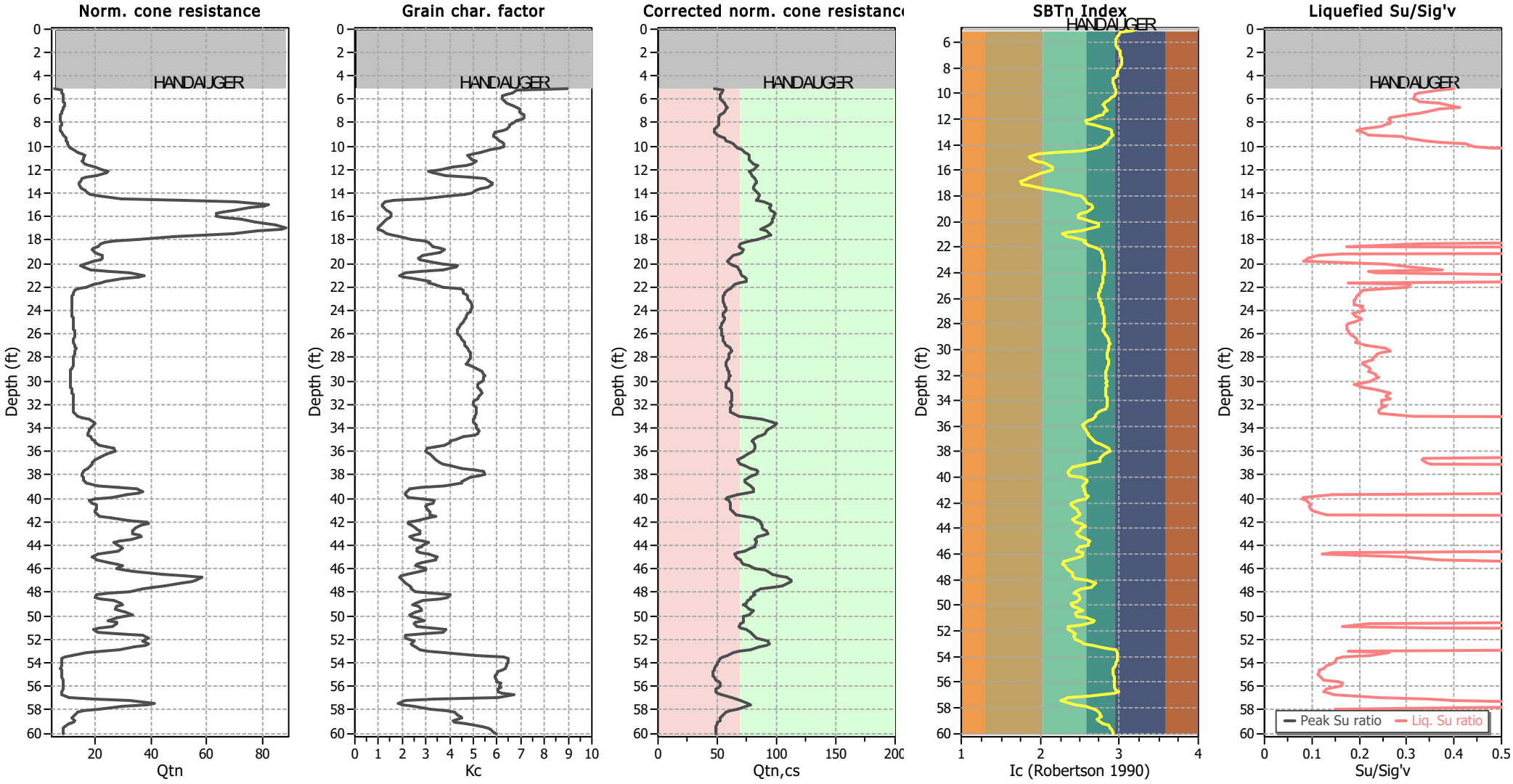




### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

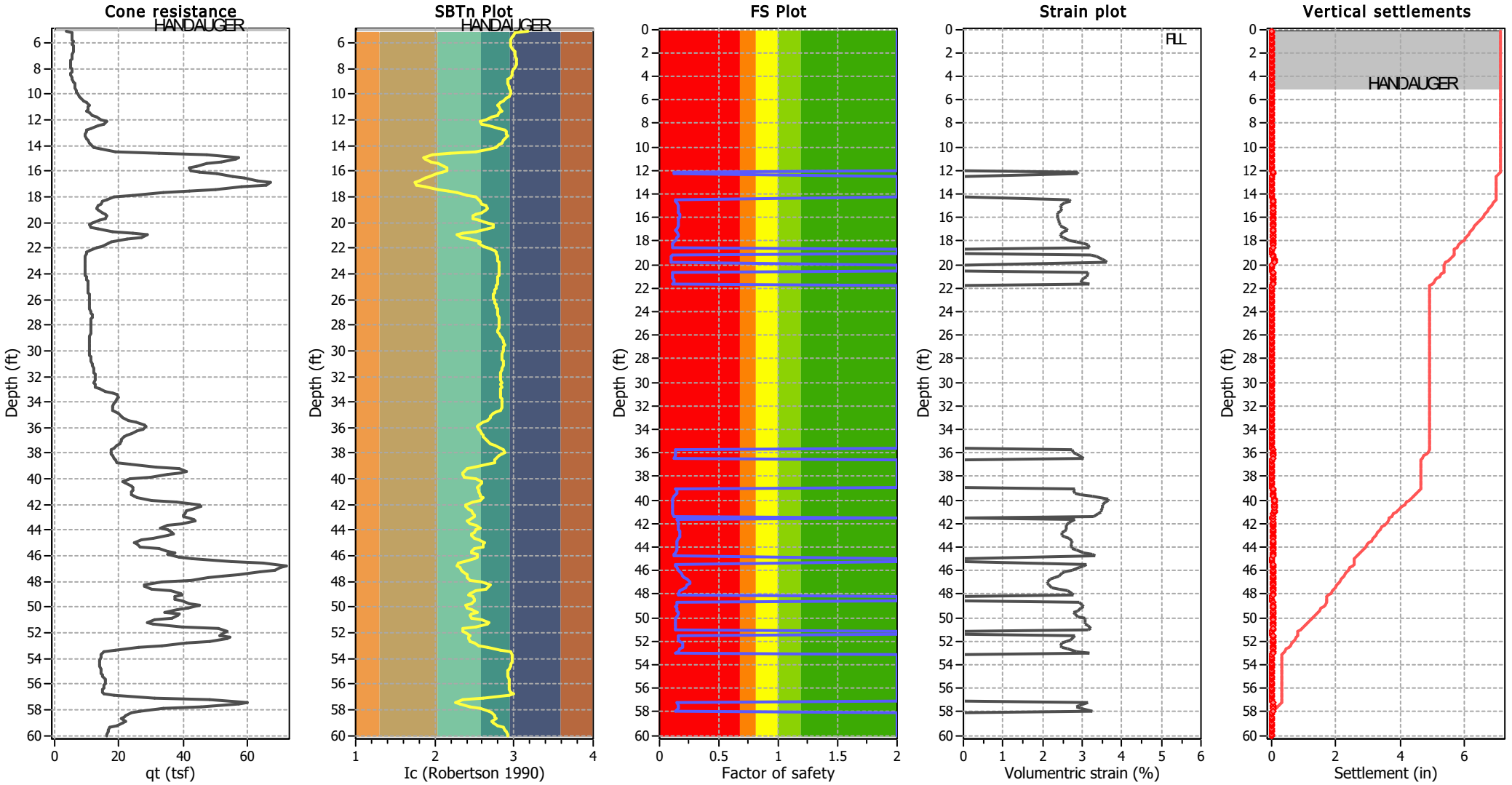
## Check for strength loss plots (Robertson (2010))




### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

## Estimation of post-earthquake settlements

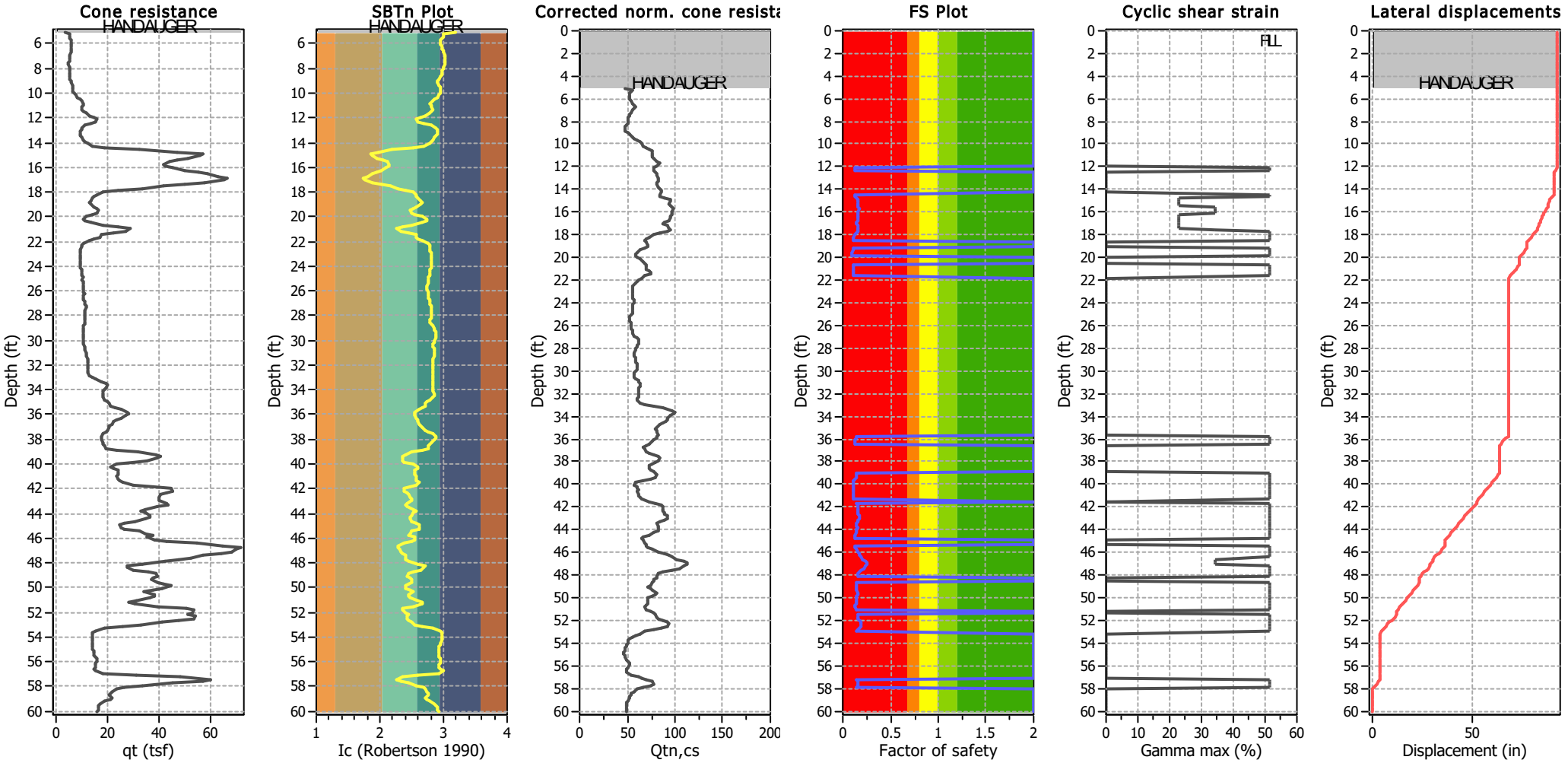



**Abbreviations**

| | |
|---|---|
| $q_t$: | Total cone resistance (cone resistance $q_c$ corrected for pore water effects) |
| $I_c$: | Soil Behaviour Type Index |
| FS: | Calculated Factor of Safety against liquefaction |
| Volumentric strain: | Post-liquefaction volumentric strain |

## Estimation of post-earthquake lateral Displacements

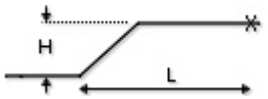
**Geometric parameters: Level ground (or gently sloping) with free face (L: 63.00 ft - H: 5.00 ft)**




**Abbreviations**

$q_t$: Total cone resistance (cone resistance $q_c$ corrected for pore water effects)
$I_c$: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
$\gamma_{max}$: Maximum cyclic shear strain
LDI: Lateral displacement index

**Surface condition**



GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

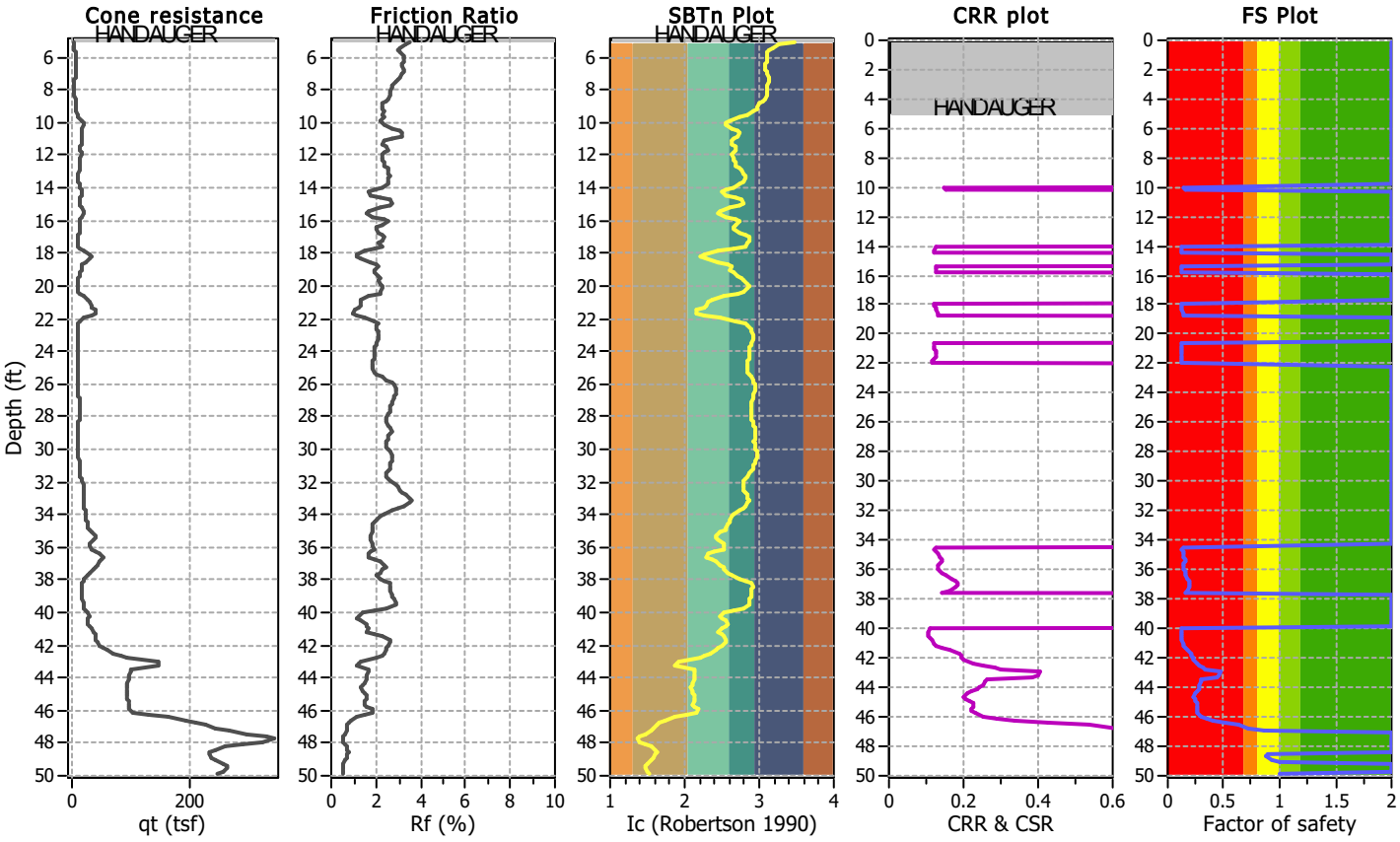
# LIQUEFACTION ANALYSIS REPORT

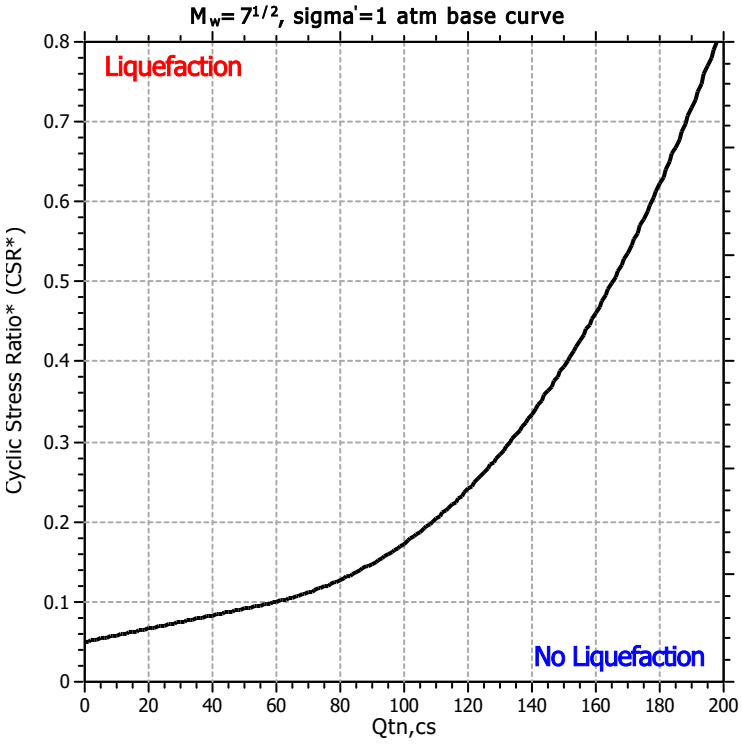
**Project title : AWWTF Improvements Project** **Location : 736 F Street, Arcata, California**

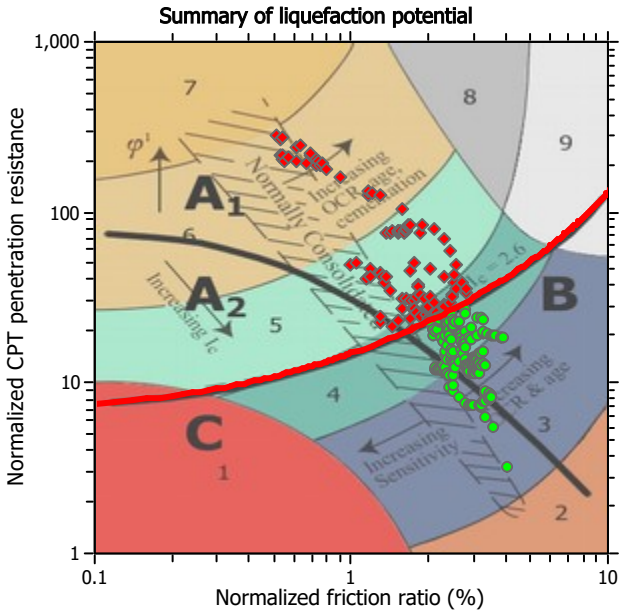
**CPT file : CPT-2**

**Input parameters and analysis data**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Analysis method:** | **NCEER (1998)** | **G.W.T. (in-situ):** | **5.00 ft** | **Use fill:** | **Yes** | **Clay like behavior applied:** | **Sands only** |
| **Fines correction method:** | **NCEER (1998)** | **G.W.T. (earthq.):** | **0.00 ft** | **Fill height:** | **5.00 ft** | **Limit depth applie:** | **No** |
| **Points to test:** | **Based on Ic value** | **Average results interv:** | **3** | **Fill weight:** | **141.00 lb/ft³** | **Limit depth:** | **N/A** |
| **Earthquake magnitude $M_w$:** | **7.30** | **Ic cut-off value:** | **2.60** | **Trans. detect. applied:** | **No** | **MSF method:** | **Method based** |
| **Peak ground acceleration:** | **0.81** | **Unit weight calculatior** | **Based on SBT** | **$K_o$ applied:** | **Yes** | | |

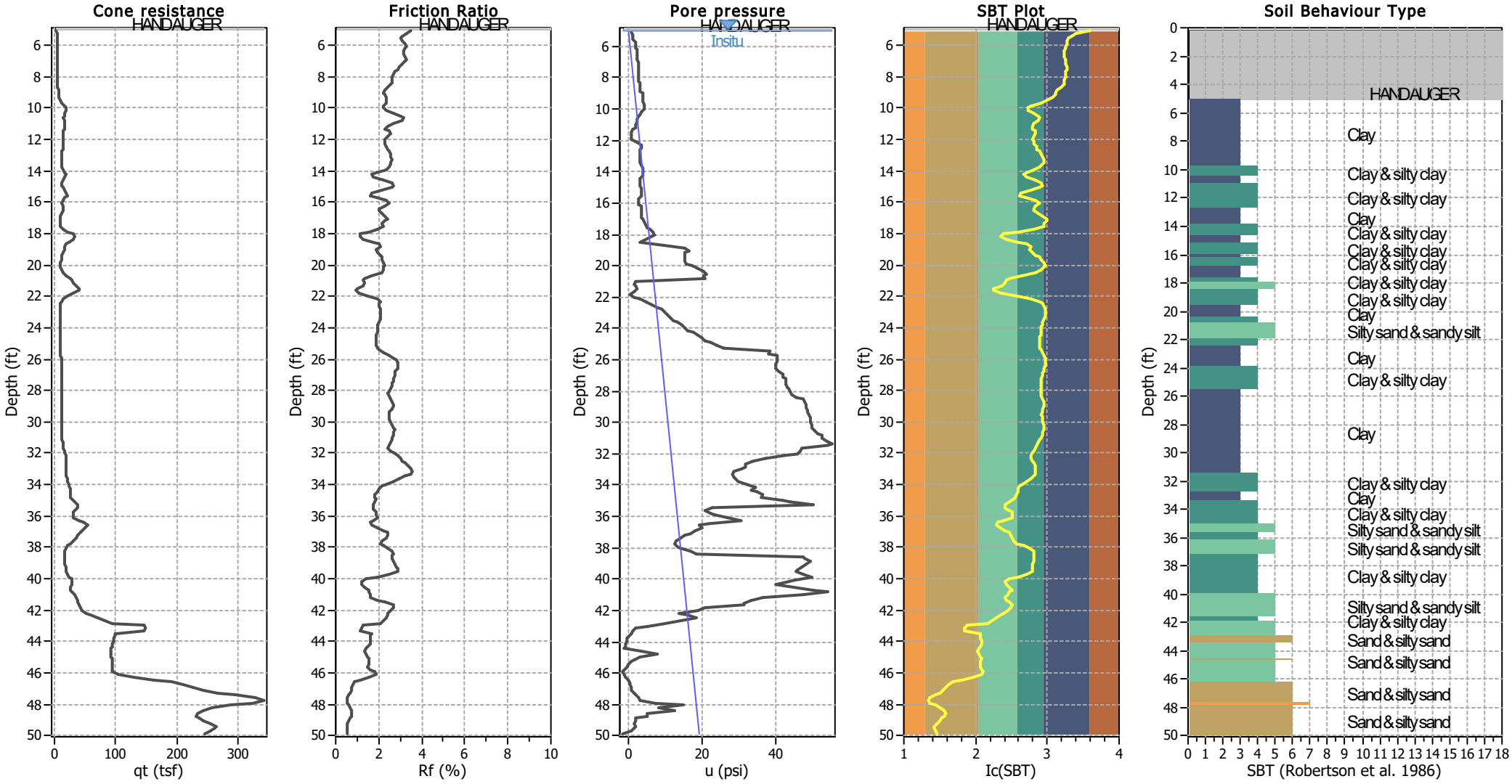



Zone $A_1$: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone $A_2$: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

## CPT basic interpretation plots



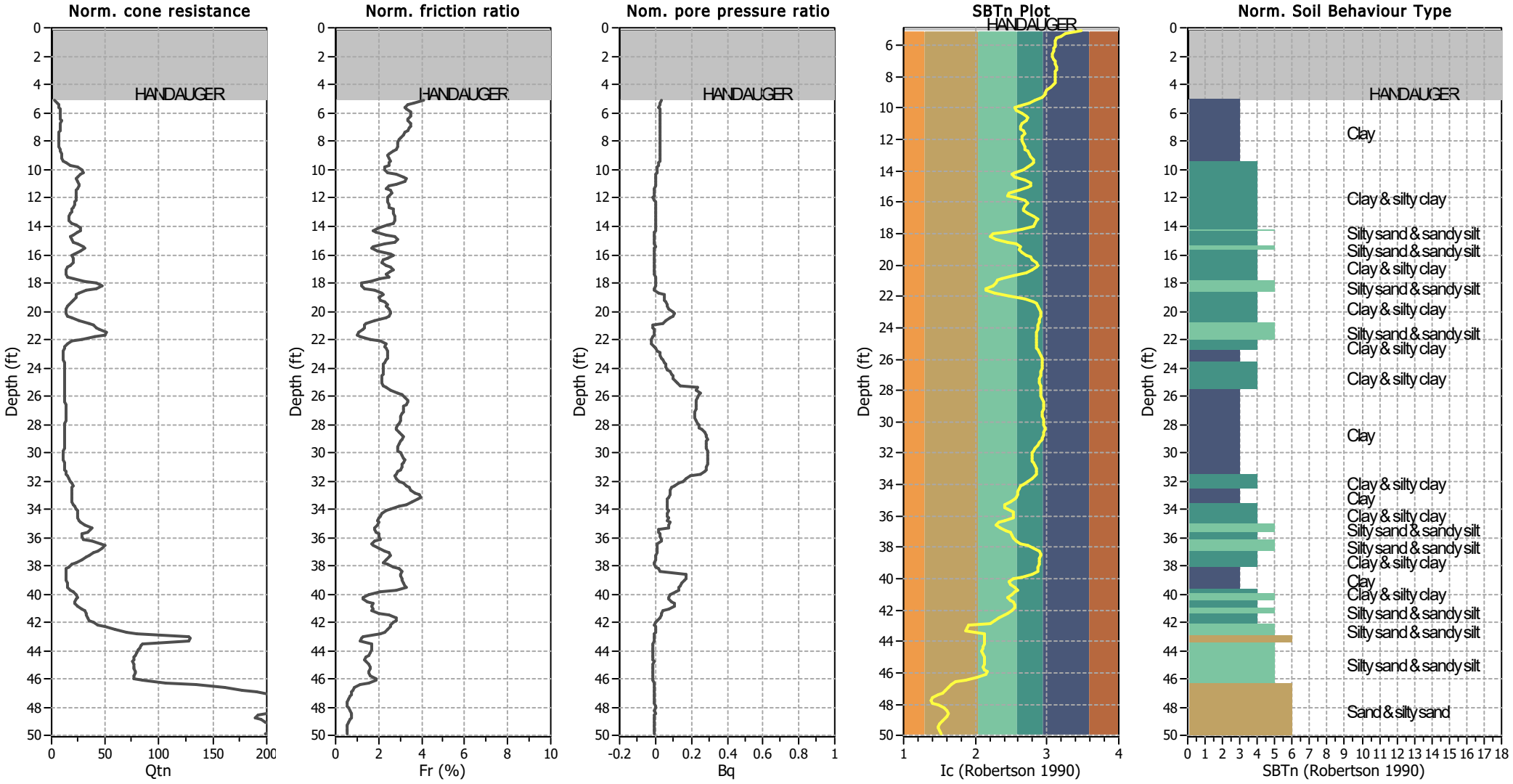

### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

**SBT legend**

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

## CPT basic interpretation plots (normalized)



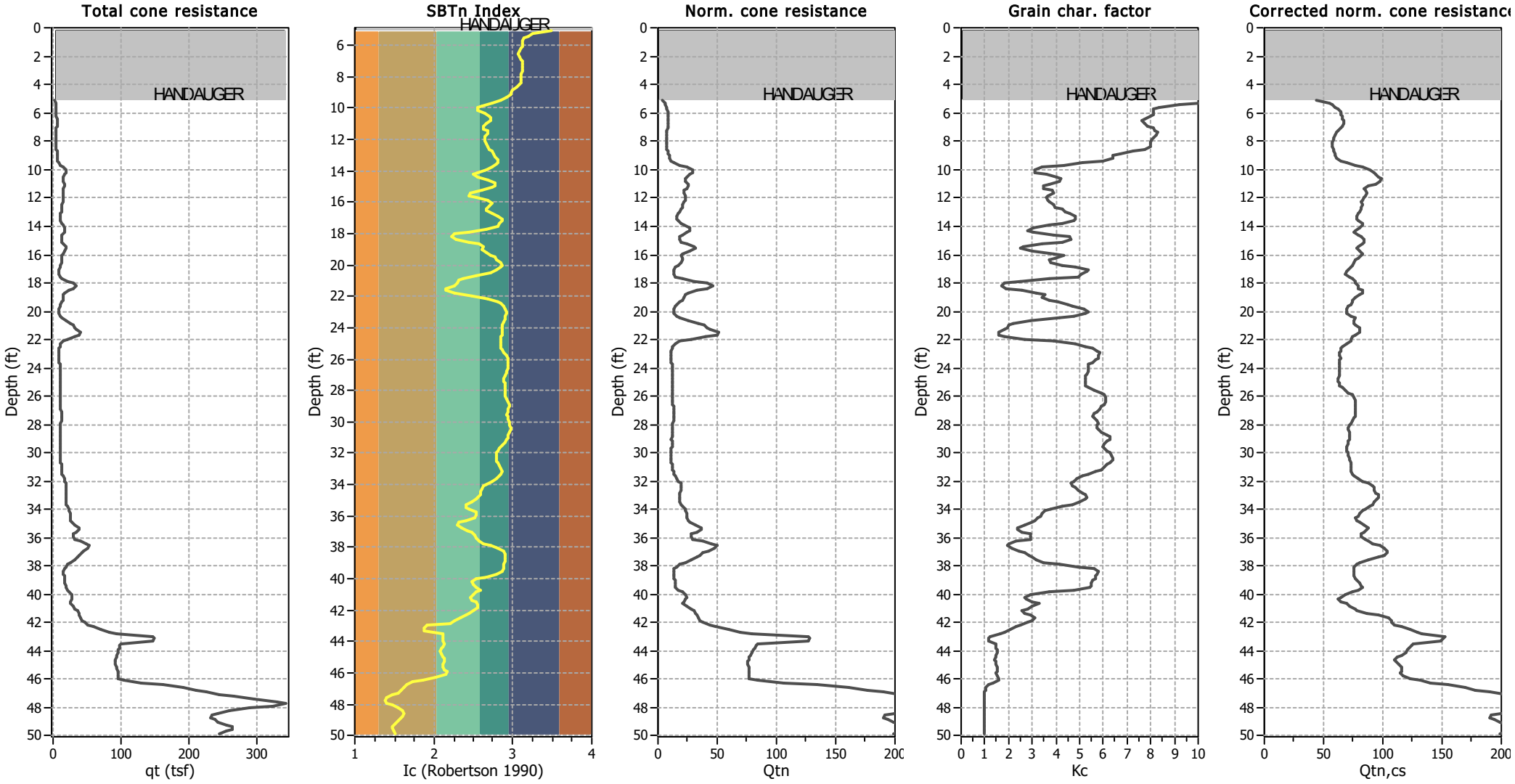

### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

**SBTn legend**

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

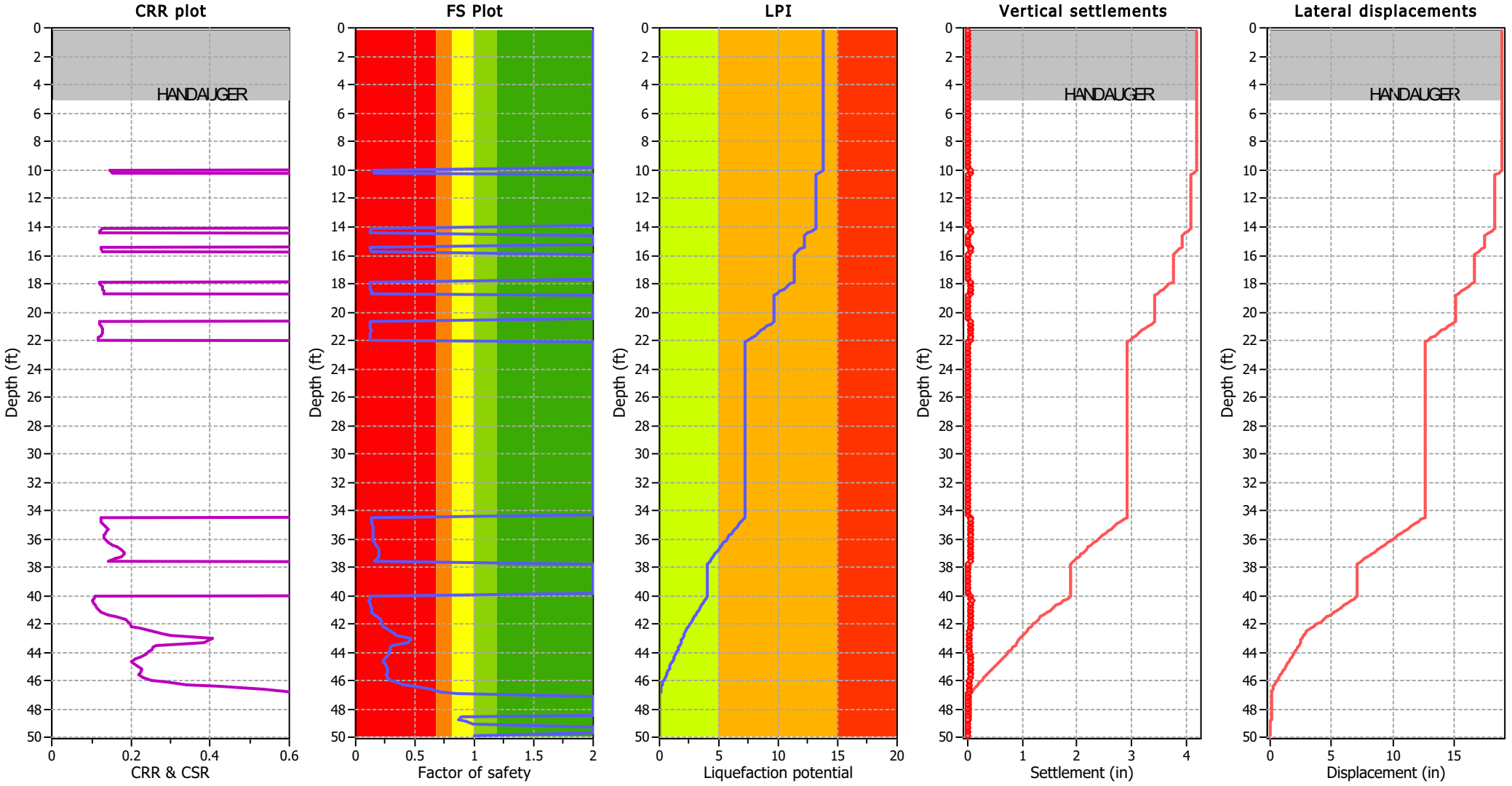
## Liquefaction analysis overall plots (intermediate results)




### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

## Liquefaction analysis overall plots




### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

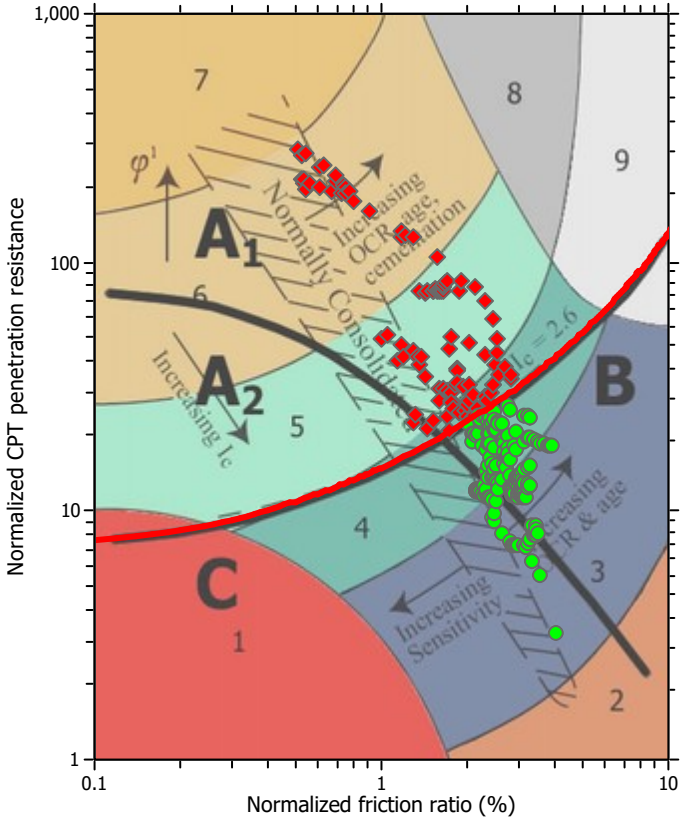
**F.S. color scheme**

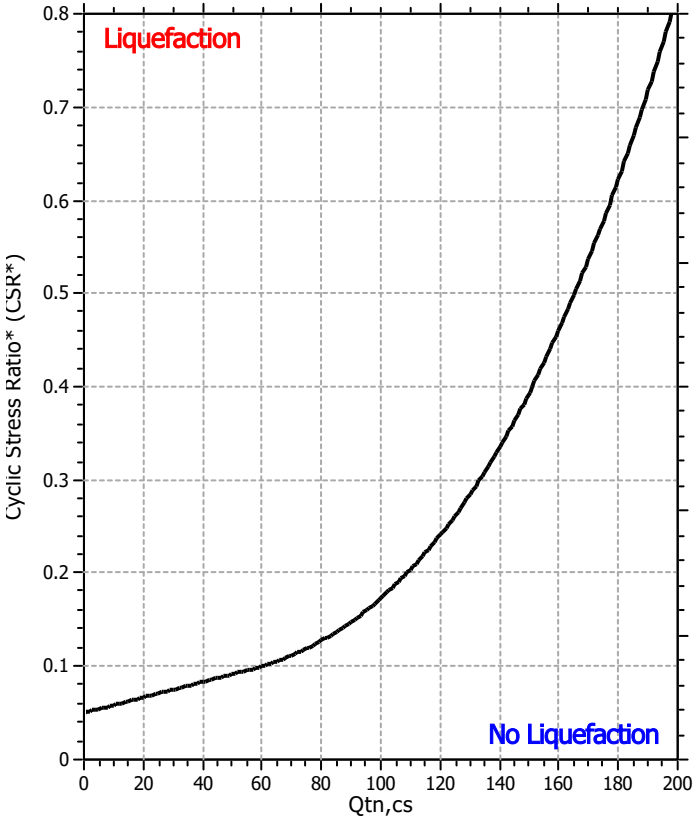
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

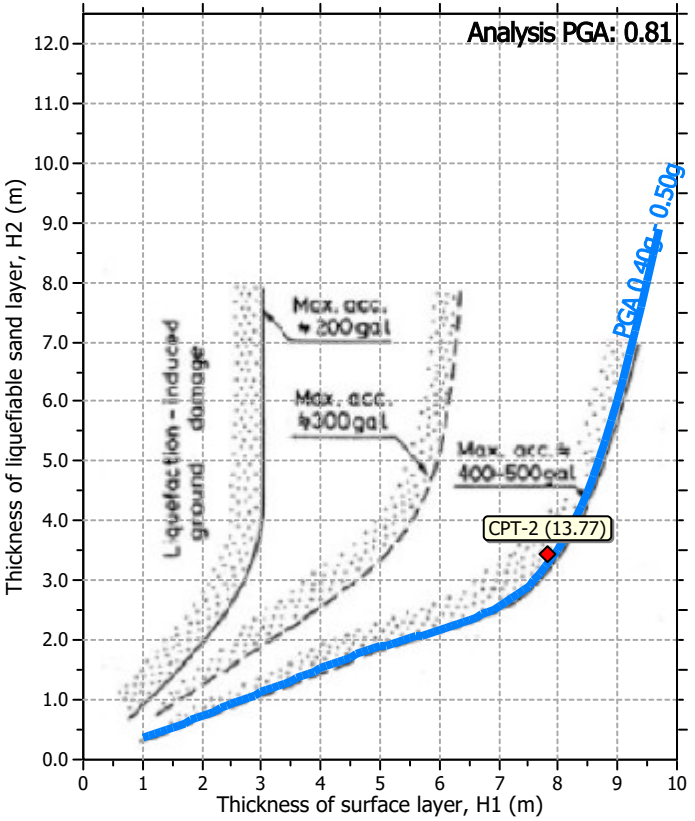
**LPI color scheme**

- Very high risk
- High risk
- Low risk

## Liquefaction analysis summary plots



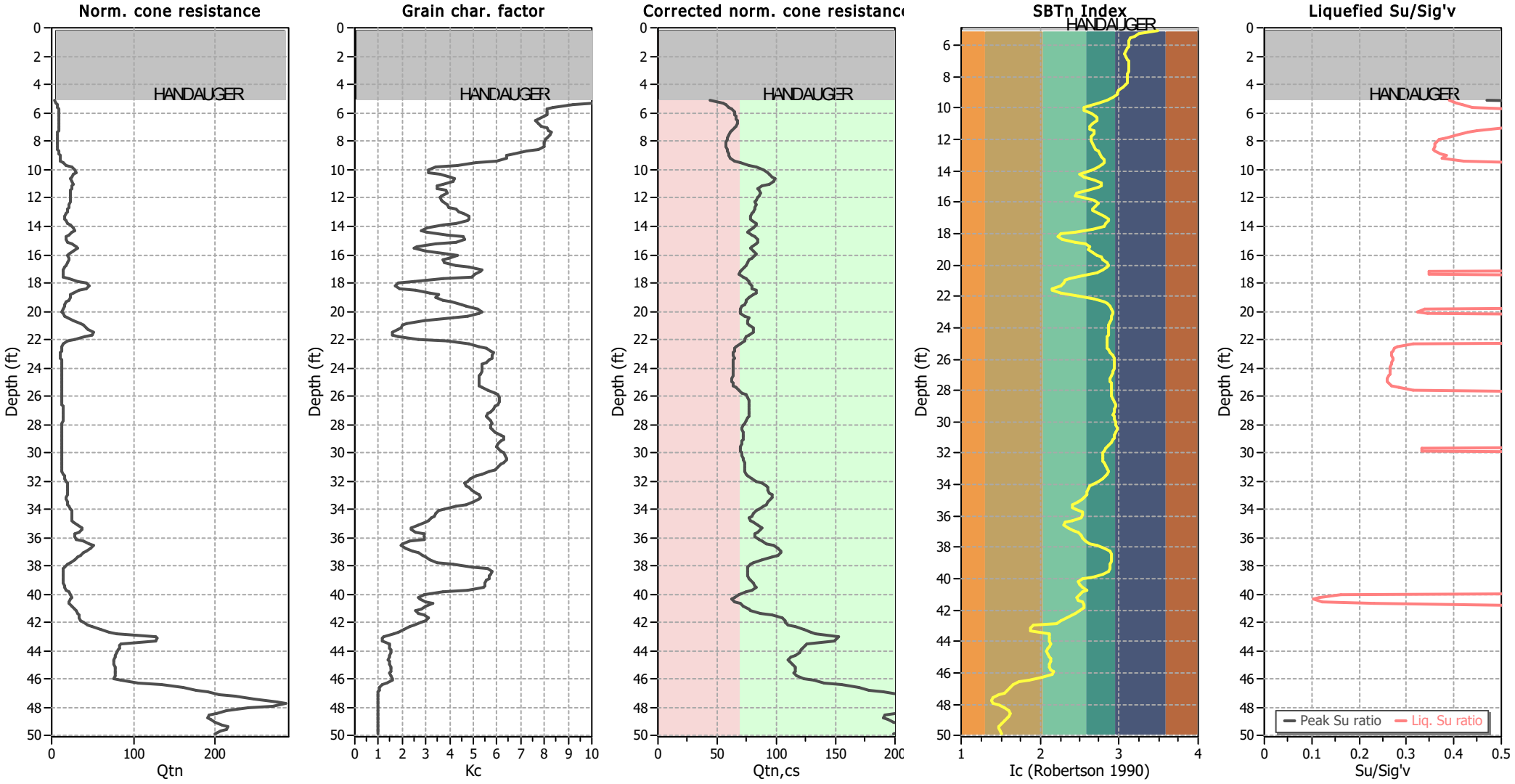




### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

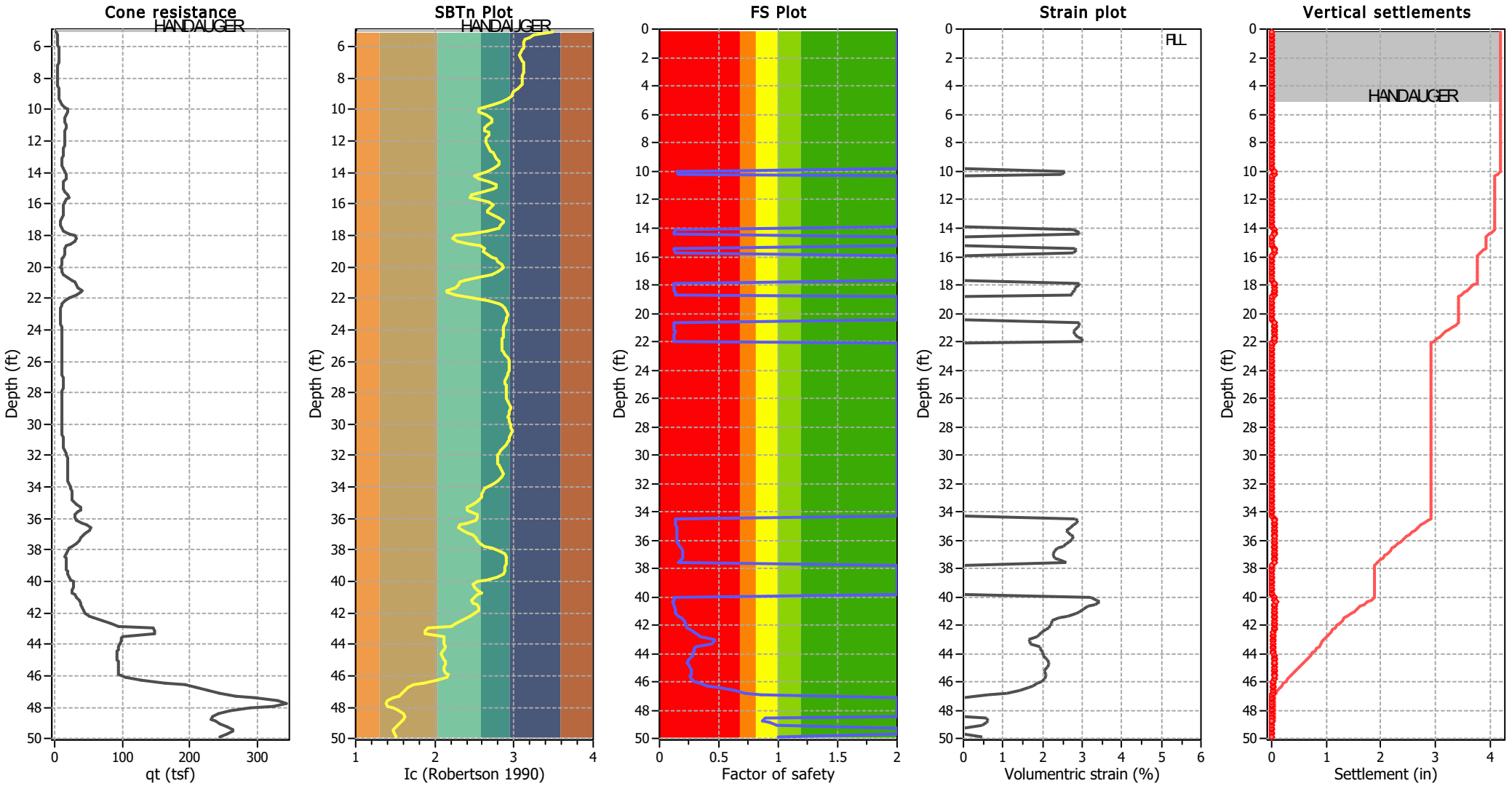
## Check for strength loss plots (Robertson (2010))




### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

## Estimation of post-earthquake settlements

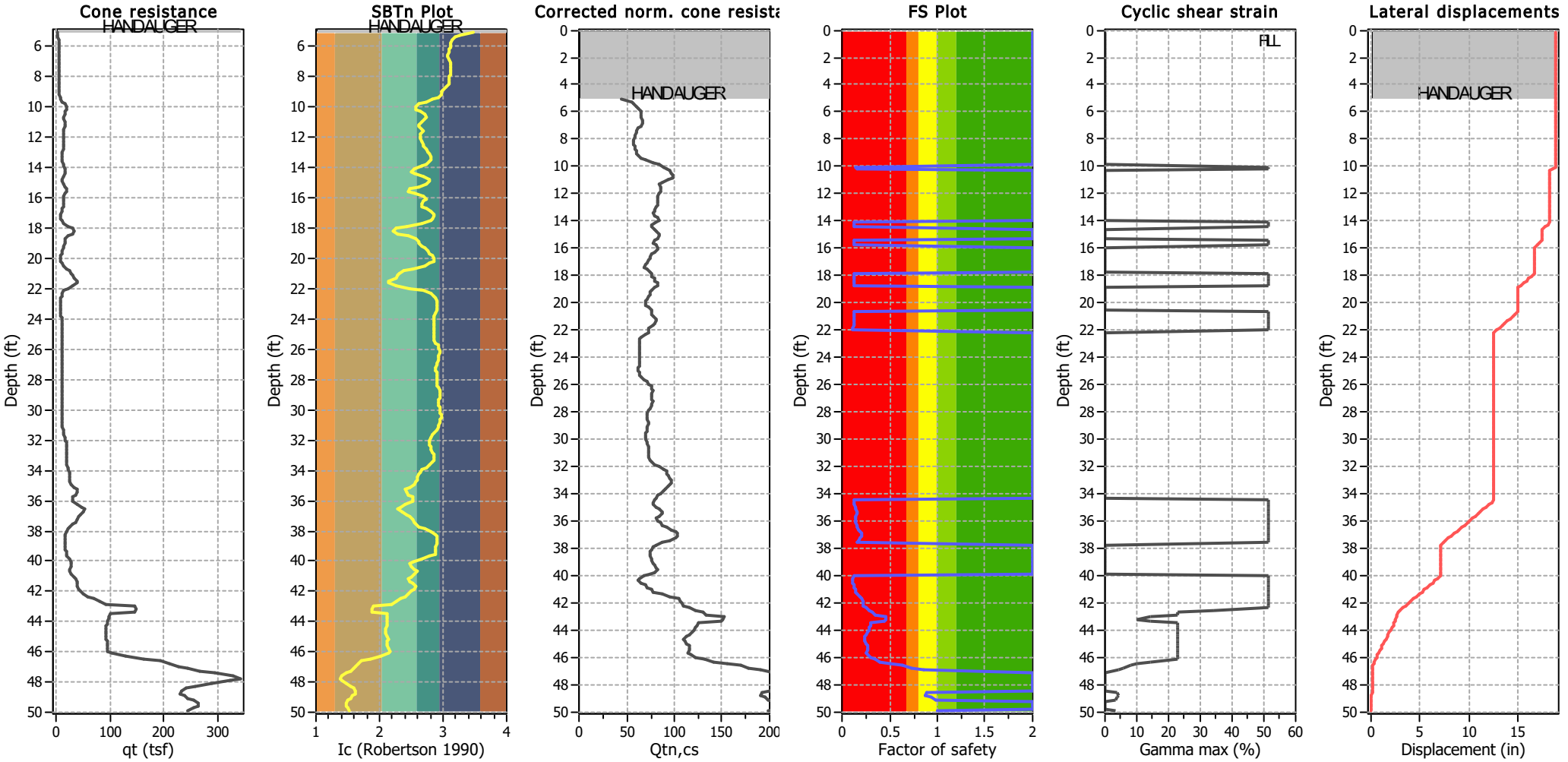



**Abbreviations**

| | |
|---|---|
| $q_t$: | Total cone resistance (cone resistance $q_c$ corrected for pore water effects) |
| $I_c$: | Soil Behaviour Type Index |
| FS: | Calculated Factor of Safety against liquefaction |
| Volumentric strain: | Post-liquefaction volumentric strain |

## Estimation of post-earthquake lateral Displacements

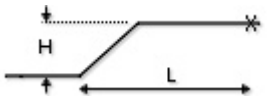
**Geometric parameters: Level ground (or gently sloping) with free face (L: 240.00 ft - H: 5.00 ft)**




**Abbreviations**

$q_t$: Total cone resistance (cone resistance $q_c$ corrected for pore water effects)
$I_c$: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
$\gamma_{max}$: Maximum cyclic shear strain
LDI: Lateral displacement index

**Surface condition**



GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

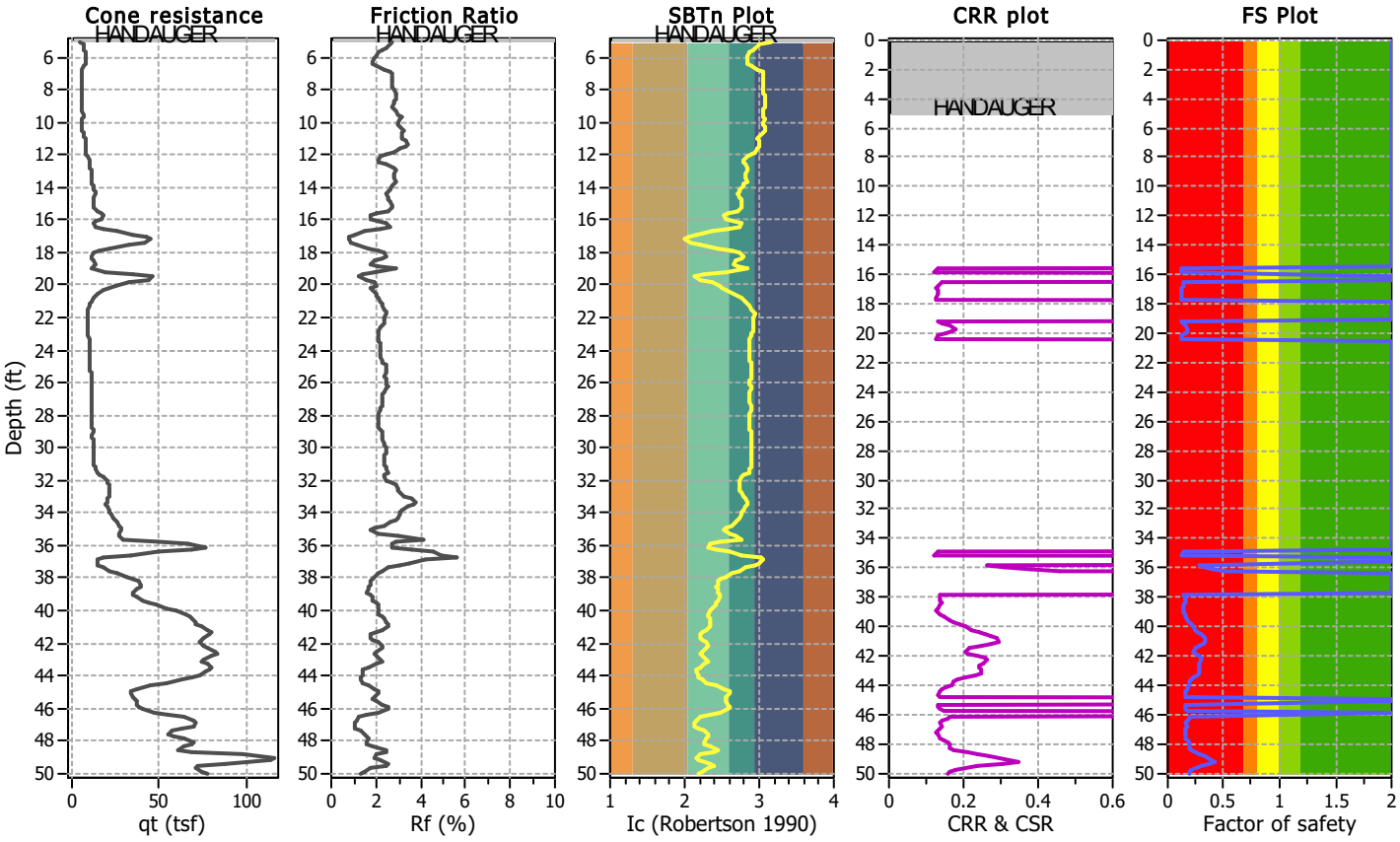
# LIQUEFACTION ANALYSIS REPORT

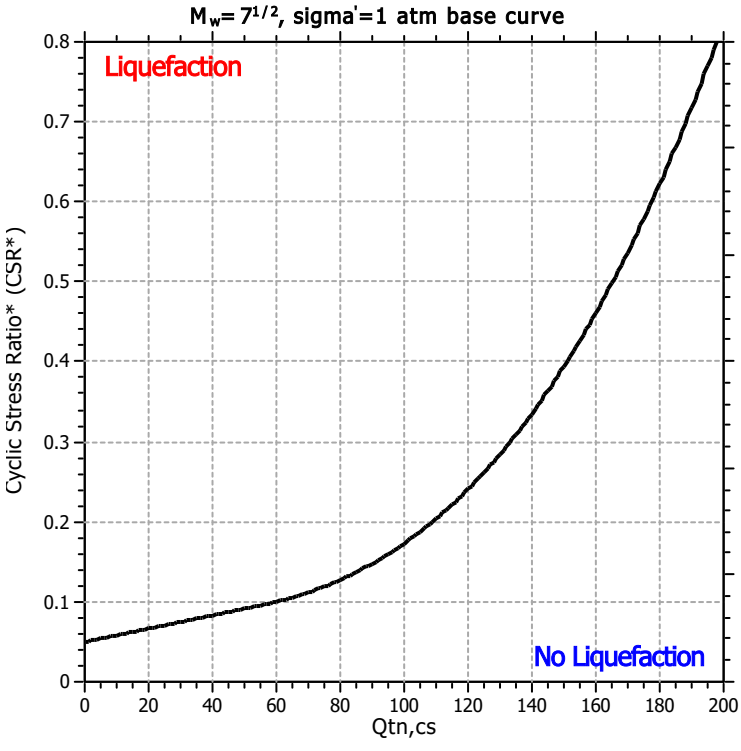
**Project title : AWWTF Improvements Project** **Location : 736 F Street, Arcata, California**

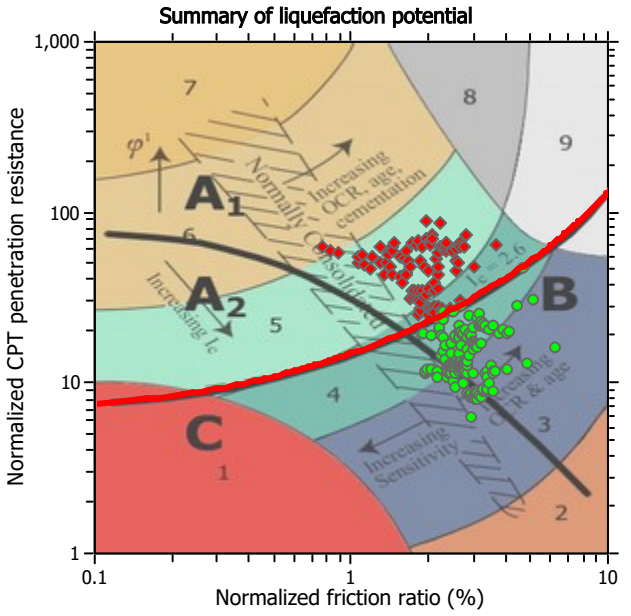
**CPT file : CPT-3**

**Input parameters and analysis data**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Analysis method:** | **NCEER (1998)** | **G.W.T. (in-situ):** | **5.00 ft** | **Use fill:** | **Yes** | **Clay like behavior applied:** | **Sands only** |
| **Fines correction method:** | **NCEER (1998)** | **G.W.T. (earthq.):** | **0.00 ft** | **Fill height:** | **5.00 ft** | **Limit depth applie:** | **No** |
| **Points to test:** | **Based on Ic value** | **Average results interv:** | **3** | **Fill weight:** | **141.00 lb/ft³** | **Limit depth:** | **N/A** |
| **Earthquake magnitude $M_w$:** | **7.30** | **Ic cut-off value:** | **2.60** | **Trans. detect. applied:** | **No** | **MSF method:** | **Method based** |
| **Peak ground acceleration:** | **0.81** | **Unit weight calculatior** | **Based on SBT** | **$K_o$ applied:** | **Yes** | | |

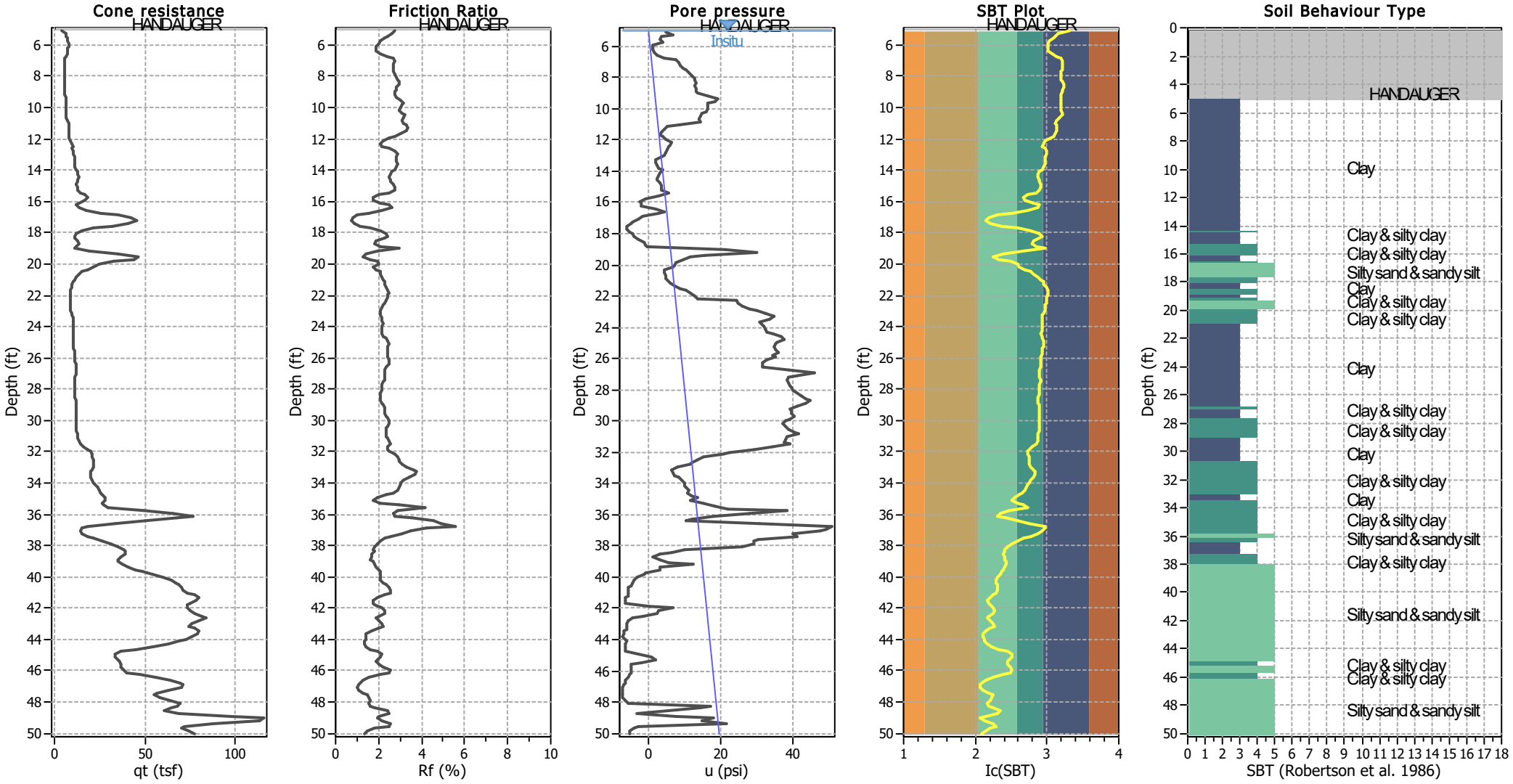



Zone $A_1$: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone $A_2$: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

# CPT basic interpretation plots



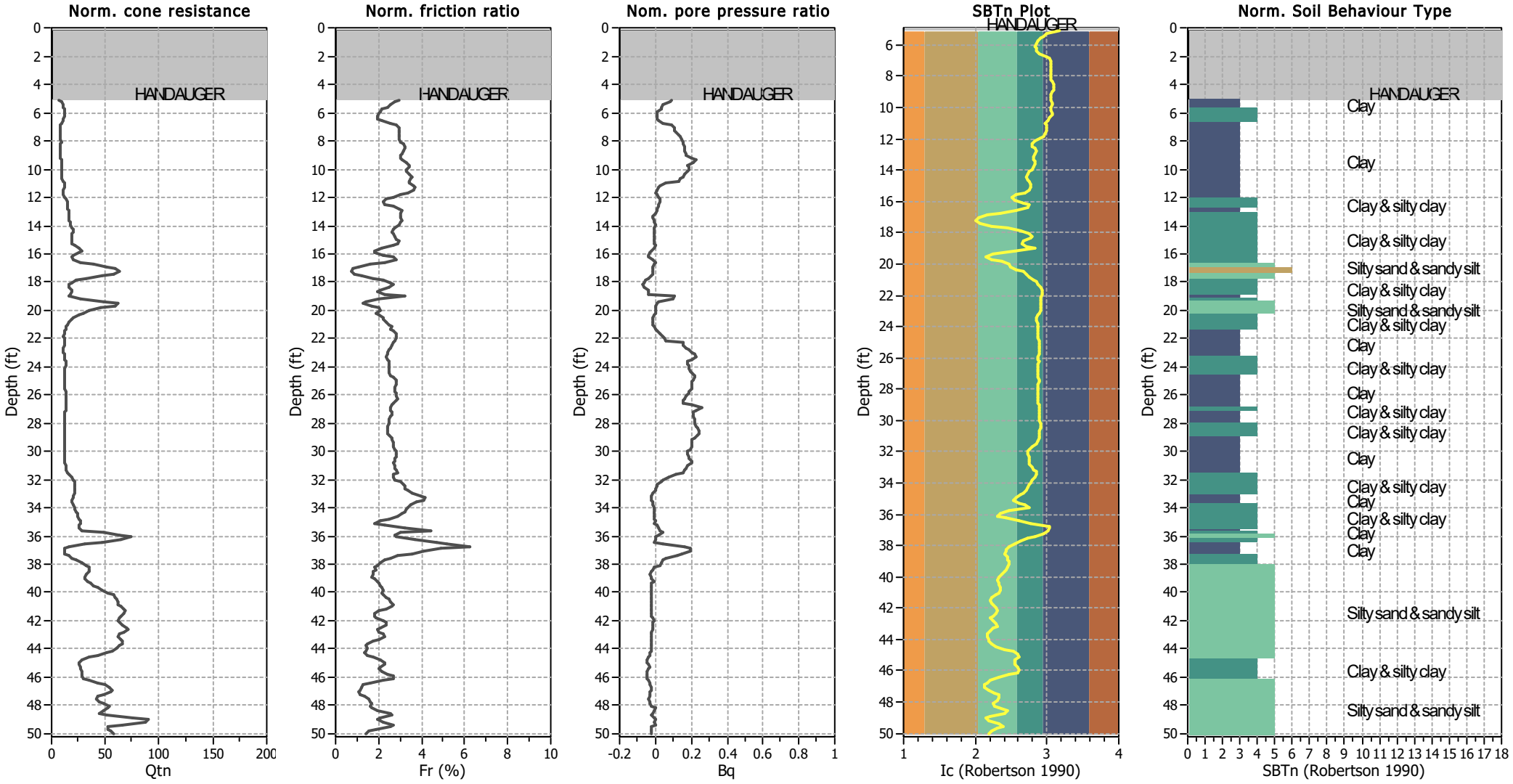

## Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

**SBT legend**

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

## CPT basic interpretation plots (normalized)



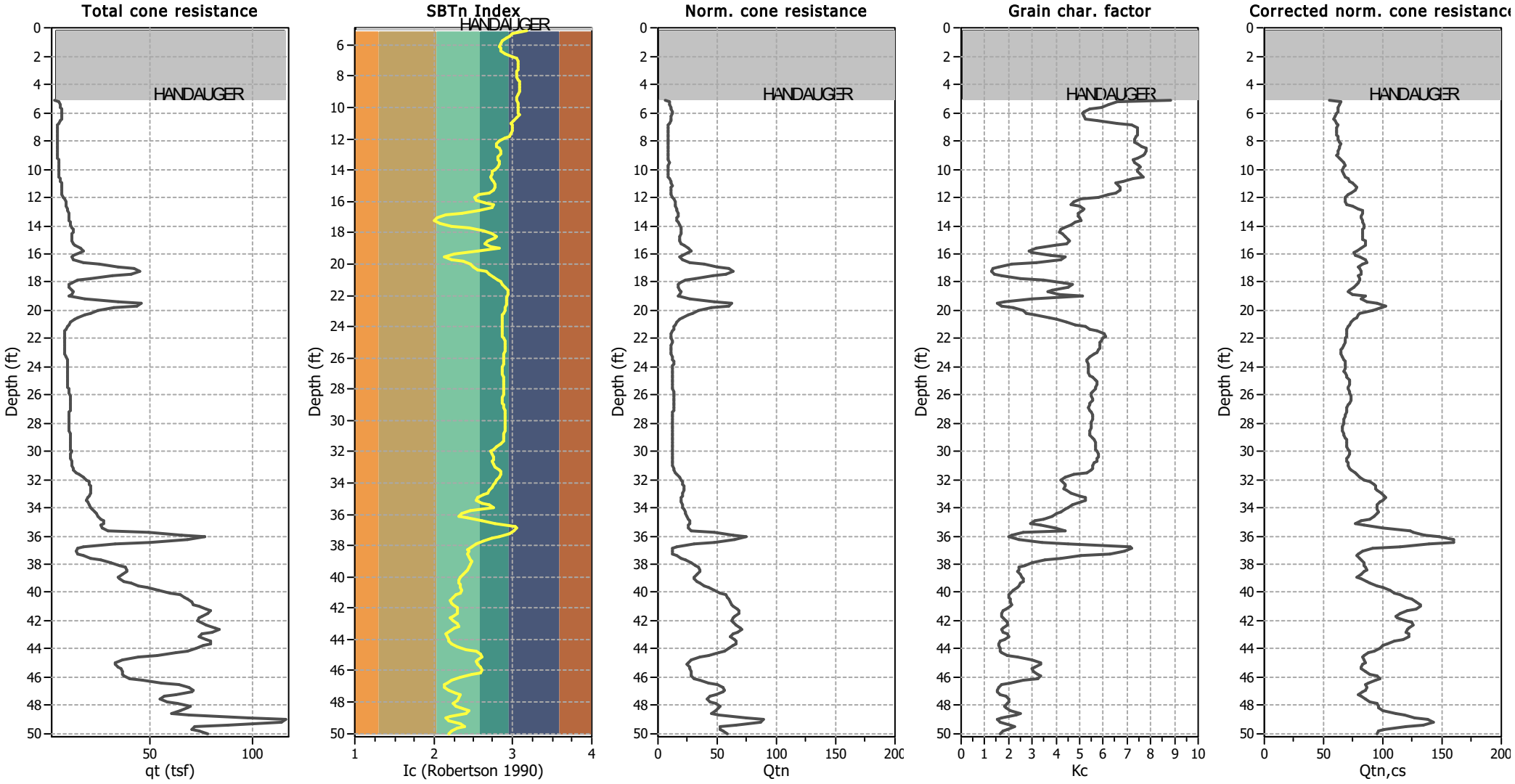

### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

**SBTn legend**

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

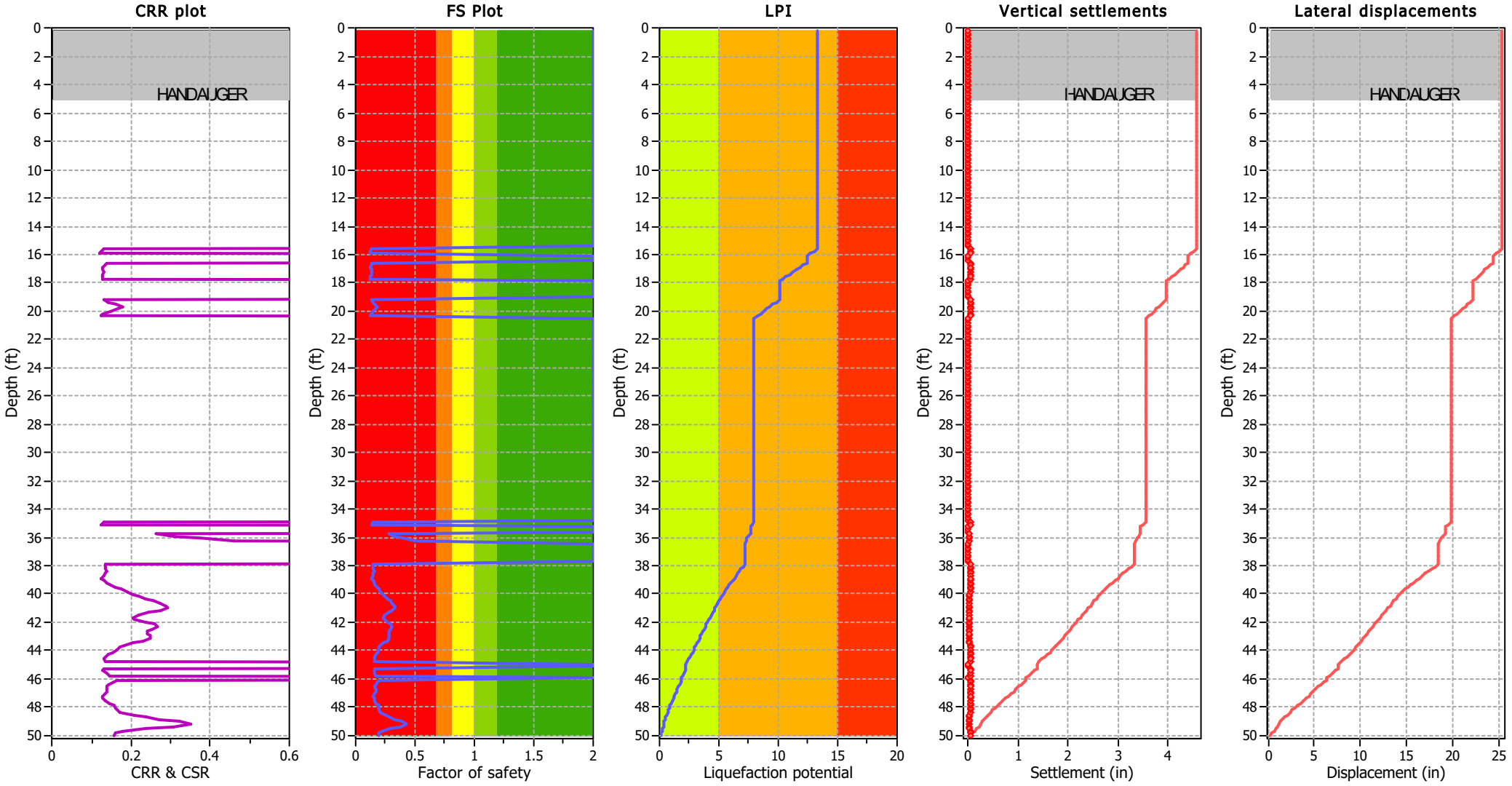
## Liquefaction analysis overall plots (intermediate results)




### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

# Liquefaction analysis overall plots




## Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

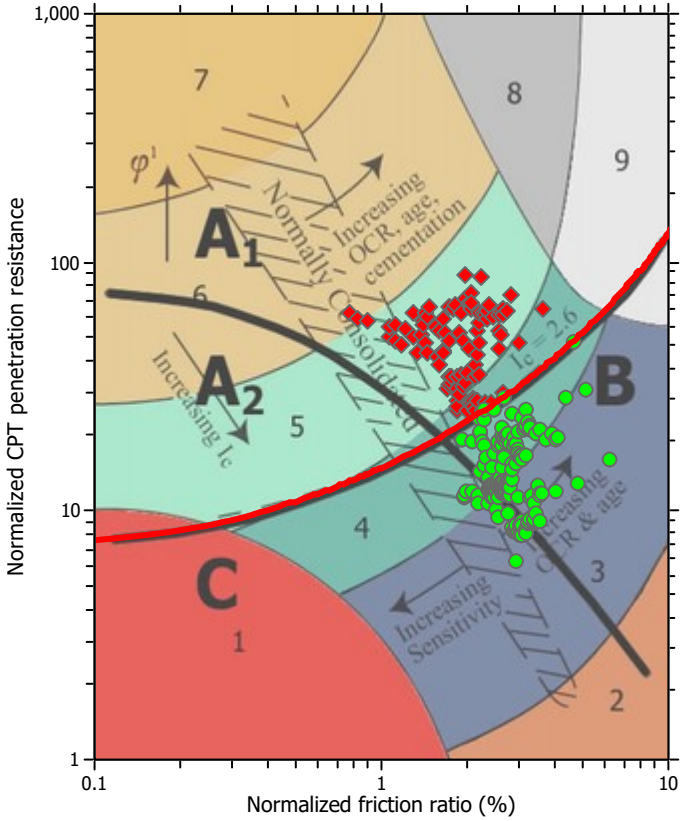
**F.S. color scheme**

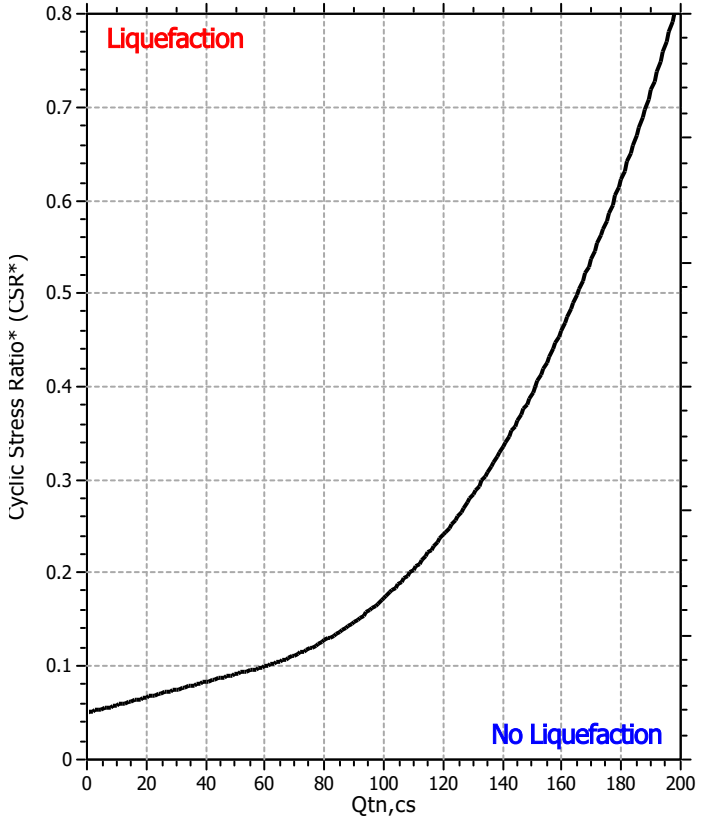
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

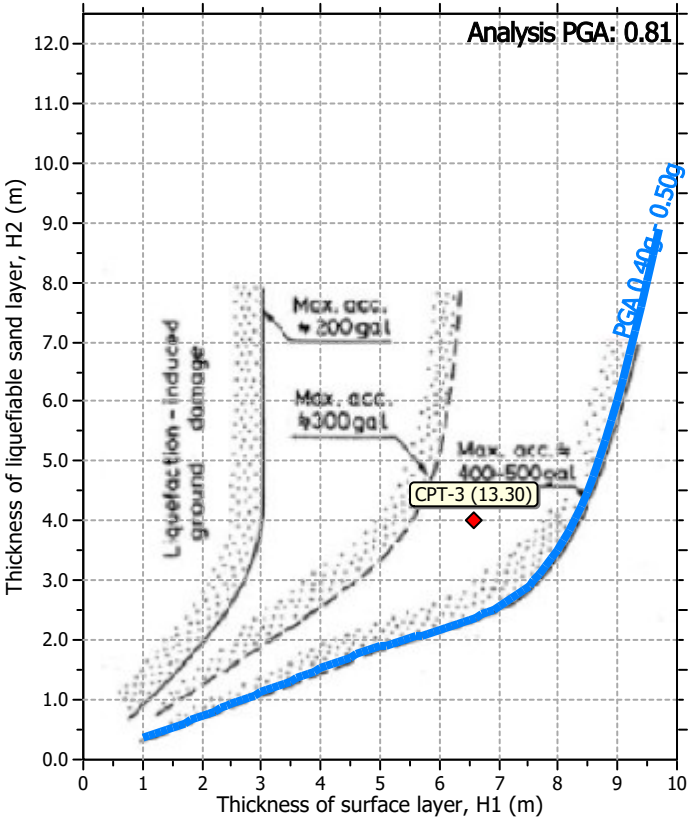
**LPI color scheme**

- Very high risk
- High risk
- Low risk

## Liquefaction analysis summary plots



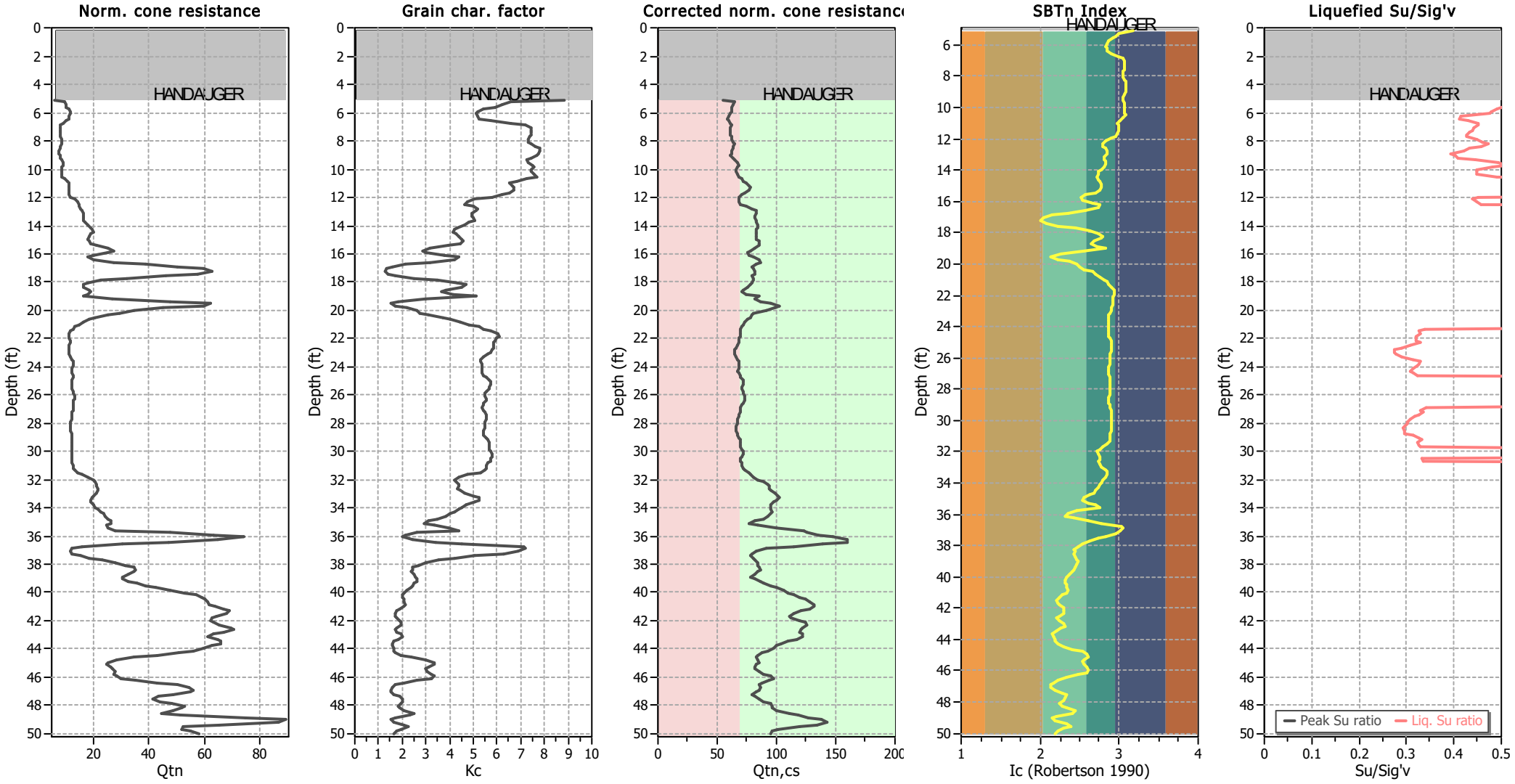




### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

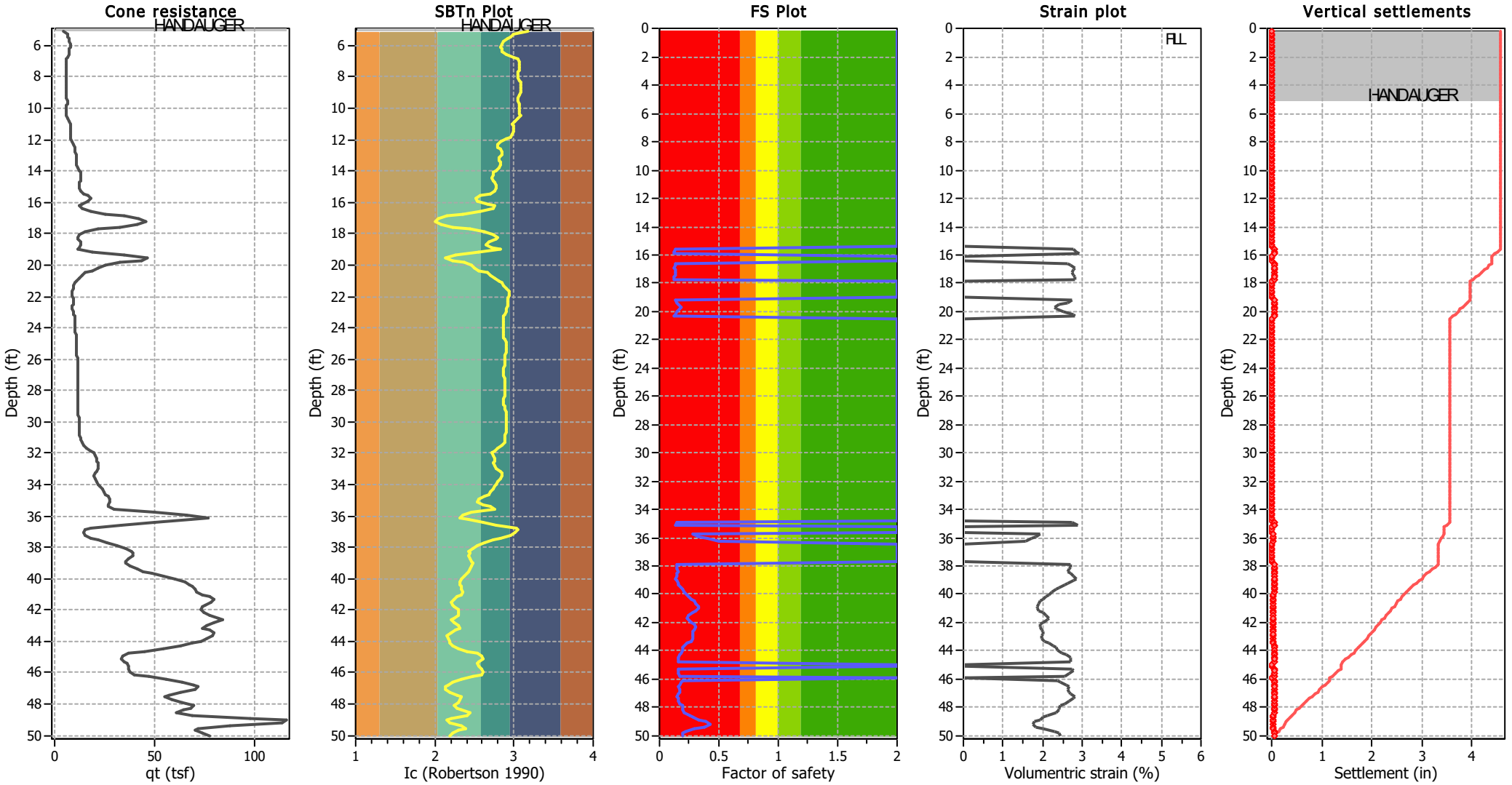
## Check for strength loss plots (Robertson (2010))




### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

## Estimation of post-earthquake settlements

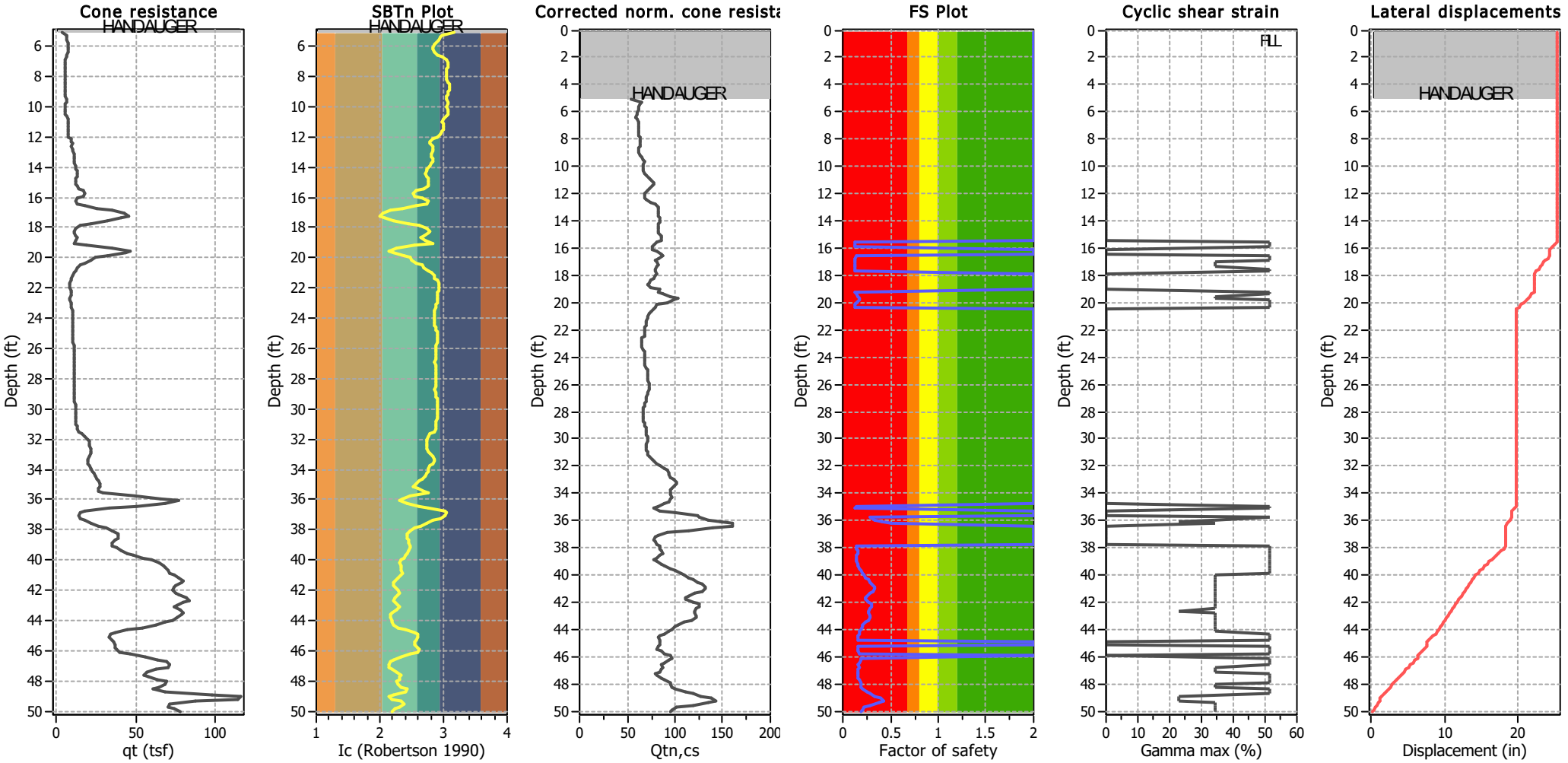



**Abbreviations**

| | |
|---|---|
| $q_t$: | Total cone resistance (cone resistance $q_c$ corrected for pore water effects) |
| $I_c$: | Soil Behaviour Type Index |
| FS: | Calculated Factor of Safety against liquefaction |
| Volumentric strain: | Post-liquefaction volumentric strain |

## Estimation of post-earthquake lateral Displacements

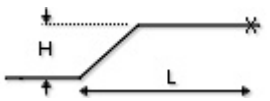
**Geometric parameters: Level ground (or gently sloping) with free face (L: 200.00 ft - H: 5.00 ft)**




**Abbreviations**

$q_t$: Total cone resistance (cone resistance $q_c$ corrected for pore water effects)
$I_c$: Soil Behaviour Type Index
$Q_{tn,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
$\gamma_{max}$: Maximum cyclic shear strain
LDI: Lateral displacement index

**Surface condition**



GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

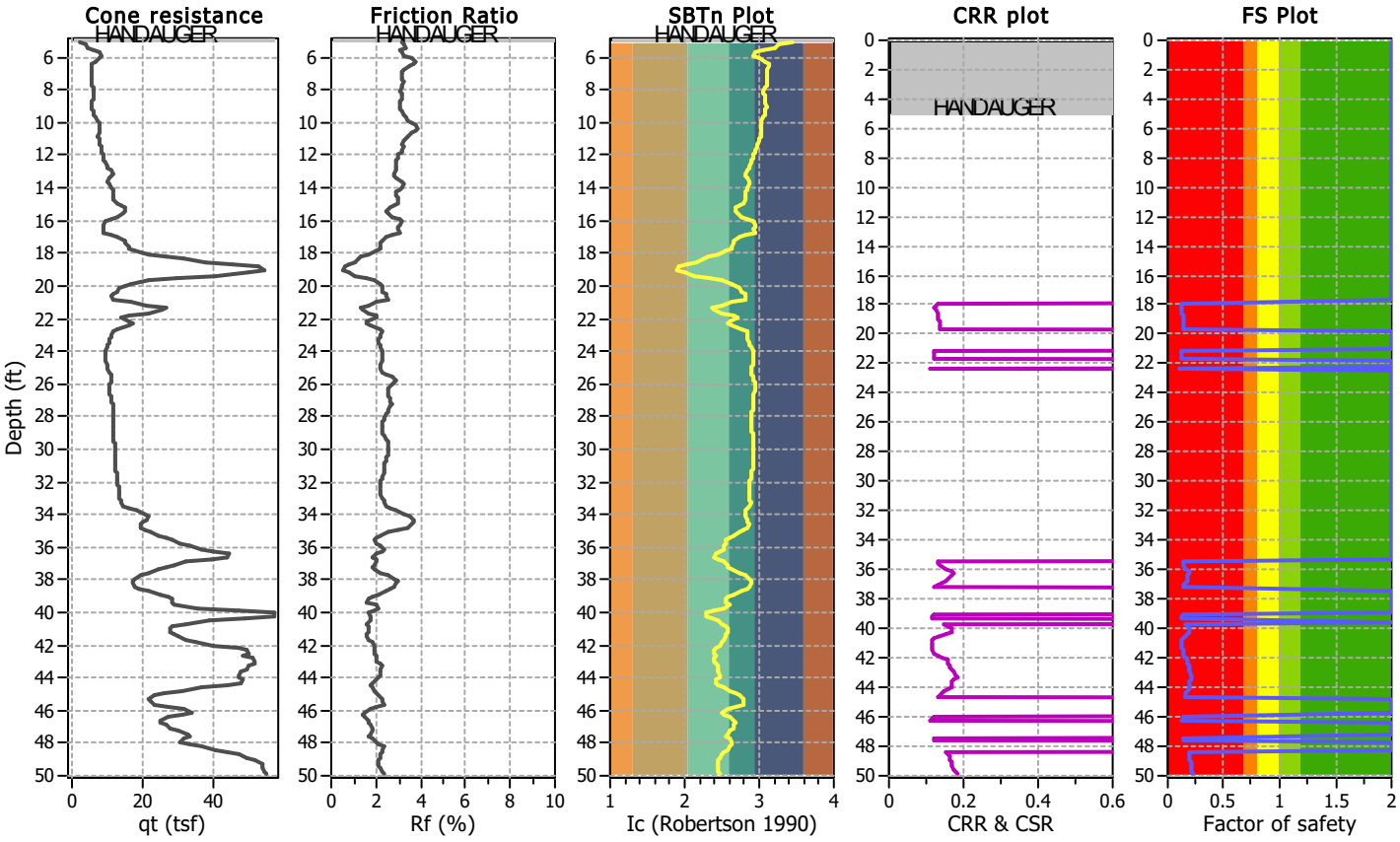
# LIQUEFACTION ANALYSIS REPORT

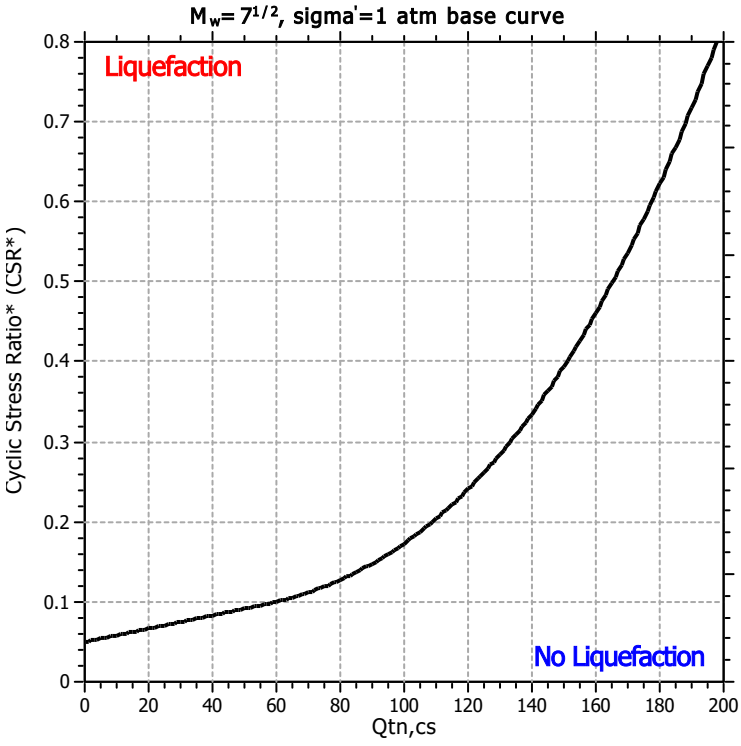
**Project title : AWWTF Improvements Project** **Location : 736 F Street, Arcata, California**

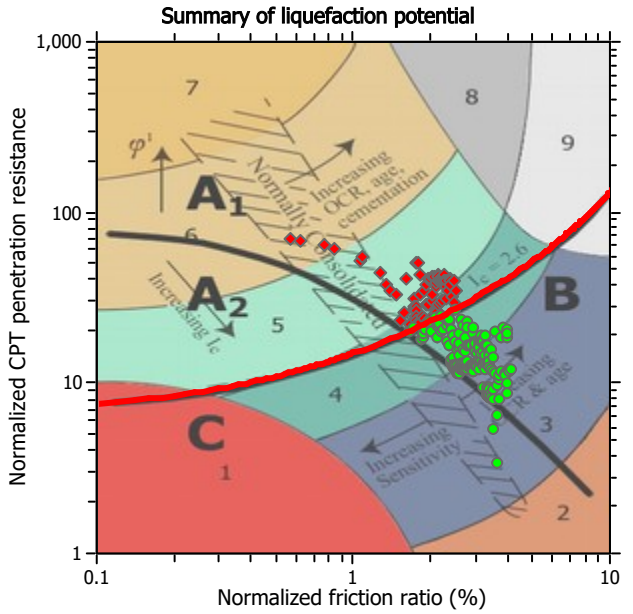
**CPT file : CPT-6**

**Input parameters and analysis data**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Analysis method:** | **NCEER (1998)** | **G.W.T. (in-situ):** | **5.00 ft** | **Use fill:** | **Yes** | **Clay like behavior applied:** | **Sands only** |
| **Fines correction method:** | **NCEER (1998)** | **G.W.T. (earthq.):** | **0.00 ft** | **Fill height:** | **5.00 ft** | **Limit depth applie:** | **No** |
| **Points to test:** | **Based on Ic value** | **Average results interv:** | **3** | **Fill weight:** | **141.00 lb/ft³** | **Limit depth:** | **N/A** |
| **Earthquake magnitude $M_w$:** | **7.30** | **Ic cut-off value:** | **2.60** | **Trans. detect. applied:** | **No** | **MSF method:** | **Method based** |
| **Peak ground acceleration:** | **0.81** | **Unit weight calculatior** | **Based on SBT** | **$K_o$ applied:** | **Yes** | | |

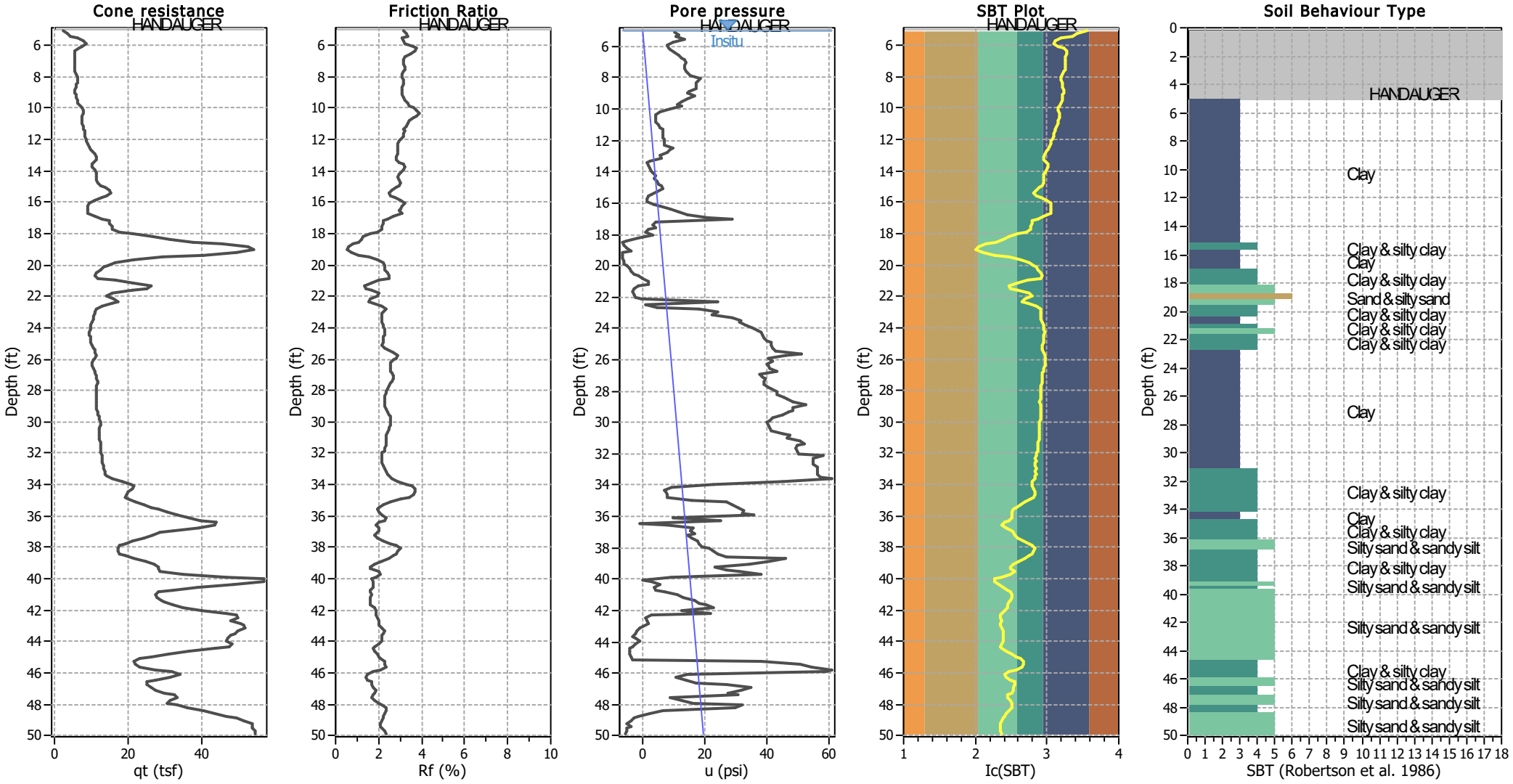



Zone $A_1$ : Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone $A_2$: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

## CPT basic interpretation plots



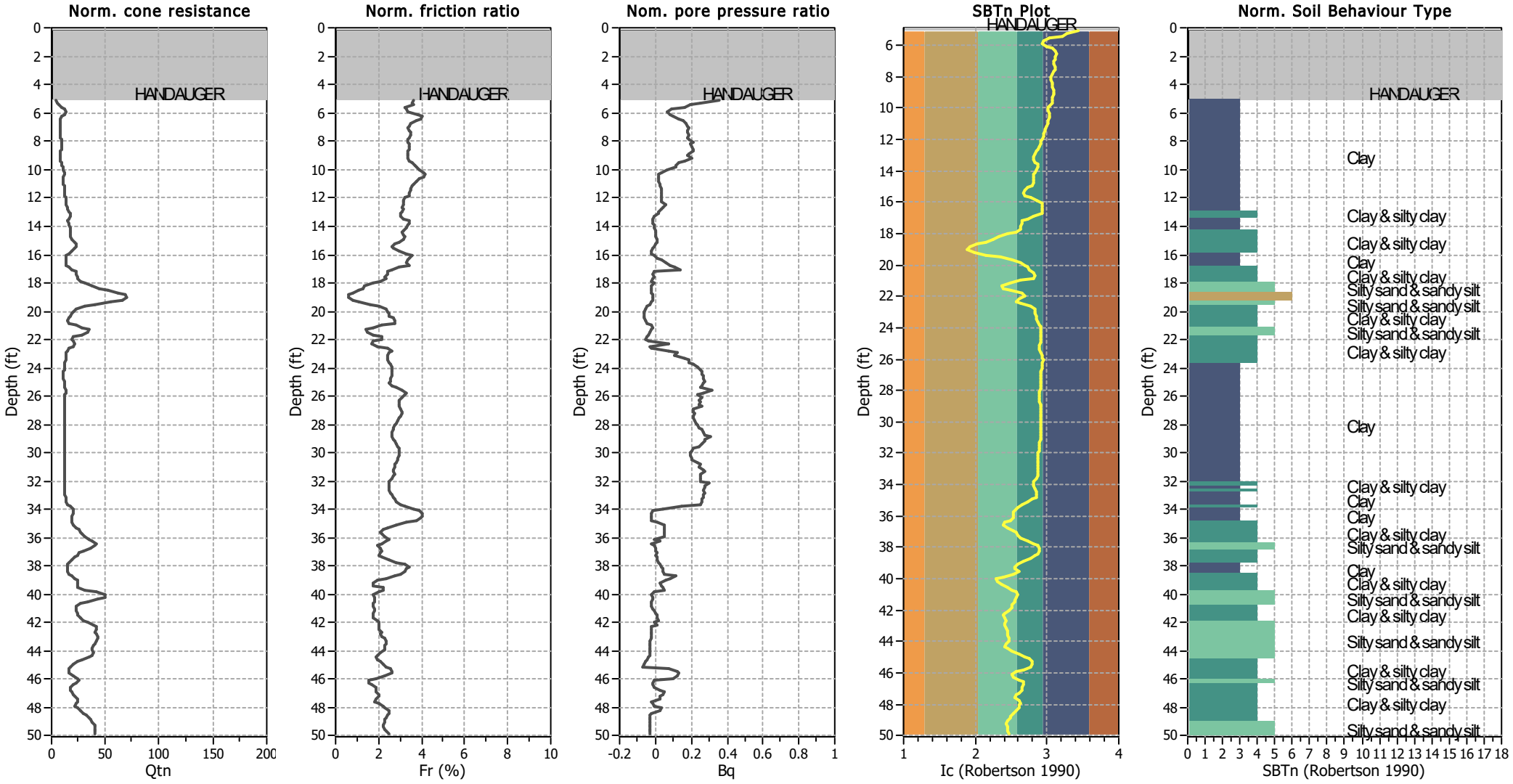

### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

**SBT legend**

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

## CPT basic interpretation plots (normalized)



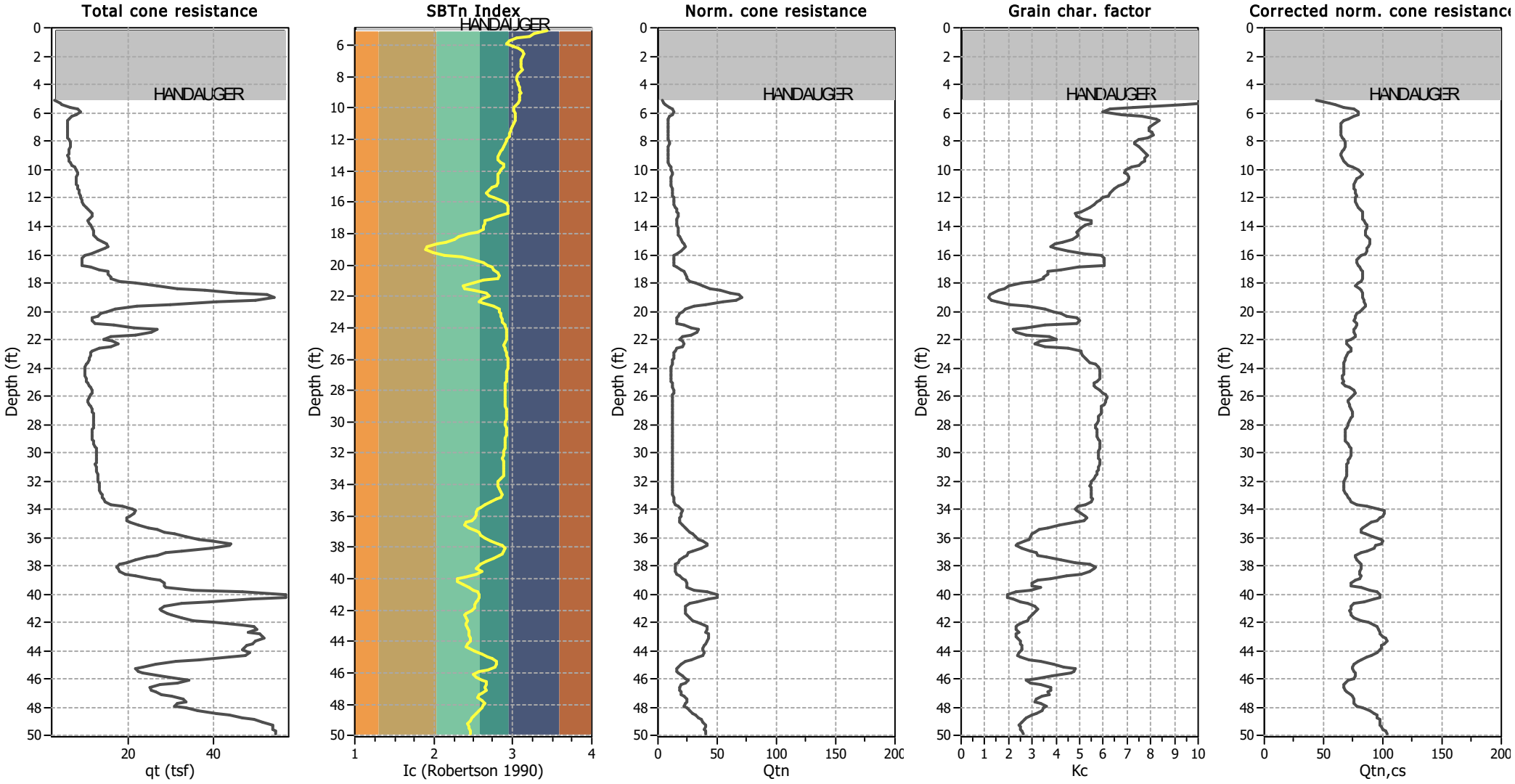

### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

**SBTn legend**

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

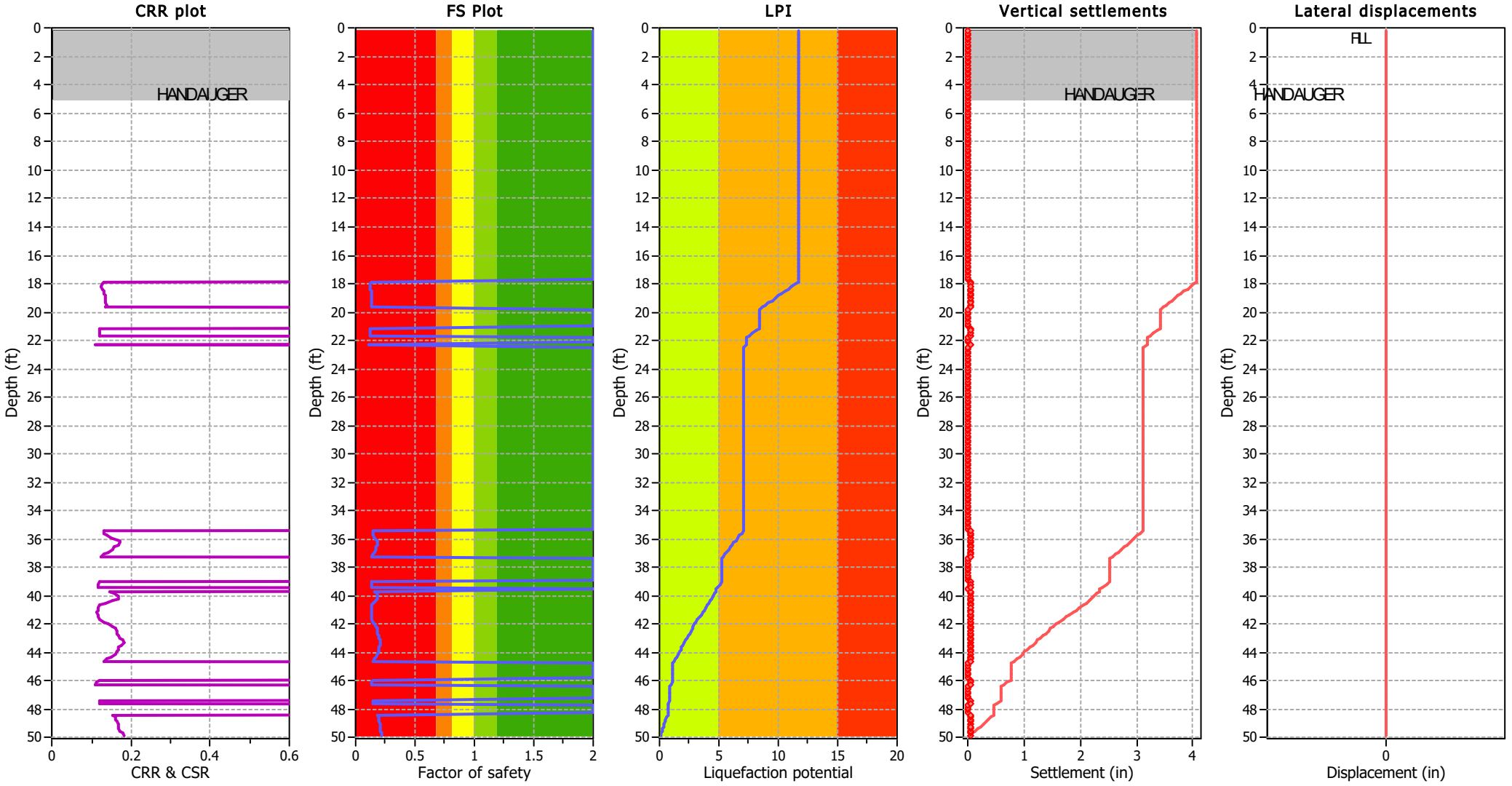
## Liquefaction analysis overall plots (intermediate results)




### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

# Liquefaction analysis overall plots




## Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

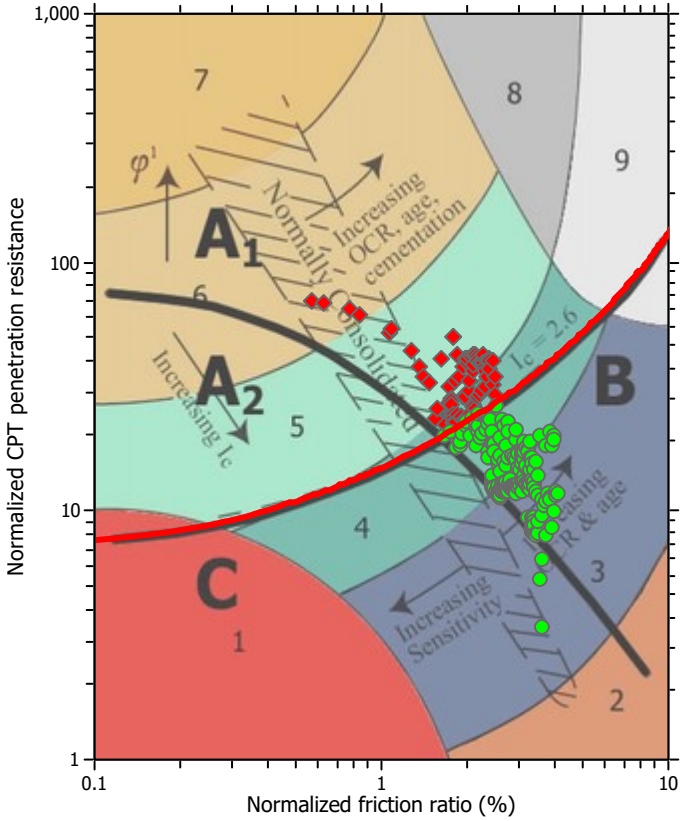
**F.S. color scheme**

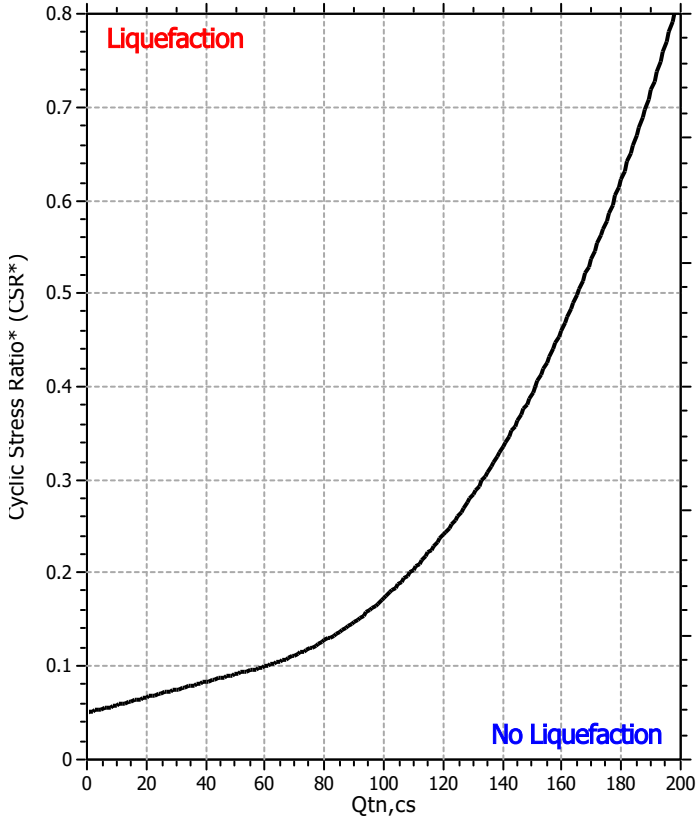
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

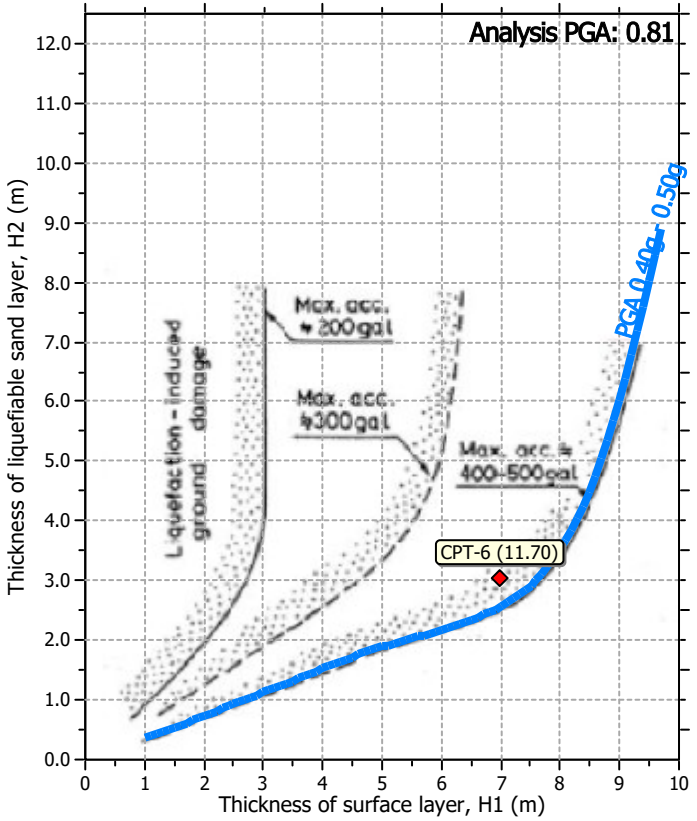
**LPI color scheme**

- Very high risk
- High risk
- Low risk

## Liquefaction analysis summary plots



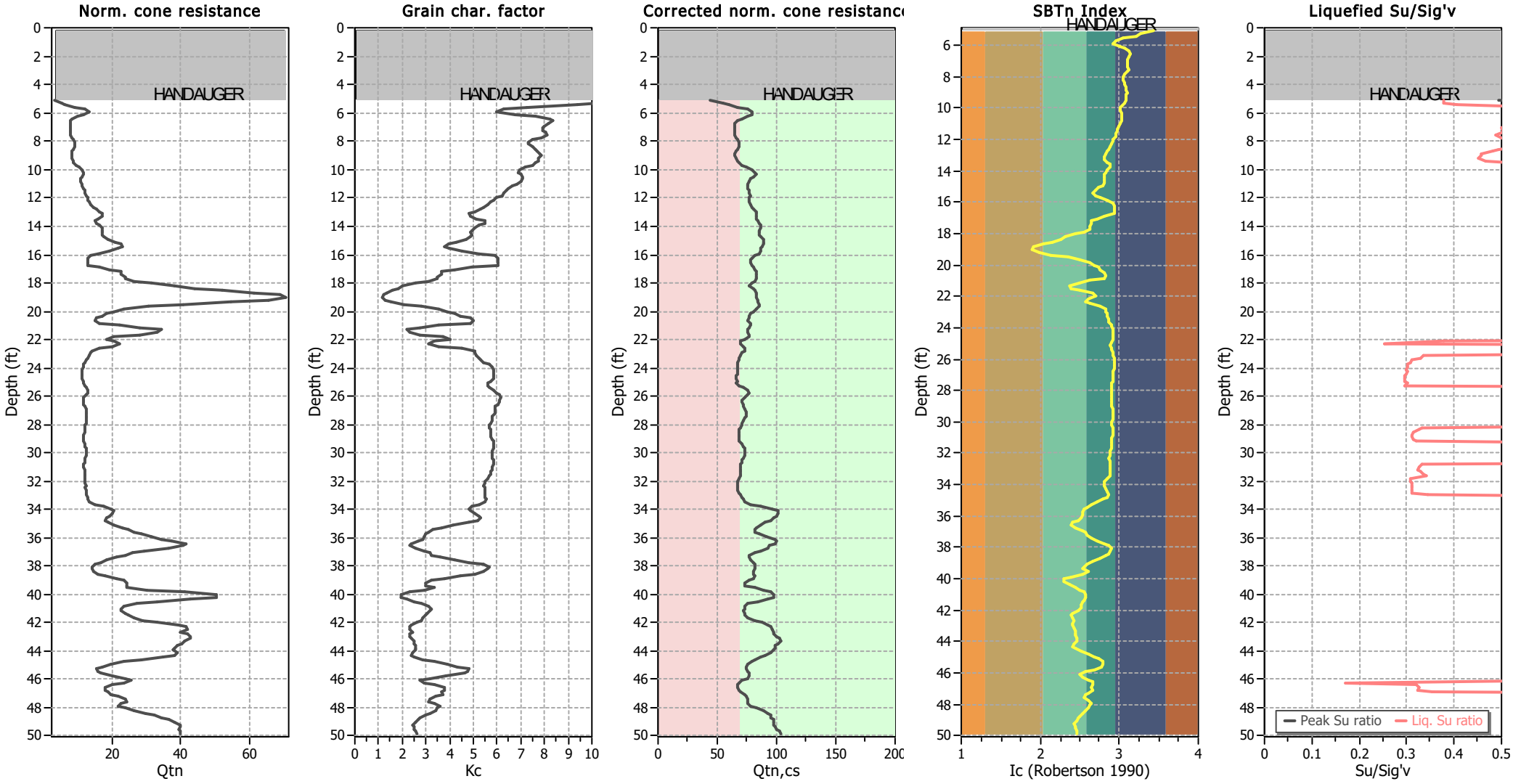




### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

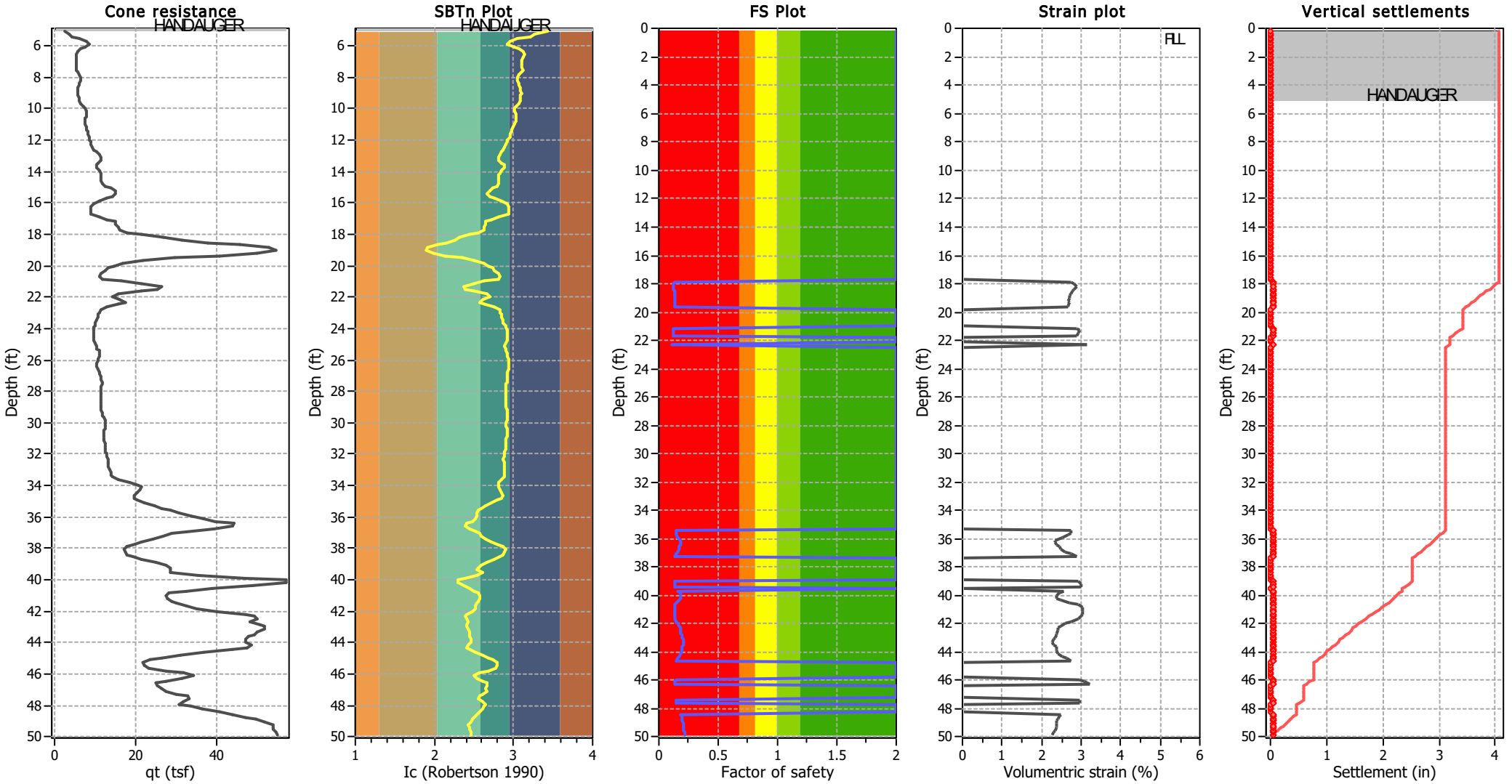
## Check for strength loss plots (Robertson (2010))




### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

## Estimation of post-earthquake settlements




**Abbreviations**

| | |
|---|---|
| $q_t$: | Total cone resistance (cone resistance $q_c$ corrected for pore water effects) |
| $I_c$: | Soil Behaviour Type Index |
| FS: | Calculated Factor of Safety against liquefaction |
| Volumentric strain: | Post-liquefaction volumentric strain |

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

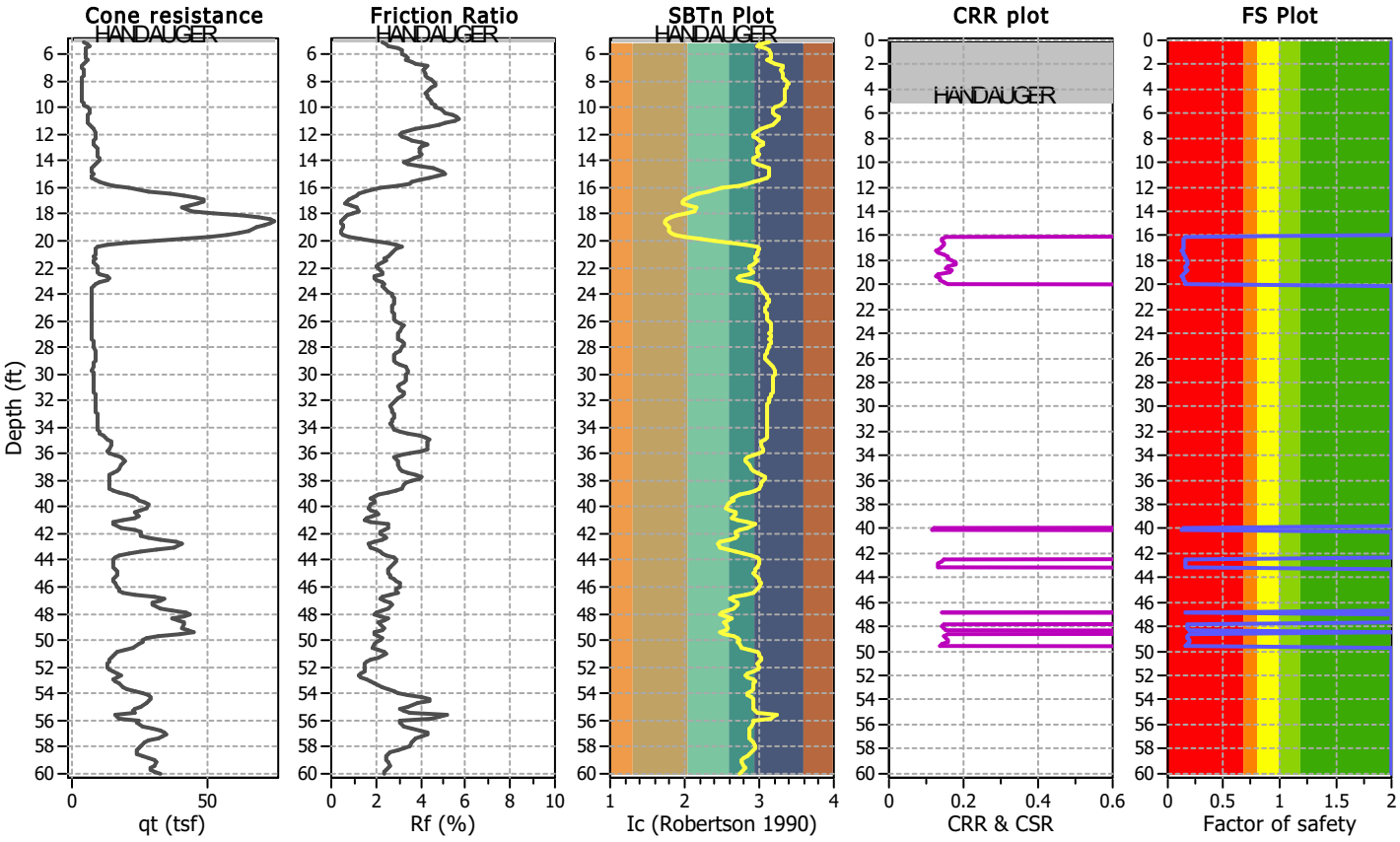
# LIQUEFACTION ANALYSIS REPORT

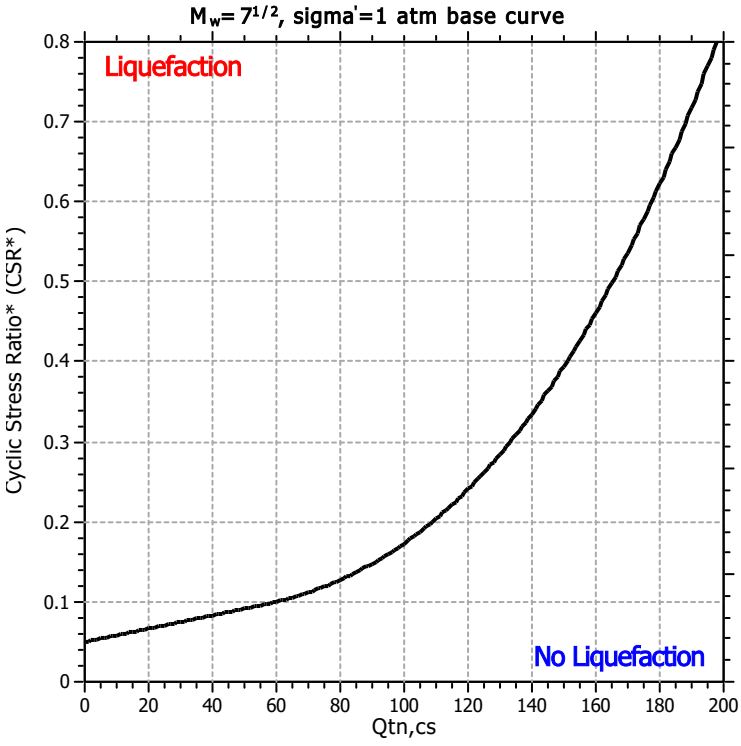
**Project title : AWWTF Improvements Project** **Location : 736 F Street, Arcata, California**

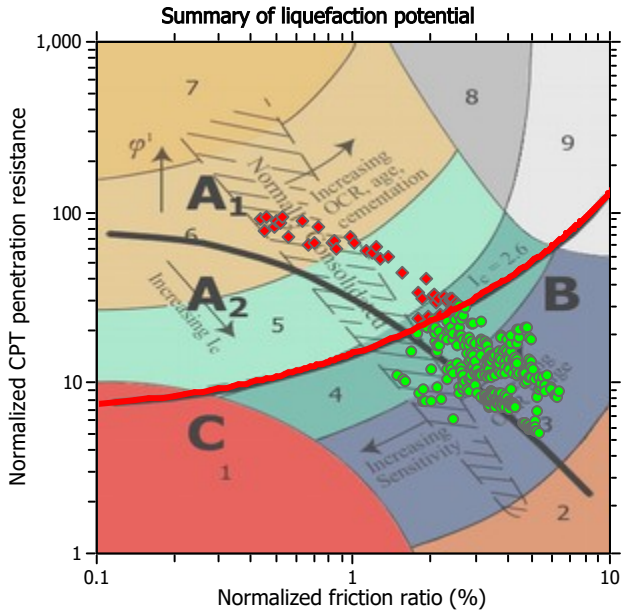
**CPT file : CPT-9**

**Input parameters and analysis data**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Analysis method:** | **NCEER (1998)** | **G.W.T. (in-situ):** | **5.00 ft** | **Use fill:** | **Yes** | **Clay like behavior applied:** | **Sands only** |
| **Fines correction method:** | **NCEER (1998)** | **G.W.T. (earthq.):** | **0.00 ft** | **Fill height:** | **5.00 ft** | **Limit depth applie:** | **No** |
| **Points to test:** | **Based on Ic value** | **Average results interv:** | **3** | **Fill weight:** | **141.00 lb/ft³** | **Limit depth:** | **N/A** |
| **Earthquake magnitude $M_w$:** | **7.30** | **Ic cut-off value:** | **2.60** | **Trans. detect. applied:** | **No** | **MSF method:** | **Method based** |
| **Peak ground acceleration:** | **0.81** | **Unit weight calculatior** | **Based on SBT** | **$K_o$ applied:** | **Yes** | | |

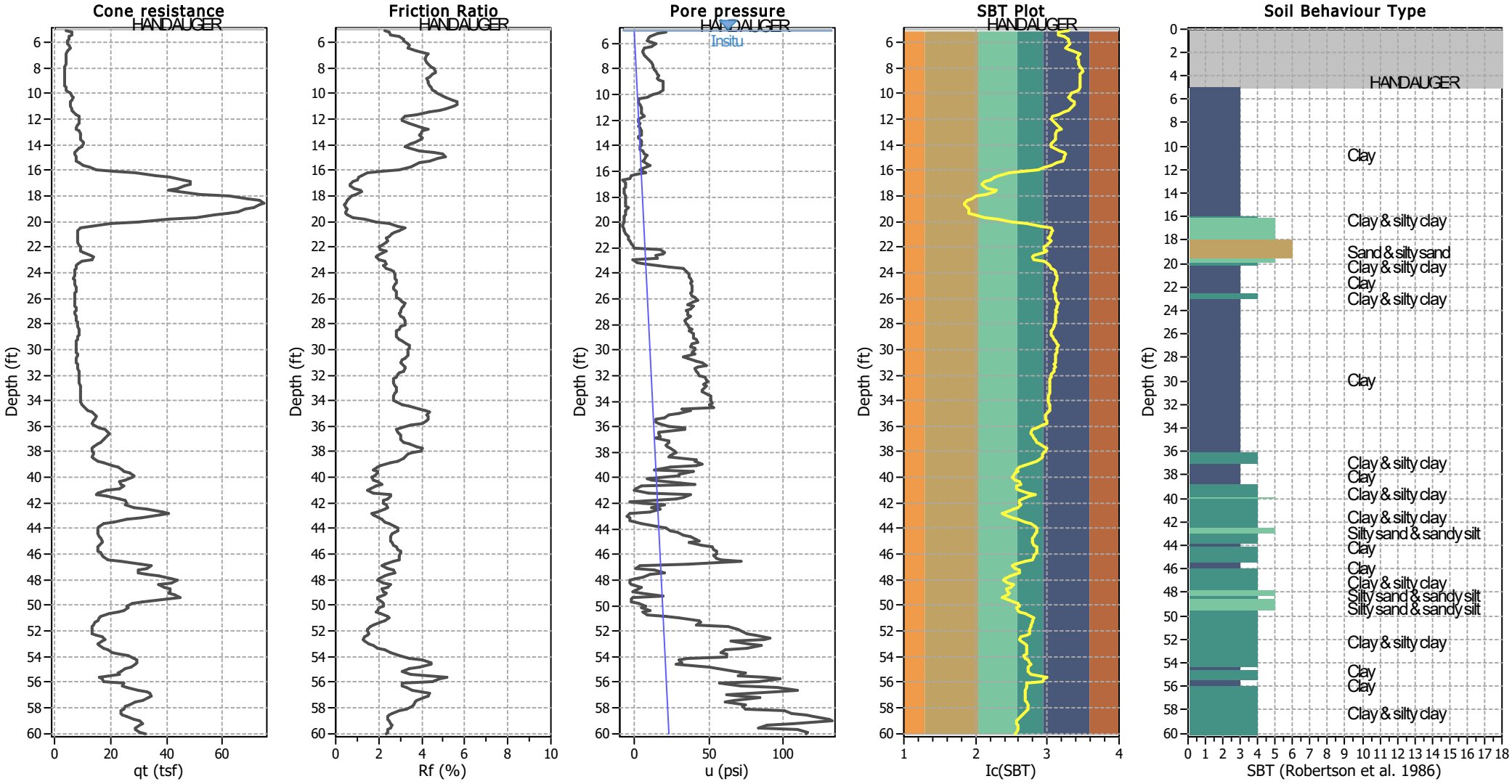



Zone $A_1$: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone $A_2$: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

## CPT basic interpretation plots



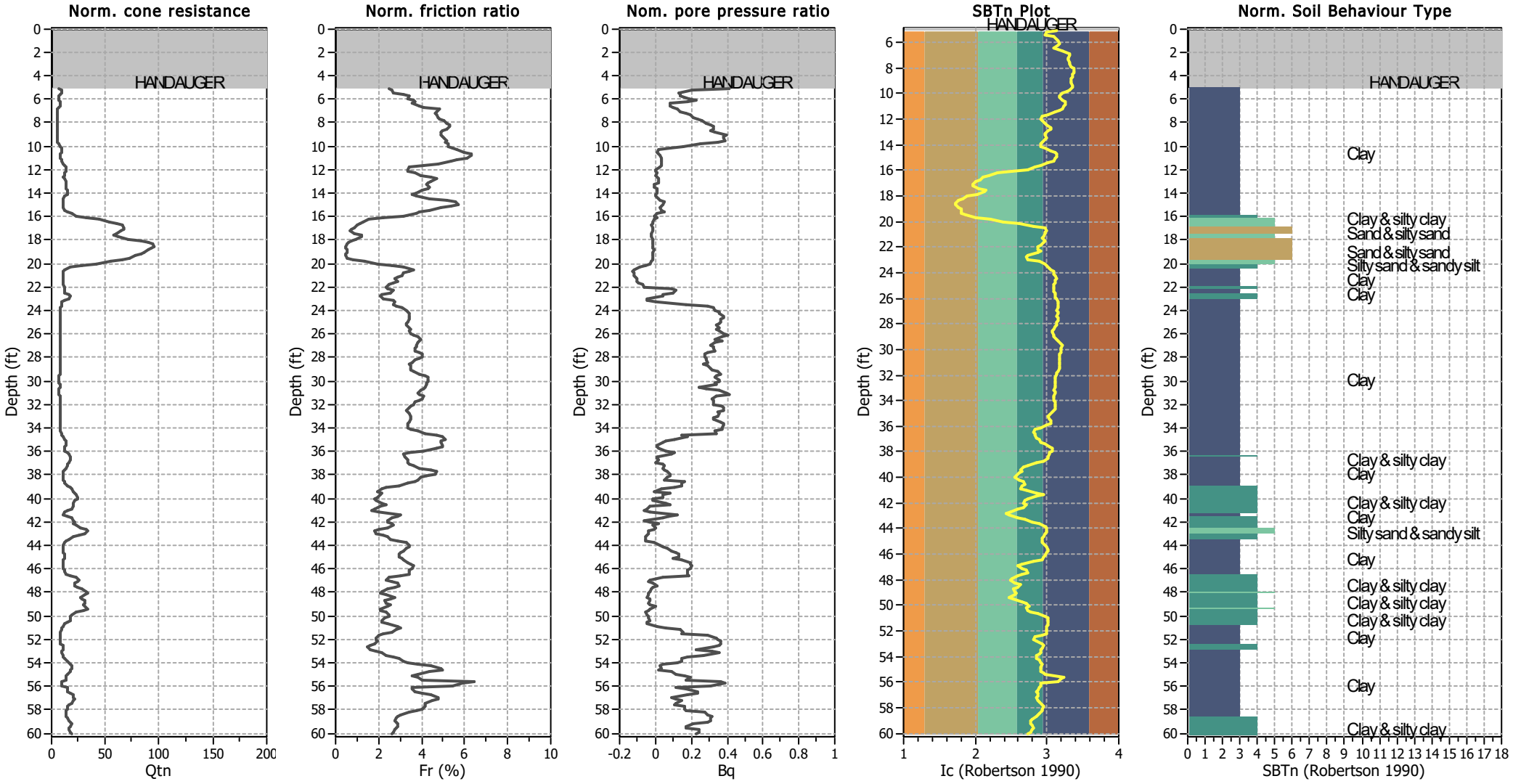

### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

**SBT legend**

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

## CPT basic interpretation plots (normalized)



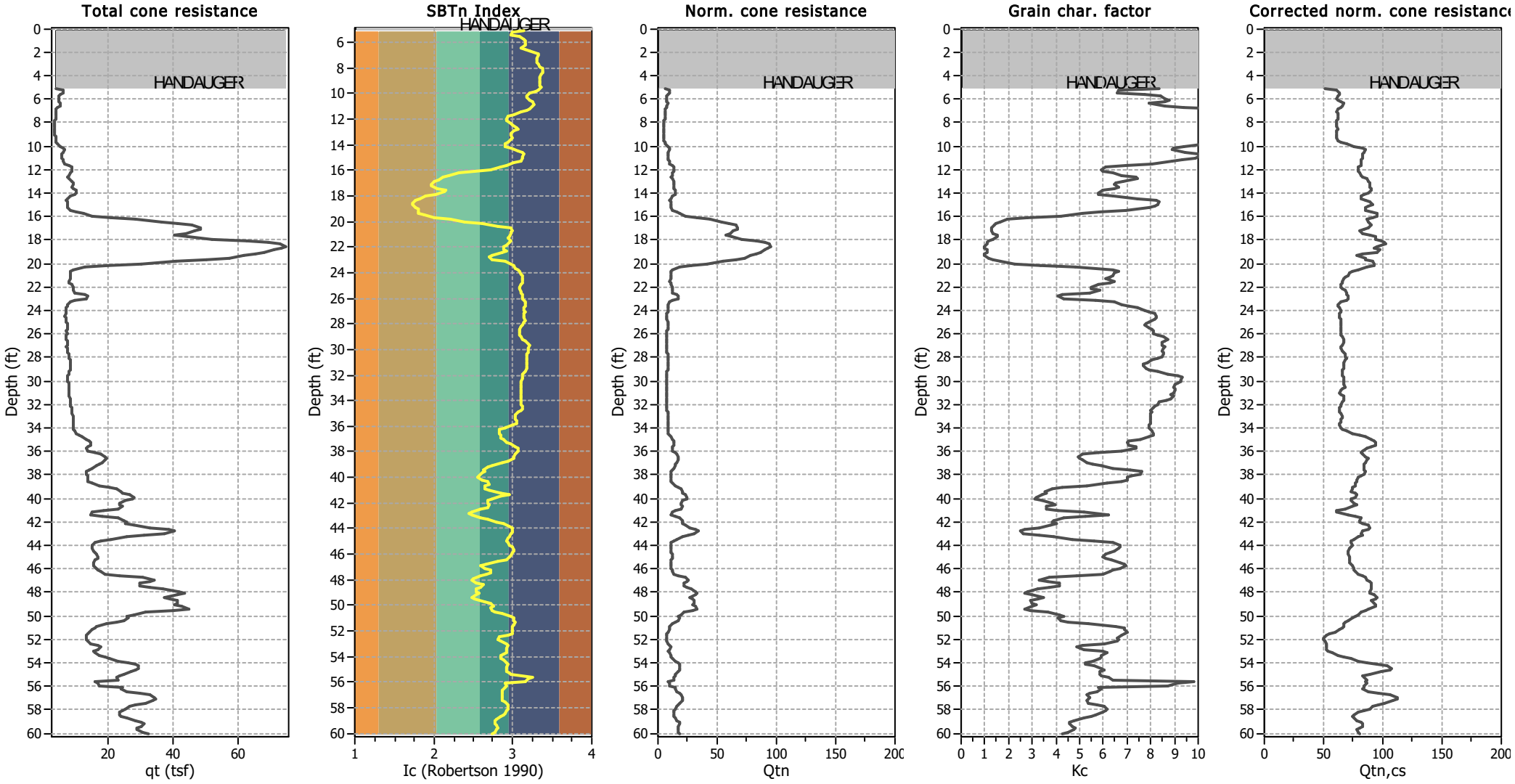

### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

**SBTn legend**

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

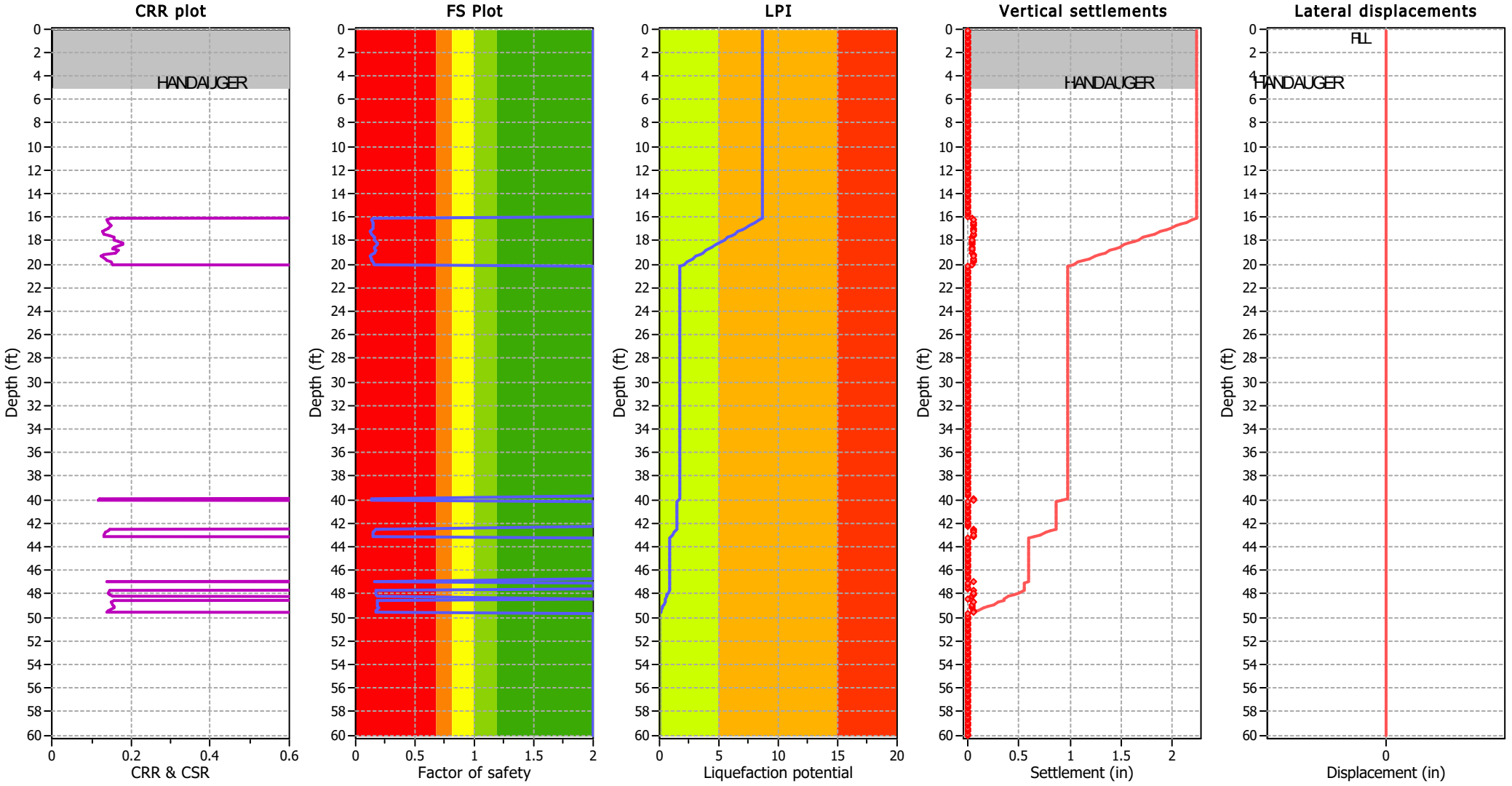
## Liquefaction analysis overall plots (intermediate results)




### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_o$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

## Liquefaction analysis overall plots




### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

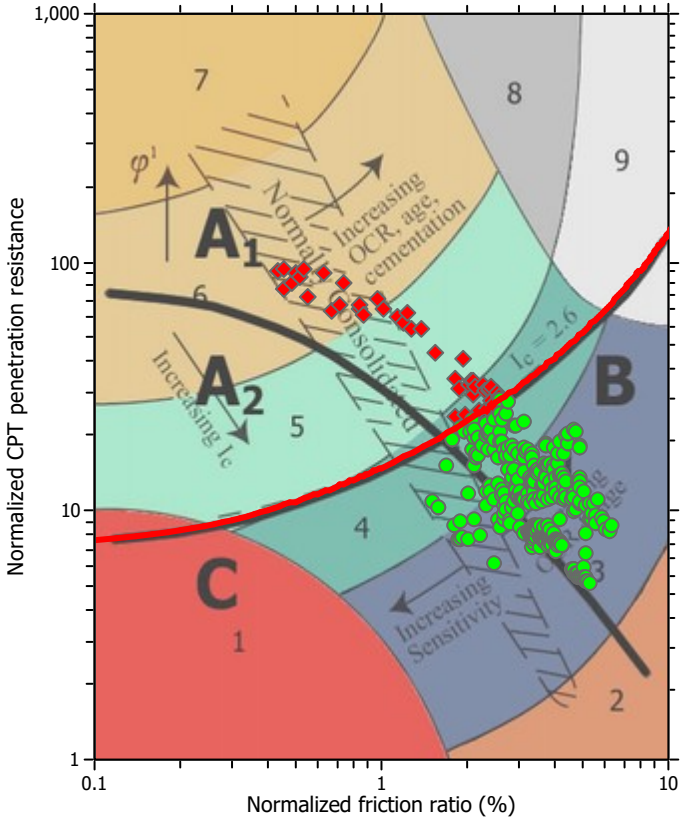
**F.S. color scheme**

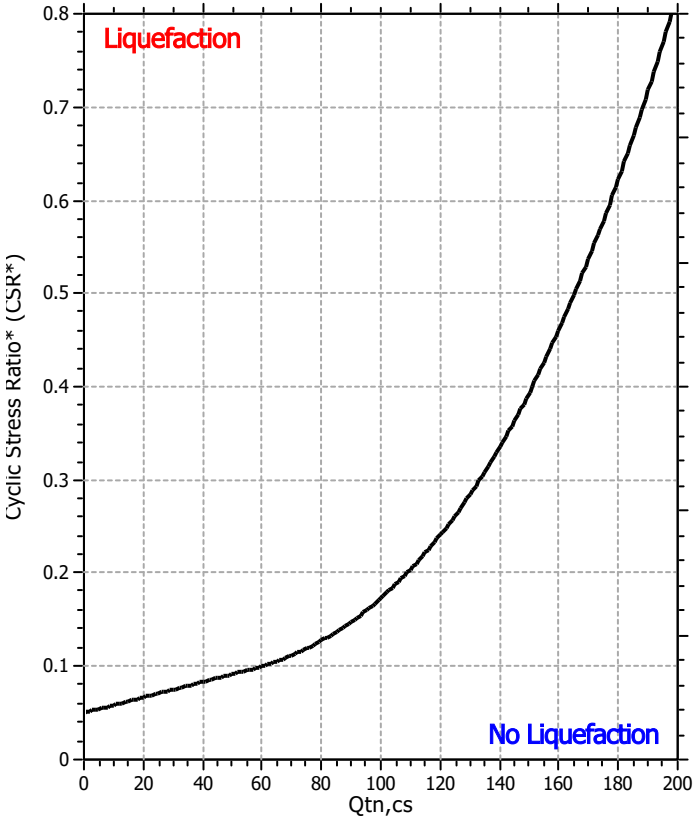
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

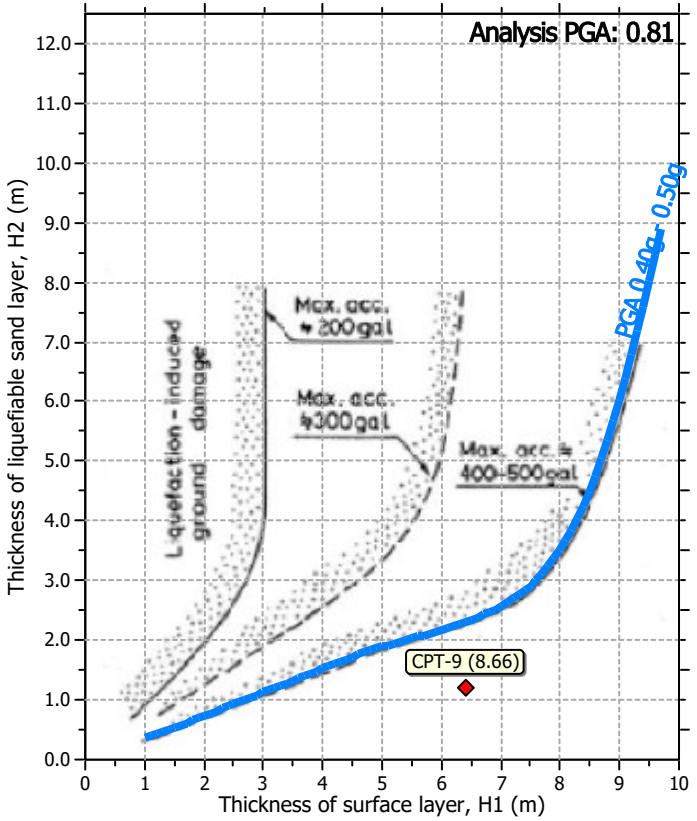
**LPI color scheme**

- Very high risk
- High risk
- Low risk

## Liquefaction analysis summary plots



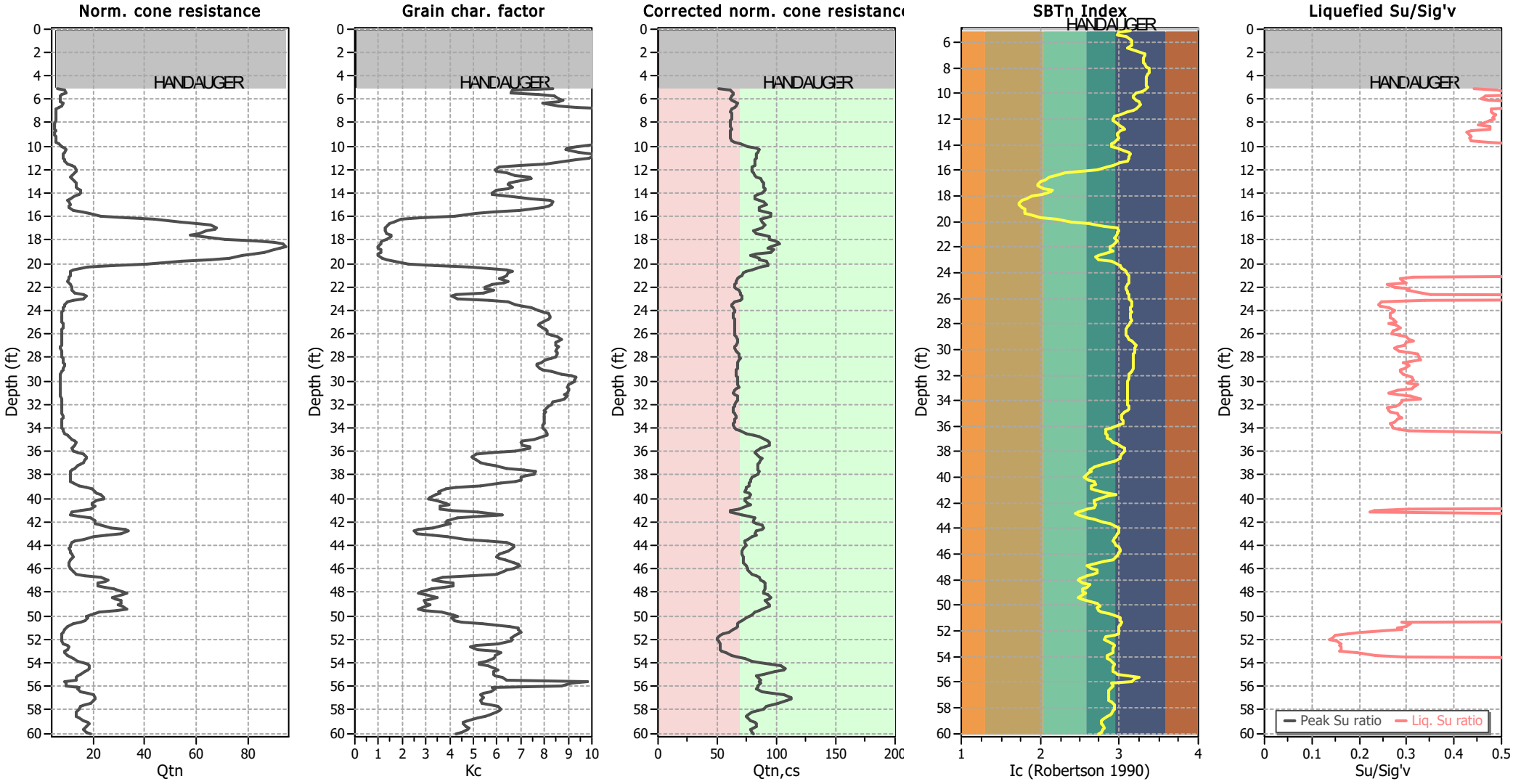




### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

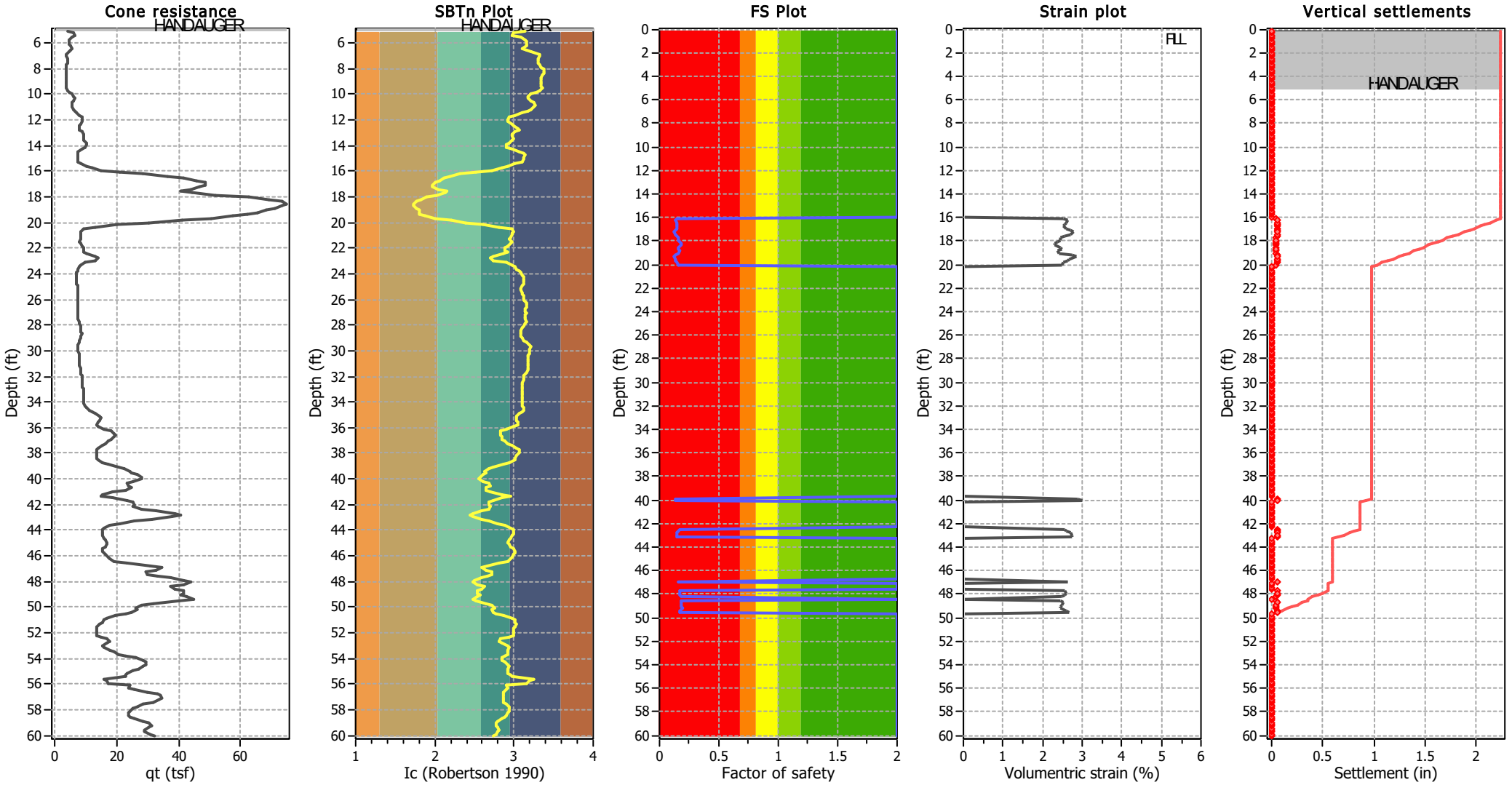
## Check for strength loss plots (Robertson (2010))




### Input parameters and analysis data

| | | | | | |
|---|---|---|---|---|---|
| Analysis method: | NCEER (1998) | Depth to water table (erthq.): | 0.00 ft | Fill weight: | 141.00 lb/ft³ |
| Fines correction method: | NCEER (1998) | Average results interval: | 3 | Transition detect. applied: | No |
| Points to test: | Based on Ic value | Ic cut-off value: | 2.60 | $K_\sigma$ applied: | Yes |
| Earthquake magnitude $M_w$: | 7.30 | Unit weight calculation: | Based on SBT | Clay like behavior applied: | Sands only |
| Peak ground acceleration: | 0.81 | Use fill: | Yes | Limit depth applied: | No |
| Depth to water table (insitu): | 5.00 ft | Fill height: | 5.00 ft | Limit depth: | N/A |

## Estimation of post-earthquake settlements

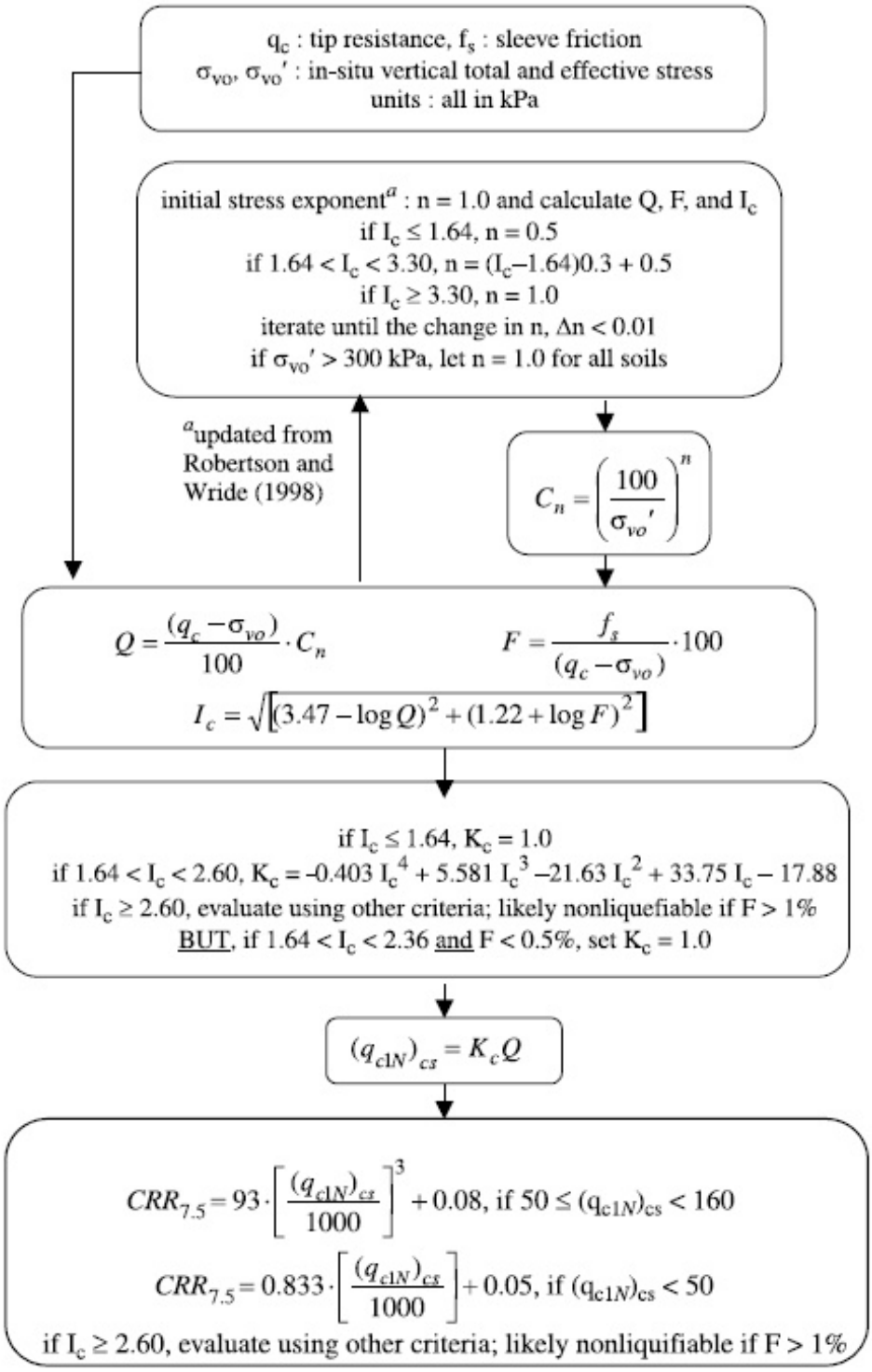



**Abbreviations**

| | |
|---|---|
| $q_t$: | Total cone resistance (cone resistance $q_c$ corrected for pore water effects) |
| $I_c$: | Soil Behaviour Type Index |
| FS: | Calculated Factor of Safety against liquefaction |
| Volumentric strain: | Post-liquefaction volumentric strain |

## Procedure for the evaluation of soil liquefaction resistance, NCEER (1998)

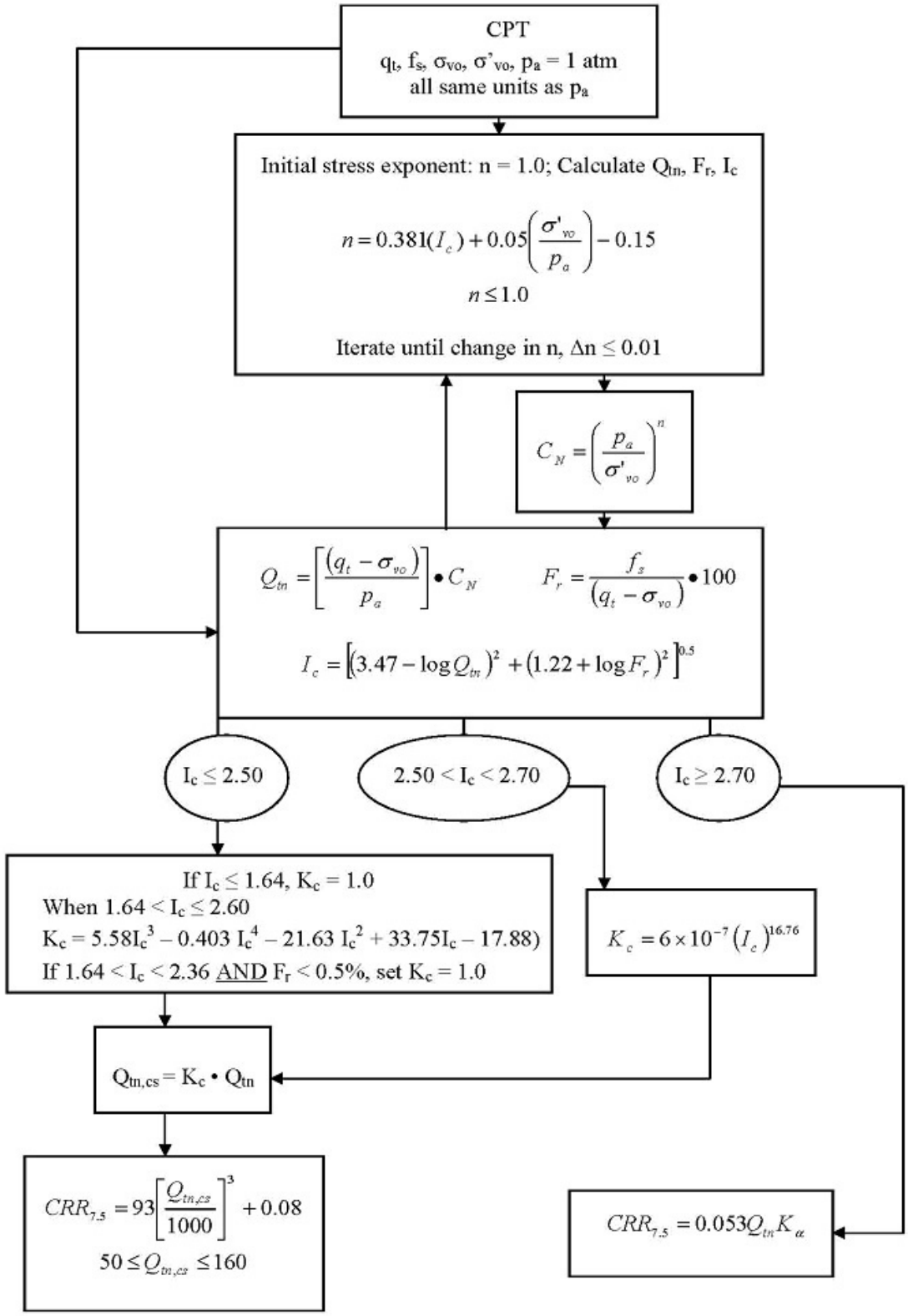
Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. The procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:




[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

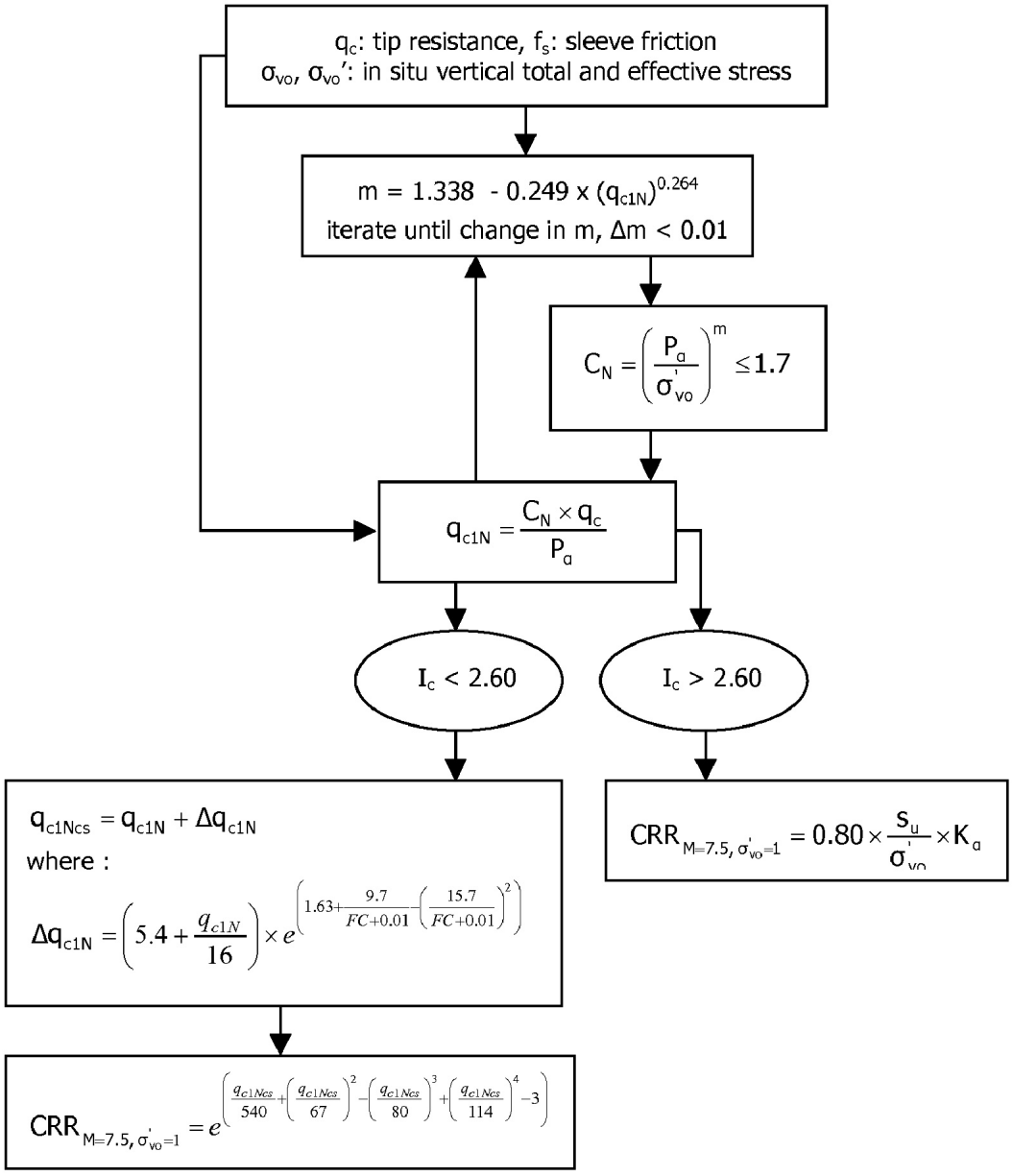
## Procedure for the evaluation of soil liquefaction resistance (all soils), Robertson (2010)

Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. This procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:

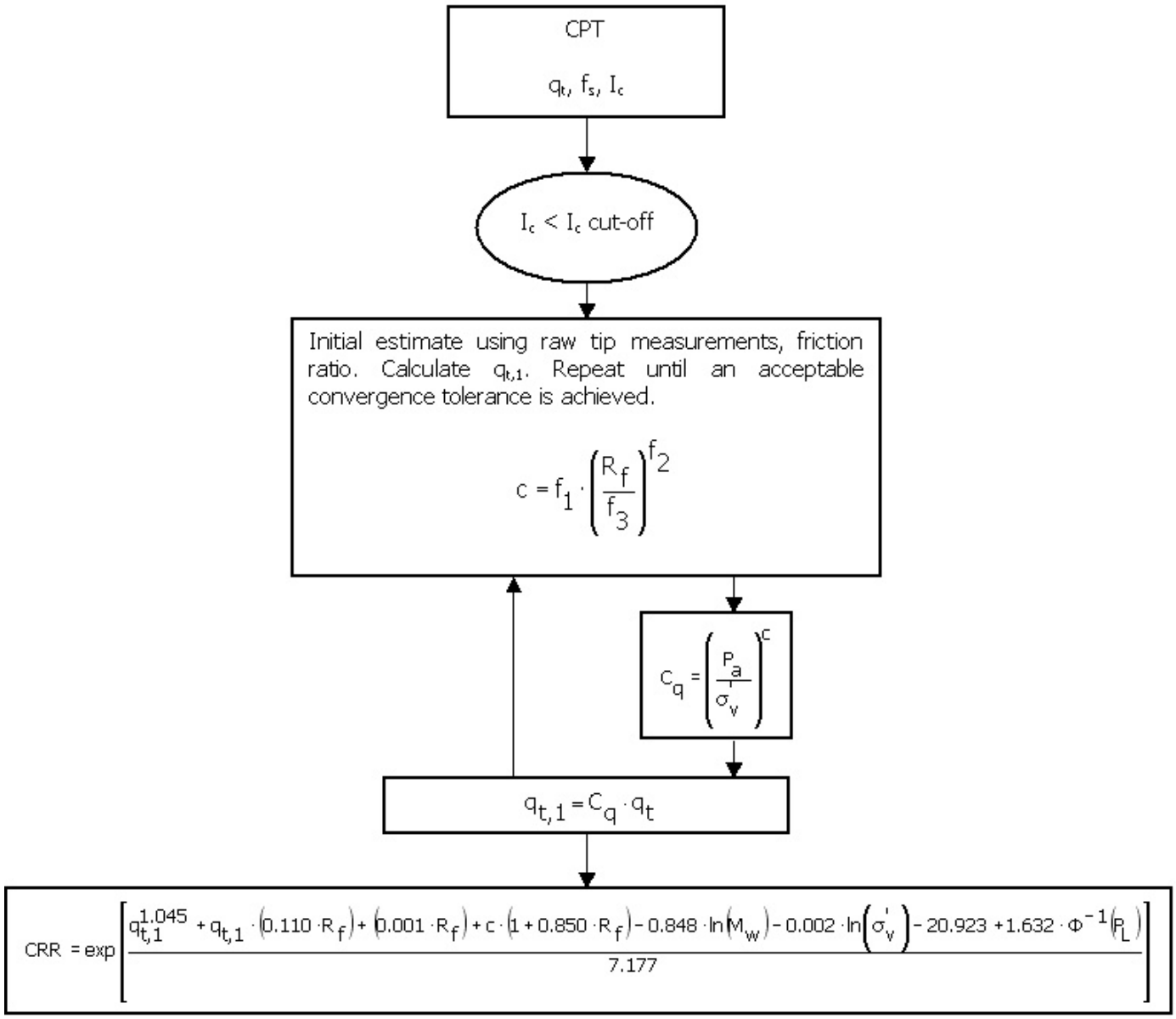



[1] P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering – from case history to practice, IS-Tokyo, June 2009

**Procedure for the evaluation of soil liquefaction resistance, Idriss & Boulanger (2008)**



**Procedure for the evaluation of soil liquefaction resistance (sandy soils), Moss et al. (2006)**



## Procedure for the evaluation of soil liquefaction resistance, Boulanger & Idriss(2014)

$$FS_{liq} = \frac{CRR_{M=7.5,\sigma'_v=1atm}}{CSR_{M=7.5,\sigma'_v=1atm}}$$

$$CSR_{M=7.5,\sigma'_v=1atm} = 0.65 \frac{\sigma_v}{\sigma'_v} \frac{a_{max}}{g} r_d \frac{1}{MSF} \frac{1}{K_\sigma}$$

$$r_d = \exp\left[\alpha(z) + \beta(z) \cdot M\right]$$

$$\alpha(z) = -1.012 - 1.126 \sin\left(\frac{z}{11.73} + 5.133\right)$$

$$\beta(z) = 0.106 + 0.118 \sin\left(\frac{z}{11.28} + 5.142\right)$$

$$K_\sigma = 1 - C_\sigma \ln\left(\frac{\sigma'_v}{P_a}\right) \le 1.1$$

$$C_\sigma = \frac{1}{37.3 - 8.27\left(q_{c1Ncs}\right)^{0.264}} \le 0.3$$

$$MSF = 1 + \left(MSF_{max} - 1\right)\left(8.64 \exp\left(\frac{-M}{4}\right) - 1.325\right)$$

$$MSF_{max} = 1.09 + \left(\frac{q_{c1Ncs}}{180}\right)^3 \le 2.2$$

$\sigma'_v$ *and* $\sigma_v$ *at start of earthquake shaking*

$$CRR_{M=7.5,\sigma'_v=1atm} = \exp\left(\frac{q_{c1Ncs}}{113} + \left(\frac{q_{c1Ncs}}{1000}\right)^2 - \left(\frac{q_{c1Ncs}}{140}\right)^3 + \left(\frac{q_{c1Ncs}}{137}\right)^4 - 2.80\right)$$

$$q_{c1Ncs} = q_{c1N} + \Delta q_{c1N}$$

$$\Delta q_{c1N} = \left(11.9 + \frac{q_{c1N}}{14.6}\right) \exp\left(1.63 - \frac{9.7}{FC+2} - \left(\frac{15.7}{FC+2}\right)^2\right)$$

$$q_{c1N} = C_{Ne} \frac{q_c}{P_a}$$

$$C_{Ne} = \left(\frac{P_a}{\sigma'_v}\right)^m \le 1.7$$

$$m = 1.338 - 0.249\left(q_{c1Ncs}\right)^{0.264} \quad with \quad 0.264 \le m \le 0.782$$

$$FC = 80\left(I_C + C_{FC}\right) - 137 \quad with \quad 0\% \le FC \le 100\%$$

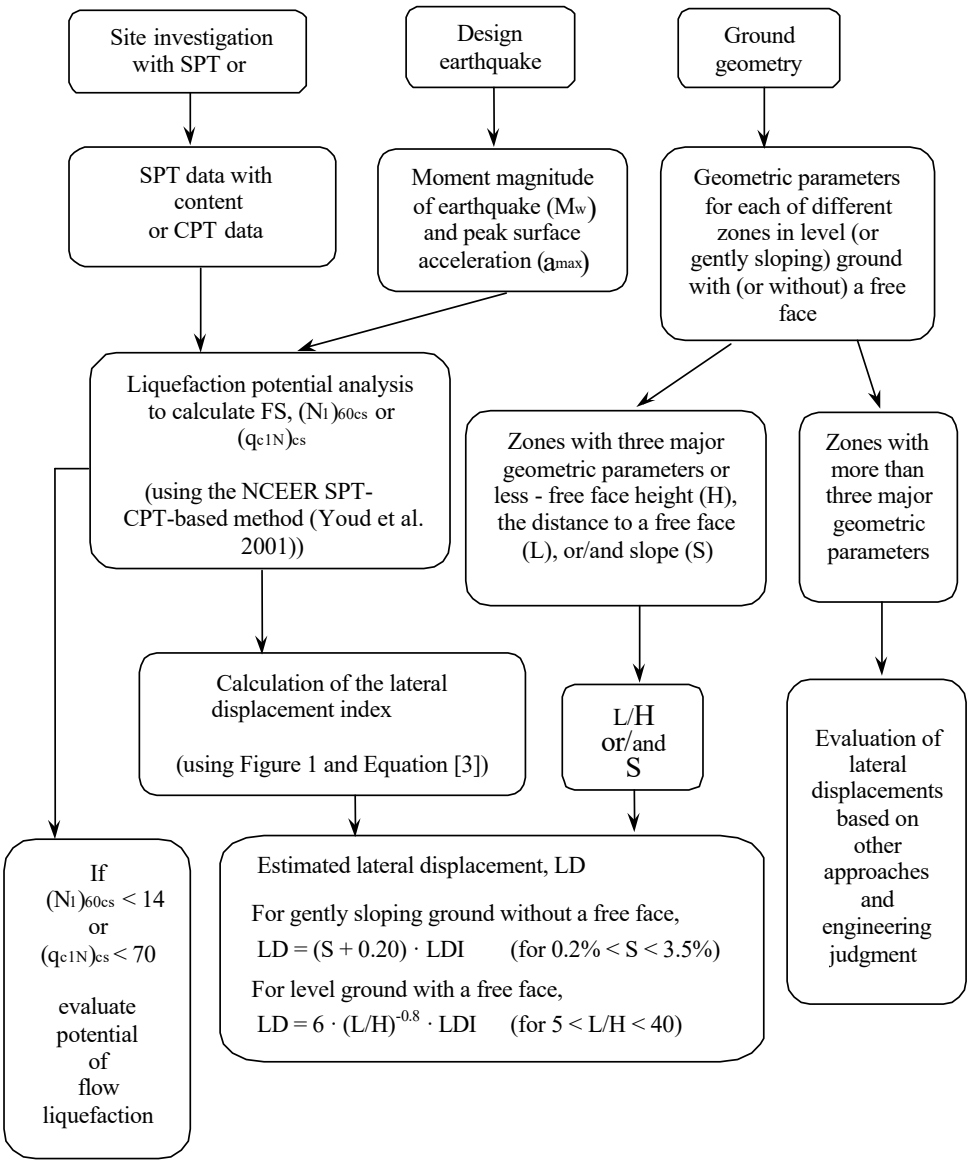
$$I_c = \left[\left(3.47 - \log\left(Q\right)\right)^2 + \left(1.22 + \log\left(F\right)\right)^2\right]^{0.5}$$

$$Q = \left(\frac{q_c - \sigma_{vc}}{P_a}\right)\left(\frac{P_a}{\sigma'_{vc}}\right)^n \; with \; 0.5 \le n \le 1.0 \; per \; Robertson \; \& \; Wride \; (1998)$$

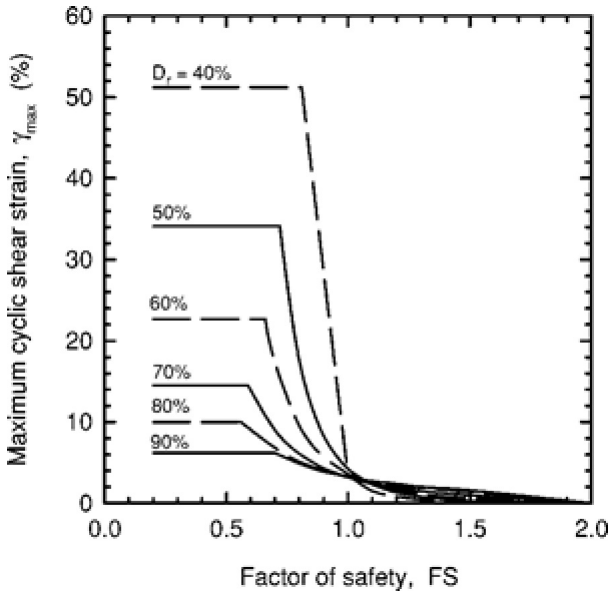
$$F = \left(\frac{f_s}{q_c - \sigma_{vc}}\right) \cdot 100\%$$

$\sigma'_v$ *at time of CPT sounding*

## Procedure for the evaluation of liquefaction-induced lateral spreading displacements




[1] Flow chart illustrating major steps in estimating liquefaction-induced lateral spreading displacements using the proposed approach



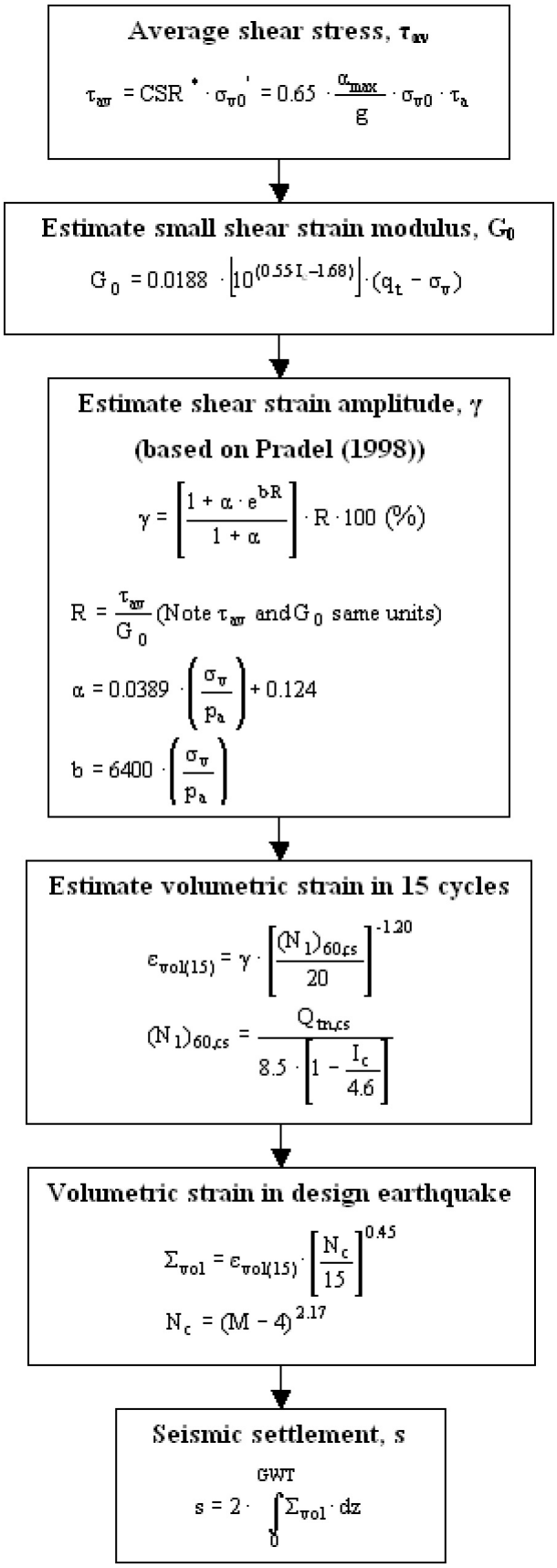

[1] **Figure 1**

$$LDI = \int_0^{z_{max}} \gamma_{max} dz$$

[1] **Equation [3]**

[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

## Procedure for the estimation of seismic induced settlements in dry sands




Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, Symposium in honor of professor I. M. Idriss, San Diego, CA

## Liquefaction Potential Index (LPI) calculation procedure

Calculation of the Liquefaction Potential Index (LPI) is used to interpret the liquefaction assessment calculations in terms of severity over depth. The calculation procedure is based on the methology developed by Iwasaki (1982) and is adopted by AFPS.

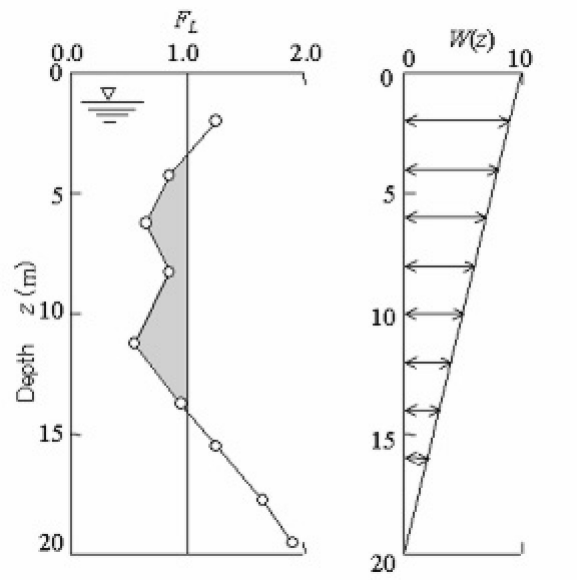
To estimate the severity of liquefaction extent at a given site, LPI is calculated based on the following equation:

$$\text{LPI} = \int_0^{20} (10 - 0{,}5z) \times F_L \times dz$$

where:
$F_L$ = 1 - F.S. when F.S. less than 1
$F_L$ = 0 when F.S. greater than 1
z depth of measurment in meters

Values of LPI range between zero (0) when no test point is characterized as liquefiable and 100 when all points are characterized as susceptible to liquefaction. Iwasaki proposed four (4) discrete categories based on the numeric value of LPI:

- LPI = 0 : Liquefaction risk is very low
- 0 < LPI <= 5 : Liquefaction risk is low
- 5 < LPI <= 15 : Liquefaction risk is high
- LPI > 15 : Liquefaction risk is very high

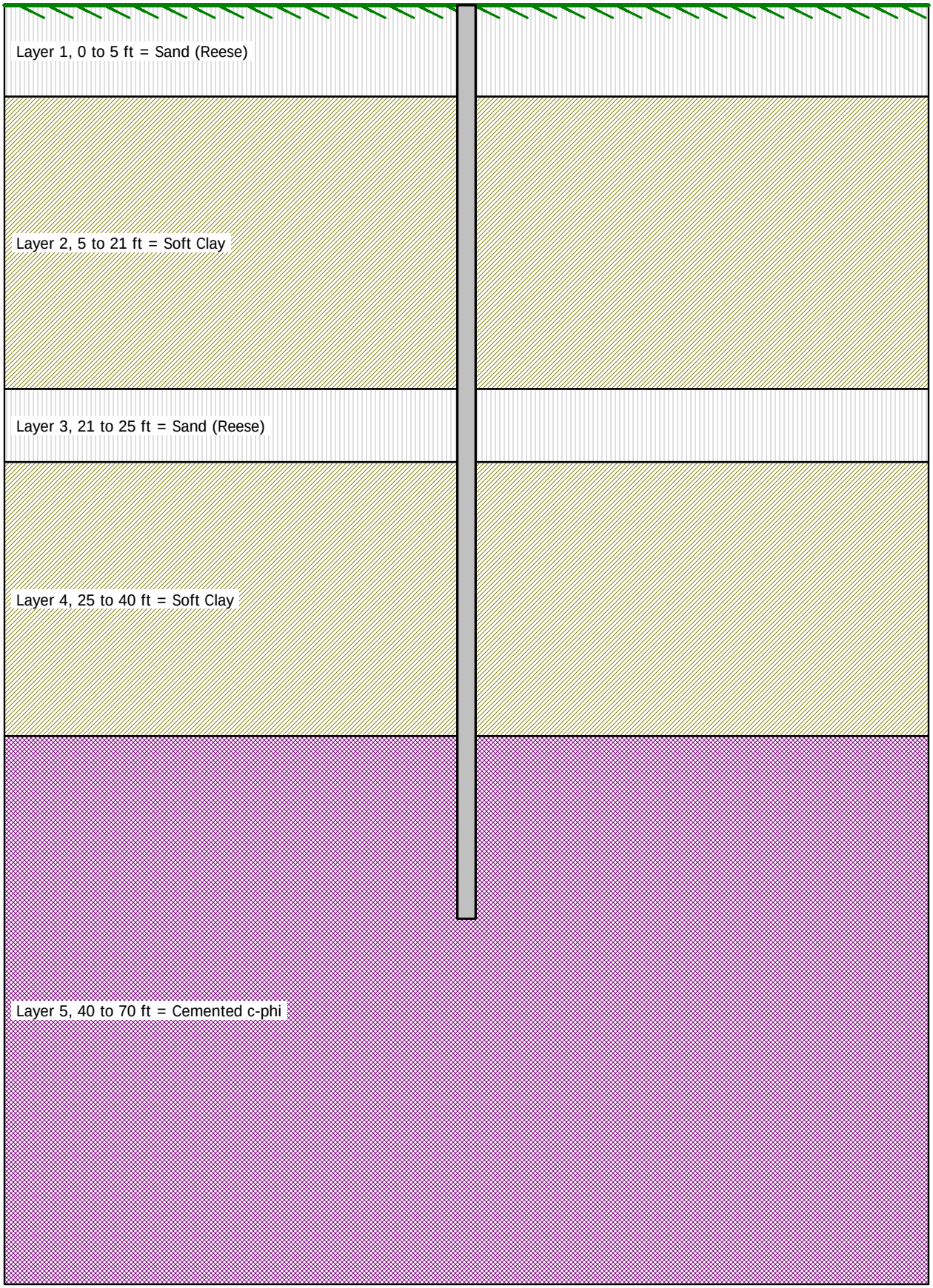



Graphical presentation of the LPI calculation procedure

# APPENDIX 8

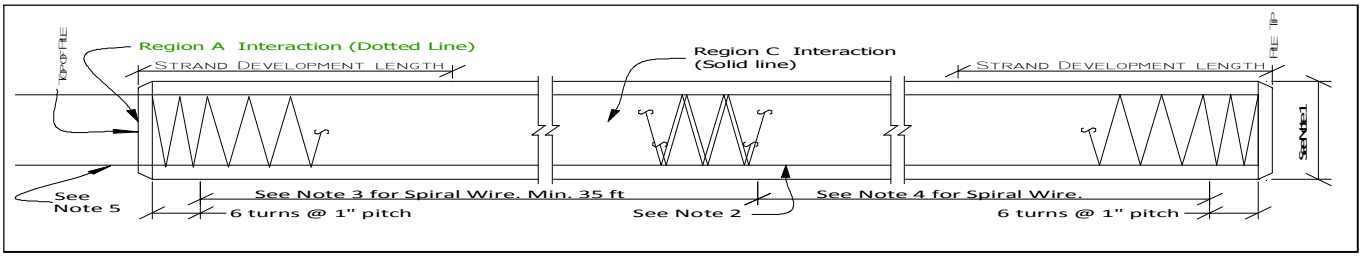
## LPile Results

Conceptual Site Model: Fill




LPile 2018.10.07, © 2018 by Ensoft, Inc.

# 12" Sq; f'c = 6,000 psi, 1022 psi prestress with No Rebars Pile Details and Interaction Diagram.




NOTE 1; 12" SQUARE PILE, CONC. F'C = 6000 PSI, AREA (AG) = 142.88 SQ-IN.

NOTE 2; 6 - 1/2"ø 270K STRAND ON 7" CIRCLE, STRESSED TO 70% = 1022 PSI ( FPC)

NOTE 3; PROVIDE W11.0 @ 2" PITCH FOR TOP 35 FT MINIMUM

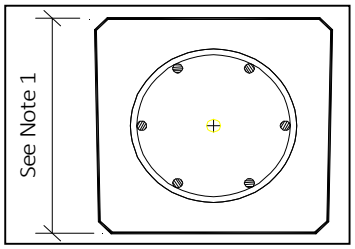
NOTE 4; PROVIDE W8.0 @ 3.625" PITCH WITH 2" COVER

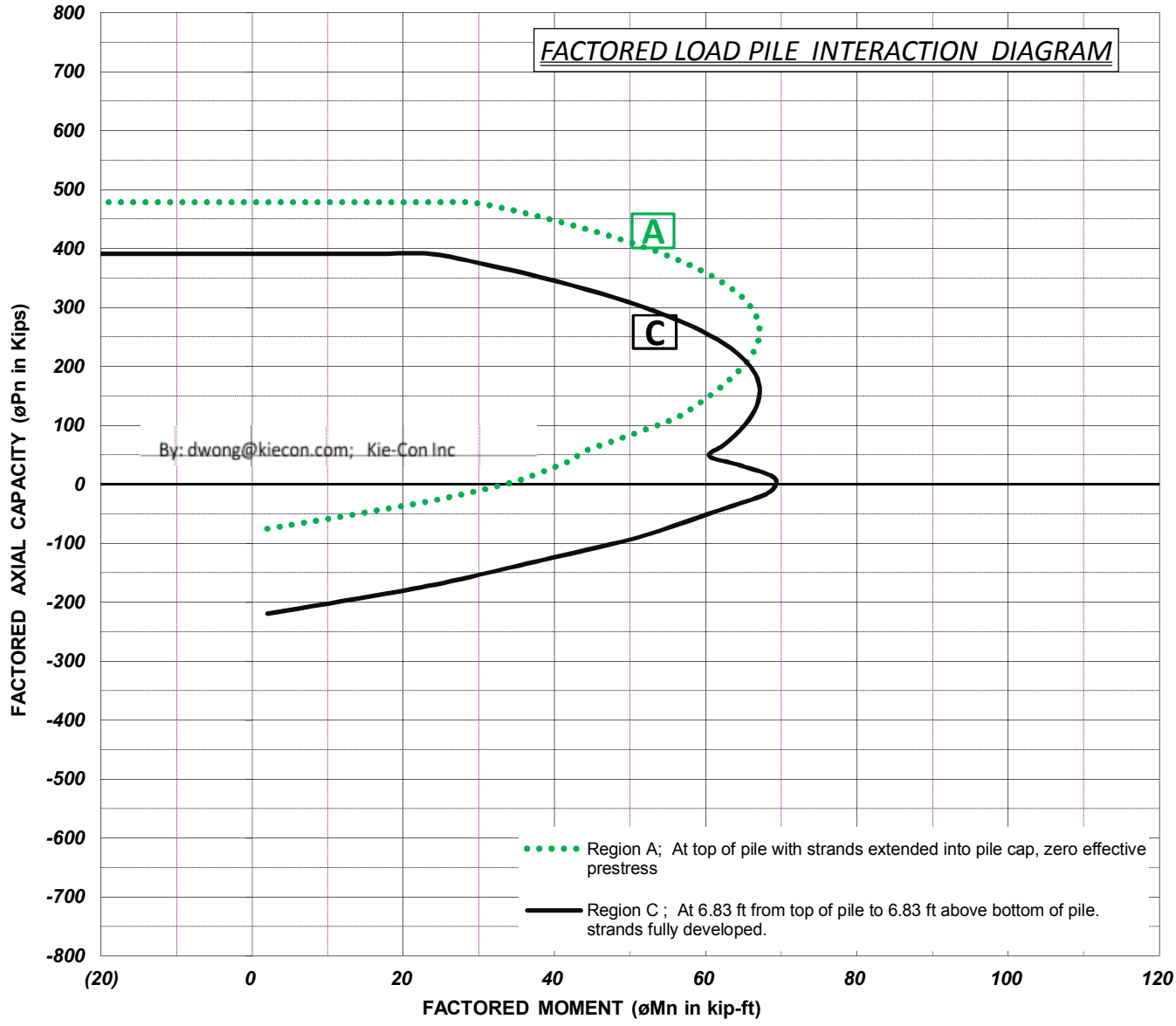
NOTE 5; STRANDS EXTENDED 4.0 FT

NOTE 6; ALLOWABLE SERVICE LOAD BASED ON N = AG(0.33 F'C-0.27FPC) = 243 KIPS

NOTE 7; **PLEASE EMAIL US IF YOU LIKE TO SEE THE INTERACTION DIAGRAMS OF DIFFERENT REBAR SIZES OR COMBINATIONS**

NOTE 8; **THE INTERACTION DIAGRAM SHOWN BELOW IS A GUIDELINE ONLY. ACTUAL DESIGN MUST BE REVIEWED BY EOR FOR EACH PROJECT.**

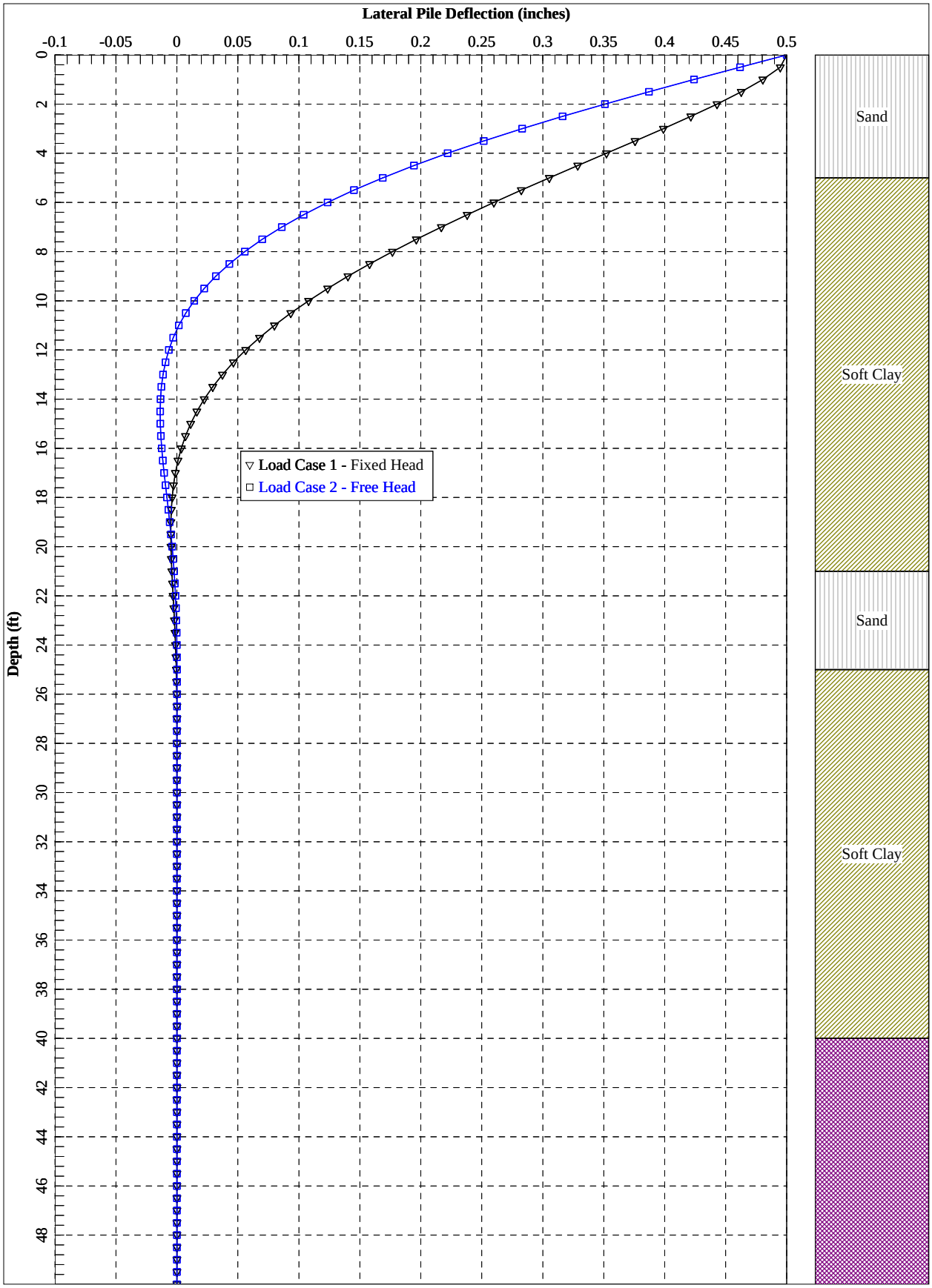


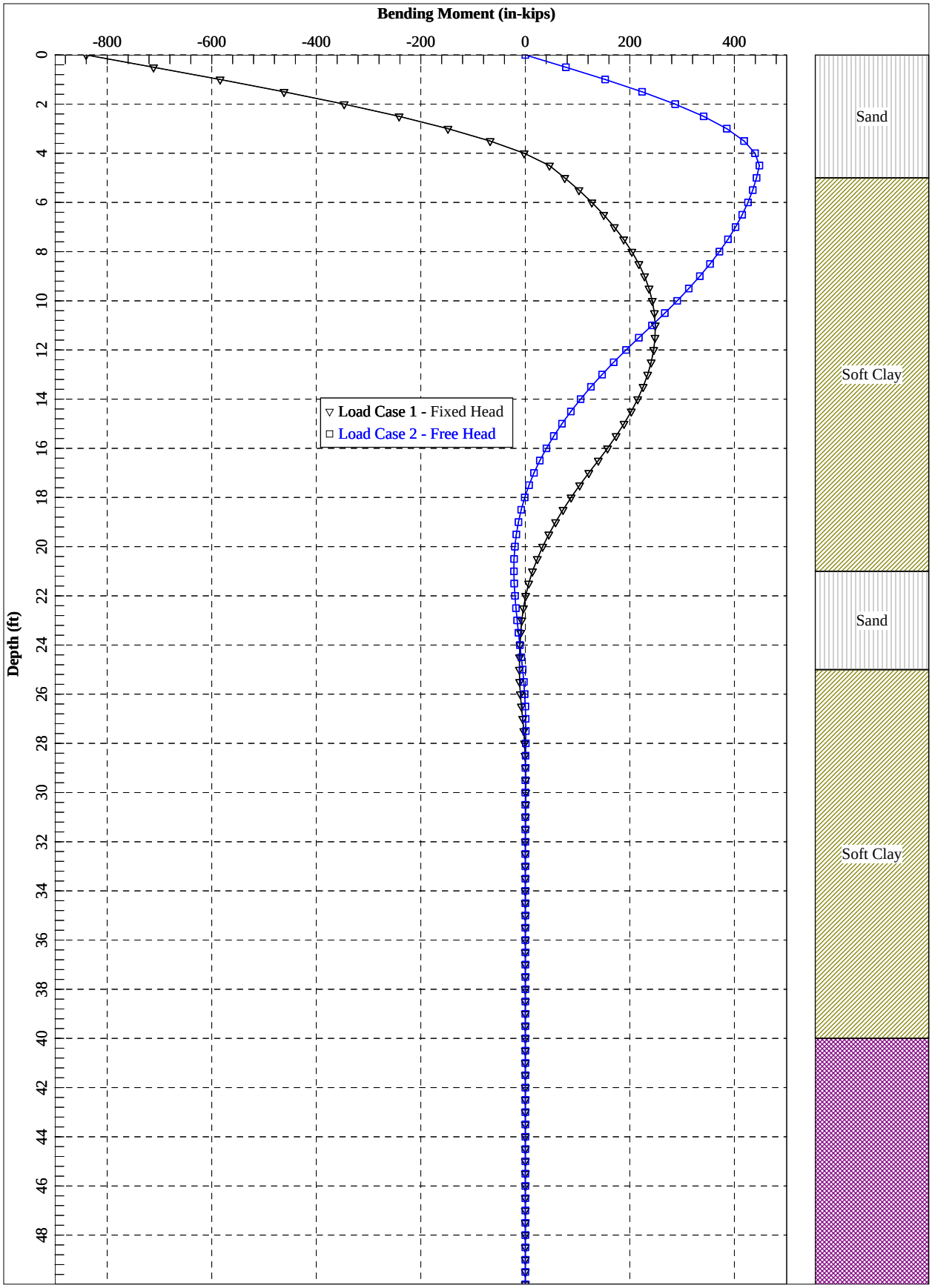

**Pile Manufacturer: KIE-CON Inc** Web Site : Kiecon.com Tel: 925/754-9494 Fax: 925/754-0624

**3551 Wilbur Ave, Antioch, Califorina** By: dwong@kiecon.com (Danny Wong) Page / Rev #:

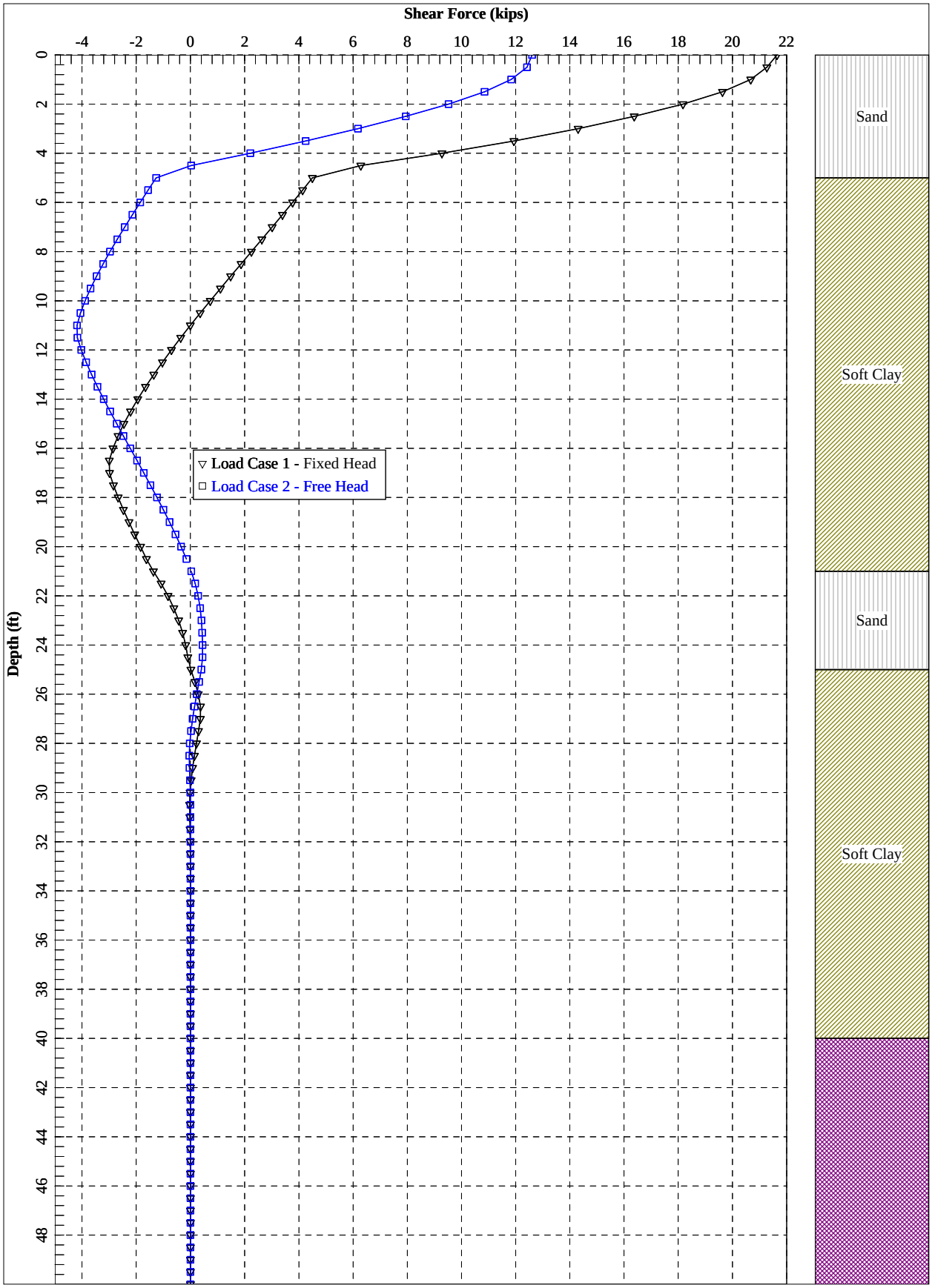
**12 Inch Square Prestressed Concrete Pile**
**0.5 Inch Deflection**



**12 Inch Square Prestressed Concrete Pile**
**0.5 Inch Deflection**



**12 Inch Square Prestressed Concrete Pile**
**0.5 Inch Deflection**



LPile for Windows, Version 2018-10.007

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
© 1985-2018 by Ensoft, Inc.
All Rights Reserved

This copy of LPile is being used by:

LACO Associates
Geo/Environmental
Serial Number of Security Device: 136157127

This copy of LPile is licensed for exclusive use by:

LACO Associates, Santa Rosa, CA

Use of this program by any entity other than LACO Associates, Santa Rosa, CA
is a violation of the software license agreement.

## Files Used for Analysis

Path to file locations on this computer:
\7900\7986 Carollo Engineers\7986.01 Arcata Wastewater Treatment Facility Design
\08 Geology\Reports\Geotech Report_Working Files-Archive\L-Pile\

Name of the input data file:
New LPile (USCS units) - 12 inch sq pp.lp10

Name of the output report file:
New LPile (USCS units) - 12 inch sq pp.lp10

Name of the plot output file:
New LPile (USCS units) - 12 inch sq pp.lp10

Name of the runtime message file:
New LPile (USCS units) - 12 inch sq pp.lp10

## Date and Time of Analysis

Date: November 20, 2018 Time: 17:28:13

## Problem Title

Project Name: Wastewater Treatment Facility Improvements

Job Number: 7986.01

Client: Carollo Engineers

Engineer: LACO Associates

Description: Lateral Load Analysis - 12-inch square precast concrete

---

## Program Options and Settings

---

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

| | | |
|---|---|---|
| - Maximum number of iterations allowed | = | 500 |
| - Deflection tolerance for convergence | = | 1.0000E-05 in |
| - Maximum allowable deflection | = | 100.0000 in |
| - Number of pile increments | = | 100 |

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

---

## Pile Structural Properties and Geometry

---

| | | |
|---|---|---|
| Number of pile sections defined | = | 1 |
| Total length of pile | = | 50.000 ft |
| Depth of ground surface below top of pile | = | 0.0000 ft |

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

| Point No. | Depth Below Pile Head feet | Pile Diameter inches |
|---|---|---|
| 1 | 0.000 | 12.0000 |
| 2 | 50.000 | 12.0000 |

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a square prestressed concrete pile

| | | |
|---|---|---|
| Length of section | = | 50.000000 ft |
| Pile Width | = | 12.000000 in |
| Corner Chamfer | = | 0.0000 in |
| Shear capacity of section | = | 0.0000 lbs |

## Ground Slope and Pile Batter Angles

| | | |
|---|---|---|
| Ground Slope Angle | = | 0.000 degrees |
| | = | 0.000 radians |
| Pile Batter Angle | = | 0.000 degrees |
| | = | 0.000 radians |

## Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 0.0000 ft |
| Distance from top of pile to bottom of layer | = | 5.000000 ft |
| Effective unit weight at top of layer | = | 130.000000 pcf |
| Effective unit weight at bottom of layer | = | 130.000000 pcf |
| Friction angle at top of layer | = | 34.000000 deg. |
| Friction angle at bottom of layer | = | 34.000000 deg. |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for subgrade k will be computed for this layer.

Layer 2 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 5.000000 ft |
| Distance from top of pile to bottom of layer | = | 21.000000 ft |
| Effective unit weight at top of layer | = | 95.000000 pcf |
| Effective unit weight at bottom of layer | = | 100.000000 pcf |

| | | |
|---|---|---|
| Undrained cohesion at top of layer | = | 200.000000 psf |
| Undrained cohesion at bottom of layer | = | 500.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 21.000000 ft |
| Distance from top of pile to bottom of layer | = | 25.000000 ft |
| Effective unit weight at top of layer | = | 120.000000 pcf |
| Effective unit weight at bottom of layer | = | 120.000000 pcf |
| Friction angle at top of layer | = | 30.000000 deg. |
| Friction angle at bottom of layer | = | 30.000000 deg. |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for subgrade k will be computed for this layer.

Layer 4 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 25.000000 ft |
| Distance from top of pile to bottom of layer | = | 40.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 115.000000 pcf |
| Undrained cohesion at top of layer | = | 600.000000 psf |
| Undrained cohesion at bottom of layer | = | 800.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is cemented silt with cohesion and friction

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 40.000000 ft |
| Distance from top of pile to bottom of layer | = | 70.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 110.000000 pcf |
| Undrained cohesion at top of layer | = | 350.000000 psf |
| Undrained cohesion at bottom of layer | = | 350.000000 psf |
| Friction angle at top of layer | = | 25.000000 deg. |
| Friction angle at bottom of layer | = | 25.000000 deg. |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for Epsilon-50 will be computed for this layer.
NOTE: Default values for subgrade k will be computed for this layer.

(Depth of the lowest soil layer extends 20.000 ft below the pile tip)

---

## Static Loading Type

---

Static loading criteria were used when computing p-y curves for all analyses.

## Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

| Load No. | Load Type | Condition 1 | Condition 2 | Axial Thrust Force, lbs |
|---|---|---|---|---|
| 1 | 5 | y = 0.500000 in | S = 0.0000 in/in | 50000. |
| 2 | 4 | y = 0.500000 in | M = 0.0000 in-lbs | 50000. |

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

## Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

### Pile Section No. 1:

#### Dimensions of Square Prestressed Pile Section:

Length of Section = 50.0000 ft
Pile Width = 12.000 in
Corner Chamfer = 0.000 in

#### Prestressing Strand Details:

Strand Type = PCI 270
Yield Stress, fpu = 270. ksi
Stress-strain curve defined using PCI 270 7-wire Lo-lax equation
If eps > 0.0086 fpu (ksi) = 270 - 0.04/(eps-0.007)
Number of Reinforcing Strands = 6
Cross-sectional Area of Single Strand = 0.153 sq. in.
Concrete Cover Thickness Over Strands = 2.000 in

#### Prestressing Strand Geometry:

| Strand No. | Diameter in | Area sq. in | X in | Y in |
|---|---|---|---|---|
| 1 | 0.500 | 0.153 | 3.750 | 0.000 |
| 2 | 0.500 | 0.153 | 1.875 | 3.248 |

| | | | | |
|---|---|---|---|---|
| 3 | 0.500 | 0.153 | -1.875 | 3.248 |
| 4 | 0.500 | 0.153 | -3.750 | 0.000 |
| 5 | 0.500 | 0.153 | -1.875 | -3.248 |
| 6 | 0.500 | 0.153 | 1.875 | -3.248 |

Computation of Loss of Prestress:

| | | |
|---|---|---|
| Initial Prestressing Force | = | 146.000 kips |
| Fraction of Loss of Prestress | = | 0.100 |
| Effective Prestressing Force After Losses | = | 131.400 kips |
| Area of Concrete, Ac | = | 143.082 sq.in |
| Area of Steel, As | = | 0.918 sq.in |
| Stress in Concrete After Losses, f_pc | = | 0.918 ksi |
| Stress in Steel After Losses | = | -143.137 ksi |
| Compressive Strain in Concrete After Losses | = | 0.0002080 |
| Tensile Strain in Steel After Losses | = | -0.0051120 |
| Axial Tension Load for Cracking of Concrete | = | -171.135 kips |

Estimated Structural Capacities Computed Using PCI Equations:

| | | |
|---|---|---|
| Nom. Axial Cap., Pn = (0.85 f'c - 0.60 f_pc) Ag | = | 655.054 kips |
| Unfac. Axial Load Cap. N = (0.33 f'c - 0.27 f_pc) Ag | = | 249.414 kips |
| Axial Capacity in Tension, Nt = As fpu | = | -247.860 kips |
| Nom. Moment Capacity, Mn = 0.37 D As fpu | = | 1100.498 in-kip |

Note: The estimate of nominal moment capacity is based on equations that assume compressive strength of concrete is 6,000 psi (41.4 MPa), the value of prestress after losses is 700 psi (4.83 MPa), and axial thrust force is zero. When input values for these factors are different, the estimated value of nominal moment capacity will differ from the capacity computed by LPile and should be considered only as an approximate check.

Concrete Properties:

| | | |
|---|---|---|
| Compressive Strength of Concrete | = | 6000. psi |
| Modulus of Elasticity of Concrete | = | 4415201. psi |
| Modulus of Rupture of Prestressed Concrete | = | -309.838668 psi |
| Compression Strain at Peak Stress | = | 0.002310 |
| Tensile Strain at Fracture of Concrete | = | -0.0000604 |
| Maximum Coarse Aggregate Size | = | 0.750000 in |

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

| Number | Axial Thrust Force kips |
|---|---|
| 1 | 50.000 |

---

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

---

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

| Load No. | Axial Thrust kips | Nominal Mom. Cap. in-kip | Max. Comp. Strain |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | 50.000 | 1060.461 | 0.00300000 |

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, Section 9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

| Axial Load No. | Resist. Factor for Moment | Nominal Moment Cap in-kips | Ult. (Fac) Ax. Thrust kips | Ult. (Fac) Moment Cap in-kips | Bend. Stiff. at Ult Mom kip-in^2 |
|---|---|---|---|---|---|
| 1 | 0.65 | 1060. | 32.500000 | 689.299356 | 4518034. |
| 1 | 0.70 | 1060. | 35.000000 | 742.322383 | 3846872. |
| 1 | 0.75 | 1060. | 37.500000 | 795.345411 | 3272675. |

## Layering Correction Equivalent Depths of Soil & Rock Layers

| Layer No. | Top of Layer Below Pile Head ft | Equivalent Top Depth Below Grnd Surf ft | Same Layer Type As Layer Above | Layer is Rock or is Below Rock Layer | F0 Integral for Layer lbs | F1 Integral for Layer lbs |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | N.A. | No | 0.00 | 20692. |
| 2 | 5.0000 | 13.2346 | No | No | 20692. | 50400. |
| 3 | 21.0000 | 9.8929 | No | No | 71092. | 114329. |
| 4 | 25.0000 | 37.2813 | No | No | 185421. | 94399. |
| 5 | 40.0000 | 18.4599 | No | No | 279820. | N.A. |

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

## Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs

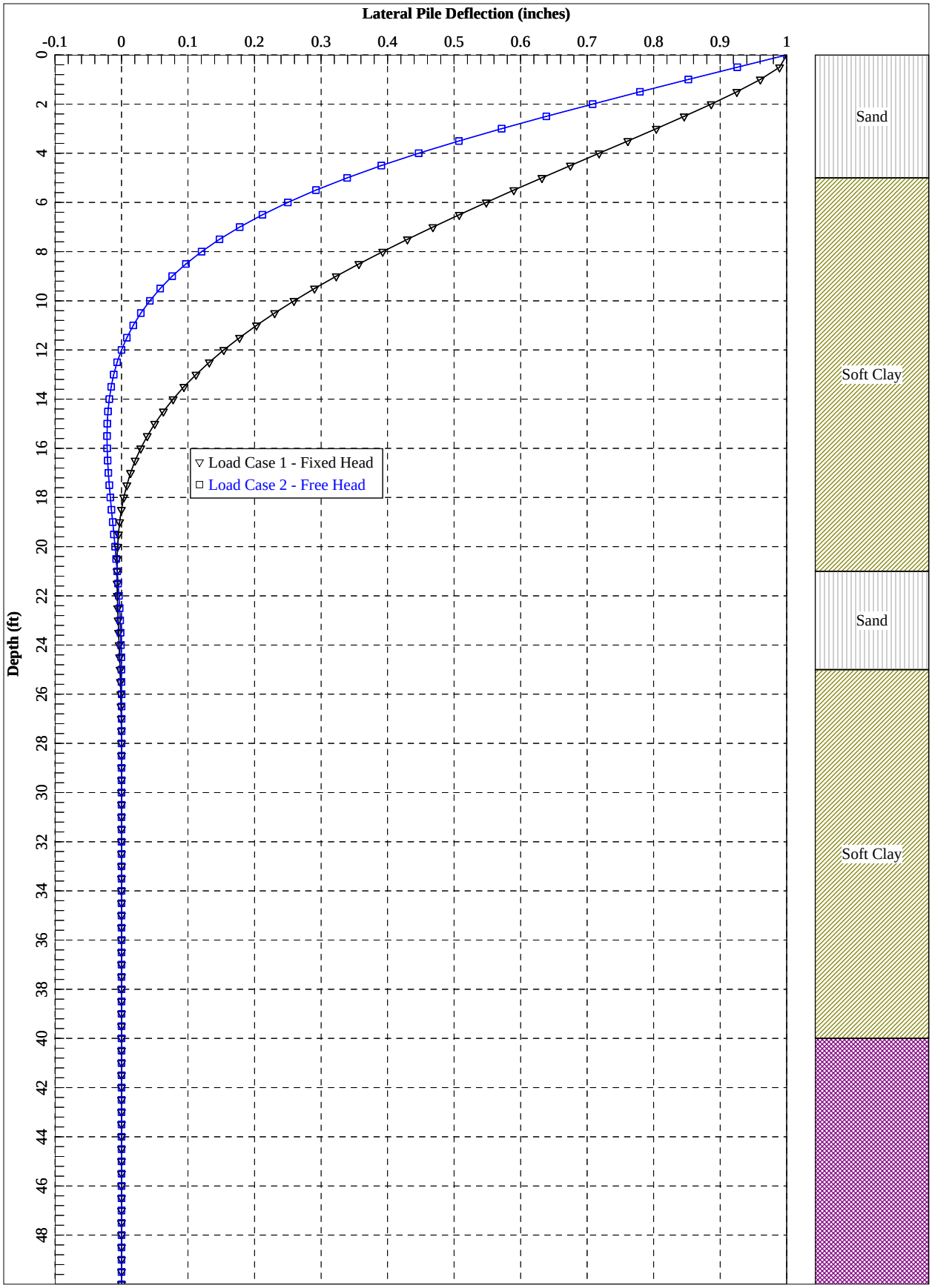
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

| Load Case No. | Load Type | Pile-head Deflection inches | Pile-head Rotation radians | Max Shear in Pile lbs | Max Moment in Pile in-lbs |
|---|---|---|---|---|---|
| 1 | 5 | 0.500000 | 0.0000 | 21646. | -840267. |
| 2 | 4 | 0.500000 | -0.006374 | 12605. | 447900. |

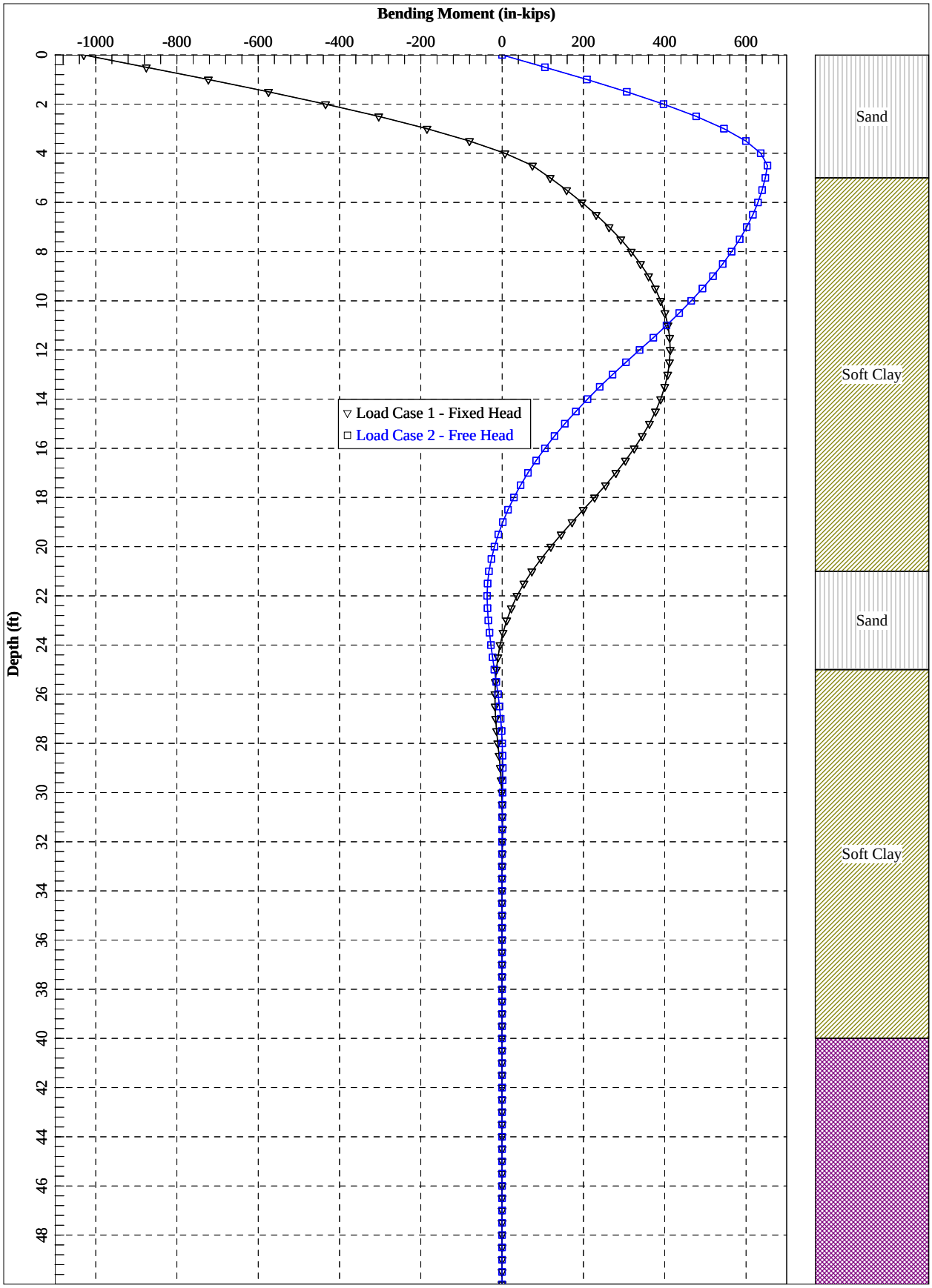
Maximum pile-head deflection = 0.5000000000 inches
Maximum pile-head rotation = -0.0063738074 radians = -0.365192 deg.

The analysis ended normally.

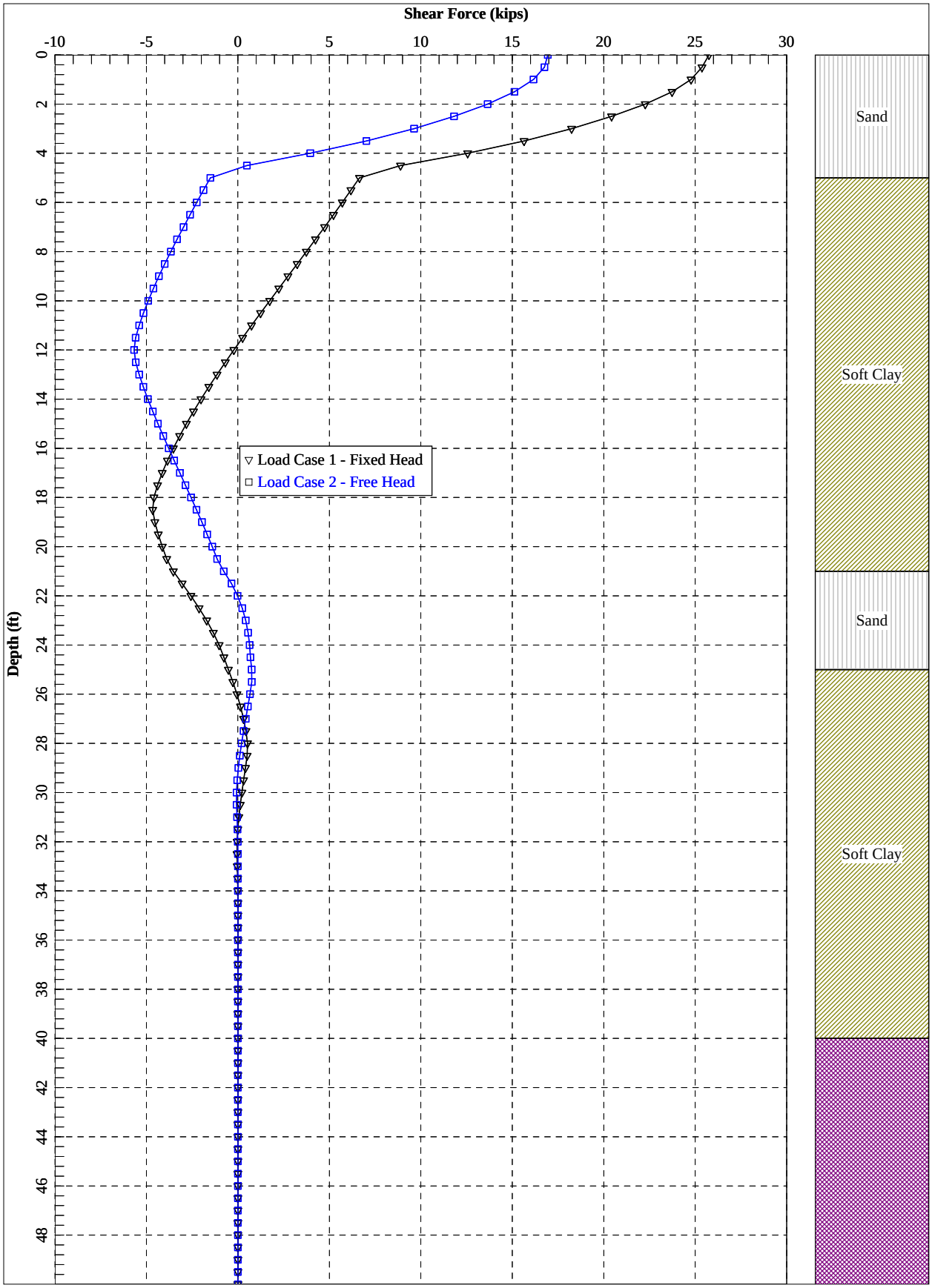
**12 Inch Square Prestressed Concrete Pile**
**1.0 Inch Deflection**



**12 Inch Square Prestressed Concrete Pile**
**1.0 Inch Deflection**



**12 Inch Square Prestressed Concrete Pile**
**1.0 Inch Deflection**



LPile for Windows, Version 2018-10.007

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
© 1985-2018 by Ensoft, Inc.
All Rights Reserved

This copy of LPile is being used by:

LACO Associates
Geo/Environmental
Serial Number of Security Device: 136157127

This copy of LPile is licensed for exclusive use by:

LACO Associates, Santa Rosa, CA

Use of this program by any entity other than LACO Associates, Santa Rosa, CA
is a violation of the software license agreement.

## Files Used for Analysis

Path to file locations on this computer:
\7900\7986 Carollo Engineers\7986.01 Arcata Wastewater Treatment Facility Design
\08 Geology\Reports\Geotech Report_Working Files-Archive\L-Pile\JER output\

Name of the input data file:
New LPile (USCS units) - 12 inch sq - 1 in def.lp10

Name of the output report file:
New LPile (USCS units) - 12 inch sq - 1 in def.lp10

Name of the plot output file:
New LPile (USCS units) - 12 inch sq - 1 in def.lp10

Name of the runtime message file:
New LPile (USCS units) - 12 inch sq - 1 in def.lp10

## Date and Time of Analysis

Date: November 20, 2018 Time: 17:48:26

## Problem Title

Project Name: Wastewater Treatment Facility Improvements

Job Number: 7986.01

New LPile (USCS units) - 12 inch sq - 1 in def.lp10o

Client: Carollo Engineers

Engineer: LACO Associates

Description: Lateral Load Analysis - 12-inch square precast concrete

---

## Program Options and Settings

---

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

| | | |
|---|---|---|
| - Maximum number of iterations allowed | = | 500 |
| - Deflection tolerance for convergence | = | 1.0000E-05 in |
| - Maximum allowable deflection | = | 100.0000 in |
| - Number of pile increments | = | 100 |

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

---

## Pile Structural Properties and Geometry

---

| | | |
|---|---|---|
| Number of pile sections defined | = | 1 |
| Total length of pile | = | 50.000 ft |
| Depth of ground surface below top of pile | = | 0.0000 ft |

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

| Point No. | Depth Below Pile Head feet | Pile Diameter inches |
|---|---|---|
| 1 | 0.000 | 12.0000 |
| 2 | 50.000 | 12.0000 |

Input Structural Properties for Pile Sections:

Pile Section No. 1:

| | | |
|---|---|---|
| Section 1 is a square prestressed concrete pile | | |
| Length of section | = | 50.000000 ft |
| Pile Width | = | 12.000000 in |
| Corner Chamfer | = | 0.0000 in |
| Shear capacity of section | = | 0.0000 lbs |

## Ground Slope and Pile Batter Angles

| | | |
|---|---|---|
| Ground Slope Angle | = | 0.000 degrees |
| | = | 0.000 radians |
| Pile Batter Angle | = | 0.000 degrees |
| | = | 0.000 radians |

## Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 0.0000 ft |
| Distance from top of pile to bottom of layer | = | 5.000000 ft |
| Effective unit weight at top of layer | = | 130.000000 pcf |
| Effective unit weight at bottom of layer | = | 130.000000 pcf |
| Friction angle at top of layer | = | 34.000000 deg. |
| Friction angle at bottom of layer | = | 34.000000 deg. |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for subgrade k will be computed for this layer.

Layer 2 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 5.000000 ft |
| Distance from top of pile to bottom of layer | = | 21.000000 ft |
| Effective unit weight at top of layer | = | 95.000000 pcf |
| Effective unit weight at bottom of layer | = | 100.000000 pcf |

| | | |
|---|---|---|
| Undrained cohesion at top of layer | = | 200.000000 psf |
| Undrained cohesion at bottom of layer | = | 500.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 21.000000 ft |
| Distance from top of pile to bottom of layer | = | 25.000000 ft |
| Effective unit weight at top of layer | = | 120.000000 pcf |
| Effective unit weight at bottom of layer | = | 120.000000 pcf |
| Friction angle at top of layer | = | 30.000000 deg. |
| Friction angle at bottom of layer | = | 30.000000 deg. |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for subgrade k will be computed for this layer.

Layer 4 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 25.000000 ft |
| Distance from top of pile to bottom of layer | = | 40.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 115.000000 pcf |
| Undrained cohesion at top of layer | = | 600.000000 psf |
| Undrained cohesion at bottom of layer | = | 800.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is cemented silt with cohesion and friction

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 40.000000 ft |
| Distance from top of pile to bottom of layer | = | 70.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 110.000000 pcf |
| Undrained cohesion at top of layer | = | 350.000000 psf |
| Undrained cohesion at bottom of layer | = | 350.000000 psf |
| Friction angle at top of layer | = | 25.000000 deg. |
| Friction angle at bottom of layer | = | 25.000000 deg. |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for Epsilon-50 will be computed for this layer.
NOTE: Default values for subgrade k will be computed for this layer.

(Depth of the lowest soil layer extends 20.000 ft below the pile tip)

---

## Static Loading Type

---

Static loading criteria were used when computing p-y curves for all analyses.

## Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

| Load No. | Load Type | Condition 1 | | Condition 2 | | Axial Thrust Force, lbs |
|---|---|---|---|---|---|---|
| 1 | 5 | y = | 1.000000 in | S = | 0.0000 in/in | 50000. |
| 2 | 4 | y = | 1.000000 in | M = | 0.0000 in-lbs | 50000. |

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

## Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

### Pile Section No. 1:

#### Dimensions of Square Prestressed Pile Section:

| | | |
|---|---|---|
| Length of Section | = | 50.0000 ft |
| Pile Width | = | 12.000 in |
| Corner Chamfer | = | 0.000 in |

#### Prestressing Strand Details:

| | | |
|---|---|---|
| Strand Type | = | PCI 270 |
| Yield Stress, fpu | = | 270. ksi |

Stress-strain curve defined using PCI 270 7-wire Lo-lax equation
If eps > 0.0086 fpu (ksi) = 270 - 0.04/(eps-0.007)

| | | |
|---|---|---|
| Number of Reinforcing Strands | = | 6 |
| Cross-sectional Area of Single Strand | = | 0.153 sq. in. |
| Concrete Cover Thickness Over Strands | = | 2.000 in |

#### Prestressing Strand Geometry:

| Strand No. | Diameter in | Area sq. in | X in | Y in |
|---|---|---|---|---|
| 1 | 0.500 | 0.153 | 3.750 | 0.000 |
| 2 | 0.500 | 0.153 | 1.875 | 3.248 |

| | | | | |
|---|---|---|---|---|
| 3 | 0.500 | 0.153 | -1.875 | 3.248 |
| 4 | 0.500 | 0.153 | -3.750 | 0.000 |
| 5 | 0.500 | 0.153 | -1.875 | -3.248 |
| 6 | 0.500 | 0.153 | 1.875 | -3.248 |

Computation of Loss of Prestress:

| | | |
|---|---|---|
| Initial Prestressing Force | = | 146.000 kips |
| Fraction of Loss of Prestress | = | 0.100 |
| Effective Prestressing Force After Losses | = | 131.400 kips |
| Area of Concrete, Ac | = | 143.082 sq.in |
| Area of Steel, As | = | 0.918 sq.in |
| Stress in Concrete After Losses, f_pc | = | 0.918 ksi |
| Stress in Steel After Losses | = | -143.137 ksi |
| Compressive Strain in Concrete After Losses | = | 0.0002080 |
| Tensile Strain in Steel After Losses | = | -0.0051120 |
| Axial Tension Load for Cracking of Concrete | = | -171.135 kips |

Estimated Structural Capacities Computed Using PCI Equations:

| | | |
|---|---|---|
| Nom. Axial Cap., Pn = (0.85 f'c - 0.60 f_pc) Ag | = | 655.054 kips |
| Unfac. Axial Load Cap. N = (0.33 f'c - 0.27 f_pc) Ag | = | 249.414 kips |
| Axial Capacity in Tension, Nt = As fpu | = | -247.860 kips |
| Nom. Moment Capacity, Mn = 0.37 D As fpu | = | 1100.498 in-kip |

Note: The estimate of nominal moment capacity is based on equations that assume compressive strength of concrete is 6,000 psi (41.4 MPa), the value of prestress after losses is 700 psi (4.83 MPa), and axial thrust force is zero. When input values for these factors are different, the estimated value of nominal moment capacity will differ from the capacity computed by LPile and should be considered only as an approximate check.

Concrete Properties:

| | | |
|---|---|---|
| Compressive Strength of Concrete | = | 6000. psi |
| Modulus of Elasticity of Concrete | = | 4415201. psi |
| Modulus of Rupture of Prestressed Concrete | = | -309.838668 psi |
| Compression Strain at Peak Stress | = | 0.002310 |
| Tensile Strain at Fracture of Concrete | = | -0.0000604 |
| Maximum Coarse Aggregate Size | = | 0.750000 in |

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

| Number | Axial Thrust Force kips |
|---|---|
| 1 | 50.000 |

---

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

---

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

| Load No. | Axial Thrust kips | Nominal Mom. Cap. in-kip | Max. Comp. Strain |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | 50.000 | 1060.461 | 0.00300000 |

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, Section 9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

| Axial Load No. | Resist. Factor for Moment | Nominal Moment Cap in-kips | Ult. (Fac) Ax. Thrust kips | Ult. (Fac) Moment Cap in-kips | Bend. Stiff. at Ult Mom kip-in^2 |
|---|---|---|---|---|---|
| 1 | 0.65 | 1060. | 32.500000 | 689.299356 | 4518034. |
| 1 | 0.70 | 1060. | 35.000000 | 742.322383 | 3846872. |
| 1 | 0.75 | 1060. | 37.500000 | 795.345411 | 3272675. |

---

## Layering Correction Equivalent Depths of Soil & Rock Layers

---

| Layer No. | Top of Layer Below Pile Head ft | Equivalent Top Depth Below Grnd Surf ft | Same Layer Type As Layer Above | Layer is Rock or is Below Rock Layer | F0 Integral for Layer lbs | F1 Integral for Layer lbs |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | N.A. | No | 0.00 | 20692. |
| 2 | 5.0000 | 13.2346 | No | No | 20692. | 50400. |
| 3 | 21.0000 | 9.8929 | No | No | 71092. | 114329. |
| 4 | 25.0000 | 37.2813 | No | No | 185421. | 94399. |
| 5 | 40.0000 | 18.4599 | No | No | 279820. | N.A. |

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

---

## Summary of Pile-head Responses for Conventional Analyses

---

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs

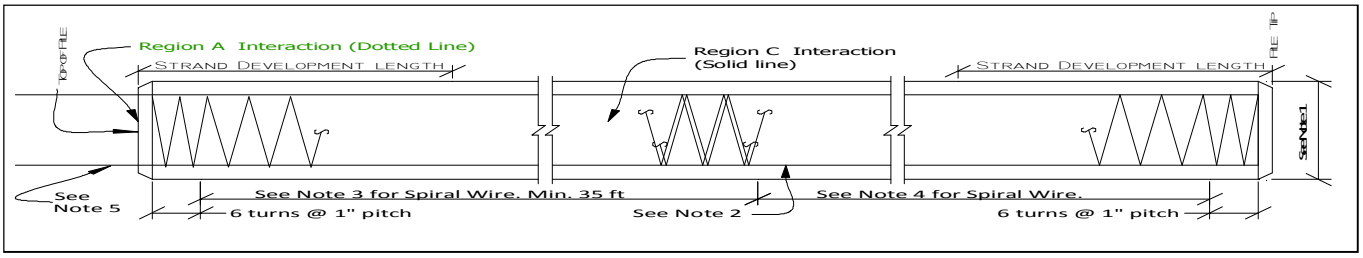
New LPile (USCS units) - 12 inch sq - 1 in def.lp10o
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

| Load Case No. | Load Type | Pile-head Deflection inches | Pile-head Rotation radians | Max Shear in Pile lbs | Max Moment in Pile in-lbs |
|---|---|---|---|---|---|
| 1 | 5 | 1.000000 | 0.0000 | 25755. | -1029133. |
| 2 | 4 | 1.000000 | -0.012384 | 16941. | 652861. |

Maximum pile-head deflection = 1.0000000000 inches
Maximum pile-head rotation = -0.0123843047 radians = -0.709568 deg.

The analysis ended normally.

# 14" Sq; f'c = 6,000 psi, 749 psi prestress with No Rebars Pile Details and Interaction Diagram.




NOTE 1; 14" SQUARE PILE, CONC. F'C = 6000 PSI, AREA (AG) = 194.88 SQ-IN.

NOTE 2; 6 - 1/2"ø 270K STRAND ON 9" CIRCLE, STRESSED TO 70% = 749 PSI ( FPC)

NOTE 3; PROVIDE W11.0 @ 2" PITCH FOR TOP 35 FT MINIMUM

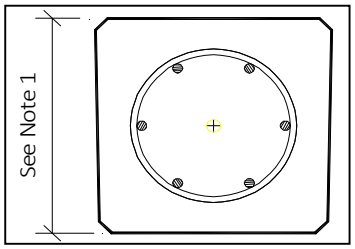
NOTE 4; PROVIDE W8.0 @ 2.875" PITCH WITH 2" COVER

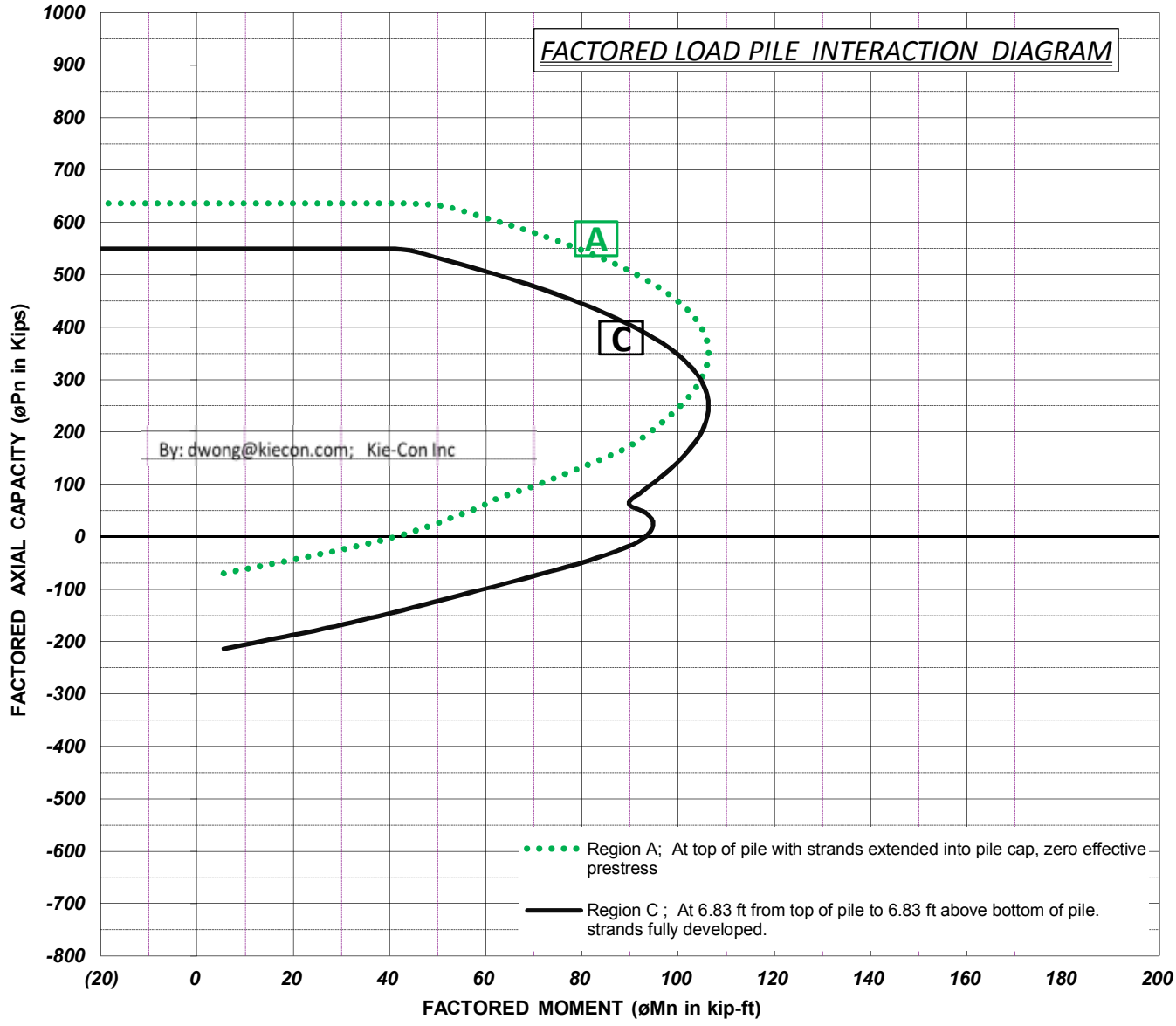
NOTE 5; STRANDS EXTENDED 4.0 FT

NOTE 6; ALLOWABLE SERVICE LOAD BASED ON N = AG(0.33 F'C-0.27FPC) = 346 KIPS

NOTE 7; **PLEASE EMAIL US IF YOU LIKE TO SEE THE INTERACTION DIAGRAMS OF DIFFERENT REBAR SIZES OR COMBINATIONS**

NOTE 8; **THE INTERACTION DIAGRAM SHOWN BELOW IS A GUIDELINE ONLY. ACTUAL DESIGN MUST BE REVIEWED BY EOR FOR EACH PROJECT.**

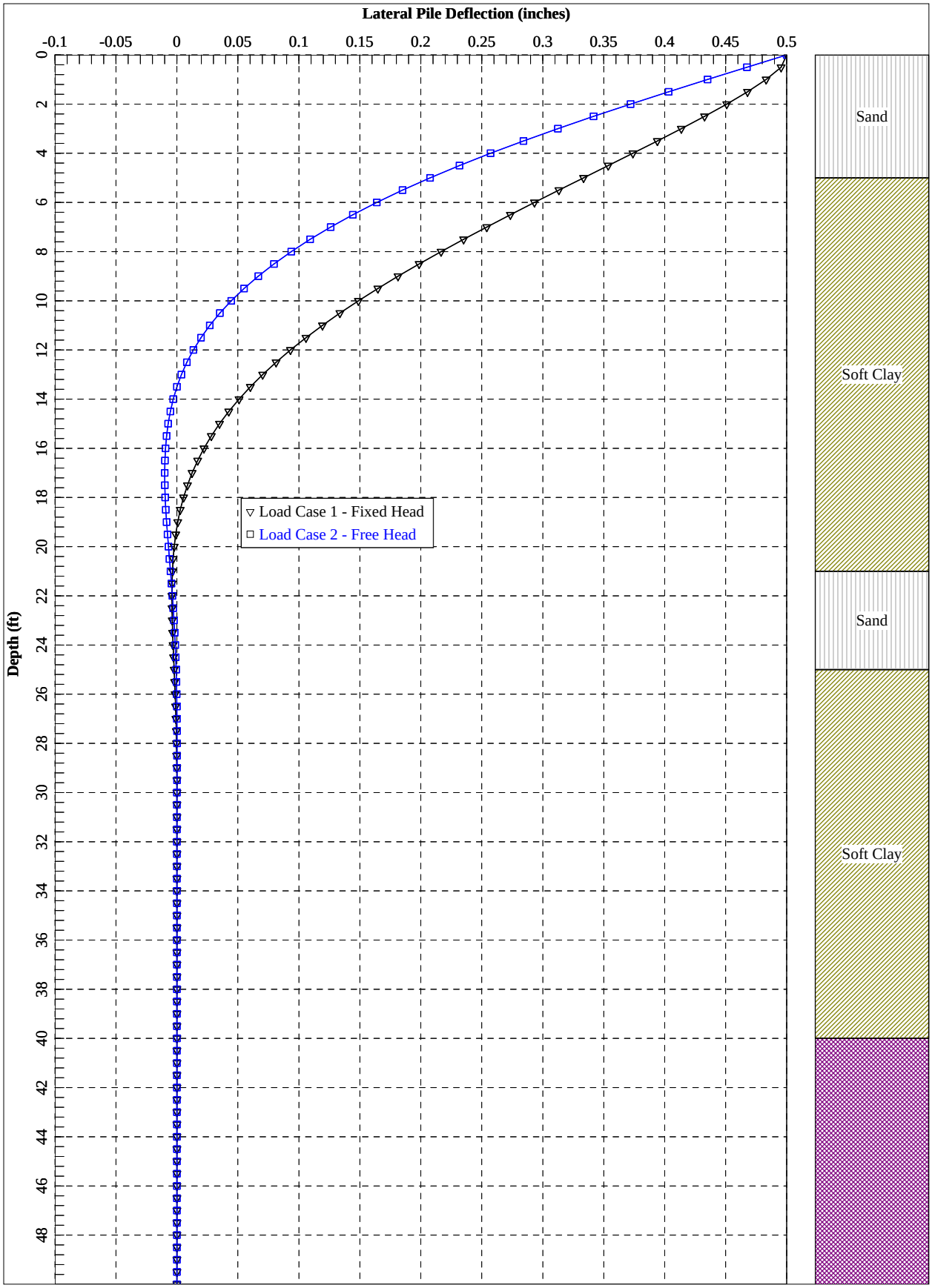


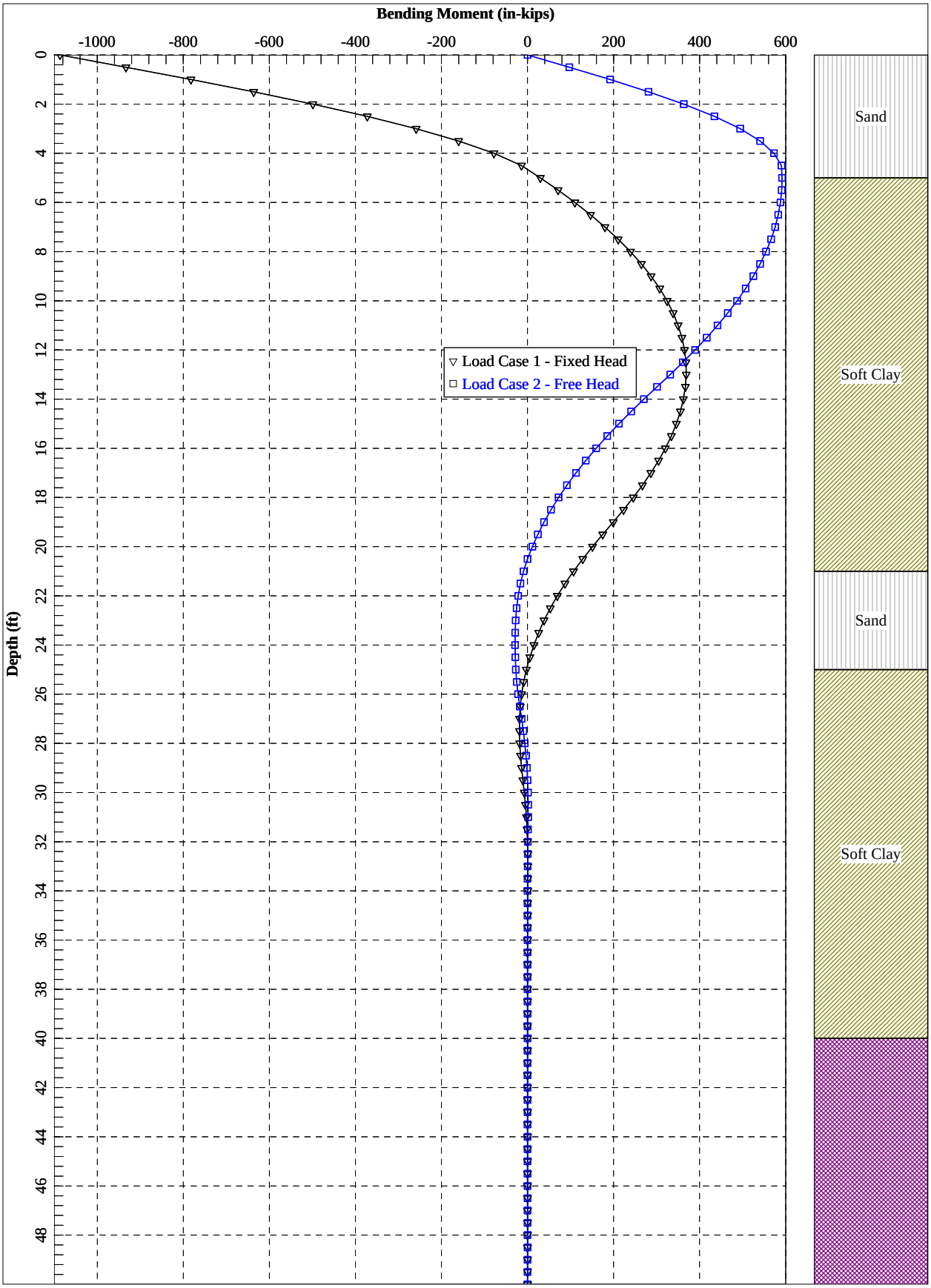

**Pile Manufacturer: KIE-CON Inc** Web Site : Kiecon.com Tel: 925/754-9494 Fax: 925/754-0624

**3551 Wilbur Ave, Antioch, Califorina** By: dwong@kiecon.com (Danny Wong) Page / Rev #:

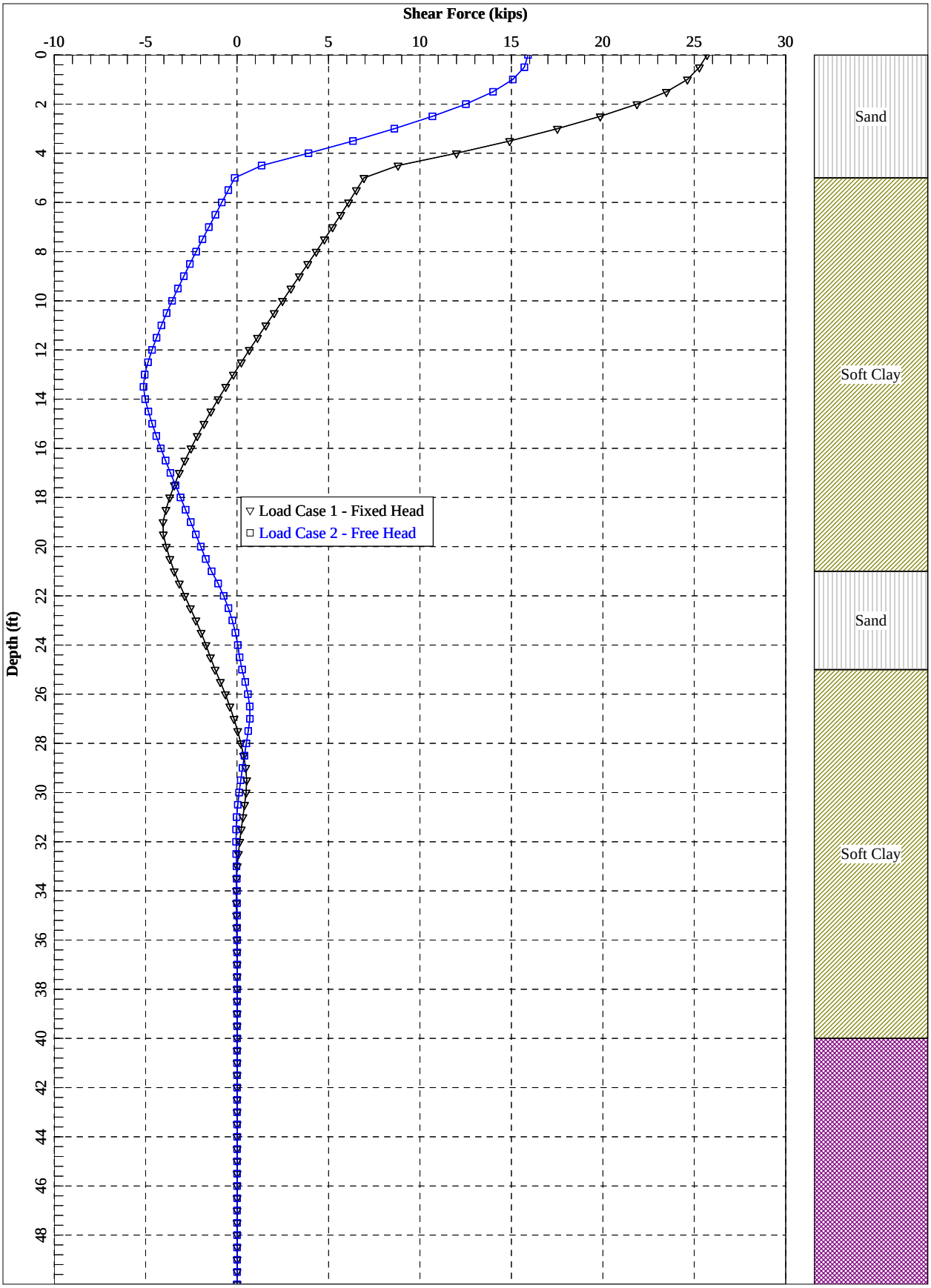
**14 Inch Square Prestressed Concrete Pile**
**0.5 Inch Deflection**



**14 Inch Square Prestressed Concrete Pile**
**0.5 Inch Deflection**



**14 Inch Square Prestressed Concrete Pile**
**0.5 Inch Deflection**



LPile for Windows, Version 2018-10.007

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
© 1985-2018 by Ensoft, Inc.
All Rights Reserved

This copy of LPile is being used by:

LACO Associates
Geo/Environmental
Serial Number of Security Device: 136157127

This copy of LPile is licensed for exclusive use by:

LACO Associates, Santa Rosa, CA

Use of this program by any entity other than LACO Associates, Santa Rosa, CA
is a violation of the software license agreement.

## Files Used for Analysis

Path to file locations on this computer:
\7900\7986 Carollo Engineers\7986.01 Arcata Wastewater Treatment Facility Design
\08 Geology\Reports\Geotech Report_Working Files-Archive\L-Pile\JER output\

Name of the input data file:
New LPile (USCS units) - 14 inch sq - 0.5 in def.lp10

Name of the output report file:
New LPile (USCS units) - 14 inch sq - 0.5 in def.lp10

Name of the plot output file:
New LPile (USCS units) - 14 inch sq - 0.5 in def.lp10

Name of the runtime message file:
New LPile (USCS units) - 14 inch sq - 0.5 in def.lp10

## Date and Time of Analysis

Date: November 20, 2018 Time: 18:03:48

## Problem Title

Project Name: Wastewater Treatment Facility Improvements

Job Number: 7986.01

Client: Carollo Engineers

Engineer: LACO Associates

Description: Lateral Load Analysis - 14-inch square precast concrete

---

## Program Options and Settings

---

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

| | | |
|---|---|---|
| - Maximum number of iterations allowed | = | 500 |
| - Deflection tolerance for convergence | = | 1.0000E-05 in |
| - Maximum allowable deflection | = | 100.0000 in |
| - Number of pile increments | = | 100 |

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

---

## Pile Structural Properties and Geometry

---

| | | |
|---|---|---|
| Number of pile sections defined | = | 1 |
| Total length of pile | = | 50.000 ft |
| Depth of ground surface below top of pile | = | 0.0000 ft |

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

| Point No. | Depth Below Pile Head feet | Pile Diameter inches |
|---|---|---|
| 1 | 0.000 | 14.0000 |
| 2 | 50.000 | 14.0000 |

Input Structural Properties for Pile Sections:

Pile Section No. 1:

| | | |
|---|---|---|
| Section 1 is a square prestressed concrete pile | | |
| Length of section | = | 50.000000 ft |
| Pile Width | = | 14.000000 in |
| Corner Chamfer | = | 0.0000 in |
| Shear capacity of section | = | 0.0000 lbs |

## Ground Slope and Pile Batter Angles

| | | |
|---|---|---|
| Ground Slope Angle | = | 0.000 degrees |
| | = | 0.000 radians |
| Pile Batter Angle | = | 0.000 degrees |
| | = | 0.000 radians |

## Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 0.0000 ft |
| Distance from top of pile to bottom of layer | = | 5.000000 ft |
| Effective unit weight at top of layer | = | 130.000000 pcf |
| Effective unit weight at bottom of layer | = | 130.000000 pcf |
| Friction angle at top of layer | = | 34.000000 deg. |
| Friction angle at bottom of layer | = | 34.000000 deg. |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for subgrade k will be computed for this layer.

Layer 2 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 5.000000 ft |
| Distance from top of pile to bottom of layer | = | 21.000000 ft |
| Effective unit weight at top of layer | = | 95.000000 pcf |
| Effective unit weight at bottom of layer | = | 100.000000 pcf |

| | | |
|---|---|---|
| Undrained cohesion at top of layer | = | 200.000000 psf |
| Undrained cohesion at bottom of layer | = | 500.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 21.000000 ft |
| Distance from top of pile to bottom of layer | = | 25.000000 ft |
| Effective unit weight at top of layer | = | 120.000000 pcf |
| Effective unit weight at bottom of layer | = | 120.000000 pcf |
| Friction angle at top of layer | = | 30.000000 deg. |
| Friction angle at bottom of layer | = | 30.000000 deg. |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for subgrade k will be computed for this layer.

Layer 4 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 25.000000 ft |
| Distance from top of pile to bottom of layer | = | 40.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 115.000000 pcf |
| Undrained cohesion at top of layer | = | 600.000000 psf |
| Undrained cohesion at bottom of layer | = | 800.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is cemented silt with cohesion and friction

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 40.000000 ft |
| Distance from top of pile to bottom of layer | = | 70.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 110.000000 pcf |
| Undrained cohesion at top of layer | = | 350.000000 psf |
| Undrained cohesion at bottom of layer | = | 350.000000 psf |
| Friction angle at top of layer | = | 25.000000 deg. |
| Friction angle at bottom of layer | = | 25.000000 deg. |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for Epsilon-50 will be computed for this layer.
NOTE: Default values for subgrade k will be computed for this layer.

(Depth of the lowest soil layer extends 20.000 ft below the pile tip)

---

## Static Loading Type

---

Static loading criteria were used when computing p-y curves for all analyses.

## Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

| Load No. | Load Type | Condition 1 | | Condition 2 | | Axial Thrust Force, lbs |
|---|---|---|---|---|---|---|
| 1 | 5 | y = | 0.500000 in | S = | 0.0000 in/in | 50000. |
| 2 | 4 | y = | 0.500000 in | M = | 0.0000 in-lbs | 50000. |

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

## Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions of Square Prestressed Pile Section:

| | | |
|---|---|---|
| Length of Section | = | 50.0000 ft |
| Pile Width | = | 14.000 in |
| Corner Chamfer | = | 0.000 in |

Prestressing Strand Details:

| | | |
|---|---|---|
| Strand Type | = | PCI 270 |
| Yield Stress, fpu | = | 270. ksi |

Stress-strain curve defined using PCI 270 7-wire Lo-lax equation
If eps > 0.0086 fpu (ksi) = 270 - 0.04/(eps-0.007)

| | | |
|---|---|---|
| Number of Reinforcing Strands | = | 6 |
| Cross-sectional Area of Single Strand | = | 0.153 sq. in. |
| Concrete Cover Thickness Over Strands | = | 2.000 in |

Prestressing Strand Geometry:

| Strand No. | Diameter in | Area sq. in | X in | Y in |
|---|---|---|---|---|
| 1 | 0.500 | 0.153 | 4.750 | 0.000 |
| 2 | 0.500 | 0.153 | 2.375 | 4.114 |

| | | | | |
|---|---|---|---|---|
| 3 | 0.500 | 0.153 | -2.375 | 4.114 |
| 4 | 0.500 | 0.153 | -4.750 | 0.000 |
| 5 | 0.500 | 0.153 | -2.375 | -4.114 |
| 6 | 0.500 | 0.153 | 2.375 | -4.114 |

Computation of Loss of Prestress:
---

| | | |
|---|---|---|
| Initial Prestressing Force | = | 146.000 kips |
| Fraction of Loss of Prestress | = | 0.100 |
| Effective Prestressing Force After Losses | = | 131.400 kips |
| Area of Concrete, Ac | = | 195.082 sq.in |
| Area of Steel, As | = | 0.918 sq.in |
| Stress in Concrete After Losses, f_pc | = | 0.674 ksi |
| Stress in Steel After Losses | = | -143.137 ksi |
| Compressive Strain in Concrete After Losses | = | 0.0001526 |
| Tensile Strain in Steel After Losses | = | -0.0051120 |
| Axial Tension Load for Cracking of Concrete | = | -185.012 kips |

Estimated Structural Capacities Computed Using PCI Equations:
---

| | | |
|---|---|---|
| Nom. Axial Cap., Pn = (0.85 f'c - 0.60 f_pc) Ag | = | 920.389 kips |
| Unfac. Axial Load Cap. N = (0.33 f'c - 0.27 f_pc) Ag | = | 352.435 kips |
| Axial Capacity in Tension, Nt = As fpu | = | -247.860 kips |
| Nom. Moment Capacity, Mn = 0.37 D As fpu | = | 1283.915 in-kip |

Note: The estimate of nominal moment capacity is based on equations that assume compressive strength of concrete is 6,000 psi (41.4 MPa), the value of prestress after losses is 700 psi (4.83 MPa), and axial thrust force is zero. When input values for these factors are different, the estimated value of nominal moment capacity will differ from the capacity computed by LPile and should be considered only as an approximate check.

Concrete Properties:
---

| | | |
|---|---|---|
| Compressive Strength of Concrete | = | 6000. psi |
| Modulus of Elasticity of Concrete | = | 4415201. psi |
| Modulus of Rupture of Prestressed Concrete | = | -309.838668 psi |
| Compression Strain at Peak Stress | = | 0.002310 |
| Tensile Strain at Fracture of Concrete | = | -0.0000604 |
| Maximum Coarse Aggregate Size | = | 0.750000 in |

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

| Number | Axial Thrust Force kips |
|---|---|
| 1 | 50.000 |

---
Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1
---

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

| Load No. | Axial Thrust kips | Nominal Mom. Cap. in-kip | Max. Comp. Strain |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | 50.000 | 1440.759 | 0.00300000 |

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, Section 9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

| Axial Load No. | Resist. Factor for Moment | Nominal Moment Cap in-kips | Ult. (Fac) Ax. Thrust kips | Ult. (Fac) Moment Cap in-kips | Bend. Stiff. at Ult Mom kip-in^2 |
|---|---|---|---|---|---|
| 1 | 0.65 | 1441. | 32.500000 | 936.493219 | 6286542. |
| 1 | 0.70 | 1441. | 35.000000 | 1009. | 5209154. |
| 1 | 0.75 | 1441. | 37.500000 | 1081. | 4380143. |

## Layering Correction Equivalent Depths of Soil & Rock Layers

| Layer No. | Top of Layer Below Pile Head ft | Equivalent Top Depth Below Grnd Surf ft | Same Layer Type As Layer Above | Layer is Rock or is Below Rock Layer | F0 Integral for Layer lbs | F1 Integral for Layer lbs |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | N.A. | No | 0.00 | 23282. |
| 2 | 5.0000 | 12.9410 | No | No | 23282. | 58800. |
| 3 | 21.0000 | 10.2698 | No | No | 82082. | 123282. |
| 4 | 25.0000 | 35.8874 | No | No | 205364. | 110132. |
| 5 | 40.0000 | 19.0666 | No | No | 315496. | N.A. |

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

## Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs

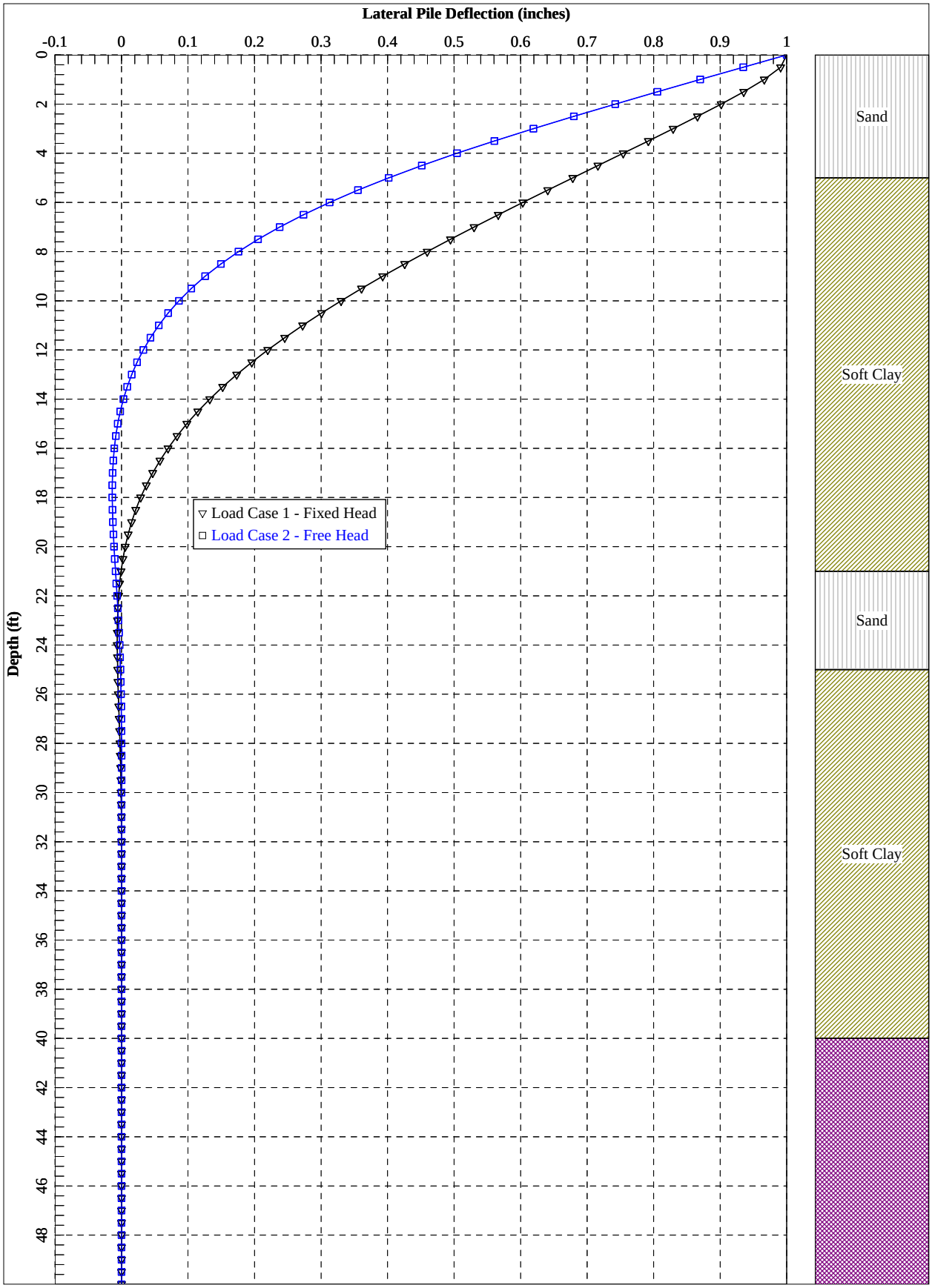
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

| Load Case No. | Load Type | Pile-head Deflection inches | Pile-head Rotation radians | Max Shear in Pile lbs | Max Moment in Pile in-lbs |
|---|---|---|---|---|---|
| 1 | 5 | 0.500000 | 0.0000 | 25700. | -1086502. |
| 2 | 4 | 0.500000 | -0.005433 | 15910. | 591436. |

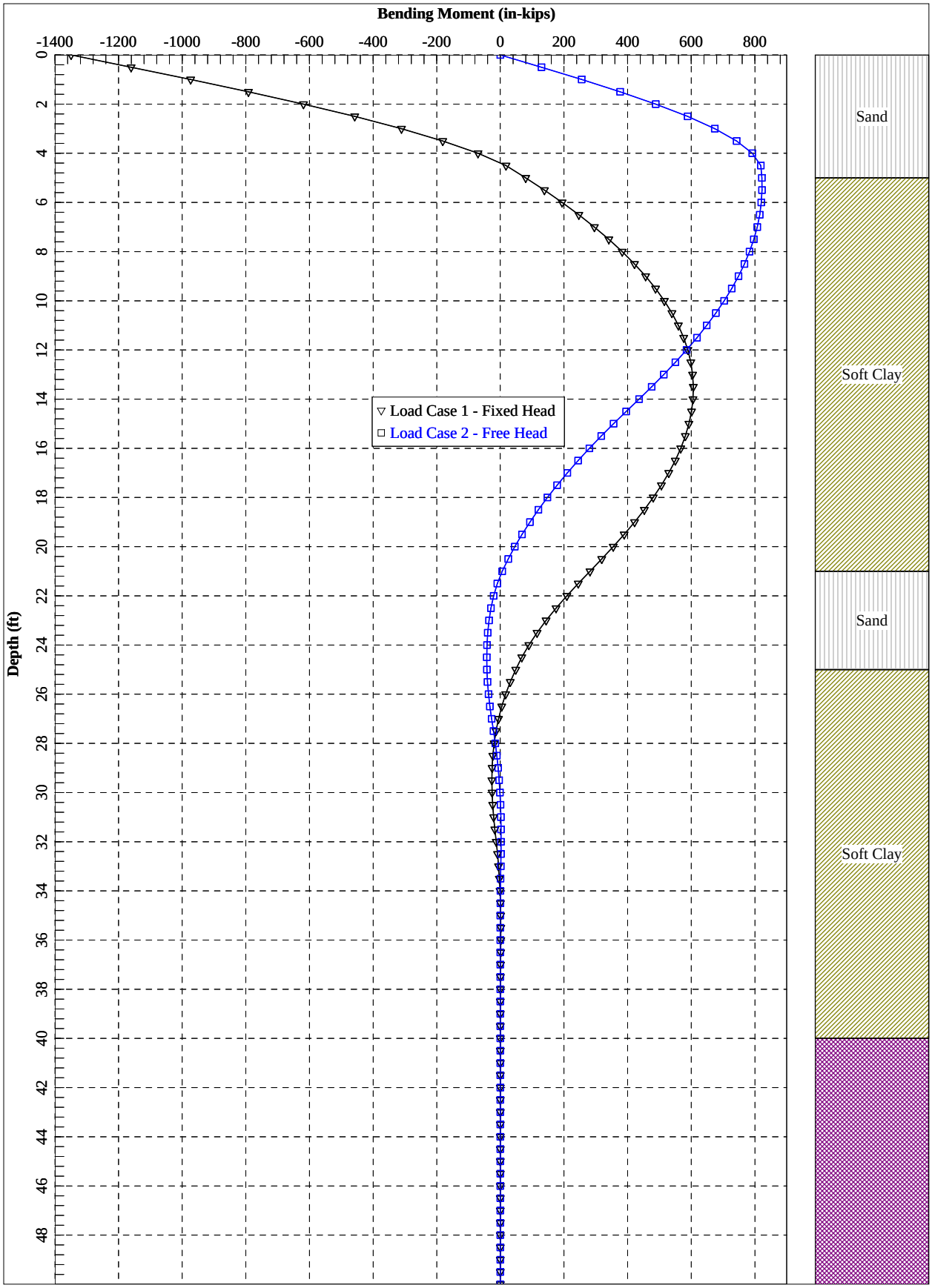
Maximum pile-head deflection = 0.5000000000 inches
Maximum pile-head rotation = -0.0054329859 radians = -0.311287 deg.

The analysis ended normally.

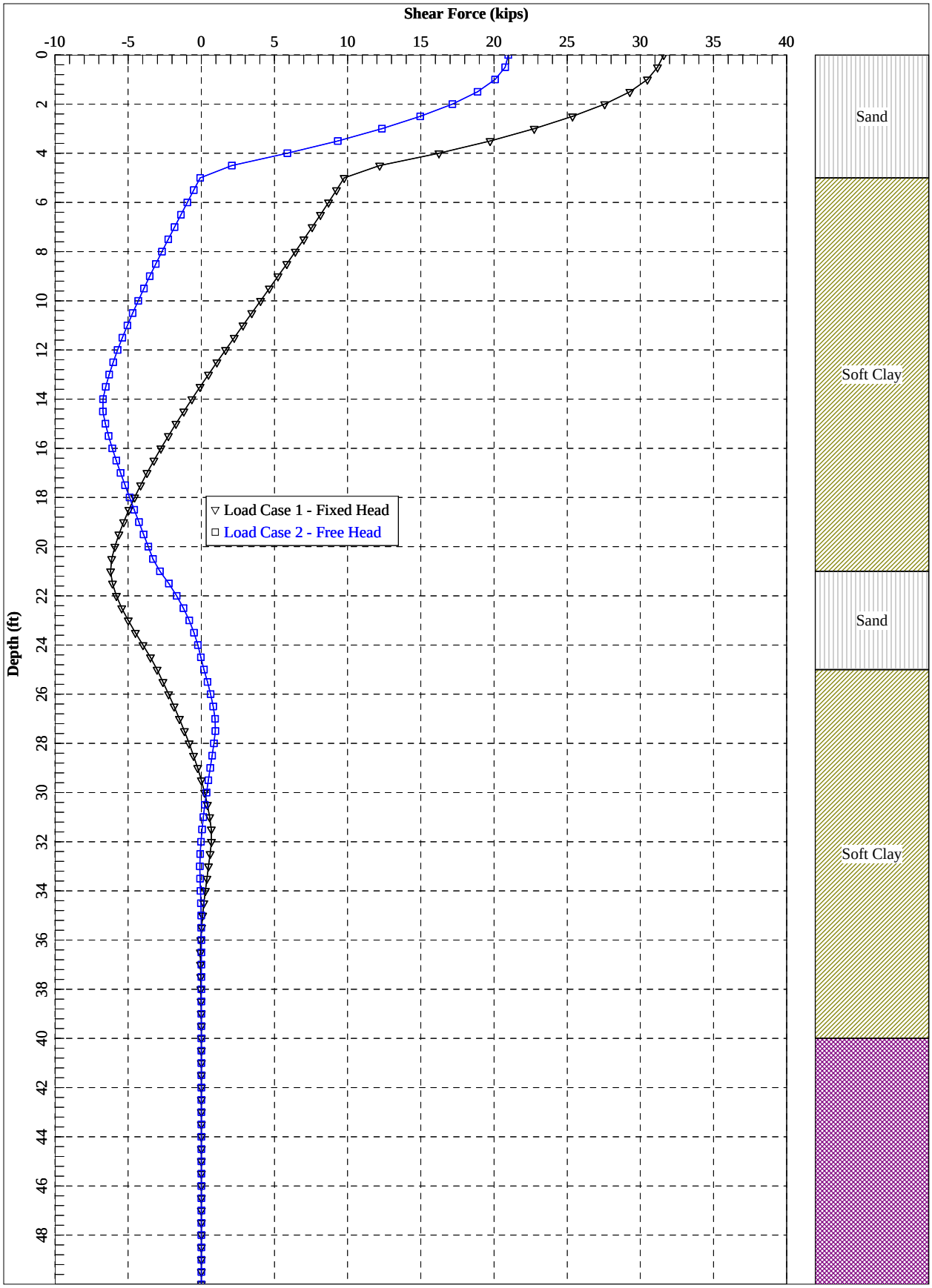
**14 Inch Square Prestressed Concrete Pile**
**1.0 Inch Deflection**



**14 Inch Square Prestressed Concrete Pile**
**1.0 Inch Deflection**



**14 Inch Square Prestressed Concrete Pile**
**1.0 Inch Deflection**



LPile for Windows, Version 2018-10.007

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
© 1985-2018 by Ensoft, Inc.
All Rights Reserved

This copy of LPile is being used by:

LACO Associates
Geo/Environmental
Serial Number of Security Device: 136157127

This copy of LPile is licensed for exclusive use by:

LACO Associates, Santa Rosa, CA

Use of this program by any entity other than LACO Associates, Santa Rosa, CA
is a violation of the software license agreement.

## Files Used for Analysis

Path to file locations on this computer:
\7900\7986 Carollo Engineers\7986.01 Arcata Wastewater Treatment Facility Design
\08 Geology\Reports\Geotech Report_Working Files-Archive\L-Pile\JER output\

Name of the input data file:
New LPile (USCS units) - 14 inch sq - 1 in def.lp10

Name of the output report file:
New LPile (USCS units) - 14 inch sq - 1 in def.lp10

Name of the plot output file:
New LPile (USCS units) - 14 inch sq - 1 in def.lp10

Name of the runtime message file:
New LPile (USCS units) - 14 inch sq - 1 in def.lp10

## Date and Time of Analysis

Date: November 20, 2018 Time: 18:13:35

## Problem Title

Project Name: Wastewater Treatment Facility Improvements

Job Number: 7986.01

New LPile (USCS units) - 14 inch sq - 1 in def.lp10o

Client: Carollo Engineers

Engineer: LACO Associates

Description: Lateral Load Analysis - 14-inch square precast concrete

---

## Program Options and Settings

---

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

| | | |
|---|---|---|
| - Maximum number of iterations allowed | = | 500 |
| - Deflection tolerance for convergence | = | 1.0000E-05 in |
| - Maximum allowable deflection | = | 100.0000 in |
| - Number of pile increments | = | 100 |

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

---

## Pile Structural Properties and Geometry

---

| | | |
|---|---|---|
| Number of pile sections defined | = | 1 |
| Total length of pile | = | 50.000 ft |
| Depth of ground surface below top of pile | = | 0.0000 ft |

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

| Point No. | Depth Below Pile Head feet | Pile Diameter inches |
|---|---|---|
| 1 | 0.000 | 14.0000 |
| 2 | 50.000 | 14.0000 |

Input Structural Properties for Pile Sections:

Pile Section No. 1:

| | | |
|---|---|---|
| Section 1 is a square prestressed concrete pile | | |
| Length of section | = | 50.000000 ft |
| Pile Width | = | 14.000000 in |
| Corner Chamfer | = | 0.0000 in |
| Shear capacity of section | = | 0.0000 lbs |

## Ground Slope and Pile Batter Angles

| | | |
|---|---|---|
| Ground Slope Angle | = | 0.000 degrees |
| | = | 0.000 radians |
| Pile Batter Angle | = | 0.000 degrees |
| | = | 0.000 radians |

## Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 0.0000 ft |
| Distance from top of pile to bottom of layer | = | 5.000000 ft |
| Effective unit weight at top of layer | = | 130.000000 pcf |
| Effective unit weight at bottom of layer | = | 130.000000 pcf |
| Friction angle at top of layer | = | 34.000000 deg. |
| Friction angle at bottom of layer | = | 34.000000 deg. |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for subgrade k will be computed for this layer.

Layer 2 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 5.000000 ft |
| Distance from top of pile to bottom of layer | = | 21.000000 ft |
| Effective unit weight at top of layer | = | 95.000000 pcf |
| Effective unit weight at bottom of layer | = | 100.000000 pcf |

| | | |
|---|---|---|
| Undrained cohesion at top of layer | = | 200.000000 psf |
| Undrained cohesion at bottom of layer | = | 500.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 21.000000 ft |
| Distance from top of pile to bottom of layer | = | 25.000000 ft |
| Effective unit weight at top of layer | = | 120.000000 pcf |
| Effective unit weight at bottom of layer | = | 120.000000 pcf |
| Friction angle at top of layer | = | 30.000000 deg. |
| Friction angle at bottom of layer | = | 30.000000 deg. |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for subgrade k will be computed for this layer.

Layer 4 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 25.000000 ft |
| Distance from top of pile to bottom of layer | = | 40.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 115.000000 pcf |
| Undrained cohesion at top of layer | = | 600.000000 psf |
| Undrained cohesion at bottom of layer | = | 800.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is cemented silt with cohesion and friction

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 40.000000 ft |
| Distance from top of pile to bottom of layer | = | 70.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 110.000000 pcf |
| Undrained cohesion at top of layer | = | 350.000000 psf |
| Undrained cohesion at bottom of layer | = | 350.000000 psf |
| Friction angle at top of layer | = | 25.000000 deg. |
| Friction angle at bottom of layer | = | 25.000000 deg. |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for Epsilon-50 will be computed for this layer.
NOTE: Default values for subgrade k will be computed for this layer.

(Depth of the lowest soil layer extends 20.000 ft below the pile tip)

---

## Static Loading Type

---

Static loading criteria were used when computing p-y curves for all analyses.

---

## Pile-head Loading and Pile-head Fixity Conditions

---

Number of loads specified = 2

| Load No. | Load Type | Condition 1 | | Condition 2 | | Axial Thrust Force, lbs |
|---|---|---|---|---|---|---|
| 1 | 5 | y = | 1.000000 in | S = | 0.0000 in/in | 50000. |
| 2 | 4 | y = | 1.000000 in | M = | 0.0000 in-lbs | 50000. |

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

---

## Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

### Dimensions of Square Prestressed Pile Section:

| | | |
|---|---|---|
| Length of Section | = | 50.0000 ft |
| Pile Width | = | 14.000 in |
| Corner Chamfer | = | 0.000 in |

### Prestressing Strand Details:

| | | |
|---|---|---|
| Strand Type | = | PCI 270 |
| Yield Stress, fpu | = | 270. ksi |

Stress-strain curve defined using PCI 270 7-wire Lo-lax equation
If eps > 0.0086 fpu (ksi) = 270 - 0.04/(eps-0.007)

| | | |
|---|---|---|
| Number of Reinforcing Strands | = | 6 |
| Cross-sectional Area of Single Strand | = | 0.153 sq. in. |
| Concrete Cover Thickness Over Strands | = | 2.000 in |

### Prestressing Strand Geometry:

| Strand No. | Diameter in | Area sq. in | X in | Y in |
|---|---|---|---|---|
| 1 | 0.500 | 0.153 | 4.750 | 0.000 |
| 2 | 0.500 | 0.153 | 2.375 | 4.114 |

| | | | | |
|---|---|---|---|---|
| 3 | 0.500 | 0.153 | -2.375 | 4.114 |
| 4 | 0.500 | 0.153 | -4.750 | 0.000 |
| 5 | 0.500 | 0.153 | -2.375 | -4.114 |
| 6 | 0.500 | 0.153 | 2.375 | -4.114 |

Computation of Loss of Prestress:

| | | |
|---|---|---|
| Initial Prestressing Force | = | 146.000 kips |
| Fraction of Loss of Prestress | = | 0.100 |
| Effective Prestressing Force After Losses | = | 131.400 kips |
| Area of Concrete, Ac | = | 195.082 sq.in |
| Area of Steel, As | = | 0.918 sq.in |
| Stress in Concrete After Losses, f_pc | = | 0.674 ksi |
| Stress in Steel After Losses | = | -143.137 ksi |
| Compressive Strain in Concrete After Losses | = | 0.0001526 |
| Tensile Strain in Steel After Losses | = | -0.0051120 |
| Axial Tension Load for Cracking of Concrete | = | -185.012 kips |

Estimated Structural Capacities Computed Using PCI Equations:

| | | |
|---|---|---|
| Nom. Axial Cap., Pn = (0.85 f'c - 0.60 f_pc) Ag | = | 920.389 kips |
| Unfac. Axial Load Cap. N = (0.33 f'c - 0.27 f_pc) Ag | = | 352.435 kips |
| Axial Capacity in Tension, Nt = As fpu | = | -247.860 kips |
| Nom. Moment Capacity, Mn = 0.37 D As fpu | = | 1283.915 in-kip |

Note: The estimate of nominal moment capacity is based on equations that assume compressive strength of concrete is 6,000 psi (41.4 MPa), the value of prestress after losses is 700 psi (4.83 MPa), and axial thrust force is zero. When input values for these factors are different, the estimated value of nominal moment capacity will differ from the capacity computed by LPile and should be considered only as an approximate check.

Concrete Properties:

| | | |
|---|---|---|
| Compressive Strength of Concrete | = | 6000. psi |
| Modulus of Elasticity of Concrete | = | 4415201. psi |
| Modulus of Rupture of Prestressed Concrete | = | -309.838668 psi |
| Compression Strain at Peak Stress | = | 0.002310 |
| Tensile Strain at Fracture of Concrete | = | -0.0000604 |
| Maximum Coarse Aggregate Size | = | 0.750000 in |

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

| Number | Axial Thrust Force kips |
|---|---|
| 1 | 50.000 |

---

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

---

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

| Load No. | Axial Thrust kips | Nominal Mom. Cap. in-kip | Max. Comp. Strain |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | 50.000 | 1440.759 | 0.00300000 |

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, Section 9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

| Axial Load No. | Resist. Factor for Moment | Nominal Moment Cap in-kips | Ult. (Fac) Ax. Thrust kips | Ult. (Fac) Moment Cap in-kips | Bend. Stiff. at Ult Mom kip-in^2 |
|---|---|---|---|---|---|
| 1 | 0.65 | 1441. | 32.500000 | 936.493219 | 6286542. |
| 1 | 0.70 | 1441. | 35.000000 | 1009. | 5209154. |
| 1 | 0.75 | 1441. | 37.500000 | 1081. | 4380143. |

## Layering Correction Equivalent Depths of Soil & Rock Layers

| Layer No. | Top of Layer Below Pile Head ft | Equivalent Top Depth Below Grnd Surf ft | Same Layer Type As Layer Above | Layer is Rock or is Below Rock Layer | F0 Integral for Layer lbs | F1 Integral for Layer lbs |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | N.A. | No | 0.00 | 23282. |
| 2 | 5.0000 | 12.9410 | No | No | 23282. | 58800. |
| 3 | 21.0000 | 10.2698 | No | No | 82082. | 123282. |
| 4 | 25.0000 | 35.8874 | No | No | 205364. | 110132. |
| 5 | 40.0000 | 19.0666 | No | No | 315496. | N.A. |

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

## Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs

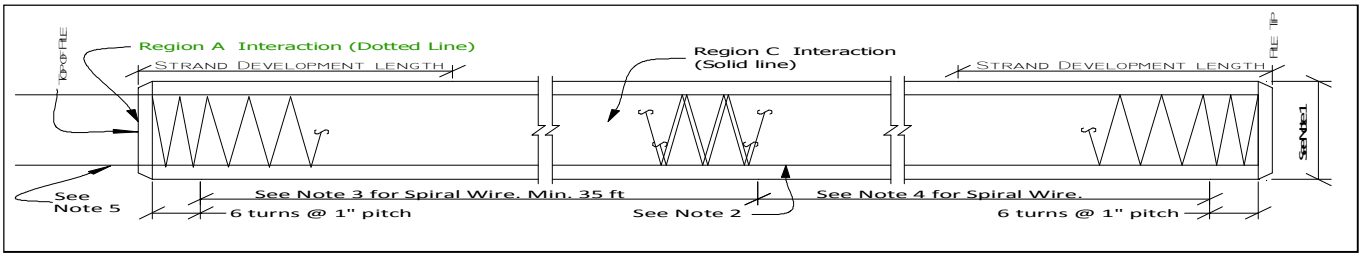
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

| Load Case No. | Load Type | Pile-head Deflection inches | Pile-head Rotation radians | Max Shear in Pile lbs | Max Moment in Pile in-lbs |
|---|---|---|---|---|---|
| 1 | 5 | 1.000000 | 0.0000 | 31603. | -1349281. |
| 2 | 4 | 1.000000 | -0.010871 | 20972. | 822622. |

Maximum pile-head deflection = 1.0000000000 inches
Maximum pile-head rotation = -0.0108714982 radians = -0.622891 deg.

The analysis ended normally.

# 16" Sq; f'c = 6,000 psi, 766 psi prestress with No Rebars Pile Details and Interaction Diagram.




NOTE 1; 16" SQUARE PILE, CONC. F'C = 6000 PSI, AREA (AG) = 254 SQ-IN.

NOTE 2; 8 - 1/2"ø 270K STRAND ON 10-1/2" CIRCLE, STRESSED TO 70% = 766 PSI ( FPC)

NOTE 3; PROVIDE WI4.0 @ 2" PITCH FOR TOP 35 FT MINIMUM

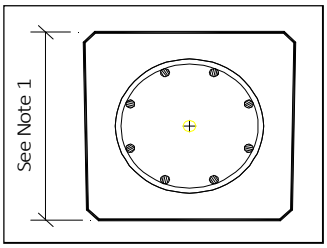
NOTE 4; PROVIDE W8.0 @ 2.5" PITCH WITH 2" COVER

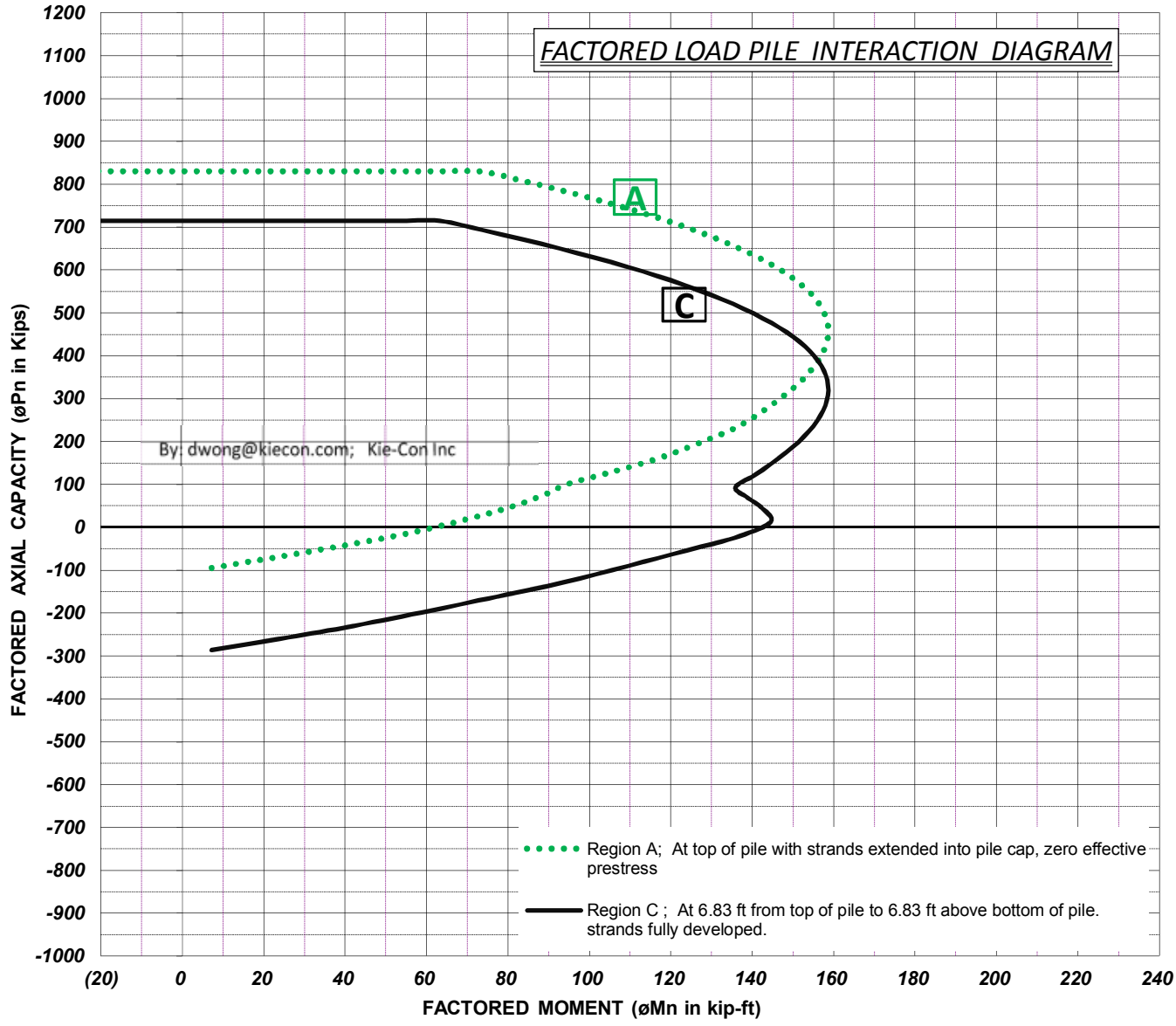
NOTE 5; STRANDS EXTENDED 4.0 FT

NOTE 6; ALLOWABLE SERVICE LOAD BASED ON N = AG(0.33 F'C-0.27FPC) = 450 KIPS

NOTE 7; **PLEASE EMAIL US IF YOU LIKE TO SEE THE INTERACTION DIAGRAMS OF DIFFERENT REBAR SIZES OR COMBINATIONS**

NOTE 8; **THE INTERACTION DIAGRAM SHOWN BELOW IS A GUIDELINE ONLY. ACTUAL DESIGN MUST BE REVIEWED BY EOR FOR EACH PROJECT.**

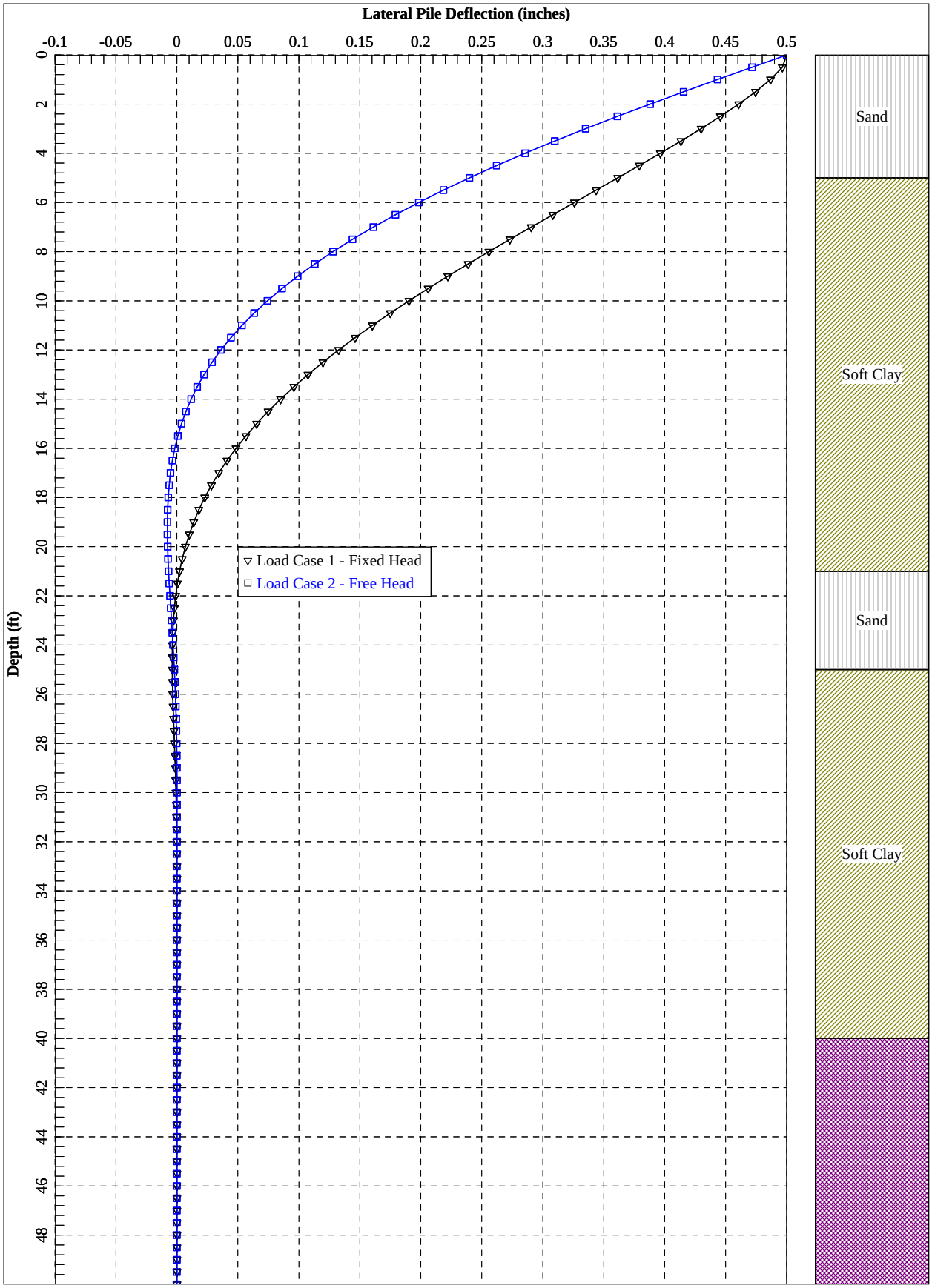


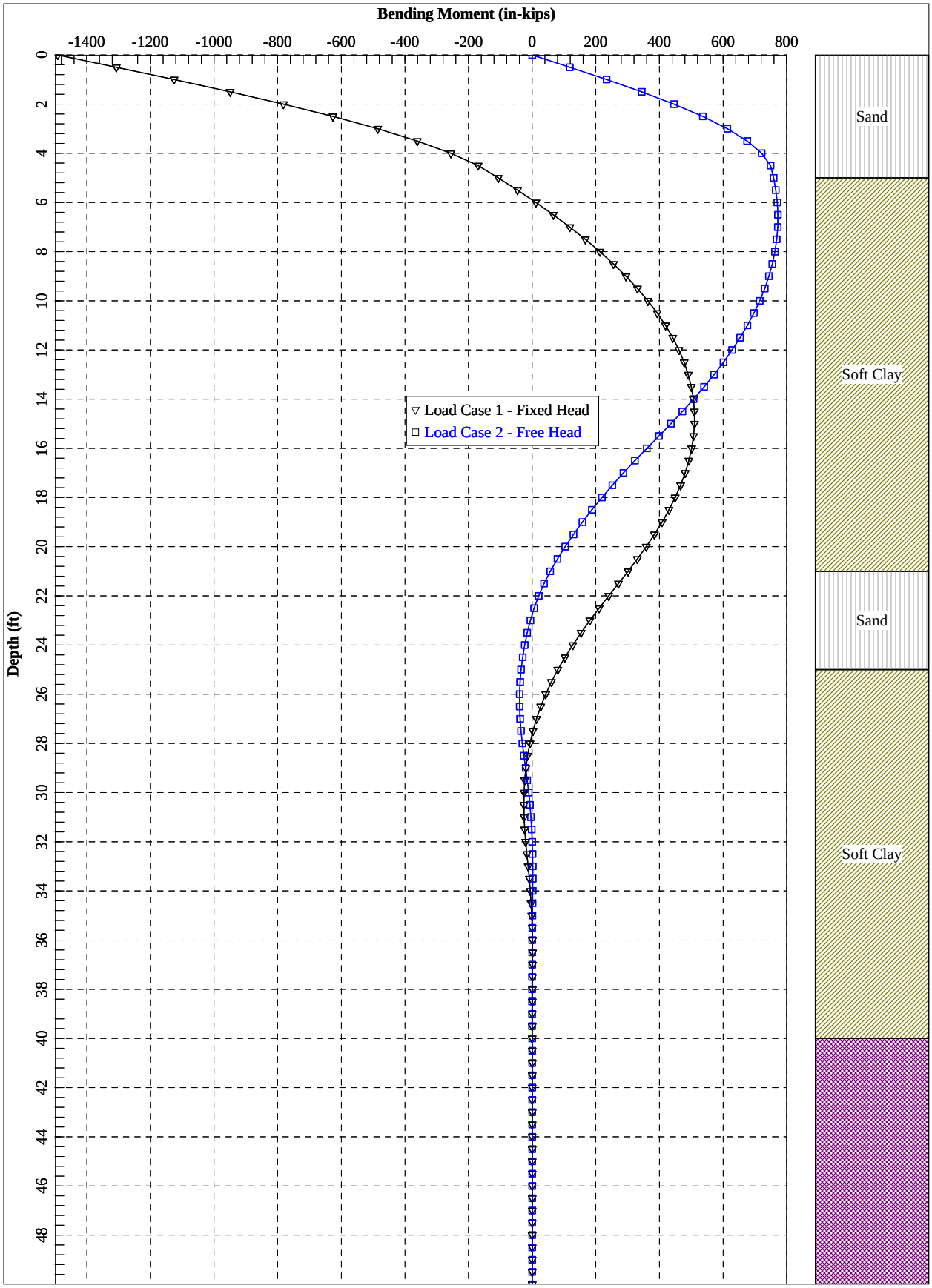

**Pile Manufacturer: KIE-CON Inc** Web Site : Kiecon.com Tel: 925/754-9494 Fax: 925/754-0624

**3551 Wilbur Ave, Antioch, Califorina** By: dwong@kiecon.com (Danny Wong) Page / Rev #:

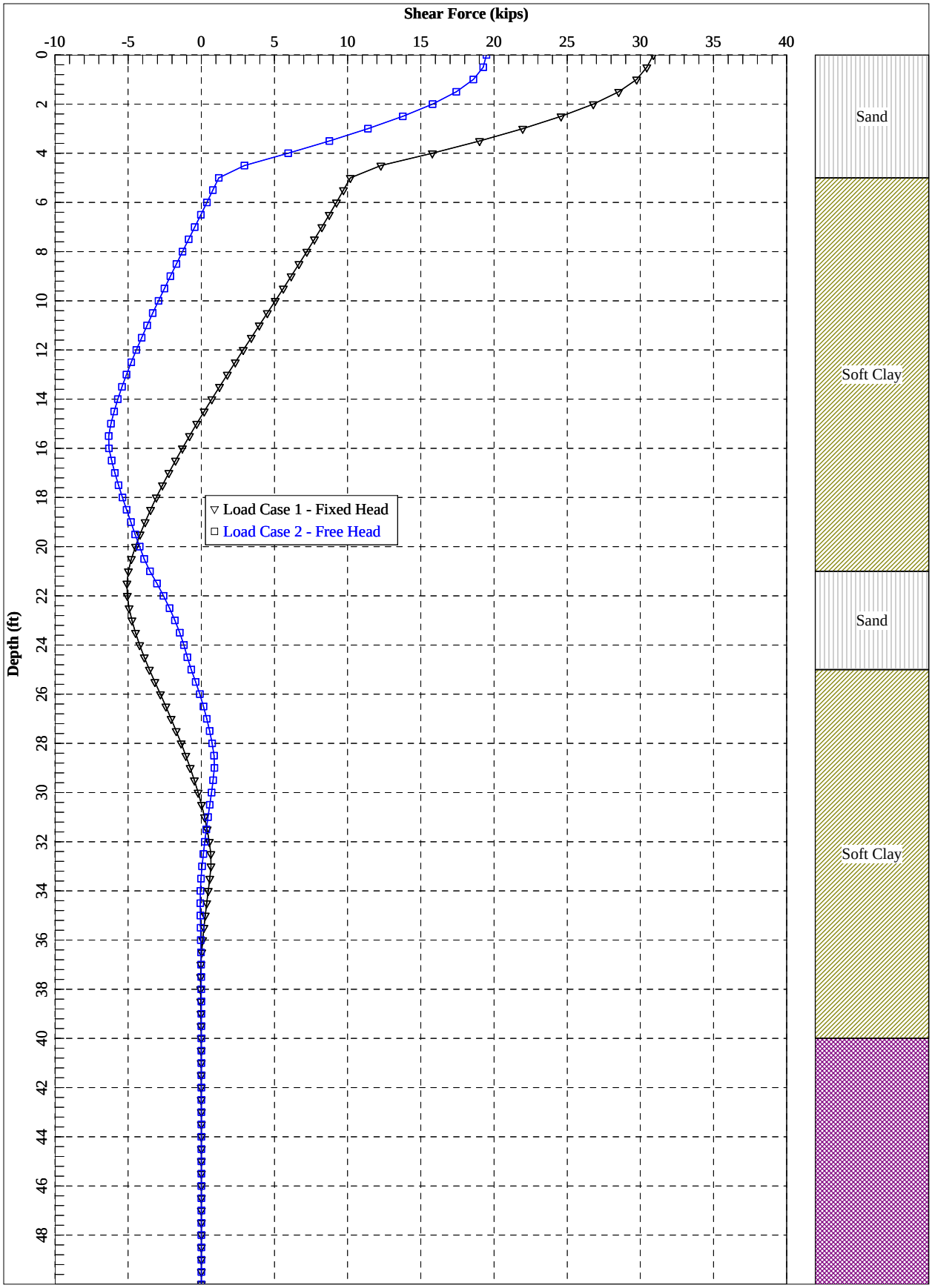
**16 Inch Square Prestressed Concrete Pile**
**0.5 Inch Deflection**



**16 Inch Square Prestressed Concrete Pile**
**0.5 Inch Deflection**



**16 Inch Square Prestressed Concrete Pile**
**0.5 Inch Deflection**



LPile for Windows, Version 2018-10.007

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
© 1985-2018 by Ensoft, Inc.
All Rights Reserved

This copy of LPile is being used by:

LACO Associates
Geo/Environmental
Serial Number of Security Device: 136157127

This copy of LPile is licensed for exclusive use by:

LACO Associates, Santa Rosa, CA

Use of this program by any entity other than LACO Associates, Santa Rosa, CA
is a violation of the software license agreement.

## Files Used for Analysis

Path to file locations on this computer:
\7900\7986 Carollo Engineers\7986.01 Arcata Wastewater Treatment Facility Design
\08 Geology\Reports\Geotech Report_Working Files-Archive\L-Pile\JER output\

Name of the input data file:
New LPile (USCS units) - 16 inch sq - 0.5 in def.lp10

Name of the output report file:
New LPile (USCS units) - 16 inch sq - 0.5 in def.lp10

Name of the plot output file:
New LPile (USCS units) - 16 inch sq - 0.5 in def.lp10

Name of the runtime message file:
New LPile (USCS units) - 16 inch sq - 0.5 in def.lp10

## Date and Time of Analysis

Date: November 21, 2018 Time: 8:48:43

## Problem Title

Project Name: Wastewater Treatment Facility Improvements

Job Number: 7986.01

New LPile (USCS units) - 16 inch sq - 0.5 in def.lp10o

Client: Carollo Engineers

Engineer: LACO Associates

Description: Lateral Load Analysis - 16-inch square precast concrete

---

## Program Options and Settings

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

| | | |
|---|---|---|
| - Maximum number of iterations allowed | = | 500 |
| - Deflection tolerance for convergence | = | 1.0000E-05 in |
| - Maximum allowable deflection | = | 100.0000 in |
| - Number of pile increments | = | 100 |

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

---

## Pile Structural Properties and Geometry

| | | |
|---|---|---|
| Number of pile sections defined | = | 1 |
| Total length of pile | = | 50.000 ft |
| Depth of ground surface below top of pile | = | 0.0000 ft |

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

| Point No. | Depth Below Pile Head feet | Pile Diameter inches |
|---|---|---|
| 1 | 0.000 | 16.0000 |
| 2 | 50.000 | 16.0000 |

Input Structural Properties for Pile Sections:

Pile Section No. 1:

| | | |
|---|---|---|
| Section 1 is a square prestressed concrete pile | | |
| Length of section | = | 50.000000 ft |
| Pile Width | = | 16.000000 in |
| Corner Chamfer | = | 0.0000 in |
| Shear capacity of section | = | 0.0000 lbs |

## Ground Slope and Pile Batter Angles

| | | |
|---|---|---|
| Ground Slope Angle | = | 0.000 degrees |
| | = | 0.000 radians |
| Pile Batter Angle | = | 0.000 degrees |
| | = | 0.000 radians |

## Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 0.0000 ft |
| Distance from top of pile to bottom of layer | = | 5.000000 ft |
| Effective unit weight at top of layer | = | 130.000000 pcf |
| Effective unit weight at bottom of layer | = | 130.000000 pcf |
| Friction angle at top of layer | = | 34.000000 deg. |
| Friction angle at bottom of layer | = | 34.000000 deg. |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for subgrade k will be computed for this layer.

Layer 2 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 5.000000 ft |
| Distance from top of pile to bottom of layer | = | 21.000000 ft |
| Effective unit weight at top of layer | = | 95.000000 pcf |
| Effective unit weight at bottom of layer | = | 100.000000 pcf |

| | | |
|---|---|---|
| Undrained cohesion at top of layer | = | 200.000000 psf |
| Undrained cohesion at bottom of layer | = | 500.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 21.000000 ft |
| Distance from top of pile to bottom of layer | = | 25.000000 ft |
| Effective unit weight at top of layer | = | 120.000000 pcf |
| Effective unit weight at bottom of layer | = | 120.000000 pcf |
| Friction angle at top of layer | = | 30.000000 deg. |
| Friction angle at bottom of layer | = | 30.000000 deg. |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for subgrade k will be computed for this layer.

Layer 4 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 25.000000 ft |
| Distance from top of pile to bottom of layer | = | 40.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 115.000000 pcf |
| Undrained cohesion at top of layer | = | 600.000000 psf |
| Undrained cohesion at bottom of layer | = | 800.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is cemented silt with cohesion and friction

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 40.000000 ft |
| Distance from top of pile to bottom of layer | = | 70.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 110.000000 pcf |
| Undrained cohesion at top of layer | = | 350.000000 psf |
| Undrained cohesion at bottom of layer | = | 350.000000 psf |
| Friction angle at top of layer | = | 25.000000 deg. |
| Friction angle at bottom of layer | = | 25.000000 deg. |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for Epsilon-50 will be computed for this layer.
NOTE: Default values for subgrade k will be computed for this layer.

(Depth of the lowest soil layer extends 20.000 ft below the pile tip)

---

## Static Loading Type

---

Static loading criteria were used when computing p-y curves for all analyses.

## Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

| Load No. | Load Type | Condition 1 | Condition 2 | Axial Thrust Force, lbs |
|---|---|---|---|---|
| 1 | 5 | y = 0.500000 in | S = 0.0000 in/in | 50000. |
| 2 | 4 | y = 0.500000 in | M = 0.0000 in-lbs | 50000. |

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

## Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

### Pile Section No. 1:

#### Dimensions of Square Prestressed Pile Section:

| | | |
|---|---|---|
| Length of Section | = | 50.0000 ft |
| Pile Width | = | 16.000 in |
| Corner Chamfer | = | 0.000 in |

#### Prestressing Strand Details:

| | | |
|---|---|---|
| Strand Type | = | PCI 270 |
| Yield Stress, fpu | = | 270. ksi |

Stress-strain curve defined using PCI 270 7-wire Lo-lax equation
If eps > 0.0086 fpu (ksi) = 270 - 0.04/(eps-0.007)

| | | |
|---|---|---|
| Number of Reinforcing Strands | = | 6 |
| Cross-sectional Area of Single Strand | = | 0.153 sq. in. |
| Concrete Cover Thickness Over Strands | = | 2.000 in |

#### Prestressing Strand Geometry:

| Strand No. | Diameter in | Area sq. in | X in | Y in |
|---|---|---|---|---|
| 1 | 0.500 | 0.153 | 5.750 | 0.000 |
| 2 | 0.500 | 0.153 | 2.875 | 4.980 |

| | | | | |
|---|---|---|---|---|
| 3 | 0.500 | 0.153 | -2.875 | 4.980 |
| 4 | 0.500 | 0.153 | -5.750 | 0.000 |
| 5 | 0.500 | 0.153 | -2.875 | -4.980 |
| 6 | 0.500 | 0.153 | 2.875 | -4.980 |

Computation of Loss of Prestress:

| | | |
|---|---|---|
| Initial Prestressing Force | = | 194.564 kips |
| Fraction of Loss of Prestress | = | 0.100 |
| Effective Prestressing Force After Losses | = | 175.108 kips |
| Area of Concrete, Ac | = | 255.082 sq.in |
| Area of Steel, As | = | 0.918 sq.in |
| Stress in Concrete After Losses, f_pc | = | 0.686 ksi |
| Stress in Steel After Losses | = | -190.749 ksi |
| Compressive Strain in Concrete After Losses | = | 0.0001555 |
| Tensile Strain in Steel After Losses | = | -0.0068125 |
| Axial Tension Load for Cracking of Concrete | = | -244.731 kips |

Estimated Structural Capacities Computed Using PCI Equations:

| | | |
|---|---|---|
| Nom. Axial Cap., Pn = (0.85 f'c - 0.60 f_pc) Ag | = | 1200.157 kips |
| Unfac. Axial Load Cap. N = (0.33 f'c - 0.27 f_pc) Ag | = | 459.431 kips |
| Axial Capacity in Tension, Nt = As fpu | = | -247.860 kips |
| Nom. Moment Capacity, Mn = 0.37 D As fpu | = | 1467.331 in-kip |

Note: The estimate of nominal moment capacity is based on equations that assume compressive strength of concrete is 6,000 psi (41.4 MPa), the value of prestress after losses is 700 psi (4.83 MPa), and axial thrust force is zero. When input values for these factors are different, the estimated value of nominal moment capacity will differ from the capacity computed by LPile and should be considered only as an approximate check.

Concrete Properties:

| | | |
|---|---|---|
| Compressive Strength of Concrete | = | 6000. psi |
| Modulus of Elasticity of Concrete | = | 4415201. psi |
| Modulus of Rupture of Prestressed Concrete | = | -309.838668 psi |
| Compression Strain at Peak Stress | = | 0.002310 |
| Tensile Strain at Fracture of Concrete | = | -0.0000604 |
| Maximum Coarse Aggregate Size | = | 0.750000 in |

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

| Number | Axial Thrust Force kips |
|---|---|
| 1 | 50.000 |

---

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

---

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

| Load No. | Axial Thrust kips | Nominal Mom. Cap. in-kip | Max. Comp. Strain |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | 50.000 | 1841.524 | 0.00300000 |

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, Section 9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

| Axial Load No. | Resist. Factor for Moment | Nominal Moment Cap in-kips | Ult. (Fac) Ax. Thrust kips | Ult. (Fac) Moment Cap in-kips | Bend. Stiff. at Ult Mom kip-in^2 |
|---|---|---|---|---|---|
| 1 | 0.65 | 1842. | 32.500000 | 1197. | 13709040. |
| 1 | 0.70 | 1842. | 35.000000 | 1289. | 11400426. |
| 1 | 0.75 | 1842. | 37.500000 | 1381. | 9446900. |

## Layering Correction Equivalent Depths of Soil & Rock Layers

| Layer No. | Top of Layer Below Pile Head ft | Equivalent Top Depth Below Grnd Surf ft | Same Layer Type As Layer Above | Layer is Rock or is Below Rock Layer | F0 Integral for Layer lbs | F1 Integral for Layer lbs |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | N.A. | No | 0.00 | 26489. |
| 2 | 5.0000 | 12.9885 | No | No | 26489. | 67200. |
| 3 | 21.0000 | 10.6203 | No | No | 93689. | 132049. |
| 4 | 25.0000 | 34.9605 | No | No | 225739. | 125865. |
| 5 | 40.0000 | 19.6554 | No | No | 351604. | N.A. |

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

## Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs

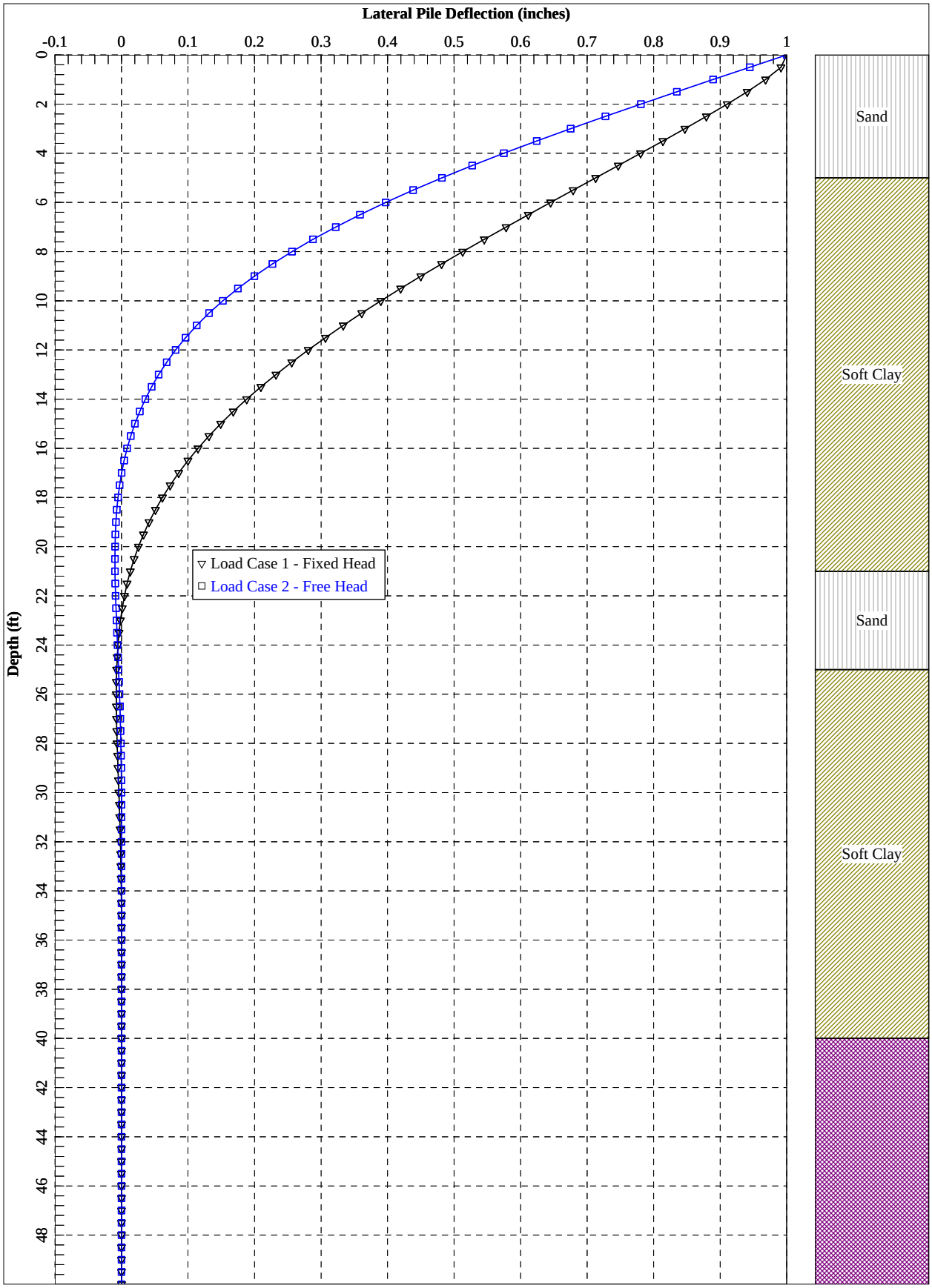
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

| Load Case No. | Load Type | Pile-head Deflection inches | Pile-head Rotation radians | Max Shear in Pile lbs | Max Moment in Pile in-lbs |
|---|---|---|---|---|---|
| 1 | 5 | 0.500000 | 0.0000 | 30887. | -1491538. |
| 2 | 4 | 0.500000 | -0.004738 | 19480. | 772437. |

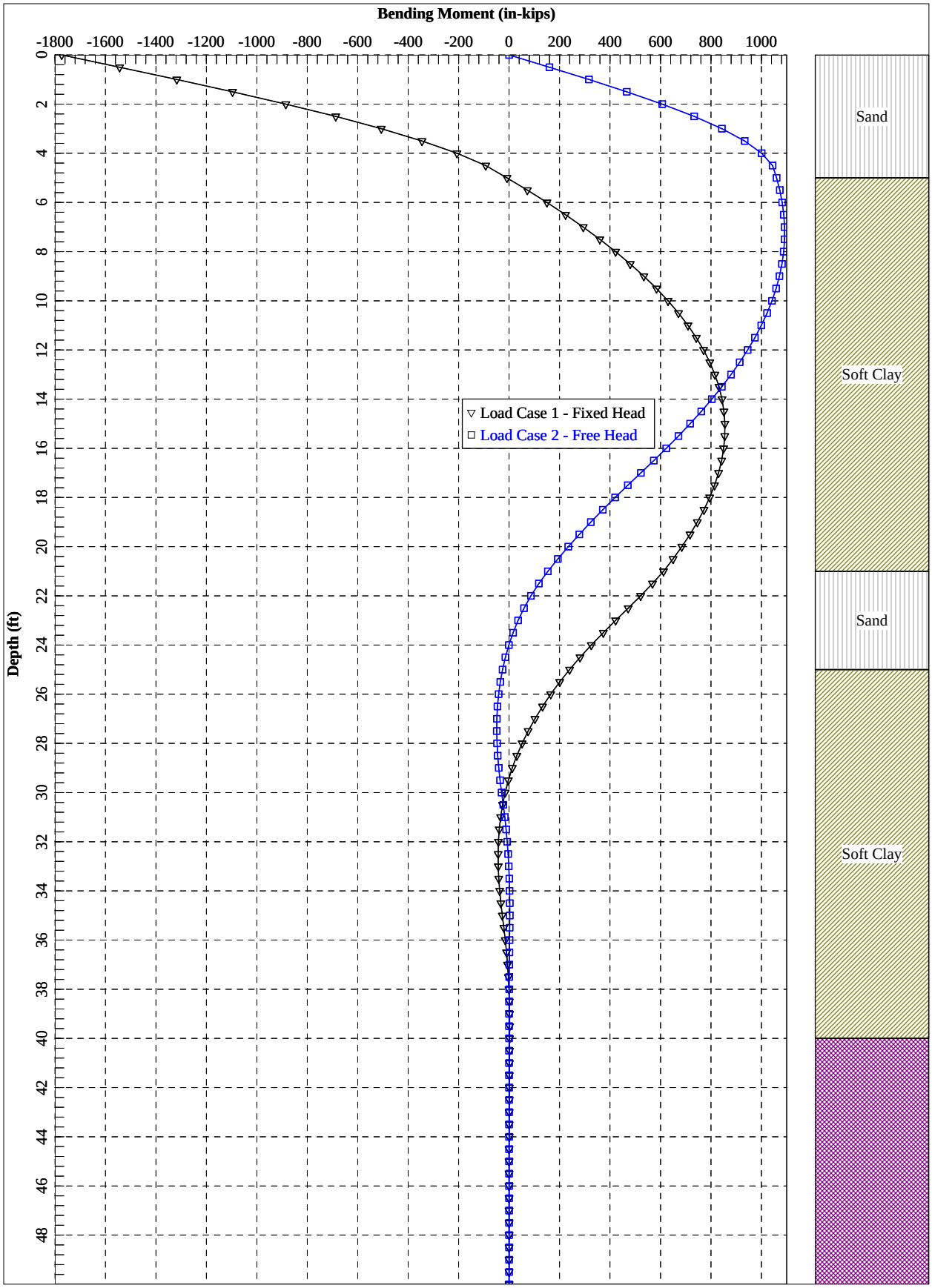
Maximum pile-head deflection = 0.5000000000 inches
Maximum pile-head rotation = -0.0047380436 radians = -0.271470 deg.

The analysis ended normally.

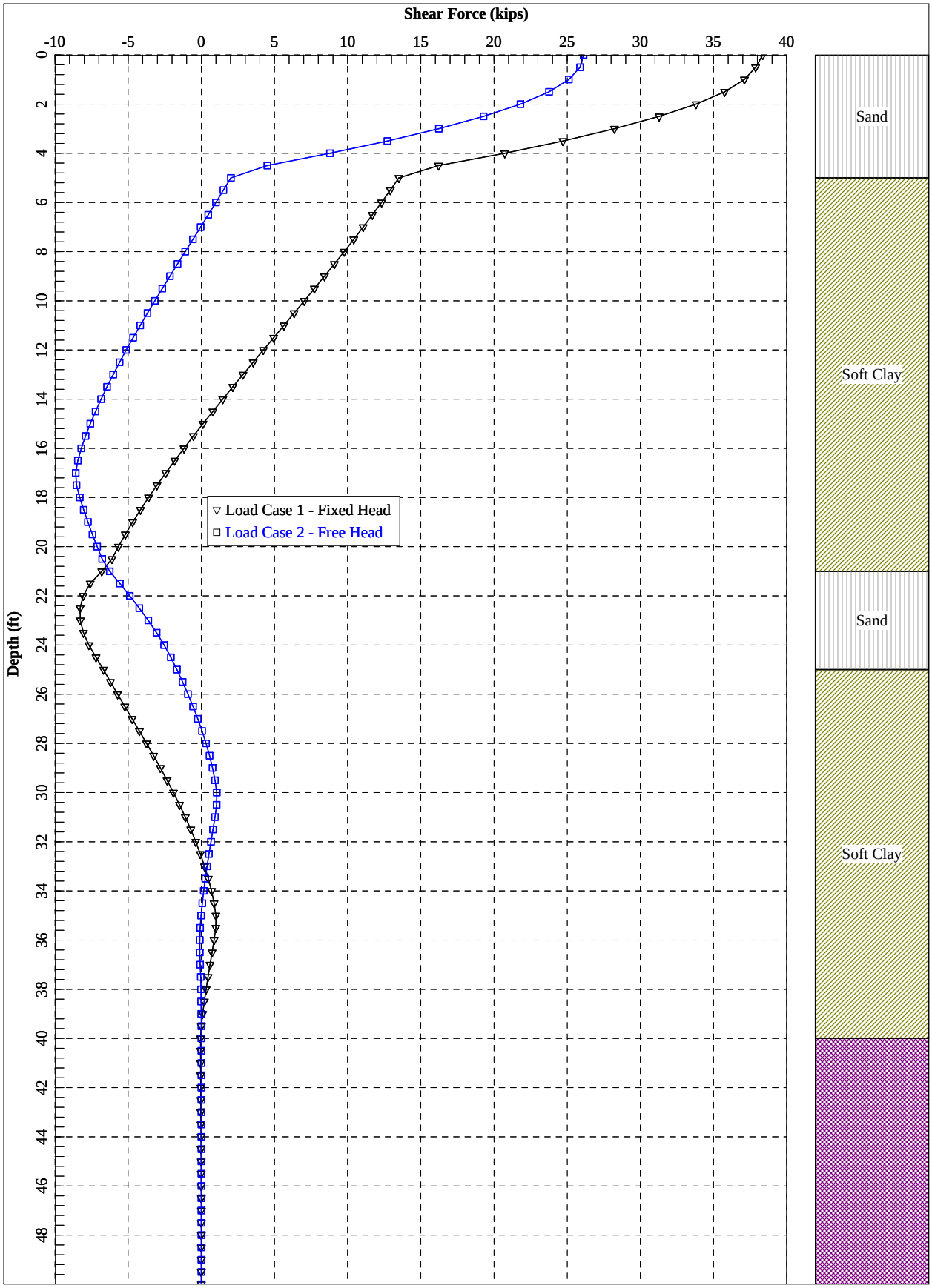
**16 Inch Square Prestressed Concrete Pile**
**1.0 Inch Deflection**



**16 Inch Square Prestressed Concrete Pile**
**1.0 Inch Deflection**



**16 Inch Square Prestressed Concrete Pile**
**1.0 Inch Deflection**



LPile for Windows, Version 2018-10.007

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
© 1985-2018 by Ensoft, Inc.
All Rights Reserved

This copy of LPile is being used by:

LACO Associates
Geo/Environmental
Serial Number of Security Device: 136157127

This copy of LPile is licensed for exclusive use by:

LACO Associates, Santa Rosa, CA

Use of this program by any entity other than LACO Associates, Santa Rosa, CA
is a violation of the software license agreement.

## Files Used for Analysis

Path to file locations on this computer:
\7900\7986 Carollo Engineers\7986.01 Arcata Wastewater Treatment Facility Design
\08 Geology\Reports\Geotech Report_Working Files-Archive\L-Pile\

Name of the input data file:
New LPile (USCS units) - 16 inch sq - 1 in def.lp10

Name of the output report file:
New LPile (USCS units) - 16 inch sq - 1 in def.lp10

Name of the plot output file:
New LPile (USCS units) - 16 inch sq - 1 in def.lp10

Name of the runtime message file:
New LPile (USCS units) - 16 inch sq - 1 in def.lp10

## Date and Time of Analysis

Date: November 21, 2018 Time: 8:59:28

## Problem Title

Project Name: Wastewater Treatment Facility Improvements

Job Number: 7986.01

New LPile (USCS units) - 16 inch sq - 1 in def.lp10o

Client: Carollo Engineers

Engineer: LACO Associates

Description: Lateral Load Analysis - 16-inch square precast concrete

---

## Program Options and Settings

---

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

| | | |
|---|---|---|
| - Maximum number of iterations allowed | = | 500 |
| - Deflection tolerance for convergence | = | 1.0000E-05 in |
| - Maximum allowable deflection | = | 100.0000 in |
| - Number of pile increments | = | 100 |

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

---

## Pile Structural Properties and Geometry

---

| | | |
|---|---|---|
| Number of pile sections defined | = | 1 |
| Total length of pile | = | 50.000 ft |
| Depth of ground surface below top of pile | = | 0.0000 ft |

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

| Point No. | Depth Below Pile Head feet | Pile Diameter inches |
|---|---|---|
| 1 | 0.000 | 16.0000 |
| 2 | 50.000 | 16.0000 |

Input Structural Properties for Pile Sections:

Pile Section No. 1:

| | | |
|---|---|---|
| Section 1 is a square prestressed concrete pile | | |
| Length of section | = | 50.000000 ft |
| Pile Width | = | 16.000000 in |
| Corner Chamfer | = | 0.0000 in |
| Shear capacity of section | = | 0.0000 lbs |

## Ground Slope and Pile Batter Angles

| | | |
|---|---|---|
| Ground Slope Angle | = | 0.000 degrees |
| | = | 0.000 radians |
| Pile Batter Angle | = | 0.000 degrees |
| | = | 0.000 radians |

## Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 0.0000 ft |
| Distance from top of pile to bottom of layer | = | 5.000000 ft |
| Effective unit weight at top of layer | = | 130.000000 pcf |
| Effective unit weight at bottom of layer | = | 130.000000 pcf |
| Friction angle at top of layer | = | 34.000000 deg. |
| Friction angle at bottom of layer | = | 34.000000 deg. |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for subgrade k will be computed for this layer.

Layer 2 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 5.000000 ft |
| Distance from top of pile to bottom of layer | = | 21.000000 ft |
| Effective unit weight at top of layer | = | 95.000000 pcf |
| Effective unit weight at bottom of layer | = | 100.000000 pcf |

| | | |
|---|---|---|
| Undrained cohesion at top of layer | = | 200.000000 psf |
| Undrained cohesion at bottom of layer | = | 500.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 21.000000 ft |
| Distance from top of pile to bottom of layer | = | 25.000000 ft |
| Effective unit weight at top of layer | = | 120.000000 pcf |
| Effective unit weight at bottom of layer | = | 120.000000 pcf |
| Friction angle at top of layer | = | 30.000000 deg. |
| Friction angle at bottom of layer | = | 30.000000 deg. |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for subgrade k will be computed for this layer.

Layer 4 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 25.000000 ft |
| Distance from top of pile to bottom of layer | = | 40.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 115.000000 pcf |
| Undrained cohesion at top of layer | = | 600.000000 psf |
| Undrained cohesion at bottom of layer | = | 800.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 5 is cemented silt with cohesion and friction

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 40.000000 ft |
| Distance from top of pile to bottom of layer | = | 70.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 110.000000 pcf |
| Undrained cohesion at top of layer | = | 350.000000 psf |
| Undrained cohesion at bottom of layer | = | 350.000000 psf |
| Friction angle at top of layer | = | 25.000000 deg. |
| Friction angle at bottom of layer | = | 25.000000 deg. |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for Epsilon-50 will be computed for this layer.
NOTE: Default values for subgrade k will be computed for this layer.

(Depth of the lowest soil layer extends 20.000 ft below the pile tip)

---

## Static Loading Type

---

Static loading criteria were used when computing p-y curves for all analyses.

## Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

| Load No. | Load Type | Condition 1 | | Condition 2 | | Axial Thrust Force, lbs |
|---|---|---|---|---|---|---|
| 1 | 5 | y = | 1.000000 in | S = | 0.0000 in/in | 50000. |
| 2 | 4 | y = | 1.000000 in | M = | 0.0000 in-lbs | 50000. |

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

## Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

### Pile Section No. 1:

#### Dimensions of Square Prestressed Pile Section:

| | | |
|---|---|---|
| Length of Section | = | 50.0000 ft |
| Pile Width | = | 16.000 in |
| Corner Chamfer | = | 0.000 in |

#### Prestressing Strand Details:

| | | |
|---|---|---|
| Strand Type | = | PCI 270 |
| Yield Stress, fpu | = | 270. ksi |

Stress-strain curve defined using PCI 270 7-wire Lo-lax equation
If eps > 0.0086 fpu (ksi) = 270 - 0.04/(eps-0.007)

| | | |
|---|---|---|
| Number of Reinforcing Strands | = | 6 |
| Cross-sectional Area of Single Strand | = | 0.153 sq. in. |
| Concrete Cover Thickness Over Strands | = | 2.000 in |

#### Prestressing Strand Geometry:

| Strand No. | Diameter in | Area sq. in | X in | Y in |
|---|---|---|---|---|
| 1 | 0.500 | 0.153 | 5.750 | 0.000 |
| 2 | 0.500 | 0.153 | 2.875 | 4.980 |

| | | | | |
|---|---|---|---|---|
| 3 | 0.500 | 0.153 | -2.875 | 4.980 |
| 4 | 0.500 | 0.153 | -5.750 | 0.000 |
| 5 | 0.500 | 0.153 | -2.875 | -4.980 |
| 6 | 0.500 | 0.153 | 2.875 | -4.980 |

Computation of Loss of Prestress:

| | | |
|---|---|---|
| Initial Prestressing Force | = | 194.564 kips |
| Fraction of Loss of Prestress | = | 0.100 |
| Effective Prestressing Force After Losses | = | 175.108 kips |
| Area of Concrete, Ac | = | 255.082 sq.in |
| Area of Steel, As | = | 0.918 sq.in |
| Stress in Concrete After Losses, f_pc | = | 0.686 ksi |
| Stress in Steel After Losses | = | -190.749 ksi |
| Compressive Strain in Concrete After Losses | = | 0.0001555 |
| Tensile Strain in Steel After Losses | = | -0.0068125 |
| Axial Tension Load for Cracking of Concrete | = | -244.731 kips |

Estimated Structural Capacities Computed Using PCI Equations:

| | | |
|---|---|---|
| Nom. Axial Cap., Pn = (0.85 f'c - 0.60 f_pc) Ag | = | 1200.157 kips |
| Unfac. Axial Load Cap. N = (0.33 f'c - 0.27 f_pc) Ag | = | 459.431 kips |
| Axial Capacity in Tension, Nt = As fpu | = | -247.860 kips |
| Nom. Moment Capacity, Mn = 0.37 D As fpu | = | 1467.331 in-kip |

Note: The estimate of nominal moment capacity is based on equations that assume compressive strength of concrete is 6,000 psi (41.4 MPa), the value of prestress after losses is 700 psi (4.83 MPa), and axial thrust force is zero. When input values for these factors are different, the estimated value of nominal moment capacity will differ from the capacity computed by LPile and should be considered only as an approximate check.

Concrete Properties:

| | | |
|---|---|---|
| Compressive Strength of Concrete | = | 6000. psi |
| Modulus of Elasticity of Concrete | = | 4415201. psi |
| Modulus of Rupture of Prestressed Concrete | = | -309.838668 psi |
| Compression Strain at Peak Stress | = | 0.002310 |
| Tensile Strain at Fracture of Concrete | = | -0.0000604 |
| Maximum Coarse Aggregate Size | = | 0.750000 in |

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

| Number | Axial Thrust Force kips |
|---|---|
| 1 | 50.000 |

---

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

---

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

| Load No. | Axial Thrust kips | Nominal Mom. Cap. in-kip | Max. Comp. Strain |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | 50.000 | 1841.524 | 0.00300000 |

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, Section 9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

| Axial Load No. | Resist. Factor for Moment | Nominal Moment Cap in-kips | Ult. (Fac) Ax. Thrust kips | Ult. (Fac) Moment Cap in-kips | Bend. Stiff. at Ult Mom kip-in^2 |
|---|---|---|---|---|---|
| 1 | 0.65 | 1842. | 32.500000 | 1197. | 13709040. |
| 1 | 0.70 | 1842. | 35.000000 | 1289. | 11400426. |
| 1 | 0.75 | 1842. | 37.500000 | 1381. | 9446900. |

## Layering Correction Equivalent Depths of Soil & Rock Layers

| Layer No. | Top of Layer Below Pile Head ft | Equivalent Top Depth Below Grnd Surf ft | Same Layer Type As Layer Above | Layer is Rock or is Below Rock Layer | F0 Integral for Layer lbs | F1 Integral for Layer lbs |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | N.A. | No | 0.00 | 26489. |
| 2 | 5.0000 | 12.9885 | No | No | 26489. | 67200. |
| 3 | 21.0000 | 10.6203 | No | No | 93689. | 132049. |
| 4 | 25.0000 | 34.9605 | No | No | 225739. | 125865. |
| 5 | 40.0000 | 19.6554 | No | No | 351604. | N.A. |

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

## Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs

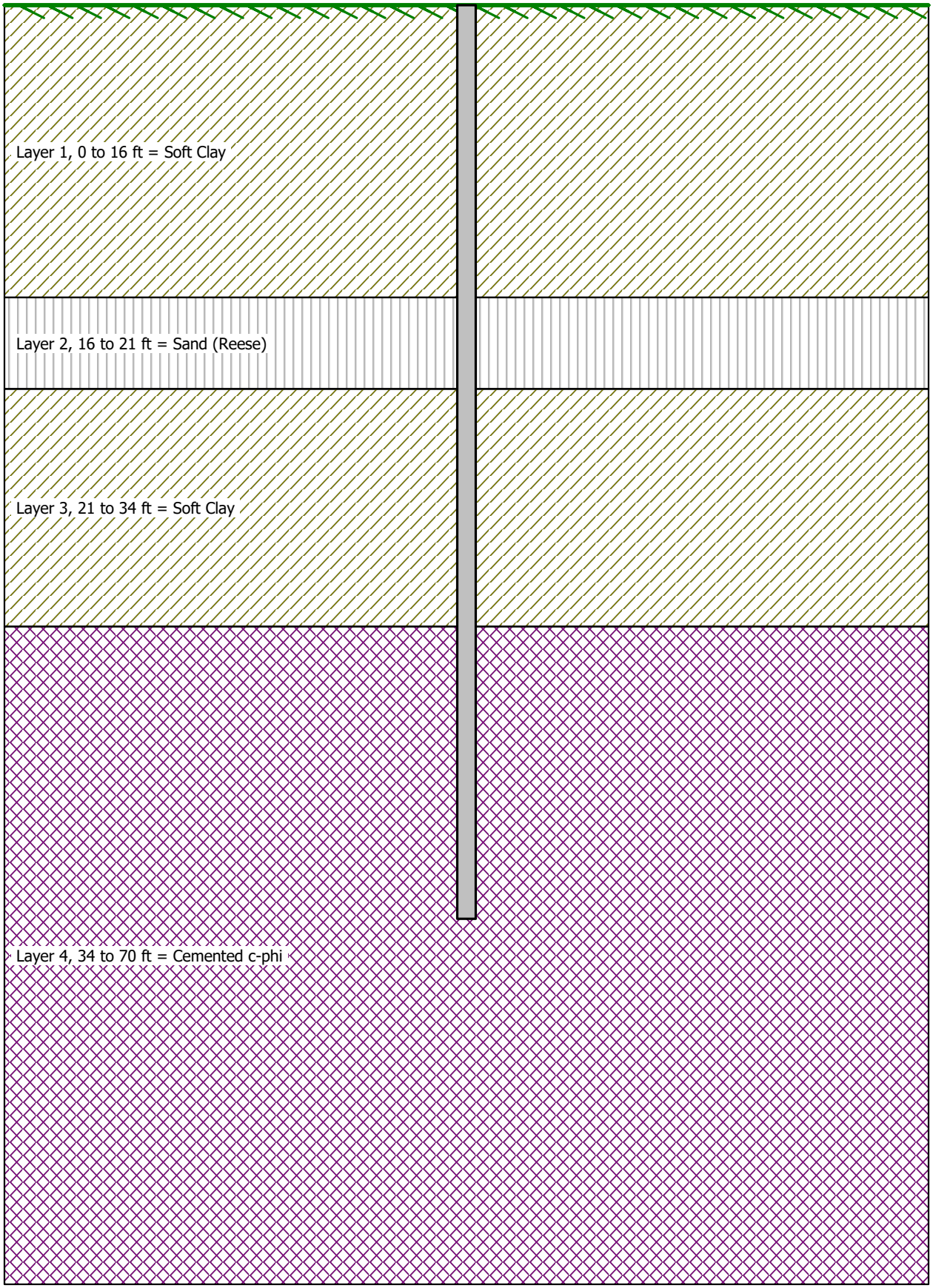
New LPile (USCS units) - 16 inch sq - 1 in def.lp10o
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

| Load Case No. | Load Type | Pile-head Deflection inches | Pile-head Rotation radians | Max Shear in Pile lbs | Max Moment in Pile in-lbs |
|---|---|---|---|---|---|
| 1 | 5 | 1.000000 | 0.0000 | 38363. | -1773058. |
| 2 | 4 | 1.000000 | -0.009231 | 26120. | 1091685. |

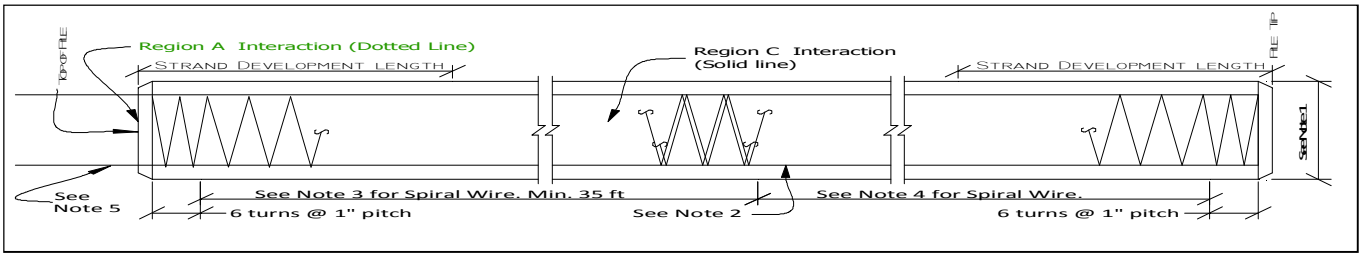
Maximum pile-head deflection = 1.0000000000 inches
Maximum pile-head rotation = -0.0092305829 radians = -0.528873 deg.

The analysis ended normally.

Conceptual Site Model: No fill



# 12" Sq; f'c = 6,000 psi, 1022 psi prestress with No Rebars Pile Details and Interaction Diagram.




NOTE 1; 12" SQUARE PILE, CONC. F'C = 6000 PSI, AREA (AG) = 142.88 SQ-IN.

NOTE 2; 6 - 1/2"ø 270K STRAND ON 7" CIRCLE, STRESSED TO 70% = 1022 PSI ( FPC)

NOTE 3; PROVIDE W11.0 @ 2" PITCH FOR TOP 35 FT MINIMUM

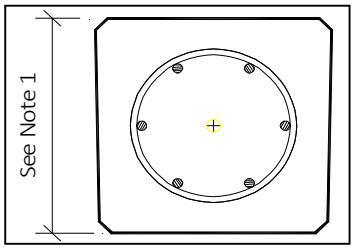
NOTE 4; PROVIDE W8.0 @ 3.625" PITCH WITH 2" COVER

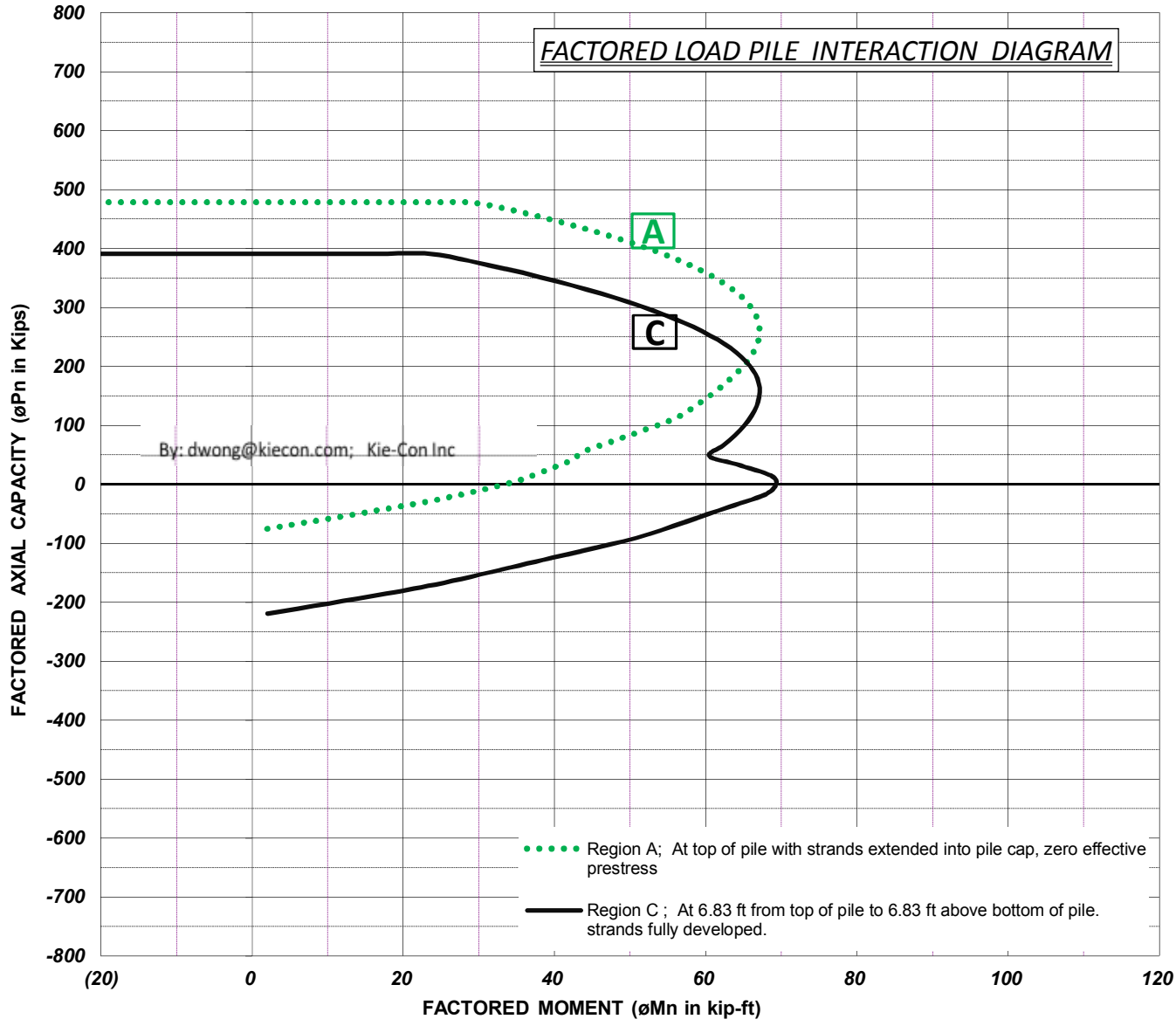
NOTE 5; STRANDS EXTENDED 4.0 FT

NOTE 6; ALLOWABLE SERVICE LOAD BASED ON N = AG(0.33 F'C-0.27FPC) = 243 KIPS

NOTE 7; **PLEASE EMAIL US IF YOU LIKE TO SEE THE INTERACTION DIAGRAMS OF DIFFERENT REBAR SIZES OR COMBINATIONS**

NOTE 8; **THE INTERACTION DIAGRAM SHOWN BELOW IS A GUIDELINE ONLY. ACTUAL DESIGN MUST BE REVIEWED BY EOR FOR EACH PROJECT.**

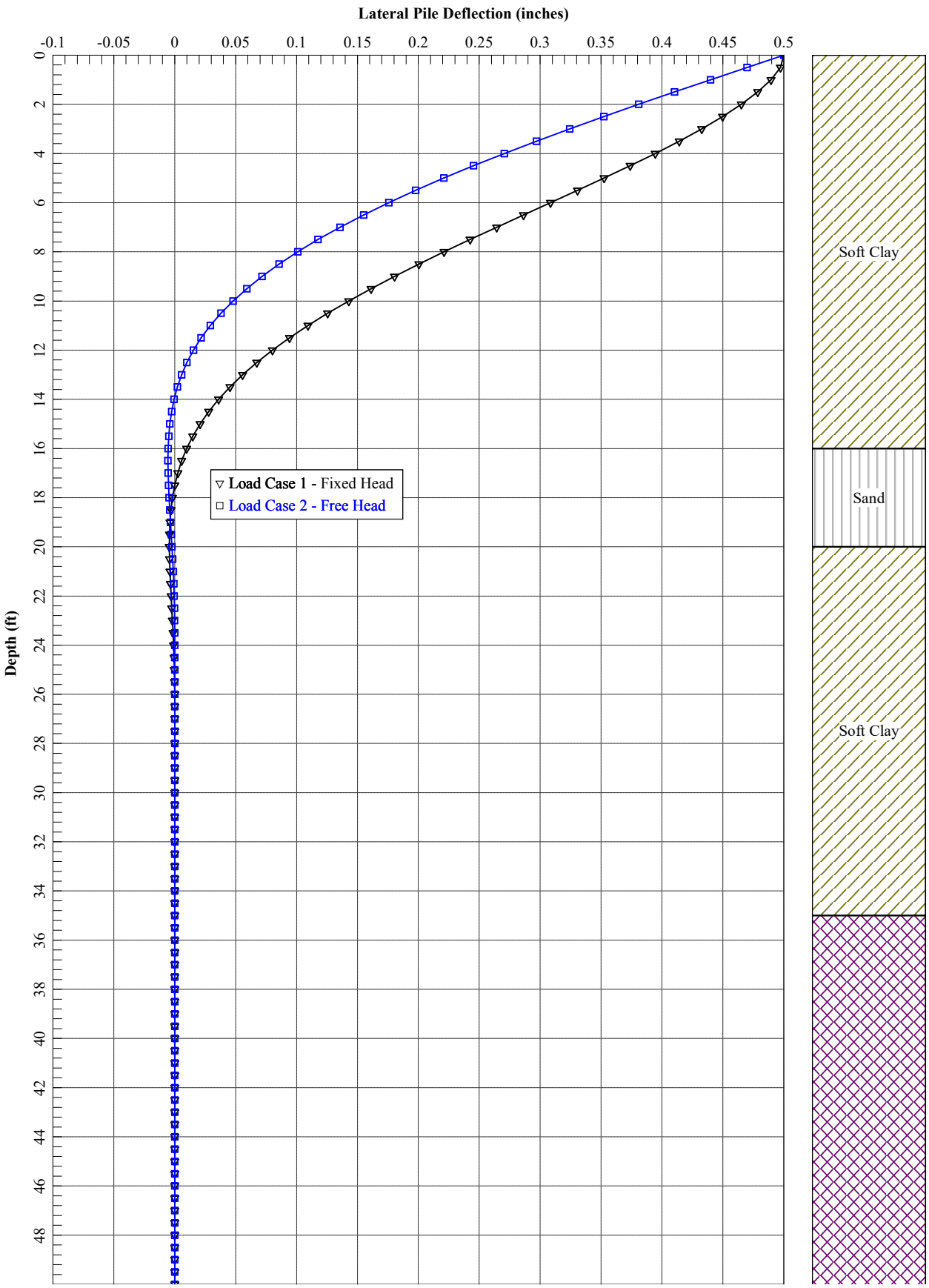


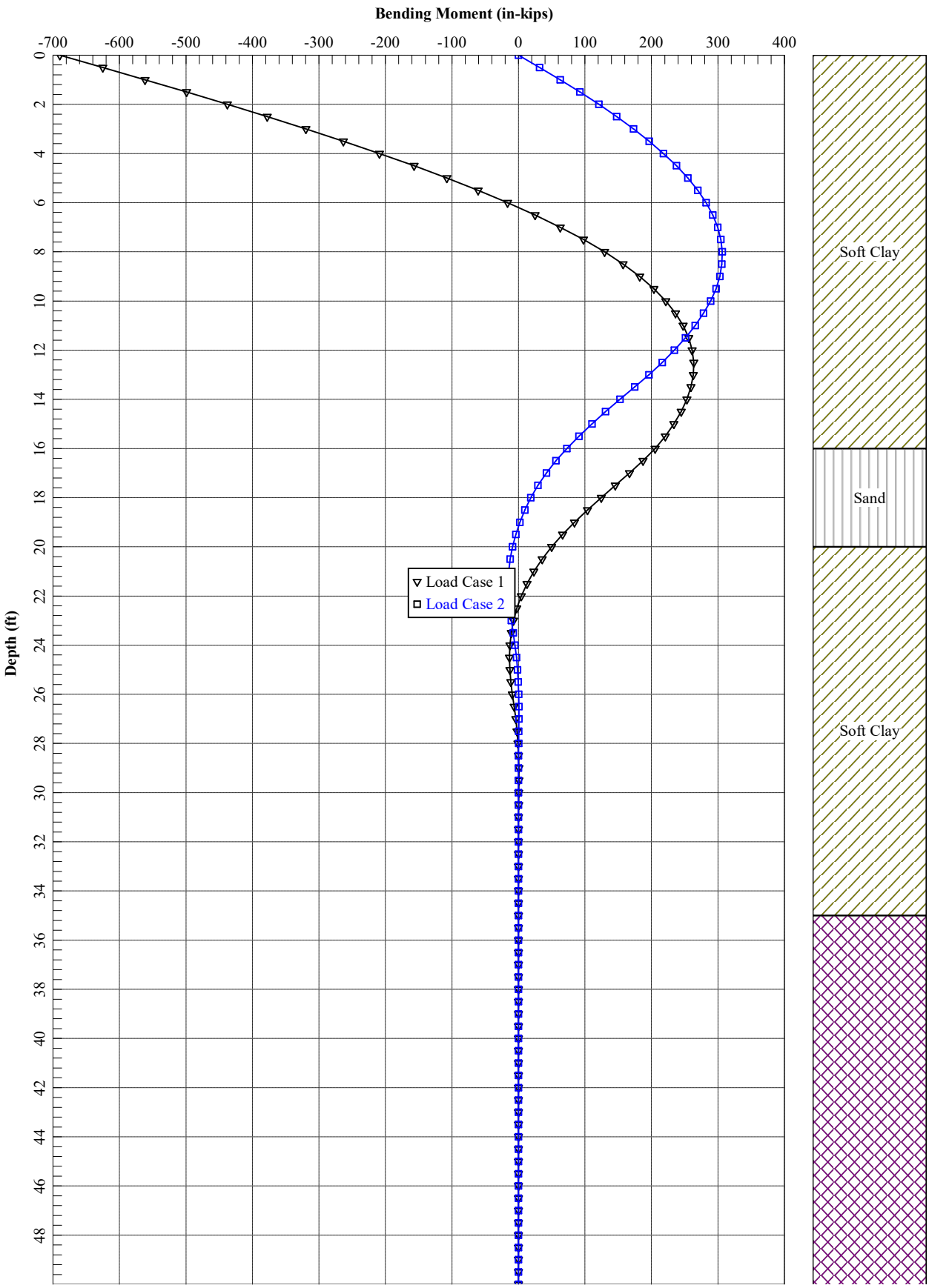

**Pile Manufacturer: KIE-CON Inc** Web Site : Kiecon.com Tel: 925/754-9494 Fax: 925/754-0624

**3551 Wilbur Ave, Antioch, Califorina** By: dwong@kiecon.com (Danny Wong) Page / Rev #:

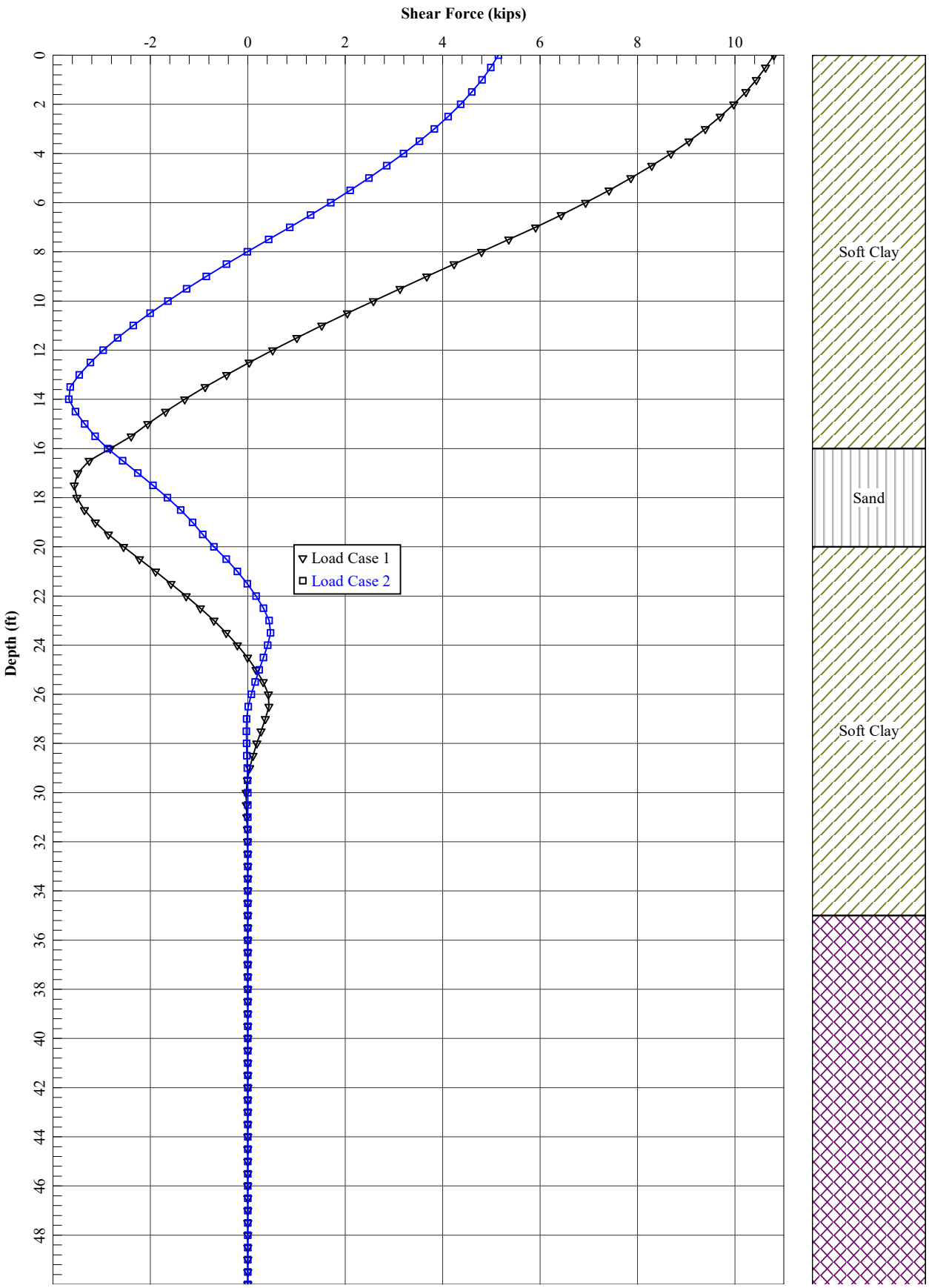
**12 Inch Square Prestressed Concrete Pile**
**0.5 Inch Deflection**



**12 Inch Square Prestressed Concrete Pile**
**0.5 Inch Deflection**



**12 Inch Square Prestressed Concrete Pile**
**0.5 Inch Deflection**



==========
==========

LPile for Windows(Beta), Version 2018-10.008

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
© 1985-2018 by Ensoft, Inc.
All Rights Reserved

==========
==========

This copy of LPile is being used by:

LACO Associates
Santa Rosa
Serial Number of Security Device: 136157127

This copy of LPile is licensed for exclusive use by:

LACO Associates, Santa Rosa, CA

Use of this program by any entity other than LACO Associates, Santa Rosa, CA
is a violation of the software license agreement.

---
---

## Files Used for Analysis

---
---

Path to file locations on this computer:
\7900\7986 Carollo Engineers\7986.01 Arcata Wastewater Treatment Facility Design
\08 Geology\Reports\Geotech Report_Working Files-Archive\L-Pile\CRGT Under Fill
\

Name of the input data file:
New LPile (USCS units) - 12 inch sq - 0.5 in def.lp10

Name of the output report file:
New LPile (USCS units) - 12 inch sq - 0.5 in def.lp10

Name of the plot output file:
New LPile (USCS units) - 12 inch sq - 0.5 in def.lp10

Name of the runtime message file:
New LPile (USCS units) - 12 inch sq - 0.5 in def.lp10

---

## Date and Time of Analysis

---

Date: February 6, 2019 Time: 8:36:49

---

## Problem Title

---

Project Name: Wastewater Treatment Facility Improvements
Job Number: 7986.01
Client: Carollo Engineers
Engineer: LACO Associates
Description: Lateral Load Analysis - 12-inch square precast concrete

---

## Program Options and Settings

---

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

| | | |
|---|---|---|
| - Maximum number of iterations allowed | = | 500 |
| - Deflection tolerance for convergence | = | 1.0000E-05 in |
| - Maximum allowable deflection | = | 100.0000 in |
| - Number of pile increments | = | 100 |

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Report only summary tables of pile-head deflection, maximum bending moment,
   and maximum shear force in output report file.
 - No p-y curves to be computed and reported for user-specified depths
 - Print using narrow report formats
   (Note: Some output information is omitted from the narrow report formats)

---

## Pile Structural Properties and Geometry

---

| | | |
|---|---|---|
| Number of pile sections defined | = | 1 |
| Total length of pile | = | 50.000 ft |
| Depth of ground surface below top of pile | = | 0.0000 ft |

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

| Point No. | Depth Below Pile Head feet | Pile Diameter inches |
|---|---|---|
| 1 | 0.000 | 12.0000 |
| 2 | 50.000 | 12.0000 |

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a square prestressed concrete pile

| | | |
|---|---|---|
| Length of section | = | 50.000000 ft |
| Pile Width | = | 12.000000 in |
| Corner Chamfer | = | 0.0000 in |
| Shear capacity of section | = | 0.0000 lbs |

---

## Ground Slope and Pile Batter Angles

---

Ground Slope Angle = 0.000 degrees
= 0.000 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

---

## Soil and Rock Layering Information

---

The soil profile is modelled using 4 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 0.0000 ft |
| Distance from top of pile to bottom of layer | = | 16.000000 ft |
| Effective unit weight at top of layer | = | 95.000000 pcf |
| Effective unit weight at bottom of layer | = | 100.000000 pcf |
| Undrained cohesion at top of layer | = | 200.000000 psf |
| Undrained cohesion at bottom of layer | = | 500.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 16.000000 ft |
| Distance from top of pile to bottom of layer | = | 20.000000 ft |
| Effective unit weight at top of layer | = | 120.000000 pcf |
| Effective unit weight at bottom of layer | = | 120.000000 pcf |
| Friction angle at top of layer | = | 30.000000 deg. |
| Friction angle at bottom of layer | = | 30.000000 deg. |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for subgrade k will be computed for this layer.

Layer 3 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 20.000000 ft |
| Distance from top of pile to bottom of layer | = | 35.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 115.000000 pcf |
| Undrained cohesion at top of layer | = | 600.000000 psf |
| Undrained cohesion at bottom of layer | = | 800.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is cemented silt with cohesion and friction

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 35.000000 ft |
| Distance from top of pile to bottom of layer | = | 70.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 110.000000 pcf |
| Undrained cohesion at top of layer | = | 350.000000 psf |
| Undrained cohesion at bottom of layer | = | 350.000000 psf |
| Friction angle at top of layer | = | 25.000000 deg. |
| Friction angle at bottom of layer | = | 25.000000 deg. |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for Epsilon-50 will be computed for this layer.
NOTE: Default values for subgrade k will be computed for this layer.

(Depth of the lowest soil layer extends 20.000 ft below the pile tip)

---

## Static Loading Type

---

Static loading criteria were used when computing p-y curves for all analyses.

---

## Pile-head Loading and Pile-head Fixity Conditions

---

Number of loads specified = 2

| Load No. | Load Type | Condition 1 | Condition 2 | Axial Thrust Force, lbs |
|---|---|---|---|---|
| 1 | 5 | y = 0.500000 in | S = 0.0000 in/in | 50000. |
| 2 | 4 | y = 0.500000 in | M = 0.0000 in-lbs | 50000. |

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

---

## Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

### Pile Section No. 1:

Dimensions of Square Prestressed Pile Section:

| | | |
|---|---|---|
| Length of Section | = | 50.0000 ft |
| Pile Width | = | 12.000 in |
| Corner Chamfer | = | 0.000 in |

Prestressing Strand Details:

| | | |
|---|---|---|
| Strand Type | = | PCI 270 |
| Yield Stress, fpu | = | 270. ksi |
| Elasticity Modulus, Es | = | 28000. ksi |

Stress-strain curve defined using PCI 270 7-wire Lo-lax equation
If eps > 0.0086 fpu (ksi) = 270 - 0.04/(eps-0.007)

| | | |
|---|---|---|
| Number of Reinforcing Strands | = | 6 |
| Cross-sectional Area of Single Strand | = | 0.153 sq. in. |
| Concrete Cover Thickness Over Strands | = | 2.000 in |

Prestressing Strand Geometry:

| Strand No. | Diameter in | Area sq. in | X in | Y in |
|---|---|---|---|---|
| 1 | 0.500 | 0.153 | 3.750 | 0.000 |
| 2 | 0.500 | 0.153 | 1.875 | 3.248 |
| 3 | 0.500 | 0.153 | -1.875 | 3.248 |
| 4 | 0.500 | 0.153 | -3.750 | 0.000 |
| 5 | 0.500 | 0.153 | -1.875 | -3.248 |
| 6 | 0.500 | 0.153 | 1.875 | -3.248 |

Computation of Loss of Prestress:

| | | |
|---|---|---|
| Initial Prestressing Force | = | 146.000 kips |
| Fraction of Loss of Prestress | = | 0.100 |
| Effective Prestressing Force After Losses | = | 131.400 kips |
| Area of Concrete, Ac | = | 143.082 sq.in |
| Area of Steel, As | = | 0.918 sq.in |
| Stress in Concrete After Losses, f_pc | = | 0.918 ksi |
| Stress in Steel After Losses | = | -143.137 ksi |
| Compressive Strain in Concrete After Losses | = | 0.0002080 |
| Tensile Strain in Steel After Losses | = | -0.0051120 |
| Axial Tension Load for Cracking of Concrete | = | -171.135 kips |

Estimated Structural Capacities Computed Using PCI Equations:

| | | |
|---|---|---|
| Nom. Axial Cap., Pn = (0.85 f'c - 0.60 f_pc) Ag | = | 655.054 kips |
| Unfac. Axial Load Cap. N = (0.33 f'c - 0.27 f_pc) Ag | = | 249.414 kips |
| Axial Capacity in Tension, Nt = As fpu | = | -247.860 kips |
| Nom. Moment Capacity, Mn = 0.37 D As fpu | = | 1100.498 in-kip |

Note: The estimate of nominal moment capacity is based on equations that assume compressive strength of concrete is 6,000 psi (41.4 MPa), the value

of prestress after losses is 700 psi (4.83 MPa), and axial thrust force is
zero. When input values for these factors are different, the estimated value
of nominal moment capacity will differ from the capacity computed by LPile
and should be considered only as an approximate check.

Concrete Properties:
---

| | | |
|---|---|---|
| Compressive Strength of Concrete | = | 6000. psi |
| Modulus of Elasticity of Concrete | = | 4415201. psi |
| Modulus of Rupture of Prestressed Concrete | = | -309.838668 psi |
| Compression Strain at Peak Stress | = | 0.002310 |
| Tensile Strain at Fracture of Concrete | = | -0.0000604 |
| Maximum Coarse Aggregate Size | = | 0.750000 in |

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

| Number | Axial Thrust Force kips |
|---|---|
| 1 | 50.000 |

---
Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1
---

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

| Load No. | Axial Thrust kips | Nominal Mom. Cap. in-kip | Max. Comp. Strain |
|---|---|---|---|
| 1 | 50.000 | 1060.461 | 0.00300000 |

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals
(0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section

9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

| Axial Load No. | Resist. Factor for Moment | Nominal Moment Cap in-kips | Ult. (Fac) Ax. Thrust kips | Ult. (Fac) Moment Cap in-kips | Bend. Stiff. at Ult Mom kip-in^2 |
|---|---|---|---|---|---|
| 1 | 0.65 | 1060. | 32.500000 | 689.299356 | 4518034. |
| 1 | 0.70 | 1060. | 35.000000 | 742.322383 | 3846872. |
| 1 | 0.75 | 1060. | 37.500000 | 795.345411 | 3272675. |

---

Layering Correction Equivalent Depths of Soil & Rock Layers

---

| Layer No. | Top of Layer Below Pile Head ft | Equivalent Top Depth Below Grnd Surf ft | Same Layer Type As Layer Above | Layer is Rock or is Below Rock Layer | F0 Integral for Layer lbs | F1 Integral for Layer lbs |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | N.A. | No | 0.00 | 45056. |
| 2 | 16.0000 | 8.6062 | No | No | 45056. | 86705. |
| 3 | 20.0000 | 27.3853 | No | No | 131761. | 94399. |
| 4 | 35.0000 | 17.2802 | No | No | 226160. | N.A. |

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals
for Layer n. Layering correction equivalent depths are computed only

for soil types with both shallow-depth and deep-depth expressions for
peak lateral load transfer. These soil types are soft and stiff clays,
non-liquefied sands, and cemented c-phi soil.

---

Summary of Pile-head Responses for Conventional Analyses

---

Definitions of Pile-head Loading Conditions:

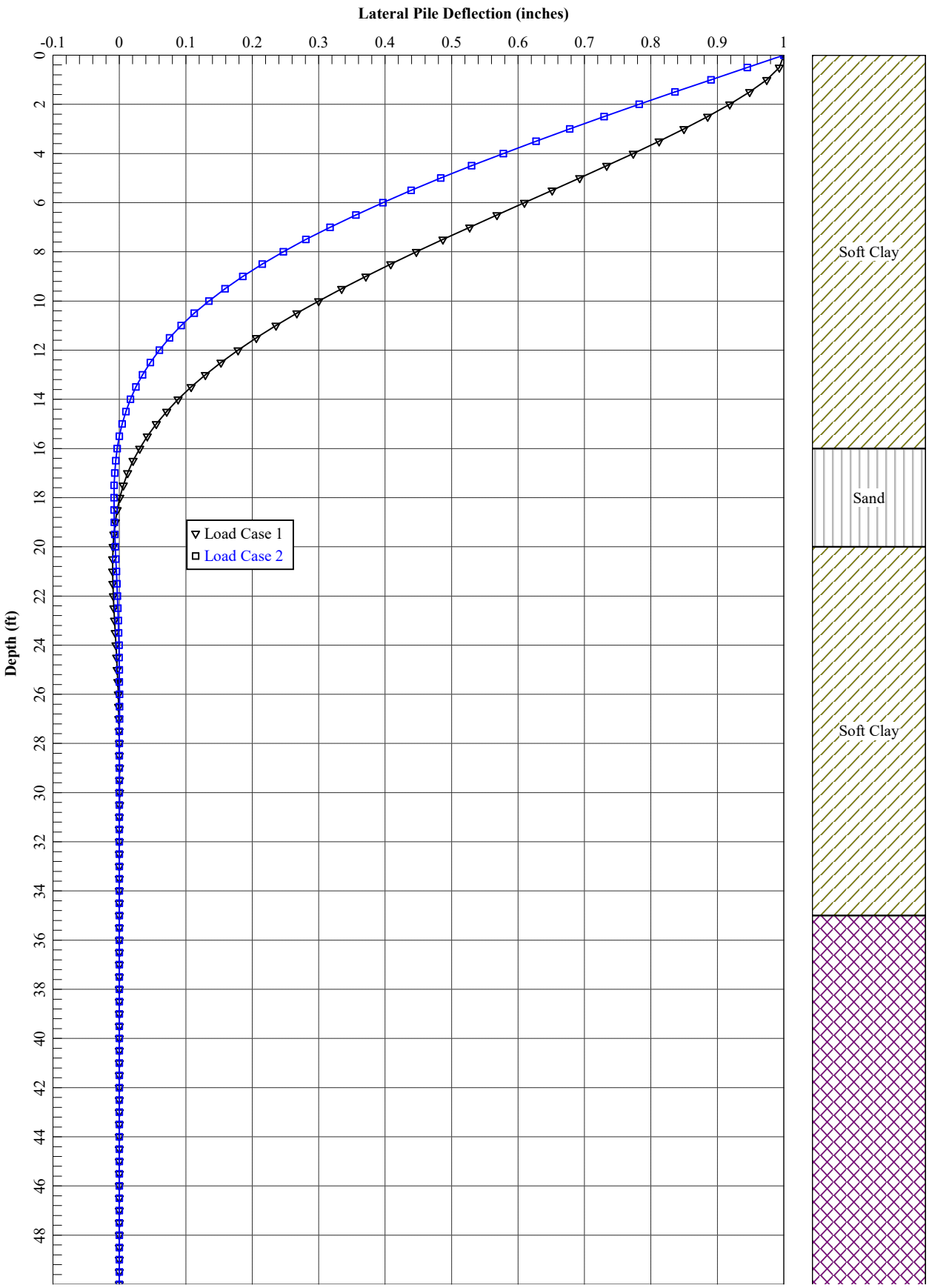
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

| Load Case No. | Load Type | Pile-head Deflection inches | Pile-head Rotation radians | Max Shear in Pile lbs | Max Moment in Pile in-lbs |
|---|---|---|---|---|---|
| 1 | 5 | 0.500000 | 0.0000 | 10797. | -689544. |
| 2 | 4 | 0.500000 | -0.005030 | 5141. | 306572. |

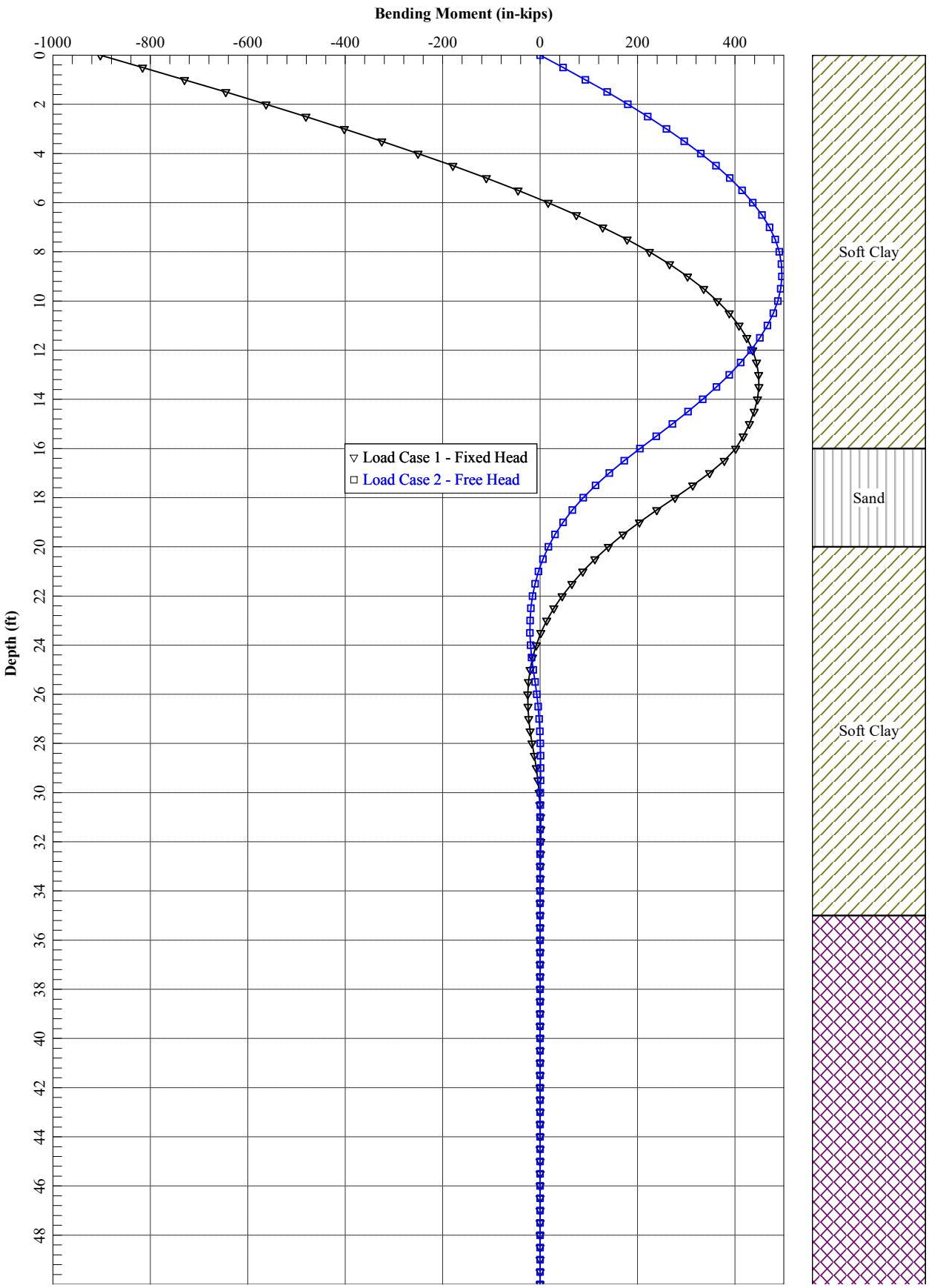
Maximum pile-head deflection = 0.5000000000 inches
Maximum pile-head rotation = -0.0050298991 radians = -0.288192 deg.

The analysis ended normally.

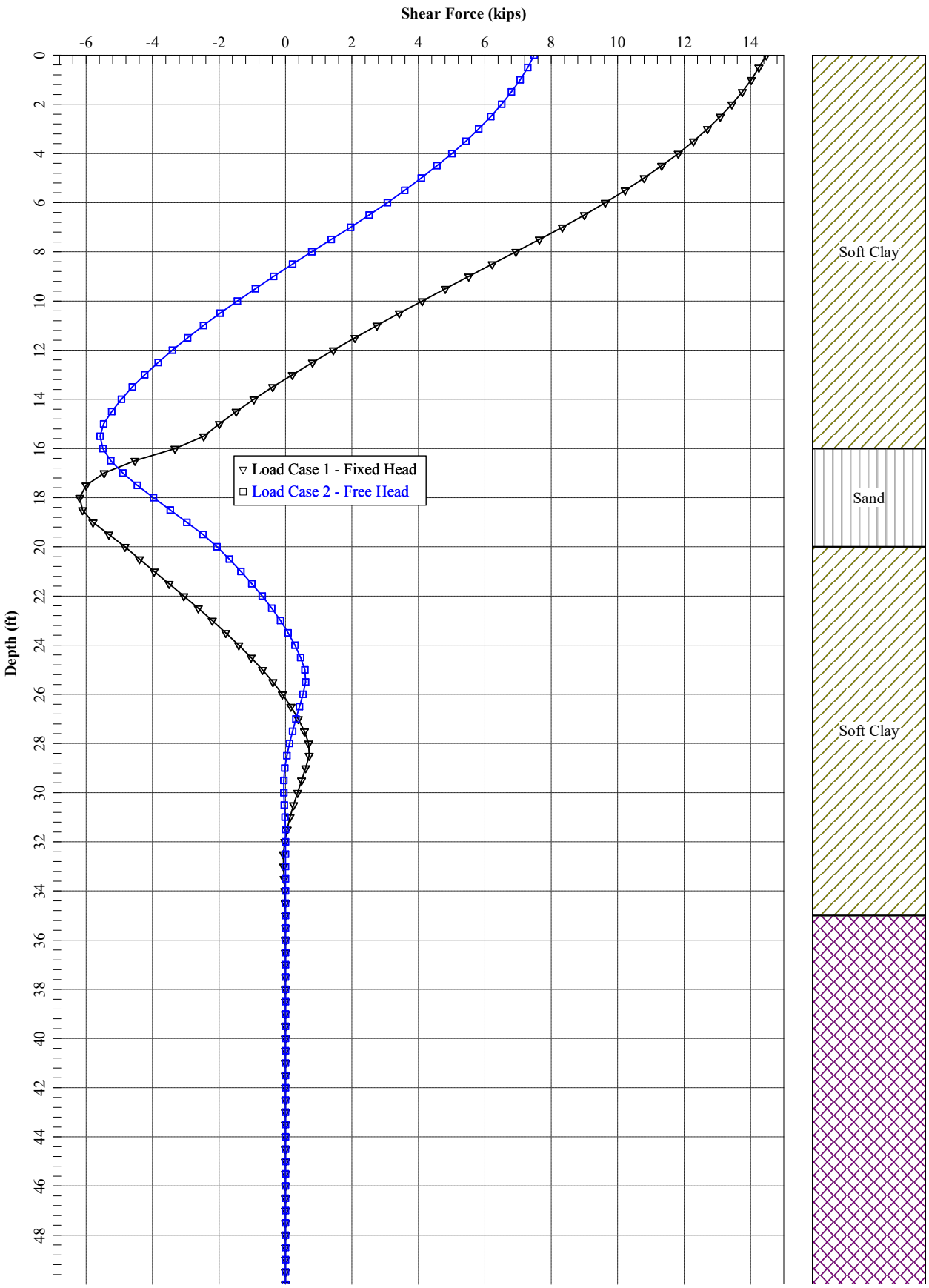
**12 Inch Square Prestressed Concrete Pile**
**1.0 Inch Deflection**



**12 Inch Square Prestressed Concrete Pile**
**1.0 Inch Deflection**



**12 Inch Square Prestressed Concrete Pile**
**1.0 Inch Deflection**



================================================================================
=======

LPile for Windows(Beta), Version 2018-10.008

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
© 1985-2018 by Ensoft, Inc.
All Rights Reserved

================================================================================
=======

This copy of LPile is being used by:

LACO Associates
Santa Rosa
Serial Number of Security Device: 136157127

This copy of LPile is licensed for exclusive use by:

LACO Associates, Santa Rosa, CA

Use of this program by any entity other than LACO Associates, Santa Rosa,
CA
is a violation of the software license agreement.

--------------------------------------------------------------------------
-------
Files Used for Analysis
--------------------------------------------------------------------------
-------

Path to file locations on this computer:
\7900\7986 Carollo Engineers\7986.01 Arcata Wastewater Treatment Facility
Design
\08 Geology\Reports\Geotech Report_Working Files-Archive\L-Pile\CRGT
Under Fill
\

Name of the input data file:
New LPile (USCS units) - 12 inch sq - 1 in def.lp10

Name of the output report file:
New LPile (USCS units) - 12 inch sq - 1 in def.lp10

Name of the plot output file:
New LPile (USCS units) - 12 inch sq - 1 in def.lp10

Name of the runtime message file:
New LPile (USCS units) - 12 inch sq - 1 in def.lp10

---

## Date and Time of Analysis

---

Date: January 23, 2019 Time: 14:52:23

---

## Problem Title

---

Project Name: Wastewater Treatment Facility Improvements
Job Number: 7986.01
Client: Carollo Engineers
Engineer: LACO Associates
Description: Lateral Load Analysis - 12-inch square precast concrete

---

## Program Options and Settings

---

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

| | | |
|---|---|---|
| - Maximum number of iterations allowed | = | 500 |
| - Deflection tolerance for convergence | = | 1.0000E-05 in |
| - Maximum allowable deflection | = | 100.0000 in |
| - Number of pile increments | = | 100 |

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Report only summary tables of pile-head deflection, maximum bending moment,
   and maximum shear force in output report file.
 - No p-y curves to be computed and reported for user-specified depths
 - Print using narrow report formats
   (Note: Some output information is omitted from the narrow report formats)

---

## Pile Structural Properties and Geometry

---

| | | |
|---|---|---|
| Number of pile sections defined | = | 1 |
| Total length of pile | = | 50.000 ft |
| Depth of ground surface below top of pile | = | 0.0000 ft |

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

| Point No. | Depth Below Pile Head feet | Pile Diameter inches |
|---|---|---|
| 1 | 0.000 | 12.0000 |
| 2 | 50.000 | 12.0000 |

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a square prestressed concrete pile

| | | |
|---|---|---|
| Length of section | = | 50.000000 ft |
| Pile Width | = | 12.000000 in |
| Corner Chamfer | = | 0.0000 in |
| Shear capacity of section | = | 0.0000 lbs |

---

## Ground Slope and Pile Batter Angles

---

Ground Slope Angle = 0.000 degrees
= 0.000 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

---

## Soil and Rock Layering Information

---

The soil profile is modelled using 4 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 0.0000 ft |
| Distance from top of pile to bottom of layer | = | 16.000000 ft |
| Effective unit weight at top of layer | = | 95.000000 pcf |
| Effective unit weight at bottom of layer | = | 100.000000 pcf |
| Undrained cohesion at top of layer | = | 200.000000 psf |
| Undrained cohesion at bottom of layer | = | 500.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 16.000000 ft |
| Distance from top of pile to bottom of layer | = | 20.000000 ft |
| Effective unit weight at top of layer | = | 120.000000 pcf |
| Effective unit weight at bottom of layer | = | 120.000000 pcf |
| Friction angle at top of layer | = | 30.000000 deg. |
| Friction angle at bottom of layer | = | 30.000000 deg. |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for subgrade k will be computed for this layer.

Layer 3 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 20.000000 ft |
| Distance from top of pile to bottom of layer | = | 35.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 115.000000 pcf |
| Undrained cohesion at top of layer | = | 600.000000 psf |
| Undrained cohesion at bottom of layer | = | 800.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is cemented silt with cohesion and friction

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 35.000000 ft |
| Distance from top of pile to bottom of layer | = | 70.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 110.000000 pcf |
| Undrained cohesion at top of layer | = | 350.000000 psf |
| Undrained cohesion at bottom of layer | = | 350.000000 psf |
| Friction angle at top of layer | = | 25.000000 deg. |
| Friction angle at bottom of layer | = | 25.000000 deg. |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for Epsilon-50 will be computed for this layer.
NOTE: Default values for subgrade k will be computed for this layer.

(Depth of the lowest soil layer extends 20.000 ft below the pile tip)

---

## Static Loading Type

---

Static loading criteria were used when computing p-y curves for all analyses.

---

## Pile-head Loading and Pile-head Fixity Conditions

---

Number of loads specified = 2

| Load No. | Load Type | Condition 1 | Condition 2 | Axial Thrust Force, lbs |
|---|---|---|---|---|
| 1 | 5 | y = 1.000000 in | S = 0.0000 in/in | 50000. |
| 2 | 4 | y = 1.000000 in | M = 0.0000 in-lbs | 50000. |

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

---

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions of Square Prestressed Pile Section:

| | | |
|---|---|---|
| Length of Section | = | 50.0000 ft |
| Pile Width | = | 12.000 in |
| Corner Chamfer | = | 0.000 in |

Prestressing Strand Details:

| | | |
|---|---|---|
| Strand Type | = | PCI 270 |
| Yield Stress, fpu | = | 270. ksi |
| Elasticity Modulus, Es | = | 28000. ksi |

Stress-strain curve defined using PCI 270 7-wire Lo-lax equation
If eps > 0.0086 fpu (ksi) = 270 - 0.04/(eps-0.007)

| | | |
|---|---|---|
| Number of Reinforcing Strands | = | 6 |
| Cross-sectional Area of Single Strand | = | 0.153 sq. in. |
| Concrete Cover Thickness Over Strands | = | 2.000 in |

Prestressing Strand Geometry:

| Strand No. | Diameter in | Area sq. in | X in | Y in |
|---|---|---|---|---|
| 1 | 0.500 | 0.153 | 3.750 | 0.000 |
| 2 | 0.500 | 0.153 | 1.875 | 3.248 |
| 3 | 0.500 | 0.153 | -1.875 | 3.248 |
| 4 | 0.500 | 0.153 | -3.750 | 0.000 |
| 5 | 0.500 | 0.153 | -1.875 | -3.248 |
| 6 | 0.500 | 0.153 | 1.875 | -3.248 |

Computation of Loss of Prestress:

| | | |
|---|---|---|
| Initial Prestressing Force | = | 146.000 kips |
| Fraction of Loss of Prestress | = | 0.100 |
| Effective Prestressing Force After Losses | = | 131.400 kips |
| Area of Concrete, Ac | = | 143.082 sq.in |
| Area of Steel, As | = | 0.918 sq.in |
| Stress in Concrete After Losses, f_pc | = | 0.918 ksi |
| Stress in Steel After Losses | = | -143.137 ksi |
| Compressive Strain in Concrete After Losses | = | 0.0002080 |
| Tensile Strain in Steel After Losses | = | -0.0051120 |
| Axial Tension Load for Cracking of Concrete | = | -171.135 kips |

Estimated Structural Capacities Computed Using PCI Equations:

| | | |
|---|---|---|
| Nom. Axial Cap., Pn = (0.85 f'c - 0.60 f_pc) Ag | = | 655.054 kips |
| Unfac. Axial Load Cap. N = (0.33 f'c - 0.27 f_pc) Ag | = | 249.414 kips |
| Axial Capacity in Tension, Nt = As fpu | = | -247.860 kips |
| Nom. Moment Capacity, Mn = 0.37 D As fpu | = | 1100.498 in-kip |

Note: The estimate of nominal moment capacity is based on equations that assume compressive strength of concrete is 6,000 psi (41.4 MPa), the value

of prestress after losses is 700 psi (4.83 MPa), and axial thrust force is
zero. When input values for these factors are different, the estimated value
of nominal moment capacity will differ from the capacity computed by LPile
and should be considered only as an approximate check.

Concrete Properties:
---

| | | |
|---|---|---|
| Compressive Strength of Concrete | = | 6000. psi |
| Modulus of Elasticity of Concrete | = | 4415201. psi |
| Modulus of Rupture of Prestressed Concrete | = | -309.838668 psi |
| Compression Strain at Peak Stress | = | 0.002310 |
| Tensile Strain at Fracture of Concrete | = | -0.0000604 |
| Maximum Coarse Aggregate Size | = | 0.750000 in |

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

| Number | Axial Thrust Force kips |
|---|---|
| 1 | 50.000 |

---
Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1
---

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

| Load No. | Axial Thrust kips | Nominal Mom. Cap. in-kip | Max. Comp. Strain |
|---|---|---|---|
| 1 | 50.000 | 1060.461 | 0.00300000 |

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals
(0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section

9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

| Axial Load No. | Resist. Factor for Moment | Nominal Moment Cap in-kips | Ult. (Fac) Ax. Thrust kips | Ult. (Fac) Moment Cap in-kips | Bend. Stiff. at Ult Mom kip-in^2 |
|---|---|---|---|---|---|
| 1 | 0.65 | 1060. | 32.500000 | 689.299356 | 4518034. |
| 1 | 0.70 | 1060. | 35.000000 | 742.322383 | 3846872. |
| 1 | 0.75 | 1060. | 37.500000 | 795.345411 | 3272675. |

---

Layering Correction Equivalent Depths of Soil & Rock Layers

---

| Layer No. | Top of Layer Below Pile Head ft | Equivalent Top Depth Below Grnd Surf ft | Same Layer Type As Layer Above | Layer is Rock or is Below Rock Layer | F0 Integral for Layer lbs | F1 Integral for Layer lbs |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | N.A. | No | 0.00 | 45056. |
| 2 | 16.0000 | 8.6062 | No | No | 45056. | 86705. |
| 3 | 20.0000 | 27.3853 | No | No | 131761. | 94399. |
| 4 | 35.0000 | 17.2802 | No | No | 226160. | N.A. |

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals
for Layer n. Layering correction equivalent depths are computed only

for soil types with both shallow-depth and deep-depth expressions for
peak lateral load transfer. These soil types are soft and stiff clays,
non-liquefied sands, and cemented c-phi soil.

---

Summary of Pile-head Responses for Conventional Analyses

---

Definitions of Pile-head Loading Conditions:

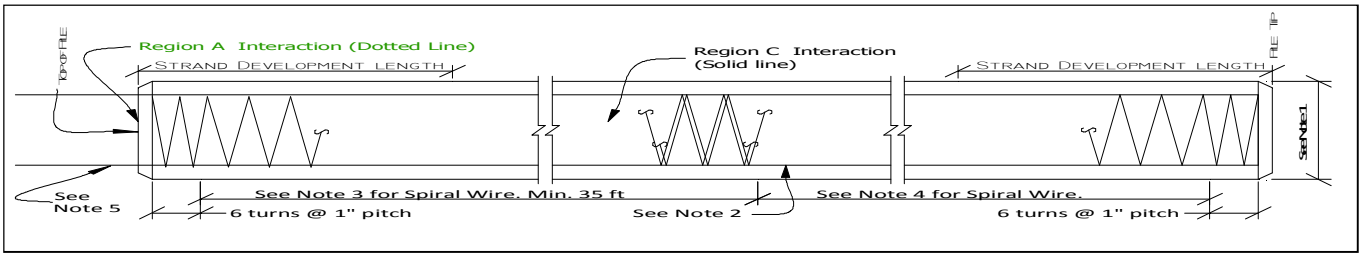
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

| Load Case No. | Load Type | Pile-head Deflection inches | Pile-head Rotation radians | Max Shear in Pile lbs | Max Moment in Pile in-lbs |
|---|---|---|---|---|---|
| 1 | 5 | 1.000000 | 0.0000 | 14475. | -902484. |
| 2 | 4 | 1.000000 | -0.009166 | 7486. | 496293. |

Maximum pile-head deflection = 1.0000000000 inches
Maximum pile-head rotation = -0.0091662920 radians = -0.525190 deg.

The analysis ended normally.

# 14" Sq; f'c = 6,000 psi, 749 psi prestress with No Rebars Pile Details and Interaction Diagram.




NOTE 1; 14" SQUARE PILE, CONC. F'C = 6000 PSI, AREA (AG) = 194.88 SQ-IN.

NOTE 2; 6 - 1/2"ø 270K STRAND ON 9" CIRCLE, STRESSED TO 70% = 749 PSI ( FPC)

NOTE 3; PROVIDE W11.0 @ 2" PITCH FOR TOP 35 FT MINIMUM

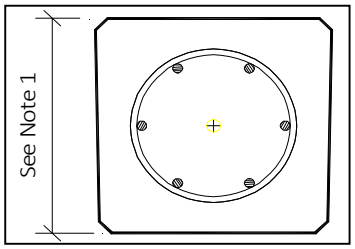
NOTE 4; PROVIDE W8.0 @ 2.875" PITCH WITH 2" COVER

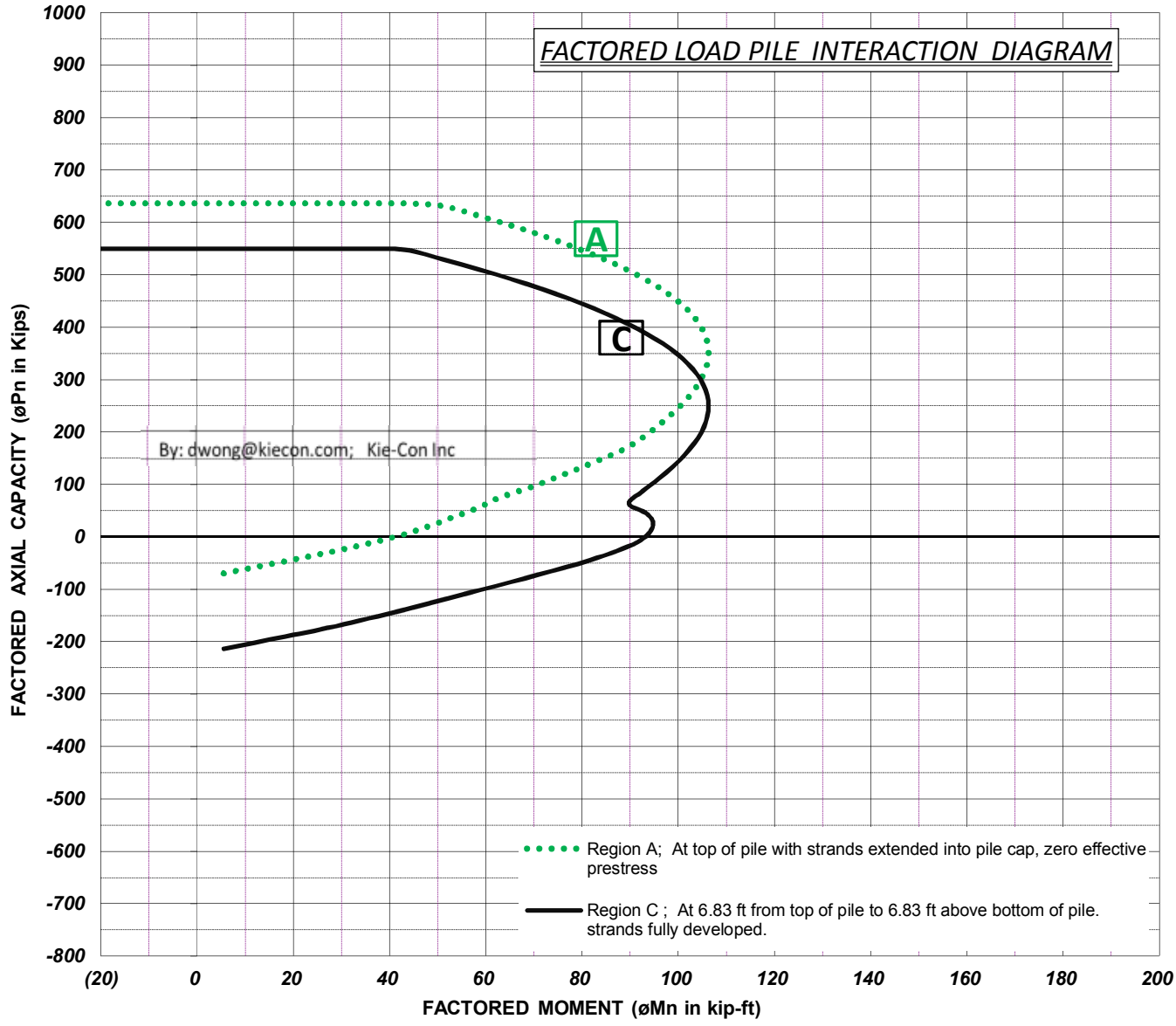
NOTE 5; STRANDS EXTENDED 4.0 FT

NOTE 6; ALLOWABLE SERVICE LOAD BASED ON N = AG(0.33 F'C-0.27FPC) = 346 KIPS

NOTE 7; **PLEASE EMAIL US IF YOU LIKE TO SEE THE INTERACTION DIAGRAMS OF DIFFERENT REBAR SIZES OR COMBINATIONS**

NOTE 8; **THE INTERACTION DIAGRAM SHOWN BELOW IS A GUIDELINE ONLY. ACTUAL DESIGN MUST BE REVIEWED BY EOR FOR EACH PROJECT.**

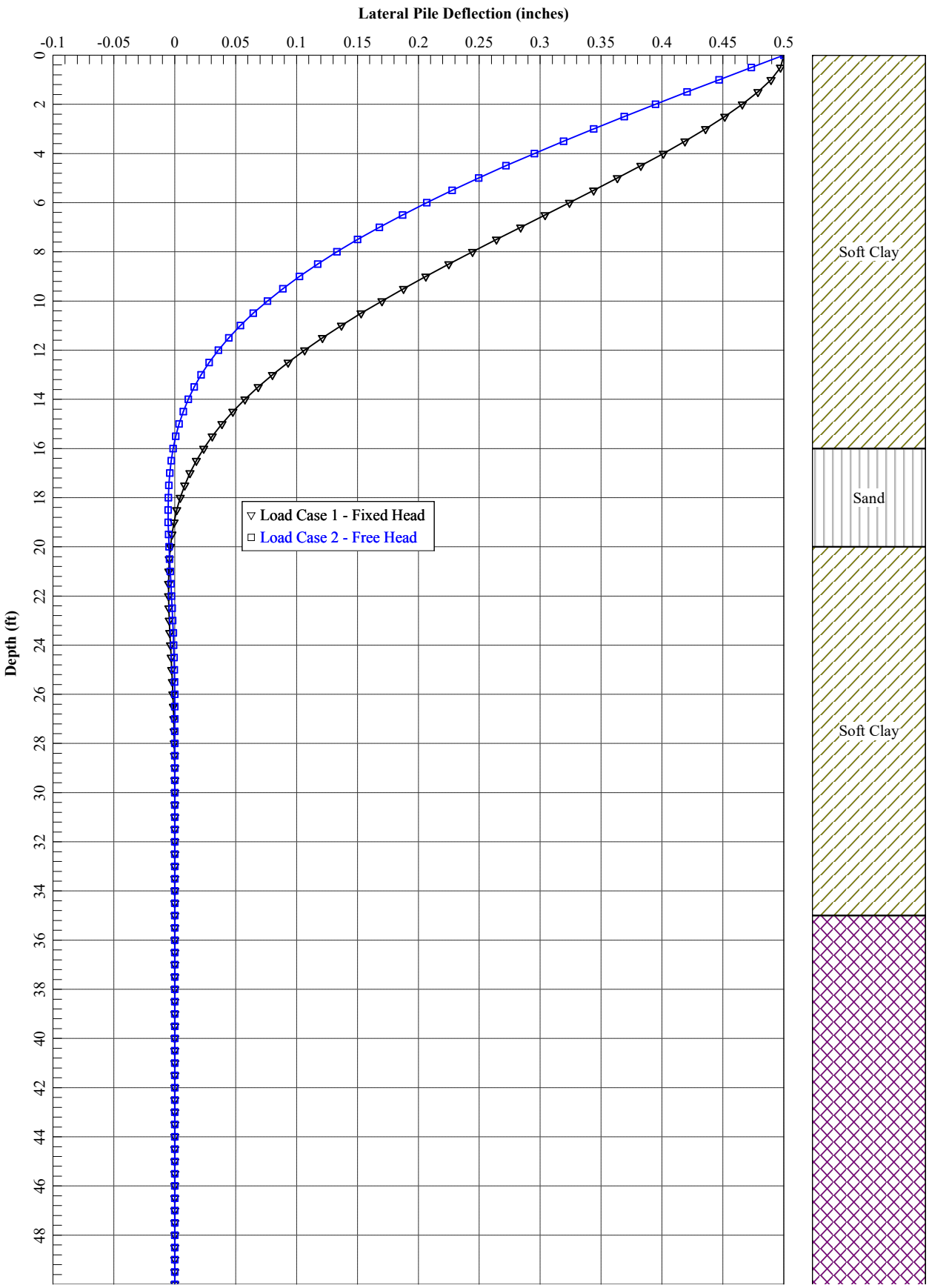


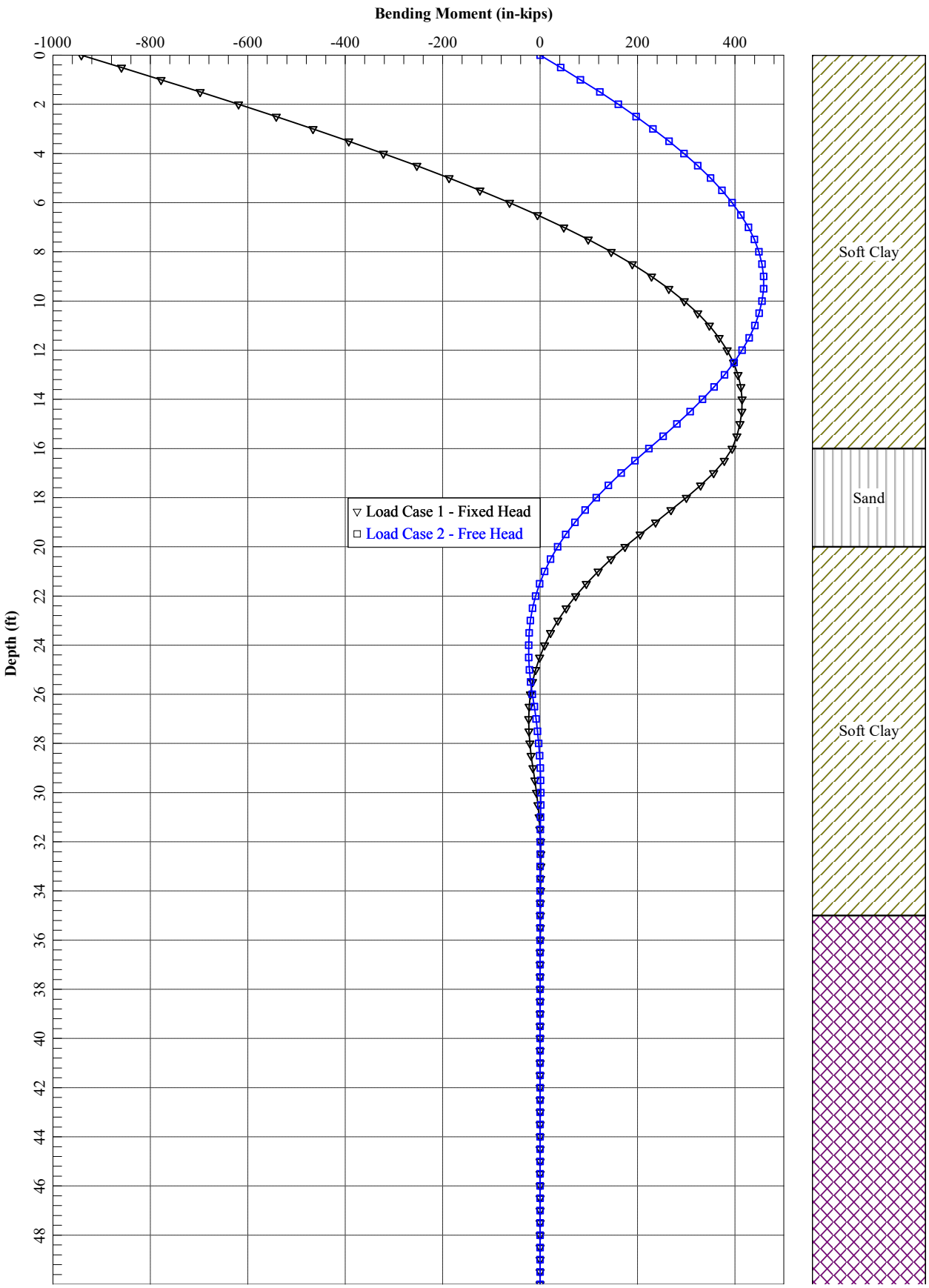

**Pile Manufacturer: KIE-CON Inc** Web Site : Kiecon.com Tel: 925/754-9494 Fax: 925/754-0624

**3551 Wilbur Ave, Antioch, Califorina** By: dwong@kiecon.com (Danny Wong) Page / Rev #:

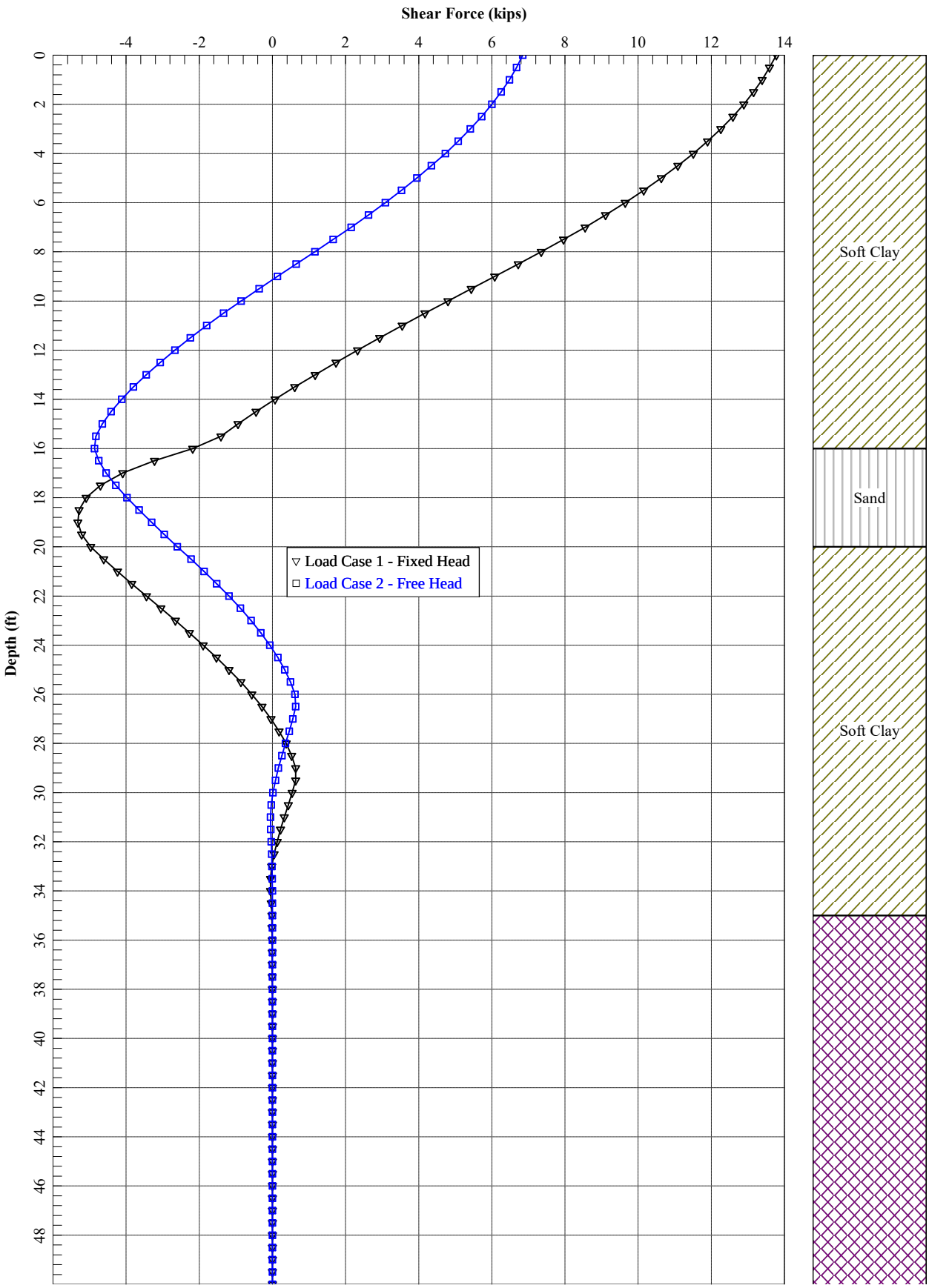
**14 Inch Square Prestressed Concrete Pile**
**0.5 Inch Deflection**



**14 Inch Square Prestressed Concrete Pile**
**0.5 Inch Deflection**



**14 Inch Square Prestressed Concrete Pile**
**0.5 Inch Deflection**



==========
==========

LPile for Windows(Beta), Version 2018-10.008

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
© 1985-2018 by Ensoft, Inc.
All Rights Reserved

==========
==========

This copy of LPile is being used by:

LACO Associates
Santa Rosa
Serial Number of Security Device: 136157127

This copy of LPile is licensed for exclusive use by:

LACO Associates, Santa Rosa, CA

Use of this program by any entity other than LACO Associates, Santa Rosa, CA
is a violation of the software license agreement.

---
---

## Files Used for Analysis

---
---

Path to file locations on this computer:
\7900\7986 Carollo Engineers\7986.01 Arcata Wastewater Treatment Facility Design
\08 Geology\Reports\Geotech Report_Working Files-Archive\L-Pile\CRGT Under Fill
\

Name of the input data file:
New LPile (USCS units) - 14 inch sq - 0.5 in def.lp10

Name of the output report file:
New LPile (USCS units) - 14 inch sq - 0.5 in def.lp10

Name of the plot output file:
New LPile (USCS units) - 14 inch sq - 0.5 in def.lp10

Name of the runtime message file:
New LPile (USCS units) - 14 inch sq - 0.5 in def.lp10

---

## Date and Time of Analysis

---

Date: January 23, 2019 Time: 14:56:22

---

## Problem Title

---

Project Name: Wastewater Treatment Facility Improvements
Job Number: 7986.01
Client: Carollo Engineers
Engineer: LACO Associates
Description: Lateral Load Analysis - 14-inch square precast concrete

---

## Program Options and Settings

---

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

| | | |
|---|---|---|
| - Maximum number of iterations allowed | = | 500 |
| - Deflection tolerance for convergence | = | 1.0000E-05 in |
| - Maximum allowable deflection | = | 100.0000 in |
| - Number of pile increments | = | 100 |

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Report only summary tables of pile-head deflection, maximum bending moment,
   and maximum shear force in output report file.
 - No p-y curves to be computed and reported for user-specified depths
 - Print using narrow report formats
   (Note: Some output information is omitted from the narrow report formats)

---

## Pile Structural Properties and Geometry

---

| | | |
|---|---|---|
| Number of pile sections defined | = | 1 |
| Total length of pile | = | 50.000 ft |
| Depth of ground surface below top of pile | = | 0.0000 ft |

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

| Point No. | Depth Below Pile Head feet | Pile Diameter inches |
|---|---|---|
| 1 | 0.000 | 14.0000 |
| 2 | 50.000 | 14.0000 |

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a square prestressed concrete pile

| | | |
|---|---|---|
| Length of section | = | 50.000000 ft |
| Pile Width | = | 14.000000 in |
| Corner Chamfer | = | 0.0000 in |
| Shear capacity of section | = | 0.0000 lbs |

---

## Ground Slope and Pile Batter Angles

---

Ground Slope Angle = 0.000 degrees
= 0.000 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

---

## Soil and Rock Layering Information

---

The soil profile is modelled using 4 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 0.0000 ft |
| Distance from top of pile to bottom of layer | = | 16.000000 ft |
| Effective unit weight at top of layer | = | 95.000000 pcf |
| Effective unit weight at bottom of layer | = | 100.000000 pcf |
| Undrained cohesion at top of layer | = | 200.000000 psf |
| Undrained cohesion at bottom of layer | = | 500.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 16.000000 ft |
| Distance from top of pile to bottom of layer | = | 20.000000 ft |
| Effective unit weight at top of layer | = | 120.000000 pcf |
| Effective unit weight at bottom of layer | = | 120.000000 pcf |
| Friction angle at top of layer | = | 30.000000 deg. |
| Friction angle at bottom of layer | = | 30.000000 deg. |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for subgrade k will be computed for this layer.

Layer 3 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 20.000000 ft |
| Distance from top of pile to bottom of layer | = | 35.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 115.000000 pcf |
| Undrained cohesion at top of layer | = | 600.000000 psf |
| Undrained cohesion at bottom of layer | = | 800.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is cemented silt with cohesion and friction

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 35.000000 ft |
| Distance from top of pile to bottom of layer | = | 70.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 110.000000 pcf |
| Undrained cohesion at top of layer | = | 350.000000 psf |
| Undrained cohesion at bottom of layer | = | 350.000000 psf |
| Friction angle at top of layer | = | 25.000000 deg. |
| Friction angle at bottom of layer | = | 25.000000 deg. |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for Epsilon-50 will be computed for this layer.
NOTE: Default values for subgrade k will be computed for this layer.

(Depth of the lowest soil layer extends 20.000 ft below the pile tip)

---

## Static Loading Type

---

Static loading criteria were used when computing p-y curves for all analyses.

---

## Pile-head Loading and Pile-head Fixity Conditions

---

Number of loads specified = 2

| Load No. | Load Type | Condition 1 | Condition 2 | Axial Thrust Force, lbs |
|---|---|---|---|---|
| 1 | 5 | y = 0.500000 in | S = 0.0000 in/in | 50000. |
| 2 | 4 | y = 0.500000 in | M = 0.0000 in-lbs | 50000. |

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

---

## Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

### Pile Section No. 1:

#### Dimensions of Square Prestressed Pile Section:

| | | |
|---|---|---|
| Length of Section | = | 50.0000 ft |
| Pile Width | = | 14.000 in |
| Corner Chamfer | = | 0.000 in |

#### Prestressing Strand Details:

| | | |
|---|---|---|
| Strand Type | = | PCI 270 |
| Yield Stress, fpu | = | 270. ksi |
| Elasticity Modulus, Es | = | 28000. ksi |

Stress-strain curve defined using PCI 270 7-wire Lo-lax equation
If eps > 0.0086 fpu (ksi) = 270 - 0.04/(eps-0.007)

| | | |
|---|---|---|
| Number of Reinforcing Strands | = | 6 |
| Cross-sectional Area of Single Strand | = | 0.153 sq. in. |
| Concrete Cover Thickness Over Strands | = | 2.000 in |

Prestressing Strand Geometry:

| Strand No. | Diameter in | Area sq. in | X in | Y in |
|---|---|---|---|---|
| 1 | 0.500 | 0.153 | 4.750 | 0.000 |
| 2 | 0.500 | 0.153 | 2.375 | 4.114 |
| 3 | 0.500 | 0.153 | -2.375 | 4.114 |
| 4 | 0.500 | 0.153 | -4.750 | 0.000 |
| 5 | 0.500 | 0.153 | -2.375 | -4.114 |
| 6 | 0.500 | 0.153 | 2.375 | -4.114 |

Computation of Loss of Prestress:

| | | |
|---|---|---|
| Initial Prestressing Force | = | 146.000 kips |
| Fraction of Loss of Prestress | = | 0.100 |
| Effective Prestressing Force After Losses | = | 131.400 kips |
| Area of Concrete, Ac | = | 195.082 sq.in |
| Area of Steel, As | = | 0.918 sq.in |
| Stress in Concrete After Losses, f_pc | = | 0.674 ksi |
| Stress in Steel After Losses | = | -143.137 ksi |
| Compressive Strain in Concrete After Losses | = | 0.0001526 |
| Tensile Strain in Steel After Losses | = | -0.0051120 |
| Axial Tension Load for Cracking of Concrete | = | -185.012 kips |

Estimated Structural Capacities Computed Using PCI Equations:

| | | |
|---|---|---|
| Nom. Axial Cap., Pn = (0.85 f'c - 0.60 f_pc) Ag | = | 920.389 kips |
| Unfac. Axial Load Cap. N = (0.33 f'c - 0.27 f_pc) Ag | = | 352.435 kips |
| Axial Capacity in Tension, Nt = As fpu | = | -247.860 kips |
| Nom. Moment Capacity, Mn = 0.37 D As fpu | = | 1283.915 in-kip |

Note: The estimate of nominal moment capacity is based on equations that assume compressive strength of concrete is 6,000 psi (41.4 MPa), the value

of prestress after losses is 700 psi (4.83 MPa), and axial thrust force is
zero. When input values for these factors are different, the estimated value
of nominal moment capacity will differ from the capacity computed by LPile
and should be considered only as an approximate check.

Concrete Properties:
---

| | | |
|---|---|---|
| Compressive Strength of Concrete | = | 6000. psi |
| Modulus of Elasticity of Concrete | = | 4415201. psi |
| Modulus of Rupture of Prestressed Concrete | = | -309.838668 psi |
| Compression Strain at Peak Stress | = | 0.002310 |
| Tensile Strain at Fracture of Concrete | = | -0.0000604 |
| Maximum Coarse Aggregate Size | = | 0.750000 in |

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

| Number | Axial Thrust Force kips |
|---|---|
| 1 | 50.000 |

---
Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1
---

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

| Load No. | Axial Thrust kips | Nominal Mom. Cap. in-kip | Max. Comp. Strain |
|---|---|---|---|
| 1 | 50.000 | 1440.759 | 0.00300000 |

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals
(0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section

9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

| Axial Load No. | Resist. Factor for Moment | Nominal Moment Cap in-kips | Ult. (Fac) Ax. Thrust kips | Ult. (Fac) Moment Cap in-kips | Bend. Stiff. at Ult Mom kip-in^2 |
|---|---|---|---|---|---|
| 1 | 0.65 | 1441. | 32.500000 | 936.493219 | 6286542. |
| 1 | 0.70 | 1441. | 35.000000 | 1009. | 5209154. |
| 1 | 0.75 | 1441. | 37.500000 | 1081. | 4380143. |

---

Layering Correction Equivalent Depths of Soil & Rock Layers

---

| Layer No. | Top of Layer Below Pile Head ft | Equivalent Top Depth Below Grnd Surf ft | Same Layer Type As Layer Above | Layer is Rock or is Below Rock Layer | F0 Integral for Layer lbs | F1 Integral for Layer lbs |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | N.A. | No | 0.00 | 51729. |
| 2 | 16.0000 | 8.8912 | No | No | 51729. | 92802. |
| 3 | 20.0000 | 26.2828 | No | No | 144532. | 110132. |
| 4 | 35.0000 | 17.8506 | No | No | 254663. | N.A. |

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals
for Layer n. Layering correction equivalent depths are computed only

for soil types with both shallow-depth and deep-depth expressions for
peak lateral load transfer. These soil types are soft and stiff clays,
non-liquefied sands, and cemented c-phi soil.

---

Summary of Pile-head Responses for Conventional Analyses

---

Definitions of Pile-head Loading Conditions:

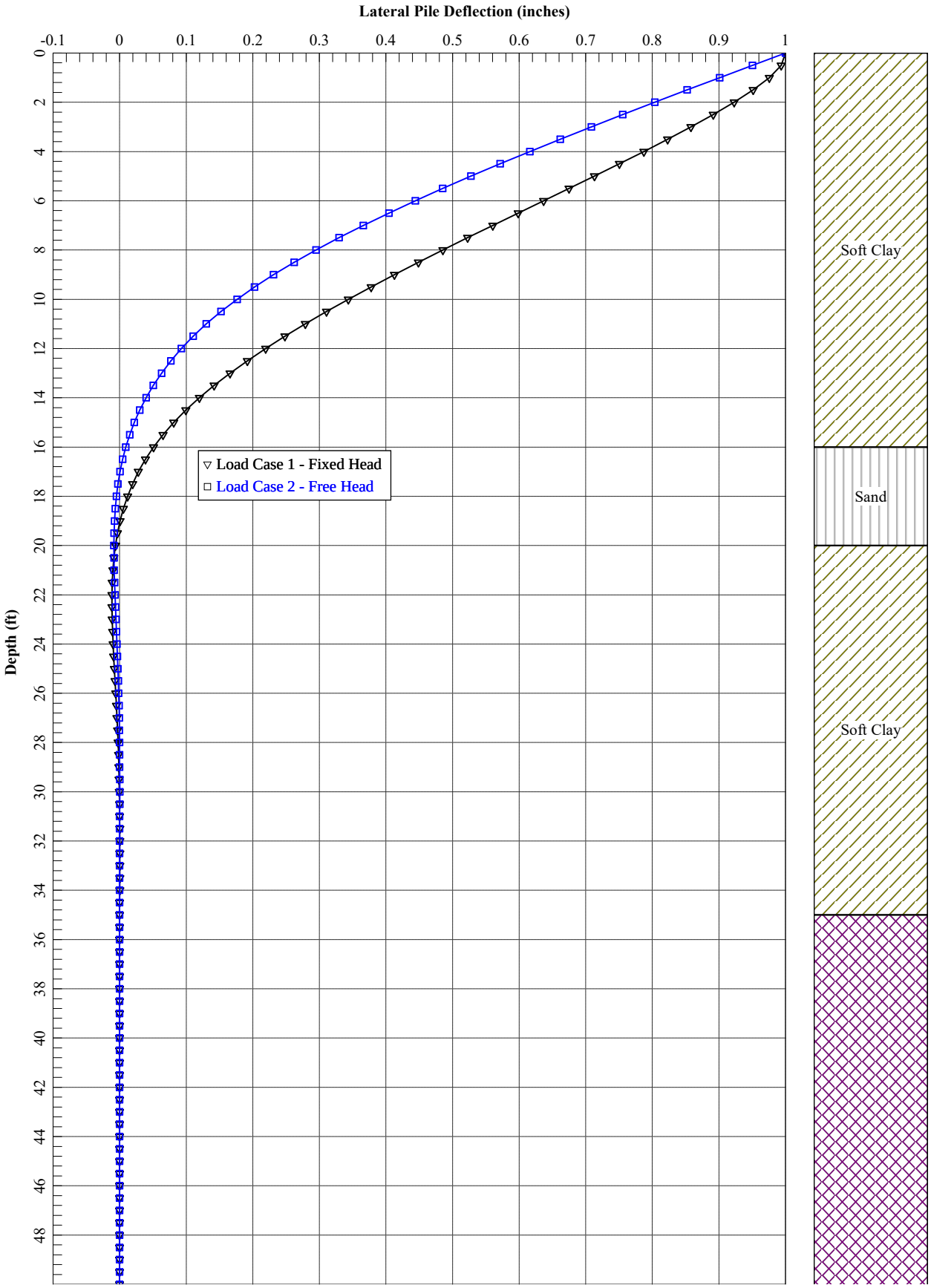
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

| Load Case No. | Load Type | Pile-head Deflection inches | Pile-head Rotation radians | Max Shear in Pile lbs | Max Moment in Pile in-lbs |
|---|---|---|---|---|---|
| 1 | 5 | 0.500000 | 0.0000 | 13781. | -941634. |
| 2 | 4 | 0.500000 | -0.004434 | 6848. | 458510. |

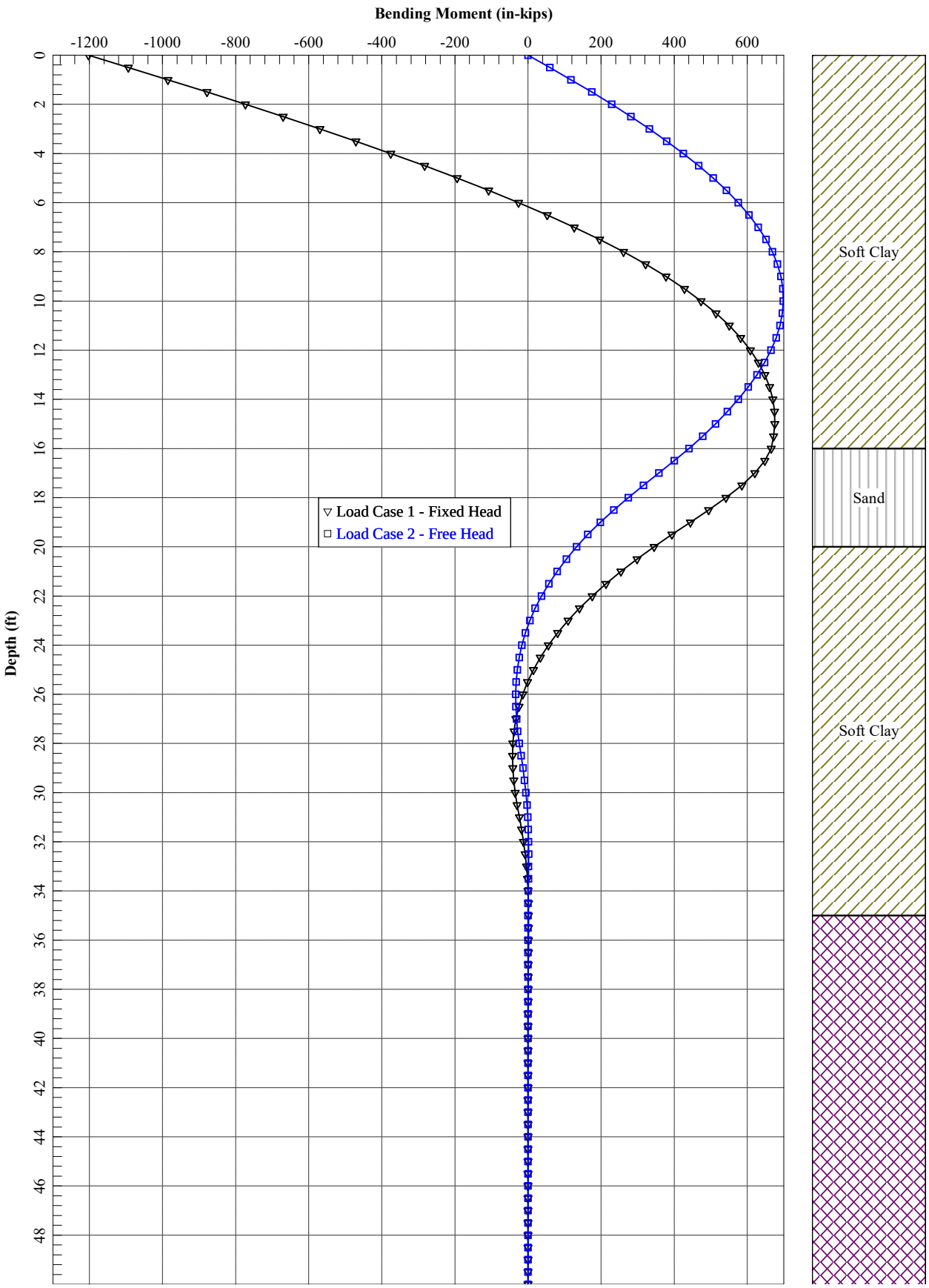
Maximum pile-head deflection = 0.5000000000 inches
Maximum pile-head rotation = -0.0044343987 radians = -0.254072 deg.

The analysis ended normally.

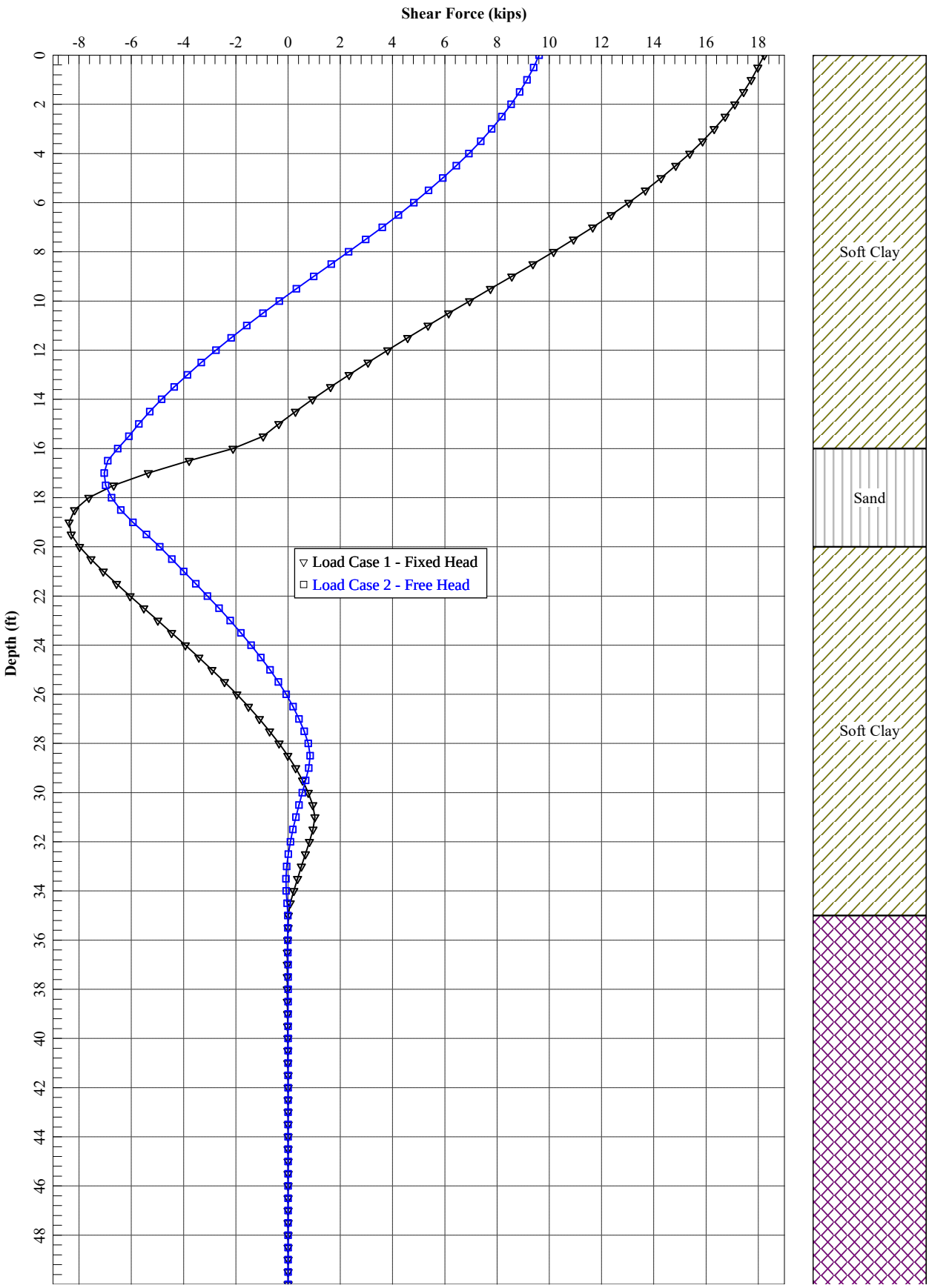
**14 Inch Square Prestressed Concrete Pile**
**1.0 Inch Deflection**



**14 Inch Square Prestressed Concrete Pile**
**1.0 Inch Deflection**



**14 Inch Square Prestressed Concrete Pile**
**1.0 Inch Deflection**



================================================================================
=======

LPile for Windows(Beta), Version 2018-10.008

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
© 1985-2018 by Ensoft, Inc.
All Rights Reserved

================================================================================
=======

This copy of LPile is being used by:

LACO Associates
Santa Rosa
Serial Number of Security Device: 136157127

This copy of LPile is licensed for exclusive use by:

LACO Associates, Santa Rosa, CA

Use of this program by any entity other than LACO Associates, Santa Rosa,
CA
is a violation of the software license agreement.

--------------------------------------------------------------------------
-------
Files Used for Analysis
--------------------------------------------------------------------------
-------

Path to file locations on this computer:
\7900\7986 Carollo Engineers\7986.01 Arcata Wastewater Treatment Facility
Design
\08 Geology\Reports\Geotech Report_Working Files-Archive\L-Pile\CRGT
Under Fill
\

Name of the input data file:
New LPile (USCS units) - 14 inch sq - 1 in def.lp10

Name of the output report file:
New LPile (USCS units) - 14 inch sq - 1 in def.lp10

Name of the plot output file:
New LPile (USCS units) - 14 inch sq - 1 in def.lp10

Name of the runtime message file:
New LPile (USCS units) - 14 inch sq - 1 in def.lp10

---

## Date and Time of Analysis

---

Date: January 23, 2019 Time: 14:59:07

---

## Problem Title

---

Project Name: Wastewater Treatment Facility Improvements
Job Number: 7986.01
Client: Carollo Engineers
Engineer: LACO Associates
Description: Lateral Load Analysis - 14-inch square precast concrete

---

## Program Options and Settings

---

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

| | | |
|---|---|---|
| - Maximum number of iterations allowed | = | 500 |
| - Deflection tolerance for convergence | = | 1.0000E-05 in |
| - Maximum allowable deflection | = | 100.0000 in |
| - Number of pile increments | = | 100 |

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Report only summary tables of pile-head deflection, maximum bending moment,
   and maximum shear force in output report file.
 - No p-y curves to be computed and reported for user-specified depths
 - Print using narrow report formats
   (Note: Some output information is omitted from the narrow report formats)

---

## Pile Structural Properties and Geometry

---

| | | |
|---|---|---|
| Number of pile sections defined | = | 1 |
| Total length of pile | = | 50.000 ft |
| Depth of ground surface below top of pile | = | 0.0000 ft |

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over
the length of the pile. A summary of values of pile diameter vs. depth follows.

| Point No. | Depth Below Pile Head feet | Pile Diameter inches |
|---|---|---|
| 1 | 0.000 | 14.0000 |
| 2 | 50.000 | 14.0000 |

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a square prestressed concrete pile

| | | |
|---|---|---|
| Length of section | = | 50.000000 ft |
| Pile Width | = | 14.000000 in |
| Corner Chamfer | = | 0.0000 in |
| Shear capacity of section | = | 0.0000 lbs |

---

## Ground Slope and Pile Batter Angles

---

Ground Slope Angle = 0.000 degrees
= 0.000 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

---

## Soil and Rock Layering Information

---

The soil profile is modelled using 4 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 0.0000 ft |
| Distance from top of pile to bottom of layer | = | 16.000000 ft |
| Effective unit weight at top of layer | = | 95.000000 pcf |
| Effective unit weight at bottom of layer | = | 100.000000 pcf |
| Undrained cohesion at top of layer | = | 200.000000 psf |
| Undrained cohesion at bottom of layer | = | 500.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 16.000000 ft |
| Distance from top of pile to bottom of layer | = | 20.000000 ft |
| Effective unit weight at top of layer | = | 120.000000 pcf |
| Effective unit weight at bottom of layer | = | 120.000000 pcf |
| Friction angle at top of layer | = | 30.000000 deg. |
| Friction angle at bottom of layer | = | 30.000000 deg. |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for subgrade k will be computed for this layer.

Layer 3 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 20.000000 ft |
| Distance from top of pile to bottom of layer | = | 35.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 115.000000 pcf |
| Undrained cohesion at top of layer | = | 600.000000 psf |
| Undrained cohesion at bottom of layer | = | 800.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is cemented silt with cohesion and friction

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 35.000000 ft |
| Distance from top of pile to bottom of layer | = | 70.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 110.000000 pcf |
| Undrained cohesion at top of layer | = | 350.000000 psf |
| Undrained cohesion at bottom of layer | = | 350.000000 psf |
| Friction angle at top of layer | = | 25.000000 deg. |
| Friction angle at bottom of layer | = | 25.000000 deg. |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for Epsilon-50 will be computed for this layer.
NOTE: Default values for subgrade k will be computed for this layer.

(Depth of the lowest soil layer extends 20.000 ft below the pile tip)

---

## Static Loading Type

---

Static loading criteria were used when computing p-y curves for all analyses.

---

## Pile-head Loading and Pile-head Fixity Conditions

---

Number of loads specified = 2

| Load No. | Load Type | Condition 1 | Condition 2 | Axial Thrust Force, lbs |
|---|---|---|---|---|
| 1 | 5 | y = 1.000000 in | S = 0.0000 in/in | 50000. |
| 2 | 4 | y = 1.000000 in | M = 0.0000 in-lbs | 50000. |

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

---

## Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

### Pile Section No. 1:

#### Dimensions of Square Prestressed Pile Section:

| | | |
|---|---|---|
| Length of Section | = | 50.0000 ft |
| Pile Width | = | 14.000 in |
| Corner Chamfer | = | 0.000 in |

#### Prestressing Strand Details:

| | | |
|---|---|---|
| Strand Type | = | PCI 270 |
| Yield Stress, fpu | = | 270. ksi |
| Elasticity Modulus, Es | = | 28000. ksi |

Stress-strain curve defined using PCI 270 7-wire Lo-lax equation
If eps > 0.0086 fpu (ksi) = 270 - 0.04/(eps-0.007)

| | | |
|---|---|---|
| Number of Reinforcing Strands | = | 6 |
| Cross-sectional Area of Single Strand | = | 0.153 sq. in. |
| Concrete Cover Thickness Over Strands | = | 2.000 in |

Prestressing Strand Geometry:

| Strand No. | Diameter in | Area sq. in | X in | Y in |
|---|---|---|---|---|
| 1 | 0.500 | 0.153 | 4.750 | 0.000 |
| 2 | 0.500 | 0.153 | 2.375 | 4.114 |
| 3 | 0.500 | 0.153 | -2.375 | 4.114 |
| 4 | 0.500 | 0.153 | -4.750 | 0.000 |
| 5 | 0.500 | 0.153 | -2.375 | -4.114 |
| 6 | 0.500 | 0.153 | 2.375 | -4.114 |

Computation of Loss of Prestress:

| | | |
|---|---|---|
| Initial Prestressing Force | = | 146.000 kips |
| Fraction of Loss of Prestress | = | 0.100 |
| Effective Prestressing Force After Losses | = | 131.400 kips |
| Area of Concrete, Ac | = | 195.082 sq.in |
| Area of Steel, As | = | 0.918 sq.in |
| Stress in Concrete After Losses, f_pc | = | 0.674 ksi |
| Stress in Steel After Losses | = | -143.137 ksi |
| Compressive Strain in Concrete After Losses | = | 0.0001526 |
| Tensile Strain in Steel After Losses | = | -0.0051120 |
| Axial Tension Load for Cracking of Concrete | = | -185.012 kips |

Estimated Structural Capacities Computed Using PCI Equations:

| | | |
|---|---|---|
| Nom. Axial Cap., Pn = (0.85 f'c - 0.60 f_pc) Ag | = | 920.389 kips |
| Unfac. Axial Load Cap. N = (0.33 f'c - 0.27 f_pc) Ag | = | 352.435 kips |
| Axial Capacity in Tension, Nt = As fpu | = | -247.860 kips |
| Nom. Moment Capacity, Mn = 0.37 D As fpu | = | 1283.915 in-kip |

Note: The estimate of nominal moment capacity is based on equations that assume compressive strength of concrete is 6,000 psi (41.4 MPa), the value

of prestress after losses is 700 psi (4.83 MPa), and axial thrust force is
zero. When input values for these factors are different, the estimated value
of nominal moment capacity will differ from the capacity computed by LPile
and should be considered only as an approximate check.

Concrete Properties:
---

| | | |
|---|---|---|
| Compressive Strength of Concrete | = | 6000. psi |
| Modulus of Elasticity of Concrete | = | 4415201. psi |
| Modulus of Rupture of Prestressed Concrete | = | -309.838668 psi |
| Compression Strain at Peak Stress | = | 0.002310 |
| Tensile Strain at Fracture of Concrete | = | -0.0000604 |
| Maximum Coarse Aggregate Size | = | 0.750000 in |

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

| Number | Axial Thrust Force kips |
|---|---|
| 1 | 50.000 |

---
Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1
---

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

| Load No. | Axial Thrust kips | Nominal Mom. Cap. in-kip | Max. Comp. Strain |
|---|---|---|---|
| 1 | 50.000 | 1440.759 | 0.00300000 |

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals
(0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section

9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

| Axial Load No. | Resist. Factor for Moment | Nominal Moment Cap in-kips | Ult. (Fac) Ax. Thrust kips | Ult. (Fac) Moment Cap in-kips | Bend. Stiff. at Ult Mom kip-in^2 |
|---|---|---|---|---|---|
| 1 | 0.65 | 1441. | 32.500000 | 936.493219 | 6286542. |
| 1 | 0.70 | 1441. | 35.000000 | 1009. | 5209154. |
| 1 | 0.75 | 1441. | 37.500000 | 1081. | 4380143. |

---

Layering Correction Equivalent Depths of Soil & Rock Layers

---

| Layer No. | Top of Layer Below Pile Head ft | Equivalent Top Depth Below Grnd Surf ft | Same Layer Type As Layer Above | Layer is Rock or is Below Rock Layer | F0 Integral for Layer lbs | F1 Integral for Layer lbs |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | N.A. | No | 0.00 | 51729. |
| 2 | 16.0000 | 8.8912 | No | No | 51729. | 92802. |
| 3 | 20.0000 | 26.2828 | No | No | 144532. | 110132. |
| 4 | 35.0000 | 17.8506 | No | No | 254663. | N.A. |

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals
for Layer n. Layering correction equivalent depths are computed only

for soil types with both shallow-depth and deep-depth expressions for
peak lateral load transfer. These soil types are soft and stiff clays,
non-liquefied sands, and cemented c-phi soil.

---

Summary of Pile-head Responses for Conventional Analyses

---

Definitions of Pile-head Loading Conditions:

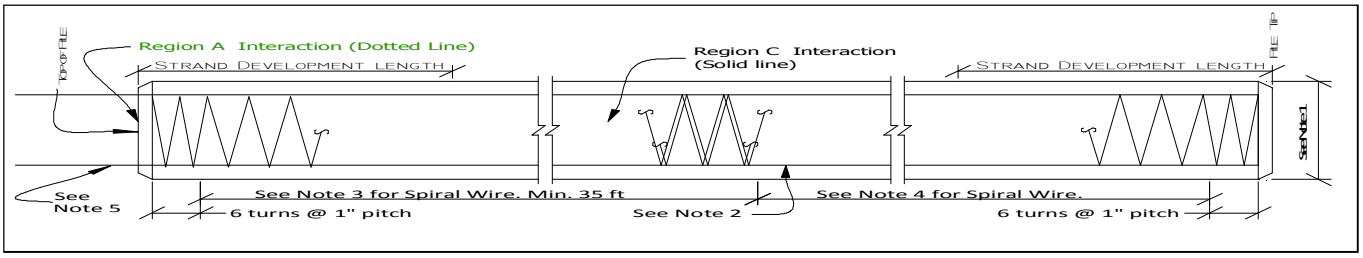
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

| Load Case No. | Load Type | Pile-head Deflection inches | Pile-head Rotation radians | Max Shear in Pile lbs | Max Moment in Pile in-lbs |
|---|---|---|---|---|---|
| 1 | 5 | 1.000000 | 0.0000 | 18226. | -1202381. |
| 2 | 4 | 1.000000 | -0.008239 | 9612. | 698730. |

Maximum pile-head deflection = 1.0000000000 inches
Maximum pile-head rotation = -0.0082394794 radians = -0.472087 deg.

The analysis ended normally.

# 16" Sq; f'c = 6,000 psi, 766 psi prestress with No Rebars Pile Details and Interaction Diagram.




NOTE 1; 16" SQUARE PILE, CONC. F'C = 6000 PSI, AREA (AG) = 254 SQ-IN.

NOTE 2; 8 - 1/2"ø 270K STRAND ON 10-1/2" CIRCLE, STRESSED TO 70% = 766 PSI ( FPC)

NOTE 3; PROVIDE WI4.0 @ 2" PITCH FOR TOP 35 FT MINIMUM

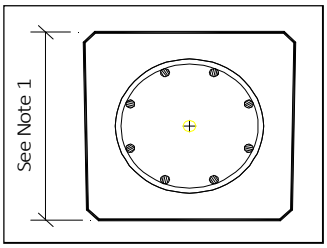
NOTE 4; PROVIDE W8.0 @ 2.5" PITCH WITH 2" COVER

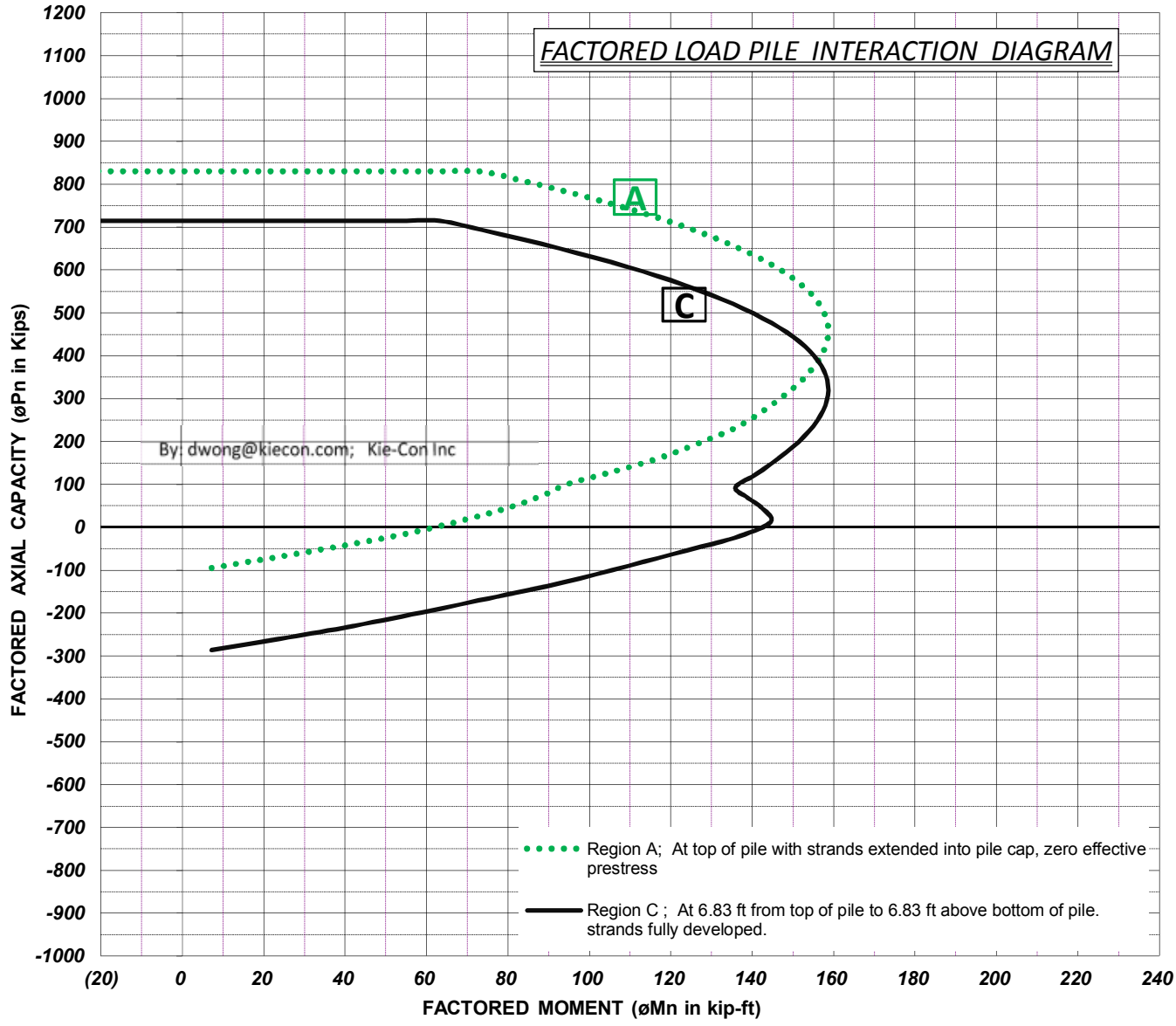
NOTE 5; STRANDS EXTENDED 4.0 FT

NOTE 6; ALLOWABLE SERVICE LOAD BASED ON N = AG(0.33 F'C-0.27FPC) = 450 KIPS

NOTE 7; **PLEASE EMAIL US IF YOU LIKE TO SEE THE INTERACTION DIAGRAMS OF DIFFERENT REBAR SIZES OR COMBINATIONS**

NOTE 8; **THE INTERACTION DIAGRAM SHOWN BELOW IS A GUIDELINE ONLY. ACTUAL DESIGN MUST BE REVIEWED BY EOR FOR EACH PROJECT.**

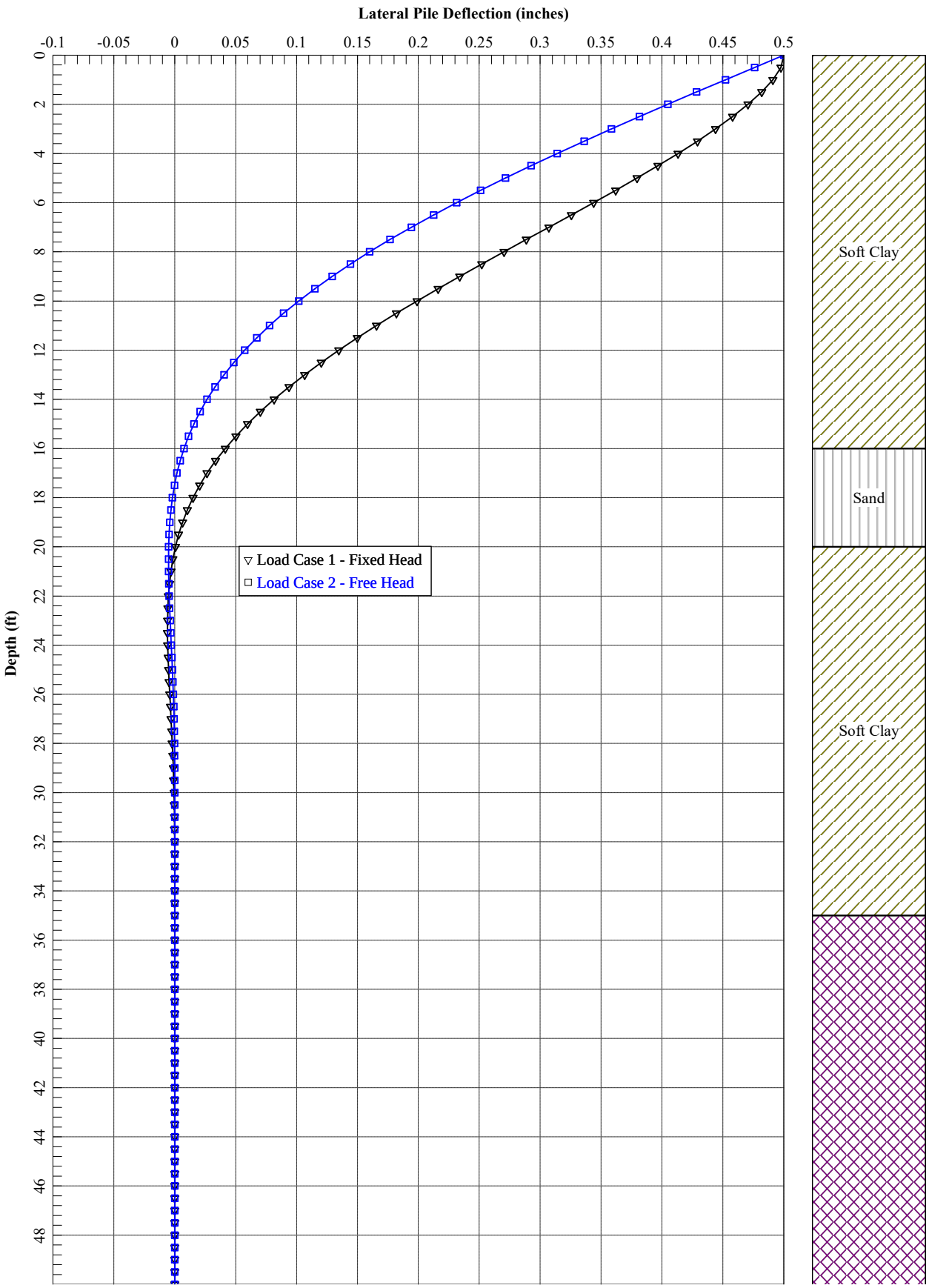


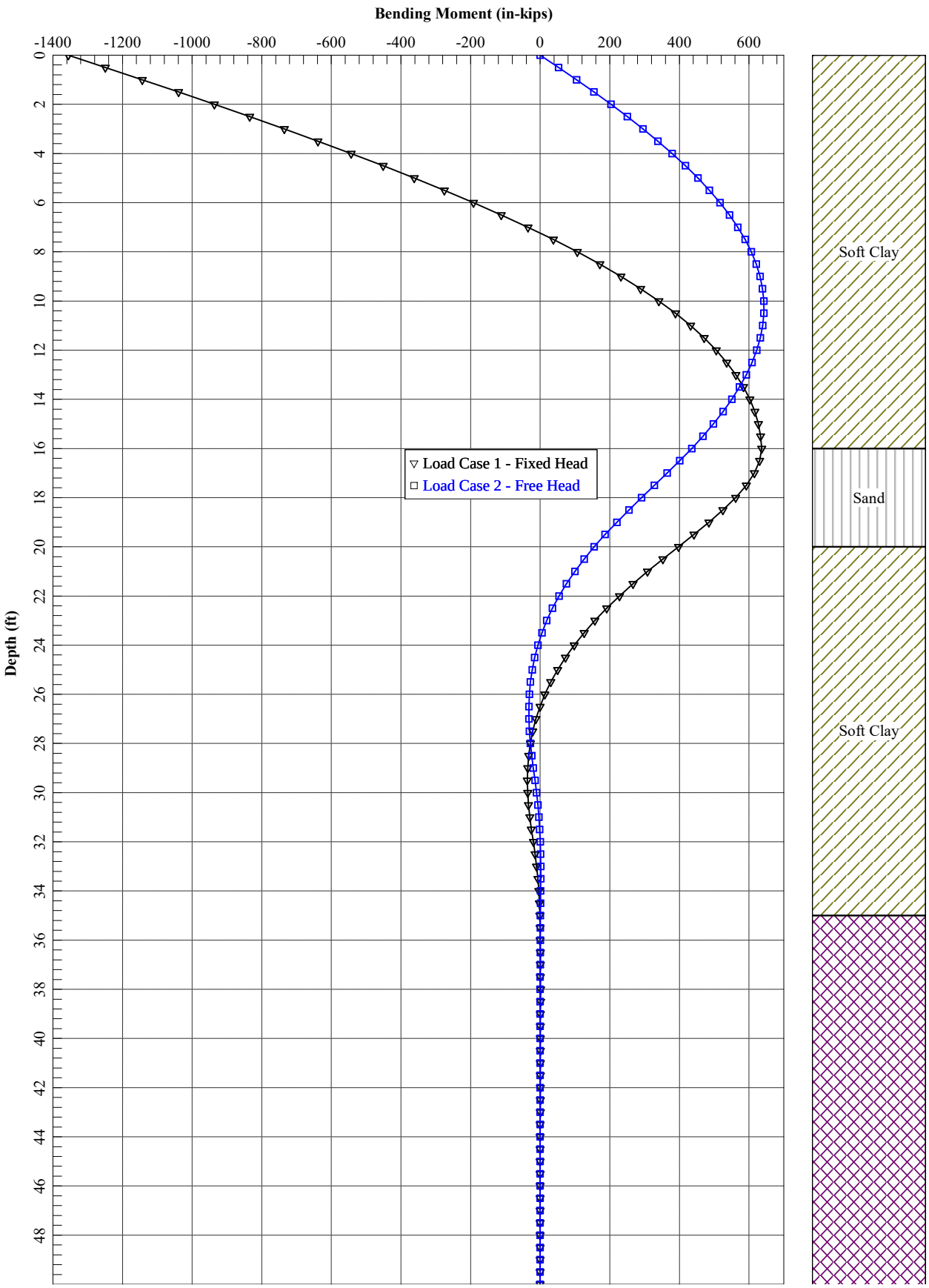

**Pile Manufacturer: KIE-CON Inc** Web Site : Kiecon.com Tel: 925/754-9494 Fax: 925/754-0624

**3551 Wilbur Ave, Antioch, Califorina** By: dwong@kiecon.com (Danny Wong) Page / Rev #:

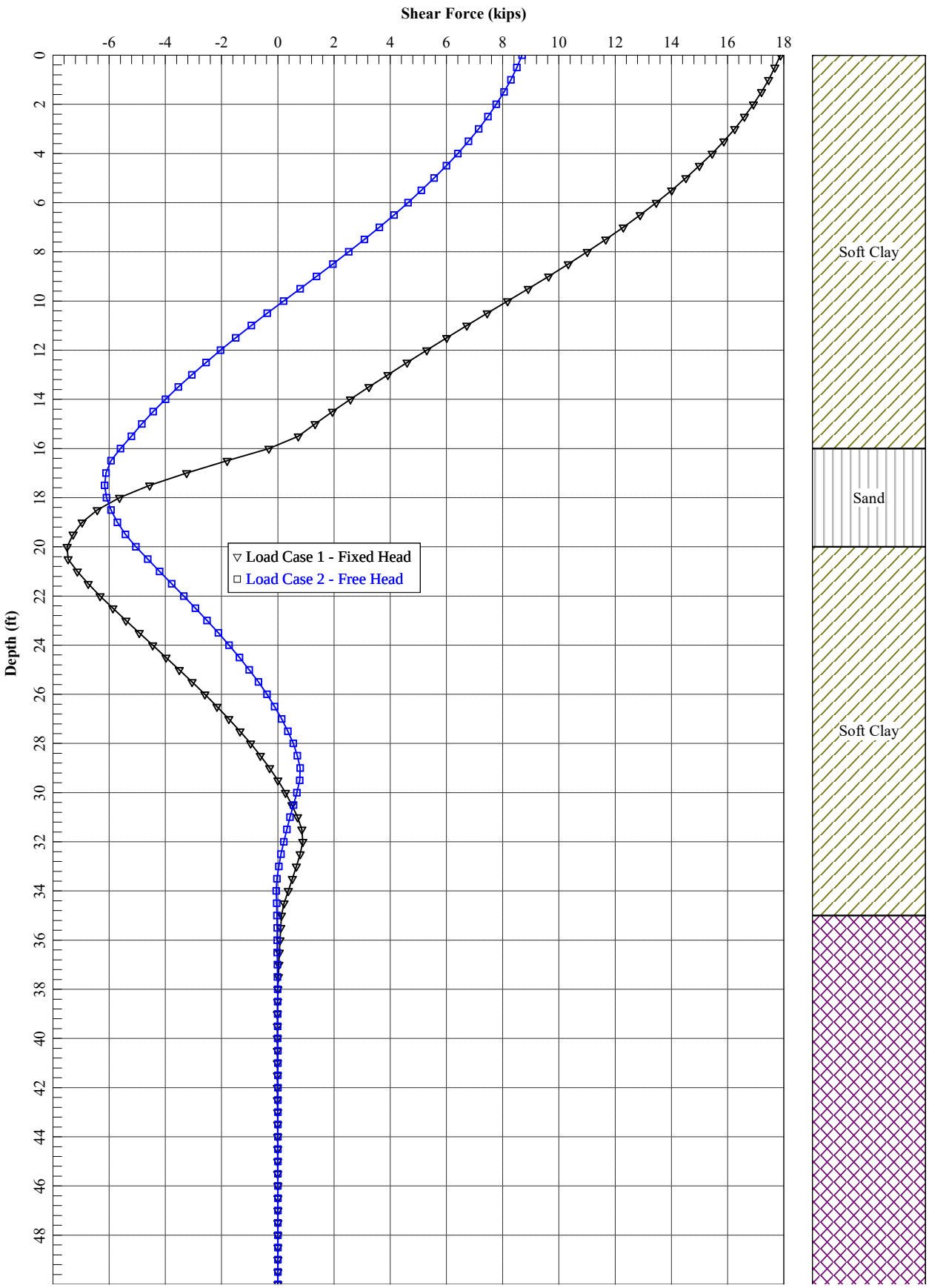
**16 Inch Square Prestressed Concrete Pile**
**0.5 Inch Deflection**



**16 Inch Square Prestressed Concrete Pile**
**0.5 Inch Deflection**



**16 Inch Square Prestressed Concrete Pile**
**0.5 Inch Deflection**



==========
==========

LPile for Windows(Beta), Version 2018-10.008

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
© 1985-2018 by Ensoft, Inc.
All Rights Reserved

==========
==========

This copy of LPile is being used by:

LACO Associates
Santa Rosa
Serial Number of Security Device: 136157127

This copy of LPile is licensed for exclusive use by:

LACO Associates, Santa Rosa, CA

Use of this program by any entity other than LACO Associates, Santa Rosa, CA
is a violation of the software license agreement.

---
---

## Files Used for Analysis

---
---

Path to file locations on this computer:
\7900\7986 Carollo Engineers\7986.01 Arcata Wastewater Treatment Facility Design
\08 Geology\Reports\Geotech Report_Working Files-Archive\L-Pile\CRGT Under Fill
\

Name of the input data file:
New LPile (USCS units) - 16 inch sq - 0.5 in def.lp10

Name of the output report file:
New LPile (USCS units) - 16 inch sq - 0.5 in def.lp10

Name of the plot output file:
New LPile (USCS units) - 16 inch sq - 0.5 in def.lp10

Name of the runtime message file:
New LPile (USCS units) - 16 inch sq - 0.5 in def.lp10

---

## Date and Time of Analysis

---

Date: January 23, 2019 Time: 15:02:44

---

## Problem Title

---

Project Name: Wastewater Treatment Facility Improvements
Job Number: 7986.01
Client: Carollo Engineers
Engineer: LACO Associates
Description: Lateral Load Analysis - 16-inch square precast concrete

---

## Program Options and Settings

---

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

| | | |
|---|---|---|
| - Maximum number of iterations allowed | = | 500 |
| - Deflection tolerance for convergence | = | 1.0000E-05 in |
| - Maximum allowable deflection | = | 100.0000 in |
| - Number of pile increments | = | 100 |

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - No p-y curves to be computed and reported for user-specified depths
 - Print using narrow report formats
   (Note: Some output information is omitted from the narrow report
formats)

---

Pile Structural Properties and Geometry

---

Number of pile sections defined = 1
Total length of pile = 50.000 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2
points.

p-y curves are computed using pile diameter values interpolated with
depth over
the length of the pile. A summary of values of pile diameter vs. depth
follows.

| Point No. | Depth Below Pile Head feet | Pile Diameter inches |
|---|---|---|
| 1 | 0.000 | 16.0000 |
| 2 | 50.000 | 16.0000 |

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a square prestressed concrete pile
Length of section = 50.000000 ft
Pile Width = 16.000000 in
Corner Chamfer = 0.0000 in
Shear capacity of section = 0.0000 lbs

---

## Ground Slope and Pile Batter Angles

---

Ground Slope Angle = 0.000 degrees
= 0.000 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

---

## Soil and Rock Layering Information

---

The soil profile is modelled using 4 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 0.0000 ft |
| Distance from top of pile to bottom of layer | = | 16.000000 ft |
| Effective unit weight at top of layer | = | 95.000000 pcf |
| Effective unit weight at bottom of layer | = | 100.000000 pcf |
| Undrained cohesion at top of layer | = | 200.000000 psf |
| Undrained cohesion at bottom of layer | = | 500.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 16.000000 ft |
| Distance from top of pile to bottom of layer | = | 20.000000 ft |
| Effective unit weight at top of layer | = | 120.000000 pcf |
| Effective unit weight at bottom of layer | = | 120.000000 pcf |
| Friction angle at top of layer | = | 30.000000 deg. |
| Friction angle at bottom of layer | = | 30.000000 deg. |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for subgrade k will be computed for this layer.

Layer 3 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 20.000000 ft |
| Distance from top of pile to bottom of layer | = | 35.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 115.000000 pcf |
| Undrained cohesion at top of layer | = | 600.000000 psf |
| Undrained cohesion at bottom of layer | = | 800.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is cemented silt with cohesion and friction

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 35.000000 ft |
| Distance from top of pile to bottom of layer | = | 70.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 110.000000 pcf |
| Undrained cohesion at top of layer | = | 350.000000 psf |
| Undrained cohesion at bottom of layer | = | 350.000000 psf |
| Friction angle at top of layer | = | 25.000000 deg. |
| Friction angle at bottom of layer | = | 25.000000 deg. |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for Epsilon-50 will be computed for this layer.
NOTE: Default values for subgrade k will be computed for this layer.

(Depth of the lowest soil layer extends 20.000 ft below the pile tip)

---

## Static Loading Type

---

Static loading criteria were used when computing p-y curves for all analyses.

---

## Pile-head Loading and Pile-head Fixity Conditions

---

Number of loads specified = 2

| Load No. | Load Type | Condition 1 | Condition 2 | Axial Thrust Force, lbs |
|---|---|---|---|---|
| 1 | 5 | y = 0.500000 in | S = 0.0000 in/in | 50000. |
| 2 | 4 | y = 0.500000 in | M = 0.0000 in-lbs | 50000. |

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

---

## Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

### Pile Section No. 1:

#### Dimensions of Square Prestressed Pile Section:

| | | |
|---|---|---|
| Length of Section | = | 50.0000 ft |
| Pile Width | = | 16.000 in |
| Corner Chamfer | = | 0.000 in |

#### Prestressing Strand Details:

| | | |
|---|---|---|
| Strand Type | = | PCI 270 |
| Yield Stress, fpu | = | 270. ksi |
| Elasticity Modulus, Es | = | 28000. ksi |

Stress-strain curve defined using PCI 270 7-wire Lo-lax equation
If eps > 0.0086 fpu (ksi) = 270 - 0.04/(eps-0.007)
Number of Reinforcing Strands = 8
Cross-sectional Area of Single Strand = 0.153 sq. in.
Concrete Cover Thickness Over Strands = 2.000 in

Prestressing Strand Geometry:
---

| Strand No. | Diameter in | Area sq. in | X in | Y in |
|---|---|---|---|---|
| 1 | 0.500 | 0.153 | 5.750 | 0.000 |
| 2 | 0.500 | 0.153 | 4.066 | 4.066 |
| 3 | 0.500 | 0.153 | 0.000 | 5.750 |
| 4 | 0.500 | 0.153 | -4.066 | 4.066 |
| 5 | 0.500 | 0.153 | -5.750 | 0.000 |
| 6 | 0.500 | 0.153 | -4.066 | -4.066 |
| 7 | 0.500 | 0.153 | -0.000 | -5.750 |
| 8 | 0.500 | 0.153 | 4.066 | -4.066 |

Computation of Loss of Prestress:
---

Initial Prestressing Force = 194.564 kips
Fraction of Loss of Prestress = 0.100
Effective Prestressing Force After Losses = 175.108 kips
Area of Concrete, Ac = 254.776 sq.in
Area of Steel, As = 1.224 sq.in
Stress in Concrete After Losses, f_pc = 0.687 ksi
Stress in Steel After Losses = -143.062 ksi
Compressive Strain in Concrete After Losses = 0.0001557
Tensile Strain in Steel After Losses = -0.0051093
Axial Tension Load for Cracking of Concrete = -245.167 kips

Estimated Structural Capacities Computed Using PCI Equations:
---

Nom. Axial Cap., Pn = (0.85 f'c - 0.60 f_pc) Ag = 1200.031 kips
Unfac. Axial Load Cap. N = (0.33 f'c - 0.27 f_pc) Ag = 459.374 kips
Axial Capacity in Tension, Nt = As fpu = -330.480 kips
Nom. Moment Capacity, Mn = 0.37 D As fpu = 1956.442 in-kip

Note: The estimate of nominal moment capacity is based on equations that

assume compressive strength of concrete is 6,000 psi (41.4 MPa), the value
of prestress after losses is 700 psi (4.83 MPa), and axial thrust force is
zero. When input values for these factors are different, the estimated value
of nominal moment capacity will differ from the capacity computed by LPile
and should be considered only as an approximate check.

Concrete Properties:
---

| | | |
|---|---|---|
| Compressive Strength of Concrete | = | 6000. psi |
| Modulus of Elasticity of Concrete | = | 4415201. psi |
| Modulus of Rupture of Prestressed Concrete | = | -309.838668 psi |
| Compression Strain at Peak Stress | = | 0.002310 |
| Tensile Strain at Fracture of Concrete | = | -0.0000604 |
| Maximum Coarse Aggregate Size | = | 0.750000 in |

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

| Number | Axial Thrust Force kips |
|---|---|
| 1 | 50.000 |

Definitions of Run Messages and Notes:
---

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in
reinforcement exceeds 0.005 while simultaneously compressive strain in
concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of
section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 50.000 kips

| Bending Curvature rad/in. | Bending Moment in-kip | Bending Stiffness kip-in2 | Depth to N Axis in | Run Msg |
|---|---|---|---|---|
| 0.0000012500 | 28.3054402469 | 22644352. | 147.5648576393 | |
| 0.0000025000 | 61.6837829066 | 24673513. | 77.7912049898 | |
| 0.0000037500 | 95.0607769237 | 25349541. | 54.5373714646 | |
| 0.0000050000 | 128.4357254408 | 25687145. | 42.9134928738 | |
| 0.0000062500 | 161.8079315299 | 25889269. | 35.9415964299 | |
| 0.0000075000 | 195.1766981682 | 26023560. | 31.2956912457 | |
| 0.0000087500 | 228.5413282140 | 26119009. | 27.9789241199 | |
| 0.0000100000 | 261.9011243925 | 26190112. | 25.4928684836 | |
| 0.0000112500 | 295.2553892753 | 26244923. | 23.5606207152 | |
| 0.0000125000 | 328.6034252801 | 26288274. | 22.0160386673 | |
| 0.0000137500 | 361.9445345229 | 26323239. | 20.7533955416 | |
| 0.0000150000 | 395.2780187770 | 26351868. | 19.7022068271 | |
| 0.0000162500 | 428.6031797758 | 26375580. | 18.8136755743 | |
| 0.0000175000 | 461.9193186221 | 26395390. | 18.0529468373 | |
| 0.0000187500 | 495.2257367986 | 26412039. | 17.3944603393 | |
| 0.0000200000 | 528.5217344823 | 26426087. | 16.8190458887 | |
| 0.0000212500 | 561.8066122771 | 26437958. | 16.3120439423 | |
| 0.0000225000 | 595.0795947625 | 26447982. | 15.8620523013 | |
| 0.0000237500 | 628.3322566917 | 26456095. | 15.4600356232 | |
| 0.0000250000 | 661.5465588628 | 26461862. | 15.0987232750 | |
| 0.0000262500 | 694.7077212707 | 26465056. | 14.7722393948 | |
| 0.0000275000 | 727.8043496086 | 26465613. | 14.4757876063 | |
| 0.0000287500 | 760.8275123432 | 26463566. | 14.2054137971 | |
| 0.0000300000 | 793.7701673943 | 26459006. | 13.9578291756 | |
| 0.0000312500 | 813.2635917827 | 26024435. | 13.6851041062 | C |
| 0.0000325000 | 830.9449748573 | 25567538. | 13.4259577207 | C |
| 0.0000337500 | 847.0142015938 | 25096717. | 13.1791837658 | C |
| 0.0000350000 | 861.6632890615 | 24618951. | 12.9437751288 | C |
| 0.0000362500 | 875.0767679842 | 24140049. | 12.7188937542 | C |
| 0.0000375000 | 887.4315895575 | 23664842. | 12.5038449980 | C |
| 0.0000387500 | 904.0680488916 | 23330788. | 12.3168458959 | C |
| 0.0000400000 | 914.7074039572 | 22867685. | 12.1197988812 | C |
| 0.0000412500 | 929.4663484905 | 22532518. | 11.9484460126 | C |
| 0.0000425000 | 943.3604182949 | 22196716. | 11.7838950871 | C |
| 0.0000437500 | 951.4153625538 | 21746637. | 11.6072130565 | C |

```
    0.0000450000     963.7688728104          21417086.      11.4549082087
C
    0.0000462500     963.7688728104          20838246.      11.2248376261
C
    0.0000475000     966.2413405270          20341923.      11.0848982967
C
    0.0000487500     977.3655771744          20048525.      10.9505760292
C
    0.0000512500     998.4240285680          19481444.      10.6966585988
C
    0.0000537500             1018.           18944518.      10.4614577049
C
    0.0000562500             1037.           18433559.      10.2421490731
C
    0.0000587500             1055.           17949772.      10.0376389710
C
    0.0000612500             1071.           17490973.       9.8462386785
C
    0.0000637500             1087.           17054484.       9.6662872162
C
    0.0000662500             1102.           16639775.       9.4969146912
C
    0.0000687500             1117.           16245719.       9.3372217381
C
    0.0000712500             1131.           15870995.       9.1863515863
C
    0.0000737500             1144.           15514239.       9.0435077425
C
    0.0000762500             1157.           15173493.       8.9077198071
C
    0.0000787500             1169.           14848628.       8.7787273129
C
    0.0000812500             1181.           14538844.       8.6560878078
C
    0.0000837500             1193.           14243412.       8.5394277843
C
    0.0000862500             1204.           13960261.       8.4278305011
C
    0.0000887500             1215.           13688994.       8.3210513717
C
    0.0000912500             1225.           13430109.       8.2193033318
C
    0.0000937500             1236.           13181122.       8.1214751652
C
    0.0000962500             1246.           12942582.       8.0278032666
C
    0.0000987500             1256.           12714178.       7.9381945653
C
    0.0001012500             1265.           12493962.       7.8517053345
C
    0.0001037500             1274.           12283461.       7.7691624237
C
    0.0001062500             1283.           12079647.       7.6890343001
C
```

| | | | |
|---|---|---|---|
| 0.0001087500 | 1292. | 11884691. | 7.6125330313 |
| 0.0001112500 | 1301. | 11695715. | 7.5381366046 |
| 0.0001137500 | 1310. | 11514405. | 7.4668540844 |
| 0.0001162500 | 1318. | 11339015. | 7.3977359640 |
| 0.0001187500 | 1326. | 11169804. | 7.3310101037 |
| 0.0001212500 | 1335. | 11006934. | 7.2668288519 |
| 0.0001237500 | 1343. | 10848515. | 7.2040996557 |
| 0.0001262500 | 1350. | 10696275. | 7.1439699088 |
| 0.0001287500 | 1358. | 10548495. | 7.0853942680 |
| 0.0001312500 | 1366. | 10405329. | 7.0285470904 |
| 0.0001337500 | 1373. | 10267427. | 6.9739303882 |
| 0.0001362500 | 1381. | 10132997. | 6.9203679186 |
| 0.0001387500 | 1388. | 10002808. | 6.8684679403 |
| 0.0001412500 | 1395. | 9877148. | 6.8185018359 |
| 0.0001437500 | 1402. | 9754664. | 6.7695351382 |
| 0.0001462500 | 1409. | 9635622. | 6.7218311982 |
| 0.0001487500 | 1416. | 9520508. | 6.6758197864 |
| 0.0001587500 | 1443. | 9090796. | 6.5032229080 |
| 0.0001687500 | 1469. | 8705376. | 6.3475096484 |
| 0.0001787500 | 1494. | 8357749. | 6.2062828099 |
| 0.0001887500 | 1518. | 8042736. | 6.0777200741 |
| 0.0001987500 | 1542. | 7756143. | 5.9604391271 |
| 0.0002087500 | 1564. | 7494145. | 5.8529542025 |
| 0.0002187500 | 1587. | 7252978. | 5.7532219692 |
| 0.0002287500 | 1608. | 7031437. | 5.6619714948 |
| 0.0002387500 | 1630. | 6826018. | 5.5767048770 |
| 0.0002487500 | 1651. | 6635998. | 5.4982295360 |

| | | | |
|---|---|---|---|
| 0.0002587500 | 1671. | 6458778. | 5.4245397314 |
| C | | | |
| 0.0002687500 | 1692. | 6294152. | 5.3568911584 |
| C | | | |
| 0.0002787500 | 1711. | 6139403. | 5.2923696177 |
| C | | | |
| 0.0002887500 | 1731. | 5994896. | 5.2329477657 |
| C | | | |
| 0.0002987500 | 1750. | 5859106. | 5.1771972521 |
| C | | | |
| 0.0003087500 | 1769. | 5730987. | 5.1243597756 |
| C | | | |
| 0.0003187500 | 1788. | 5610475. | 5.0754231048 |
| C | | | |
| 0.0003287500 | 1807. | 5496663. | 5.0295933385 |
| C | | | |
| 0.0003387500 | 1825. | 5388495. | 4.9855435227 |
| C | | | |
| 0.0003487500 | 1844. | 5286132. | 4.9445740365 |
| C | | | |
| 0.0003587500 | 1862. | 5189080. | 4.9064379873 |
| C | | | |
| 0.0003687500 | 1879. | 5096737. | 4.8704756467 |
| C | | | |
| 0.0003787500 | 1897. | 5008450. | 4.8357465287 |
| C | | | |
| 0.0003887500 | 1914. | 4923659. | 4.8030930331 |
| C | | | |
| 0.0003987500 | 1930. | 4839591. | 4.7714446983 |
| C | | | |
| 0.0004087500 | 1944. | 4757163. | 4.7410593068 |
| C | | | |
| 0.0004187500 | 1959. | 4677712. | 4.7120325781 |
| C | | | |
| 0.0004287500 | 1973. | 4600867. | 4.6836095309 |
| C | | | |
| 0.0004387500 | 1986. | 4526837. | 4.6568205665 |
| C | | | |
| 0.0004487500 | 1999. | 4455483. | 4.6315863679 |
| C | | | |
| 0.0004587500 | 2012. | 4386442. | 4.6077237032 |
| C | | | |
| 0.0004687500 | 2024. | 4317934. | 4.5843527479 |
| C | | | |
| 0.0004787500 | 2034. | 4248673. | 4.5607820985 |
| C | | | |
| 0.0004887500 | 2043. | 4179665. | 4.5362649949 |
| C | | | |
| 0.0004987500 | 2051. | 4112405. | 4.5127184945 |
| C | | | |
| 0.0005087500 | 2059. | 4046942. | 4.4902070660 |
| C | | | |
| 0.0005187500 | 2066. | 3983246. | 4.4687144361 |
| C | | | |

| | | | |
|---|---|---|---|
| 0.0005287500 | 2073. | 3921278. | 4.4482208415 C |
| 0.0005387500 | 2080. | 3860698. | 4.4291358445 C |
| 0.0005487500 | 2086. | 3801791. | 4.4109484559 C |
| 0.0006087500 | 2117. | 3477945. | 4.3157359930 C |
| 0.0006687500 | 2141. | 3200831. | 4.2480773994 C |
| 0.0007287500 | 2158. | 2961919. | 4.1975923183 C |
| 0.0007887500 | 2173. | 2754363. | 4.1635694279 C |
| 0.0008487500 | 2183. | 2572583. | 4.1427414766 C |
| 0.0009087500 | 2191. | 2411117. | 4.1304416297 C |

---

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

---

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

| Load No. | Axial Thrust kips | Nominal Mom. Cap. in-kip | Max. Comp. Strain |
|---|---|---|---|
| 1 | 50.000 | 2140.838 | 0.00300000 |

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section 9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

| Axial | Resist. | Nominal | Ult. (Fac) | Ult. (Fac) | Bend. Stiff. |
|---|---|---|---|---|---|

| Load No. | Factor for Moment | Moment Cap in-kips | Ax. Thrust kips | Moment Cap in-kips | at Ult Mom kip-in^2 |
|---|---|---|---|---|---|
| 1 | 0.65 | 2141. | 32.500000 | 1392. | 9939523. |
| 1 | 0.70 | 2141. | 35.000000 | 1499. | 8297160. |
| 1 | 0.75 | 2141. | 37.500000 | 1606. | 7059952. |

Layering Correction Equivalent Depths of Soil & Rock Layers

| Layer No. | Top of Layer Below Pile Head ft | Equivalent Top Depth Below Grnd Surf ft | Same Layer Type As Layer Above | Layer is Rock or is Below Rock Layer | F0 Integral for Layer lbs | F1 Integral for Layer lbs |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | N.A. | No | 0.00 | 58198. |
| 2 | 16.0000 | 9.1161 | No | No | 58198. | 98121. |
| 3 | 20.0000 | 25.3807 | No | No | 156319. | 125865. |
| 4 | 35.0000 | 18.3553 | No | No | 282184. | N.A. |

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals
for Layer n. Layering correction equivalent depths are computed only
for soil types with both shallow-depth and deep-depth expressions for
peak lateral load transfer. These soil types are soft and stiff clays,
non-liquefied sands, and cemented c-phi soil.

---

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

---

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.500000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 50000.0 lbs

| Depth X feet | Deflect. y inches | Bending Moment in-lbs | Shear Force lbs | Soil Res. p lb/inch | Bending Stiffness in-lb^2 |
|---|---|---|---|---|---|
| 0.000 | 0.50000 | -1355972. | 17884. | -28.49960 | 1.057E+10 |
| 0.50000 | 0.49769 | -1249170. | 17679. | -33.90604 | 1.057E+10 |
| 1.00000 | 0.49113 | -1143376. | 17460. | -39.35252 | 1.555E+10 |
| 1.50000 | 0.48192 | -1038867. | 17207. | -44.83458 | 1.840E+10 |
| 2.00000 | 0.47068 | -935869. | 16922. | -50.33514 | 2.238E+10 |
| 2.50000 | 0.45794 | -834609. | 16603. | -55.84097 | 2.546E+10 |
| 3.00000 | 0.44401 | -735300. | 16251. | -61.33642 | 2.647E+10 |
| 3.50000 | 0.42908 | -638149. | 15867. | -66.80205 | 2.646E+10 |
| 4.00000 | 0.41329 | -543360. | 15450. | -72.21658 | 2.643E+10 |
| 4.50000 | 0.39675 | -451133. | 15001. | -77.55847 | 2.639E+10 |
| 5.00000 | 0.37960 | -361668. | 14520. | -82.80591 | 2.632E+10 |
| 5.50000 | 0.36196 | -275159. | 14007. | -87.93680 | 2.621E+10 |
| 6.00000 | 0.34394 | -191796. | 13465. | -92.92874 | 2.601E+10 |
| 6.50000 | 0.32565 | -111766. | 12893. | -97.75902 | 2.554E+10 |
| 7.00000 | 0.30720 | -35248. | 12292. | -102.40459 | 2.334E+10 |

| | | | | | |
|---|---|---|---|---|---|
| 7.50000 | 0.28870 | 37587. | 11664. | -106.84200 | 2.353E+10 |
| 8.00000 | 0.27026 | 106573. | 11011. | -111.04928 | 2.549E+10 |
| 8.50000 | 0.25197 | 171553. | 10333. | -115.00273 | 2.593E+10 |
| 9.00000 | 0.23391 | 232381. | 9632. | -118.67825 | 2.613E+10 |
| 9.50000 | 0.21618 | 288921. | 8909. | -122.05130 | 2.624E+10 |
| 10.00000 | 0.19884 | 341047. | 8178. | -121.82200 | 2.630E+10 |
| 10.50000 | 0.18197 | 388765. | 7449. | -121.13602 | 2.635E+10 |
| 11.00000 | 0.16563 | 432094. | 6725. | -120.16939 | 2.638E+10 |
| 11.50000 | 0.14988 | 471069. | 6008. | -118.91541 | 2.640E+10 |
| 12.00000 | 0.13478 | 505730. | 5299. | -117.36692 | 2.642E+10 |
| 12.50000 | 0.12036 | 536131. | 4600. | -115.51617 | 2.643E+10 |
| 13.00000 | 0.10667 | 562338. | 3914. | -113.35471 | 2.644E+10 |
| 13.50000 | 0.09375 | 584425. | 3241. | -110.87310 | 2.644E+10 |
| 14.00000 | 0.08162 | 602481. | 2584. | -108.06075 | 2.645E+10 |
| 14.50000 | 0.07032 | 616606. | 1945. | -104.90549 | 2.645E+10 |
| 15.00000 | 0.05985 | 626912. | 1326. | -101.39320 | 2.646E+10 |
| 15.50000 | 0.05023 | 633526. | 729.62084 | -97.50717 | 2.646E+10 |
| 16.00000 | 0.04148 | 636586. | -314.98466 | -250.69466 | 2.646E+10 |
| 16.50000 | 0.03360 | 630578. | -1802. | -244.92464 | 2.646E+10 |
| 17.00000 | 0.02657 | 615710. | -3241. | -234.65256 | 2.645E+10 |
| 17.50000 | 0.02038 | 592352. | -4557. | -204.10793 | 2.645E+10 |
| 18.00000 | 0.01500 | 561606. | -5633. | -154.47793 | 2.644E+10 |
| 18.50000 | 0.01038 | 525261. | -6426. | -109.86372 | 2.642E+10 |
| 19.00000 | 0.006473 | 484925. | -6966. | -70.38751 | 2.641E+10 |
| 19.50000 | 0.003231 | 442021. | -7286. | -36.05526 | 2.638E+10 |
| 20.00000 | 0.000592 | 397790. | -7496. | -34.09645 | 2.635E+10 |
| 20.50000 | -0.001504 | 352304. | -7457. | 47.22349 | 2.631E+10 |

| | | | | | |
|---|---|---|---|---|---|
| 21.00000 | -0.003118 | 308494. | -7133. | 60.84227 | 2.626E+10 |
| 21.50000 | -0.004309 | 266853. | -6745. | 68.49804 | 2.620E+10 |
| 22.00000 | -0.005133 | 227660. | -6319. | 73.39100 | 2.612E+10 |
| 22.50000 | -0.005643 | 191093. | -5869. | 76.55199 | 2.601E+10 |
| 23.00000 | -0.005889 | 157269. | -5404. | 78.46588 | 2.587E+10 |
| 23.50000 | -0.005916 | 126258. | -4930. | 79.40569 | 2.567E+10 |
| 24.00000 | -0.005766 | 98098. | -4454. | 79.54249 | 2.539E+10 |
| 24.50000 | -0.005477 | 72793. | -3978. | 78.99093 | 2.496E+10 |
| 25.00000 | -0.005083 | 50328. | -3508. | 77.83092 | 2.426E+10 |
| 25.50000 | -0.004614 | 30660. | -3046. | 76.11873 | 2.291E+10 |
| 26.00000 | -0.004097 | 13731. | -2596. | 73.89255 | 2.264E+10 |
| 26.50000 | -0.003558 | -539.95329 | -2160. | 71.19785 | 2.264E+10 |
| 27.00000 | -0.003020 | -12247. | -1743. | 68.07461 | 2.264E+10 |
| 27.50000 | -0.002502 | -21503. | -1345. | 64.55658 | 2.264E+10 |
| 28.00000 | -0.002017 | -28433. | -968.94855 | 60.67267 | 2.266E+10 |
| 28.50000 | -0.001578 | -33177. | -617.58800 | 56.44751 | 2.316E+10 |
| 29.00000 | -0.001190 | -35886. | -292.58974 | 51.88524 | 2.340E+10 |
| 29.50000 | -0.000858 | -36724. | 3.99686 | 46.97696 | 2.346E+10 |
| 30.00000 | -0.000582 | -35868. | 269.99560 | 41.68929 | 2.339E+10 |
| 30.50000 | -0.000361 | -33509. | 502.86854 | 35.93502 | 2.319E+10 |
| 31.00000 | -0.000192 | -29853. | 699.11814 | 29.48151 | 2.282E+10 |
| 31.50000 | -7.051E-05 | -25134. | 852.14066 | 21.52600 | 2.264E+10 |
| 32.00000 | 1.129E-05 | -19638. | 885.05985 | -10.55294 | 2.264E+10 |
| 32.50000 | 6.186E-05 | -14520. | 792.56831 | -20.27757 | 2.264E+10 |
| 33.00000 | 8.935E-05 | -10131. | 661.92328 | -23.27077 | 2.264E+10 |
| 33.50000 | 0.000101 | -6579. | 518.64056 | -24.49013 | 2.264E+10 |
| 34.00000 | 0.000102 | -3908. | 370.73819 | -24.81065 | 2.264E+10 |

| | | | | |
|---|---|---|---|---|
| 34.50000 | 9.638E-05 | -2129. | 222.49194 | -24.60476 |
| 2.264E+10 | | | | |
| 35.00000 | 8.771E-05 | -1237. | 132.73984 | -5.31260 |
| 2.264E+10 | | | | |
| 35.50000 | 7.707E-05 | -535.62797 | 102.41578 | -4.79541 |
| 2.264E+10 | | | | |
| 36.00000 | 6.558E-05 | -6.87626 | 75.46335 | -4.18873 |
| 2.264E+10 | | | | |
| 36.50000 | 5.408E-05 | 371.08169 | 52.26691 | -3.54342 |
| 2.264E+10 | | | | |
| 37.00000 | 4.317E-05 | 621.44713 | 32.93731 | -2.89978 |
| 2.264E+10 | | | | |
| 37.50000 | 3.325E-05 | 767.37107 | 17.37356 | -2.28814 |
| 2.264E+10 | | | | |
| 38.00000 | 2.454E-05 | 830.86112 | 5.31999 | -1.72972 |
| 2.264E+10 | | | | |
| 38.50000 | 1.716E-05 | 832.01514 | -3.58275 | -1.23786 |
| 2.264E+10 | | | | |
| 39.00000 | 1.110E-05 | 788.54016 | -9.75397 | -0.81922 |
| 2.264E+10 | | | | |
| 39.50000 | 6.300E-06 | 715.51070 | -13.63702 | -0.47513 |
| 2.264E+10 | | | | |
| 40.00000 | 2.632E-06 | 625.31955 | -15.67102 | -0.20287 |
| 2.264E+10 | | | | |
| 40.50000 | -4.121E-08 | 527.77554 | -16.26988 | 0.003244 |
| 2.264E+10 | | | | |
| 41.00000 | -1.876E-06 | 430.30637 | -15.80793 | 0.15074 |
| 2.264E+10 | | | | |
| 41.50000 | -3.026E-06 | 338.22960 | -14.61119 | 0.24817 |
| 2.264E+10 | | | | |
| 42.00000 | -3.638E-06 | 255.06023 | -12.95342 | 0.30441 |
| 2.264E+10 | | | | |
| 42.50000 | -3.845E-06 | 182.82950 | -11.05595 | 0.32808 |
| 2.264E+10 | | | | |
| 43.00000 | -3.761E-06 | 122.39500 | -9.09029 | 0.32714 |
| 2.264E+10 | | | | |
| 43.50000 | -3.483E-06 | 73.72791 | -7.18280 | 0.30869 |
| 2.264E+10 | | | | |
| 44.00000 | -3.088E-06 | 36.16774 | -5.42053 | 0.27873 |
| 2.264E+10 | | | | |
| 44.50000 | -2.635E-06 | 8.63911 | -3.85776 | 0.24219 |
| 2.264E+10 | | | | |
| 45.00000 | -2.168E-06 | -10.17139 | -2.52260 | 0.20286 |
| 2.264E+10 | | | | |
| 45.50000 | -1.717E-06 | -21.67795 | -1.42339 | 0.16354 |
| 2.264E+10 | | | | |
| 46.00000 | -1.301E-06 | -27.29536 | -0.55457 | 0.12607 |
| 2.264E+10 | | | | |
| 46.50000 | -9.287E-07 | -28.37222 | 0.09811 | 0.09150 |
| 2.264E+10 | | | | |
| 47.00000 | -6.011E-07 | -26.15300 | 0.55324 | 0.06021 |
| 2.264E+10 | | | | |
| 47.50000 | -3.151E-07 | -21.76404 | 0.83012 | 0.03208 |
| 2.264E+10 | | | | |

```
   48.00000   -6.368E-08    -16.21838      0.94614     0.006589
2.264E+10
   48.50000    1.619E-07    -10.43422      0.91484     -0.01702
2.264E+10
   49.00000    3.710E-07     -5.26209      0.74494     -0.03961
2.264E+10
   49.50000    5.716E-07     -1.51549      0.44017     -0.06198
2.264E+10
   50.00000    7.699E-07        0.000        0.000     -0.08474
2.264E+10

Output Summary for Load Case No. 1:

Pile-head deflection             =     0.50000000 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =      -1355972. inch-lbs
Maximum shear force              =         17884. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =       0.000000 feet below pile head
Number of iterations             =             17
Number of zero deflection points =              4



---------------------------------------------------------------------------
-------
                 Computed Values of Pile Loading and Deflection
                   for Lateral Loading for Load Case Number 2
---------------------------------------------------------------------------
-------

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head                              =     0.500000
inches
Moment at pile head                                    =          0.0 in-
lbs
Axial load at pile head                                =      50000.0 lbs

    Depth      Deflect.      Bending       Shear      Soil Res.
Bending
      X            y         Moment        Force          p
Stiffness
    feet        inches       in-lbs         lbs        lb/inch      in-
lb^2
-----------  -----------  -----------  -----------  -----------  --------
---
      0.000      0.50000        0.000        8691.    -28.49960
2.264E+10
    0.50000      0.47600       52835.        8506.    -33.40613
2.264E+10
    1.00000      0.45209      104463.        8291.    -38.28065
2.547E+10
    1.50000      0.42833      154705.        8046.    -43.10634
2.585E+10
```

| | | | | | |
|---|---|---|---|---|---|
| 2.00000 | 0.40478 | 203385. | 7773. | -47.86621 | 2.605E+10 |
| 2.50000 | 0.38151 | 250328. | 7472. | -52.54291 | 2.617E+10 |
| 3.00000 | 0.35858 | 295362. | 7143. | -57.11881 | 2.625E+10 |
| 3.50000 | 0.33606 | 338319. | 6787. | -61.57599 | 2.630E+10 |
| 4.00000 | 0.31401 | 379036. | 6405. | -65.89626 | 2.634E+10 |
| 4.50000 | 0.29247 | 417356. | 5997. | -70.06117 | 2.637E+10 |
| 5.00000 | 0.27150 | 453124. | 5565. | -74.05201 | 2.639E+10 |
| 5.50000 | 0.25115 | 486196. | 5109. | -77.84985 | 2.641E+10 |
| 6.00000 | 0.23146 | 516432. | 4631. | -81.43549 | 2.642E+10 |
| 6.50000 | 0.21248 | 543701. | 4132. | -84.78953 | 2.643E+10 |
| 7.00000 | 0.19424 | 567881. | 3614. | -87.89229 | 2.644E+10 |
| 7.50000 | 0.17677 | 588858. | 3078. | -90.72385 | 2.645E+10 |
| 8.00000 | 0.16010 | 606529. | 2526. | -93.26398 | 2.645E+10 |
| 8.50000 | 0.14426 | 620801. | 1960. | -95.49207 | 2.645E+10 |
| 9.00000 | 0.12926 | 631593. | 1382. | -97.38710 | 2.646E+10 |
| 9.50000 | 0.11512 | 638836. | 792.59658 | -98.92744 | 2.646E+10 |
| 10.00000 | 0.10185 | 642475. | 203.40279 | -97.47049 | 2.646E+10 |
| 10.50000 | 0.08945 | 642560. | -375.81675 | -95.60269 | 2.646E+10 |
| 11.00000 | 0.07793 | 639161. | -943.02125 | -93.46548 | 2.646E+10 |
| 11.50000 | 0.06728 | 632353. | -1497. | -91.05120 | 2.646E+10 |
| 12.00000 | 0.05749 | 622224. | -2035. | -88.35025 | 2.645E+10 |
| 12.50000 | 0.04855 | 608872. | -2556. | -85.35026 | 2.645E+10 |
| 13.00000 | 0.04043 | 592406. | -3058. | -82.03481 | 2.645E+10 |
| 13.50000 | 0.03312 | 572947. | -3539. | -78.38120 | 2.644E+10 |
| 14.00000 | 0.02659 | 550627. | -3997. | -74.35706 | 2.643E+10 |
| 14.50000 | 0.02082 | 525592. | -4430. | -69.91404 | 2.642E+10 |
| 15.00000 | 0.01575 | 498005. | -4835. | -64.97616 | 2.641E+10 |

| | | | | | |
|---|---|---|---|---|---|
| 15.50000 | 0.01137 | 468045. | -5208. | -59.41536 | 2.640E+10 |
| 16.00000 | 0.007622 | 435914. | -5596. | -69.80040 | 2.638E+10 |
| 16.50000 | 0.004471 | 401240. | -5932. | -42.22461 | 2.636E+10 |
| 17.00000 | 0.001868 | 365019. | -6113. | -18.17768 | 2.633E+10 |
| 17.50000 | -0.000236 | 328119. | -6161. | 2.35969 | 2.629E+10 |
| 18.00000 | -0.001890 | 291281. | -6095. | 19.47206 | 2.624E+10 |
| 18.50000 | -0.003145 | 255124. | -5937. | 33.29999 | 2.618E+10 |
| 19.00000 | -0.004049 | 220148. | -5705. | 44.03083 | 2.610E+10 |
| 19.50000 | -0.004649 | 186742. | -5417. | 51.88989 | 2.599E+10 |
| 20.00000 | -0.004991 | 155191. | -5052. | 69.64439 | 2.586E+10 |
| 20.50000 | -0.005117 | 126137. | -4630. | 71.00826 | 2.567E+10 |
| 21.00000 | -0.005066 | 99630. | -4203. | 71.55388 | 2.541E+10 |
| 21.50000 | -0.004873 | 75692. | -3774. | 71.41145 | 2.502E+10 |
| 22.00000 | -0.004572 | 54319. | -3348. | 70.66916 | 2.442E+10 |
| 22.50000 | -0.004191 | 35487. | -2927. | 69.38813 | 2.336E+10 |
| 23.00000 | -0.003754 | 19150. | -2516. | 67.60989 | 2.264E+10 |
| 23.50000 | -0.003288 | 5245. | -2117. | 65.37389 | 2.264E+10 |
| 24.00000 | -0.002813 | -6307. | -1733. | 62.71905 | 2.264E+10 |
| 24.50000 | -0.002348 | -15600. | -1366. | 59.67717 | 2.264E+10 |
| 25.00000 | -0.001908 | -22744. | -1018. | 56.27425 | 2.264E+10 |
| 25.50000 | -0.001504 | -27860. | -691.73062 | 52.53111 | 2.264E+10 |
| 26.00000 | -0.001145 | -31083. | -388.74851 | 48.46293 | 2.296E+10 |
| 26.50000 | -0.000834 | -32559. | -111.15931 | 44.06680 | 2.311E+10 |
| 27.00000 | -0.000574 | -32446. | 139.00314 | 39.32068 | 2.310E+10 |
| 27.50000 | -0.000364 | -30914. | 359.46602 | 34.16694 | 2.294E+10 |
| 28.00000 | -0.000203 | -28151. | 547.34912 | 28.46075 | 2.264E+10 |
| 28.50000 | -8.704E-05 | -24360. | 698.01937 | 21.76266 | 2.264E+10 |

| | | | | | |
|---|---|---|---|---|---|
| 29.00000 | -9.493E-06 | -19784. | 796.93011 | 11.20758 | 2.264E+10 |
| 29.50000 | 3.660E-05 | -14803. | 782.00525 | -16.18253 | 2.264E+10 |
| 30.00000 | 5.916E-05 | -10403. | 675.55618 | -19.30049 | 2.264E+10 |
| 30.50000 | 6.517E-05 | -6698. | 557.20644 | -20.14942 | 2.264E+10 |
| 31.00000 | 6.054E-05 | -3717. | 437.21408 | -19.84803 | 2.264E+10 |
| 31.50000 | 5.000E-05 | -1451. | 321.30901 | -18.78699 | 2.264E+10 |
| 32.00000 | 3.716E-05 | 139.82777 | 213.49398 | -17.15136 | 2.264E+10 |
| 32.50000 | 2.453E-05 | 1113. | 116.98824 | -15.01722 | 2.264E+10 |
| 33.00000 | 1.368E-05 | 1545. | 34.96052 | -12.32535 | 2.264E+10 |
| 33.50000 | 5.280E-06 | 1533. | -27.74095 | -8.57514 | 2.264E+10 |
| 34.00000 | -6.810E-07 | 1213. | -52.02356 | 0.48093 | 2.264E+10 |
| 34.50000 | -4.714E-06 | 909.40419 | -40.50895 | 3.35727 | 2.264E+10 |
| 35.00000 | -7.302E-06 | 726.91069 | -29.11031 | 0.44228 | 2.264E+10 |
| 35.50000 | -8.733E-06 | 560.28137 | -26.15325 | 0.54341 | 2.264E+10 |
| 36.00000 | -9.274E-06 | 413.17035 | -22.74588 | 0.59238 | 2.264E+10 |
| 36.50000 | -9.159E-06 | 287.35208 | -19.16847 | 0.60009 | 2.264E+10 |
| 37.00000 | -8.586E-06 | 183.11423 | -15.63800 | 0.57673 | 2.264E+10 |
| 37.50000 | -7.722E-06 | 99.62423 | -12.31345 | 0.53145 | 2.264E+10 |
| 38.00000 | -6.700E-06 | 35.25858 | -9.30262 | 0.47216 | 2.264E+10 |
| 38.50000 | -5.622E-06 | -12.11217 | -6.66980 | 0.40545 | 2.264E+10 |
| 39.00000 | -4.563E-06 | -44.88583 | -4.44365 | 0.33660 | 2.264E+10 |
| 39.50000 | -3.575E-06 | -65.53828 | -2.62492 | 0.26964 | 2.264E+10 |
| 40.00000 | -2.692E-06 | -76.47844 | -1.19364 | 0.20745 | 2.264E+10 |
| 40.50000 | -1.930E-06 | -79.94423 | -0.11552 | 0.15192 | 2.264E+10 |
| 41.00000 | -1.295E-06 | -77.93455 | 0.65250 | 0.10409 | 2.264E+10 |
| 41.50000 | -7.842E-07 | -72.17147 | 1.15775 | 0.06433 | 2.264E+10 |
| 42.00000 | -3.881E-07 | -64.08695 | 1.44815 | 0.03248 | 2.264E+10 |

```
   42.50000   -9.392E-08    -54.82817      1.56962     0.008014
2.264E+10
   43.00000    1.131E-07    -45.27653      1.56415    -0.009839
2.264E+10
   43.50000    2.482E-07    -36.07549      1.46865     -0.02200
2.264E+10
   44.00000    3.259E-07    -27.66342      1.31440     -0.02942
2.264E+10
   44.50000    3.596E-07    -20.30828      1.12696     -0.03306
2.264E+10
   45.00000    3.611E-07    -14.14167      0.92642     -0.03379
2.264E+10
   45.50000    3.401E-07     -9.19031      0.72791     -0.03238
2.264E+10
   46.00000    3.044E-07     -5.40395      0.54229     -0.02949
2.264E+10
   46.50000    2.602E-07     -2.67879      0.37692     -0.02563
2.264E+10
   47.00000    2.117E-07     -0.87624      0.23641     -0.02121
2.264E+10
   47.50000    1.618E-07      0.16299      0.12336     -0.01648
2.264E+10
   48.00000    1.122E-07      0.60910      0.03912     -0.01161
2.264E+10
   48.50000    6.352E-08      0.63732     -0.01573    -0.006677
2.264E+10
   49.00000    1.587E-08      0.42511     -0.04085    -0.001694
2.264E+10
   49.50000   -3.110E-08      0.15187     -0.03582     0.003372
2.264E+10
   50.00000   -7.783E-08        0.000        0.000     0.008567
2.264E+10

Output Summary for Load Case No. 2:

Pile-head deflection             =     0.50000000 inches
Computed slope at pile head      =    -0.00399948 radians
Maximum bending moment           =        642560. inch-lbs
Maximum shear force              =          8691. lbs
Depth of maximum bending moment  =    10.50000000 feet below pile head
Depth of maximum shear force     =       0.000000 feet below pile head
Number of iterations             =             13
Number of zero deflection points =              5


---------------------------------------------------------------------------
-------
            Summary of Pile-head Responses for Conventional Analyses
---------------------------------------------------------------------------
-------

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
```

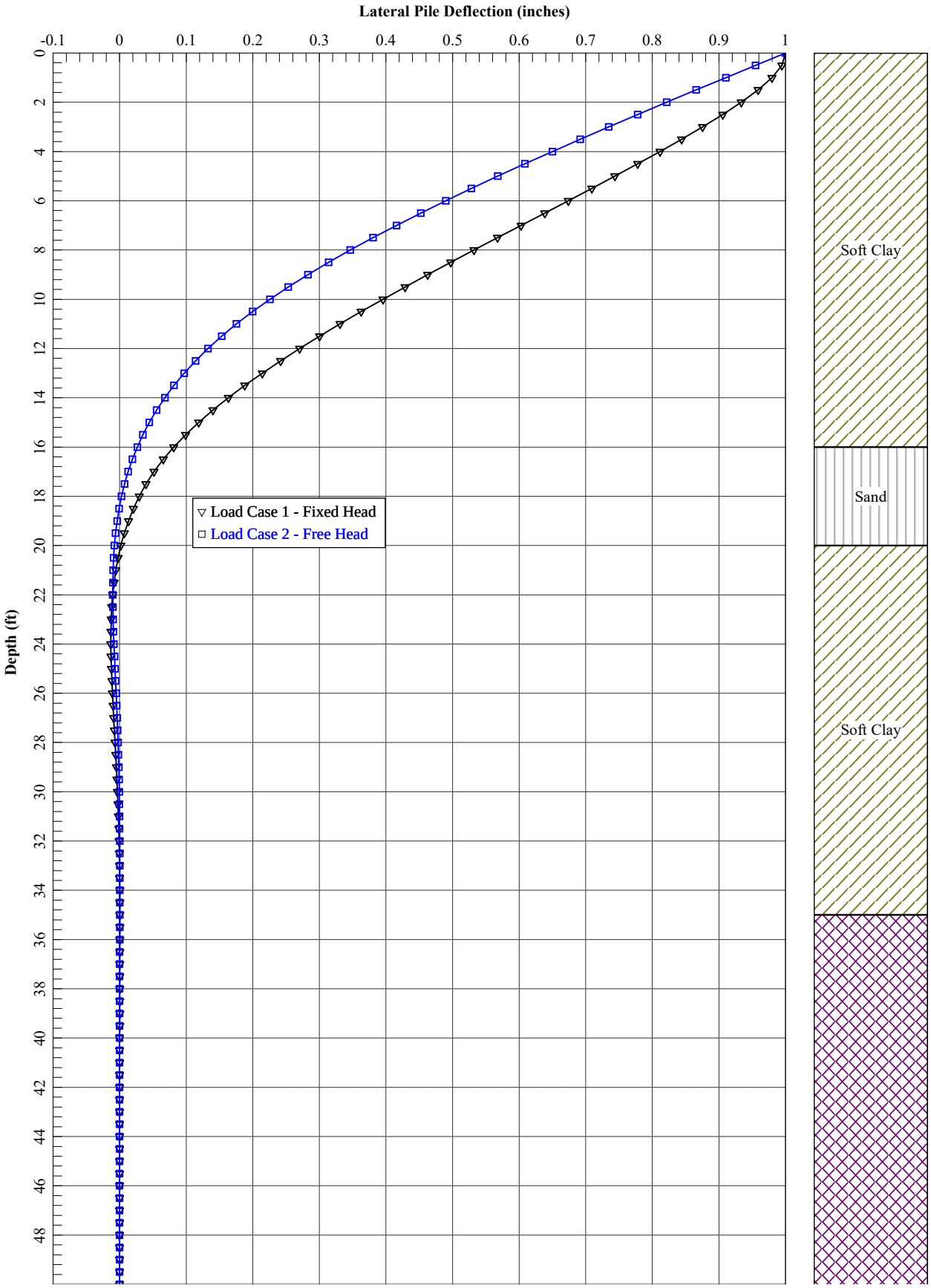
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

| Load Case No. | Load Type | Pile-head Deflection inches | Pile-head Rotation radians | Max Shear in Pile lbs | Max Moment in Pile in-lbs |
|---|---|---|---|---|---|
| 1 | 5 | 0.500000 | 0.0000 | 17884. | -1355972. |
| 2 | 4 | 0.500000 | -0.003999 | 8691. | 642560. |

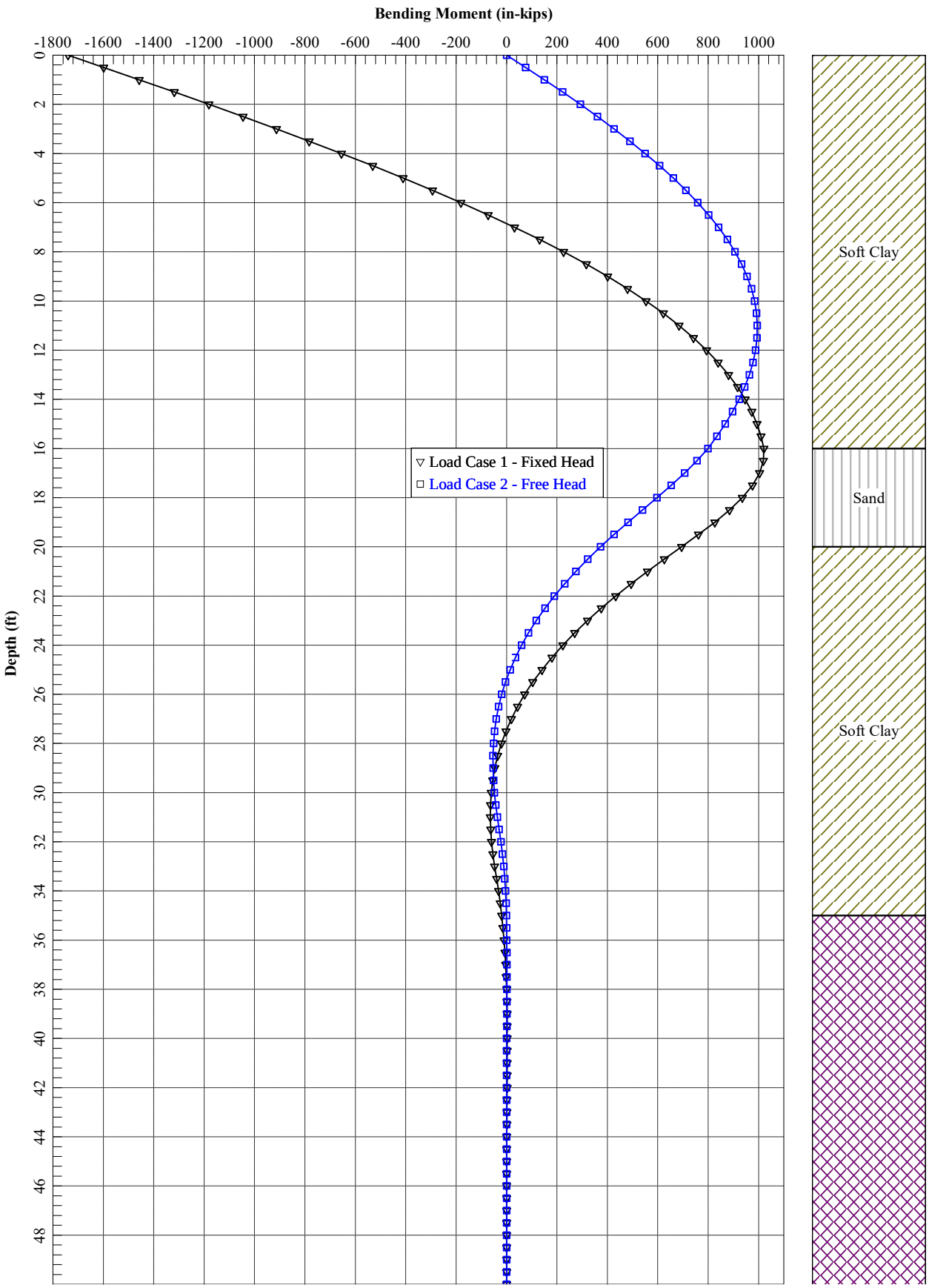
Maximum pile-head deflection = 0.5000000000 inches
Maximum pile-head rotation = -0.0039994794 radians = -0.229153 deg.

The analysis ended normally.

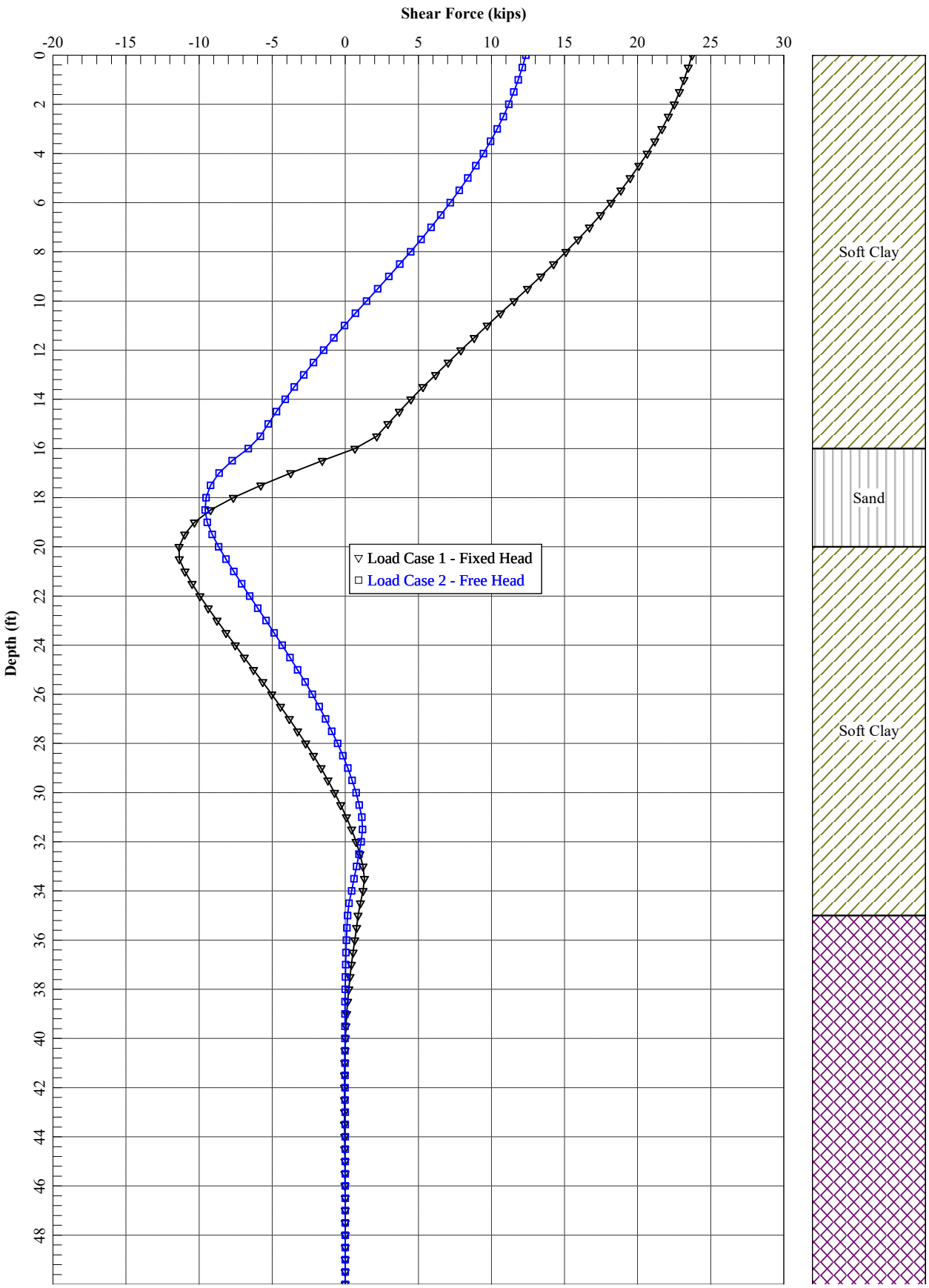
**16 Inch Square Prestressed Concrete Pile**
**1.0 Inch Deflection**



**16 Inch Square Prestressed Concrete Pile**
**1.0 Inch Deflection**



**16 Inch Square Prestressed Concrete Pile**
**1.0 Inch Deflection**



==========
==========

LPile for Windows(Beta), Version 2018-10.008

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
© 1985-2018 by Ensoft, Inc.
All Rights Reserved

==========
==========

This copy of LPile is being used by:

LACO Associates
Santa Rosa
Serial Number of Security Device: 136157127

This copy of LPile is licensed for exclusive use by:

LACO Associates, Santa Rosa, CA

Use of this program by any entity other than LACO Associates, Santa Rosa, CA
is a violation of the software license agreement.

---
---

## Files Used for Analysis

---
---

Path to file locations on this computer:
\7900\7986 Carollo Engineers\7986.01 Arcata Wastewater Treatment Facility Design
\08 Geology\Reports\Geotech Report_Working Files-Archive\L-Pile\CRGT Under Fill
\

Name of the input data file:
New LPile (USCS units) - 16 inch sq - 1 in def.lp10

Name of the output report file:
New LPile (USCS units) - 16 inch sq - 1 in def.lp10

Name of the plot output file:
New LPile (USCS units) - 16 inch sq - 1 in def.lp10

Name of the runtime message file:
New LPile (USCS units) - 16 inch sq - 1 in def.lp10

---

## Date and Time of Analysis

---

Date: January 23, 2019 Time: 15:04:51

---

## Problem Title

---

Project Name: Wastewater Treatment Facility Improvements
Job Number: 7986.01
Client: Carollo Engineers
Engineer: LACO Associates
Description: Lateral Load Analysis - 16-inch square precast concrete

---

## Program Options and Settings

---

Computational Options:
- Use unfactored loads in computations (conventional analysis)

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

| | | |
|---|---|---|
| - Maximum number of iterations allowed | = | 500 |
| - Deflection tolerance for convergence | = | 1.0000E-05 in |
| - Maximum allowable deflection | = | 100.0000 in |
| - Number of pile increments | = | 100 |

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
 - Output files use decimal points to denote decimal symbols.
 - Values of pile-head deflection, bending moment, shear force, and
   soil reaction are printed for full length of pile.
 - Printing Increment (nodal spacing of output points) = 1
 - No p-y curves to be computed and reported for user-specified depths
 - Print using narrow report formats
   (Note: Some output information is omitted from the narrow report
formats)

---

Pile Structural Properties and Geometry

---

Number of pile sections defined = 1
Total length of pile = 50.000 ft
Depth of ground surface below top of pile = 0.0000 ft

Pile diameters used for p-y curve computations are defined using 2
points.

p-y curves are computed using pile diameter values interpolated with
depth over
the length of the pile. A summary of values of pile diameter vs. depth
follows.

| Point No. | Depth Below Pile Head feet | Pile Diameter inches |
|---|---|---|
| 1 | 0.000 | 16.0000 |
| 2 | 50.000 | 16.0000 |

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a square prestressed concrete pile
Length of section = 50.000000 ft
Pile Width = 16.000000 in
Corner Chamfer = 0.0000 in
Shear capacity of section = 0.0000 lbs

---

## Ground Slope and Pile Batter Angles

---

Ground Slope Angle = 0.000 degrees
= 0.000 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

---

## Soil and Rock Layering Information

---

The soil profile is modelled using 4 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 0.0000 ft |
| Distance from top of pile to bottom of layer | = | 16.000000 ft |
| Effective unit weight at top of layer | = | 95.000000 pcf |
| Effective unit weight at bottom of layer | = | 100.000000 pcf |
| Undrained cohesion at top of layer | = | 200.000000 psf |
| Undrained cohesion at bottom of layer | = | 500.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 16.000000 ft |
| Distance from top of pile to bottom of layer | = | 20.000000 ft |
| Effective unit weight at top of layer | = | 120.000000 pcf |
| Effective unit weight at bottom of layer | = | 120.000000 pcf |
| Friction angle at top of layer | = | 30.000000 deg. |
| Friction angle at bottom of layer | = | 30.000000 deg. |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for subgrade k will be computed for this layer.

Layer 3 is soft clay, p-y criteria by Matlock, 1970

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 20.000000 ft |
| Distance from top of pile to bottom of layer | = | 35.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 115.000000 pcf |
| Undrained cohesion at top of layer | = | 600.000000 psf |
| Undrained cohesion at bottom of layer | = | 800.000000 psf |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 4 is cemented silt with cohesion and friction

| | | |
|---|---|---|
| Distance from top of pile to top of layer | = | 35.000000 ft |
| Distance from top of pile to bottom of layer | = | 70.000000 ft |
| Effective unit weight at top of layer | = | 110.000000 pcf |
| Effective unit weight at bottom of layer | = | 110.000000 pcf |
| Undrained cohesion at top of layer | = | 350.000000 psf |
| Undrained cohesion at bottom of layer | = | 350.000000 psf |
| Friction angle at top of layer | = | 25.000000 deg. |
| Friction angle at bottom of layer | = | 25.000000 deg. |
| Epsilon-50 at top of layer | = | 0.0000 |
| Epsilon-50 at bottom of layer | = | 0.0000 |
| Subgrade k at top of layer | = | 0.0000 pci |
| Subgrade k at bottom of layer | = | 0.0000 pci |

NOTE: Default values for Epsilon-50 will be computed for this layer.
NOTE: Default values for subgrade k will be computed for this layer.

(Depth of the lowest soil layer extends 20.000 ft below the pile tip)

---

## Static Loading Type

---

Static loading criteria were used when computing p-y curves for all analyses.

---

## Pile-head Loading and Pile-head Fixity Conditions

---

Number of loads specified = 2

| Load No. | Load Type | Condition 1 | Condition 2 | Axial Thrust Force, lbs |
|---|---|---|---|---|
| 1 | 5 | y = 1.000000 in | S = 0.0000 in/in | 50000. |
| 2 | 4 | y = 1.000000 in | M = 0.0000 in-lbs | 50000. |

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

---

## Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

### Pile Section No. 1:

#### Dimensions of Square Prestressed Pile Section:

| | | |
|---|---|---|
| Length of Section | = | 50.0000 ft |
| Pile Width | = | 16.000 in |
| Corner Chamfer | = | 0.000 in |

#### Prestressing Strand Details:

| | | |
|---|---|---|
| Strand Type | = | PCI 270 |
| Yield Stress, fpu | = | 270. ksi |
| Elasticity Modulus, Es | = | 28000. ksi |

Stress-strain curve defined using PCI 270 7-wire Lo-lax equation
If eps > 0.0086 fpu (ksi) = 270 - 0.04/(eps-0.007)
Number of Reinforcing Strands = 8
Cross-sectional Area of Single Strand = 0.153 sq. in.
Concrete Cover Thickness Over Strands = 2.000 in

Prestressing Strand Geometry:
---

| Strand No. | Diameter in | Area sq. in | X in | Y in |
|---|---|---|---|---|
| 1 | 0.500 | 0.153 | 5.750 | 0.000 |
| 2 | 0.500 | 0.153 | 4.066 | 4.066 |
| 3 | 0.500 | 0.153 | 0.000 | 5.750 |
| 4 | 0.500 | 0.153 | -4.066 | 4.066 |
| 5 | 0.500 | 0.153 | -5.750 | 0.000 |
| 6 | 0.500 | 0.153 | -4.066 | -4.066 |
| 7 | 0.500 | 0.153 | -0.000 | -5.750 |
| 8 | 0.500 | 0.153 | 4.066 | -4.066 |

Computation of Loss of Prestress:
---

Initial Prestressing Force = 194.564 kips
Fraction of Loss of Prestress = 0.100
Effective Prestressing Force After Losses = 175.108 kips
Area of Concrete, Ac = 254.776 sq.in
Area of Steel, As = 1.224 sq.in
Stress in Concrete After Losses, f_pc = 0.687 ksi
Stress in Steel After Losses = -143.062 ksi
Compressive Strain in Concrete After Losses = 0.0001557
Tensile Strain in Steel After Losses = -0.0051093
Axial Tension Load for Cracking of Concrete = -245.167 kips

Estimated Structural Capacities Computed Using PCI Equations:
---

Nom. Axial Cap., Pn = (0.85 f'c - 0.60 f_pc) Ag = 1200.031 kips
Unfac. Axial Load Cap. N = (0.33 f'c - 0.27 f_pc) Ag = 459.374 kips
Axial Capacity in Tension, Nt = As fpu = -330.480 kips
Nom. Moment Capacity, Mn = 0.37 D As fpu = 1956.442 in-kip

Note: The estimate of nominal moment capacity is based on equations that

assume compressive strength of concrete is 6,000 psi (41.4 MPa), the value
of prestress after losses is 700 psi (4.83 MPa), and axial thrust force is
zero. When input values for these factors are different, the estimated value
of nominal moment capacity will differ from the capacity computed by LPile
and should be considered only as an approximate check.

Concrete Properties:
---

| | | |
|---|---|---|
| Compressive Strength of Concrete | = | 6000. psi |
| Modulus of Elasticity of Concrete | = | 4415201. psi |
| Modulus of Rupture of Prestressed Concrete | = | -309.838668 psi |
| Compression Strain at Peak Stress | = | 0.002310 |
| Tensile Strain at Fracture of Concrete | = | -0.0000604 |
| Maximum Coarse Aggregate Size | = | 0.750000 in |

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

| Number | Axial Thrust Force kips |
|---|---|
| 1 | 50.000 |

Definitions of Run Messages and Notes:
---

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in
reinforcement exceeds 0.005 while simultaneously compressive strain in
concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of
section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 50.000 kips

| Bending Curvature rad/in. | Bending Moment in-kip | Bending Stiffness kip-in2 | Depth to N Axis in | Run Msg |
|---|---|---|---|---|
| 0.0000012500 | 28.3054402469 | 22644352. | 147.5648576393 | |
| 0.0000025000 | 61.6837829066 | 24673513. | 77.7912049898 | |
| 0.0000037500 | 95.0607769237 | 25349541. | 54.5373714646 | |
| 0.0000050000 | 128.4357254408 | 25687145. | 42.9134928738 | |
| 0.0000062500 | 161.8079315299 | 25889269. | 35.9415964299 | |
| 0.0000075000 | 195.1766981682 | 26023560. | 31.2956912457 | |
| 0.0000087500 | 228.5413282140 | 26119009. | 27.9789241199 | |
| 0.0000100000 | 261.9011243925 | 26190112. | 25.4928684836 | |
| 0.0000112500 | 295.2553892753 | 26244923. | 23.5606207152 | |
| 0.0000125000 | 328.6034252801 | 26288274. | 22.0160386673 | |
| 0.0000137500 | 361.9445345229 | 26323239. | 20.7533955416 | |
| 0.0000150000 | 395.2780187770 | 26351868. | 19.7022068271 | |
| 0.0000162500 | 428.6031797758 | 26375580. | 18.8136755743 | |
| 0.0000175000 | 461.9193186221 | 26395390. | 18.0529468373 | |
| 0.0000187500 | 495.2257367986 | 26412039. | 17.3944603393 | |
| 0.0000200000 | 528.5217344823 | 26426087. | 16.8190458887 | |
| 0.0000212500 | 561.8066122771 | 26437958. | 16.3120439423 | |
| 0.0000225000 | 595.0795947625 | 26447982. | 15.8620523013 | |
| 0.0000237500 | 628.3322566917 | 26456095. | 15.4600356232 | |
| 0.0000250000 | 661.5465588628 | 26461862. | 15.0987232750 | |
| 0.0000262500 | 694.7077212707 | 26465056. | 14.7722393948 | |
| 0.0000275000 | 727.8043496086 | 26465613. | 14.4757876063 | |
| 0.0000287500 | 760.8275123432 | 26463566. | 14.2054137971 | |
| 0.0000300000 | 793.7701673943 | 26459006. | 13.9578291756 | |
| 0.0000312500 | 813.2635917827 | 26024435. | 13.6851041062 | C |
| 0.0000325000 | 830.9449748573 | 25567538. | 13.4259577207 | C |
| 0.0000337500 | 847.0142015938 | 25096717. | 13.1791837658 | C |
| 0.0000350000 | 861.6632890615 | 24618951. | 12.9437751288 | C |
| 0.0000362500 | 875.0767679842 | 24140049. | 12.7188937542 | C |
| 0.0000375000 | 887.4315895575 | 23664842. | 12.5038449980 | C |
| 0.0000387500 | 904.0680488916 | 23330788. | 12.3168458959 | C |
| 0.0000400000 | 914.7074039572 | 22867685. | 12.1197988812 | C |
| 0.0000412500 | 929.4663484905 | 22532518. | 11.9484460126 | C |
| 0.0000425000 | 943.3604182949 | 22196716. | 11.7838950871 | C |
| 0.0000437500 | 951.4153625538 | 21746637. | 11.6072130565 | C |

```
    0.0000450000     963.7688728104          21417086.      11.4549082087
C
    0.0000462500     963.7688728104          20838246.      11.2248376261
C
    0.0000475000     966.2413405270          20341923.      11.0848982967
C
    0.0000487500     977.3655771744          20048525.      10.9505760292
C
    0.0000512500     998.4240285680          19481444.      10.6966585988
C
    0.0000537500             1018.           18944518.      10.4614577049
C
    0.0000562500             1037.           18433559.      10.2421490731
C
    0.0000587500             1055.           17949772.      10.0376389710
C
    0.0000612500             1071.           17490973.       9.8462386785
C
    0.0000637500             1087.           17054484.       9.6662872162
C
    0.0000662500             1102.           16639775.       9.4969146912
C
    0.0000687500             1117.           16245719.       9.3372217381
C
    0.0000712500             1131.           15870995.       9.1863515863
C
    0.0000737500             1144.           15514239.       9.0435077425
C
    0.0000762500             1157.           15173493.       8.9077198071
C
    0.0000787500             1169.           14848628.       8.7787273129
C
    0.0000812500             1181.           14538844.       8.6560878078
C
    0.0000837500             1193.           14243412.       8.5394277843
C
    0.0000862500             1204.           13960261.       8.4278305011
C
    0.0000887500             1215.           13688994.       8.3210513717
C
    0.0000912500             1225.           13430109.       8.2193033318
C
    0.0000937500             1236.           13181122.       8.1214751652
C
    0.0000962500             1246.           12942582.       8.0278032666
C
    0.0000987500             1256.           12714178.       7.9381945653
C
    0.0001012500             1265.           12493962.       7.8517053345
C
    0.0001037500             1274.           12283461.       7.7691624237
C
    0.0001062500             1283.           12079647.       7.6890343001
C
```

| | | | |
|---|---|---|---|
| 0.0001087500 | 1292. | 11884691. | 7.6125330313 |
| 0.0001112500 | 1301. | 11695715. | 7.5381366046 |
| 0.0001137500 | 1310. | 11514405. | 7.4668540844 |
| 0.0001162500 | 1318. | 11339015. | 7.3977359640 |
| 0.0001187500 | 1326. | 11169804. | 7.3310101037 |
| 0.0001212500 | 1335. | 11006934. | 7.2668288519 |
| 0.0001237500 | 1343. | 10848515. | 7.2040996557 |
| 0.0001262500 | 1350. | 10696275. | 7.1439699088 |
| 0.0001287500 | 1358. | 10548495. | 7.0853942680 |
| 0.0001312500 | 1366. | 10405329. | 7.0285470904 |
| 0.0001337500 | 1373. | 10267427. | 6.9739303882 |
| 0.0001362500 | 1381. | 10132997. | 6.9203679186 |
| 0.0001387500 | 1388. | 10002808. | 6.8684679403 |
| 0.0001412500 | 1395. | 9877148. | 6.8185018359 |
| 0.0001437500 | 1402. | 9754664. | 6.7695351382 |
| 0.0001462500 | 1409. | 9635622. | 6.7218311982 |
| 0.0001487500 | 1416. | 9520508. | 6.6758197864 |
| 0.0001587500 | 1443. | 9090796. | 6.5032229080 |
| 0.0001687500 | 1469. | 8705376. | 6.3475096484 |
| 0.0001787500 | 1494. | 8357749. | 6.2062828099 |
| 0.0001887500 | 1518. | 8042736. | 6.0777200741 |
| 0.0001987500 | 1542. | 7756143. | 5.9604391271 |
| 0.0002087500 | 1564. | 7494145. | 5.8529542025 |
| 0.0002187500 | 1587. | 7252978. | 5.7532219692 |
| 0.0002287500 | 1608. | 7031437. | 5.6619714948 |
| 0.0002387500 | 1630. | 6826018. | 5.5767048770 |
| 0.0002487500 | 1651. | 6635998. | 5.4982295360 |

| | | | |
|---|---|---|---|
| 0.0002587500 | 1671. | 6458778. | 5.4245397314 |
| C | | | |
| 0.0002687500 | 1692. | 6294152. | 5.3568911584 |
| C | | | |
| 0.0002787500 | 1711. | 6139403. | 5.2923696177 |
| C | | | |
| 0.0002887500 | 1731. | 5994896. | 5.2329477657 |
| C | | | |
| 0.0002987500 | 1750. | 5859106. | 5.1771972521 |
| C | | | |
| 0.0003087500 | 1769. | 5730987. | 5.1243597756 |
| C | | | |
| 0.0003187500 | 1788. | 5610475. | 5.0754231048 |
| C | | | |
| 0.0003287500 | 1807. | 5496663. | 5.0295933385 |
| C | | | |
| 0.0003387500 | 1825. | 5388495. | 4.9855435227 |
| C | | | |
| 0.0003487500 | 1844. | 5286132. | 4.9445740365 |
| C | | | |
| 0.0003587500 | 1862. | 5189080. | 4.9064379873 |
| C | | | |
| 0.0003687500 | 1879. | 5096737. | 4.8704756467 |
| C | | | |
| 0.0003787500 | 1897. | 5008450. | 4.8357465287 |
| C | | | |
| 0.0003887500 | 1914. | 4923659. | 4.8030930331 |
| C | | | |
| 0.0003987500 | 1930. | 4839591. | 4.7714446983 |
| C | | | |
| 0.0004087500 | 1944. | 4757163. | 4.7410593068 |
| C | | | |
| 0.0004187500 | 1959. | 4677712. | 4.7120325781 |
| C | | | |
| 0.0004287500 | 1973. | 4600867. | 4.6836095309 |
| C | | | |
| 0.0004387500 | 1986. | 4526837. | 4.6568205665 |
| C | | | |
| 0.0004487500 | 1999. | 4455483. | 4.6315863679 |
| C | | | |
| 0.0004587500 | 2012. | 4386442. | 4.6077237032 |
| C | | | |
| 0.0004687500 | 2024. | 4317934. | 4.5843527479 |
| C | | | |
| 0.0004787500 | 2034. | 4248673. | 4.5607820985 |
| C | | | |
| 0.0004887500 | 2043. | 4179665. | 4.5362649949 |
| C | | | |
| 0.0004987500 | 2051. | 4112405. | 4.5127184945 |
| C | | | |
| 0.0005087500 | 2059. | 4046942. | 4.4902070660 |
| C | | | |
| 0.0005187500 | 2066. | 3983246. | 4.4687144361 |
| C | | | |

| | | | |
|---|---|---|---|
| 0.0005287500 | 2073. | 3921278. | 4.4482208415 C |
| 0.0005387500 | 2080. | 3860698. | 4.4291358445 C |
| 0.0005487500 | 2086. | 3801791. | 4.4109484559 C |
| 0.0006087500 | 2117. | 3477945. | 4.3157359930 C |
| 0.0006687500 | 2141. | 3200831. | 4.2480773994 C |
| 0.0007287500 | 2158. | 2961919. | 4.1975923183 C |
| 0.0007887500 | 2173. | 2754363. | 4.1635694279 C |
| 0.0008487500 | 2183. | 2572583. | 4.1427414766 C |
| 0.0009087500 | 2191. | 2411117. | 4.1304416297 C |

---

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

---

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

| Load No. | Axial Thrust kips | Nominal Mom. Cap. in-kip | Max. Comp. Strain |
|---|---|---|---|
| 1 | 50.000 | 2140.838 | 0.00300000 |

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section 9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

| Axial | Resist. | Nominal | Ult. (Fac) | Ult. (Fac) | Bend. Stiff. |
|---|---|---|---|---|---|

| Load No. | Factor for Moment | Moment Cap in-kips | Ax. Thrust kips | Moment Cap in-kips | at Ult Mom kip-in^2 |
|---|---|---|---|---|---|
| 1 | 0.65 | 2141. | 32.500000 | 1392. | 9939523. |
| 1 | 0.70 | 2141. | 35.000000 | 1499. | 8297160. |
| 1 | 0.75 | 2141. | 37.500000 | 1606. | 7059952. |

Layering Correction Equivalent Depths of Soil & Rock Layers

| Layer No. | Top of Layer Below Pile Head ft | Equivalent Top Depth Below Grnd Surf ft | Same Layer Type As Layer Above | Layer is Rock or is Below Rock Layer | F0 Integral for Layer lbs | F1 Integral for Layer lbs |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | N.A. | No | 0.00 | 58198. |
| 2 | 16.0000 | 9.1161 | No | No | 58198. | 98121. |
| 3 | 20.0000 | 25.3807 | No | No | 156319. | 125865. |
| 4 | 35.0000 | 18.3553 | No | No | 282184. | N.A. |

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals
for Layer n. Layering correction equivalent depths are computed only
for soil types with both shallow-depth and deep-depth expressions for
peak lateral load transfer. These soil types are soft and stiff clays,
non-liquefied sands, and cemented c-phi soil.

---

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

---

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 1.000000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 50000.0 lbs

| Depth X feet | Deflect. y inches | Bending Moment in-lbs | Shear Force lbs | Soil Res. p lb/inch | Bending Stiffness in-lb^2 |
|---|---|---|---|---|---|
| 0.000 | 1.00000 | -1740150. | 23717. | -35.90724 | 5.927E+09 |
| 0.50000 | 0.99472 | -1598377. | 23457. | -42.70932 | 5.927E+09 |
| 1.00000 | 0.97972 | -1457656. | 23180. | -49.53812 | 8.871E+09 |
| 1.50000 | 0.95882 | -1318423. | 22862. | -56.38928 | 1.134E+10 |
| 2.00000 | 0.93372 | -1181010. | 22503. | -63.24586 | 1.456E+10 |
| 2.50000 | 0.90571 | -1045728. | 22103. | -70.09355 | 1.819E+10 |
| 3.00000 | 0.87563 | -912866. | 21662. | -76.91730 | 2.295E+10 |
| 3.50000 | 0.84411 | -782701. | 21180. | -83.70262 | 2.646E+10 |
| 4.00000 | 0.81153 | -655497. | 20658. | -90.43098 | 2.646E+10 |
| 4.50000 | 0.77806 | -531503. | 20095. | -97.07840 | 2.643E+10 |
| 5.00000 | 0.74387 | -410968. | 19493. | -103.62032 | 2.636E+10 |
| 5.50000 | 0.70911 | -294135. | 18852. | -110.03155 | 2.624E+10 |
| 6.00000 | 0.67395 | -181244. | 18173. | -116.28618 | 2.597E+10 |
| 6.50000 | 0.63854 | -72526. | 17458. | -122.35760 | 2.496E+10 |
| 7.00000 | 0.60302 | 31793. | 16706. | -128.21830 | 2.303E+10 |

| | | | | | |
|---|---|---|---|---|---|
| 7.50000 | 0.56755 | 131493. | 15920. | -133.84091 | 2.571E+10 |
| 8.00000 | 0.53227 | 226365. | 15100. | -139.19623 | 2.611E+10 |
| 8.50000 | 0.49730 | 316211. | 14250. | -144.25381 | 2.627E+10 |
| 9.00000 | 0.46277 | 400842. | 13370. | -148.98182 | 2.636E+10 |
| 9.50000 | 0.42878 | 480083. | 12463. | -153.34665 | 2.640E+10 |
| 10.00000 | 0.39544 | 553770. | 11544. | -153.19450 | 2.644E+10 |
| 10.50000 | 0.36286 | 621904. | 10627. | -152.46778 | 2.645E+10 |
| 11.00000 | 0.33113 | 684508. | 9715. | -151.38027 | 2.646E+10 |
| 11.50000 | 0.30032 | 741615. | 8811. | -149.91425 | 2.646E+10 |
| 12.00000 | 0.27053 | 793275. | 7918. | -148.04900 | 2.646E+10 |
| 12.50000 | 0.24181 | 839551. | 7036. | -145.75978 | 2.531E+10 |
| 13.00000 | 0.21429 | 880519. | 6170. | -143.02788 | 2.393E+10 |
| 13.50000 | 0.18810 | 916273. | 5321. | -139.83811 | 2.283E+10 |
| 14.00000 | 0.16334 | 946920. | 4493. | -136.17435 | 2.197E+10 |
| 14.50000 | 0.14014 | 972588. | 3689. | -132.01835 | 2.017E+10 |
| 15.00000 | 0.11868 | 993416. | 2910. | -127.38312 | 1.961E+10 |
| 15.50000 | 0.09904 | 1009567. | 2161. | -122.26449 | 1.917E+10 |
| 16.00000 | 0.08129 | 1021221. | 662.38440 | -377.39653 | 1.886E+10 |
| 16.50000 | 0.06550 | 1019192. | -1572. | -367.54603 | 1.892E+10 |
| 17.00000 | 0.05164 | 1003835. | -3730. | -351.48935 | 1.933E+10 |
| 17.50000 | 0.03965 | 975730. | -5772. | -329.25693 | 2.010E+10 |
| 18.00000 | 0.02942 | 935685. | -7662. | -300.75094 | 2.238E+10 |
| 18.50000 | 0.02068 | 884737. | -9221. | -218.97806 | 2.377E+10 |
| 19.00000 | 0.01329 | 825839. | -10311. | -144.49254 | 2.570E+10 |
| 19.50000 | 0.007051 | 761682. | -10981. | -78.68769 | 2.646E+10 |
| 20.00000 | 0.001850 | 694640. | -11367. | -49.96769 | 2.647E+10 |
| 20.50000 | -0.002406 | 625751. | -11351. | 55.17921 | 2.646E+10 |

| | | | | | |
|---|---|---|---|---|---|
| 21.00000 | -0.005811 | 558807. | -10961. | 74.83388 | 2.644E+10 |
| 21.50000 | -0.008454 | 494519. | -10480. | 85.71626 | 2.641E+10 |
| 22.00000 | -0.01042 | 433283. | -9944. | 92.90075 | 2.638E+10 |
| 22.50000 | -0.01180 | 375361. | -9371. | 97.85625 | 2.634E+10 |
| 23.00000 | -0.01267 | 320937. | -8774. | 101.24527 | 2.628E+10 |
| 23.50000 | -0.01309 | 270136. | -8160. | 103.43230 | 2.620E+10 |
| 24.00000 | -0.01315 | 223040. | -7536. | 104.64272 | 2.611E+10 |
| 24.50000 | -0.01289 | 179695. | -6907. | 105.02711 | 2.597E+10 |
| 25.00000 | -0.01239 | 140119. | -6278. | 104.69167 | 2.577E+10 |
| 25.50000 | -0.01169 | 104302. | -5653. | 103.71408 | 2.546E+10 |
| 26.00000 | -0.01085 | 72211. | -5035. | 102.15248 | 2.495E+10 |
| 26.50000 | -0.009896 | 43793. | -4428. | 100.05061 | 2.393E+10 |
| 27.00000 | -0.008881 | 18973. | -3836. | 97.44064 | 2.264E+10 |
| 27.50000 | -0.007835 | -2340. | -3260. | 94.35349 | 2.264E+10 |
| 28.00000 | -0.006792 | -20257. | -2705. | 90.82654 | 2.264E+10 |
| 28.50000 | -0.005782 | -34902. | -2172. | 86.89383 | 2.331E+10 |
| 29.00000 | -0.004826 | -46416. | -1663. | 82.57868 | 2.407E+10 |
| 29.50000 | -0.003940 | -54954. | -1182. | 77.89114 | 2.445E+10 |
| 30.00000 | -0.003134 | -60684. | -729.75709 | 72.83403 | 2.464E+10 |
| 30.50000 | -0.002417 | -63787. | -309.05745 | 67.39919 | 2.474E+10 |
| 31.00000 | -0.001792 | -64460. | 77.81967 | 61.55985 | 2.475E+10 |
| 31.50000 | -0.001262 | -62911. | 428.26088 | 55.25388 | 2.471E+10 |
| 32.00000 | -0.000823 | -59369. | 739.05147 | 48.34298 | 2.460E+10 |
| 32.50000 | -0.000471 | -54082. | 1006. | 40.49139 | 2.441E+10 |
| 33.00000 | -0.000199 | -47333. | 1219. | 30.64063 | 2.412E+10 |
| 33.50000 | 2.873E-06 | -39478. | 1305. | -2.01169 | 2.366E+10 |
| 34.00000 | 0.000144 | -31693. | 1215. | -28.00113 | 2.302E+10 |

| | | | | | |
|---|---|---|---|---|---|
| 34.50000 | 0.000236 | -24912. | 1031. | -33.28621 | 2.264E+10 |
| 35.00000 | 0.000289 | -19329. | 878.60598 | -17.49077 | 2.264E+10 |
| 35.50000 | 0.000310 | -14373. | 768.19256 | -19.31370 | 2.264E+10 |
| 36.00000 | 0.000309 | -10111. | 651.00578 | -19.74856 | 2.264E+10 |
| 36.50000 | 0.000292 | -6560. | 534.38163 | -19.12616 | 2.264E+10 |
| 37.00000 | 0.000264 | -3696. | 423.76461 | -17.74618 | 2.264E+10 |
| 37.50000 | 0.000231 | -1472. | 322.91513 | -15.87031 | 2.264E+10 |
| 38.00000 | 0.000195 | 182.03859 | 234.14802 | -13.71872 | 2.264E+10 |
| 38.50000 | 0.000159 | 1342. | 158.58355 | -11.46944 | 2.264E+10 |
| 39.00000 | 0.000126 | 2088. | 96.39553 | -9.25990 | 2.264E+10 |
| 39.50000 | 9.533E-05 | 2502. | 47.04516 | -7.19022 | 2.264E+10 |
| 40.00000 | 6.912E-05 | 2656. | 9.49213 | -5.32746 | 2.264E+10 |
| 40.50000 | 4.713E-05 | 2618. | -17.62201 | -3.71059 | 2.264E+10 |
| 41.00000 | 2.931E-05 | 2446. | -35.82082 | -2.35568 | 2.264E+10 |
| 41.50000 | 1.537E-05 | 2190. | -46.67074 | -1.26096 | 2.264E+10 |
| 42.00000 | 4.918E-06 | 1888. | -51.68823 | -0.41154 | 2.264E+10 |
| 42.50000 | -2.536E-06 | 1570. | -52.27379 | 0.21635 | 2.264E+10 |
| 43.00000 | -7.493E-06 | 1261. | -49.66964 | 0.65170 | 2.264E+10 |
| 43.50000 | -1.045E-05 | 974.75290 | -44.93729 | 0.92575 | 2.264E+10 |
| 44.00000 | -1.185E-05 | 721.86292 | -38.95103 | 1.06966 | 2.264E+10 |
| 44.50000 | -1.210E-05 | 507.42349 | -32.40390 | 1.11271 | 2.264E+10 |
| 45.00000 | -1.155E-05 | 333.00137 | -25.82240 | 1.08112 | 2.264E+10 |
| 45.50000 | -1.047E-05 | 197.47307 | -19.58716 | 0.99730 | 2.264E+10 |
| 46.00000 | -9.079E-06 | 97.83171 | -13.95679 | 0.87949 | 2.264E+10 |
| 46.50000 | -7.529E-06 | 29.84436 | -9.09301 | 0.74177 | 2.264E+10 |
| 47.00000 | -5.931E-06 | -11.44175 | -5.08519 | 0.59417 | 2.264E+10 |
| 47.50000 | -4.352E-06 | -31.33672 | -1.97319 | 0.44316 | 2.264E+10 |

```
   48.00000   -2.823E-06    -35.27548      0.23255      0.29209
2.264E+10
   48.50000   -1.350E-06    -28.69623      1.53442      0.14187
2.264E+10
   49.00000    7.817E-08    -17.00750      1.93498    -0.008346
2.264E+10
   49.50000    1.479E-06     -5.61788      1.42893     -0.16034
2.264E+10
   50.00000    2.871E-06        0.000        0.000     -0.31597
2.264E+10

Output Summary for Load Case No. 1:

Pile-head deflection             =     1.00000000 inches
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =      -1740150. inch-lbs
Maximum shear force              =         23717. lbs
Depth of maximum bending moment  =       0.000000 feet below pile head
Depth of maximum shear force     =       0.000000 feet below pile head
Number of iterations             =             21
Number of zero deflection points =              4



--------------------------------------------------------------------------
-------
                 Computed Values of Pile Loading and Deflection
                   for Lateral Loading for Load Case Number 2
--------------------------------------------------------------------------
-------

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head                                =     1.000000
inches
Moment at pile head                                      =          0.0 in-
lbs
Axial load at pile head                                  =      50000.0 lbs

    Depth      Deflect.      Bending       Shear      Soil Res.
Bending
      X            y         Moment        Force          p
Stiffness
    feet        inches       in-lbs         lbs        lb/inch      in-
lb^2
-----------  -----------  -----------  -----------  -----------  --------
---
      0.000      1.00000        0.000       12347.    -35.90724
2.264E+10
    0.50000      0.95516       75680.       12113.    -42.13550
2.264E+10
    1.00000      0.91044      149836.       11842.    -48.34161
2.583E+10
    1.50000      0.86593      222242.       11533.    -54.50593
2.610E+10
```

| | | | | | |
|---|---|---|---|---|---|
| 2.00000 | 0.82172 | 292671. | 11188. | -60.60837 | 2.624E+10 |
| 2.50000 | 0.77792 | 360897. | 10806. | -66.62820 | 2.632E+10 |
| 3.00000 | 0.73461 | 426700. | 10389. | -72.54399 | 2.637E+10 |
| 3.50000 | 0.69188 | 489863. | 9936. | -78.33361 | 2.641E+10 |
| 4.00000 | 0.64982 | 550172. | 9449. | -83.97413 | 2.643E+10 |
| 4.50000 | 0.60851 | 607420. | 8929. | -89.44171 | 2.645E+10 |
| 5.00000 | 0.56803 | 661407. | 8376. | -94.71150 | 2.646E+10 |
| 5.50000 | 0.52844 | 711940. | 7793. | -99.75751 | 2.647E+10 |
| 6.00000 | 0.48983 | 758833. | 7180. | -104.55239 | 2.646E+10 |
| 6.50000 | 0.45224 | 801910. | 6539. | -109.06718 | 2.627E+10 |
| 7.00000 | 0.41576 | 841007. | 5872. | -113.27169 | 2.527E+10 |
| 7.50000 | 0.38047 | 875965. | 5181. | -117.13763 | 2.410E+10 |
| 8.00000 | 0.34650 | 906641. | 4468. | -120.63814 | 2.321E+10 |
| 8.50000 | 0.31392 | 932904. | 3734. | -123.74618 | 2.245E+10 |
| 9.00000 | 0.28285 | 954637. | 2984. | -126.43520 | 2.165E+10 |
| 9.50000 | 0.25336 | 971739. | 2219. | -128.68093 | 2.019E+10 |
| 10.00000 | 0.22560 | 984122. | 1451. | -127.05809 | 1.986E+10 |
| 10.50000 | 0.19963 | 991841. | 695.37252 | -124.93356 | 1.965E+10 |
| 11.00000 | 0.17548 | 994973. | -46.93902 | -122.50362 | 1.957E+10 |
| 11.50000 | 0.15315 | 993602. | -773.76843 | -119.77285 | 1.961E+10 |
| 12.00000 | 0.13265 | 987829. | -1483. | -116.74609 | 1.976E+10 |
| 12.50000 | 0.11395 | 977762. | -2174. | -113.42794 | 2.004E+10 |
| 13.00000 | 0.09701 | 963525. | -2844. | -109.82179 | 2.142E+10 |
| 13.50000 | 0.08168 | 945253. | -3491. | -105.89510 | 2.210E+10 |
| 14.00000 | 0.06790 | 923091. | -4113. | -101.62761 | 2.268E+10 |
| 14.50000 | 0.05558 | 897198. | -4709. | -96.99383 | 2.347E+10 |
| 15.00000 | 0.04464 | 867744. | -5276. | -91.94882 | 2.440E+10 |

| | | | | | |
|---|---|---|---|---|---|
| 15.50000 | 0.03497 | 834916. | -5811. | -86.41902 | 2.545E+10 |
| 16.00000 | 0.02649 | 798918. | -6643. | -190.86968 | 2.634E+10 |
| 16.50000 | 0.01910 | 755994. | -7737. | -173.75934 | 2.646E+10 |
| 17.00000 | 0.01274 | 706763. | -8630. | -123.97011 | 2.647E+10 |
| 17.50000 | 0.007342 | 653021. | -9223. | -73.53323 | 2.646E+10 |
| 18.00000 | 0.002830 | 596588. | -9531. | -29.15862 | 2.645E+10 |
| 18.50000 | -0.000869 | 539064. | -9591. | 9.20002 | 2.643E+10 |
| 19.00000 | -0.003834 | 481835. | -9438. | 41.69144 | 2.641E+10 |
| 19.50000 | -0.006142 | 426074. | -9107. | 68.54849 | 2.637E+10 |
| 20.00000 | -0.007869 | 372751. | -8658. | 80.99167 | 2.633E+10 |
| 20.50000 | -0.009086 | 322319. | -8158. | 85.91271 | 2.628E+10 |
| 21.00000 | -0.009861 | 274958. | -7632. | 89.26102 | 2.621E+10 |
| 21.50000 | -0.01026 | 230791. | -7090. | 91.42926 | 2.612E+10 |
| 22.00000 | -0.01034 | 189899. | -6538. | 92.65210 | 2.601E+10 |
| 22.50000 | -0.01016 | 152330. | -5981. | 93.08266 | 2.584E+10 |
| 23.00000 | -0.009760 | 118101. | -5423. | 92.82696 | 2.560E+10 |
| 23.50000 | -0.009199 | 87206. | -4869. | 91.96143 | 2.523E+10 |
| 24.00000 | -0.008513 | 59615. | -4321. | 90.54241 | 2.461E+10 |
| 24.50000 | -0.007740 | 35279. | -3784. | 88.61154 | 2.334E+10 |
| 25.00000 | -0.006913 | 14131. | -3259. | 86.19863 | 2.264E+10 |
| 25.50000 | -0.006063 | -3915. | -2751. | 83.33840 | 2.264E+10 |
| 26.00000 | -0.005219 | -18961. | -2260. | 80.06643 | 2.264E+10 |
| 26.50000 | -0.004406 | -31123. | -1791. | 76.41515 | 2.296E+10 |
| 27.00000 | -0.003641 | -40532. | -1344. | 72.41109 | 2.373E+10 |
| 27.50000 | -0.002938 | -47331. | -923.06784 | 68.06598 | 2.412E+10 |
| 28.00000 | -0.002306 | -51676. | -528.71229 | 63.38587 | 2.432E+10 |
| 28.50000 | -0.001749 | -53735. | -163.44988 | 58.36827 | 2.440E+10 |

| | | | | | |
|---|---|---|---|---|---|
| 29.00000 | -0.001273 | -53689. | 170.64363 | 52.99623 | 2.440E+10 |
| 29.50000 | -0.000875 | -51731. | 471.30693 | 47.22487 | 2.432E+10 |
| 30.00000 | -0.000554 | -48069. | 735.82519 | 40.94788 | 2.415E+10 |
| 30.50000 | -0.000305 | -42929. | 960.35497 | 33.89538 | 2.388E+10 |
| 31.00000 | -0.000120 | -36566. | 1138. | 25.17504 | 2.345E+10 |
| 31.50000 | 8.229E-06 | -29294. | 1185. | -9.52851 | 2.276E+10 |
| 32.00000 | 9.037E-05 | -22363. | 1087. | -22.98951 | 2.264E+10 |
| 32.50000 | 0.000137 | -16257. | 937.83553 | -26.71588 | 2.264E+10 |
| 33.00000 | 0.000158 | -11112. | 772.86608 | -28.27393 | 2.264E+10 |
| 33.50000 | 0.000161 | -6984. | 601.89298 | -28.71710 | 2.264E+10 |
| 34.00000 | 0.000153 | -3889. | 430.29556 | -28.48204 | 2.264E+10 |
| 34.50000 | 0.000139 | -1819. | 261.41685 | -27.81086 | 2.264E+10 |
| 35.00000 | 0.000121 | -750.61562 | 155.92060 | -7.35456 | 2.264E+10 |
| 35.50000 | 0.000103 | 53.44085 | 114.60799 | -6.41631 | 2.264E+10 |
| 36.00000 | 8.490E-05 | 626.50593 | 79.08976 | -5.42310 | 2.264E+10 |
| 36.50000 | 6.769E-05 | 1004. | 49.51529 | -4.43505 | 2.264E+10 |
| 37.00000 | 5.207E-05 | 1222. | 25.71783 | -3.49743 | 2.264E+10 |
| 37.50000 | 3.839E-05 | 1314. | 7.29952 | -2.64201 | 2.264E+10 |
| 38.00000 | 2.680E-05 | 1311. | -6.29259 | -1.88870 | 2.264E+10 |
| 38.50000 | 1.730E-05 | 1240. | -15.70117 | -1.24749 | 2.264E+10 |
| 39.00000 | 9.764E-06 | 1124. | -21.60470 | -0.72035 | 2.264E+10 |
| 39.50000 | 4.018E-06 | 981.31945 | -24.67497 | -0.30308 | 2.264E+10 |
| 40.00000 | -1.676E-07 | 828.02358 | -25.54544 | 0.01292 | 2.264E+10 |
| 40.50000 | -3.037E-06 | 675.12694 | -24.78940 | 0.23909 | 2.264E+10 |
| 41.00000 | -4.833E-06 | 530.78402 | -22.90669 | 0.38848 | 2.264E+10 |
| 41.50000 | -5.786E-06 | 400.38405 | -20.31755 | 0.47457 | 2.264E+10 |
| 42.00000 | -6.102E-06 | 287.03678 | -17.36220 | 0.51055 | 2.264E+10 |

| | | | | | |
|---|---|---|---|---|---|
| 42.50000 | -5.961E-06 | 192.04643 | -14.30466 | 0.50863 | 2.264E+10 |
| 43.00000 | -5.516E-06 | 115.35160 | -11.33966 | 0.47970 | 2.264E+10 |
| 43.50000 | -4.886E-06 | 55.91680 | -8.60143 | 0.43304 | 2.264E+10 |
| 44.00000 | -4.168E-06 | 12.06714 | -6.17343 | 0.37629 | 2.264E+10 |
| 44.50000 | -3.431E-06 | -18.23716 | -4.09838 | 0.31540 | 2.264E+10 |
| 45.00000 | -2.723E-06 | -37.18574 | -2.38783 | 0.25479 | 2.264E+10 |
| 45.50000 | -2.074E-06 | -46.95905 | -1.03107 | 0.19747 | 2.264E+10 |
| 46.00000 | -1.499E-06 | -49.61975 | -0.002941 | 0.14524 | 2.264E+10 |
| 46.50000 | -1.004E-06 | -47.04784 | 0.72945 | 0.09889 | 2.264E+10 |
| 47.00000 | -5.829E-07 | -40.91218 | 1.20130 | 0.05839 | 2.264E+10 |
| 47.50000 | -2.272E-07 | -32.67105 | 1.44589 | 0.02313 | 2.264E+10 |
| 48.00000 | 7.659E-08 | -23.59448 | 1.49152 | -0.007925 | 2.264E+10 |
| 48.50000 | 3.429E-07 | -14.80134 | 1.35961 | -0.03604 | 2.264E+10 |
| 49.00000 | 5.856E-07 | -7.30461 | 1.06389 | -0.06253 | 2.264E+10 |
| 49.50000 | 8.168E-07 | -2.05837 | 0.61063 | -0.08856 | 2.264E+10 |
| 50.00000 | 1.045E-06 | 0.000 | 0.000 | -0.11499 | 2.264E+10 |

Output Summary for Load Case No. 2:

| | | |
|---|---|---|
| Pile-head deflection | = | 1.00000000 inches |
| Computed slope at pile head | = | -0.00747346 radians |
| Maximum bending moment | = | 994973. inch-lbs |
| Maximum shear force | = | 12347. lbs |
| Depth of maximum bending moment | = | 11.00000000 feet below pile head |
| Depth of maximum shear force | = | 0.000000 feet below pile head |
| Number of iterations | = | 19 |
| Number of zero deflection points | = | 4 |

---

Summary of Pile-head Responses for Conventional Analyses

---

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs

Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

| Load Case No. | Load Type | Pile-head Deflection inches | Pile-head Rotation radians | Max Shear in Pile lbs | Max Moment in Pile in-lbs |
|---|---|---|---|---|---|
| 1 | 5 | 1.000000 | 0.0000 | 23717. | -1740150. |
| 2 | 4 | 1.000000 | -0.007473 | 12347. | 994973. |

Maximum pile-head deflection = 1.0000000000 inches
Maximum pile-head rotation = -0.0074734602 radians = -0.428198 deg.

The analysis ended normally.

## Shear-Induced Building Settlement (Ds) calculation procedure

The shear-induced building settlement (Ds) due to liquefaction below the building can be estimated using the relationship developed by Bray and Macedo (2017):

$$Ln(Ds) = c1 + c2 * LBS + 0.58 * Ln\left(Tanh\left(\frac{HL}{6}\right)\right) + 4.59 * Ln(Q) - 0.42 * Ln(Q)^2 - 0.02 * B + 0.84 * Ln(CAVdp) + 0.41 * Ln(Sa1) + \varepsilon$$

where Ds is in the units of mm, c1= -8.35 and c2= 0.072 for LBS ≤ 16, and c1= -7.48 and c2= 0.014 otherwise. Q is the building contact pressure in units of kPa, HL is the cumulative thickness of the liquefiable layers in the units of m, B is the building width in the units of m, CAVdp is a standardized version of the cumulative absolute velocity in the units of g-s, Sa1 is 5%-damped pseudo-acceleration response spectral value at a period of 1 s in the units of g, and ε is a normal random variable with zero mean and 0.50 standard deviation in Ln units. The liquefaction-induced building settlement index (LBS) is:

$$LBS = \sum W * \frac{\varepsilon_{shear}}{z} dz$$

where z (m) is the depth measured from the ground surface > 0, W is a foundation-weighting factor wherein W = 0.0 for z less than Df, which is the embedment depth of the foundation, and W = 1.0 otherwise. The shear strain parameter (ε_shear) is the liquefaction-induced free-field shear strain (in %) estimated using Zhang et al. (2004). It is calculated based on the estimated Dr of the liquefied soil layer and the calculated safety factor against liquefaction triggering (FSL).

## References


- Lunne, T., Robertson, P.K., and Powell, J.J.M 1997. Cone penetration testing in geotechnical practice, E & FN Spon Routledge, 352 p, ISBN 0-7514-0393-8.
- Boulanger, R.W. and Idriss, I. M., 2007. Evaluation of Cyclic Softening in Silts and Clays. ASCE Journal of Geotechnical and Geoenvironmental Engineering June, Vol. 133, No. 6 pp 641-652
- Boulanger, R.W. and Idriss, I. M., 2014. CPT AND SPT BASED LIQUEFACTION TRIGGERING PROCEDURES. DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING COLLEGE OF ENGINEERING UNIVERSITY OF CALIFORNIA AT DAVIS
- Robertson, P.K. and Cabal, K.L., 2007, Guide to Cone Penetration Testing for Geotechnical Engineering. Available at no cost at http://www.geologismiki.gr/
- Robertson, P.K. 1990. Soil classification using the cone penetration test. Canadian Geotechnical Journal, 27 (1), 151-8.
- Robertson, P.K. and Wride, C.E., 1998. Cyclic Liquefaction and its Evaluation based on the CPT Canadian Geotechnical Journal, 1998, Vol. 35, August.
- Youd, T.L., Idriss, I.M., Andrus, R.D., Arango, I., Castro, G., Christian, J.T., Dobry, R., Finn, W.D.L., Harder, L.F., Hynes, M.E., Ishihara, K., Koester, J., Liao, S., Marcuson III, W.F., Martin, G.R., Mitchell, J.K., Moriwaki, Y., Power, M.S., Robertson, P.K., Seed, R., and Stokoe, K.H., Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshop on Evaluation of Liquefaction Resistance of Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 127, October, pp 817-833
- Zhang, G., Robertson. P.K., Brachman, R., 2002, Estimating Liquefaction Induced Ground Settlements from the CPT, Canadian Geotechnical Journal, 39: pp 1168-1180
- Zhang, G., Robertson. P.K., Brachman, R., 2004, Estimating Liquefaction Induced Lateral Displacements using the SPT and CPT, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 130, No. 8, 861-871
- Pradel, D., 1998, Procedure to Evaluate Earthquake-Induced Settlements in Dry Sandy Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 124, No. 4, 364-368
- Iwasaki, T., 1986, Soil liquefaction studies in Japan: state-of-the-art, Soil Dynamics and Earthquake Engineering, Vol. 5, No. 1, 2-70
- Papathanassiou G., 2008, LPI-based approach for calibrating the severity of liquefaction-induced failures and for assessing the probability of liquefaction surface evidence, Eng. Geol. 96:94–104
- P.K. Robertson, 2009, Interpretation of Cone Penetration Tests - a unified approach., Canadian Geotechnical Journal, Vol. 46, No. 11, pp 1337-1355
- P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering - from case history to practice, IS-Tokyo, June 2009
- Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, *Symposium in honor of professor I. M. Idriss,* SAN diego, CA
- R. E. S. Moss, R. B. Seed, R. E. Kayen, J. P. Stewart, A. Der Kiureghian, K. O. Cetin, CPT-Based Probabilistic and Deterministic Assessment of In Situ Seismic Soil Liquefaction Potential, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 132, No. 8, August 1, 2006
- I. M. Idriss and R. W. Boulanger, 2008. Soil liquefaction during earthquakes, Earthquake Engineering Research Institute MNO-12
- Jonathan D. Bray & Jorge Macedo, Department of Civil & Environmental Engineering, Univ. of California, Berkeley, CA, USA, Simplified procedure for estimating liquefaction -induced building settlement, *Proceedings of the 19th International Conference on Soil Mechanics and Geotechnical Engineering, Seoul 201*

# ATTACHMENT 8

*U.S. Environmental Protection Agency (EPA) Website. 2019. Environmental Justice Screening and Mapping Tool (EJSCREEN) – City of Arcata, CA. Available at: https://ejscreen.epa.gov/mapper/. Accessed on: 9/25/20.*

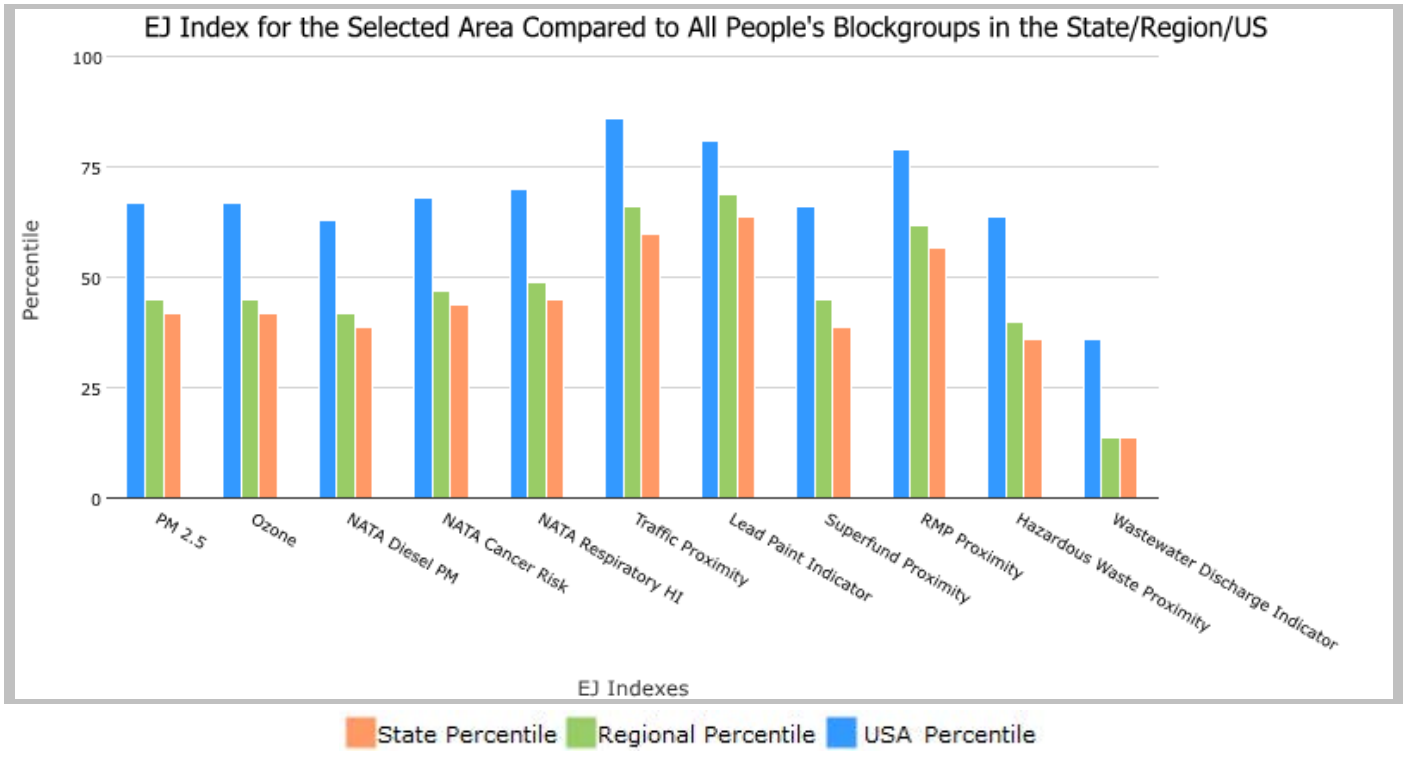
# EJSCREEN Report (Version 2019)

**1 miles Ring Centered at 40.854681,-124.089310, CALIFORNIA, EPA Region 9**

**Approximate Population: 2,295**

**Input Area (sq. miles): 3.14**

| Selected Variables | State Percentile | EPA Region Percentile | USA Percentile |
|---|---|---|---|
| **EJ Indexes** | | | |
| EJ Index for PM2.5 | 42 | 45 | 67 |
| EJ Index for Ozone | 42 | 45 | 67 |
| EJ Index for NATA* Diesel PM | 39 | 42 | 63 |
| EJ Index for NATA* Air Toxics Cancer Risk | 44 | 47 | 68 |
| EJ Index for NATA* Respiratory Hazard Index | 45 | 49 | 70 |
| EJ Index for Traffic Proximity and Volume | 60 | 66 | 86 |
| EJ Index for Lead Paint Indicator | 64 | 69 | 81 |
| EJ Index for Superfund Proximity | 39 | 45 | 66 |
| EJ Index for RMP Proximity | 57 | 62 | 79 |
| EJ Index for Hazardous Waste Proximity | 36 | 40 | 64 |
| EJ Index for Wastewater Discharge Indicator | 14 | 14 | 36 |




This report shows the values for environmental and demographic indicators and EJSCREEN indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state, EPA region, or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJSCREEN documentation for discussion of these issues before using reports.

# EJSCREEN Report (Version 2019)

**1 miles Ring Centered at 40.854681,-124.089310, CALIFORNIA, EPA Region 9**

**Approximate Population: 2,295**

**Input Area (sq. miles): 3.14**




| Sites reporting to EPA | |
|---|---|
| Superfund NPL | 0 |
| Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF) | 0 |

# EJSCREEN Report (Version 2019)

**1 miles Ring Centered at 40.854681,-124.089310, CALIFORNIA, EPA Region 9**

**Approximate Population: 2,295**

**Input Area (sq. miles): 3.14**

| Selected Variables | Value | State Avg. | %ile in State | EPA Region Avg. | %ile in EPA Region | USA Avg. | %ile in USA |
|---|---|---|---|---|---|---|---|
| **Environmental Indicators** | | | | | | | |
| Particulate Matter (PM 2.5 in µg/m$^3$) | 5.5 | 9.78 | 1 | 9.21 | 3 | 8.3 | 3 |
| Ozone (ppb) | 26.7 | 48.2 | 0 | 48.9 | 0 | 43 | 0 |
| NATA* Diesel PM (µg/m$^3$) | 0.121 | 0.468 | 5 | 0.479 | <50th | 0.479 | <50th |
| NATA* Cancer Risk (lifetime risk per million) | 24 | 36 | 6 | 35 | <50th | 32 | <50th |
| NATA* Respiratory Hazard Index | 0.43 | 0.55 | 18 | 0.53 | <50th | 0.44 | <50th |
| Traffic Proximity and Volume (daily traffic count/distance to road) | 1400 | 2000 | 59 | 1700 | 66 | 750 | 86 |
| Lead Paint Indicator (% Pre-1960 Housing) | 0.34 | 0.29 | 62 | 0.24 | 68 | 0.28 | 65 |
| Superfund Proximity (site count/km distance) | 0.023 | 0.18 | 10 | 0.15 | 16 | 0.13 | 21 |
| RMP Proximity (facility count/km distance) | 0.83 | 1.1 | 60 | 0.99 | 64 | 0.74 | 72 |
| Hazardous Waste Proximity (facility count/km distance) | 0.1 | 3.4 | 7 | 2.9 | 10 | 4 | 19 |
| Wastewater Discharge Indicator (toxicity-weighted concentration/m distance) | 2.6E-06 | 17 | 55 | 31 | 56 | 14 | 43 |
| **Demographic Indicators** | | | | | | | |
| Demographic Index | 49% | 48% | 52 | 47% | 54 | 36% | 72 |
| Minority Population | 29% | 62% | 14 | 59% | 17 | 39% | 48 |
| Low Income Population | 69% | 34% | 91 | 34% | 91 | 33% | 93 |
| Linguistically Isolated Population | 3% | 9% | 32 | 8% | 37 | 4% | 64 |
| Population With Less Than High School Education | 8% | 18% | 35 | 17% | 37 | 13% | 44 |
| Population Under 5 years of age | 4% | 6% | 28 | 6% | 29 | 6% | 31 |
| Population over 64 years of age | 7% | 13% | 22 | 14% | 23 | 15% | 17 |

* The National-Scale Air Toxics Assessment (NATA) is EPA's ongoing, comprehensive evaluation of air toxics in the United States. EPA developed the NATA to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that NATA provides broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. More information on the NATA analysis can be found at: https://www.epa.gov/national-air-toxics-assessment.

For additional information, see: www.epa.gov/environmentaljustice

EJSCREEN is a screening tool for pre-decisional use only. It can help identify areas that may warrant additional consideration, analysis, or outreach. It does not provide a basis for decision-making, but it may help identify potential areas of EJ concern. Users should keep in mind that screening tools are subject to substantial uncertainty in their demographic and environmental data, particularly when looking at small geographic areas. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJSCREEN documentation for discussion of these issues before using reports. This screening tool does not provide data on every environmental impact and demographic factor that may be relevant to a particular location. EJSCREEN outputs should be supplemented with additional information and local knowledge before taking any action to address potential EJ concerns.

# ATTACHMENT 9

*Stillwater Sciences. 2020. Final Delineation of Waters and Wetlands for the City of Arcata Wastewater Treatment Plant Improvement Project, California. April and August 2020.*

FINAL REPORT ◦ AUGUST 2020

# Preliminary Delineation of Waters and Wetlands for the City of Arcata Wastewater Treatment Plant Improvement Project, California









PREPARED FOR
City of Arcata
736 F Street
Arcata, CA 95521

PREPARED BY
Stillwater Sciences
850 G Street, Suite K
Arcata, CA 95521

Stillwater Sciences

Suggested citation:
Stillwater Sciences. 2020. Preliminary Delineation of Waters and Wetlands for the City of Arcata Wastewater Treatment Plant Improvement Project, California. Final Report. Prepared by Stillwater Sciences, Arcata, California.

Cover photos: Wetland delineation Survey area, Arcata, California, Stillwater Sciences 2019 and 2020.

# Table of Contents

**1 INTRODUCTION ..... 1**

1.1 Project Description and Proponent ..... 1
1.2 Project Location and Survey area ..... 1
1.3 Purpose of the Wetland Delineation ..... 2

**2 METHODS ..... 4**

2.1 Existing Conditions ..... 4
2.2 Field Delineation ..... 4
2.2.1 Waters determination ..... 4
2.2.2 Wetland determination ..... 5

**3 RESULTS ..... 6**

3.1 Historical Conditions ..... 6
3.2 Existing Conditions ..... 7
3.2.1 Hydrology ..... 7
3.2.2 Soil units ..... 9
3.2.3 Vegetation ..... 11
3.2.4 Precipitation ..... 11
3.3 Preliminary Jurisdictional Waters and Wetlands ..... 12
3.3.1 Waters ..... 24
3.3.2 Wetlands ..... 25
3.3.3 Upland developed ..... 30

**4 REFERENCES ..... 31**

## Tables

Table 1. Preliminary USACE-jurisdictional waters of the U.S., including wetlands, waters of the State, and LCP-jurisdictional wetlands in the Survey area. ..... 12
Table 2. Preliminary LCP-jurisdictional wetlands in the Survey area. ..... 29

## Figures

Figure 1. Project location and waters/wetland delineation Survey area. ..... 3
Figure 2. National Wetlands Inventory map of the Survey area. ..... 8
Figure 3. Mapped soil units in the Survey area. ..... 10
Figure 4. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 13
Figure 5. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 14
Figure 6. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 15
Figure 7. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 16
Figure 8. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 17
Figure 9. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 18
Figure 10. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 19
Figure 11. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 20
Figure 12. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 21
Figure 13. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 22
Figure 14. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 23

## Appendices

Appendix A. Wetland Delineation Datasheets

# 1 INTRODUCTION

## 1.1 Project Description and Proponent

The City of Arcata owns the wastewater collection, treatment, and disposal facilities that serve approximately 16,800 residents in the service area. The Arcata Wastewater Treatment Facility (AWTF) currently discharges treated wastewater to Humboldt Bay in conjunction with enhanced treatment wastewater to constructed freshwater marshes in the Arcata Marsh Wildlife Sanctuary (AMWS). These features collectively form the Arcata Wastewater Treatment Plant (WWTP).

The City of Arcata is proposing to replace a portion of existing Arcata WWTP infrastructure and upgrade several components as part of the Arcata WWTP Improvement Project (hereinafter, Project). The work will include installation of buried pipe for the flow reconfiguration of disinfected enhancement wetlands effluent, installing a discharge pipe into a constructed brackish marsh at the north end of the Arcata Bay section of Humboldt Bay (future outfall discharge point), relocation of the electrical equipment building in the AWTF to allow for improved road access for fire and emergency services (requiring installation of a new utility service line), and constructing a mitigation wetland area.

The Project proponent, City of Arcata, may be contacted at:

Mark Andre, Environmental Services-Director
City of Arcata
736 F Street
Arcata, CA 95521
(707) 822-8184
MAndre@cityofarcata.org

## 1.2 Project Location and Survey area

The Project is located at 600 South G Street in Arcata, Humboldt County, California (Figure 1). The Survey area includes:

- Areas associated with the current and future Arcata WWTP including the southern edge of Gearheart enhancement marsh, the northern, eastern, and southern edges of Hauser enhancement marsh, the south east corner of Brackish Pond, and the adjacent levees, trails, and roadways within the AMWS;
- The AWTF including the levees surrounding various treatment marshes and oxidation ponds and the area northeast to South G Street;
- Multiple staging areas within paved and gravel parking lots; and
- A potential wetland mitigation area just south of Humboldt State University's Samoa Facility (just east of Post Mile 8.00) to the northern edge of Western Pond.

These locations can be accessed from CA-255 (Samoa Boulevard) in Arcata, California by heading south on South I Street and South G Street (Figure 1). The potential wetland mitigation area can be accessed south of Post Mile 8.00 on CA-255 (Figure 1). The Survey area is in Section 34 of Township 6 North, Range 1 East of the Arcata North U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle. Elevations range from 0 to 18 feet above mean sea level.

The entire Survey area is within the City of Arcata's Coastal Zone governed by the City's Local Coastal Program—LCP and Land Use and Development Guide (LUDG) General Plan (City of Arcata 2008). A portion of the potential mitigation area near Western Pond and a staging area along South I Street also fall within the appeal zone for the California Coastal Commission (CCC), where coastal development permits may be appealed to the CCC.

## 1.3 Purpose of the Wetland Delineation

The purpose of this delineation is to: (1) assess the geographic extent of water and wetland resources in the Survey area; (2) delineate any waters of the U.S., including wetlands, potentially subject to the jurisdiction of the U.S. Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act (CWA) and/or Section 10 of the Rivers and Harbors Act of 1899; (3) delineate any additional waters of the State that may be subject to the jurisdiction of the State Water Resources Control Board (SWRCB), California Department of Fish and Wildlife (CDFW), and/or City of Arcata LCP/LUDG and CCC.

The wetland features in the Survey area are considered preliminary until verified by the San Francisco Regulatory Branch of the USACE. The USACE determines CWA jurisdiction of the wetland features in the Survey area. Previous correspondence between the USACE and the City of Arcata indicates that portions of the Arcata Wastewater Treatment Marsh are exempt from USACE-jurisdiction (City of Arcata 2010, Attachment 5). Per the April 21, 2020 final rule of the *Navigable Waters Protection Rule* (85 FR 22250), waste treatment systems, defined as "all components, including lagoons and treatment ponds (such as settling or cooling ponds), designed to either convey or retain, concentrate, settle, reduce, or remove pollutants, either actively or passively, from wastewater prior to discharge (or eliminating any such discharge)," are non-jurisdictional waters (i.e., not waters of the United States) (33 CFR 328). Furthermore, waters and features that are excluded in the final rule cannot be determined to be jurisdictional even when the water satisfies one or more of the conditions to be a jurisdictional water (e.g., lakes and ponds, and impoundments of jurisdictional waters). The final rule also notes that when an applicant receives a permit to impound a water of the United States in order to construct a waste treatment system (i.e., the permit received in 1956 for construction of the AWTF oxidation ponds and surrounding levees within the Humboldt Bay tidelands), the permitting agencies have affirmatively relinquished jurisdiction over the resulting waste treatment system as long as it is used for this permitted purpose.




**Figure 1.** Project location and waters/wetland delineation Survey area.

# 2 METHODS

## 2.1 Existing Conditions

Prior to the delineation, existing information on soils, hydrology, and precipitation in the Survey area was evaluated. Information on potential jurisdictional waters and wetlands was obtained from the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) online application, *Wetlands Mapper* (USFWS 2019) and the LCP *Coastal Wetlands Map* (City of Arcata 1989). Available data from the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) Web Soil Survey website were reviewed for the Survey area and nearby vicinity (NRCS 2019a). Mean high water shoreline data for Humboldt Bay (Northern Hydrology & Engineering 2014) were incorporated into Geographic Information Systems (GIS) and reviewed. Precipitation and climate records from the National Climatic Data Center (NCDC 2019 and 2020) were reviewed for nearby weather station Eureka Weather Forecast Office (WFO), Woodley Island, California.

## 2.2 Field Delineation

A delineation of potential jurisdictional waters and wetlands were conducted by qualified personnel on October 2–3, 8, and 17, 2019, March 12, 2020, and May 29, 2020 in accordance with the *Corps of Engineers Wetlands Delineation Manual* (1987 Manual, USACE 1987), *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Version 2.0)* (WMVC Supplement; USACE 2010), and USACE *Regulatory Guidance Letter (RGL) No. 05-05* (USACE 2005). The delineation included any feature that could potentially meet the definition of a water protected under the Clean Water Act (and thus be subject to USACE-jurisdiction), the Porter Cologne Act (SWRCB [State]-jurisdiction), Section 1602 of Streambed Alteration Agreement (California Department of Fish and Wildlife [CDFW]-jurisdiction) and the City of Arcata LCP/LUDG (LCP-jurisdiction). LCP-jurisdiction includes one-parameter wetlands within the coastal zone and two-parameter wetlands within the City of Arcata. In addition, any wetland feature delineated within the Coastal Zone was reviewed for consistency against the LCP Coastal Wetland Map and the USFWS NWI map.

### 2.2.1 Waters determination

Under Section 404 of the CWA, the limits of USACE jurisdiction is defined at the High Tide Line (HTL) or Ordinary High Water Mark (OHWM). Under Section 10 of the Rivers and Harbors Act of 1899 for activities in navigable waters (i.e., Humboldt Bay) the limits of USACE jurisdiction is defined at Mean High Water (MHW). Furthermore, waters of the State include any surface water or groundwater, including saline waters, within the boundaries of the state (Porter-Cologne Act, Section 13050). All waters associated with the Arcata WWTP including Gearheart, Hauser, and Allen enhancement marshes and the AWTF treatment marshes and oxidation ponds (Figure 1) are exempt from USACE-jurisdiction per the final rule (33 CFR Part 328); however, they were delineated as waters of the State (State-jurisdiction).

The extent of waters in the Survey area were delineated by the location of the OHWM, HTL, and MHW. The OHWM is defined as the elevation established on the shore by water fluctuations, and is indicated by physical characteristics such as: (a) a clear, natural line impressed on the bank; (b) shelving; (c) changes in the character of soil; (d) destruction of terrestrial vegetation; (e) the presence of litter and debris; or (f) other appropriate means that consider the characteristics of the surrounding areas. The OHWM was identified in accordance with the USACE RGL 05-05

(USACE 2005) and the OHWM Guide (Mersel and Lichvar 2014). 33 CFR 328.3(d) defines the HTL as the line of intersection of the land with the water's surface at the maximum height reached by a rising tide and may be determined, in the absence of actual data, by: (a) a line of oil or scum along shore objects; (b) a more or less continuous deposit of fine shell or debris on the foreshore or berm; (c) other physical markings or characteristics; (d) vegetation lines; or (e) tidal gages, or other suitable means that delineate the general height reached by a rising tide. The HTL encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm. The 2014 mean high water shoreline data for Humboldt Bay (Northern Hydrology & Engineering 2014) was used to delineate the extent of Section 10 waters.

Prior to the wetland delineation surveys, aerial photographs and topographic maps were reviewed to identify limits and connections of potential wetlands to traditional navigable waters (TNW) such as the Humboldt Bay. During the wetland delineation, waters in the Survey area were further reviewed for their connectivity to a TNW based on culvert connections and the existing drainage network. The OHWM and HTL of potentially jurisdictional waters were delineated in the field. Boundaries were mapped via a sub-meter Global Positioning System (GPS) unit (Trimble Geo 7x) and later post-processed, corrected, and incorporated into GIS where maps detailing the delineation results were generated.

### 2.2.2 Wetland determination

Wetlands were delineated in accordance with the 1987 Manual (USACE 1987) and WMVC Supplement (USACE 2010). The 1987 Manual and WMVC Supplement provide technical guidelines and methods for the three-parameter approach to determining the location and boundaries of USACE jurisdictional wetlands. This approach requires that an area must support positive indicators of hydrophytic vegetation, hydric soils, and wetland hydrology to be considered a jurisdictional wetland. A three-parameter wetland with a direct hydrological surface connection to a jurisdictional water in a typical year is considered an USACE jurisdictional wetland (i.e., adjacent wetlands). Connectivity of delineated wetlands to jurisdictional waters was evaluated in accordance with USACE RGL 07-01 (USACE 2007). As the Survey area is located within the Coastal Zone, all wetland features were also evaluated for potential LCP-jurisdiction which requires that only one or two of the three USACE wetland parameters (hydrophytic vegetation, hydric soils, and/or wetland hydrology) be present (1976 California Coastal Act, Public Resources Code Section 30000 *et seq*., City of Arcata 2008).

A total of 28 data points were sampled in potential USACE- and LCP-jurisdictional wetlands in the Survey area. If a data point met all three wetland parameters, it was considered an USACE wetland; if a point only met one or two wetland parameters, it was considered a LCP wetland; if a point met no wetland parameters, it was considered upland. Potential wetland areas were identified based on information generated from the pre-field review (e.g., the NWI *Wetland Mapper* results) and observations of hydrology and vegetation in the field. If a data point met all three parameters for a USACE jurisdictional wetland, then a paired data point was placed along the preliminary transition zone (the area in which a change from wetland to non-wetland conditions occurs) to determine the wetland/upland boundary. If a wetland was sampled and no adjacent uplands were identified within the Survey area, then a paired upland data point was not sampled. At each data point, a soil pit was dug and the following information was recorded using the USACE (2010) data forms:

1. **Vegetation**: Dominant plant species for each stratum (i.e., tree, sapling/shrub, herb, woody vine) by scientific name (genus and species) following the taxonomy the online *Jepson eFlora* (Jepson Flora Project 2019). Absolute percent cover and dominance were determined using the 50/20 rule outlined in the *WMVC Supplement*, and the wetland indicator status (OBL [obligate], FACW [facultative-wet], FAC [facultative], FACU [facultative-upland], and UPL [upland]) defined for the WMVC Region in the *National Wetland Plant List: 2016 Wetland Ratings* (Lichvar et al. 2016). Plant species not listed in the *2016 National Wetland Plant List* were considered upland (UPL) species. A dominance test was performed to determine if the data point exhibited hydrophytic vegetation. If the dominance test was not conclusive and wetland hydrology and hydric soils were present, then the prevalence index was calculated.
2. **Hydrology**: Presence and depth of surface water, groundwater, and/or soil saturation were recorded. In addition, if primary (e.g., oxidized rhizospheres along living roots) and secondary indicators (e.g., drainage patterns, dry-season water table, saturation visible on aerial imagery) were observed, then they were also recorded at each data point.
3. **Soils**: Moistened soil matrix descriptions were recorded for each data point using the following: depth of the sample, color (as defined in Munsell soil color charts [Munsell Color 2000]), and texture. If present, redox features were then described by type (e.g., concentration, depletion, reduced matrix) and location (e.g., pore lining, root channel, or matrix). Hydric soils were determined using the *WMVC Supplement* primary indicators, such as sandy redox (S5). In addition, mapped soil units (described in Section 3.1.2) were considered and the current National List of Hydric Soils (NRCS 2019b) was consulted.

The location of each data point and wetland boundaries were recorded using a sub-meter accuracy GPS and photographs were taken of the representative site characteristics. All GPS data were post-processed, corrected, and incorporated into GIS. Mapped wetlands were classified according to the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979, Federal Geographic Data Committee [FCDC] 2013) based on the vegetation composition and structure at the data points.

# 3 RESULTS

## 3.1 Historical Conditions

Historically, the Survey area was composed of Arcata Bay tidelands (i.e., tidal sloughs and marshes) (U.S. Coast Survey 1870). In the late 1800s, much of the Survey area was used for various industrial activities (e.g., wharf, railroad, timber transport) and later diked for agricultural purposes (i.e., farming and pasture) and nearby lumber mill operations. The WWTP enhancement marshes and AWTF oxidation ponds and treatment marshes were constructed between 1949–1983. Construction of the AWTF oxidation ponds and its surrounding levees within the tidelands of Humboldt Bay (approximately 70 acres) was authorized on May 17, 1956 by the USACE San Francisco District. Prior to the recent restoration associated with the McDaniel Slough Marsh Enhancement Project (City of Arcata 2013) and other mitigation efforts, a portion of the potential mitigation area near Western Pond was used for agricultural grazing. Brackish Pond, Western Pond, and North Pond were formerly grazed pasture prior to construction in 2007 and 2013.

The conversion of land and the historical industrial and agricultural land use in the Survey area has altered the natural vegetation, hydrology, and soils. Normal conditions have since established for much of the Survey area's restored and undeveloped areas.

## 3.2 Existing Conditions

### 3.2.1 Hydrology

The Project is in the Mad River Lowland Subbasin of the Mad River Groundwater Basin. This basin includes the coastal floodplain from the Freshwater Fault north to the Mad River and is primarily composed of alluvium that is underlain by the Pleistocene Hookton Formation. This water-bearing formation consists of clay, sand, and gravel (CDWR 2004). The Hookton Formation is recharged by rainfall in the upland recharge areas east of Arcata (DWR 1973) in addition to lateral water movement into the alluvium from adjacent formations and some upward movement from leakage due to differences in head between the alluvium and underlying formations (Fuller 1975).

The Project is located within the Humboldt Bay Subwatershed (Hydrologic Unit Code [HUC] 12: 180101020601) of the Humboldt Bay-Frontal Pacific Ocean watershed in the North Coast Hydrologic Region and within the Jacoby Creek Watershed of the Eureka Plain Hydrologic Unit No. 110.00 (NRCWCB 2019). The Project is also within the Janes Creek and Jolly Giant Creek watersheds within the City of Arcata (City of Arcata 2016). The Survey area abuts Arcata Bay, the northernmost estuary of Humboldt Bay (a TNW). Arcata Bay occupies the low seaward end of several valleys which have been filled by floodplain and tidal flat deposits (Murray and Wunner 1988). The Project also includes Butcher Slough, a tributary to Arcata Bay (Figure 1).

The WWTP man-made freshwater enhancement marshes in the Survey area include Hauser Marsh, Gearheart Marsh, and Allen Marsh. Water associated with these enhancement marshes originates from the disinfection basins of the WWTP. This treated wastewater is eventually pumped back to the AWTF for final disinfection then discharged via an outfall pipe into the Arcata Bay section of Humboldt Bay. Additional man-made features in the Survey area include Brackish Pond, Western Pond, and North Pond (Figure 1). Brackish and Western ponds have direct connections (e.g., drainpipes with tidal flap, tide gate) to McDaniel Slough and eventually the Arcata Bay section of Humboldt Bay. The future outfall of treated AWTF effluent will discharge into Brackish Pond. The North Pond does not have a surface water connection to adjacent water bodies (Figure 1). The roadside ditch along South G Street near the AWTF has surface water connection to a tributary to Butcher Slough (Figure 1). Additional man-made waters adjacent to the Survey area include Klopp Lake and the AWTF oxidation ponds and treatment marshes. At these locations, the proposed Project construction occurs within the upland constructed levees above the mean high, high water and the normal water surface elevation of the AWTF oxidation ponds and treatment marshes.

The NWI *Wetlands Mapper* includes various palustrine and estuarine wetlands the Survey area (Figure 2). These features largely correlate with the LCP Coastal Wetlands Map and the field delineation results (Section 3.3).

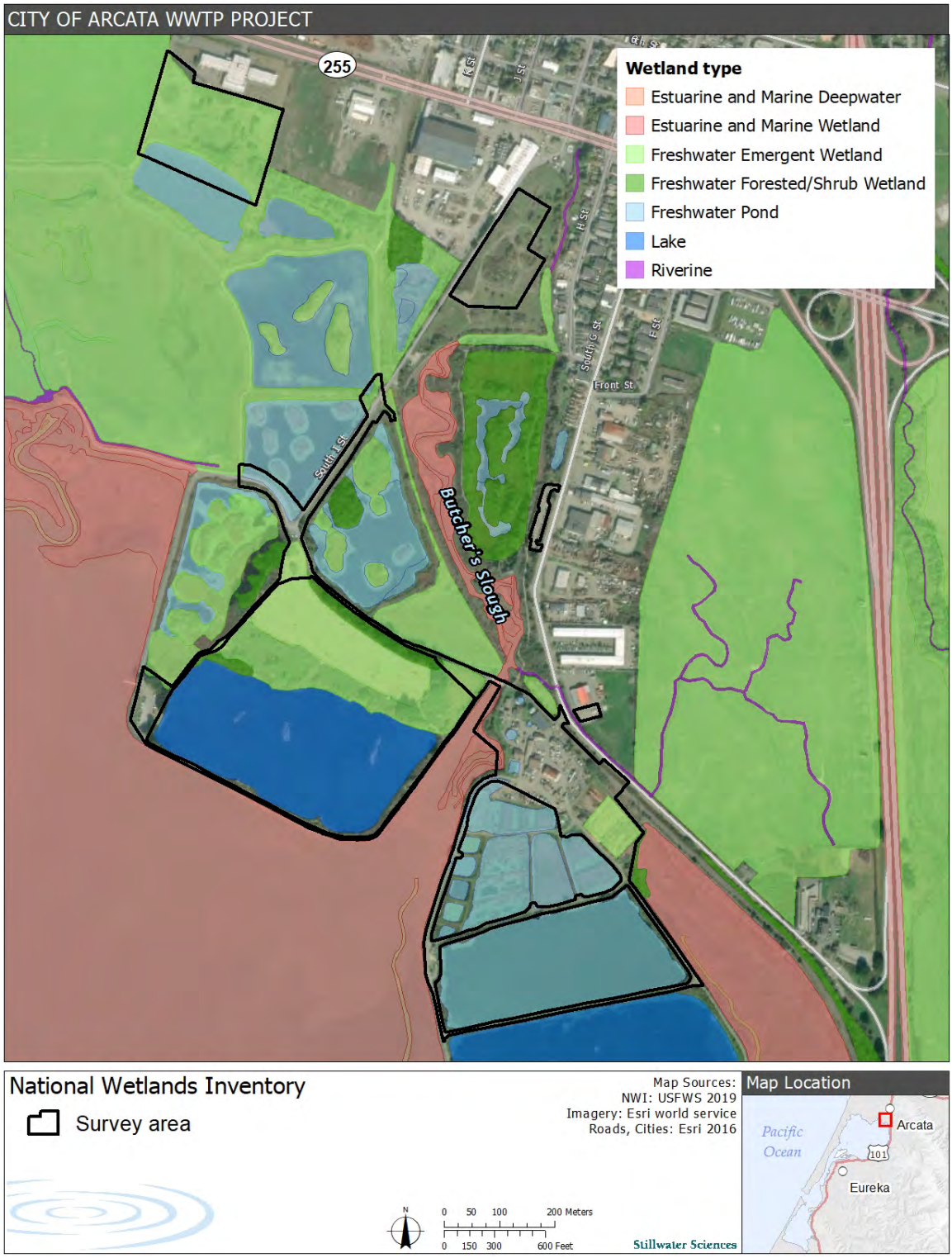



**Figure 2.** National Wetlands Inventory map of the Survey area (Source: USFWS 2020).

### 3.2.2 Soil units

Soil units in the Survey area included Occidental, 0–2% slopes; Hydraquents-Wassents mucky silt loam, strongly saline, 0–3 % slopes, very frequently flooded; and Urban land-Anthraltic Xerorthents association, 0–2% slopes (Figure 3). The NRCS soil survey mapped the AMWS and AWTF oxidation ponds and treatment marshes as water and no mapped soil unit was described within these limits (Figure 3). Prior to the current setting (i.e., AMWS, AWTF, McDaniel Slough Restoration), this region was composed of bay tidelands that were eventually diked and used for various industrial and agricultural purposes. As such, soils at these locations are disturbed and contain dredge spoils and nonnative fill material.

Occidental (0 to 2% slopes) is found in areas with elevations that range from 0 to 30 feet above mean sea level and with a mean annual precipitation of 35–80 inches, a mean annual air temperature of 50–55º F, and a frost-free period of 275–330 days (NRCS 2019a). The Occidental series is primarily located along the backslope of salt marshes. A typical profile consists of peat in the upper 0–3 inches (Oi horizon) with silty clay loam forming all other horizons below. It has a drainage class of very poorly drained with a depth to water table and redoximorphic features ranging from 0–4 inches (NRCS 2017, 2019a). It frequently ponds and is occasionally flooded with a slightly saline to strong saline profile. Occidental series is listed as a hydric soil in the region (NRCS 2019a) with an aquic soil regime (NRCS 2017). The water table from August through November is typically ≥35 inches (NRCS 2017) however ranges from 0–35 inches depth in December–July. The Project's potential mitigation site near the McDaniel Slough and one staging area on the South I Street were located within this mapped soil unit.

Hydraquents-Wassents mucky silt loam, strongly saline, 0–3 % slopes, very frequently flooded, is composed of 50% Hydraquents, low tidal and similar soils, 40% Wassents, and 10% minor components. It is found from 0 to 10 feet above mean sea level with a mean annual precipitation of 35–80 inches, a mean annual air temperature of 50–55ºF, and a frost-free period of 275–365 days (NRCS 2019a). Hydraquents, low tidal is located on tidal flats with a parent material of mucky, silty, and clayey estuarine deposits and a slope of 0–3%. A typical profile consists entirely (0–59 inches) of mucky silty clay loam. It has a drainage class of very poorly drained, a depth to water table of 0 inches, is very frequently flooded, and strongly saline (NRCS 2019a). Hydraquents, low tidal is listed as a hydric soil in the region. The Wassents series shares Hydraquents properties and qualities except for its typical profile has mucky silt loam in the upper 6 inches, has a slope of 0–1%, and a subaqueous drainage class. Wassents is also listed as a hydric soil in the region. Minor components of this map unit include the Hydraquents, high tidal (5%) and marine waters (5%) (NRCS 2019a). The Arcata Bay section of Humboldt Bay is mapped as this soil unit type.

Urban land-Anthraltic Xerorthents association (0 to 2% slopes) is composed of 80% urban land, industrial and 20% anthralitic xerorthents and similar soils. This association is found from 0 to 10 feet above mean sea level with a mean annual precipitation of 41–43 inches, a mean annual air temperature of 50–55ºF, and a frost-free period of 275–330 days (NRCS 2019a). Anthraltic Xerorthents is located on backslopes of fluviomarine terraces with a parent material of coarse-loamy fluviomarine deposit or coarse-loamy dredge spoils. A typical profile consists of gravelly loamy fine sand within the upper 0–6 inches with sandy loam, gravelly sand, and sand forming the horizons below. It has a drainage class of moderately well drained (NRCS 2019a). The AWTF and levees adjacent to the Arcata Bay section of Humboldt Bay as well as the industrial areas along South G Street are included in this mapped soil unit.

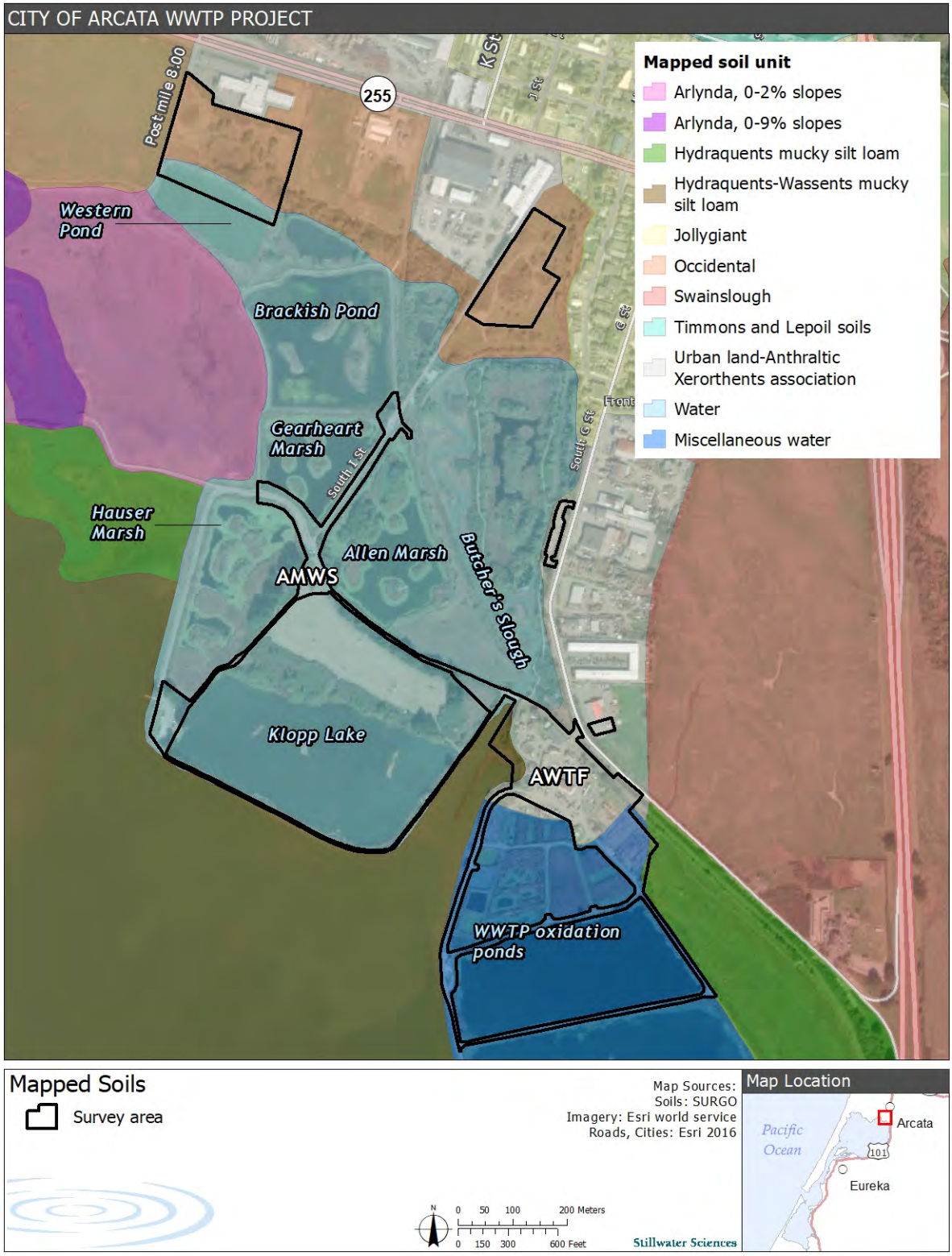



**Figure 3.** Mapped soil units in the Survey area.

Palustrine wetland data points closely resembled the hydric soil Occidental series (NRCS 2019a) with matrix colors ranging from 10YR (value of 2–4 and chroma of 1–2), 5Y 4/1, and 2.5Y (value of 2.5 and 5 and chroma of 1–2) (Appendix A). Data points commonly contained clay loam, silty clay, silty loam, silty clay loam and sandy loam. Soil samples were considered hydric when a positive primary indicator, such as redox depressions, depleted matrix, or loamy gleyed matrix was identified (data points W2–W7 in Appendix A). Estuarine wetland data point W1 confirmed the mapped hydric soil Wassents mucky silt loam (Appendix A). The soil matrix profile was 2.5Y and Gley 1 and confirmed hydric soils with hydrogen sulfide (A4) and loamy gleyed matrix (F2) (Appendix A). Estuarine wetland data point W8 contained a soil profile composed of sandy clay with significant redox features and closely resembled the mapped soil unit Anthraltic Xerorthents (Appendix A).

### 3.2.3 Vegetation

In undeveloped and restored areas, native vegetation is predominant. Vegetation communities documented in the Survey area include coastal scrub, riparian scrub, riparian forest, coastal and introduced grasslands, north coast salt marsh, and freshwater and brackish marshes. Stands of nonnative and landscaped vegetation were mostly observed along developed areas in the Survey area (e.g., roadside corridors, areas surrounding parking areas, and graveled low-use areas).

### 3.2.4 Precipitation

Local climate conditions are moist, cool, and influenced by the conditions of the Pacific Ocean, with wet cool winters and cool summers with frequent fog and strong winds. Rainfall occurs primarily between October through May, with mean annual rainfall ranging from 40–49 inches (based on the 1981–2010 period of record monthly normal [normal] for nearby Eureka WFO weather station) (NCDC 2019). The average monthly temperature range is approximately 46–49º F in winter and 54–59º F in the summer (NCDC 2019).

The Eureka WFO weather station recorded twice the normal monthly precipitation in September 2019 (i.e., 1.92 inches recorded in September 2019). The majority of which (i.e., 1.05 inches) was derived from a rain event two weeks preceding the initial field delineation in October 2019. No features from this precipitation event (i.e., ponding, high-water table, upper soil surface saturation) were observed, which indicated sufficient time had elapsed to drain shallow subsurface storm flow; as such, conditions were considered typical for the early October field delineation. Overall, the cumulative precipitation recorded for October 2019 (i.e., 1.51 inches) was below the normal average of 2.87 inches indicating conditions were drier for the month. However, the United States (U.S.) Drought Monitor did not indicate abnormally dry or drought conditions for Humboldt County in October 2019 (National Drought Mitigation Center 2019). Weather conditions during the October 2019 delineation varied from sunny and clear to scattered clouds with a high of 61–64º F, which was warmer than the Eureka WFO weather station normal average temperature of 54.4º F for October (NCDC 2019).

In March 2020, the Eureka WFO weather station recorded a total of 3.7 inches precipitation, less than the monthly normal (5.3 inches in March) (NCDC 2020). Low precipitation was recorded prior to the March 12, 2020 wetland delineation (0.1 inches accumulated since March 1) and the U.S. Drought Monitor indicated abnormally dry conditions for the region (National Drought Mitigation Center 2020). Weather was sunny with clear skies during the March 12, 2020 delineation with a high temperature of 56º F (within the monthly normal temperature range for March [43–57º F]).

The slightly drier and/or warmer conditions during the October 2019 and March 2020 wetland delineations are unlikely to have influenced the delineation results as wetland features remained evident regardless of precipitation and temperature throughout the Survey area.

Prior to the May 29, 2020 delineation, the Eureka WFO weather station recorded above normal precipitation for the month (<2 inches above normal). All recorded precipitation occurred between May 2 and May 18. Consequently, any temporarily saturated and/or ponded features from this period had sufficient time to drain prior to the May wetland delineation. As a result, the earlier precipitation events were not likely to have influenced delineation results.

## 3.3 Preliminary Jurisdictional Waters and Wetlands

The Survey area contains 3 acres of potentially USACE-jurisdictional waters of the U.S. and 2acres of potentially USACE-jurisdictional wetlands adjacent to these waters (Table 1, Figures 4 through 7 and 14, Appendix A). The potentially jurisdictional waters of the U.S. are also considered to be waters of the State under State- and LCP-jurisdiction. In addition, there are 10.87 acres of wetlands that are only subject to State- and LCP-jurisdiction (Table 1; Figures 4 through 9, 11, 13, and 14; Appendix A).

**Table 1.** Preliminary USACE-jurisdictional waters of the U.S., including wetlands, waters of the State, and LCP-jurisdictional wetlands in the Survey area.

| Description | Acreage |
|---|---|
| ***Waters*** | |
| Arcata Bay (Humboldt Bay) (W-1) [1, 2] | 0.3 |
| Brackish Pond (W-2) [1] | 0.1 |
| Western Pond (W-3) [1] | 1.8 |
| North Pond (W-4) [3] | 0.7 |
| Roadside Ditch (W-5) [1] | <0.1 (0.04) |
| Tributary to Butcher Slough (W-6) | <0.1 (0.01) |
| Arcata WWTP enhancement marshes (SW-01 and SW-02)[3, 4] | 0.6 |
| AWTF oxidation ponds and treatment marshes (SW-03 through SW-11) | 3.0 |
| ***Wetlands*[1]** | |
| Seasonally saturated palustrine persistent emergent wetlands (SS-01 through SS-05) | 0.7 |
| Seasonally flooded palustrine persistent emergent wetlands (SF-01) | 0.4 |
| Semipermanently flooded palustrine persistent emergent wetlands (SP-01) | <0.1 (0.06) |
| Seasonally saturated/flooded palustrine broadleaved deciduous scrub-shrub wetlands (BL-01 and BL-04) | 0.6 |
| Estuarine regularly flooded persistent emergent wetlands (EP-01 and EP-02) | 0.3 |
| ***Additional LCP-jurisdictional wetlands*** | |
| One-parameter wetlands within the City of Arcata Coastal Zone (OP-01) | 1.5 |
| One-parameter riparian within the City of Arcata Coastal Zone (R-01 through R-14) | 0.8 |
| Two-parameter wetlands within the City of Arcata Coastal Zone (TP-01 through TP-13) | 5.0 |

[1] Subject to Section 404 of the CWA thus under USACE-jurisdiction as well as State- and LCP-jurisdiction.
[2] Subject to Section 10 of the Rivers and Harbors Act and USACE-jurisdictional
[3] Subject to State- and LCP-jurisdiction
[4] The constructed freshwater WWTP enhancement ponds in the Survey area were not considered USACE-jurisdictional waters and are described in Section 3.2.1.2.

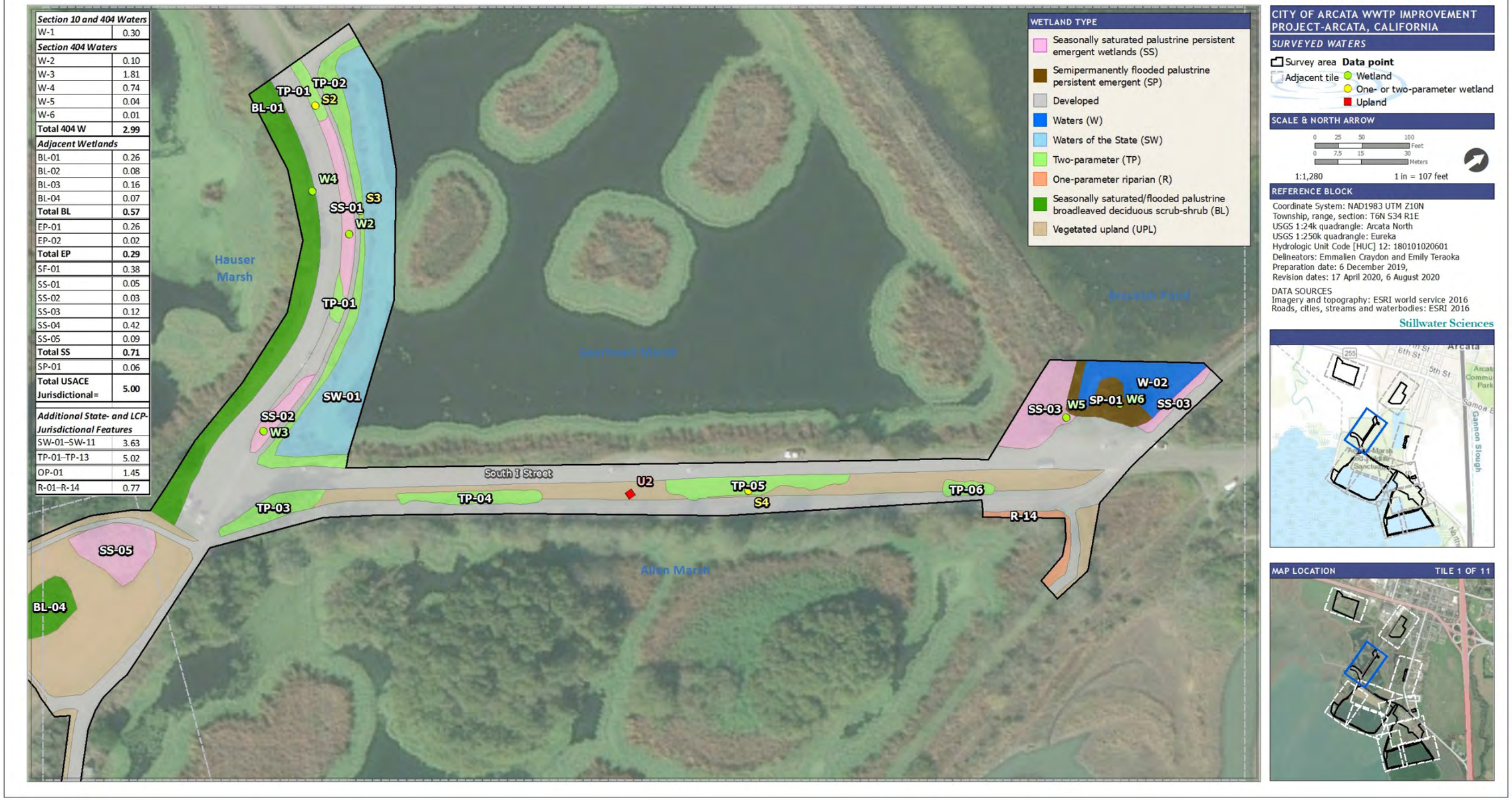



**Figure 4.** Preliminary jurisdictional waters and wetlands in the Survey area.




| *Section 10 and 404 Waters* | |
|---|---|
| W-1 | 0.30 |
| *Section 404 Waters* | |
| W-2 | 0.10 |
| W-3 | 1.81 |
| W-4 | 0.74 |
| W-5 | 0.04 |
| W-6 | 0.01 |
| **Total 404 W** | **2.99** |
| *Adjacent Wetlands* | |
| BL-01 | 0.26 |
| BL-02 | 0.08 |
| BL-03 | 0.16 |
| BL-04 | 0.07 |
| **Total BL** | **0.57** |
| EP-01 | 0.26 |
| EP-02 | 0.02 |
| **Total EP** | **0.29** |
| SF-01 | 0.38 |
| SS-01 | 0.05 |
| SS-02 | 0.03 |
| SS-03 | 0.12 |
| SS-04 | 0.42 |
| SS-05 | 0.09 |
| **Total SS** | **0.71** |
| SP-01 | 0.06 |
| **Total USACE Jurisdictional=** | **5.00** |
| *Additional State- and LCP-Jurisdictional Features* | |
| SW-01–SW-11 | 3.63 |
| TP-01–TP-13 | 5.02 |
| OP-01 | 1.45 |
| R-01–R-14 | 0.77 |

**Figure 5.** Preliminary jurisdictional waters and wetlands in the Survey area.

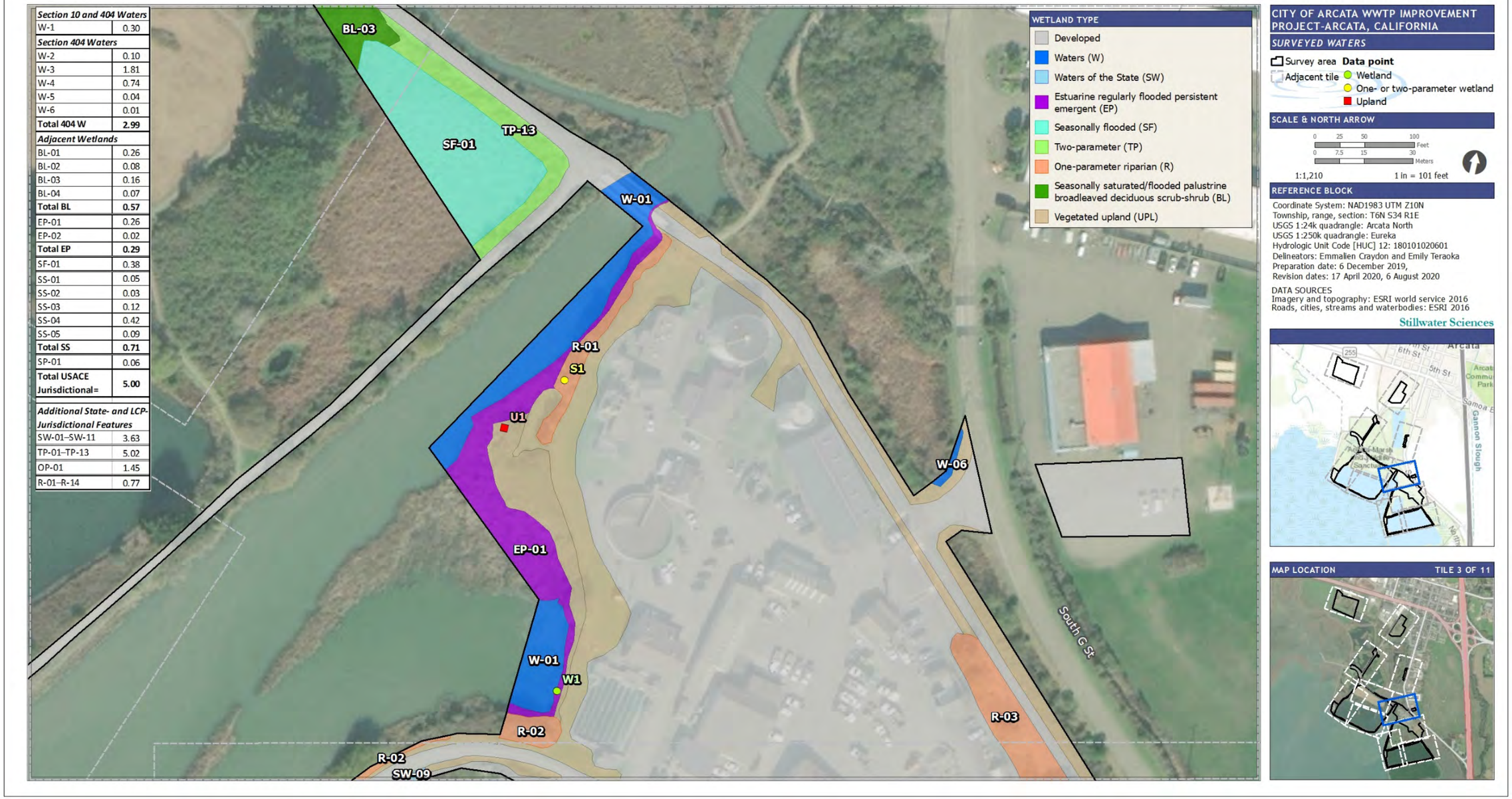
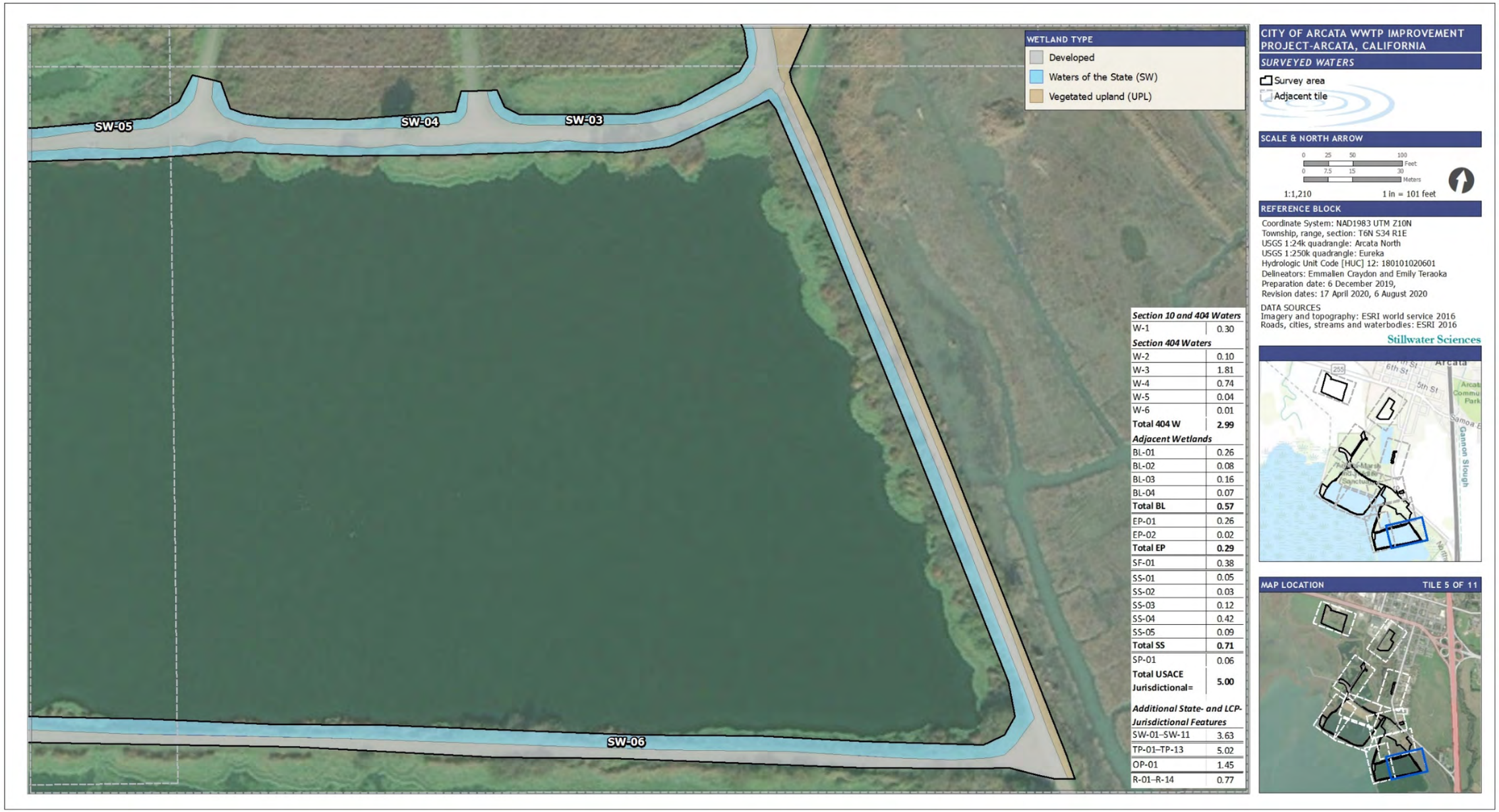



**Figure 6.** Preliminary jurisdictional waters and wetlands in the Survey area.




| *Section 10 and 404 Waters* | |
|---|---|
| W-1 | 0.30 |
| *Section 404 Waters* | |
| W-2 | 0.10 |
| W-3 | 1.81 |
| W-4 | 0.74 |
| W-5 | 0.04 |
| W-6 | 0.01 |
| **Total 404 W** | **2.99** |
| *Adjacent Wetlands* | |
| BL-01 | 0.26 |
| BL-02 | 0.08 |
| BL-03 | 0.16 |
| BL-04 | 0.07 |
| **Total BL** | **0.57** |
| EP-01 | 0.26 |
| EP-02 | 0.02 |
| **Total EP** | **0.29** |
| SF-01 | 0.38 |
| SS-01 | 0.05 |
| SS-02 | 0.03 |
| SS-03 | 0.12 |
| SS-04 | 0.42 |
| SS-05 | 0.09 |
| **Total SS** | **0.71** |
| SP-01 | 0.06 |
| **Total USACE Jurisdictional=** | **5.00** |
| *Additional State- and LCP-Jurisdictional Features* | |
| SW-01–SW-11 | 3.63 |
| TP-01–TP-13 | 5.02 |
| OP-01 | 1.45 |
| R-01–R-14 | 0.77 |

**Figure 7.** Preliminary jurisdictional waters and wetlands in the Survey area.




| | |
|---|---|
| ***Section 10 and 404 Waters*** | |
| W-1 | 0.30 |
| ***Section 404 Waters*** | |
| W-2 | 0.10 |
| W-3 | 1.81 |
| W-4 | 0.74 |
| W-5 | 0.04 |
| W-6 | 0.01 |
| **Total 404 W** | **2.99** |
| ***Adjacent Wetlands*** | |
| BL-01 | 0.26 |
| BL-02 | 0.08 |
| BL-03 | 0.16 |
| BL-04 | 0.07 |
| **Total BL** | **0.57** |
| EP-01 | 0.26 |
| EP-02 | 0.02 |
| **Total EP** | **0.29** |
| SF-01 | 0.38 |
| SS-01 | 0.05 |
| SS-02 | 0.03 |
| SS-03 | 0.12 |
| SS-04 | 0.42 |
| SS-05 | 0.09 |
| **Total SS** | **0.71** |
| SP-01 | 0.06 |
| **Total USACE Jurisdictional=** | **5.00** |
| ***Additional State- and LCP-Jurisdictional Features*** | |
| SW-01–SW-11 | 3.63 |
| TP-01–TP-13 | 5.02 |
| OP-01 | 1.45 |
| R-01–R-14 | 0.77 |

**Figure 8.** Preliminary jurisdictional waters and wetlands in the Survey area.




**Figure 9.** Preliminary jurisdictional waters and wetlands in the Survey area.




**Figure 10.** Preliminary jurisdictional waters and wetlands in the Survey area.

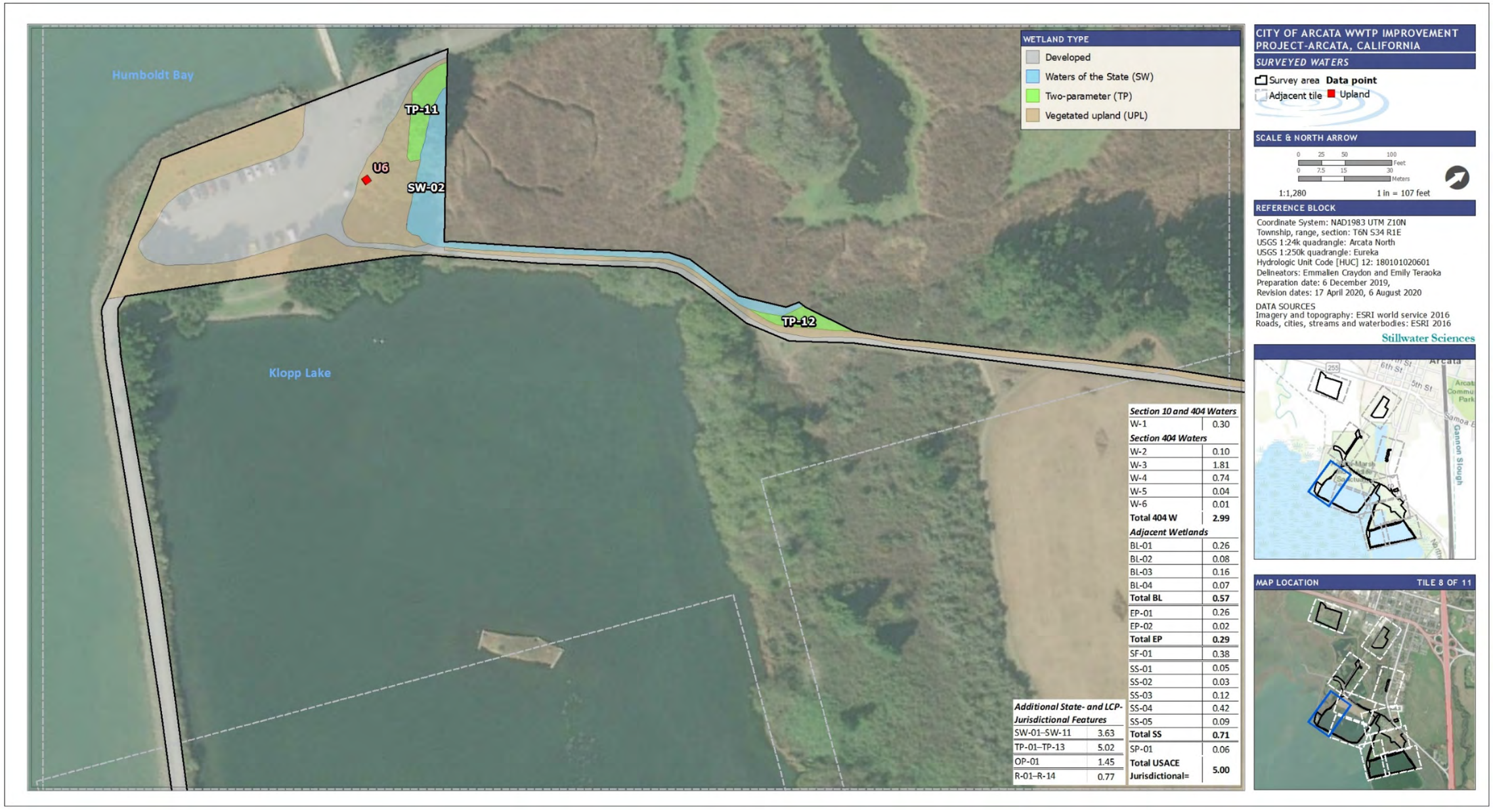



**Figure 11.** Preliminary jurisdictional waters and wetlands in the Survey area.




**Figure 12.** Preliminary jurisdictional waters and wetlands in the Survey area.




**Figure 13.** Preliminary jurisdictional waters and wetlands in the Survey area.

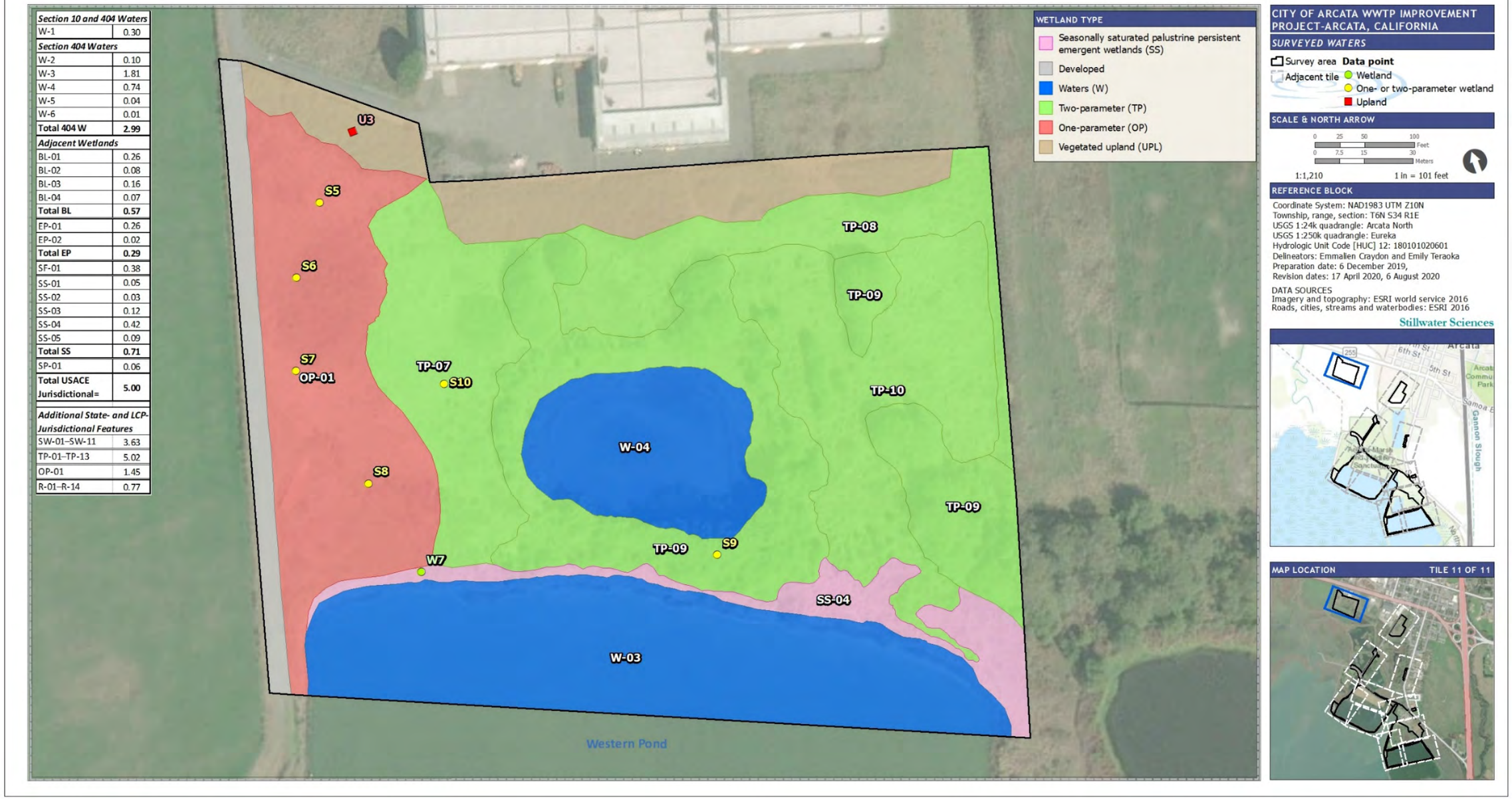



**Figure 14.** Preliminary jurisdictional waters and wetlands in the Survey area.

### 3.3.1 Waters

The Survey area includes 3.0 acres of potential USACE- jurisdictional waters subject to Section 10 and/or Section 404 of the CWA (W-1 through W-6) as well as an additional 3.6 acres of non-federal waters of the State (SW-01 and SW-11) (Table 1, Figures 4, 6–9, 11, and 14).

#### 3.3.1.1 Waters of the U.S.

Tidal waters of the Arcata Bay section of Humboldt Bay are the Navigable Waters of the U.S. documented in the Survey area (W-1, Figure 6). Humboldt Bay includes the Port of Humboldt Bay, a protected deep-water port with harbor facilities designed to serve cargo and other vessels, and a number of marinas that serve hundreds of small to mid-size boats and pleasure crafts (Humboldt Bay Harbor, Recreation, and Conservation District 2019). Furthermore, commercial oyster production operations that produce more than half of all oysters farmed in California are located in Humboldt Bay (Pomeroy et al. 2010).

Navigable Waters of the U.S. in the Survey Area (W-1) were categorized by the MHW (Sections 10 and 404 waters) and the ground-truthed HTL (Section 404 waters) (Figure 6, Table 1). HTL indicators were a line of scum and wracking debris along the shore, as well as the transition of vegetated and unvegetated habitat (i.e., the boundary between open mudflat and north coast salt marsh). In cases where that HTL included north coast salt marsh habitat the HTL was adjusted to the lower extent of this habitat. The north coast salt marsh habitat was categorized as estuarine wetlands and is described in Section 3.2.2. The upland levee crest boundaries surrounding the man-made Klopp Lake were delineated and indicated on Figures 6, 10, and 11.

Other Waters of the U.S. in the Survey area totaled 2.7 acres and included the nontidal waters Western Pond, Brackish Pond, North Pond, and a roadside ditch along South G Street that connects to a tributary to Butcher Slough (W-2 through W-6, respectively; all Section 404 waters) (Table 1, Figures 4, 6, 7, and 14). Both Western Pond and Brackish Pond are excavated ponds that are separated from the adjacent tidal waters of McDaniel Slough and eventually the Arcata Bay section of Humboldt Bay by a constructed eco-levee. Water is exchanged between these water bodies through drainpipes and a tide gate in the eco-levee. North Pond (W-4) is manmade pond with no direct surface connection to nearby waterbodies. Future construction may connect this water to the Arcata Bay. The perennial roadside ditch along South G Street, W-5, connects to a tributary to Butcher Slough (W-6) and eventually the Arcata Bay (Figures 6 and 7). At all four locations, the OHWM was identified in the field by a change in slope, lack of vegetation, and/or change in vegetation.

#### 3.3.1.2 Waters of the State and LCP-jurisdictional waters

In addition to all potential USACE-jurisdictional waters described in Section 3.3.1.1, non-federal waters of the State totaled 3.6 acres in the Survey area and included the Arcata WWTP enhancement marshes (SW-01 and SW-02) and AWTF oxidation ponds and treatment marshes (SW-03 through SW-11) (Table 1, Figures 4, 7–9, and 11). These waters are also potential LCP-jurisdictional waters.

Hauser, Gearheart, and Allen enhancement marshes in or adjacent to the Survey area function as enhancement marshes that treat wastewater within the Arcata WWTP. Waters associated with these ponds eventually feedback into the AWTF prior to the receiving waters of the Arcata Bay. These marshes were composed of a mixture of open water and herbaceous emergent vegetation (i.e., *Typha latifolia* [broad-leaved cattail], *Schoenoplectus acutus* var. *occidentalis* [common

tule]). The primary OHWM indicators at these locations included a break in slope and changes in vegetation. Upland vegetation bordered the southern and eastern ends of Hauser Marsh (SW-02) and was best characterized by data point U6 (Appendix A, Figure 6). Vegetation was composed of *Pinus radiata* (Monterey pine, UPL) with an understory of nonnative grasses and forbs. This feature lacked both wetland hydrology and hydric soils.

The AWTF treatment marshes and oxidation ponds are bound by constructed upland levees. The upland levee crests were included in the Survey area. If any riparian vegetation was noted along the levee crest then the riparian canopy edge was delineated as the upland boundary (Figures 7 through 9).

### 3.3.2 Wetlands

There is a total of 2.0 acres of potential USACE-jurisdictional wetlands and an additional 7.2 acres of LCP-jurisdictional wetlands in the Survey area (Table 1; Figures 4–7, 11, 13, and 14; Appendix A).

Wetland types within the Survey area include both nontidal (i.e., palustrine seasonally saturated/flooded or semi-permanently flooded persistent emergent wetlands and palustrine seasonally saturated broadleaved deciduous scrub-shrub wetlands), and tidal (i.e., estuarine regularly flooded persistent emergent wetlands). FGDC (2013) defines the palustrine system as all nontidal wetlands dominated by trees, shrubs, persistent emergent plants, emergent mosses or lichens (i.e., non-vascular) and all similar wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 parts per thousand. Estuarine system is defined as consisting of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land. Emergent wetlands are characterized by erect, rooted herbaceous hydrophytes, excluding mosses and lichens, that are the tallest life form, have at least 30% areal coverage, and are present for most of the growing season in most years (FGDC 2013). Broadleaved deciduous scrub-shrub wetlands are characterized by woody plants of this leaf type that are less than 20 feet tall and are the dominant life form with at least 30% areal coverage (FGDC 2013).

In general, due to landscape position and historic land modification, delineated wetlands did not always border a vegetated upland and a wetland data point was not paired. All constructed features (e.g., paved and graveled roads, trails) in the Survey area were delineated as upland.

#### 3.3.2.1 USACE-jurisdictional wetlands

**Palustrine emergent wetlands**

There are five seasonally saturated palustrine emergent wetlands (0.7 ac), one semi-permanently flooded palustrine emergent wetland (<0.1 ac), and one seasonally flooded palustrine emergent wetland (0.4 ac)in the Survey area (Table 1).

*Seasonally saturated wetlands*

Three seasonally saturated wetlands were located in low gradient depressions between developed trails and South I Street near Gearheart Marsh (SS-01, SS-02, and SS-05, Figure 4). At these locations, vegetation varied from mixed facultative forbs and grasses (SS-01, SS-02) to a dense patch of *Carex obnupta* (slough sedge, OBL; SS-05). Data point W3 characterizes these palustrine emergent wetlands. Dominant vegetation at this location included *Symphyotrichum chilense* (common Pacific aster, FAC), *Juncus effusus* (soft rush, FACW), and *Agrostis capillaris*

(colonial bent, FAC); application of the dominance test using the "50/20 rule" confirmed hydrophytic vegetation was present. The soil profile consisted of clay loam that contained prominent redox concentrations (2–10%) within the upper 15 inches of the soil profile and confirmed the primary hydric soil indicator as redox depressions (F8). Wetland hydrology was established from the presence of oxidized rhizospheres along living roots (C3) (Appendix A). The paired upland data point S2 characterized a two-parameter wetland (TP-01) which lacked hydrophytic vegetation (Figure 4). Dominant upland vegetation at data point S2 included *Convolvulus arvensis* (bindweed, NL/UPL) and *Rubus ursinus* (California blackberry, UPL) (Appendix A).

Another seasonally saturated emergent wetland (SS-03) was located along a vegetated berm adjacent to Brackish Pond (W-2) (Figure 4). Wetland SS-03 is composed of a mixture of facultative plants (e.g., common Pacific aster, *Dipsacus fullonum* [wild teasel], and *Conium maculatum* [poison hemlock]) and upland coastal scrub species (*Baccharis pilularis* [coyote brush]). These facultative species tend to occur in disturbed and, at least periodic, saturated soils in the North Coast region. Some gravel fill was noted within the upper four inches and below 10 inches of the soil profile, however an intact soil horizon was observed within the sample (4–10 inches) and the primary hydric soil indicator of depleted matrix (F3) was confirmed (data point W5, Appendix A). The presence of this hydric soil indicated enough time had elapsed since the 2007 ground disturbance from the creation of Brackish Pond and the area was saturated for long enough period to develop redoximorphic features. Wetland hydrology was established from the presence of the primary indicator, oxidized rhizospheres along living roots (C3) (Appendix A). The upland boundary at this location was delineated by the parking and developed areas along South I Street as well as developed trails (Figure 4).

Seasonal-saturated wetland SS-04 was adjacent to Western Pond (W-3) near a potential mitigation area (Figure 14). Dominant hydrophytic vegetation included *Salix* spp. saplings (various willows, FAC and FACW), *Deschampsia cespitosa* (tufted hair grass, FACW), *Festuca arundinacea* (tall fescue, FAC), and colonial bent. Redoximorphic features within the upper 12 inches of the soil sample confirmed the hydric soil indicator redox dark surface (F6) and the presence of oxidized rhizospheres along living roots confirmed wetland hydrology at this location (Appendix A). Upland boundaries were defined by one- and two-parameter wetlands: OP-01, TP-07, TP-09 and TP-10 (Figure 14).

#### *Semi-permanently flooded wetlands*

A semi-permanently flooded wetland (SP-01) was delineated along the levee toeslope immediately adjacent to Brackish Pond (W-2) (Figure 4). Hydrophytic plant species at this location included common Pacific aster, *Atriplex prostrata* (fat-hen, FAC), *Potentilla anserina* subsp. *pacifica* (Pacific silverweed, OBL), and tufted hair grass. Overstory canopy included *Sequoia sempervirens* (coast redwood, NL/UPL) (data point W6, Appendix A). The soil profile consisted of silty clay loam that contained greater than 60% gleyed matrix and confirmed the primary hydric soil indicator as loamy gleyed matrix (F2). Wetland hydrology was established from the presence of a high-water table five inches from the soil surface with saturation extending to the surface of the soil pit (Appendix A). Wetland SP-01 was bordered by upland developed areas and the wetland SS-03 (Figure 4).

#### *Seasonally flooded wetlands*

The feature known as "No Name Pond" in the AMWS was previously delineated in 2010. This feature was classified as a seasonally flooded wetland (SF-01) during the May 2020 delineation. Review of aerial imagery over the last three decades indicate that most of the open water area in this wetland has since filled in with dense emergent vegetation. Vegetation was primarily

composed of *Typha latifolia* (broadleaved cattail). The northern extent of SF-01 is bound by the Humboldt Bay Trail and the easterly extent is bound by a segment of the AMWS trial network (Figure 6). *Rubus armeniacus* [Himalayan blackberry, FAC] along with other coastal scrub species (i.e., coyote brush, twinberry, California blackberry) form a dense upland thicket along the shoulder and backslope of the adjacent levee/trail prisms.

**Palustrine broadleaved deciduous scrub-shrub wetlands**

Palustrine broadleaved deciduous scrub-shrub wetlands, BL-01 through BL-04, totaled 0.6 acre in the Survey area. BL-01 was located along the seasonally saturated shoulder and backslope of the Hauser Marsh levee along South I Street Road (Figure 4). BL-02 extended along the west side of the Humboldt Bay Trail near the AWTF (Figure 7). BL-03 and BL-04 were just south of the Humboldt Bay Trail segment between AWTF and South I Street (Figure 5).

Canopy within wetland BL-01 included *Salix lasiolepis* (arroyo willow, FACW) and Sitka willow. Herbaceous understory species included nonnative facultative plants common to disturbed sites (i.e., *Trifolium repens* [white clover], *Lotus corniculatus* [bird's-foot trefoil], colonial bent, and *Festuca perennis* [rye grass, FAC]). Hydric soils were determined by the primary indicator depleted matrix and oxidized rhizospheres along living roots confirmed wetland hydrology (data point W4, Appendix A). No paired upland point was identified rather the upland region was delineated by the developed areas of South I Street (Figure 4).

Wetlands BL-02 and BL-03 were previously delineated in 2010 for the Humboldt Bay Trail (North) Project (see Wetland 12 and 14 *in* Winzler & Kelly 2010). Wetlands BL-02 through BL-04 receive seasonal runoff from the adjacent areas (i.e., trails, roadsides, and hillslope) and were primarily composed of woody vegetation (i.e., arroyo willow, *Morella californica* [wax myrtle, FACW], *Rubus ursinus* [California blackberry, FACU], Himalayan blackberry). As such, these features were typed as palustrine seasonally flooded broadleaved deciduous scrub-shrub wetlands during the 2020 delineations (Figures 5 and 7).

Wetland BL-02 formed a low-gradient drainage that connects to the estuarine wetland EP-02 (Figure 7). Riparian vegetation was mostly composed of arroyo willow and wax myrtle. Riparian canopy that extended beyond the drainage area was classified as one-parameter riparian wetlands, R-03 and R-04 (Figure 7). Adjacent upland habitat (UPL-05) was described by data point U4 which is composed of mostly nonnative upland grasses and lacks wetland hydrology and hydric soil indicators (Figure 7, Appendix A).

Wetland BL-03 included the low depressional ditch between the Humboldt Bay Trail and the historic landfill in the AMWS. It connects to the seasonally flooded wetland SF-03 through a culvert (Figure 5). This wetland was composed of arroyo willow, *Lonicera involucrata* (twinberry), *Sambucus racemosa* (red elderberry), and California and Himalayan blackberry. Wetland BL-04 is east of SS-05 and Hauser Marsh within a topographic low depression. It is composed of mostly arroyo willow, Himalayan blackberry, and slough sedge (Figure 5).

#### Estuarine persistent emergent wetlands

Estuarine persistent emergent wetlands (EP-01 and EP-02) in the Survey area contained north coast salt marsh habitat. Wetland EP-01 is regularly flooded by Arcata Bay tidal waters (W-01) (Figure 6). Hydrophytic salt marsh species observed within this wetland included *Salicornia pacifica* (common pickleweed, OBL), *Distichlis spicata* (salt grass, FACW), *Triglochin maritima* (common arrow-grass, OBL), *Jaumea carnosa* (marsh jaumea, OBL), *Spartina densiflora* (dense-flowered cord grass, OBL), fat-hen, tufted hair grass, and *Limonium californicum* (western marsh-rosemary, OBL) (data point W1, Appendix A). Anaerobic soils (e.g., hydrogen sulfide odor) along with other primary indicators (e.g., loamy gleyed matrix and a high-water table) confirmed hydric soils and wetland hydrology at data point W1 (Appendix A). This wetland is bordered by coastal scrub uplands (UPL-02, data point U1) composed of coyote brush, *Helminthotheca echioides* (bristly ox-tongue, FAC), *Rubus armeniacus* (Himalayan blackberry, FAC), California blackberry, poison hemlock, radish, common Pacific aster, and rye grass and one-parameter riparian habitat (R-01 and R-02) (Figure 6, Appendix A).

EP-02 was identified along the west side of the Humboldt Bay Trail (North) and connects to palustrine wetland BL-02 (Figure 7). This feature was located at the upper extent of the HTL and abuts Arcata Bay to the southeast (Figures 1 and 7). EP-02 is composed of north coast salt marsh species, characterized by data point W8 (Figure 7). Hydrophytic vegetation included high cover from tufted hair grass (Appendix A). The soil profile consisted of a matrix 2.5Y4/2–5/2 with high redox concentrations (30%) and depletions (5–15%) and confirmed the hydric soil indicator sandy redox (S5). A high water table was observed at 9.5 inches below the surface. Surrounding uplands, UPL-05, lacked hydric soils and wetland hydrology. Upland vegetation included *Dactylis glomerata* (orchard grass, FACU), *Anthoxanthum odoratum* (sweet vernal grass, FAC), and coyote brush (UPL). An additional upland data point (U5) was collected within the nearby vegetated areas of AWTF (Figure 7). No wetland parameters were observed at this location (Appendix A).

### 3.3.2.2 LCP-jurisdictional wetlands

In addition to all potential USACE-jurisdictional waters and adjacent wetlands described in Sections 3.2.1 and 3.2.2, an additional 6.9 acres of potential LCP-jurisdictional wetlands were identified in the Survey area (Table 1, Figures 4–7, 11, 13, and 14). Boundaries for these wetlands were delineated from data points with one or two positive primary wetland parameters located within the Coastal Zone. Table 2 provides the acreage of each delineated feature in the Survey area.

**Table 2.** Preliminary LCP-jurisdictional wetlands in the Survey area.

| Description | Acreage |
|---|---|
| ***Two-parameter wetlands*** | |
| TP-01 | 0.03 |
| TP-02 | 0.13 |
| TP-03 | 0.05 |
| TP-04 | 0.04 |
| TP-05 | 0.07 |
| TP-06 | 0.02 |
| TP-07 | 0.85 |
| TP-08 | 0.68 |
| TP-09 | 1.70 |
| TP-10 | 1.21 |
| TP-11 | 0.05 |
| TP-12 | 0.03 |
| TP-13 | 0.15 |
| ***One-parameter wetlands*** | |
| R-01 | 0.07 |
| R-02 | 0.06 |
| R-03 | 0.22 |
| R-04 | 0.01 |
| R-05 | 0.02 |
| R-06 | 0.01 |
| R-07 | 0.003 |
| R-08 | 0.12 |
| R-09 | 0.01 |
| R-10 | 0.02 |
| R-11 | 0.02 |
| R-12 | 0.07 |
| R-13 | 0.13 |
| R-14 | 0.03 |
| OP-01 | 1.45 |
| **Overall** | **7.24** |

Two-parameter wetlands (TP-01 and TP-02) between South I Street and Gearheart Marsh lacked hydrophytic vegetation; however, both hydric soils and hydrology were observed (Figure 4). Dominant upland plant species included bindweed and California blackberry. This upland plant composition is likely due to the slightly higher topographic position of these features. TP-11 through TP-13 were similarly positioned along upper shoulder and crest of surrounding levees of Hauser Marsh and No Name Pond and mostly composed of California blackberry with some shrubs of Himalayan blackberry, red elderberry, twinberry, willow, and coyote brush (Figure 11). Additional two-parameter wetlands TP-03 through TP-06 were located in patches along a managed (i.e., mowed) vegetated area between Gearheart and Allen marshes (Figure 4). These wetlands were located along the lower end of the adjacent trail prism and all but TP-03 contained dominant hydrophytic vegetation comprised primarily by *Scirpus microcarpus* (small-fruited bulrush, OBL) with a mixture of facultative and upland species common to disturbed sites (i.e., rye grass, *Raphanus sativus* [radish, NL/UPL], Himalayan blackberry) (Appendix A). A small stand of *Picea sitchensis* (Sitka spruce, FAC) formed TP-03. These two-parameter wetlands were best characterized by data point S4 (Appendix A). Hydrophytic vegetation was dominant and wetland hydrology was confirmed by a high water table at 11.5 inch depth from surface, while

hydric soils were lacking. The upland boundary for these wetlands were delineated by parking and managed areas along South I Street and developed trails as well as by vegetated uplands (UPL-03) characterized by upland data point U2 (Figure 4). At this upland data point, vegetation was dominated by upland ruderal plant species including *Daucus carota* (wild carrot, FACU), rye grass, and radish; both hydric soil and wetland hydrology were lacking (Appendix A).

One- and two-parameter wetlands located at the potential mitigation area near Western Pond did not have wetland hydrology indicators within the sampled soil pits, indicating the water table and saturation were generally below 16 inches in depth but at or near the land surface for a duration sufficient to promote the formation of hydric soils (TP-07–TP-10) and/or to support the growth of hydrophytes (TP-07–TP-10, OP-01) (Appendix A, Figure 14). These wetlands are characterized by vegetation communities commonly associated with seasonally wet conditions including tall fescue meadows (TP-07), *Juncus lescurii* (San Francisco rush, FACW) swales (TP-08), and various aged willow stands (TP-10 [<5 years] and TP-09 [<10 years]). These vegetation communities are common to brackish marshes and low-gradient areas with some tidal influence. Data point S10 best characterizes TP-07 and TP-08 wetlands; data point S9 describes TP-09 and TP-10 (Appendix A). Uplands were delineated where the upland scrub species (e.g., California blackberry) (UPL-02 had established dominant cover and hydric soils and hydrology were lacking (data point U3, Appendix A; Figure 14).

One-parameter riparian wetlands in the Survey area include R-01 through R-13. Wetlands R-01 and R-02 were positioned along the crest and upper slopes of the AWTF levee along Butcher Slough and Arcata Bay (W-1) (Figure 6). Vegetation was primarily hydrophytic tree and shrub species including *Alnus rubra* (red alder, FACW), *Pinus contorta* subsp. *contorta* (shore pine, FAC), wax myrtle, and *Salix* spp. (various willows). The one-parameter riparian wetlands R-01 and R-02 were bound by uplands UPL-01 and UPL-02, which were often managed (i.e., mowed) and composed of upland ruderal herbaceous forbs and grasses (Figure 6, Appendix A). The riparian canopy that extended beyond the narrow drainages near the Humboldt Bay Trail (North) and South G street formed the one-parameter riparian wetlands R-03 and R-04 (Figure 7). The riparian canopy overhang from Allen Marsh was captured in R-14 which abutted the upland AMWS trail network (Figure 4).

The staging area on the northern end of South I Street contains several patches of one-parameter riparian wetlands composed of willow scrub (e.g., arroyo and shining willow) (R-05 through R-13, Figure 13). This staging area is primarily upland developed habitat containing graveled and paved roads as well as large vegetated mounds/spoil piles (Figure 13). Data point S11 best characterizes the one-parameter riparian wetlands observed at this location (Appendix A). Hydrophytic vegetation was dominant while both hydric soils and wetland hydrology were lacking. Other vegetated areas in this staging area were composed of upland ruderal herbaceous species (UPL-07; data point U6, Appendix A). Dominant vegetation at these locations included nonnative *Bromus hordeaceus* (soft chess, FACU), *Plantago lanceolata* (English plantain, FACU), and wild teasel (Appendix A).

### 3.3.3 Upland developed

Four staging areas were assessed during the March 12, 2020 wetland delineation. Except for the staging area along the northern end of South I Street (Figure 13), these features were paved and/or graveled areas with frequent use by the public (e.g., vehicle parking, access) and lacked wetland hydrology, hydrophytic vegetation and hydric soils (Figures 6, 11, and 12). In general, all paved and graveled areas in the Survey area were delineated as upland developed habitat. Data points U6 and U7 characterize the adjacent vegetated upland habitat for the two staging areas

along South I Street (Figures 11 and 13, Appendix A). These features contain upland grassland and coastal scrub species and Monterey pine. The adjacent vegetated habitats of the two staging areas along South G Street were not assessed as the Project activities will not extend beyond the paved/graveled features (Figures 6 and 12). All active trail networks and levee crests in the Survey area were delineated as upland developed habitat (Figures 4 through 11).

# 4 REFERENCES

Baldwin, B. G., D. H. Goldman, D. J. Keil, R. Patterson, and T. J. Rosatti, editors. 2012. The Jepson manual, vascular plants of California. Second edition. University of California Press, Berkeley, California.

CDWR (California Department of Water Resources). 2004, updated. California's groundwater: Bulletin 118. 2003 basins and subbasins of the North Coast Hydrologic Region. http://www.water.ca.gov/groundwater/bulletin118/northcoast.cfm

City of Arcata. 1989. Local Coastal Program (Coastal land use element and implementing ordinances). https://www.cityofarcata.org/DocumentCenter/View/45/1989-Certified-Local-Coastal-Program---Coastal-Land-Use-Element-and-Implementing-Ordinances-PDF

City of Arcata. 2008. City of Arcata General Plan. Arcata, California. https://www.cityofarcata.org/DocumentCenter/View/43/Chapter-4-Environmental-Quality--Management---2-Resource-Conservation--Management-Element-PDF

City of Arcata. 2013. City of Arcata McDaniel Slough Wetland Enhancement Project. Status final report. Arcata, California.

City of Arcata. 2010. Request for Jurisdictional Determination regarding non-waters of the United States; or alternatively, application for waste treatment exemption for existing Arcata Wastewater Treatment ponds/marshes and wetlands.

City of Arcata. 2016. City of Arcata Watersheds. Available online at https://www.cityofarcata.org/DocumentCenter/View/8456/City-of-Arcata-Watersheds-PDF [Accessed November 2019].

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. FWS/OBS-79/31. U.S. Fish and Wildlife Service, Washington, D.C.

FGDC (Federal Geographic Data Committee). 2013. Classification of wetlands and deepwater habitats of the United States. Adapted from Cowardin et al. 1979. Prepared by the Wetlands Subcommittee, Federal Geographic Data Committee, Reston, Virginia.

Fuller, R. H. 1975. Water quality in the Mad River basin, Humboldt and Trinity counties, California. Water Resources Investigations Report, 44-75. USGS, Water Resources Division, Menlo Park, California.

Humboldt Bay Harbor, Recreation, and Conservation District. 2019. Humboldt Bay Harbor, Recreation, and Conservation District. Website. www.humboldtbay.org [December 2019].

Jepson Flora Project, editors. 2019. Jepson eFlora. Website. http://ucjeps.berkeley.edu/eflora/ [Accessed December 2019].

Lichvar, R. W., D. L. Banks, W. N. Kirchner, and N. C. Melvin. 2016. The National wetland plant list: 2016 wetland ratings. Phytoneuron 2016-30: 1–17.

Mersel, M. K., and R. W. Lichvar. 2014. A guide to ordinary high water mark (OHWM) delineation for non-perennial streams in the Western Mountains, Valleys, and Coast Region of the United States. ERDC/CRREL TR-14-1. USACE, Hanover, New Hampshire.

Munsell Color. 2000. Munsell soil color charts, revised washable edition. Munsell Color, Grand Rapids, Michigan.

Murray, A., and R. Wunner. 1988. The Jacoby Creek watershed: past, present, and future. Prepared by Natural Resources Division, Redwood Community Action Agency for the California Wildlife Conservation Board.

National Drought Mitigation Center. 2019. United States Drought Monitor, California. Query for 1 October –29 October 2019. Prepared by B. Fuchs, R. Heim, and D. Simeral, National Drought Mitigation Center. Website. https://droughtmonitor.unl.edu/).

National Drought Mitigation Center. 2020. United States Drought Monitor, California. Query for 3 March –17 March 2020. Prepared by A. Hartman, and D. Bathke, National Drought Mitigation Center. Website. https://droughtmonitor.unl.edu/.

NCDC (National Climatic Data Center). 2019. Climate data. Website. http://www.ncdc.noaa.gov/cdo-web/datatools/ [Accessed December 2019].

NCDC. 2020. Climate data. Website. http://www.ncdc.noaa.gov/cdo-web/datatools/ [Accessed April 2020].

Northern Hydrology & Engineering. 2015. Mean High Water shoreline data, Year 2012. ArcGIS Shape files. Humboldt Bay: sea level rise, hydrodynamic modeling, and inundation vulnerability mapping. Prepared for the California State Coastal Conservancy and the Coastal Ecosystems Institute of Northern California. Prepared by Northern Hydrology & Engineering, McKinleyville, California.

NRCS (U.S. Department of Agriculture Natural Resource Conservation Service). 2017. NRCS Official soil series description: Occidental series. Website. https://soilseries.sc.egov.usda.gov/OSD_Docs/O/OCCIDENTAL.html [Accessed December 2019].

NRCS. 2019a. National list of hydric soils. Website. http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/use/hydric/ [Accessed December 2019 and April 2020].

NRCS. 2019b. Custom soil resource report for Humboldt County, Central Part, California; Wetland Delineation for the Arcata WWTP Improvement Project. Downloaded from NRCS Websoil Survey website: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

NRCWCB (North Coast Regional Water Quality Control Board). 2019. Eureka Plain. Website. https://www.waterboards.ca.gov/northcoast/water_issues/programs/watershed_info/eureka_plain/ [Accessed December 2019].

Pomeroy, C., C. J. Thomson, and M. M. Stevens. 2010. California's North Coast fishing communities historical perspective and recent trends: Eureka fishing community profile. National Oceans and Atmospheres Administration California Sea Grant Program.

USACE (U.S. Army Corps of Engineers). 1956. Office of the District Engineer permit to construct levees to provide a sewage oxidation pond in Humboldt Bay, California. 17 May 1956, to City of Arcata, California from San Francisco District, California, USACE.

USACE. 1987. Corps of Engineers wetlands delineation manual. Technical Report Y-87-1. USACE, Environmental Laboratory, Waterways Experiment Station, Vicksburg, Mississippi.

USACE. 2005. Ordinary high water mark identification. Regulatory Guidance Letter No. 05-05.

USACE. 2007. Practices for documenting jurisdiction under Section 404 of the Clean Water Act (CWA) and Sections 9 & 10 of the Rivers & Harbors Act (RHA) of 1899. Regulatory Guidance Letter 07-01.

USACE. 2010. Regional supplement to the Corps of Engineers wetland delineation manual: western mountains, valleys, and coast region (Version 2.0). Prepared by USACE, Vicksburg, Mississippi.

USEPA (U.S. Environmental Protection Agency) and USACE. 2008. Clean Water Act jurisdiction following the U.S. Supreme Court's decision in Rapanos v. United States & Carabell v. United States. Available at https://www.epa.gov/cwa-404/2008-rapanos-guidance-and-related-documents

USFWS (United States Fish and Wildlife Service). 2020. National Wetlands Inventory (NWI) wetlands and riparian polygon data. Geospatial wetlands data. USFWS, Arlington, Virginia. Website. http://www.fws.gov/wetlands/

Winzler & Kelly. 2010. Wetlands delineation and habitat mapping Rail-With-Trail Connectivity Project, City of Arcata Humboldt County, California. Prepared for K. Diemer, Environmental Services Department, City of Arcata, by Winzler & Kelly, Eureka, California.

# Appendices

# Appendix A

# Wetland Delineation Datasheets

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/2/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: W1

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): tidal marsh; toe slope along levee Local relief (concave, convex, none): none Slope (%): 0-2

Subregion (LRR): LRRA Lat: See EP-01 wetland; data point W1 in map Long: Datum: WGS 84

Soil Map Unit Name: Hydraquents - wassents mucky silt loam NWI classification: E2AB3M

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes X No _____ |
| Hydric Soil Present? | Yes X No _____ | |
| Wetland Hydrology Present? | Yes X No _____ | |

Remarks:

All three wetland parameters are present in the sampled area. Sampled location is within salt marsh along Arcata Bay and is within the Coastal Zone.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 2m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 2m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 1m^2) | | | |
| 1. Spartina densiflora | 60 | Yes | |
| 2. Salicornia pacifica | 25 | Yes | |
| 3. Atriplex prostrata | 5 | | |
| 4. Deschampsia cespitosa | 5 | | |
| 5. Jaumea carnosa | 3 | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 98 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 1m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 10

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No _____

Remarks:

Dominant vegetation is composed of hydrophytic salt marsh species. Additional species include Distichlis spicata and Limonium californicum.

## SOIL

Sampling Point: W1

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Redox Features Type[1] | Redox Features Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-6 | 2.5Y 3/1 | 100 | | | | | mucky silt loam | w/ gravel fill |
| 6-14 | GLEY 14/N | 100 | | | | | mucky silt loam | w/ gravel fill |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☑ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☑ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): 14

**Hydric Soil Present?** Yes X No _____

Remarks:

Gleyed matrix colors confirmed hydric soil indicator loamy gleyed matrix. (Gravel/fill assoicated with adjacent levee) Confirmed Wassents - (Hydric soil)

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☑ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☑ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes X No _____ Depth (inches): 6" from surface

Saturation Present? (includes capillary fringe) Yes X No _____ Depth (inches): 6" to surface

**Wetland Hydrology Present?** Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Arcata Bay tidelands (U.S. Coast Survey 1870)

Remarks:

Multiple primary and secondary indications of wetland hydrology present.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/8/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: W2

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): depression, diked former bay tidelands Local relief (concave, convex, none): concave Slope (%): 0

Subregion (LRR): LRRA Lat: see SS-01 wetland, data point W2 in map Long: Datum: WGS 84

Soil Map Unit Name: Water NWI classification: no listing

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes x No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes x No _____ | **Is the Sampled Area within a Wetland?** Yes x No _____ |
| Hydric Soil Present? | Yes x No _____ | |
| Wetland Hydrology Present? | Yes x No _____ | |

Remarks:

All three wetland parameters are present in the sampled area. Sampled location is within the Coastal Zone.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 2m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 2m2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | = Total Cover | | |
| **Herb Stratum** (Plot size: 2m2) | | | |
| 1. Bromus carinatus | 20 | YES | NL/UPL |
| 2. Holcus lanatus | 20 | YES | FAC |
| 3. Symphyotrichum chilense | 15 | YES | FAC |
| 4. Sonchus asper | 5 | NO | |
| 5. Equisetum arvense | 10 | NO | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 70 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 2m2) | | | |
| 1. Rubus armeniacus | 10 | YES | FAC |
| 2. | | | |
| | 10 = Total Cover | | |

% Bare Ground in Herb Stratum 20

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes x No _____

Remarks:

Dominant vegetation is primarily composed of facultative species and the dominance test passed for hydrophytic vegetation. Vegetation is routinely mowed, location between S. I Street and trail in the Arcata Marsh Wildlife Sanctuary.

## SOIL

Sampling Point: W2

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | % | Redox Features Color (moist) | % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-8 | 2.5Y 5/2 | 98 | 10YR 5/8 | 2 | C | PL | Clay loam | |
| 8-15 | 5Y 4/1 | 90 | 7.5 YR 4/6 | 10 | C | PL | Clay loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☑ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes X No _____

Remarks:

Located within a low depression, and redoximorphic features present in soil profiled confirming hydric soil indicator redox depressions.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☑ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No high water table or saturation present at location however primary wetland hydrology indicator oxidized rhizospheres along living roots was evident.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/8/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: W3

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): depression, diked former bay tidelands Local relief (concave, convex, none): concave Slope (%): 0

Subregion (LRR): LRRA Lat: see SS-02 wetland; data point W3 in map Long: Datum: WGS 84

Soil Map Unit Name: WATER NWI classification: no listing

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation some, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes X No _____ |
| Hydric Soil Present? | Yes X No _____ | |
| Wetland Hydrology Present? | Yes X No _____ | |

Remarks:

All three wetland parameters are present in the sampled area. Sampled location is within the Coastal Zone.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 3m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 3m2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 3m2) | | | |
| 1. Achillea millefolium | 2 | | |
| 2. Rumex crispus | 10 | | |
| 3. Symphyotrichum chilense | 60 | YES | FAC |
| 4. Ranunculus repens | 3 | | |
| 5. Cyperus eragrostis | 3 | | |
| 6. Juncus effusus | 15 | YES | FACW |
| 7. Oenanthe sarmentosa | 2 | | |
| 8. Agrostis capillaris | 15 | YES | FAC |
| 9. Holcus lanatus | 5 | | |
| 10. Sonchus oleraceus | 10 | | |
| 11. | | | |
| | 125 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 3m2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species | x 1 = |
| FACW species | x 2 = |
| FAC species | x 3 = |
| FACU species | x 4 = |
| UPL species | x 5 = |
| Column Totals: (A) | (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No _____

Remarks:

Dominant vegetation is primarily composed of facultative species and the dominance test passed for hydrophytic vegetation. Vegetation is routinely mowed, location between S. I Street and trail in the Arcata Marsh Wildlife Sanctuary.

## SOIL

Sampling Point: W3

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | % | Redox Features Color (moist) | % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-8 | 2.5Y 5/2 | 98 | 10YR 5/8 | 2 | C | PL | Clay loam | |
| 8-15 | 5Y 4/1 | 90 | 7.5 YR 4/6 | 10 | C | PL | Clay loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☑ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes X No _____

Remarks:

Located within a low depression, and redoximorphic features present in soil profiled confirming hydric soil indicator redox depressions.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☑ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No high water table or saturation present at location however primary wetland hydrology indicator oxidized rhizospheres along living roots was evident.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/8/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: W4

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Vegetated levee (former bay tidelands, diked) Local relief (concave, convex, none): none Slope (%): 0-1

Subregion (LRR): LRRA Lat: See BL-01 wetland; data point W4 in maps Long: See GPS WPT 130 Datum: WGS 84

Soil Map Unit Name: Water NWI classification: no listing

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes x No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes x No _____ | **Is the Sampled Area within a Wetland?** Yes x No _____ |
| Hydric Soil Present? | Yes x No _____ | |
| Wetland Hydrology Present? | Yes x No _____ | |

Remarks:

All three wetland parameters are present in the sampled area. Sampled location is within the Coastal Zone. Area located between South I Street and Arcata WWTP Gearheart treatment marsh.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 3m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. Salix lasiolepis | 80 | Yes | FACW |
| 2. Salix (sitchensis) | 20 | Yes | FACW |
| 3. | | | |
| 4. | | | |
| | 80 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 3m2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 3m2) | | | |
| 1. Trifolium repens | 20 | Yes | FAC |
| 2. Lotus corniculatus | 20 | Yes | FAC |
| 3. Agrostis capillaris | 25 | Yes | FAC |
| 4. Festuca perennis | 10 | | |
| 5. Symphyotrichum chilense | 5 | | |
| 6. Juncus effusus | 10 | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 90 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 3m2) | | | |
| 1. Rubus armeniacus | 15 | Yes | FAC |
| 2. | | | |
| | 15 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes x No _____

Remarks:

Dominant midstory canopy composed of fac-wet willow species; herbaceous vegetation is primarily composed of facultative species and the dominance test passed for hydrophytic vegetation. Regular vegetation management (mowing) immediately adjacent to S. I Street

## SOIL

Sampling Point: W4

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Redox Features Type[1] | Redox Features Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-6 | 10YR 4/2 | 100 | | | | | silty clay loam | |
| 6-15 | 10YR 4/1 | 10 | 10YR 6/1 | 50 | D | M | silty clay loam | |
| | | | 7.5YR 5/8 | 40 | C | PL | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes X No _____

Remarks:

Soil profile contains a depleted matrix with redox concentrations.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☑ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☑ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No high water table or saturation present at location however primary wetland hydrology indicator oxidized rhizospheres along living roots was evident

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/3/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: W5

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Vegetated levee berm (Former bay tidelands, diked) Local relief (concave, convex, none): flat/berm Slope (%): 0

Subregion (LRR): LRR A Lat: See SS-03 wetland; Data point W5 in maps Long: Datum: WGS 84

Soil Map Unit Name: Water NWI classification: PEM1B

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes x No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes x No _____ | **Is the Sampled Area within a Wetland?** Yes x No _____ |
| Hydric Soil Present? | Yes x No _____ | |
| Wetland Hydrology Present? | Yes x No _____ | |

Remarks:

All three wetland parameters are present in the sampled area. Sampled area is within the Coastal Zone. Sampled area is along a vegetated levee berm between two Arcata WTTP treatment marshes. Artificial fill within the soil profile.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 4 m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 4 m^2) | | | |
| 1. Baccharis pilularis | 35 | Yes | UPL |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 4 m^2) | | | |
| 1. Symphyotrichum chilense | 40 | Yes | FAC |
| 2. Rumex crispus | 3 | No | |
| 3. Dipsacus fullonum | 2 | No | |
| 4. Daucus carota | 1 | No | |
| 5. Conium maculatum | 2 | No | |
| 6. Juncus effusus | 20 | No | |
| 7. Holcus lanatus | 5 | No | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 73 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 4 m^2) | | | |
| 1. Rubus armeniacus | 45 | Yes | FAC |
| 2. | | | |
| | 45 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 67 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes x No _____

Remarks:

Dominant vegetation is primarily composed of facultative species and the dominance test passed for hydrophytic vegetation.

## SOIL

Sampling Point: W5

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-4 | 10YR 2/1 | 100 | | | | | clay loam | 60% rock |
| 4-8 | 10YR 4/1 | 90 | 10YR 4/6 | 10 | C | PL | silty clay | matrix w/ depleted color |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: base-fill

Depth (inches): 8

**Hydric Soil Present?** Yes X No ____

Remarks:

Disturbed area ; fill observed within the soil sample however band of intact soil layer with redox concentrations in a depleted matrix

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☑ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes ____ No X Depth (inches): ____

Water Table Present? Yes ____ No X Depth (inches): ____

Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): ____

**Wetland Hydrology Present?** Yes X No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Formerly bay tidelands (U.S. Coast Survey 1870); then diked and land had modified use (pasture/industrial)

Remarks:

No high water table or saturation present at location however primary wetland hydrology indicator oxidized rhizospheres along living roots was evident.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/3/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: W6

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): toeslope of levee; fringe to Brackish Pond Local relief (concave, convex, none): concave-flat Slope (%): 0-1

Subregion (LRR): LRRA Lat: See SP-01 wetland, data point W6 in map Long: Datum: WGS 84

Soil Map Unit Name: Water NWI classification: PEM1B

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes X No _____ |
| Hydric Soil Present? | Yes X No _____ | |
| Wetland Hydrology Present? | Yes X No _____ | |

Remarks:

All three wetland parameters are present in the sampled area. Immediately adjacent to Brackish Pond. Sampled location is within the Coastal Zone.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 4 m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. Sequoia sempervirens | 45 | Yes | NL/UPL |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 45 | = Total Cover | |
| **Sapling/Shrub Stratum** (Plot size: 4 m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 | = Total Cover | |
| **Herb Stratum** (Plot size: 4 m^2) | | | |
| 1. Symphyotrichum chilense | 40 | Yes | FAC |
| 2. Atriplex prostrata | 40 | Yes | FAC |
| 3. Polypogon monspliensis | 15 | No | |
| 4. Potentilla anserina | 5 | No | |
| 5. Triglochin maritima | 5 | No | |
| 6. Deschampsia cespitosa | 5 | No | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 110 | = Total Cover | |
| **Woody Vine Stratum** (Plot size: 4 m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 | = Total Cover | |

% Bare Ground in Herb Stratum 5

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 67 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes x No _____

Remarks:

Dominant vegetation is primarily composed of facultative species and the dominance test passed for hydrophytic vegetation.

## SOIL

Sampling Point: W6

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-4 | 10YR 3/1 | 100 | | | | | clay loam | |
| 4-11 | GLEY 1 2.5/N | 50 | GLEY 1 4/N | 35 | D | M | silty clay loam | |
| | | | 10YR 4/6 | 15 | C | M | silty clay | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☑ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: Fill/Rock

Depth (inches): 11

**Hydric Soil Present?** Yes X No ____

Remarks:

Soil profile contains a gleyed matrix and confirmed hyrdic soil indicator loamy gleyed matrix.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes ____ No X Depth (inches): ____

Water Table Present? Yes X No ____ Depth (inches): 5" below surface

Saturation Present? (includes capillary fringe) Yes X No ____ Depth (inches): surface to below

**Wetland Hydrology Present?** Yes X No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

A high water table and saturation present throughout the entire soil pit and wetland hydrology was confirmed at this location.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement | City/County: Arcata/ Humboldt | Sampling Date: 10/2/2019

Applicant/Owner: City of Arcata | State: CA | Sampling Point: W7

Investigator(s): Emmalien Craydon/Emily King Teraoka | Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Fringe of excavated pond | Local relief (concave, convex, none): concave edge | Slope (%): 1

Subregion (LRR): LRRA | Lat: See wetland SS-04; data point W7 | Long: | Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes | NWI classification: PEM1D

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes X No _____ |
| Hydric Soil Present? | Yes X No _____ | |
| Wetland Hydrology Present? | Yes X No _____ | |

Remarks:

All three wetland parameters are present in the sampled area. Sampled location is within the Coastal Zone. Adjacent to Western Pond.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 4m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum (Plot size: 4m^2)** | | | |
| 1. Salix (sitchensis) | 5 | Yes | FACW |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 5 = Total Cover | | |
| **Herb Stratum (Plot size: 2m^2)** | | | |
| 1. Deschampsia cespitosa | 25 | Yes | FACW |
| 2. Festuca arundinacea | 30 | Yes | FAC |
| 3. Helminthotheca echioides | 10 | | |
| 4. Agrostis capillaris | 15 | Yes | FAC |
| 5. Achillea millefolium | 5 | | |
| 6. Plantago lanceolata | 5 | | |
| 7. Leontodon saxatilis | 5 | | |
| 8. Potentilla anserina | 2 | | |
| 9. Daucus carota | 15 | Yes | FACU |
| 10. Juncus effusus | 2 | | |
| 11. Lotus corniculatus | 5 | | |
| | 119 = Total Cover | | |
| **Woody Vine Stratum (Plot size: 2m^2)** | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 80 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species | x 1 = |
| FACW species | x 2 = |
| FAC species | x 3 = |
| FACU species | x 4 = |
| UPL species | x 5 = |
| Column Totals: (A) | (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No _____

Remarks:

Dominant vegetation is primarily composed of facultative species and the dominance test passed for hydrophytic vegetation.

## SOIL

Sampling Point: W7

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | % | Redox Features Color (moist) | % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-4 | 10YR 4/1 | 85 | 10YR 5/8 | 15 | C | PL | silty clay loam | |
| 4-12 | 2.5YR 2.5/1 | 95 | 2.5YR 4/8 | 5 | C | PL | silty clay | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☑ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes X No _____

Remarks:

Soil profile matrix color's with redox concentrations confirms hydric soil indicator redox dark surface.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☑ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial); currently restored wetland along excavated/created Western Pond (McDaniel Slough Project)

Remarks:

No high water table or saturation present at location however primary wetland hydrology indicator oxidized rhizospheres along living roots was evident.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 3/12/2020

Applicant/Owner: City of Arcata State: CA Sampling Point: W8

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): coastal marsh Local relief (concave, convex, none): concave Slope (%): 0

Subregion (LRR): LRRA Lat: see EP-02 Long: Datum: WGS 84

Soil Map Unit Name: Urban land-Anthraltic Xerorthents association, 0–2% slopes. NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No see notes (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No ____ | **Is the Sampled Area within a Wetland?** Yes X No ____ |
| Hydric Soil Present? | Yes X No ____ | |
| Wetland Hydrology Present? | Yes X No ____ | |

Remarks:

The sampled area is within an one-parameter wetland within the Coastal Zone/City of Arcata LCP-jurisdiction. Only hydrophytic vegetation observed at this location. Precipitation below monthly normal, abnormally dry conditions reported (Nat Drought Mit Center 2020)

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 5m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum (Plot size: 3m2)** | | | |
| 1. Baccharis piluaris | 20 | Yes | NL-UPL |
| 2. Salix (hookeriana) | 5 | Yes | FACW |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 25 = Total Cover | | |
| **Herb Stratum (Plot size: 3m2)** | | | |
| 1. Deschampsia cespitosa | 70 | Yes | FAC |
| 2. Holcus lanatus | 8 | No | |
| 3. Foeninulum vulgare | 1 | No | |
| 4. Syphyotrichum chilense | 5 | No | |
| 5. Dispacus fullonum | 5 | No | |
| 6. Helminotheca echoides | 1 | No | |
| 7. Juncus lescurii | 5 | No | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 95 = Total Cover | | |
| **Woody Vine Stratum (Plot size: 3m2)** | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 67 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No ____

Remarks:

Dominance test passed for hydrophytic vegetation. Species composition is a mixture of saltmarsh species bordered by coyote brush and willow

## SOIL

Sampling Point: W8

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | % | Redox Features Color (moist) | % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-14 | 2.5Y4/2 | 65 | 7.5YR5/8 | 30 | C | Pl | sandy clay | |
| " | " | | 2.5Y6/1 | 5 | D | M | Sandy clay | |
| 14-17 | 2.5Y5/2 | 55 | 10YR5/8 | 30 | C | Pl | sandy clay | |
| " | " | | 2.5Y7/1 | 15 | D | M | sandy clay | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☑ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes X No _____

Remarks:

Soil profile contains redox concentrations in upper 12 inches

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☑ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes X No _____ Depth (inches): 9.5" below surface

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (industrial)

Remarks:

High water table within the upper 12 inches indicating wetland hydrology in the sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 5/29/2020

Applicant/Owner: City of Arcata State: CA Sampling Point: W9

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): toeslope, drainage on artificial fill Local relief (concave, convex, none): concave Slope (%): 1

Subregion (LRR): LRRA Lat: See BL-03 Long: See GPS WPT Datum: WGS 84

Soil Map Unit Name: Water NWI classification: PSS1C

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes X No _____ |
| Hydric Soil Present? | Yes X No _____ | |
| Wetland Hydrology Present? | Yes X No _____ | |

Remarks:

All three wetland parameters are present in the sampled area. Sampled area is within the Coastal Zone. Precipitation in May 2020 was above "monthly normal" for the region.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 5m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. Salix lasiolepis | 20 | Yes | FACW |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 20 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 5m2) | | | |
| 1. Salix lasiolepis | 100 | Yes | FACW |
| 2. Lonicera involucrata | 30 | Yes | FAC |
| 3. Sambucus racemosa | 10 | No | FACU |
| 4. | | | |
| 5. | | | |
| | 140 = Total Cover | | |
| **Herb Stratum** (Plot size: 5m2) | | | |
| 1. Ranunculus repens | 5 | Yes | FAC |
| 2. Polystichum munitum | 5 | Yes | FACU |
| 3. Deschampsia cespitosa | 2 | No | FACW |
| 4. Festuca perenne | 5 | Yes | FAC |
| 5. Holcus lanatus | 5 | Yes | FAC |
| 6. Epilobium ciliatum | 5 | Yes | FACW |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 27 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 5m2) | | | |
| 1. Rubus ursinus | 20 | Yes | FACU |
| 2. Rubus armeniacus | 50 | Yes | FAC |
| | 70 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 8 (A)

Total Number of Dominant Species Across All Strata: 10 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 80 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No _____

Remarks:

## SOIL

Sampling Point: W9

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-6 | 7.5YR2.5/1 | 100 | | | | | sandy clay loam | |
| 6-15 | 7.5YR 2.5/1 | 80 | 7.5YR5/8 | 20 | C | PL | sandy clay loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☑ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes X No _____

Remarks:

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☑ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☑ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Three secondary indicators of wetland hydrology are present at this sampling location.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/2/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: S1

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): crest/ upper edge of levee; fluviomarine terrace Local relief (concave, convex, none): convex to flat Slope (%): 0

Subregion (LRR): LRRA Lat: See R-01 riparian, data point S1 in map Long: Datum: WGS 84

Soil Map Unit Name: Urban land-Anthraltic Xerorthents association, 0–2% slopes. NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes _____ No X |
| Hydric Soil Present? | Yes _____ No X | |
| Wetland Hydrology Present? | Yes _____ No X | |

Remarks:

One wetland parameter present (hydrophytic vegetation) and the sampled area is within the Coastal Zone. Riparian vegetation present at this location.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 5 m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. Alnus rubra | 85 | Yes | FACW |
| 2. Pinus contorta ssp. contorta | 15 | No | |
| 3. | | | |
| 4. | | | |
| | 100 | = Total Cover | |
| **Sapling/Shrub Stratum** (Plot size: 5 m^2) | | | |
| 1. Baccharis pilularis | 10 | Yes | NL-UPL |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 10 | = Total Cover | |
| **Herb Stratum** (Plot size: 2 m^2) | | | |
| 1. Symphyotrichum chilense | 20 | Yes | FAC |
| 2. Daucus carota | 5 | No | |
| 3. Vicia sativa ssp. sativa | 2 | No | |
| 4. Raphanus sativus | 5 | No | |
| 5. Achillea millefolium | 2 | No | |
| 6. Plantago lanceolata | 2 | No | |
| 7. Cynosurus echinatus | 5 | No | |
| 8. Festuca perennis | 50 | Yes | FAC |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 101 | = Total Cover | |
| **Woody Vine Stratum** (Plot size: 2 m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 | = Total Cover | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No _____

Remarks:

Dominant vegetation is primarily composed of facultative and fac-wet species and the dominance test passed for hydrophytic vegetation.

## SOIL

Sampling Point: S1

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-13 | 10YR 3/1 | 100 | | | C | PL | sandy loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes _____ No X

Remarks:

No hydric soil indicators observed in sampled soil profile.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/8/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: S2

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): depression (historic bay tidelands, diked ) Local relief (concave, convex, none): slight concave Slope (%): 1

Subregion (LRR): LRRA Lat: See TP-01 wetland; data point S2 in map Long: Datum: WGS 84

Soil Map Unit Name: Water NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes x No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes _____ | No x | **Is the Sampled Area within a Wetland?** Yes _____ No x |
| Hydric Soil Present? | Yes x | No _____ | |
| Wetland Hydrology Present? | Yes x | No _____ | |

Remarks:

The sampled area is within a two-parameter wetland within the Coastal Zone/City of Arcata LCP-jurisdiction. Both hydric soil and wetland hydrology were identified, however dominant vegetation was composed of upland species.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 3m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 3m2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 2m2) | | | |
| 1. Convolvulus arvensis | 80 | Yes | NL-UPL |
| 2. Holcus lanatus | 20 | No | |
| 3. Agrostis capillaris | 5 | No | |
| 4. Raphanus sativus | 5 | No | |
| 5. Brassica rapa | 5 | No | |
| 6. Festuca perennis | 5 | No | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 120 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 2m2) | | | |
| 1. Rubus ursinus | 30 | Yes | FACU |
| 2. | | | |
| | 30 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes _____ No x

Remarks:

Dominant vegetation is not hydrophytic. Dominance test failed for hydrophytic vegetation. Vegetation is routinely mowed, location between S. I Street and trail in the Arcata Marsh Wildlife Sanctuary.

## SOIL

Sampling Point: S2

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | % | Redox Features Color (moist) | % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-8 | 2.5Y5/2 | 98 | 10YR5/8 | 2 | C | PL | CLAY LOAM | |
| 8-15 | 5Y4/1 | 90 | 7.5YR4/6 | 10 | C | PL | CLAY LOAM | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes X No _____

Remarks:

Soil profile contains a depleted matrix with redox concentrations and confirms hydric soil indicator depleted matrix.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☑ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial); now Arcata Marsh Wildlife Sanctuary

Remarks:

No high water table or saturation present at location however primary wetland hydrology indicator oxidized rhizospheres along living roots was evident.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/8/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: S3

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): fringe of WWTP treatment marsh Local relief (concave, convex, none): sloped Slope (%): 10

Subregion (LRR): LRRA Lat: See TP-02 wetland, data point S3 in map Long: Datum: WGS 84

Soil Map Unit Name: Water NWI classification: PAB3Hh

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes _____ | No X | **Is the Sampled Area within a Wetland?** Yes _____ No X |
| Hydric Soil Present? | Yes X | No _____ | |
| Wetland Hydrology Present? | Yes X | No _____ | |

Remarks:

The sampled area is within a two-parameter wetland within the Coastal Zone/City of Arcata LCP-jurisdiction. Both hydric soil and wetland hydrology were identified, however dominant vegetation was composed of upland species. Adjacent to WWTP treatment marsh.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 3m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 3m2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 3m2) | | | |
| 1. Equisetum arvense | 20 | Yes | FAC |
| 2. Convolvulus arvensis | 15 | Yes | NL-UPL |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 35 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 3m2) | | | |
| 1. Rubus ursinus | 100 | Yes | FACU |
| 2. Rubus armeniacus | 5 | No | |
| | 105 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes _____ No X

Remarks:

Dominance test failed for hydrophytic vegetation. Dominant vegetation is primarily upland species.

## SOIL

Sampling Point: S3

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | % | Redox Features Color (moist) | % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-7 | 10YR 4/1 | 85 | 10YR 5/8 | 15 | C | PL | clay loam | |
| 7-14 | 10YR 4/1 | 80 | 10YR 4/6 | 20 | C | PL | clay loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☑ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes X No _____

Remarks:

Soil profile matrix color's with redox concentrations confirms hydric soil indicator redox dark surface.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☑ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial); currently adjacent to Arcata WWTP treatment marsh

Remarks:

No high water table or saturation present at location however primary wetland hydrology indicator oxidized rhizospheres along living roots was evident.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/17/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: S4

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): base of trail prism, toeslope (historic bay tidelands/marsh, diked) Local relief (concave, convex, none): toeslope Slope (%): 0

Subregion (LRR): LRRA Lat: See TP-05 wetland; Data point S4 in map Long: Datum: WGS 84

Soil Map Unit Name: Water NWI classification: no listing

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation some, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes _____ No X |
| Hydric Soil Present? | Yes _____ No X | |
| Wetland Hydrology Present? | Yes X No _____ | |

Remarks:

The sampled area is within a two-parameter wetland within the Coastal Zone/City of Arcata LCP-jurisdiction. Both hydrophytic vegetation and wetland hydrology were identified, however hydric soils were lacking.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 4m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 4m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 4m^2) | | | |
| 1. Scirpus microcarpus | 30 | Yes | OBL |
| 2. Raphanus sativus | 20 | Yes | NL/UPL |
| 3. Ranunculus repens | 8 | No | |
| 4. Juncus effusus | 10 | No | |
| 5. Festuca perennis | 20 | Yes | FAC |
| 6. Holcus lanatus | 5 | No | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 93 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 4m^2) | | | |
| 1. Rubus armeniacus | 15 | Yes | FAC |
| 2. | | | |
| | 15 = Total Cover | | |

% Bare Ground in Herb Stratum 15

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No _____

Remarks:

Vegetation is routinely mowed, location between S. I Street and trail in the Arcata Marsh Wildlife Sanctuary.

## SOIL

Sampling Point: S4

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Redox Features Type[1] | Redox Features Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-11 | 10YR 3/2 | 100 | | | | | clay loam w/ gravel | |
| 11-20 | 10YR 3/1 | 100 | | | | | clay loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): n/a

**Hydric Soil Present?** **Yes** _____ **No** X

Remarks:

No hydric soil indicators observed in sampled soil profile.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☑ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes X No _____ Depth (inches): 11.5

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** X **No** _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial); currently Arcata Marsh Wildlife Sanctuary

Remarks:

Water table present 11.5 inches below surface.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/3/2019

Applicant/Owner: City of Arcata/HSU State: CA Sampling Point: S5

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Diked former pasture (historic bay tidelands) Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: See OP-01 wetland, Data point S5 in map Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: PEM1D

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes x No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes x No _____ | **Is the Sampled Area within a Wetland?** Yes _____ No x |
| Hydric Soil Present? | Yes _____ No x | |
| Wetland Hydrology Present? | Yes _____ No x | |

Remarks:

This location is a one-parameter wetland (only hydrophytic vegetation present) within the City of Arcata LCP-jurisdiction/Coastal Zone.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 4 m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 4 m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 4 m^2) | | | |
| 1. Festuca arundinacea | 80 | Yes | FAC |
| 2. Helminthotheca echioides | 10 | No | |
| 3. Dipsacus fullonum | 5 | No | |
| 4. Conium maculatum | 5 | No | |
| 5. Holcus lanatus | 15 | No | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 115 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 4 m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes x No _____

Remarks:

Dominant vegetation is primarily composed of facultative species and the dominance test passed for hydrophytic vegetation.

## SOIL

Sampling Point: S5

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-10 | 10YR 3/2 | 100 | | | | | silt loam | |
| 10-12 | 10YR 3/1 | 98 | 10YR 5/6 | 2 | C | PL | silt loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** **Yes** _____ **No** X

Remarks:

Although some redox features were present, the soil profile did not meet hydric soil indicator parameters.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/17/2019

Applicant/Owner: City of Arcata/HSU State: CA Sampling Point: S6

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Diked former pasture (historic bay tidelands) Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: See OP-01 wetland, Data point S6 in map Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: PEM1D

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No ____ | **Is the Sampled Area within a Wetland?** Yes ____ No X |
| Hydric Soil Present? | Yes ____ No X | |
| Wetland Hydrology Present? | Yes ____ No X | |

Remarks:

This location is a one-parameter wetland (only hydrophytic vegetation present) within the City of Arcata LCP-jurisdiction/Coastal Zone.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 4m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 4m2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 4m2) | | | |
| 1. Conium maculatum | 15 | Yes | FAC |
| 2. Epilobium ciliatum | 5 | Yes | FACW |
| 3. Cirsium vulgare | 5 | Yes | FACU |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 25 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 4m2) | | | |
| 1. Rubus armeniacus | 80 | Yes | FAC |
| 2. | | | |
| | 80 = Total Cover | | |

% Bare Ground in Herb Stratum 20

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No ____

Remarks:

Dominance test passed for hydrophytic vegetation. Species composition is mostly nonnative weed species that are facultative.

## SOIL

Sampling Point: S6

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-18 | 10YR 3/2 | 100 | | | | | Silt loam | |
| 18-22 | 10YR 3/2 | 97 | 10YR 5/8 | 1 | C | Pl | Silt loam | |
| | | | 10YR 5/1 | 2 | D | M | Silt loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** **Yes** _____ **No** X

Remarks:

Although some redox features were present, the soil profile did not meet hydric soil indicator parameters.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/17/2019

Applicant/Owner: City of Arcata/HSU State: CA Sampling Point: S7

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Diked coast pasture (former bay tidelands/marsh) Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRA Lat: See OP-02 wetland, data point S7 in map Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: PEM1D

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No ____ (If no, explain in Remarks.)

Are Vegetation X, Soil X, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes ____ No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No ____ | **Is the Sampled Area within a Wetland?** Yes ____ No X |
| Hydric Soil Present? | Yes ____ No X | |
| Wetland Hydrology Present? | Yes ____ No X | |

Remarks:

This location is a one-parameter wetland (only hydrophytic vegetation present) within the City of Arcata LCP-jurisdiction/Coastal Zone.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 4m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 4m2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 4m2) | | | |
| 1. Festuca arundinacea | 15 | No | FAC |
| 2. Elymus repens | 85 | Yes | FAC |
| 3. Holcus lanatus | 5 | No | |
| 4. Daucus carota | 5 | No | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 110 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: ____) | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No ____

Remarks:

## SOIL

Sampling Point: S7

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | % | Redox Features Color (moist) | % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-17 | 10 YR 3/1 | 98 | 10 YR 5/8 | 1 | C | PL | Silty Loam | |
| | | | 10 YR 6/1 | <1 | D | M | Silty Loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** **Yes** _____ **No** X

Remarks:

No hydric soil indicators observed in sampled soil profile.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/3/2019

Applicant/Owner: City of Arcata/HSU State: CA Sampling Point: S8

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Diked former pasture (historic bay tidelands) Local relief (concave, convex, none): none Slope (%): 0-2

Subregion (LRR): LRRA Lat: See OP-01 wetland, Data point S8 in map Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: PEM1D

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes _____ No X |
| Hydric Soil Present? | Yes _____ No X | |
| Wetland Hydrology Present? | Yes _____ No X | |

Remarks:

This location is a one-parameter wetland (only hydrophytic vegetation present) within the City of Arcata LCP-jurisdiction/Coastal Zone.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 2m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 2m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 2m^2) | | | |
| 1. Conium maculatum | 5 | No | |
| 2. Festuca perennis | 45 | Yes | FAC |
| 3. Symphyotrichum chilense | 45 | Yes | FAC |
| 4. Lotus corniculatus | 5 | No | |
| 5. Trifoilum repens | 10 | No | |
| 6. Raphanus sativus | 10 | No | |
| 7. Ranunculus repens | 10 | No | |
| 8. Cirsium vulgare | 2 | No | |
| 9. Plantago major | 5 | No | |
| 10. Dipsacus fulanum | 15 | No | |
| 11. Daucus carota | 5 | No | |
| | 157 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 2m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species | x 1 = |
| FACW species | x 2 = |
| FAC species | x 3 = |
| FACU species | x 4 = |
| UPL species | x 5 = |
| Column Totals: (A) | (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No _____

Remarks:

Dominant vegetation is primarily composed of facultative species and the dominance test passed for hydrophytic vegetation.

## SOIL

Sampling Point: S8

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-10 | 10YR 2/2 | 100 | | | | | | fill within profile |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): gravel/fill throughout

**Hydric Soil Present? Yes** _____ **No** X

Remarks:

No hydric soil indicators observed in sampled soil profile.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present? Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/3/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: S9

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Diked former pasture (historic bay tidelands) Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: See TP-09 wetland, Data point S9 in map Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: PEM1D

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes X | No _____ | **Is the Sampled Area within a Wetland?** Yes X No _____ |
| Hydric Soil Present? | Yes X | No _____ | |
| Wetland Hydrology Present? | Yes _____ | No X | |

Remarks:

The sampled area is within a two-parameter wetland within the Coastal Zone/City of Arcata LCP-jurisdiction. Both hydrophytic vegetation and hydric soils were identified and no wetland hydrology indicators were present. Restoration activities (willow plantings) fairly recent.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 8 m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. Picea sitchensis | 10 | | |
| 2. Salix (lasiolepis) | 40 | Yes | FACW |
| 3. Salix lasiandra | 30 | Yes | FACW |
| 4. Salix (sitchensis) | 40 | Yes | FACW |
| | 120 | = Total Cover | |
| **Sapling/Shrub Stratum** (Plot size: 2 m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 | = Total Cover | |
| **Herb Stratum** (Plot size: 2 m^2) | | | |
| 1. Ranunculus repens | 15 | Yes | FAC |
| 2. Conium maculatum | 5 | No | |
| 3. Juncus (patens) | 2 | No | |
| 4. Agrostis capillaris | 20 | Yes | FAC |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 42 | = Total Cover | |
| **Woody Vine Stratum** (Plot size: 2 m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 | = Total Cover | |

% Bare Ground in Herb Stratum 65

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No _____

Remarks:

Dominant vegetation is primarily composed of facultative and fac-wet species and the dominance test passed for hydrophytic vegetation.

## SOIL

Sampling Point: S9

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-14 | 10YR 2/1 | 98 | 10YR 5/8 | 2 | C | PL | clay loam | |
| 14-16 | 10YR 2/1 | 90 | 10YR 5/8 | 10 | C | PL | clay loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☑ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): 16

**Hydric Soil Present?** Yes X No _____

Remarks:

Soil profile matrix color's with redox concentrations confirms hydric soil indicator redox dark surface.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial); now restored McDaniel Slough Project

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/17/2019

Applicant/Owner: City of Arcata/HSU State: CA Sampling Point: S10

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Diked former pasture (historic bay tidelands) Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: See TP-07 wetland, Data point S10 in map Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: PEM1D

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes _____ No X |
| Hydric Soil Present? | Yes X No _____ | |
| Wetland Hydrology Present? | Yes _____ No X | |

Remarks:

The sampled area is within a two-parameter wetland within the Coastal Zone/City of Arcata LCP-jurisdiction. Both hydrophytic vegetation and hydric soil were identified, however wetland hydrology indicators were not observed.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 4m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 4m2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 4m2) | | | |
| 1. Conium maculatum | 45 | Yes | FAC |
| 2. Epilobium ciliatum | 1 | No | |
| 3. Festuca arundinaceae | 90 | Yes | FAC |
| 4. Rumex crispus | 5 | No | |
| 5. Holcus lanatus | 8 | No | |
| 6. Galium sp. | 5 | No | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 154 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 4m2) | | | |
| 1. | | | |
| 2. | | | |
| | _____ = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No _____

Remarks:

Dominance test passed for hydrophytic vegetation. Species composition is mostly nonnative species that are facultative.

## SOIL

Sampling Point: S10

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-8 | 10YR 3/2 | 100 | | | | | clay loam | |
| 8-16 | 10YR 3/2 | 20 | 10YR 5/8 | 20 | C | PI | clay loam | |
| 8-16 | | | 10YR 5/1 | 60 | D | M | clay loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☑ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes X No _____

Remarks:

Soil profile contains a depleted matrix with redox concentrations and confirms hydric soil indicator depleted matrix.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 3/12/2020

Applicant/Owner: City of Arcata State: CA Sampling Point: S11

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): coastal plain Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: see R-05 through R-12/13 Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No see notes (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes X | No ____ | **Is the Sampled Area within a Wetland?** Yes ____ No X |
| Hydric Soil Present? | Yes ____ | No X | |
| Wetland Hydrology Present? | Yes ____ | No X | |

Remarks:

The sampled area is within an one-parameter wetland within the Coastal Zone/City of Arcata LCP-jurisdiction. Only hydrophytic vegetation observed at this location. Precipitation below monthly normal, abnormally dry conditions reported (Nat Drought Mit Center 2020)

### VEGETATION – Use scientific names of plants.

| | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| **Tree Stratum** (Plot size: 10m2) | | | |
| 1. Salix lasiandra | 10 | Yes | FACW |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 10 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 10m2) | | | |
| 1. Salix (sitchensis) | 10 | Yes | FACW |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 10 = Total Cover | | |
| **Herb Stratum** (Plot size: 5m2) | | | |
| 1. Vicia sativa sativa | 15 | Yes | UPL |
| 2. Mentha puleginum | 10 | Yes | OBL |
| 3. Plantago lanceolata | 5 | No | |
| 4. Cyperus eragrostis | 5 | No | |
| 5. Festuca perenne | 5 | No | |
| 6. Holcus lanatus | 10 | Yes | FAC |
| 7. Bromus hordeacous | 15 | Yes | FACU |
| 8. Trifolium repens | 5 | No | |
| 9. Dipscasus fullonum | 10 | Yes | FAC |
| 10. Anthoxanthum odoratum | 5 | No | |
| 11. | | | |
| | 85 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 5m2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 15

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 71 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No ____

Remarks:

Dominance test passed for hydrophytic vegetation. Species composition is a mixture of willow with an understory of mostly herbaceous nonnative species.

## SOIL

Sampling Point: S11

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-9 | 10YR 3/1 | 100 | | | | | silty clay loam | contains gravel/fill |
| 9-12 | 10YR 3/1 | 98 | 10YR 4/6 | 2 | C | Pl | silty clay loam | contains gravel/fill |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** **Yes** _____ **No** X

Remarks:

Soil profile contains redox concentrations however located below 6 inches from surface and less than 3" in upper 12" of soil profile and a hydric soil indicator was not confirmed

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/2/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: U1

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Fluviomarine terrace Local relief (concave, convex, none): none Slope (%): 1

Subregion (LRR): LRRA Lat: See UPL-01 upland; data point U1 in map Long: Datum: WGS 84

Soil Map Unit Name: Urban land-Anthraltic Xerorthents association, 0–2% slopes. NWI classification: No listing

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes _____ | No X | **Is the Sampled Area within a Wetland?** Yes _____ No X |
| Hydric Soil Present? | Yes _____ | No X | |
| Wetland Hydrology Present? | Yes _____ | No X | |

Remarks:

No wetland parameters were present and the sampled area is within an upland.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 5 m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. Pinus contorta ssp. contorta | 5 | No | |
| 2. Alnus rubra | 25 | Yes | FAC |
| 3. | | | |
| 4. | | | |
| | 30 | = Total Cover | |
| **Sapling/Shrub Stratum** (Plot size: 5 m^2) | | | |
| 1. Baccharis pilularis | 60 | Yes | NL-UPL |
| 2. Genista monspessulana | 10 | No | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 70 | = Total Cover | |
| **Herb Stratum** (Plot size: 5 m^2) | | | |
| 1. Symphyotrichum chilense | 8 | Yes | FAC |
| 2. Daucus carota | 8 | Yes | FACU |
| 3. Angelica lucida | 1 | No | |
| 4. Dipsacus fullonum | 5 | No | |
| 5. Avena barbata | 2 | No | |
| 6. Anthoxanthum odoratum | 10 | Yes | FACU |
| 7. Plantago lanceolata | 5 | No | |
| 8. Foeniculum vulgare | 3 | No | |
| 9. Festuca arundinacea | 2 | No | |
| 10. Cynosurus echinatus | 5 | No | |
| 11. | | | |
| | 49 | = Total Cover | |
| **Woody Vine Stratum** (Plot size: 5 m^2) | | | |
| 1. Rubus armeniacus | 45 | Yes | FAC |
| 2. | | | |
| | 45 | = Total Cover | |

% Bare Ground in Herb Stratum 45

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes _____ No X

Remarks:

Dominance test not conclusive for hydrophytic vegetaiton and prevalence test not required since hydric soils and wetland hydrology were not observed. Based on dominant upland plant species composition, vegetation is considered upland.

## SOIL

Sampling Point: U1

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-13 | 10YR 3/1 | 100 | | | | | Sandy loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** **Yes** _____ **No** X

Remarks:

No hydric soil indicators observed in sampled soil profile.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/17/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: U2

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): near base of trial prism, toeslope Local relief (concave, convex, none): none Slope (%): 1

Subregion (LRR): LRRA Lat: See UPL-03 upland; datapoint U2 Long: Datum: WGS 84

Soil Map Unit Name: Water NWI classification: no listing

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation X, Soil X, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes _____ | No X | **Is the Sampled Area within a Wetland?** Yes _____ No X |
| Hydric Soil Present? | Yes _____ | No X | |
| Wetland Hydrology Present? | Yes _____ | No X | |

Remarks:

No wetland parameters were present and the sampled area is within an upland.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 4m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 4m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 4m^2) | | | |
| 1. Festuca perennis | 25 | Yes | FAC |
| 2. Ranunculus repens | 2 | | |
| 3. Daucus carota | 25 | Yes | FACU |
| 4. Raphanus sativus | 60 | Yes | NL/UPL |
| 5. Symphyotrichum chilense | 5 | | |
| 6. Geranium (molle) | 2 | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 119 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 4m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 35

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes _____ No X

Remarks:

Dominance test failed for hydrophytic vegetation. Dominant vegetation is primarily upland species. Vegetation is routinely mowed, location between S. I Street and trail in the Arcata Marsh Wildlife Sanctuary.

## SOIL

Sampling Point: U2

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-12 | 7.5YR 3/1 | 100 | | | | | sandy loam | lots of rocks |
| 12-17 | 7.5YR 3/1 | 99 | 7.5YR 5/8 | 1 | C | PL | sandy loam | less fill, lots of sand |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes _____ No X

Remarks:

A lot of mixed fill within the soil profile. Although some redox features were present, the soil profile did not meet hydric soil indicator parameters.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes X No _____ Depth (inches): 14"

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Although water table was observed in the soil pit it was below 12" from the surface and did not pass wetland hydrology parameters for high water table.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/3/2019

Applicant/Owner: City of Arcata/HSU State: CA Sampling Point: U3

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Diked former pasture (historic bay tidelands) Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: See UPL-04 upland, Data point U3 in map Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: PEM1D

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes x No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes _____ | No x | **Is the Sampled Area within a Wetland?** Yes _____ No x |
| Hydric Soil Present? | Yes _____ | No x | |
| Wetland Hydrology Present? | Yes _____ | No x | |

Remarks:

No wetland parameters were present and the sampled area is within an upland.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 2 m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 2m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 2 m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 0 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 2 m^2) | | | |
| 1. Rubus ursinus | 100 | Yes | FACU |
| 2. | | | |
| | 100 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 0 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes _____ No x

Remarks:

Dominance test failed for hydrophytic vegetation. Vegetative cover entirely comprised of the upland species California blackberry.

## SOIL

Sampling Point: U3

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-10 | 10YR 3/2 | 100 | | | | | silt loam | |
| 10-12 | 10YR 3/1 | 98 | 10YR 5/6 | 2 | C | PL | silt loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** **Yes** _____ **No** X

Remarks:

Although some redox features were present, the soil profile did not meet hydric soil indicator parameters.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 3/12/2020

Applicant/Owner: City of Arcata State: CA Sampling Point: U4

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): coastal plain Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: see UPL-05 Long: Datum: WGS 84

Soil Map Unit Name: Urban land-Anthraltic Xerorthents association, 0–2% slopes NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No see notes (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes x No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes ____ | No x | **Is the Sampled Area within a Wetland?** Yes ____ No x |
| Hydric Soil Present? | Yes ____ | No x | |
| Wetland Hydrology Present? | Yes ____ | No x | |

Remarks:

No wetland parameters were present and the sampled area is within an upland.

Precipitation below monthly normal, abnormally dry conditions reported (Nat Drought Mit Center

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 3m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum (Plot size: 3m^2)** | | | |
| 1. Baccharis piluaris | 5 | Yes | NL- UPL |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 5 = Total Cover | | |
| **Herb Stratum (Plot size: 3m^2)** | | | |
| 1. Dactylis glomerata | 50 | Yes | FACU |
| 2. Geranium dissectum | 5 | No | |
| 3. Foeniculum vulgare | 5 | No | FACU |
| 4. Rubus armeniacus | 5 | No | |
| 5. Prunella vulgaris | 2 | No | |
| 6. Vicia sp. | 2 | No | |
| 7. Anthoxanthum odoratum | 15 | Yes | FAC |
| 8. Daucus carota | 5 | No | |
| 9. Helminotheca echoides | 2 | No | |
| 10. Holcus lanatus | 10 | No | |
| 11. | | | |
| | 101 = Total Cover | | |
| **Woody Vine Stratum (Plot size: 3m^2)** | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 10

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes ____ No x

Remarks:

Dominance test failed for hydrophytic vegetation. Vegetative cover comprised of upland species.

## SOIL

Sampling Point: U4

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-6 | 10YR 4/2 | 100 | | | | | mixed fill | fill/gravel |
| 6-10 | 10YR 4/2 | 96 | 10YR5/8 | 4 | C | PL | sandy clay loam | |
| 10-17 | 10YR5/2 | 65 | 10YR5/8 | 30 | C | PL | sandy clay loam | |
| | | | 10YR7/1 | 5 | D | M | sandy clay loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes _____ No X

Remarks:

Redox features were below 6 inches of soil profile and depletions were less than 2 inches in the upper 12 inches from the surface. The soil profile did not meet hydric soil indicator parameters.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 3/12/2020

Applicant/Owner: City of Arcata State: CA Sampling Point: U5

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): coastal plain Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: see UPL-05 Long: Datum: WGS 84

Soil Map Unit Name: Urban land-Anthraltic Xerorthents association, 0–2% slopes NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No see notes (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes x No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes ____ | No x | **Is the Sampled Area within a Wetland?** Yes ____ No x |
| Hydric Soil Present? | Yes ____ | No x | |
| Wetland Hydrology Present? | Yes ____ | No x | |

Remarks:

No wetland parameters were present and the sampled area is within an upland.

~~Precipitation below monthly normal, abnormally dry conditions reported (Nat Drought Mit Center 2020)~~

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 3m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 3m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 3m^2) | | | |
| 1. Bromus diandrus | 45 | Yes | NL-UPL |
| 2. Foeniculum vulgare | 10 | No | |
| 3. Brassica rapa | 20 | Yes | FACU |
| 4. Trifolium dubium | 10 | No | |
| 5. Lamium purpureum | 5 | No | |
| 6. Anthoxanthum odoratum | 5 | No | |
| 7. Festuca (microstachys) | 15 | No | |
| 8. Poa annua | 5 | No | |
| 9. Geranium dissectum | 10 | No | |
| 10. Glyceria declinata | 1 | No | |
| 11. | | | |
| | 126 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 3m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 20

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes ____ No x

Remarks:

Dominance test failed for hydrophytic vegetation. Vegetative cover comprised of upland species.

## SOIL

Sampling Point: U5

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-12 | 10YR 3/1 | 100 | | | | | sandy loam | with fill |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: mixed fill/gravel

Depth (inches): 12

**Hydric Soil Present? Yes** ____ **No** X

Remarks:

No redox features present and the soil profile did not meet hydric soil indicator parameters.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes ____ No X Depth (inches): ____

Water Table Present? Yes ____ No X Depth (inches): ____

Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): ____

**Wetland Hydrology Present? Yes** ____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 3/12/2020

Applicant/Owner: City of Arcata State: CA Sampling Point: U6

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): berm Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: see UPL-06 Long: Datum: WGS 84

Soil Map Unit Name: Water NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No see notes (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes x No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes ____ | No x | **Is the Sampled Area within a Wetland?** Yes ____ No x |
| Hydric Soil Present? | Yes ____ | No x | |
| Wetland Hydrology Present? | Yes ____ | No x | |

Remarks:

No wetland parameters were present and the sampled area is within an upland.
Precipitation below monthly normal, abnormally dry conditions reported (Nat Drought Mit Center 2020)

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 5m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. Pinus radiata | 60 | Yes | UPL |
| 2. Pinus contorta contorta | 10 | No | FAC |
| 3. | | | |
| 4. | | | |
| | 70 | = Total Cover | |
| **Sapling/Shrub Stratum** (Plot size: 3m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 | = Total Cover | |
| **Herb Stratum** (Plot size: 3m^2) | | | |
| 1. Raphanus sativus | 15 | Yes | NI-UPL |
| 2. Festuca microstachys | 35 | Yes | NI-UPL |
| 3. Briza major | 15 | Yes | NI-UPL |
| 4. Rumex acetosella | 10 | No | |
| 5. Plantago lanceolata | 5 | No | |
| 6. Daucus carota | 2 | No | |
| 7. Holcus lanatus | 10 | No | |
| 8. Eschscholzia californica | 5 | No | |
| 9. Allium triquentra | 8 | No | |
| 10. Anthoxanthum odoratum | 10 | No | |
| 11. | | | |
| | 115 | = Total Cover | |
| **Woody Vine Stratum** (Plot size: 3m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 | = Total Cover | |

% Bare Ground in Herb Stratum 10

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes ____ No x

Remarks:

Dominance test failed for hydrophytic vegetation. Vegetative cover comprised of upland species.

## SOIL

Sampling Point: U6

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-12 | 10YR 3/2 | 100 | | | | | mixed fill/ sandy loam | fill/gravel |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** **Yes** _____ **No** X

Remarks:

The soil profile did not meet hydric soil indicator parameters.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 3/12/2020

Applicant/Owner: City of Arcata State: CA Sampling Point: U7

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): coastal plain Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: see UPL-07 Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No see notes (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes x No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes ____ | No x | **Is the Sampled Area within a Wetland?** Yes ____ No x |
| Hydric Soil Present? | Yes ____ | No x | |
| Wetland Hydrology Present? | Yes ____ | No x | |

Remarks:

No wetland parameters were present and the sampled area is within an upland.
Precipitation below monthly normal, abnormally dry conditions reported (Nat Drought Mit Center 2020)

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 3 m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum (Plot size: 3m^2)** | | | |
| 1. Baccharis piluaris | 15 | Yes | NL-UPL |
| 2. Salix hookeriana | 10 | Yes | FACW |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 25 = Total Cover | | |
| **Herb Stratum (Plot size: 3m^2)** | | | |
| 1. Trifolium dubium | 5 | No | |
| 2. Bromus hordeaceaus | 45 | Yes | FACU |
| 3. Plantago lanceolata | 5 | No | |
| 4. Briza major | 5 | No | |
| 5. Daucus carota | 5 | No | |
| 6. Plantago lanceolata | 8 | Yes | FACU |
| 7. Conium maculatum | 5 | No | |
| 8. Lotus corniculatus | 2 | No | |
| 9. Festuca (microstachys) | 2 | No | |
| 10. Brassica rapa | 5 | No | |
| 11. Dispacus fullonum | 8 | Yes | FAC |
| | 95 = Total Cover | | |
| **Woody Vine Stratum (Plot size: 2 m^2)** | | | |
| 1. Rubus armeniacus | 100 | Yes | FACU |
| 2. | | | |
| | 100 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes ____ No x

Remarks:

Dominance test not conclusive for hydrophytic vegetation. Vegetative cover comprised of upland species.

## SOIL

Sampling Point: U7

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-12 | 10YR 3/2 | 100 | | | | | sandy loam | a lot of fill/gravel |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: fill/gravel/rock

Depth (inches): 12

**Hydric Soil Present?** Yes _____ No X

Remarks:

No redox features were present within upper 12 inches of the soil profile which had a lot of fill/gravel and no hydric soil indicator parameters observed.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 5/29/2020

Applicant/Owner: City of Arcata State: CA Sampling Point: U8

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): compacted imported fill, near historic landfill Local relief (concave, convex, none): none Slope (%): 1

Subregion (LRR): LRRA Lat: Long: See GPS WPT Datum: WGS 84

Soil Map Unit Name: Water NWI classification: PEM1A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No x (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes ____ | No X | **Is the Sampled Area within a Wetland?** Yes ____ No X |
| Hydric Soil Present? | Yes ____ | No X | |
| Wetland Hydrology Present? | Yes ____ | No X | |

Remarks:

No wetland parameters are present and the sampled area is within an upland. Sampled area is within the Coastal Zone. Precipitation in May 2020 was above "monthly normal" for the region.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 3m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 3m2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 3m2) | | | |
| 1. Anthoxanthum odoratum | 50 | Yes | FACU |
| 2. Festuca perenne | 5 | No | |
| 3. Vicia gigantea | 25 | Yes | NL-UPL |
| 4. Raphanus sativa | 5 | No | |
| 5. Pkantago lanceolata | 1 | No | |
| 6. Hypocharis radicata | 3 | No | |
| 7. Symphyotrichum chilense | 3 | No | |
| 8. Daucus carota | 1 | No | |
| 9. Holcus lanatus | 2 | No | |
| 10. Bromus/Agrostis | 5 | No | |
| 11. Vicia sativa | 5 | No | |
| | 105 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 3m2) | | | |
| 1. Rubus armeniacus | 15 | Yes | FAC |
| 2. | | | |
| | 15 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes ____ No X

Remarks:

Dominant vegetation failed the dominance test for hydrophytic vegetation.

## SOIL

Sampling Point: U8

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-8 | 10 YR4/2 | 100 | | | | | silty clay loam | |
| 8-15 | 10YR 4/1 | 90 | 10YR5/8 | 10 | C | PL | silty clay loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** **Yes** _____ **No** X

Remarks:

No hydric soil indicators are present.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No wetland hydrology indicators are present at this sampling location.

# ATTACHMENT 10

LACO Associates. 2017. Engineering Geologic and Hydrogeologic Exploration Arcata Waste Water Treatment Plant, Arcata, Humboldt County, California.

LACO

# TECHNICAL MEMORANDUM

## Engineering Geologic and Hydrogeologic Exploration
## Arcata Waste Water Treatment Plant
## Arcata, Humboldt County, California

---

Date: February 24, 2017

Project No.: 6938.21

Prepared For: City of Arcata
736 F Street
Arcata, California, 95521

Prepared By: Christopher J. Watt, C.E.G., C.H.G.
Principal Engineering Geologist

Vanessa Davis, Staff Geologist

Steven Medina, Staff Geologist

Reviewed By: Eric Wilson, P.G., C.E.G.
Senior Engineering Geologist

Enclosures:

| | |
|---|---|
| Figure 1: | Site Map and Boring Locations |
| Figure 2: | Historical Channels |
| Appendix 1: | Boring Logs |
| Appendix 2: | Laboratory Analytical Results |
| Appendix 3 | Thermal Images of Possible Seeps |
| Appendix 4: | Tidal and Pressure Graphs Over Time |
| Appendix 5: | Slope Stability Analysis |

---

21 W. 4th Street, Eureka, California 95501 707 443-5054 Fax 707 443-0553
311 S. Main Street, Ukiah, California 95482 707 462-0222 Fax 707 462-0223
3450 Regional Parkway, Suite B2, Santa Rosa, California 95403 707 525-1222

Toll Free 800 515-5054 www.lacoassociates.com

# 1.0 INTRODUCTION

This report presents the results of the Engineering Geologic and Hydrogeologic investigation performed by LACO Associates (LACO) for the City of Arcata (Client). The purpose of the investigation was to evaluate effluent seepage from the oxidation ponds located at the Arcata Waste Water Treatment Plant (WWTP), hereafter referred to as the Site, with respect to the proposed development of Treatment Marsh Number 7. A Site Location and Boring Map is presented as Figure 1.

The Arcata WWTP uses several passive and natural processes to clean the City's effluent to water quality objectives (WQO) regulated by the NCWQCB. The existing oxidation ponds are under consideration for expansion by the potential lowering of pond bottom elevations and the possibility of increasing levee crest elevation. The proposed modifications are intended to increase the treatment capacity for long term functionality. This functionality is related to an increase capacity to meet future loads; to increase levee height to account for sea level rise; to assess potential impacts of the modifications, such as increased head, increased seepage, and slope instability.

# 2.0 SCOPE OF SERVICES

In accordance with LACO's Proposal dated December 16, 2016, data was collected at the WWTP to evaluate hydraulic and geotechnical properties of pond and levee soils from January 11, 2017 to January 19, 2017, under the direction of a LACO Certified Engineering Geologist. The collection of data consisted of the following:

- Review of operational records provided by the City of Arcata staff:
  - oxidation pond water levels;
  - flows in and out of various ponds;
  - personal observations;
- Review of historic photos and relevant reports;
- Conducting a field exploration that included:
  - water level monitoring in oxidation pond number 2 for 8 days;
  - site visit to directly observe bay side levee toe;
  - collection and testing of soil samples from the levee system;
- Conducting laboratory testing for selected soil samples to characterize soil properties; and
- Preparing this Engineering Geologic and Hydrogeologic Report as requested by the City of Arcata.

# 3.0 FIELD EXPLORATION AND LABORATORY TESTING

The subsurface investigation performed on January 12 to January 19, 2017, included hand auguring, soil sampling, and logging of four exploratory borings at the approximate locations shown on Figure 1 – Site Map and Boring Locations. The boring locations were selected because of access, location near proposed Treatment Marsh 7 and spatial representation. The four borings were advanced to discrete depths to collect levee soil samples using a Shelby Tube. One boring, B4, was collected east and below the levee material. Once the desired depth was reached, a 12-inch Shelby tube was attached to a push rod and

driven into the boring no more than 12 inches with a slide hammer, ensuring that the rod was plumb with the boring.

In order to separate the sample from the underlying soil, a duration of 10 – 15 minutes was allotted in order for the soil to expand within the Shelby tube, then the tube was slowly rotated to shear the material at the end of the tube and to alleviate water and/or suction pressures and improve recovery. To improve recovery of highly cohesive and compressible bay mud underlying the levee, sampling was conducted at the base of a test pit. The test pit was dug with a backhoe to a depth of 8 feet in the area of the boring. The Shelby tube was then pushed to approximately 9 feet at which point the sample was excavated using the backhoe bucket; extreme care was given to ensure that the backhoe bucket went well below the Shelby tube during excavation. Once samples were pulled, the Shelby tubes were kept upright and detached from the push rod. Afterwards, the sample was inspected to ensure the target soil was present and any voids on the top or bottom were filled with nonabsorbent material and capped to ensure moisture was not lost. A LACO geologist logged the borings and obtained relatively undisturbed samples for laboratory testing. Soils were logged and collected in general accordance with the American Society for Testing and Materials (ASTM) Test Procedure D2488 and D1587. Boring logs are presented in Appendix 1.

# 4.0 SITE CONDITIONS

Located at the north end of Humboldt Bay, the WWTP occupies 307 acres of the Arcata Marsh and Wildlife Sanctuary. The marsh and sanctuary includes freshwater marshes, saltwater marches, tidal sloughs, grassy uplands, mudflats, and brackish mash (Arcata Marsh & Wildlife Sanctuary, 2017). The facility contains a series of oxidation ponds, treatment wetlands, and enhancement marshes that are used to treat wastewater before discharging the effluent into Humboldt Bay.

## 4.1 Soils

Although the facility was developed on historic tidal flats consisting of 20 - 30 feet of bay mud deposits on the northern section of Humboldt Bay, there are historic channels, creeks, and sloughs which traverse the area, potentially associated with granular soils that have a significantly higher permeability than the bay mud deposits which may affect flux between the oxidation ponds and bay.

# 5.0 SEEPAGE INVESTIGATION

## 5.1 Document Review

The document review consisted of reviewing operational records provided by city staff. Records included original levee plans and personal observations. The review also included reviewing historic photos and relevant reports.

Prior to the construction of the WWTP in 1949, the area north Humboldt Bay was an undeveloped tidal flat which appears to have been crossed by a several potential channels including but not limited to the Jolly Giant Creek and portions of McDaniel Slough. These potential channels may represent areas of potentially high permeability sediments within the low permeability tidal muds. The potentially higher permeability

sediments were located using the original levee plans and historic aerial photographs from the Historic Atlas of Humboldt Bay and Eel River Delta between 1931 and 1969. Approximately five potential channels appear to have existed before the construction of the oxidation ponds and levees. These historic channels were mapped in GIS and labeled according to corresponding year as seen in Figure 2.

## 5.2 Permeability Sampling and Analysis

Relatively undisturbed samples collected during field exploration were submitted to a state certified laboratory. Laboratory testing was performed to estimate permeability of the levee soils.

Laboratory test results are included as Appendix 2 and are summarized in Table 1.

*Table 1: Laboratory Test Results*

| Boring | Sampling Method | Sampling Depth (bgs) | Side of Levee | Hydraulic Conductivity (cm/s) |
|---|---|---|---|---|
| B1 | Hand auger/Shelby tube | 4.7 – 5.7 | Pond side | 3.0E-07 |
| B2 | | 2.5 – 3.5 | Bay side | 2.0E-06 |
| B3 | | 3.25 – 4.25 | Pond side | 1.0E-06 |
| B4 | | 8.0 – 9.0 | Pond Side | 8.0E-08 |

## 5.3 Thermal and Visual Observations

The levee evaluation also included visual observation with the aid of Flir t420 thermal camera. The camera was used scan for flowing water near the levee toe during low tide. Several areas of flow were noted around the levee, from approximately Dr. Gearheart's office to approximately the old outwash, predominately near the southwest corner of Oxidation Pond Number 1 (Figure 2). Several thermal images (Appendix 3) record the observed flow and we estimated a maximum discharge rate of no more than 0.1 gallon per minute.

## 5.4 Water Level Monitoring

A pressure transducer (Hobo Logger) was installed to a depth of approximately 4 feet below the water surface in Oxidation Pond Number. The Hobo Logger collected pressure and temperature data every 15 minutes from January 11 to January 18, 2017. Upon retrieval of the pressure transducer, data was downloaded and pressure measurements were corrected for atmospheric noise; atmospheric pressure was subtracted from the pressure measurements thereby eliminating the low and high pressure weather system influence on the data. Both pressure and tide were graphed versus time to see if any correlation or tidal influence on the ponds exists. Each comparison consisted of a 24 hour period and for several days (Appendix 4).

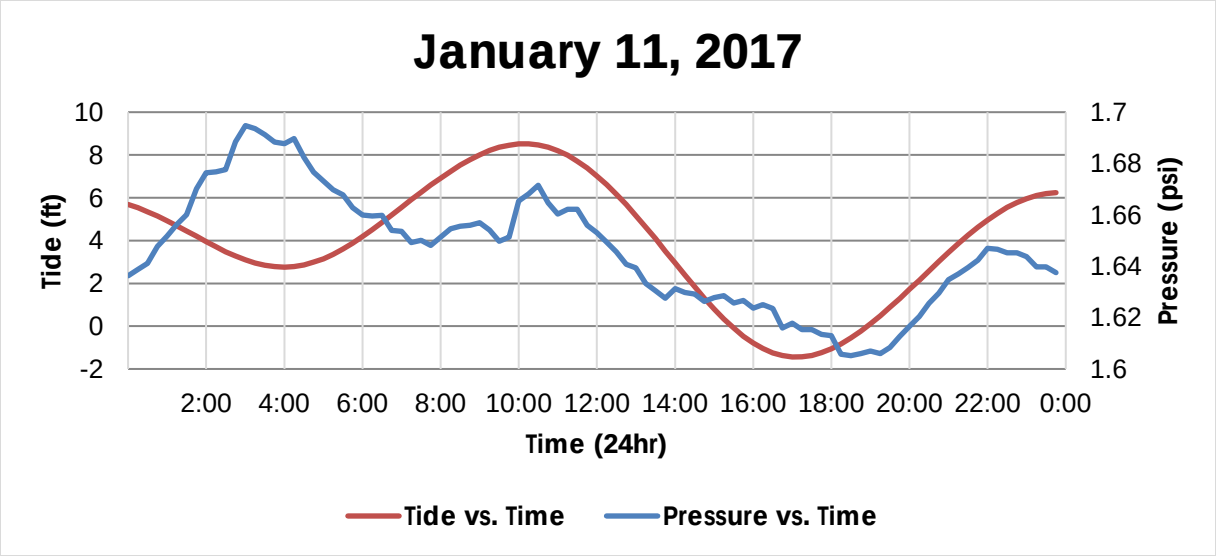



**Figure A: Daily tidal cycle and Oxidation Pond #2 pressure measurements**

The daily comparison of tide and pressure from January 11, 2017, to January 18, 2017, correlates, but further evaluation is needed to check the potential magnitude of flux between the oxidation ponds and bay. Figure A depicts the correlation between tide and pond pressure. However, given the flownet estimation and calculations with the measured hydraulic conductivity from B3, the theoretical likelihood is that seepage through the levee, using the highest hydraulic conductivity value from B3 is 267 gallons per day per hundred feet of levee. A complete daily tide and pressure versus time graphs are located in Appendix 3.

## 6.0 LEVEE SLOPE INSTABILITY ANALYSIS

The impact on levee stability of the proposed improvements was evaluated by constructing a series of quantitative slope instability analysis models. Existing levee geometry was taken from three representative cross-sections at stations 16+00, 31+00 and 39+00, chosen for their proximity to borings conducted as part of this and previous (LACO, 2009) exploration reports. The resulting geologic cross-sections were modified by the addition of 3 feet of fill to the crown and in-board pond slopes.

The pre-modification levee topography for the three sections was based on levee sections prepared as part of a civil design set, dated June 9, 2009, prepared, by LACO as part of the Arcata Levee Repair Project. Pond bathymetry and depth of sludge were incorporated from measurements made by Jeff Woodke, of Humboldt State University.

Soil engineering properties included in the model, such as density, cohesion, and friction angle were either measured directly by laboratory analysis (LACO, 2009), estimated based on a combination of Standard Penetration Test (SPT) data and grain-size analysis following procedures outlined in the 2013 Caltrans Geotechnical Manual (after Bowles 1977), or by engineering judgment and experience with local soils. The material divisions used broadly follow those used by the 2009 report with the addition of a unit representing unconsolidated bay mud. Material parameters used are presented in Table 2 below:

*Table 2. Instability Analysis Material Parameters*

| Material | Description | Unit Weight (lb/ft3) | Cohesion (psf) | Friction Angle (degrees) |
|---|---|---|---|---|
| 1 | Proposed Fill | 100 | 800 | 16 |
| 2 | Existing Revetment | 140 | 0 | 50 |
| 3 | Existing Granular Levee Fill | 132 | 0 | 35 |
| 4 | Existing Fine Grained Fill | 108 | 1000 | 25 |
| 5 | Unconsolidated Bay Mud | 100 | 400 | 0 |
| 6 | Partially Consolidated Bay Mud | 100 | 800 | 16 |

To provide an assessment of the full range of conditions that may occur during the design life of the levee, seismic slope stability analyses were run. The impacts of a design level earthquake on slope stability were estimated using the pseudo-static approach, where the earthquake load is simulated by "equivalent" static horizontal acceleration acting on the mass of the landslide. The pseudo-static seismic loading coefficient was calculated in accordance with guidelines presented in California Geologic Survey Special Publication 117A, and Note 48 using a 6.9 magnitude earthquake on the Fickle Hill Fault Zone.

The analyses were performed using the computer program Slide 7.0. The analyses utilized the Modified Bishop method to search for the critical failure surface and calculate the factor of safety against sliding. The critical failure surface is defined as the surface with the lowest calculated factor of safety. In general, factors of safety greater than 1.0 indicate stable conditions, while factors of safety less than 1.0 indicated an unstable condition.

The following worst case scenarios were considered in the slope instability models:

- A design level earthquake, at low tide with the ponds filled to 1 foot below the levee crown; and
- A design level earthquake, with the ponds empty, and high tide 1 foot below the levee crown.

The results of our analysis are presented in Appendix 5 The slope stability analysis for each of the sections, run for the high tide, empty pond scenario, generated critical failure surfaces (the surface with the lowest factor of safety) extending through the bay mud under the levee prism to a toe surfacing within the pond. The resulting failure surfaces had pseudo-static factors of safety ranging from 1.33 to 1.49. The slope stability analysis for each of the sections run for the low tide, full pond scenario, generated critical failure surfaces, initiating on the levee slope within the pond and surfacing in the tidal flat approximately 30 to 50 feet from the levee toe. The resulting failure surfaces had had pseudo-static factors of safety ranging from 1.45 to 1.71. Based on CGS Special Publication 117A guild-lines Pseudo-Static analysis with a factor of safety of greater than 1 is considered stable.

# 7.0 CONCLUSIONS AND RECOMMEDATIONS

- Construction of additional treatment facilities inside the levee system will not result in a measureable discharge of untreated effluent to the bay through or under the levee system. A project specific geotechnical report is recommended to develop earthwork recommendations.

- Construction of improvements to increase the height of the levee crest using bay mud deposits is feasible. A project specific geotechnical report is recommended to develop earthwork recommendations.

- Average theoretical seepage from the oxidation ponds to the bay through the levee materials is insignificant (0.01 gpm for the entire levee system) and the rate of movement (<1 foot/year) is such that any seepage would likely result in attenuation of wastewater constituents to below regulated levels.

- There is a potential for preferential seepage from the oxidation ponds to the bay through higher permeability sediments within and below the levee system. While flow on the order of 0.1 gallons per minute was observed at the levee toe during low tide at several locations, the source of flow was not confirmed. Several sources for the flow exist which are not mutually exclusive: 1) discharge of infiltrated rainwater; 2) discharge of bay water trapped behind the geotextile located under the rip-rap; 3) effluent seepage through the levee; and 4) effluent seepage under the levee. Chemical testing of the flow is recommended to aid in its characterization.

# 8.0 REFERENCES

Arcata Marsh & Wildlife Sanctuary | Arcata, CA." Arcata Marsh & Wildlife Sanctuary | Arcata, CA. N.p., n.d. Web. 08 Feb. 2017.

Bowles, J. E., 1977, Foundation Analysis and Design, McGraw-Hill, Inc., New York

LACO Associates, 2009, Geotechnical Soils Report, City of Arcata, Project # 6938.01/.02

# FIGURES

**Figure 1: Site Map and Boring Locations**

**Figure 2: Historical Channels**

| LACO<br>EUREKA • UKIAH • SANTA ROSA<br>1-800-515-5054 www.lacoassociates.com | PROJECT City of Arcata: WWTP Hydrogeo | BY VSD | FIGURE 1 |
|---|---|---|---|
| | CLIENT City of Arcata | DATE 2/23/2017 | |
| | LOCATION South G Street, Arcata, California | CHECK SJM | JOB NO. 6938.21 |
| | Site Map and Boring Locations | | |




LACO Associates and shall not be reused in whole or part for any other project without LACO Associates written authorization.

| LACO<br>EUREKA • UKIAH • SANTA ROSA<br>1-800-515-5054 www.lacoassociates.com | PROJECT City of Arcata: WWTP Hydrogeo | BY VSD | FIGURE 2 |
|---|---|---|---|
| | CLIENT City of Arcata | DATE 2/23/2017 | |
| | LOCATION South G Street, Arcata, California | CHECK SJM | JOB NO. 6938.21 |




LACO Associates and shall not be reused in whole or part for any other project without LACO Associates written authorization.

# APPENDIX 1

## Boring Logs

# BORING NUMBER B1



LACO
21 W. 4th Street, Eureka, California 95501 707 443-5054 Fax 707 443-0553
311 Main Street, Ukiah, California 95482 707 462-0222 Fax 707 462-0223
3450 Regional Parkway, Suite B2, Santa Rosa, California 95403 707 443-5054 Fax 707 443-0553
www.lacoassociates.com

**CLIENT** City of Arcata
**PROJECT NAME** Arcata Wastewaster Treatment Plant
**PROJECT NUMBER** 6938.21
**PROJECT LOCATION** 569 G Street, Arcata, CA
**DATE STARTED** 1/12/17 **COMPLETED** 1/12/17
**GROUND ELEVATION** 10 ft **HOLE SIZE** 2.5 inches
**DRILLING CONTRACTOR** LACO
**GROUND WATER LEVELS:**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 1.50 ft / Elev 8.50 ft
**LOGGED BY** VSD **CHECKED BY** VSD
**AT END OF DRILLING** ---
**NOTES**
**AFTER DRILLING** ---

| DEPTH (ft) | SAMPLE TYPE NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|
| 0.0 | | OL | | (OL) Organic Soil, dark brown, moist, firm, medium plasticity, ~ 10% fine sand |
| 0.8 | | | | 9.3 |
| | | CL | | (CL) Lean Clay, medium to dark brown, moist, soft, low to medium plasticity, ~10% fine sand |
| | | | | ▽ |
| 2.3 | | | | 7.8 |
| 2.5 | | SP-SC | | (SP-SC) Poorly Graded Sand with Silt, dark green and brown, wet, medium dense, low to medium plasticity, fine sand |
| 4.0 | | | | 6.0 |
| | | CL | | (CL) Lean Clay, medium gray, moist, firm, low to medium plasticity, fine sand |
| 5.0 | | | | |
| 6.5 | | | | 3.5 |

Bottom of borehole at 6.5 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/7/17 09:48 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\6938.21 AWWTP.GPJ

# BORING NUMBER B2



LACO
21 W. 4th Street, Eureka, California 95501 707 443-5054 Fax 707 443-0553
311 Main Street, Ukiah, California 95482 707 462-0222 Fax 707 462-0223
3450 Regional Parkway, Suite B2, Santa Rosa, California 95403 707 443-5054 Fax 707 443-0553
www.lacoassociates.com

**CLIENT** City of Arcata
**PROJECT NAME** Arcata Wastewater Treatment Plant
**PROJECT NUMBER** 6938.21
**PROJECT LOCATION** 569 G Street, Arcata, CA
**DATE STARTED** 1/12/17 **COMPLETED** 1/12/17
**GROUND ELEVATION** 11 ft **HOLE SIZE** 2.5 inches
**DRILLING CONTRACTOR** LACO
**GROUND WATER LEVELS:**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 2.00 ft / Elev 9.00 ft
**LOGGED BY** VSD **CHECKED BY** VSD
**AT END OF DRILLING** ---
**NOTES**
**AFTER DRILLING** ---

| DEPTH (ft) | SAMPLE TYPE NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|
| 0 | | OL | | (OL) Organic Soil, dark brown, moist, soft, medium plasticity, ~ 10% fine sand |
| | | | | 0.8 — 10.3 |
| 1 | | CL | | (CL) Lean Clay, light to medium brown, moist, soft, low to medium plasticity, ~10% fine sand: roots present |
| 2 | | | | 2.0 ▽ — 9.0 |
| | | CL | | (CL) Lean Clay with Sand, gray, wet, low to medium plasticity, ~15% fine sand |
| 3 | | | | 3.5 — 7.5 |
| | | | | Bottom of borehole at 3.5 feet. |

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/7/17 09:48 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\6938.21 AWWTP.GPJ

# BORING NUMBER B3



LACO
21 W. 4th Street, Eureka, California 95501 707 443-5054 Fax 707 443-0553
311 Main Street, Ukiah, California 95482 707 462-0222 Fax 707 462-0223
3450 Regional Parkway, Suite B2, Santa Rosa, California 95403 707 443-5054 Fax 707 443-0553
www.lacoassociates.com

**CLIENT** City of Arcata
**PROJECT NAME** Arcata Wastewaster Treatment Plant
**PROJECT NUMBER** 6938.21
**PROJECT LOCATION** 569 G Street, Arcata, CA
**DATE STARTED** 1/12/17 **COMPLETED** 1/12/17
**GROUND ELEVATION** 12 ft **HOLE SIZE** 2.5 inches
**DRILLING CONTRACTOR** LACO
**GROUND WATER LEVELS:**
**DRILLING METHOD** Hand Auger
**AT TIME OF DRILLING** --- Not Encountered
**LOGGED BY** VSD **CHECKED BY** VSD
**AT END OF DRILLING** ---
**NOTES**
**AFTER DRILLING** ---

| DEPTH (ft) | SAMPLE TYPE NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION | |
|---|---|---|---|---|---|
| 0 | | OL | | (OL) Organic Soil, dark brown, moist, medium stiff, plastic fines, fine sand | |
| | | | | | 0.5 |
| | | CL | | (CL) Lean Clay with Gravel, medium brown, moist, low to medium plasticity, fine sand | |
| 1 | | | | | |
| 2 | | | | | |
| | | | | | 2.3 |
| | | CL | | (CL) Lean Clay, dark brown, moist, soft, low to medium plasticity, fine sand | |
| 3 | | | | | 3.0 |
| | | CL-ML | | (CL-ML) Lean Clay, dark gray, moist, stiff, low to medium plasticity, fine sand | |
| 4 | | | | | |
| | | | | | 4.3 |
| | | | | Bottom of borehole at 4.3 feet. | |

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/7/17 09:49 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\6938.21 AWWTP.GPJ

# BORING NUMBER B4



LACO
21 W. 4th Street, Eureka, California 95501 707 443-5054 Fax 707 443-0553
311 Main Street, Ukiah, California 95482 707 462-0222 Fax 707 462-0223
3450 Regional Parkway, Suite B2, Santa Rosa, California 95403 707 443-5054 Fax 707 443-0553
www.lacoassociates.com

**CLIENT** City of Arcata
**PROJECT NAME** Arcata Wastewaster Treatment Plant
**PROJECT NUMBER** 6938.21
**PROJECT LOCATION** 569 G Street, Arcata, CA
**DATE STARTED** 1/19/17 **COMPLETED** 1/19/17
**GROUND ELEVATION** 14 ft **HOLE SIZE** 2.5 inches
**DRILLING CONTRACTOR** LACO
**GROUND WATER LEVELS:**
**DRILLING METHOD** Hand Auger
**AT TIME OF DRILLING** --- Not Encountered
**LOGGED BY** SJM **CHECKED BY** SJM
**AT END OF DRILLING** ---
**NOTES**
**AFTER DRILLING** ---

| DEPTH (ft) | SAMPLE TYPE NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|
| 0.0 | | OL | | (OL) Organic Soil, dark brown, moist, medium stiff, plastic fines, fine sand |
| 2.0 | | | | |
| 2.5 | | CL | | (CL) Lean Clay, dark brown, moist, soft, low to medium plasticity, fine sand |
| 5.0 | | | | |
| 6.0 | | | | |
| 7.5 | | CL | | (CL) Lean Clay, dark gray, moist, stiff, low to medium plasticity, fine sand |
| 7.5 | | CH | | (CH) Fat Clay, light gray, wet, stiff to hard, high plasticity; Bay Mud |
| 9.0 | | | | Bottom of borehole at 9.0 feet. |

12.0
8.0
6.5
5.0

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 2/7/17 09:49 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\6938.21 AWWTP.GPJ

# APPENDIX 2

## Laboratory Results

# Hydraulic Conductivity
**ASTM D 5084**
Method C: Falling Head Rising Tailwater

| | | | | | |
|---|---|---|---|---|---|
| **Job No:** | 592-045 | **Boring:** | B-1 | **Date:** | 02/06/17 |
| **Client:** | Laco Associates | **Sample:** | | **By:** | MD/PJ |
| **Project:** | 6938.21 | **Depth, ft.:** | 4.8 | **Remolded:** | |

**Visual Classification:** Greenish Gray Sandy CLAY

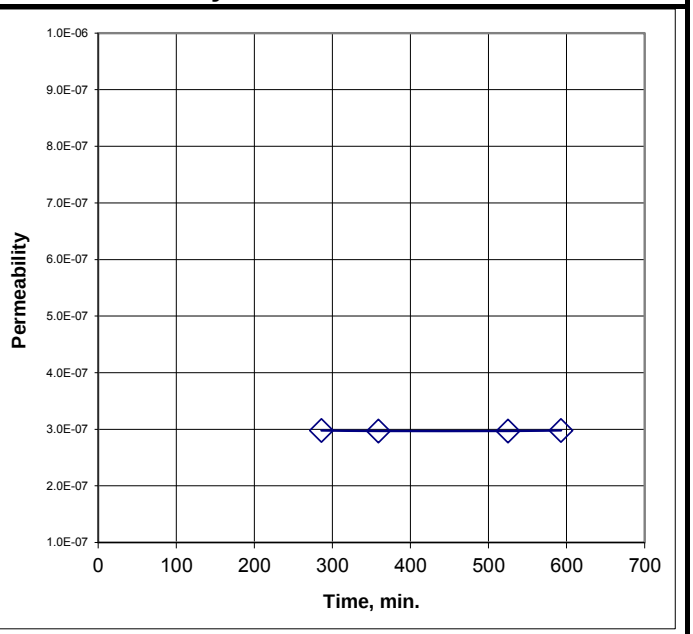
**Max Sample Pressures, psi:**

| Cell: | Bottom | Top | Avg. Sigma3 |
|---|---|---|---|
| 43.5 | 39 | 38 | 5 |

**B: =** >0.95 **("B" is an indication of saturation)**

**Max Hydraulic Gradient: =** 15

| Date | Minutes | Head, (in) | K,cm/sec |
|---|---|---|---|
| 1/31/2017 | 0.00 | 42.69 | Start of Test |
| 1/31/2017 | 286.00 | 38.99 | 3.0E-07 |
| 1/31/2017 | 359.00 | 38.09 | 3.0E-07 |
| 1/31/2017 | 525.00 | 36.09 | 3.0E-07 |
| 1/31/2017 | 593.00 | 35.29 | 3.0E-07 |




**Average Hydraulic Conductivity: 3.E-07 cm/sec**

| Sample Data: | Initial (As-Received) | | Final (At-Test) |
|---|---|---|---|
| Height, in | 2.98 | | 2.80 |
| Diameter, in | 2.97 | | 2.95 |
| Area, in2 | 6.93 | | 6.82 |
| Volume in3 | 20.61 | | 19.09 |
| Total Volume, cc | 337.7 | | 312.8 |
| Volume Solids, cc | 171.7 | | 171.7 |
| Volume Voids, cc | 166.1 | | 141.1 |
| Void Ratio | 1.0 | | 0.8 |
| Total Porosity, % | 49.2 | | 45.1 |
| Air-Filled Porosity (θa),% | 2.9 | | 1.3 |
| Water-Filled Porosity (θw),% | 46.3 | | 43.8 |
| Saturation, % | 94.1 | | 97.1 |
| Specific Gravity | 2.70 | Assumed | 2.70 |
| Wet Weight, gm | 619.7 | | 600.5 |
| Dry Weight, gm | 463.5 | | 463.5 |
| Tare, gm | 0.00 | | 0.00 |
| Moisture, % | 33.7 | | 29.6 |
| Wet Bulk Density, pcf | 114.5 | | 119.8 |
| Dry Bulk Density, pcf | 85.6 | | 92.5 |
| Wet Bulk Dens.ρb, (g/cm$^3$) | 1.83 | | 1.92 |
| Dry Bulk Dens.ρb, (g/cm$^3$) | 1.37 | | 1.48 |

Remarks:

# Hydraulic Conductivity
**ASTM D 5084**
Method C: Falling Head Rising Tailwater

| | | | | | |
|---|---|---|---|---|---|
| **Job No:** | 592-045 | **Boring:** | B-2 | **Date:** | 02/07/17 |
| **Client:** | Laco Associates | **Sample:** | | **By:** | MD/PJ |
| **Project:** | 6938.21 | **Depth, ft.:** | 2.5 | **Remolded:** | |

**Visual Classification:** Greenish Gray CLAY w/ organics

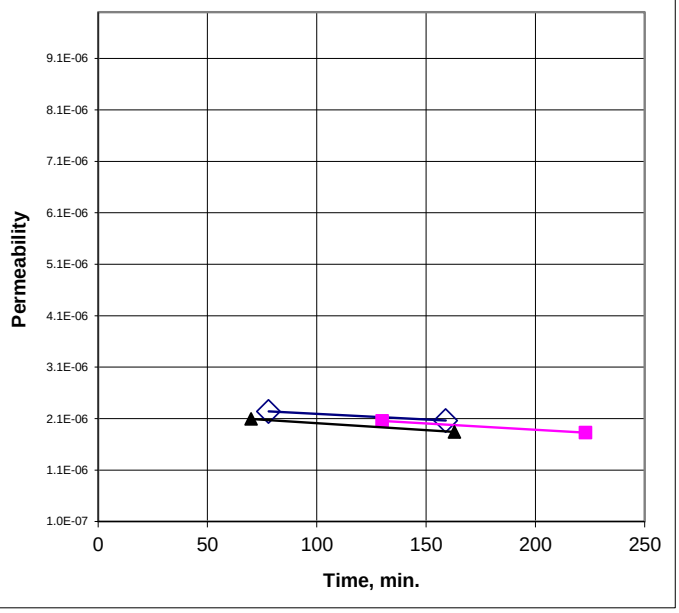
**Max Sample Pressures, psi:**

| Cell: | Bottom | Top | Avg. Sigma3 |
|---|---|---|---|
| 53.5 | 49 | 48 | 5 |

**B: =** >0.95 **("B" is an indication of saturation)**

**Max Hydraulic Gradient: =** 12

| Date | Minutes | Head, (in) | K,cm/sec |
|---|---|---|---|
| 2/1/2017 | 0.00 | 29.79 | Start of Test |
| 2/1/2017 | 78.00 | 25.29 | 2.2E-06 |
| 2/1/2017 | 159.00 | 21.89 | 2.1E-06 |
| 2/2/2017 | 130.00 | 27.89 | 2.1E-06 |
| 2/2/2017 | 223.00 | 24.29 | 1.8E-06 |
| 2/3/2017 | 70.00 | 29.69 | 2.1E-06 |
| 2/3/2017 | 163.00 | 25.49 | 1.8E-06 |




**Average Hydraulic Conductivity: 2.E-06 cm/sec**

| Sample Data: | Initial (As-Received) | | Final (At-Test) |
|---|---|---|---|
| **Height, in** | 2.96 | | 2.95 |
| **Diameter, in** | 2.88 | | 2.86 |
| **Area, in2** | 6.51 | | 6.42 |
| **Volume in3** | 19.28 | | 18.92 |
| **Total Volume, cc** | 316.0 | | 310.0 |
| **Volume Solids, cc** | 134.9 | | 134.9 |
| **Volume Voids, cc** | 181.1 | | 175.1 |
| **Void Ratio** | 1.3 | | 1.3 |
| **Total Porosity, %** | 57.3 | | 56.5 |
| **Air-Filled Porosity (θa),%** | 3.2 | | 0.0 |
| **Water-Filled Porosity (θw),%** | 54.1 | | 56.5 |
| **Saturation, %** | 94.4 | | 99.9 |
| **Specific Gravity** | 2.70 | Assumed | 2.70 |
| **Wet Weight, gm** | 535.2 | | 539.2 |
| **Dry Weight, gm** | 364.2 | | 364.2 |
| **Tare, gm** | 0.00 | | 0.00 |
| **Moisture, %** | 47.0 | | 48.1 |
| **Wet Bulk Density, pcf** | 105.7 | | 108.5 |
| **Dry Bulk Density, pcf** | 71.9 | | 73.3 |
| **Wet Bulk Dens.ρb, (g/cm$^3$)** | 1.69 | | 1.74 |
| **Dry Bulk Dens.ρb, (g/cm$^3$)** | 1.15 | | 1.17 |

Remarks:

# Hydraulic Conductivity
**ASTM D 5084**
Method C: Falling Head Rising Tailwater

| | | | | | |
|---|---|---|---|---|---|
| **Job No:** | 592-045 | **Boring:** | B-3 | **Date:** | 02/07/17 |
| **Client:** | Laco Associates | **Sample:** | | **By:** | MD/PJ |
| **Project:** | 6938.21 | **Depth, ft.:** | 5.3 | **Remolded:** | |

**Visual Classification:** Greenish Gray CLAY

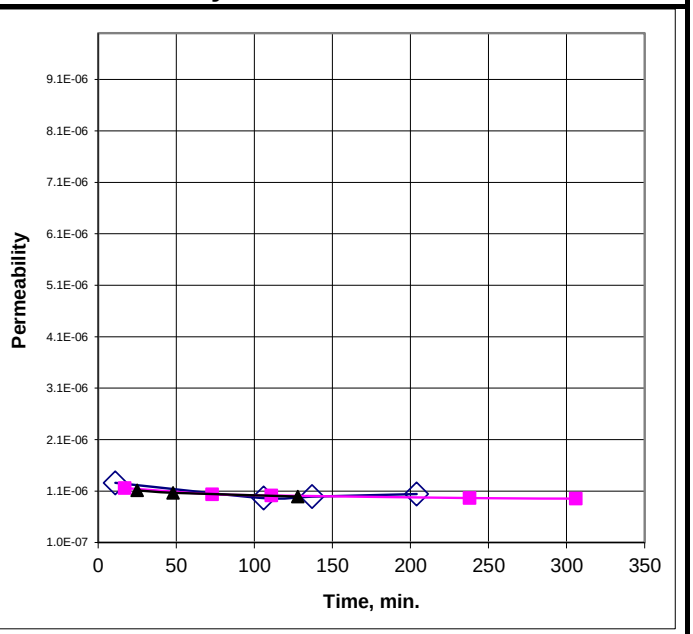
**Max Sample Pressures, psi:**

| Cell: | Bottom | Top | Avg. Sigma3 |
|---|---|---|---|
| 43.5 | 39 | 38 | 5 |

**B: =** >0.95 **("B" is an indication of saturation)**

**Max Hydraulic Gradient: =** 14

| Date | Minutes | Head, (in) | K,cm/sec |
|---|---|---|---|
| 1/31/2017 | 0.00 | 42.69 | Start of Test |
| 1/31/2017 | 11.00 | 42.14 | 1.3E-06 |
| 1/31/2017 | 106.00 | 38.74 | 9.6E-07 |
| 1/31/2017 | 137.00 | 37.49 | 9.9E-07 |
| 1/31/2017 | 204.00 | 34.84 | 1.0E-06 |
| 1/31/2017 | 17.00 | 41.89 | 1.2E-06 |
| 1/31/2017 | 73.00 | 39.69 | 1.0E-06 |
| 1/31/2017 | 111.00 | 38.29 | 1.0E-06 |
| 1/31/2017 | 238.00 | 34.19 | 9.6E-07 |
| 1/31/2017 | 306.00 | 32.19 | 9.5E-07 |
| 2/1/2017 | 25.00 | 41.59 | 1.1E-06 |
| 2/1/2017 | 48.00 | 40.69 | 1.1E-06 |
| 2/1/2017 | 128.00 | 37.89 | 9.9E-07 |




**Average Hydraulic Conductivity: 1.E-06 cm/sec**

| Sample Data: | Initial (As-Received) | | Final (At-Test) |
|---|---|---|---|
| **Height, in** | 2.97 | | 2.95 |
| **Diameter, in** | 2.87 | | 2.87 |
| **Area, in2** | 6.47 | | 6.45 |
| **Volume in3** | 19.21 | | 18.99 |
| **Total Volume, cc** | 314.9 | | 311.1 |
| **Volume Solids, cc** | 154.3 | | 154.3 |
| **Volume Voids, cc** | 160.5 | | 156.8 |
| **Void Ratio** | 1.0 | | 1.0 |
| **Total Porosity, %** | 51.0 | | 50.4 |
| **Air-Filled Porosity (θa),%** | 1.5 | | 2.0 |
| **Water-Filled Porosity (θw),%** | 49.5 | | 48.4 |
| **Saturation, %** | 97.0 | | 96.1 |
| **Specific Gravity** | 2.70 | Assumed | 2.70 |
| **Wet Weight, gm** | 572.4 | | 567.3 |
| **Dry Weight, gm** | 416.6 | | 416.6 |
| **Tare, gm** | 0.00 | | 0.00 |
| **Moisture, %** | 37.4 | | 36.2 |
| **Wet Bulk Density, pcf** | 113.4 | | 113.8 |
| **Dry Bulk Density, pcf** | 82.6 | | 83.6 |
| **Wet Bulk Dens.ρb, (g/cm$^3$)** | 1.82 | | 1.82 |
| **Dry Bulk Dens.ρb, (g/cm$^3$)** | 1.32 | | 1.34 |

Remarks:

# Hydraulic Conductivity
**ASTM D 5084**
Method C: Falling Head Rising Tailwater

| | | | | | |
|---|---|---|---|---|---|
| **Job No:** | 592-046 | **Boring:** | B-4 | **Date:** | 02/09/17 |
| **Client:** | Laco Associates | **Sample:** | | **By:** | MD/PJ |
| **Project:** | 6938.21 | **Depth, ft.:** | 8-9 | **Remolded:** | |

**Visual Classification:** Very Dark Greenish Gray CLAY (Bay Mud)

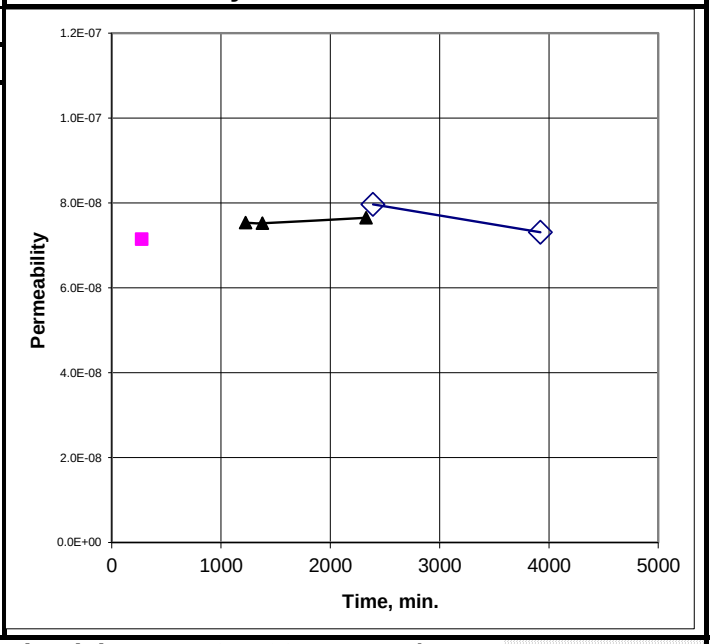
**Max Sample Pressures, psi:**

| Cell: | Bottom | Top | Avg. Sigma3 |
|---|---|---|---|
| 43.5 | 39.5 | 37.5 | 5 |

**B: =** >0.95 **("B" is an indication of saturation)**

**Max Hydraulic Gradient: =** 24

| Date | Minutes | Head, (in) | K,cm/sec |
|---|---|---|---|
| 2/3/2017 | 0.00 | 36.79 | Start of Test |
| 2/5/2017 | 2391.00 | 30.94 | 8.0E-08 |
| 2/6/2017 | 3922.00 | 27.89 | 7.3E-08 |
| 2/6/2017 | 274.00 | 41.59 | 7.1E-08 |
| 2/7/2017 | 1227.00 | 64.38 | 7.5E-08 |
| 2/7/2017 | 1380.00 | 63.68 | 7.5E-08 |
| 2/8/2017 | 2327.00 | 59.38 | 7.7E-08 |




**Average Hydraulic Conductivity: 8.E-08 cm/sec**

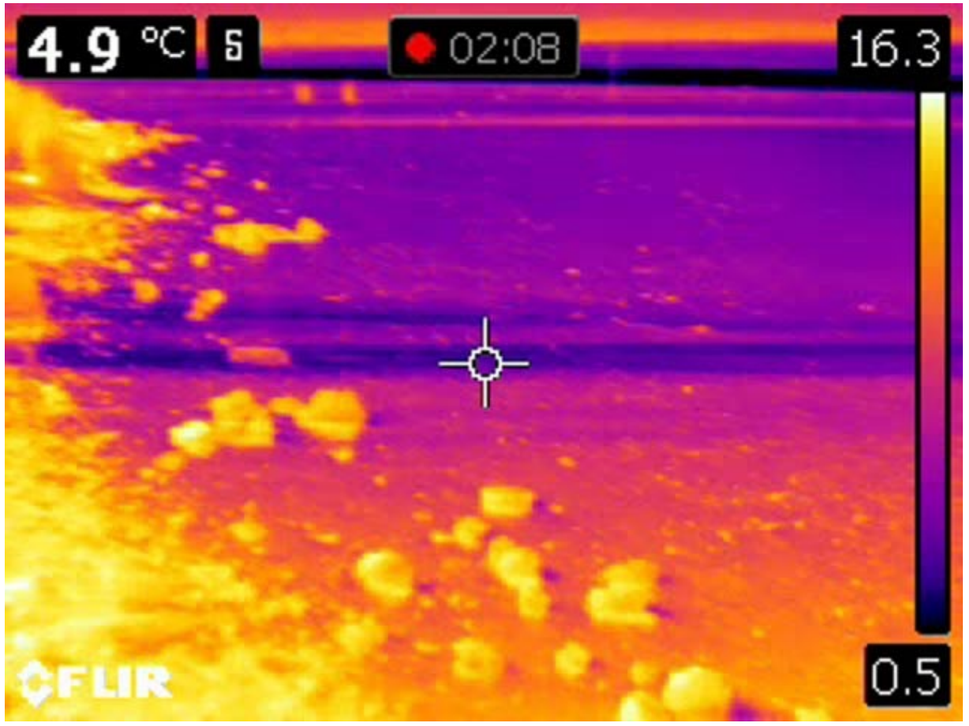
| Sample Data: | Initial (As-Received) | | Final (At-Test) |
|---|---|---|---|
| **Height, in** | 2.98 | | 2.94 |
| **Diameter, in** | 2.87 | | 2.83 |
| **Area, in2** | 6.45 | | 6.27 |
| **Volume in3** | 19.18 | | 18.43 |
| **Total Volume, cc** | 314.3 | | 302.0 |
| **Volume Solids, cc** | 137.5 | | 137.5 |
| **Volume Voids, cc** | 176.8 | | 164.5 |
| **Void Ratio** | 1.3 | | 1.2 |
| **Total Porosity, %** | 56.3 | | 54.5 |
| **Air-Filled Porosity (θa),%** | 0.5 | | 0.2 |
| **Water-Filled Porosity (θw),%** | 55.8 | | 54.3 |
| **Saturation, %** | 99.2 | | 99.7 |
| **Specific Gravity** | 2.70 | Assumed | 2.70 |
| **Wet Weight, gm** | 546.5 | | 535.2 |
| **Dry Weight, gm** | 371.2 | | 371.2 |
| **Tare, gm** | 0.00 | | 0.00 |
| **Moisture, %** | 47.2 | | 44.2 |
| **Wet Bulk Density, pcf** | 108.5 | | 110.6 |
| **Dry Bulk Density, pcf** | 73.7 | | 76.7 |
| **Wet Bulk Dens.ρb, (g/cm$^3$)** | 1.74 | | 1.77 |
| **Dry Bulk Dens.ρb, (g/cm$^3$)** | 1.18 | | 1.23 |

Remarks:

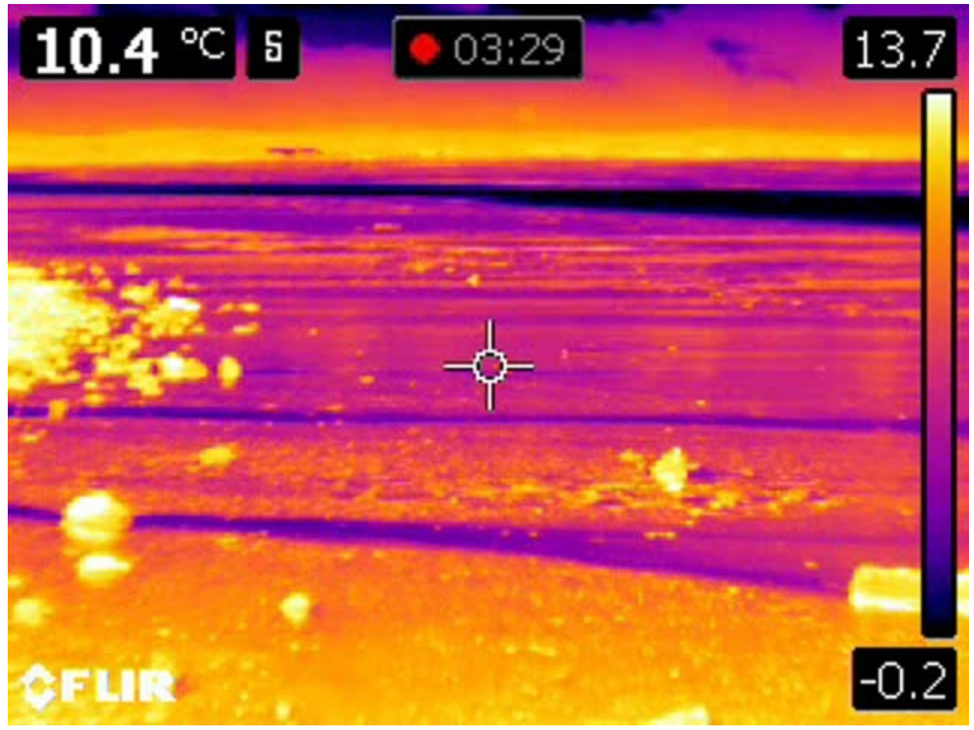
# APPENDIX 3

## Thermal Images of Possible Seeps

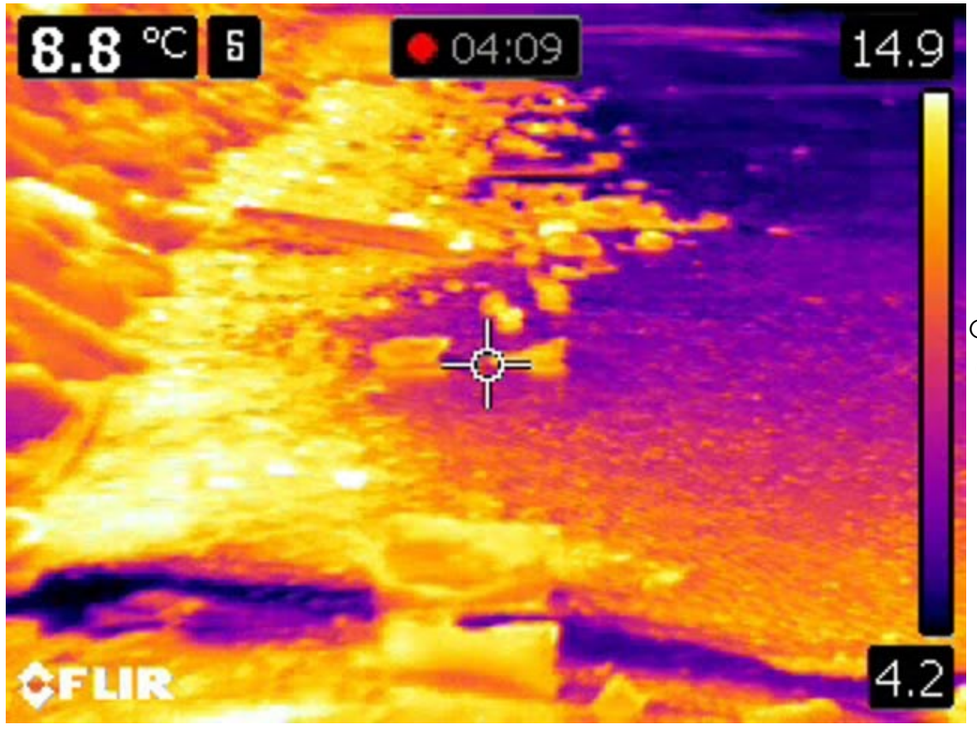
Possible Seep 1: approximately 450 feet from outfall



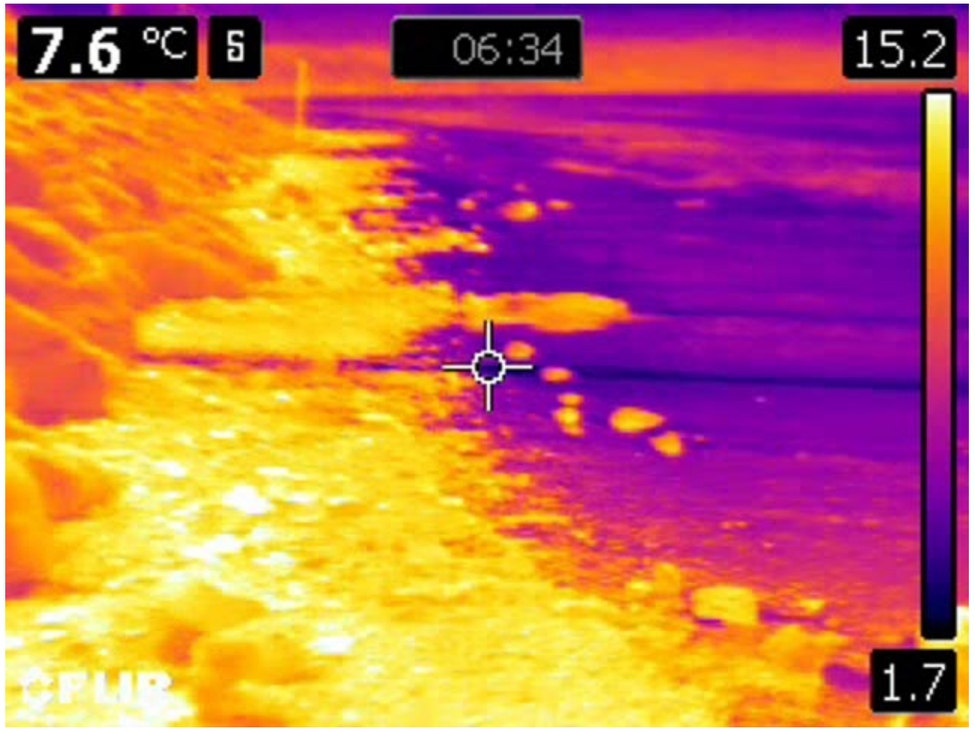

Possible Seep 2: approximately 480 feet from outfall



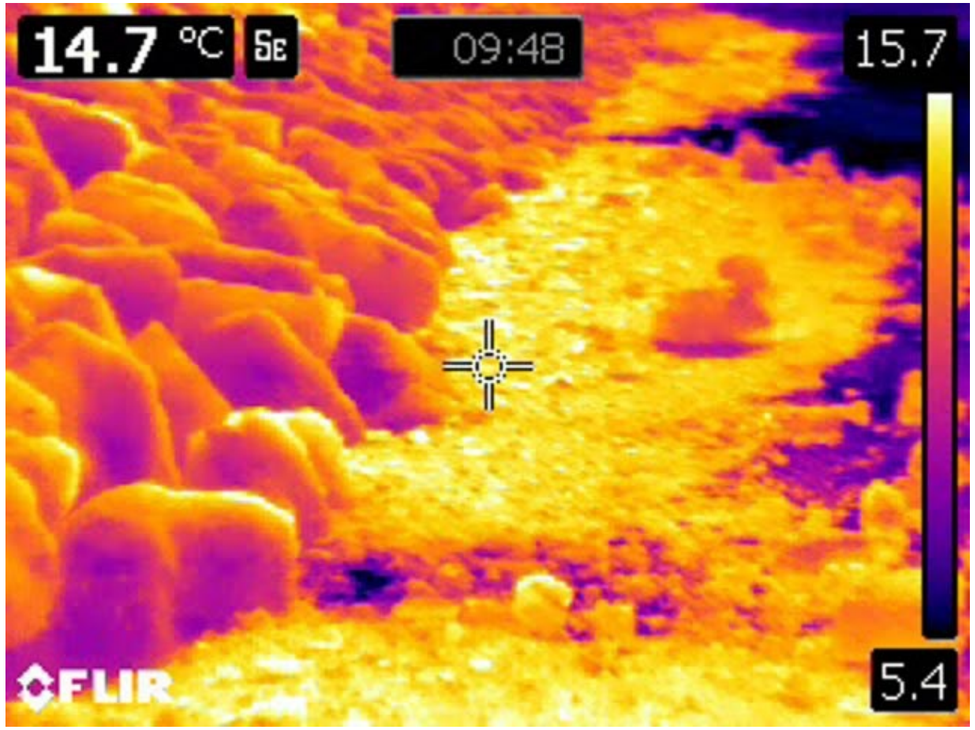

Other Channel noted by thermal observation



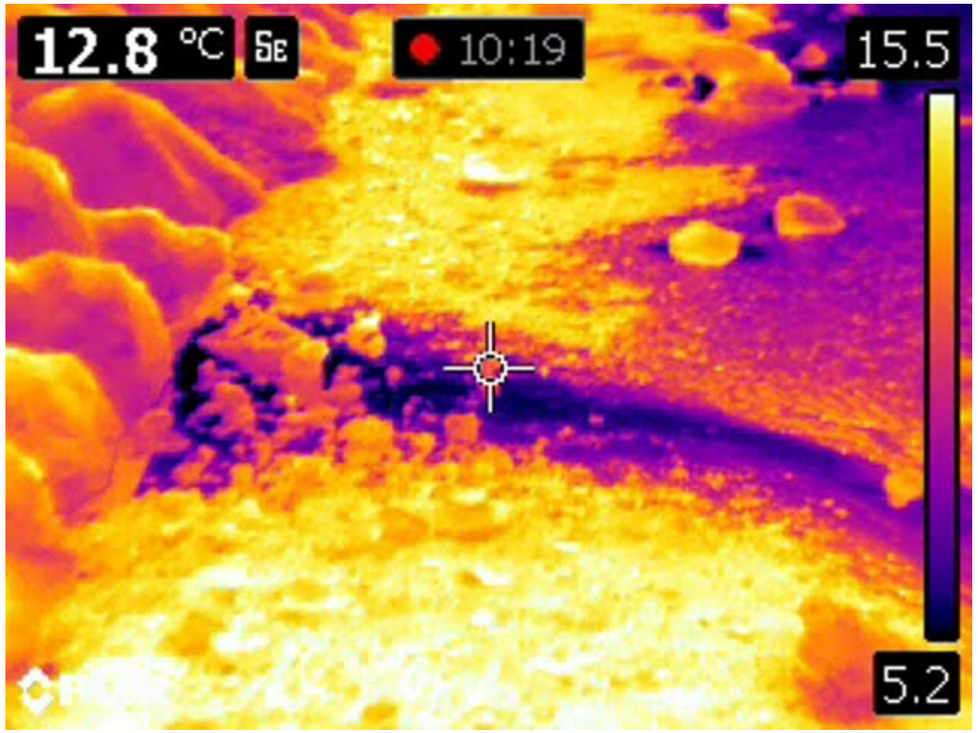

Other Channel noted by thermal observation



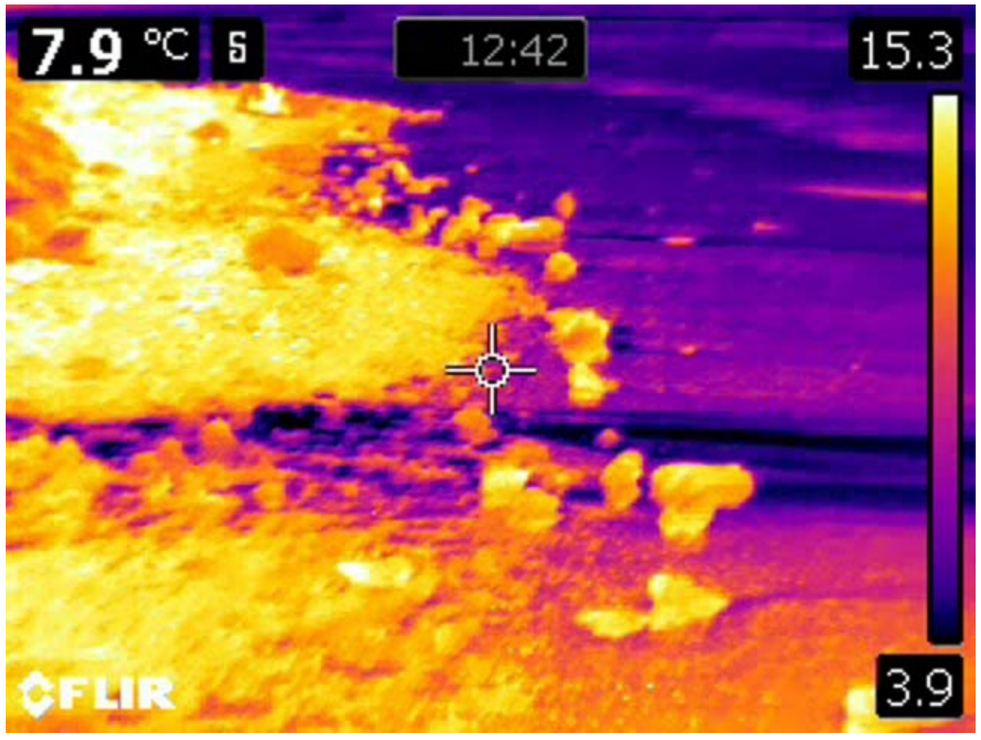
Possible Seep 3: approximately 1,500 feet from outfall



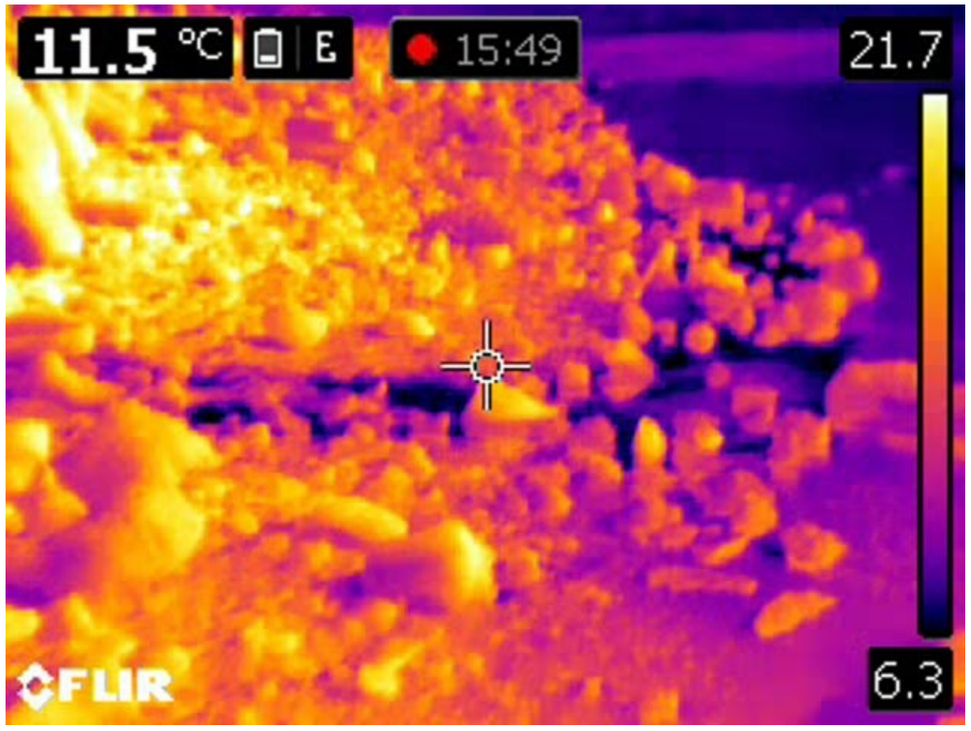

Possible Seep 4: approximately 1,700 feet from outfall



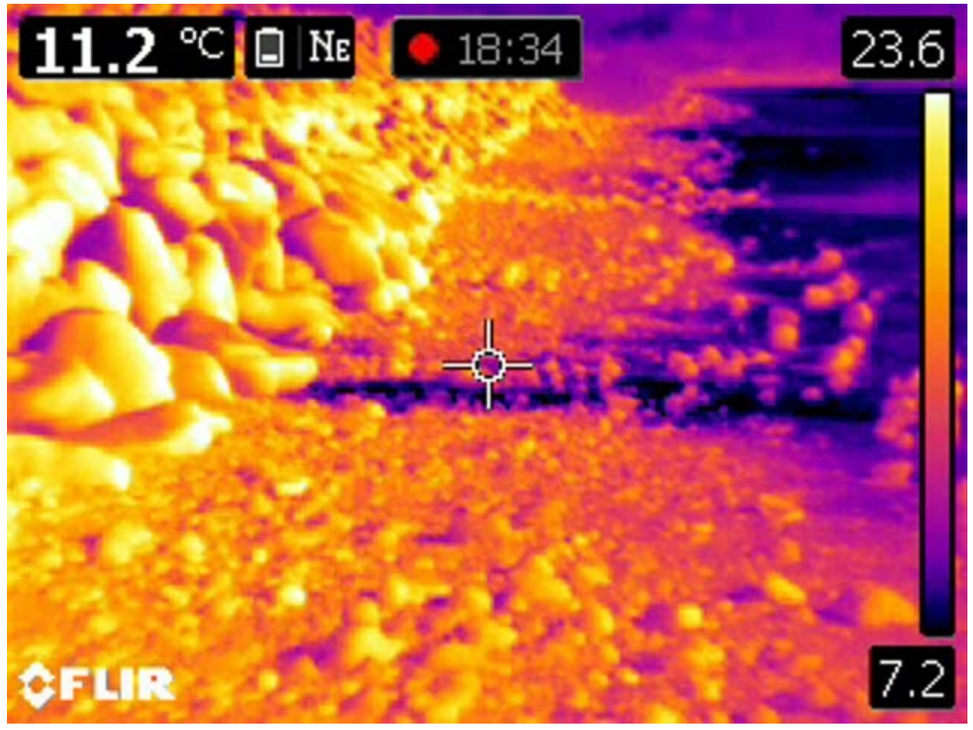

Possible Seep 5: approximately 1,740 feet from outfall



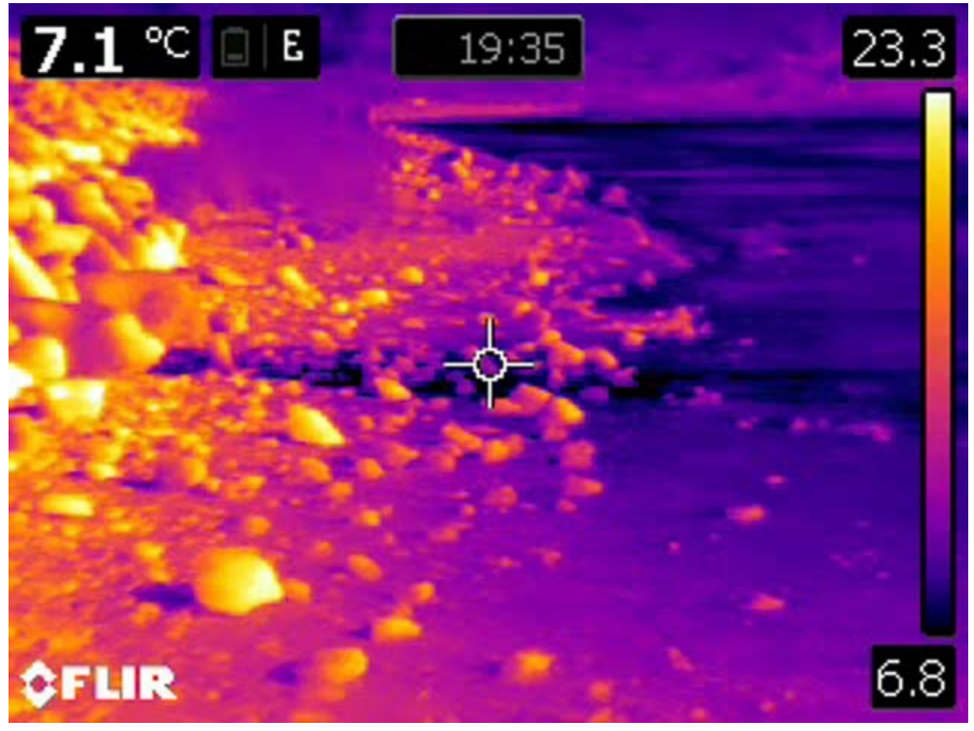

Possible Seep 6: approximately 1,750 feet from outfall



Possible Seep 7: approximately 900 feet from old out-fall

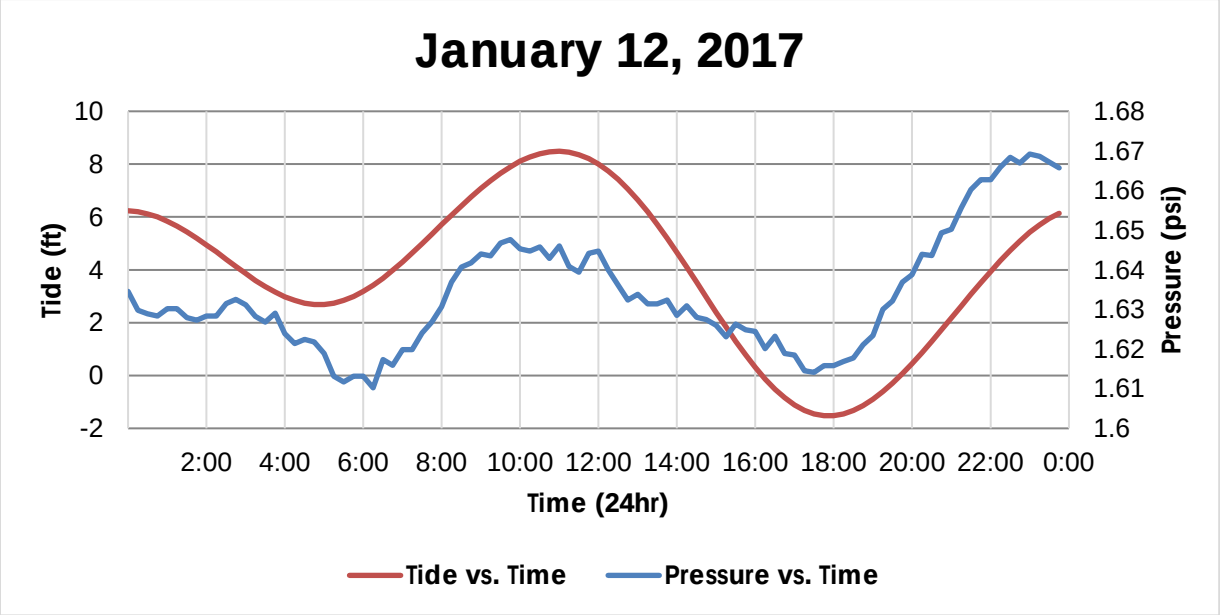


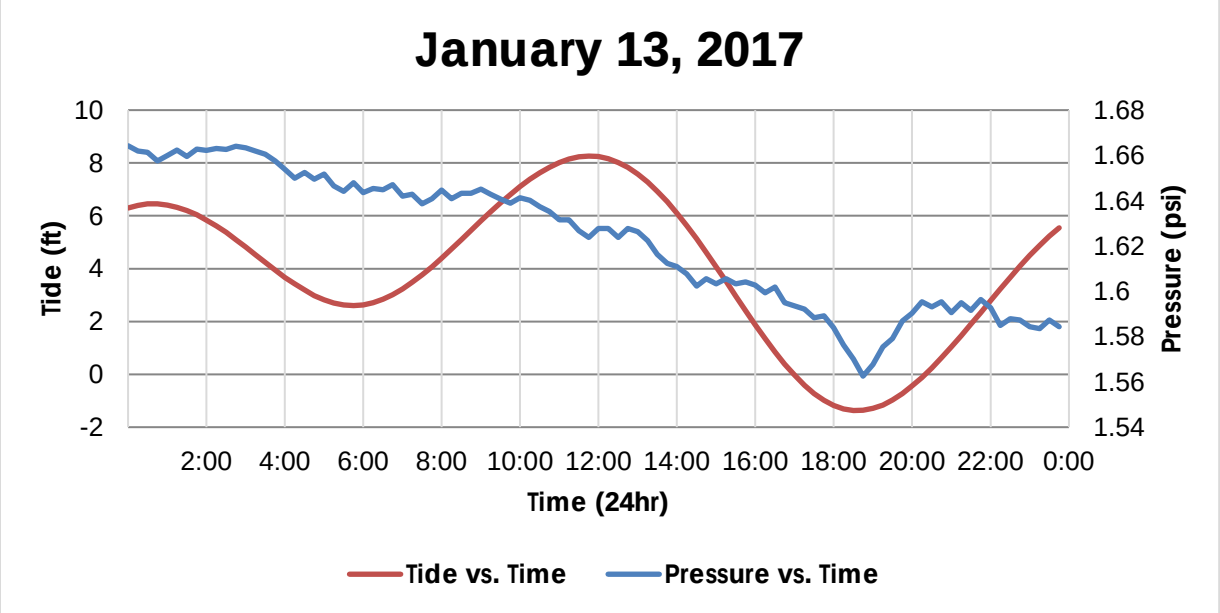

Possible Seep 8: approximately 530 feet from old outfall

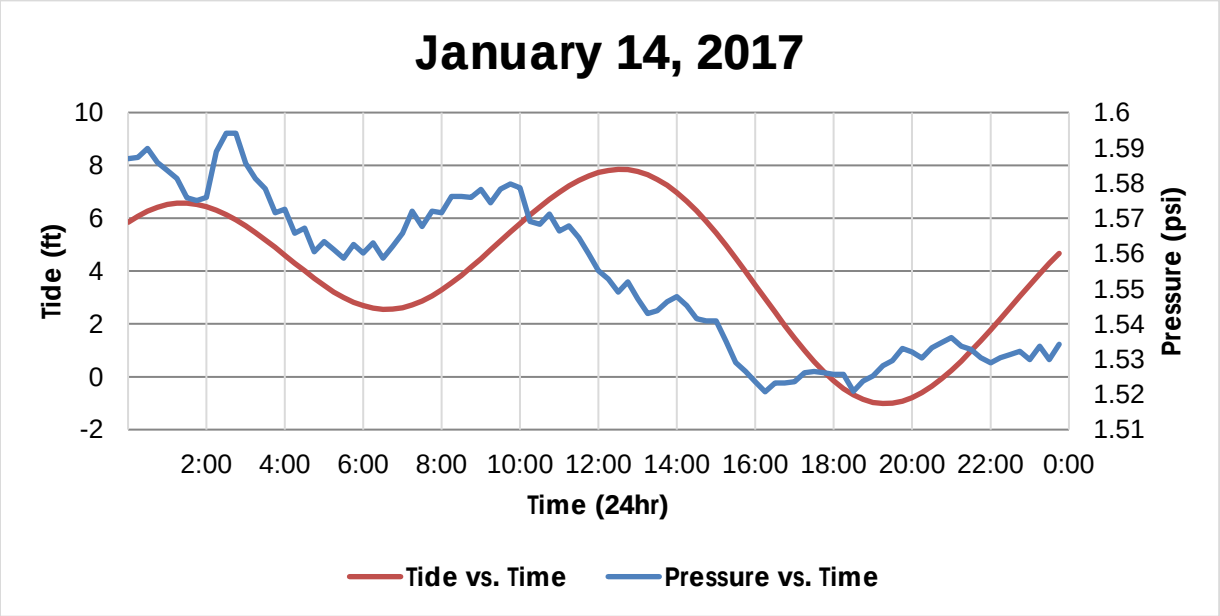


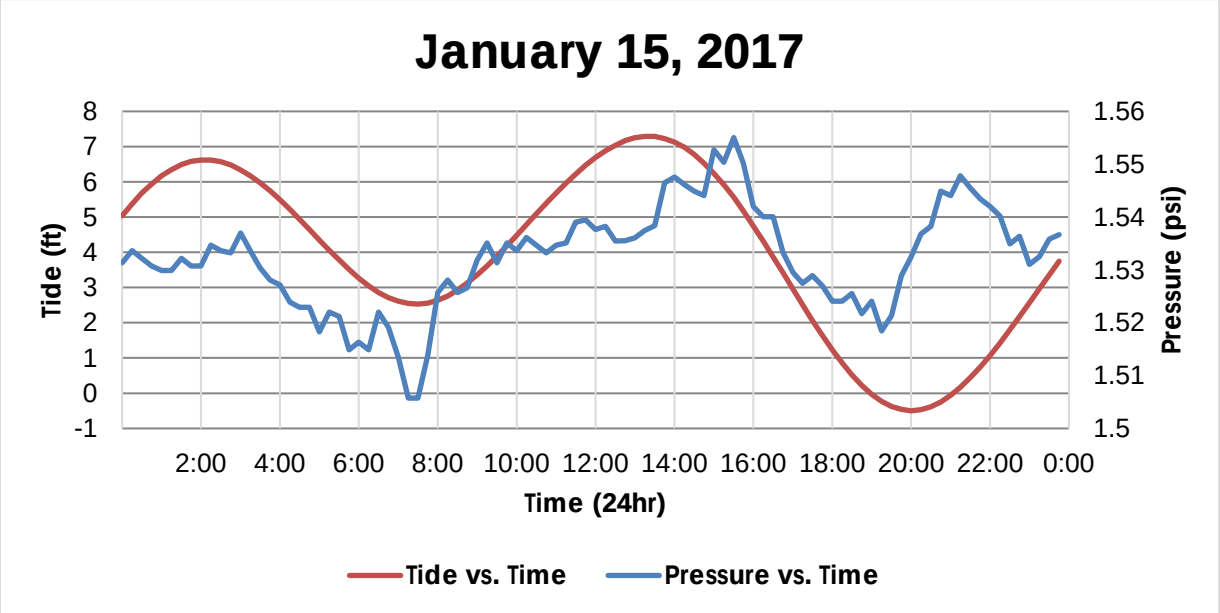
# APPENDIX 4

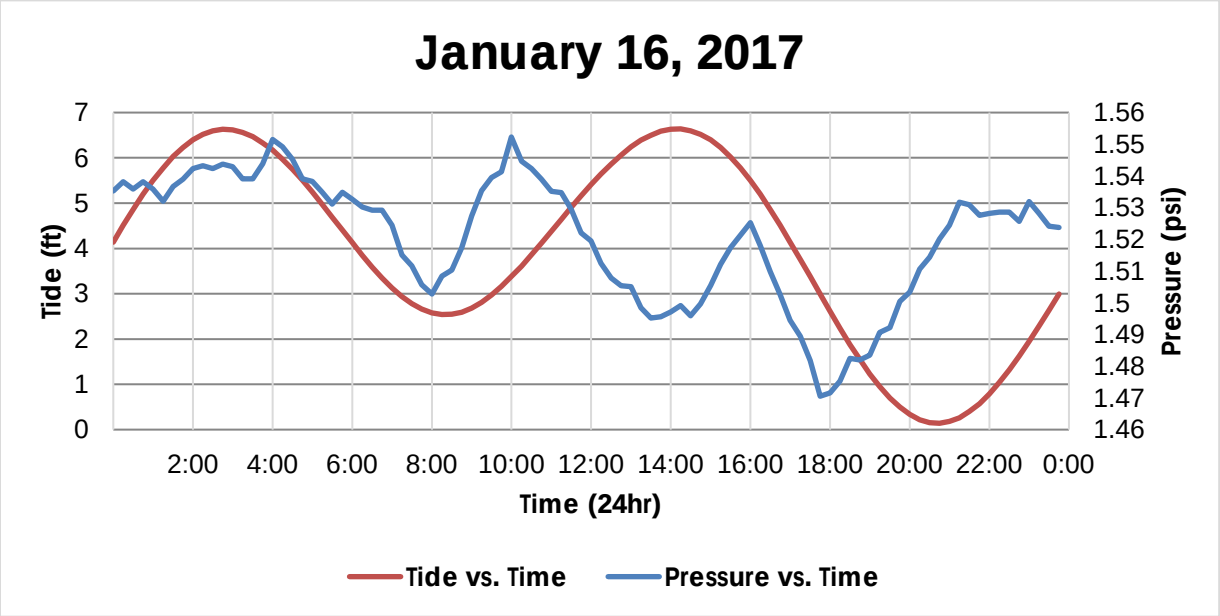
## Daily Tide and Pressure versus Time

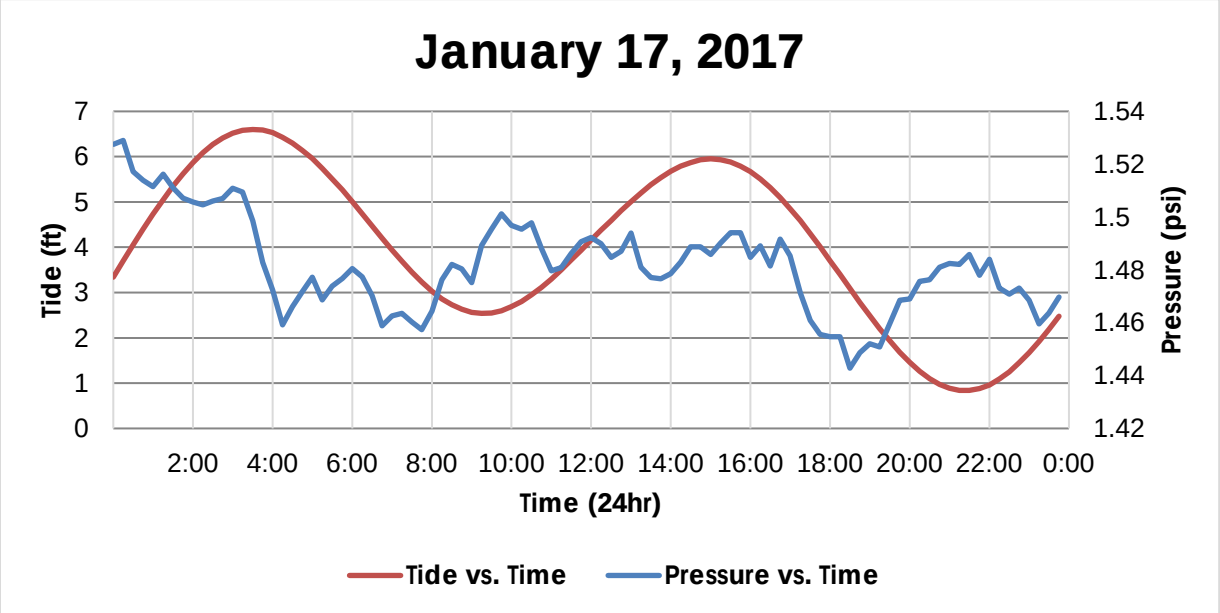

January 12, 2017
Tide (ft)
10
8
6
4
2
0
-2
Pressure (psi)
1.68
1.67
1.66
1.65
1.64
1.63
1.62
1.61
1.6
2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00
Time (24hr)
Tide vs. Time
Pressure vs. Time

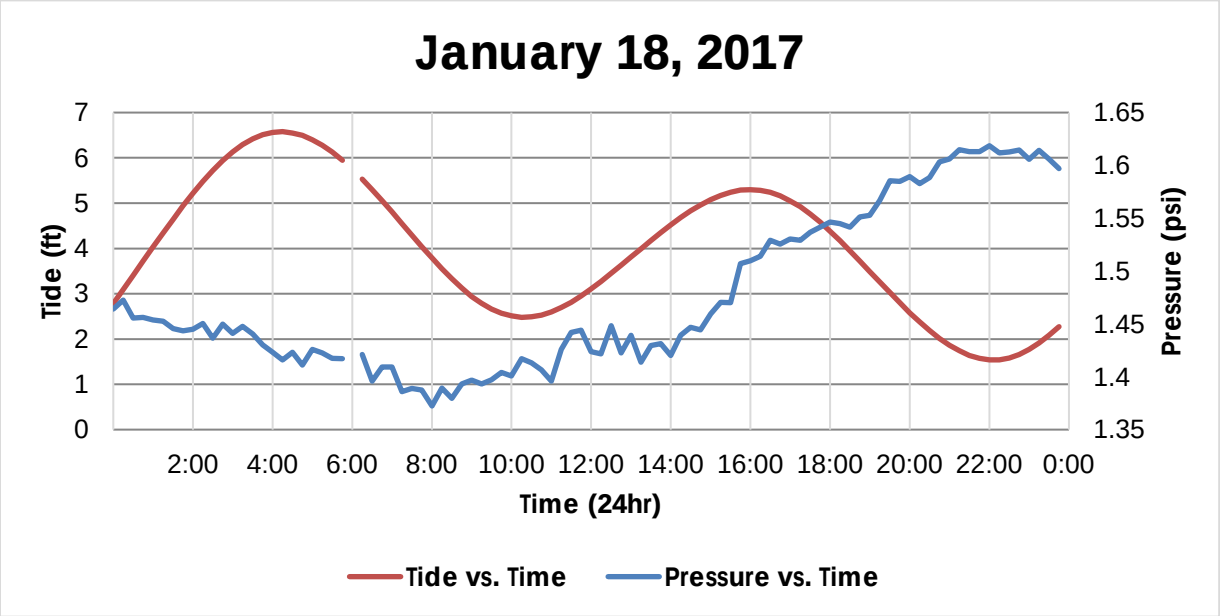

January 13, 2017
Tide (ft)
10
8
6
4
2
0
-2
Pressure (psi)
1.68
1.66
1.64
1.62
1.6
1.58
1.56
1.54
2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00
Time (24hr)
Tide vs. Time
Pressure vs. Time


January 14, 2017
Tide (ft)
10
8
6
4
2
0
-2
Pressure (psi)
1.6
1.59
1.58
1.57
1.56
1.55
1.54
1.53
1.52
1.51
2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00
Time (24hr)
Tide vs. Time
Pressure vs. Time


January 15, 2017
Tide (ft)
8
7
6
5
4
3
2
1
0
-1
Pressure (psi)
1.56
1.55
1.54
1.53
1.52
1.51
1.5
2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00
Time (24hr)
Tide vs. Time
Pressure vs. Time


January 16, 2017
Tide (ft)
Pressure (psi)
Time (24hr)
2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00
Tide vs. Time
Pressure vs. Time


January 17, 2017
Tide (ft)
Pressure (psi)
Time (24hr)
2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00
Tide vs. Time
Pressure vs. Time


January 18, 2017
Tide (ft)
Pressure (psi)
7
6
5
4
3
2
1
0
1.65
1.6
1.55
1.5
1.45
1.4
1.35
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time (24hr)
Tide vs. Time
Pressure vs. Time

# APPENDIX 5

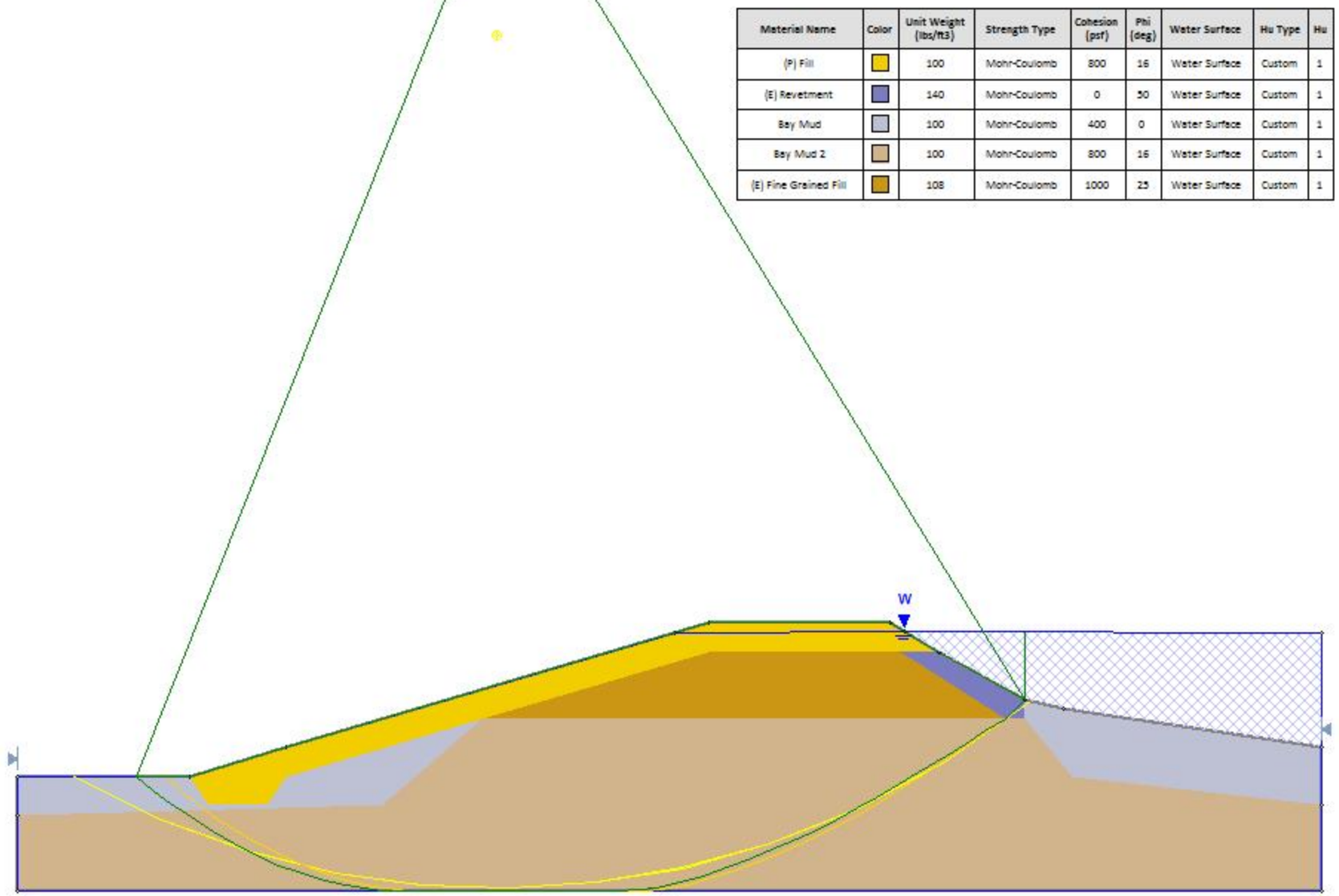
## Slope Stability Analysis

# SECTION 16+00, EMPTY POND - SEA LEVEL RISE - KING TIDE

1.491 Critical Failure Surface Factor of Safety

0.28 Pseudo Static Seismic Coefficent

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| (P) Fill | | 100 | Mohr-Coulomb | 800 | 16 | Water Surface | Custom | 1 |
| (E) Revetment | | 140 | Mohr-Coulomb | 0 | 50 | Water Surface | Custom | 1 |
| Bay Mud | | 100 | Mohr-Coulomb | 400 | 0 | Water Surface | Custom | 1 |
| Bay Mud 2 | | 100 | Mohr-Coulomb | 800 | 16 | Water Surface | Custom | 1 |
| (E) Fine Grained Fill | | 108 | Mohr-Coulomb | 1000 | 25 | Water Surface | Custom | 1 |

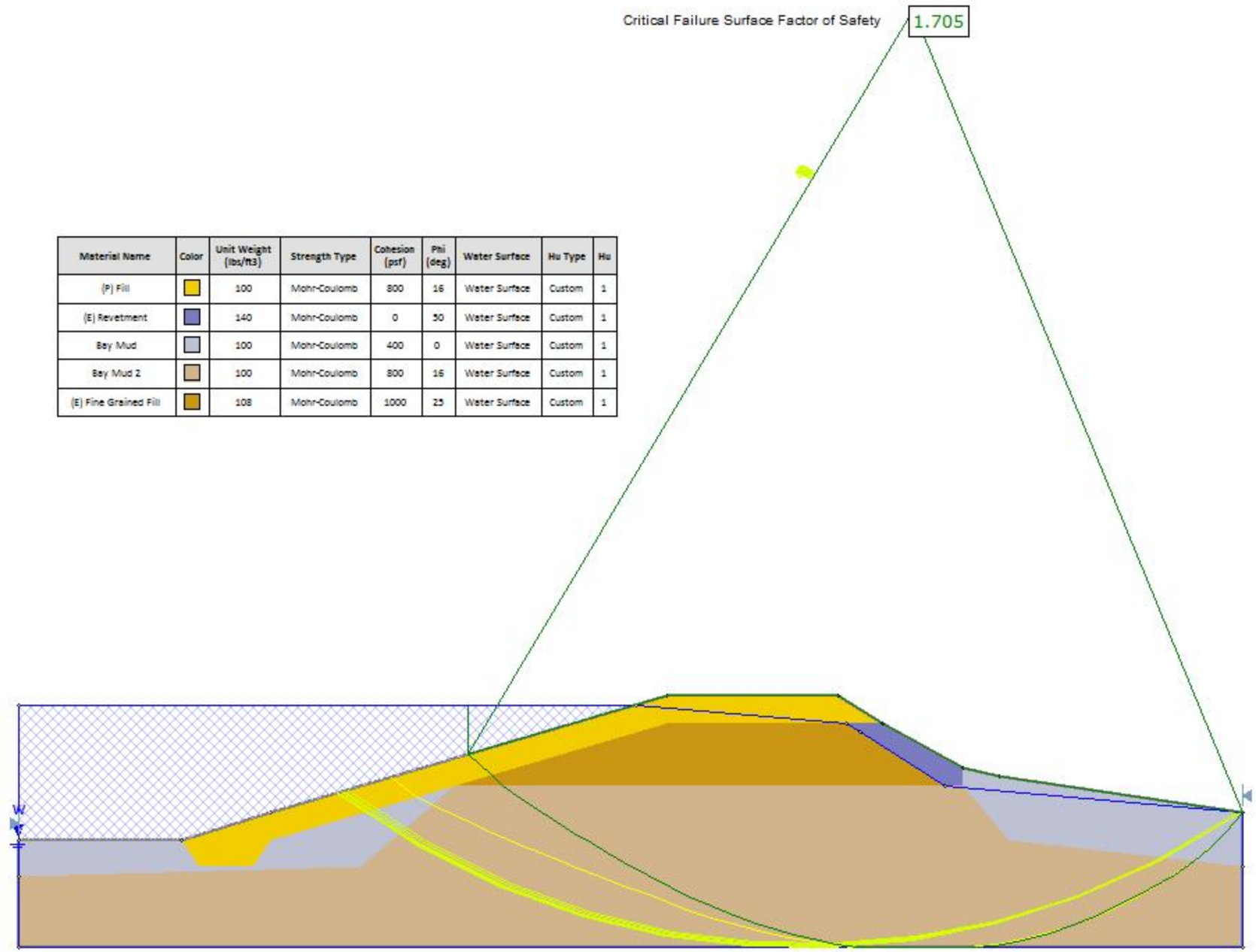


# SECTION 16+00, FULL POND - LOW TIDE

Pseudo Static Seismic Coefficent 0.28

Critical Failure Surface Factor of Safety 1.705

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| (P) Fill | | 100 | Mohr-Coulomb | 800 | 16 | Water Surface | Custom | 1 |
| (E) Revetment | | 140 | Mohr-Coulomb | 0 | 50 | Water Surface | Custom | 1 |
| Bay Mud | | 100 | Mohr-Coulomb | 400 | 0 | Water Surface | Custom | 1 |
| Bay Mud 2 | | 100 | Mohr-Coulomb | 800 | 16 | Water Surface | Custom | 1 |
| (E) Fine Grained Fill | | 108 | Mohr-Coulomb | 1000 | 25 | Water Surface | Custom | 1 |

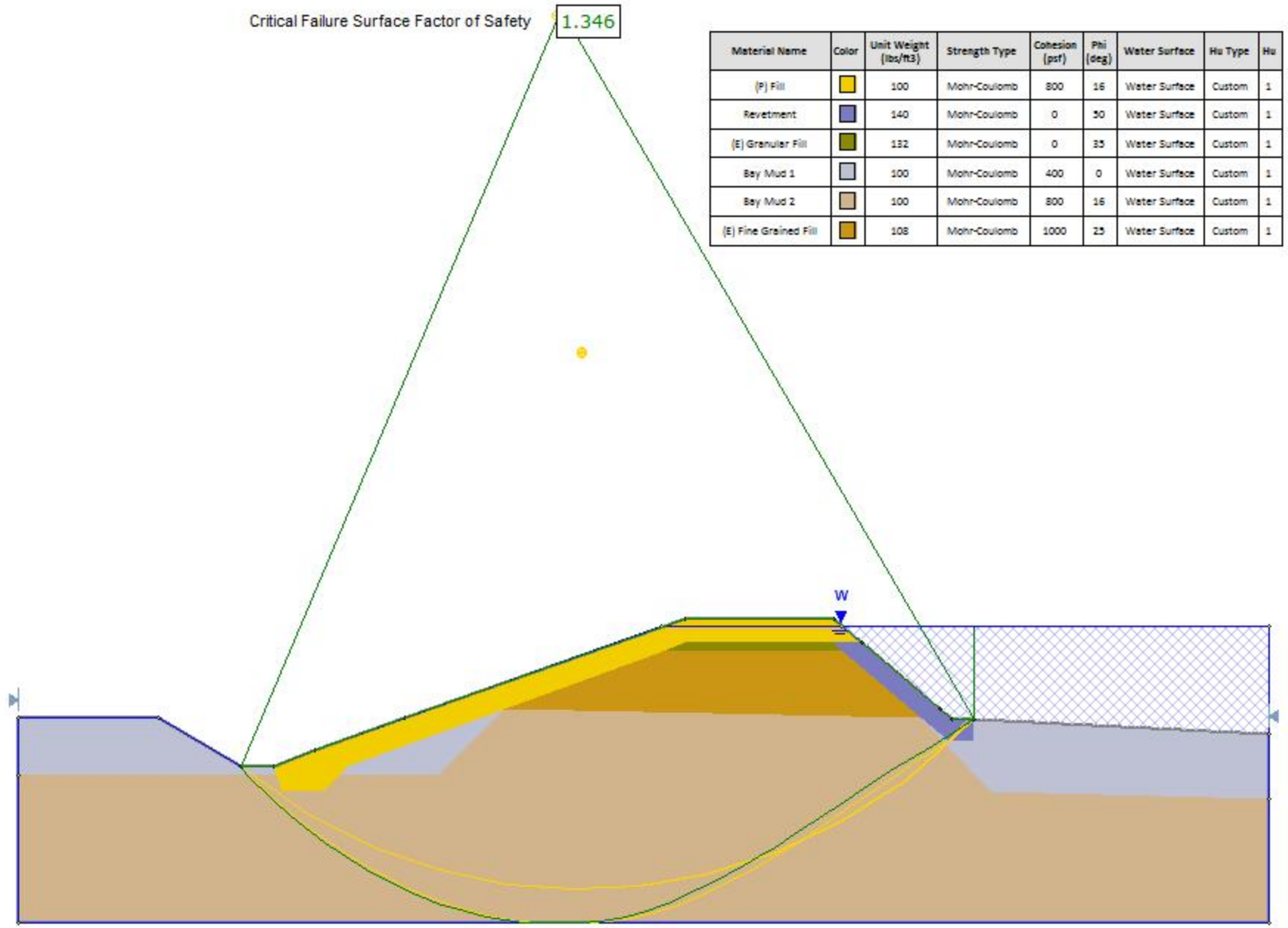


Pseudo Static Seismic Coefficent 0.28

# SECTION 31+00, EMPTY POND - SEA LEVEL RISE - KING TIDE

Critical Failure Surface Factor of Safety 1.346

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Hu Type | Hu |
|---|---|---|---|---|---|---|---|---|
| (P) Fill | | 100 | Mohr-Coulomb | 800 | 16 | Water Surface | Custom | 1 |
| Revetment | | 140 | Mohr-Coulomb | 0 | 50 | Water Surface | Custom | 1 |
| (E) Granular Fill | | 132 | Mohr-Coulomb | 0 | 35 | Water Surface | Custom | 1 |
| Bay Mud 1 | | 100 | Mohr-Coulomb | 400 | 0 | Water Surface | Custom | 1 |
| Bay Mud 2 | | 100 | Mohr-Coulomb | 800 | 16 | Water Surface | Custom | 1 |
| (E) Fine Grained Fill | | 108 | Mohr-Coulomb | 1000 | 25 | Water Surface | Custom | 1 |

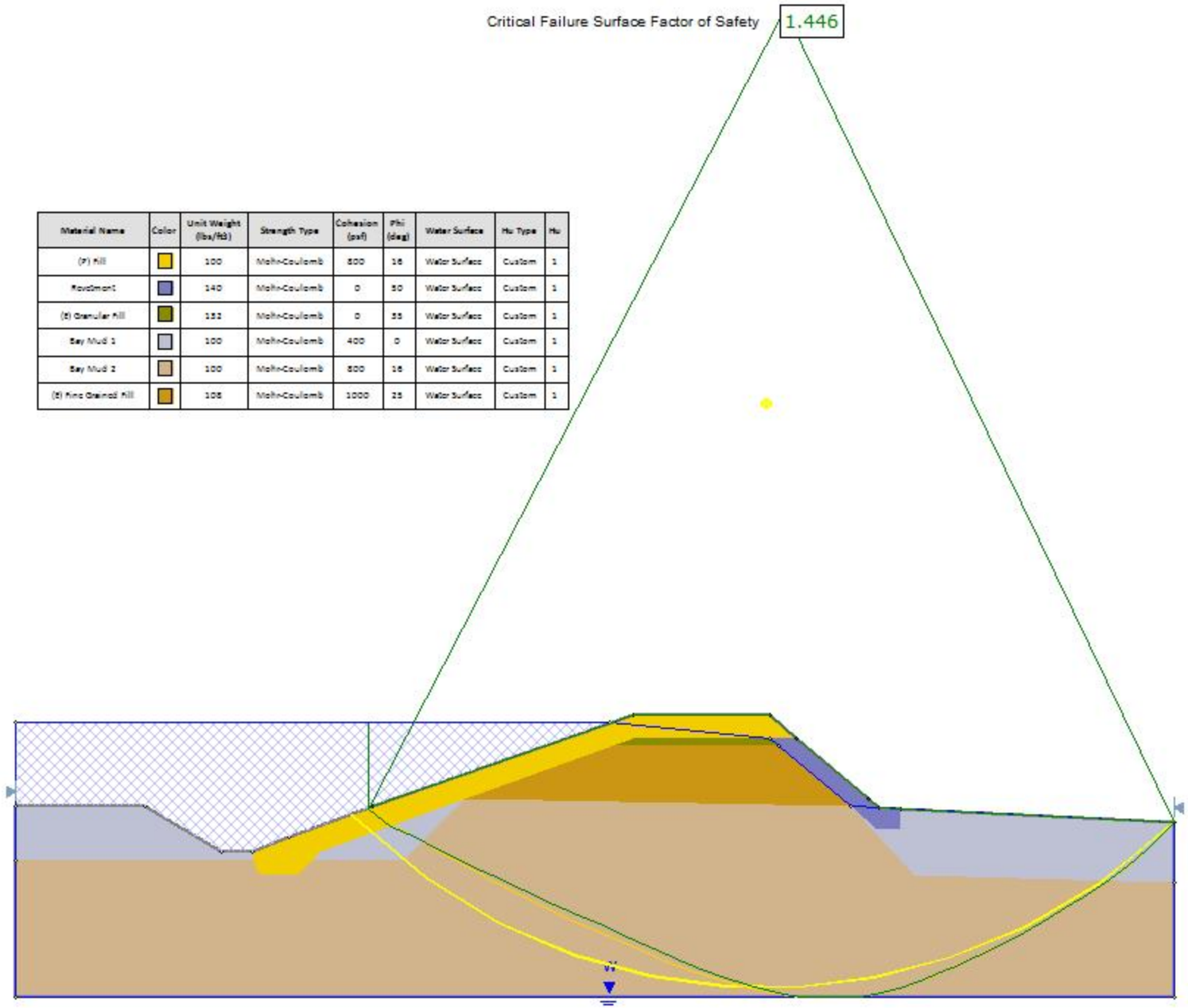


# SECTION 31+00, FULL POND - LOW TIDE

Pseudo Static Seismic Coefficent 0.28

Critical Failure Surface Factor of Safety 1.446

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Ru Type | Ru |
|---|---|---|---|---|---|---|---|---|
| (F) Fill | | 100 | Mohr-Coulomb | 500 | 16 | Water Surface | Custom | 1 |
| Revetment | | 140 | Mohr-Coulomb | 0 | 50 | Water Surface | Custom | 1 |
| (E) Granular Fill | | 132 | Mohr-Coulomb | 0 | 33 | Water Surface | Custom | 1 |
| Bay Mud 1 | | 100 | Mohr-Coulomb | 400 | 0 | Water Surface | Custom | 1 |
| Bay Mud 2 | | 100 | Mohr-Coulomb | 500 | 16 | Water Surface | Custom | 1 |
| (E) Fine Grained Fill | | 105 | Mohr-Coulomb | 1000 | 25 | Water Surface | Custom | 1 |

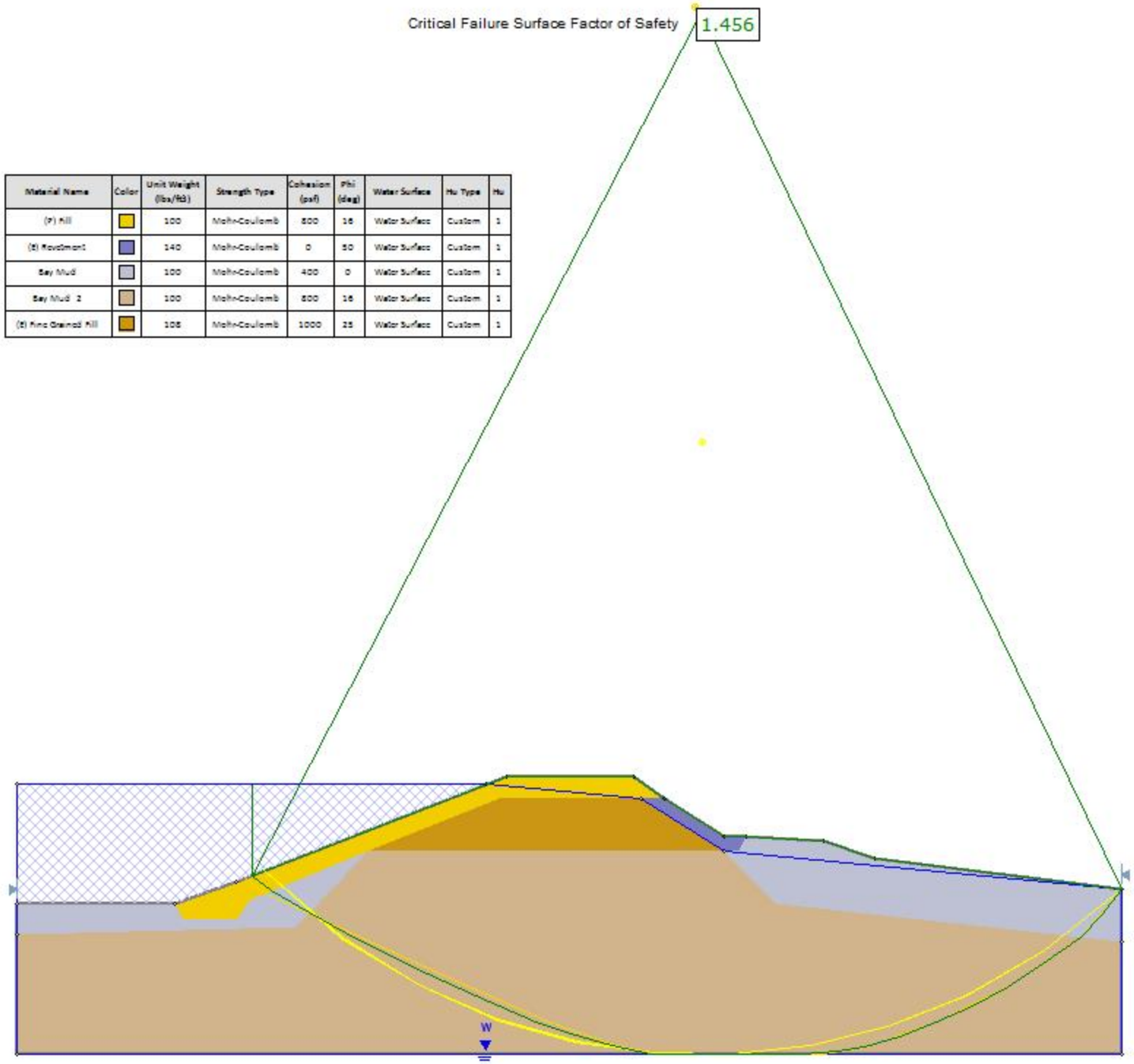


# SECTION 39+00, FULL POND - LOW TIDE

Critical Failure Surface Factor of Safety 1.456

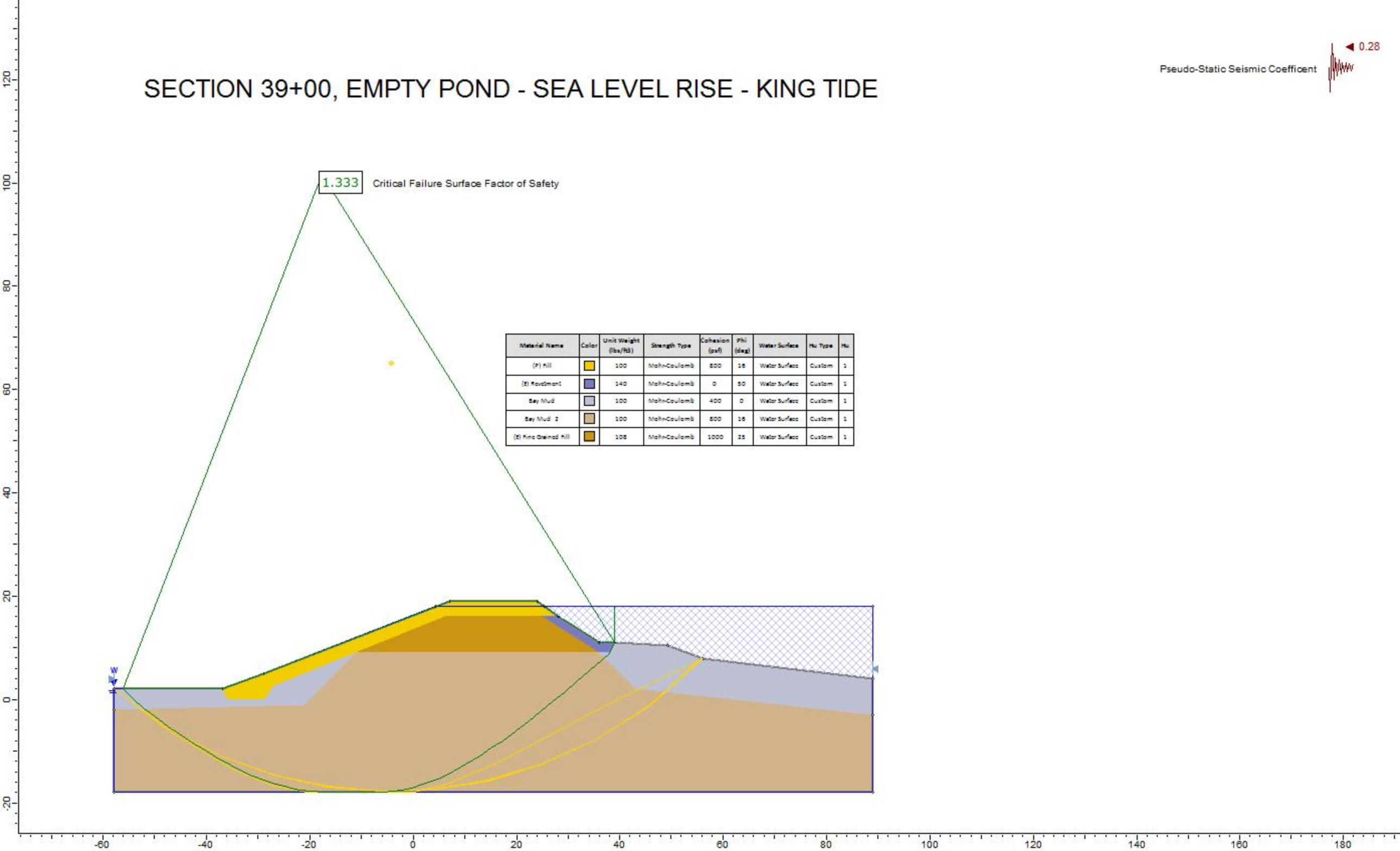
Pseudo-Static Seismic Coefficent 0.28

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Ru Type | Ru |
|---|---|---|---|---|---|---|---|---|
| (F) Fill | | 100 | Mohr-Coulomb | 500 | 16 | Water Surface | Custom | 1 |
| (E) Revetment | | 140 | Mohr-Coulomb | 0 | 50 | Water Surface | Custom | 1 |
| Bay Mud | | 100 | Mohr-Coulomb | 400 | 0 | Water Surface | Custom | 1 |
| Bay Mud 2 | | 100 | Mohr-Coulomb | 500 | 16 | Water Surface | Custom | 1 |
| (E) Fine Grained Fill | | 105 | Mohr-Coulomb | 1000 | 25 | Water Surface | Custom | 1 |



# SECTION 39+00, EMPTY POND - SEA LEVEL RISE - KING TIDE

Pseudo-Static Seismic Coefficent 0.28




| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Ru Type | Ru |
|---|---|---|---|---|---|---|---|---|
| (P) Fill | | 100 | Mohr-Coulomb | 600 | 16 | Water Surface | Custom | 1 |
| (E) Revetment | | 140 | Mohr-Coulomb | 0 | 50 | Water Surface | Custom | 1 |
| Bay Mud | | 100 | Mohr-Coulomb | 400 | 0 | Water Surface | Custom | 1 |
| Bay Mud 2 | | 100 | Mohr-Coulomb | 600 | 16 | Water Surface | Custom | 1 |
| (E) Fine Grained Fill | | 105 | Mohr-Coulomb | 1000 | 25 | Water Surface | Custom | 1 |

# ATTACHMENT 11

Stillwater Scinces. *Impact Assesment and Figures.* August 2020.

| Survey area features | Permanent impacts (acre) | Temporary Impacts (acre) | No Impacts (acre) | Total Acreage in Survey area |
|---|---|---|---|---|
| ***Preliminary USACE-jurisdictional waters of the U.S., including wetlands*** | | | | |
| **Seasonally saturated/flooded palustrine broadleaved deciduous scrub-shrub wetlands** | **0.001** | **0.04** | **0.53** | **0.57** |
| BL-01 | | | 0.26 | 0.26 |
| *BL-02* | *0.001* | *0.04* | *0.03* | *0.08* |
| BL-03 | | | 0.16 | 0.16 |
| BL-04 | | | 0.07 | 0.07 |
| **Estuarine regularly flooded persistent emergent wetlands** | **0** | **0.002** | **0.28** | **0.29** |
| EP-01 | | | 0.26 | 0.26 |
| *EP-02* | | *0.002* | *0.02* | *0.02* |
| **Seasonally flooded palustrine persistent emergent wetlands** | **0** | **0** | **0.38** | **0.38** |
| SF-01 | | | 0.38 | 0.38 |
| **Seasonally saturated palustrine persistent emergent wetlands** | **0.01** | **0.03** | **0.67** | **0.71** |
| SS-01 | | | 0.05 | 0.05 |
| SS-02 | | | 0.03 | 0.03 |
| *SS-03* | *0.01* | *0.03* | *0.08* | *0.12* |
| SS-04 | | | 0.42 | 0.42 |
| SS-05 | | | 0.09 | 0.09 |
| **Semipermanently flooded palustrine persistent emergent wetlands** | **0.02** | **0.02** | **0.02** | **0.06** |
| *SP-01* | *0.02* | *0.02* | *0.02* | *0.06* |
| **Waters** | **0.01** | **0.01** | **2.98** | **2.99** |
| Arcata Bay (Humboldt Bay) (W-1) | | | 0.30 | 0.30 |
| *Brackish Pond (W-2)* | *0.01* | *0.01* | *0.09* | *0.10* |
| Western Pond (W-3) | | | 1.81 | 1.81 |
| North Pond (W-4) | | | 0.74 | 0.74 |
| Roadside Ditch (W-5) | | | 0.04 | 0.04 |
| Tributary to Butcher Slough (W-06) | | | 0.01 | 0.01 |
| **Total** | **0.04** | **0.10** | **4.86** | **5.00** |
| ***Additional Waters of the State*** | | | | |
| **Waters of the State (Arcata WWTP enhancement marshes)** | **0** | **0** | **0.58** | **0.58** |
| SW-01 | | | 0.42 | 0.42 |
| SW-02 | | | 0.17 | 0.17 |
| **Waters of the State (AWTF treatment marshes and oxidation ponds)** | **0.0004** | **0.05** | **2.99** | **3.04** |
| *SW-03* | | *0.00005* | *0.19* | *0.19* |
| SW-04 | | | 0.07 | 0.07 |
| SW-05 | | | 0.10 | 0.10 |
| *SW-06* | *0.0004* | *0.05* | *1.02* | *1.06* |
| SW-07 | | | 0.14 | 0.14 |
| SW-08 | | | 0.02 | 0.02 |
| SW-09 | | | 0.07 | 0.07 |
| SW-10 | | | 0.03 | 0.03 |
| *SW-11* | | *0.001* | *1.36* | *1.36* |
| **Total** | **0.0004** | **0.05** | **3.58** | **3.63** |
| ***Additional LCP-jurisdictional wetlands*** | | | | |
| **Two-parameter** | **0** | **0.05** | **4.97** | **5.02** |
| TP-01 | | | 0.03 | 0.03 |
| TP-02 | | | 0.13 | 0.13 |
| *TP-03* | | *0.01* | *0.04* | *0.05* |
| *TP-04* | | *0.02* | *0.02* | *0.04* |
| *TP-05* | | *0.02* | *0.06* | *0.07* |
| *TP-06* | | *0.01* | *0.01* | *0.02* |
| TP-07 | | | 0.85 | 0.85 |
| TP-08 | | | 0.68 | 0.68 |
| TP-09 | | | 1.70 | 1.70 |

| | | | | |
|---|---|---|---|---|
| TP-10 | | | 1.21 | 1.21 |
| TP-11 | | | 0.05 | 0.05 |
| TP-12 | | | 0.03 | 0.03 |
| TP-13 | | | 0.15 | 0.15 |
| **One-parameter** | **0** | **0** | **1.45** | **1.45** |
| OP-01 | | | 1.45 | 1.45 |
| **Riparian** | **0** | **0.06** | **0.71** | **0.77** |
| R-01 | | | 0.07 | 0.07 |
| R-02 | | | 0.06 | 0.06 |
| *R-03* | | *0.05* | *0.17* | *0.22* |
| R-04 | | | 0.01 | 0.01 |
| R-05 | | | 0.02 | 0.02 |
| R-06 | | | 0.01 | 0.01 |
| R-07 | | | 0.00 | 0.003 |
| R-08 | | | 0.12 | 0.12 |
| R-09 | | | 0.01 | 0.01 |
| R-10 | | | 0.02 | 0.02 |
| R-11 | | | 0.02 | 0.02 |
| R-12 | | | 0.07 | 0.07 |
| R-13 | | | 0.13 | 0.13 |
| *R-14* | | *0.003* | *0.03* | *0.03* |
| **Total** | **0** | **0.11** | **7.13** | **7.24** |
| | | ***Non-Jurisdictional Uplands*** | | |
| **Vegetated upland** | **0.01** | **0.38** | **8.89** | **9.28** |
| *UPL-01* | *0.00* | *0.09* | *0.49* | *0.58* |
| UPL-02 | | | 0.16 | 0.16 |
| *UPL-03* | | *0.07* | *0.17* | *0.24* |
| UPL-04 | | | 0.83 | 0.83 |
| *UPL-05* | *0.002* | *0.12* | *0.89* | *1.01* |
| *UPL-06* | *0.001* | *0.05* | *0.51* | *0.56* |
| UPL-07 | | | 3.45 | 3.45 |
| *UPL-08* | *0.001* | *0.01* | *0.11* | *0.12* |
| *UPL-09* | | *0.02* | *0.16* | *0.18* |
| UPL-10 | | | 0.01 | 0.01 |
| *UPL-11* | *0.0003* | *0.02* | *0.01* | *0.03* |
| UPL-12 | | | 0.17 | 0.17 |
| UPL-13 | | | 0.02 | 0.02 |
| UPL-14 | | | 0.45 | 0.45 |
| *UPL-15* | *0.001* | *0.01* | *0.08* | *0.08* |
| *UPL-16* | | *0.01* | *0.02* | *0.03* |
| UPL-17 | | | 0.07 | 0.07 |
| UPL-18 | | | 0.59 | 0.59 |
| UPL-19 | | | 0.70 | 0.70 |
| **Developed** | **0.02** | **1.32** | **13.16** | **14.50** |
| **Total** | **0.03** | **1.70** | **22.05** | **23.77** |




# ARCATA WWTP UPGRADES, CALIFORNIA

## *PROJECT IMPACTS*

DATA SOURCES
Imagery: ESRI world service
Roads, cities, streams and waterbodies: ESRI world service

MAP PROJECTION
NAD_1983_UTM_Zone_10N
Transverse_Mercator

## LEGEND

- Adjacent tile
- Survey area
- Permanent impact
- Temporary impact

**Wetland type**

- Seasonally saturated palustrine persistent emergent wetlands (SS)
- Semipermanently flooded palustrine persistent emergent (SP)
- Developed
- Waters (W)
- Two-parameter (TP)
- One-parameter riparian (R)
- Vegetated upland (UPL)

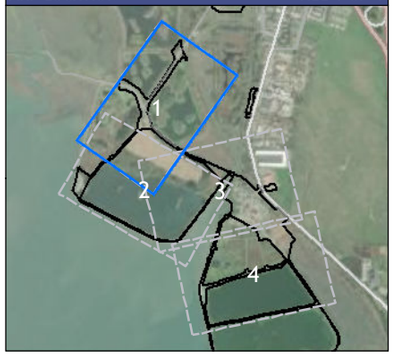
Stillwater Sciences

## SCALE & NORTH ARROW

0 50 100 200 Feet
0 15 30 60 Meters

1:2,000 1 in = 51 meters

## MAP LOCATION TILE 1 OF 4






# ARCATA WWTP UPGRADES, CALIFORNIA

## *PROJECT IMPACTS*

DATA SOURCES
Imagery: ESRI world service
Roads, cities, streams and waterbodies: ESRI world service

MAP PROJECTION
NAD_1983_UTM_Zone_10N
Transverse_Mercator

### LEGEND

- Adjacent tile
- Survey area
- Permanent impact
- Temporary impact

**Wetland type**

- Developed
- Vegetated upland (UPL)

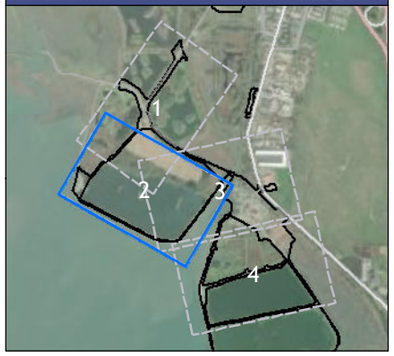
Stillwater Sciences

### SCALE & NORTH ARROW

0 50 100 200 Feet
0 15 30 60 Meters

1:2,000 1 in = 51 meters

### MAP LOCATION TILE 2 OF 4






# ARCATA WWTP UPGRADES, CALIFORNIA

## *PROJECT IMPACTS*

DATA SOURCES
Imagery: ESRI world service
Roads, cities, streams and waterbodies: ESRI world service

MAP PROJECTION
NAD_1983_UTM_Zone_10N
Transverse_Mercator

### LEGEND

- Adjacent tile
- Survey area
- Permanent impact
- Temporary impact

**Wetland type**

- Developed
- Estuarine regularly flooded persistent emergent (EP)
- One-parameter riparian (R)
- Seasonally saturated/flooded palustrine broadleaved deciduous scrub-shrub (BL)
- Vegetated upland (UPL)

Stillwater Sciences

### SCALE & NORTH ARROW

0 50 100 200 Feet
0 15 30 60 Meters

1:2,000 1 in = 51 meters

### MAP LOCATION TILE 3 OF 4






# ARCATA WWTP UPGRADES, CALIFORNIA

## *PROJECT IMPACTS*

DATA SOURCES
Imagery: ESRI world service
Roads, cities, streams and waterbodies: ESRI world service

MAP PROJECTION
NAD_1983_UTM_Zone_10N
Transverse_Mercator

### LEGEND

- Adjacent tile
- Survey area
- Permanent impact
- Temporary impact

**Wetland type**

- Developed
- Waters of the State (SW)
- Vegetated upland (UPL)

Stillwater Sciences

### SCALE & NORTH ARROW

0 50 100 200 Feet
0 15 30 60 Meters

1:2,000 1 in = 51 meters

### MAP LOCATION TILE 4 OF 4



# ATTACHMENT 12

Humboldt County. *Humboldt County Web GIS-Airport Compatibility Zones*. Available at https://webgis.co.humboldt.ca.us/HCEGIS2.0/ . Accessed on: 05/12/19




# Airport Compatibility Zones

Humboldt County Planning and Building Department

0 5,500 11,000 22,000 Feet

0 1 2 4 Miles

RF= 1:144,448 1 in = 12,037 ft

N W E S

Printed: May 12, 2019 Web AppBuilder 2.0 for ArcGIS

**Highways and Roads**

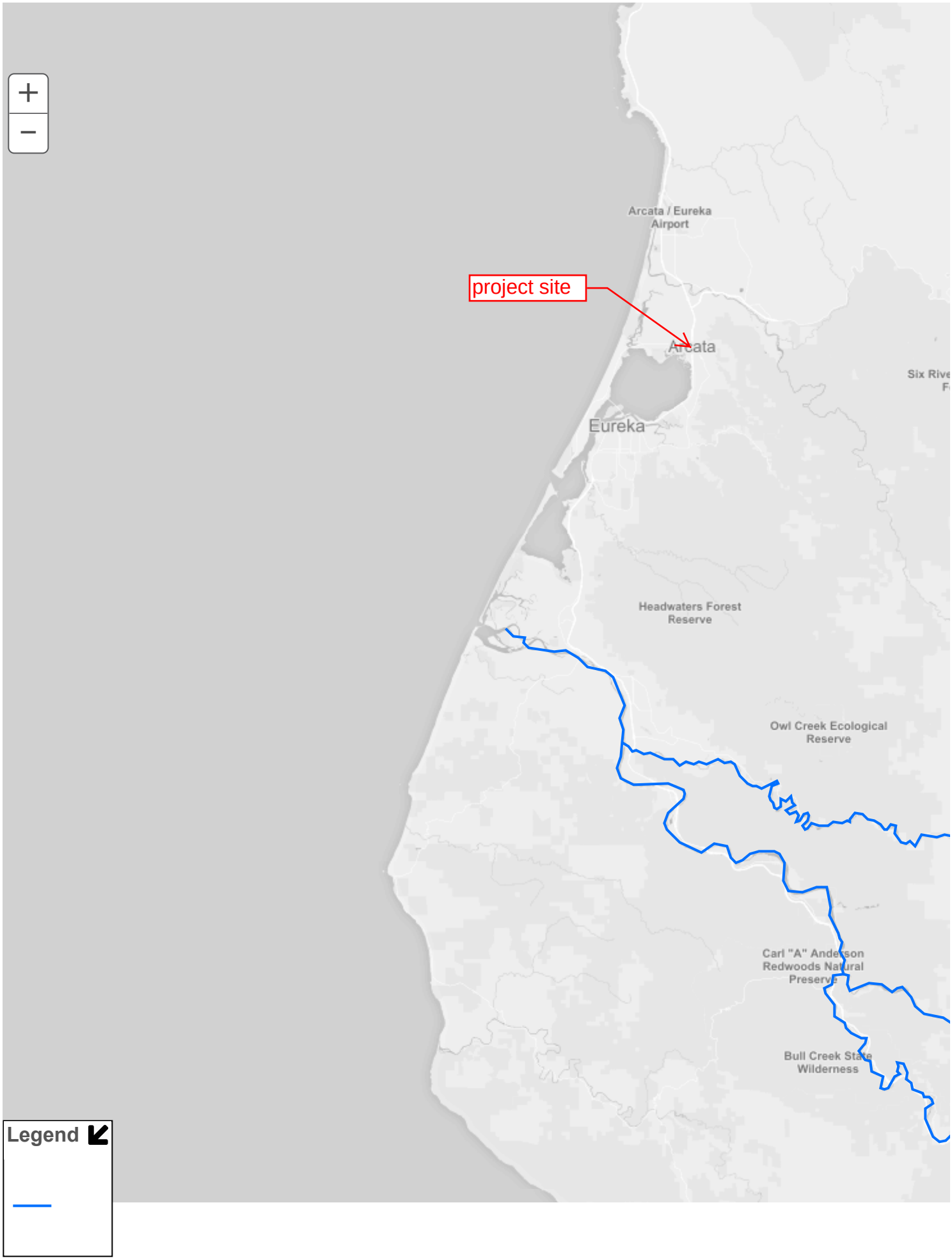
- Principal Arterials
- Minor Arterials
- Major Collectors
- Minor Collectors
- Local Roads
- Private or Unclassified
- Major River or Stream
- City Boundary
- City Boundary (750K)
- Counties

Map Disclaimer:
While every effort has been made to assure the accuracy of this information, it should be understood that it does not have the force & effect of law, rule, or regulation. Should any difference or error occur, the law will take precedence.

Source: Humboldt County GIS, Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, FRAP, FEMA, USGS

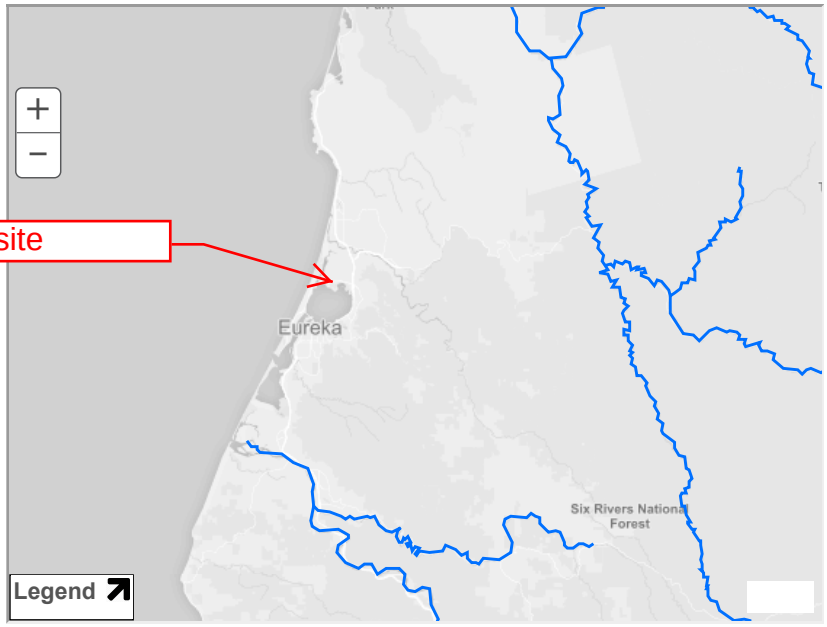
# ATTACHMENT 13

US Wild and Scenic Rivers System. 2020. *National Wild and Scenic Rivers Map.* Available at https://www.rivers.gov/river-app/index.html?state=CA. Accessed 08/31/20


Arcata / Eureka Airport
project site
Arcata
Eureka
Six Rive
Headwaters Forest Reserve
Owl Creek Ecological Reserve
Carl "A" Anderson Redwoods Natural Preserve
Bull Creek State Wilderness
Legend

## CALIFORNIA

California has approximately 189,454 miles of river, of which 1,999.6 miles are designated as wild & scenic—1% of the state's river miles.




+ View larger map

Choose A State Go
Choose A River Go

*Seen as barren by the first explorers to today's first-time visitors, the rivers of the high desert simply hide their treasures well.*

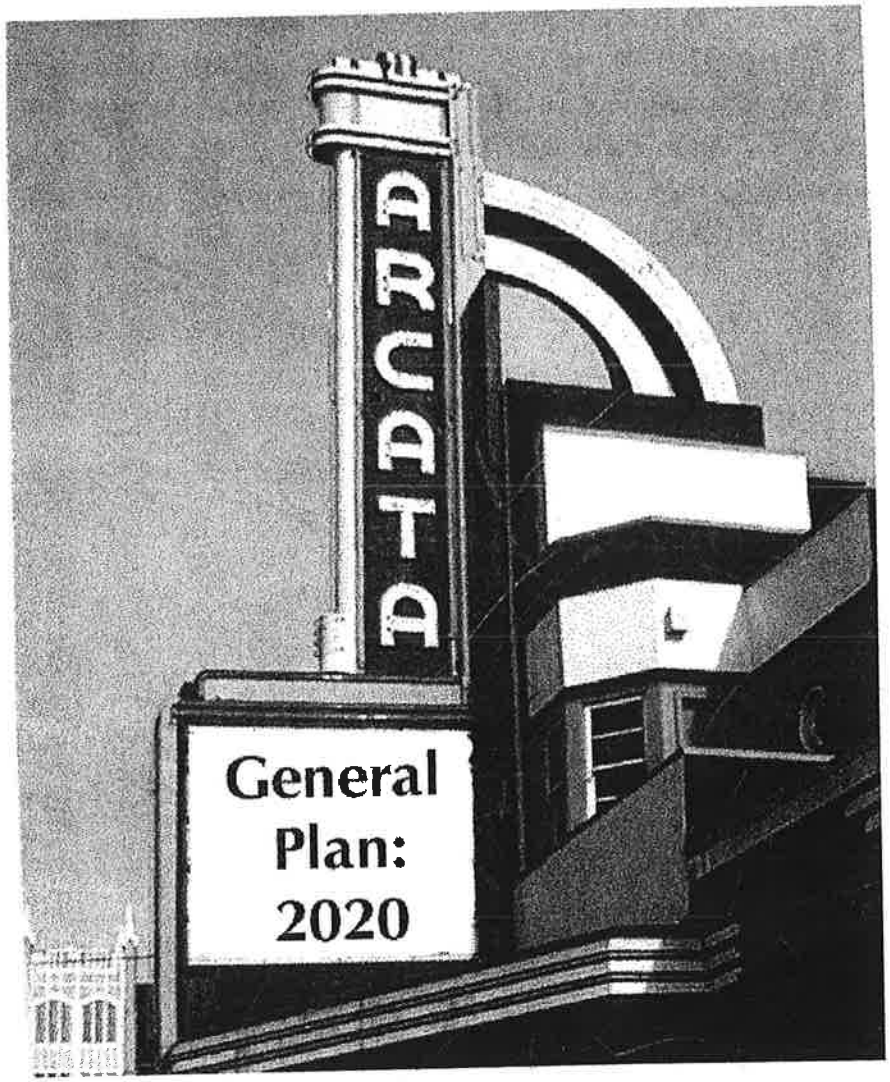
**Amargosa River**
**American River (Lower)**
**American River (North Fork)**
**Bautista Creek**
**Big Sur River**
**Black Butte River**
**Cottonwood Creek**
**Deep Creek**
**Eel River**
**Feather River**
**Fuller Mill Creek**
**Kern River**
**Kings River**
**Klamath River**
**Merced River**
**Owens River Headwaters**
**Palm Canyon Creek**

**Piru Creek**
**San Jacinto River (North Fork)**
**Sespe Creek**
**Sisquoc River**
**Surprise Canyon Creek**
**Smith River**
**Trinity River**
**Tuolumne River**
**Whitewater River**

# ATTACHMENT 14

City of Arcata. 2000. *Excerpts from Air Quality Element of the Arcata General Plan.*

# Arcata General Plan: 2020 and Local Coastal Land Use Plan




**October, 2000**
**Amended October, 2008**
**(Ordinance No. 1377, September 3, 2008)**

AQ-2e **Recognize that poor air quality is caused by the combination of high pollutant emissions and meteorological conditions which do not allow for dispersal of pollutants.** The City shall coordinate a joint effort with the NCUAQMD to minimize the impact of high pollutant incidents and notify the public about meteorological conditions that contribute to poor air quality. The joint effort shall include employing the following measures:

1. Implement added air pollution control measures during predictable meteorological events of stagnant air. Inform the public of high pollutant incidents and encourage measures which minimize impacts, such as limiting use of wood-burning fireplaces, gas powered equipment, and avoiding non-essential vehicle travel.
2. Promote and encourage employer-based Transportation Demand Measures (such as subsidized bus fare, flexible work hours, and incentives to carpool) to reduce automobile travel, particularly during periods of poor air quality.
3. Support and encourage local industrial and commercial efforts to reduce emissions and particulate pollution from industrial plants and trucks, particularly during periods of poor air quality.
4. Require traffic and construction site dust control measures at construction projects. Require measures which reduce emissions from construction activity and maximize efficiency of traffic flow during inversion conditions.

AQ-2f **Enforce air quality control measures and monitoring at construction sites.** Construction emissions shall be controlled because, although they are temporary in nature, they can often be the greatest air quality impact of a project. Require the following control measures for construction activities when necessary:

1. Water all active construction areas twice per day and use erosion control measures to prevent water runoff containing silt and debris from entering the storm drain system.
2. Cover trucks hauling soil, sand, and other loose material.
3. Pave, water, or apply non-toxic soil stabilizers on unpaved access roads and parking areas.
4. Sweep paved access roads and parking areas daily.
5. Sweep streets daily if visible material is carried onto adjacent public streets.

For larger construction sites (four acres or greater) require the following measures when necessary in addition to those above:

6. Hydroseed or apply non-toxic soil stabilizers to inactive construction areas.
7. Enclose, cover, water, or apply non-toxic soil binders to open materials stockpiles.
8. Limit traffic speeds to 15 mph on unpaved access roads.

9. Install erosion control measures to prevent silt runoff onto public roadways.
10. Replant vegetation in disturbed areas within 30 days after project completion.

For construction sites near sensitive receptors, require the following measures when necessary, in addition to those above:

11. Install wheel washers for exiting trucks, or wash all equipment leaving site.
12. Install wind breaks, or plant trees/vegetation at windward sides of construction areas, or avoid removing existing vegetation which acts as a windbreak.
13. Suspend excavation and grading activity when winds exceed 25 mph.
14. Limit area subject to excavation, grading, and other construction activities at any one time.

AQ-2g **Enforce air quality control measures and monitoring for agricultural operations.** Air emissions from agricultural operations, including field burning, airborne soils, and over-spray from herbicide applications, shall be controlled and monitored through air quality standards as well as adherence to the Land Use Code.

**POLICY AQ-3 REGIONAL AIR QUALITY STANDARDS, MONITORING AND EDUCATION**

**Objective.** Participate in regional efforts to improve and monitor air quality and meet air quality goals, coordinate transportation and land use development planning with the North Coast Unified Air Quality Management District, and educate the public.

AQ-3a **Air quality standards and monitoring.** Identify potential emission sources of airborne toxins from mobile and stationary sources. This may be in coordination with the California Air Resource Board and the NCUAQMD, as appropriate. Enforce rigid high standards to restrict fumes, smoke, dust, or other environmental pollutants from stationary sources of pollution.

AQ-3b **Develop and distribute material to educate the public on air quality issues**. Work with Humboldt State University, the California Air Resources Board, and the NCUAQMD to develop educational material regarding air quality, impact of air quality on people, plants and animals, and what citizens can do to improve air quality. The City will make this information available.

AQ-3c **Cooperation in enforcement activities and programs**. Cooperate with the NCUAQMD in implementing and enforcing the district's rules and programs. Consider joint implementation of programs between the City and the district such as:

# ATTACHMENT 15

Redwood Empire Municipal Insurance Fund. 2020. *Program Year 2020-2021 Memorandum of Coverage-Property.*

REMIF
REDWOOD
EMPIRE
MUNICIPAL
INSURANCE
FUND

*414 W. Napa Street | 2nd Floor, Suite C | Sonoma, CA 95476*
*Phone (707) 938-2388 | Fax (707) 938-0374 | www.remif.com*

*Member cities/towns: Arcata, Cloverdale, Cotati, Eureka, Ft. Bragg, Fortuna, Healdsburg, Lakeport, Rohnert Park, St. Helena, Sebastopol, Sonoma, Ukiah, Willits, Windsor*

# PROGRAM YEAR

# 2020-2021

# MEMORANDUM OF COVERAGE

# PROPERTY

**REDWOOD EMPIRE MUNICIPAL INSURANCE FUND**
**MEMORANDUM OF COVERAGE**
**PROPERTY PROGRAM (SHORT FORM)**

## PROPERTY COVERAGE

Property coverage is provided when a city/town has property damage due to all perils except earthquake or those exclusions listed in the excess coverage/policy. The property must be owned by the member agency or the member agency must have a lease-holder interest in the property and have that lease holder interest declared with the insurance company.

## DEDUCTIBLES SELECTED AND COVERAGE AMOUNTS

| | | | |
|---|---|---|---|
| REMIF | 0 | Lakeport | $100,000 |
| Arcata | $100,000 | Rohnert Park | $100,000 |
| Cloverdale | $100,000 | Sebastopol | $100,000 |
| Cotati | $100,000 | Sonoma | $100,000 |
| Eureka | $100,000 | St. Helena | $100,000 |
| Fort Bragg | $100,000 | Ukiah | $100,000 |
| Fortuna | $100,000 | Willits | $100,000 |
| Healdsburg | $100,000 | Windsor | $100,000 |

Deductibles for all property loss are outlined above. Deductibles for wildfire are $500,000 and $100,000 for flood loss in high flood zones.

REMIF SELF-INSURED FUND - Difference between entity selected deductible and excess coverage deductible.

EXCESS INSURANCE - Replacement value in excess of excess coverage deductible unless settlement is resolved by agreed upon stated values.

NEW PROJECT/PURCHASE NOTIFICATION

Any construction project, purchase of building or equipment exceeding $1,000,000 must be reported to REMIF within thirty (30) days of the signing of the construction agreement or assumption of control of the new property or equipment.

## CENTRAL POOL PROPERTY COVERAGE PROGRAM

COVERAGE AGREEMENT

Effective July 1 of each year unless otherwise indicated, coverage is provided against all risk of physical loss except those exclusions to the coverage that are stated in this agreement or in the excess policy that is in place at the time of the loss. The loss can occur to covered entity owned, leased, or rented real and personal property that is under the care, custody and control of the covered entity and may include such additional expenses as loss of revenue or rent, as long as

these expenses are incurred as a result of the covered direct physical loss. In the case of rented or leased property, the entity must submit to REMIF a request naming the property owner as a Loss Payee, as required by the leasing or renting contract, prior to any loss, before coverage can be extended to the property owner. Coverage is provided on a replacement cost basis as defined by the excess policy in effect at the time of the loss. In unusual circumstances, coverage may be on a stated value basis.

Generally, replacement cost means that reimbursement will be made by replacing the lost property or equipment with equivalent property or equipment or if replacement is not desired, payment of an amount agreed upon, based on the stated value of the property or equipment.

All reasonable costs incurred to adjust and resolve the covered loss shall be included in any settlement. This cost may include, but it is not necessarily limited to, outside adjusting company fees and expenses.

Except as otherwise indicated, terms and conditions appearing in the excess property insurance policy in effect at the time of the occurrence will apply to this coverage.

The protection afforded by the Authority is self insurance, and under no circumstances shall be construed as any form of insurance.

EXCLUSIONS

The specific exclusions are contained in the excess property policy in effect at the time of the loss/occurrence.

C. MEMBERS COVERED

Coverage shall apply to those entities identified above under "Deductibles Selected and Coverage Amounts.

D. LIMITS

The Authority shall pay all covered losses up to excess deductible amounts per occurrence that are in excess of each participating entity's deductible or retention. Losses in excess of the deductible will be paid by the excess insurance policy up to the replacement value on all covered property, except where specific limits are stated in the excess policy in effect at the time of the occurrence. The total that will be paid on any occurrence is the limit of the excess coverage. Above the excess coverage, the entity is responsible for payment of those losses. Business interruption and extra expense coverage is part of the policy. Coverage for employee's personal property is included if the entity has a policy statement that allows it to pay for the employee's personal losses.

E. COURSE OF CONSTRUCTION

If a building project requires the entity to provide course of construction insurance, the Authority must be notified of such prior to the beginning of the contract so the proper endorsement can be

obtained to ensure that coverage is in place. It is recommended that the contractor be required to provide the course of construction coverage to protect the member.

F. POLICY

A copy of the excess general property insurance policy is kept at the REMIF office. One will be furnished any participating entity upon written request.

## LOSS AND CLAIMS REPORTING

PROPERTY LOSSES

Property losses which exceed the entity's deductible will require loss adjusting services to be provided by REMIF or by the excess carrier's designated adjustment company. If the loss does not exceed REMIF's retention level, REMIF will choose the adjuster and/or law firm in the matter. If the lawsuit exceeds REMIF's retention level, the excess carrier must be notified immediately and has the right to assign an adjusting firm and/or law firm of their choice. All property losses in excess of the member entity's deductible should be reported immediately. If the loss is a significant one (i.e., property loss in excess of $25,000) REMIF and the third party liability claims administrator should be notified immediately. It is imperative that specific details of the loss, including lists and values of contents or description of equipment and/or building loss, be sent to the General Manager within seven (7) working days of the loss. In order to protect any coverage offered by the excess insurance carrier, the risk manager must report these losses to the broker and carrier immediately. If the loss occurs during off hours or on weekends, and exceeds the $25,000 threshold, the third party liability claims administrator should be immediately contacted. This should be followed with a telephone call or an e-mail to the REMIF office with a message being left for the General Manager or with staff that might be at the office.

As a reminder, it is imperative that major losses be reported as soon as possible so that coverage by REMIF's excess carrier will not be jeopardized and the adjusting of the loss can begin immediately to help expedite a return to normal at the loss site.

VALUE REPORTING

Each entity should designate a staff person who can work with the REMIF staff in keeping REMIF notified of property value changes, additions, and deletions. REMIF needs to be notified within ten (10) days of any acquisition or disposal of any properties and/or equipment that are in excess of $1,000,000. In turn, REMIF must report within a thirty (30) day period of time to the excess carrier those changes in excess of $1,000,000. All other changes should be reported, to REMIF, within thirty (30) days if they exceed $100,000.

The property coverage obtained by REMIF is based on a stated replacement value. Therefore, to assure proper coverage and reimbursement in case of a loss, current property valuation is important to the success of the property coverage program for the following reasons:

- to assess loss potentials and achieve limits of coverage adequate for the largest possible loss;
- to use as a factor of the property coverage rate to calculate each participating entity's contribution for the property coverage;
- to use as a basis by the excess carrier for a loss adjustment;
- to avoid disputes with the excess carrier due to undervalue reporting.

For the reasons stated above, it is important that the values be reported to the Authority staff and that this be done on a consistent yearly basis so that there is consistency among all participating entities.

Once a year, REMIF will submit to the entity's designee, a property list. This list should be reviewed and revised to reflect new properties, equipment and accurate values for current properties and equipment, in order to be sure that adequate coverage will be available in case of a loss. The list should also be reduced to reflect property that no longer belongs to the city or that the city does not want to insure. Rental and leased properties and equipment should also be on the property list, whether they are leased, rented by the entity or owned by the entity and leased/rented to a third party. The value of the property/equipment that is rented or leased by the entity will only be covered if the contractor requires the entity to provide property coverage.

[Incorporated herein by reference, excess property coverage policy]

# ATTACHMENT 16

Alliant Insurance Services. 2020. *Excerpts from Alliant Property Insurance Program Binder of Insurance.*



# California Joint Powers Risk Management Authority

2020 – 2021

## Alliant Property Insurance Program (APIP) Binder of Insurance


Robert Lowe,
Vice President / Producer

Thomas Bryson, PE, ARM
Senior Vice President

Andrea Ferry
Account Manager

# ALLIANT INSURANCE SERVICES, INC.
## ALLIANT PROPERTY INSURANCE PROGRAM (APIP)
### PROPERTY EVIDENCE ATTACHMENT

| | |
|---|---|
| **TYPE OF INSURANCE:** | ☒ Insurance ☐ Reinsurance |
| **NAMED INSURED:** | California Joint Powers Risk Management Authority |
| **DECLARATION:** | 35-JPA/Pools 2 |
| **POLICY PERIOD:** | July 1, 2020 to July 1, 2021 |
| **REFERENCE NUMBER:** | APIP2020 (Dec 35) |
| **COMPANIES:** | See Attached List of Companies |
| **TOTAL INSURED VALUES:** | $ 10,397,558,483 as of June 28, 2020 |

**COVERAGES & LIMITS:**

| | | |
|---|---|---|
| $ 375,000,000 | Excess of 25,000,000 Primary Policy. Below Sub-Limits are Inclusive of Primary Per Occurrence: all Perils, Coverages (subject to policy exclusions) and all Named Insureds (as defined in the policy) combined, per Declaration, regardless of the number of Named Insureds, coverages, extensions of coverage, or perils insured, subject to the following per occurrence and/or aggregate sub-limits as noted below. |
| $ 75,000,000 | per occurrence and Annual Aggregate excess of 25,000,000 Primary Flood Placement and underlying deductibles Flood Limit - Per Occurrence and in the Annual Aggregate (for those Named Insured(s) that purchase this optional dedicated coverage). |
| $ 25,000,000 | per occurrence and Annual Aggregate Excess of Primary A&V Placement and underlying deductibles Per Occurrence and in the Annual Aggregate for scheduled locations in Flood Zones A & V (inclusive of all 100 year exposures). This Sub-limit does not increase the specific flood limit of liability for those Named Insured(s) that purchase this optional dedicated coverage. |
| Not Applicable | Per Occurrence for losses to locations in Tier 1 and/or Tier 2 Counties and resulting from a Named Windstorm. |
| Not Covered | Earthquake Shock - Per Occurrence and in the Annual Aggregate (for those Named Insured(s) that purchase this optional dedicated coverage). |
| $ 100,000,000 | Combined Business Interruption, Rental Income and Tuition Income (and related fees). However, if specific values for such coverage have not been reported as part of the Named Insured's schedule of values held on file with Alliant Insurance Services, Inc., this sub-limit amount is limited to $500,000 per Named Insured subject to maximum of $2,500,000 Per Occurrence, Per Declaration for Business Interruption, Rental Income and Tuition Income combined. Coverage for power generating plants is excluded, unless otherwise specified. |
| $ 50,000,000 | Extra Expense. |

| | | | |
|---|---|---|---|
| **COVERAGES & LIMITS: (continued)** | $ | 25,000,000 | Miscellaneous Unnamed Locations for existing Named Insured's excluding Earthquake coverage for Alaska and California locations. If Flood coverage is purchased for scheduled locations, this extension will extend to include Flood coverage for any location not situated in Flood Zones A or V. |
| | | 180 days | Extended Period of Indemnity |
| | | See Policy Provisions | $25,000,000 Automatic Acquisition up to $100,000,000 or a Named Insured's Policy Limit of Liability if less than $100,000,000 for 120 days excluding licensed vehicles for which a sub-limit of $10,000,000 applies per policy Automatic Acquisition and Reporting Condition. Additionally, automatic coverage is granted for up to 60 days, subject to a sub-limit of $2,500,000 for additional property and/or interests in Tier 1 Wind Counties, Parishes and Independent Cities for the states of Virginia, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Louisiana, Texas and/or situated anywhere within the states of Florida and Hawaii. The peril of EQ is excluded for the states of Alaska and California. If Flood coverage is purchased for all scheduled locations, this extension will extend to include Flood coverage for any location not situated in Flood Zones A or V. |
| | $ | 1,000,000 | Unscheduled Landscaping, tees, sand traps, greens, athletic fields and artificial turf and further subject to $25,000 / 25 gallon maximum per item for existing Named Insureds excluding Earthquake coverage for Alaska and California locations. If Flood coverage is purchased for scheduled locations, this extension includes Flood coverage for any location not situated in Flood Zones A or V. |
| | $ | 5,000,000 | or 110% of the scheduled values, whichever is greater, for Scheduled Landscaping, tees, sand traps, greens, athletic fields and artificial turf and further subject to $25,000 / 25 gallon maximum per item. |
| | $ | 50,000,000 | Errors & Omissions - This extension does not increase any more specific limit stated elsewhere in this policy or Declarations. |
| | $ | 25,000,000 | Course of Construction and Additions (including new) for projects with completed values not exceeding the sub-limit shown. |
| | $ | 2,500,000 | Money & Securities for named perils only as referenced within the policy. |
| | $ | 2,500,000 | Unscheduled Fine Arts. |
| | $ | 250,000 | Accidental Contamination per occurrence and annual aggregate per Named Insured with $500,000 annual aggregate for all Named Insureds per Declaration. |

# ATTACHMENT 17

City of Arcata. 2002. *Report of Findings for City of Arcata Corporation Yard Phase II Over Excavation and Stockpiling of Contaminated Soils and Proposed Groundwater Monitoring Well Installation.*

RWQCB
REGION 1
JAN 24 2002
SAW FCR
RLT LGR KAD
NPQ RSG EJL
KA

January 21, 2002

Mr. Ron Allen
California Regional Water Quality Control Board
North Coast Region
5550 Skylane Boulevard Suite A
Santa Rosa, California 95403

**Subject: Report of Findings for City of Arcata Corporation Yard Phase II Over Excavation and Stockpiling of contaminated soils and proposed groundwater monitoring well installation.**

## Introduction:

This report was prepared by the City of Arcata Public Works Department (APW) to document the additional approved overexcavation of contaminated soils and recommended installation of groundwater monitoring wells to assess potential groundwater impacts.

## Brief History

Between October 25th and October 30th, 2000, it is estimated that approximately 550 gallons of gasoline were released into the temporarily constructed wooden platform beneath a diesel and gasoline pump dispenser.

Based on the visual investigation of surface contamination, the gasoline spread-out through a portion of the Corporation Yard and migrated offsite via an 8-inch diameter pipe underneath a trail/walkway and entered a minor drainage course (vegetated swale), which ultimately drains to a slough channel and into Humboldt Bay. There was additional assumed migration to the south towards and beneath the old concrete dispenser island which had historical piping leakage and/or dripping in the area.

Surface water and soil sampling performed on November 1, 2000, indicated surface contamination extended approximately 125 feet down gradient/slope from the source of the release to the north. Soil and surface water samples were collected near the source and down gradient.

Excavation and stockpiling of contaminated soils and groundwater/product recovery began on November 1, 2000 and was completed on November 6, 2000. Approximately 250 cubic yards of material was winterized onsite. Refer to report dated December 2000 Report of Findings for Additional Investigation City of Arcata Corporation Yard prepared by the City. All previous analytical sampling results from the site are located in Attachment 2.

## Field Work Oct 2001

Groundwater grab samples were collected using disposable bailers from the three previously excavated pit areas to assess relative contamination concentrations. Refer to Table 1 for results.

Sample Pit 3 exhibited the highest concentrations at 870 part per billion (ppb) total petroleum hydrocarbons as gasoline (TPH-g) and 140 ppb TPH as diesel (TPH-d) and MTBE at 9800 ppb which was located below the initial release area. Samples 1 and 2 exhibited minor contamination.

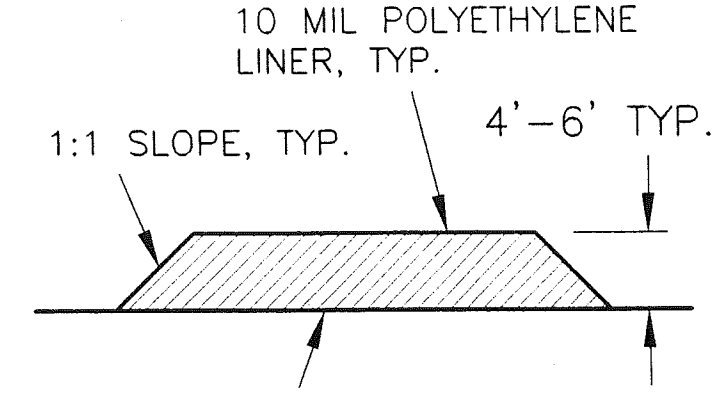
Approximately 500 cubic yards of soil was excavated and winterized between October 4 and October 9, 2001 in accordance with the approved work plan. The existing 250 cubic yard soil piles were moved adjacent to the new piles. The old concrete pump island was removed. 14 confirmation soil samples were submitted for analysis of TPH-d, TPH-g ,BTEX and MTBE following the work (See results in Table 1). Approximately 800 gallons of water was pumped from the excavation during the work and is stored onsite pending analytical results for TPH-d, TPH-g, BTXE and MTBE. It is anticipated this groundwater will be removed by Chico drain oil in February 2002 once analysis is complete.

The site was backfilled with no. 3 drain rock about 1.0' around the 6" diam. perforated pvc pipe manifold laid in the excavation bottom (see Figure 2 for pipe location). The excavation was then backfilled with pea gravel to approximately 1.0' below existing grade. Pea gravel was covered with plastic and filter fabric (see Figure 3) and brought to grade with crushed base rock. 6" diam. cleanouts were brought to grade from the groundwater recovery pipe. All soils are currently winterized onsite in four piles totaling approx. (750 cubic yards).

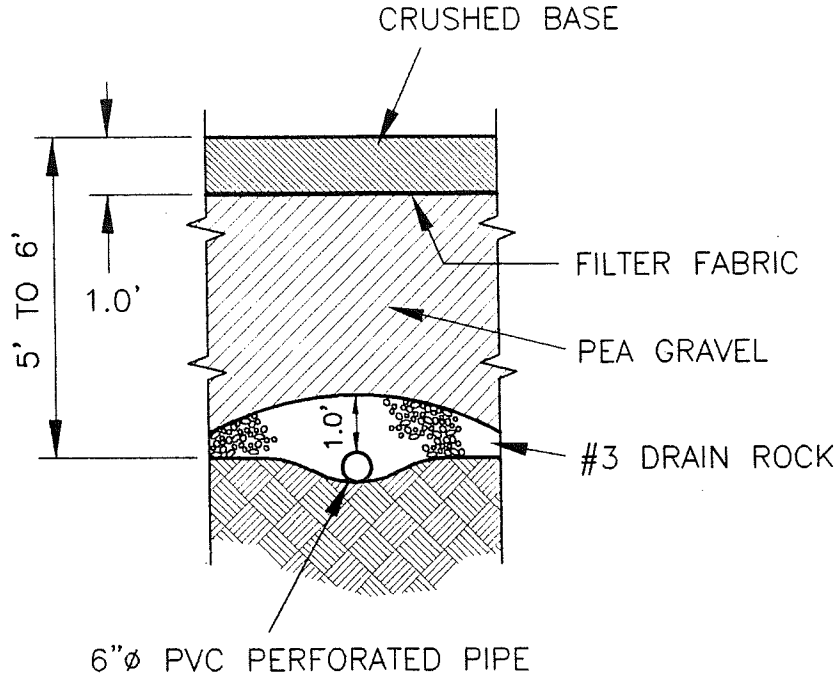
## Results of Investigations

The excavation extended approximately 5-6 feet in depth throughout the area. The soils encountered were typically silty fill with pockets of gravel, rock, concrete and asphalt chunks. Some woody debris and stumps were removed from the south wall near sample 54 and woody debris remains in the ground at this location.
Residual Gasoline (TPH-g) and Diesel (TPH-d) contamination remains in the sidewalls samples at < 25 ppm gasoline and <200 ppm diesel in the majority of the sidewall samples and all bottom samples. Exceptions are noted near the existing traffic storage area/concrete containment structure sample 60 with TPH-g at 790 ppm and TPH-d at 2800 ppm and sample 54 with TPH-g at 150 ppm and TPH-d at 2400 ppm to the south (See Table 1).

The groundwater recovered from the excavation principally came from waters encased around the woody debris found on the southerly wall near sample 54.

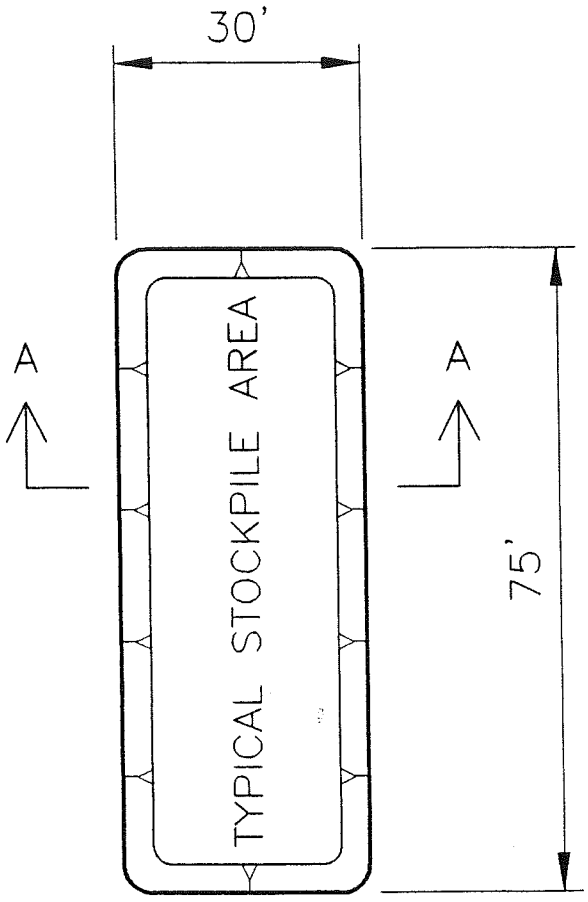



SECTION A-A




CROSS SECTION OF
EXCAVATION & BACKFILL

N.T.S.




TYPICAL SOIL STOCKPILES
CROSS SECTIONS

N.T.S.

FILE: CORP YARD COASTAL PERMIT_FIG_1.dwg

FIG.-3

## Recommendations

### Overexcavation

It is recommended additional overexcavation of approximately 100 cubic yards total near samples 54/ WP-4 to remove the buried woody debris/soil and also near sample 60 in the shallow sandy/gravelly soils which contained obvious gas/diesel contamination. This work could occur in April/May once groundwater has lowered or is removed. Confirmation sidewall and bottom samples will be collected in accordance with the previously approved overexcavation plan.

### Installation of Groundwater Monitoring Wells

We recommend installing five groundwater monitoring well installation where shown on Figure 2. This phase of the hydrogeologic investigation will consist of the installation of five (5) monitoring wells for monitoring groundwater contamination levels as well as seasonal groundwater elevations and groundwater gradient direction. Soil samples will also be collected from the well borings and tested for hydrocarbon contaminants if present.

The locations of the proposed monitoring wells have chosen based on observed contamination and assumed/observed groundwater gradient direction. The proposed well placement will allow for determination of localized groundwater gradient and direction. Wells 1, 2, and 3 are in the assumed downgradient direction and wells 4 and 5 will provide assessment of potential offsite impacts.

Prior to installation of the wells, the City of Arcata will obtain a monitoring well construction permit from the HCDEH.

### Monitoring Well Construction

Five monitoring wells will be installed using a truck-mounted drill-rig equipped with an 8 1/4 inch outside diameter hollow-stem augers. Approximately 3-5 feet of perforated well screen will be installed from just above the highest seasonal groundwater level to the bottom of the wellborn. All wells will be completed in the shallow water- bearing zone. Maximum well depth is not anticipated to exceed 8 feet bgs. The monitoring wells will be constructed of clean, flush-threaded, two-inch diameter PVC well materials. Well screen, with O.O2-inch perforations, will extend from the bottom of each boring to approximately 3 feet bgs, and blank casing will be extended to ground surface. A filter pack of Lonestar #3 or #2/12 sand will extend from the bottom of each boring to one foot above the screened interval. The filter pack will be sealed by a one-foot layer of hydrated bentonite. The remaining annular space will be filled with cement bentonite grout and surface construction of the wells will consist of a locking, flush mount, traffic, and waterproof cover. Proposed monitoring well construction details are shown in Figure 4. We will not advance borings through the aquitard or aquiclude immediately below the first water bearing zone.

Augers and samplers will be decontaminated between use by either steam cleaning or an Alconox@ wash followed by a double rinse in clean tap water to prevent cross-

contamination. Soil cuttings and auger/sampler rinsate will be stored on-site in labeled 55-gallons drums pending future removal and disposal.

## Well Development, Groundwater Sampling and Testing

Approximately 12 to 72 hours after installation, the static water level will be recorded and the wells will be developed using a bailer and/or 1.7-inch hand pump. The ph, conductivity, and temperature of the water will be tested at regular intervals to verify that representative samples of formation groundwater are present in the wells. The wells will be allowed to recharge and stabilize for 12 to 24 hours. The water levels will be re-measured after recovery. Three well volumes will be purged from the wells, again testing pH, conductivity, temperature, and clarity for signs representative formation waters, and then groundwater samples will be collected. Should the well(s) be contaminated with free product, the thickness of the product will be measured using water sensitive paste (both before and after purging). Groundwater samples will be taken from the wells with disposable PVC bailers, stored in appropriate containers (i.e. VOA vials), placed under field refrigeration, and transported to a State certified laboratory under appropriate chain of custody documentation for analyses. Groundwater samples will be tested for TPH-d TPH-g, BTXE and MTBE.

We will determine the elevation and location of each well to an accuracy of 0.01 feet, with respect to a mean sea level datum point.

## Groundwater Direction and Gradient

Groundwater flow direction and hydraulic gradient will be determined for each set of water level data by resolving a three point problem for the orientation of a hypothetical planar surface in space. Results of the three-point problem will be used to generate a groundwater contour map, depicting the groundwater elevations projected across the site and the local flow direction

## Groundwater Monitoring Program

We believe that it will be necessary to conduct monitoring for a minimum of one year in order to fully assess the impact of released product on the groundwater flow direction, and the hydraulic gradient. Quarterly sampling of the monitoring wells, for laboratory analyses, will be collected for one year. Monthly water levels will be determined and a tidal influence study will be performed. We recommend that water levels only be measured at each quarterly sampling event should the hydraulic data indicate that this would be acceptable. Sampling procedures are outlined in the previous section. Four quarterly reports will be generated during the course of a one-year monitoring period. The reports will include monthly water level measurements, calculated hydraulic gradient, groundwater flow direction(s), a summary of observations, and quarterly laboratory analyses.

## QA/QC

Groundwater sample quality control and assurance measures will include a trip blank consisting of a sample container filled at the laboratory with distilled (blank) water.

**Site Sanitation Procedures**

All drill cutting and groundwater extracted from wells and boreholes will be stored on site in D.O. T. 55-gallon drums. Laboratory analyses will be utilized to establish proper disposal procedures for cuttings and purge/development waters. Rinsate generated from steam cleaning drilling, development, and sampling equipment will be contained in a portable washbasin and pumped into 55-gallon drums for storage prior to disposal.

**Groundwater Pumping/Treatment**

The groundwater in the excavation area from pit 3 will be pumped this winter into the above ground 3200 gallon P.E. tank. A water sample will be collected and analyzed for TPH-d TPH-g, BTXE and MTBE. Based on the analytical results and the initial groundwater monitoring well analytical results groundwater treatment options will be determined and a groundwater remediation plan will be submitted to the RWQCB for approval.

**Winterized Soil Pile Remediation**

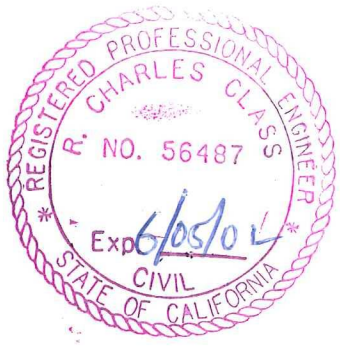
Soil piles will continue to be winterized onsite and proposed additional material (100 CY) will be added to the existing area. It is anticipated that soil biopiles or other intrinsic processes will be used to treat soil contaminants onsite. The soil piles will be uncovered during the dry weather (summer 2002) and mixed/blended to allow homogenization of the piles.
Random soil samples will be collected (1 per 100 CY) and analyzed for TPH-d TPH-g, BTXE and MTBE. Based upon the results a remediation alternative will be submitted to the RWQCB for approval.

We look forward to your response and approval of this plan for installation of groundwater monitoring wells and additional overexcavation of contaminated soils. Please do not hesitate to contact me at 707.825.2173 if you have any questions.

Sincerely,

R. Charles (Doby) Class
Deputy Public Works Director

CC: Melissa Martel, HCDEH
Jim Baskin, California Coastal Commission
Jill Geist, City of Arcata



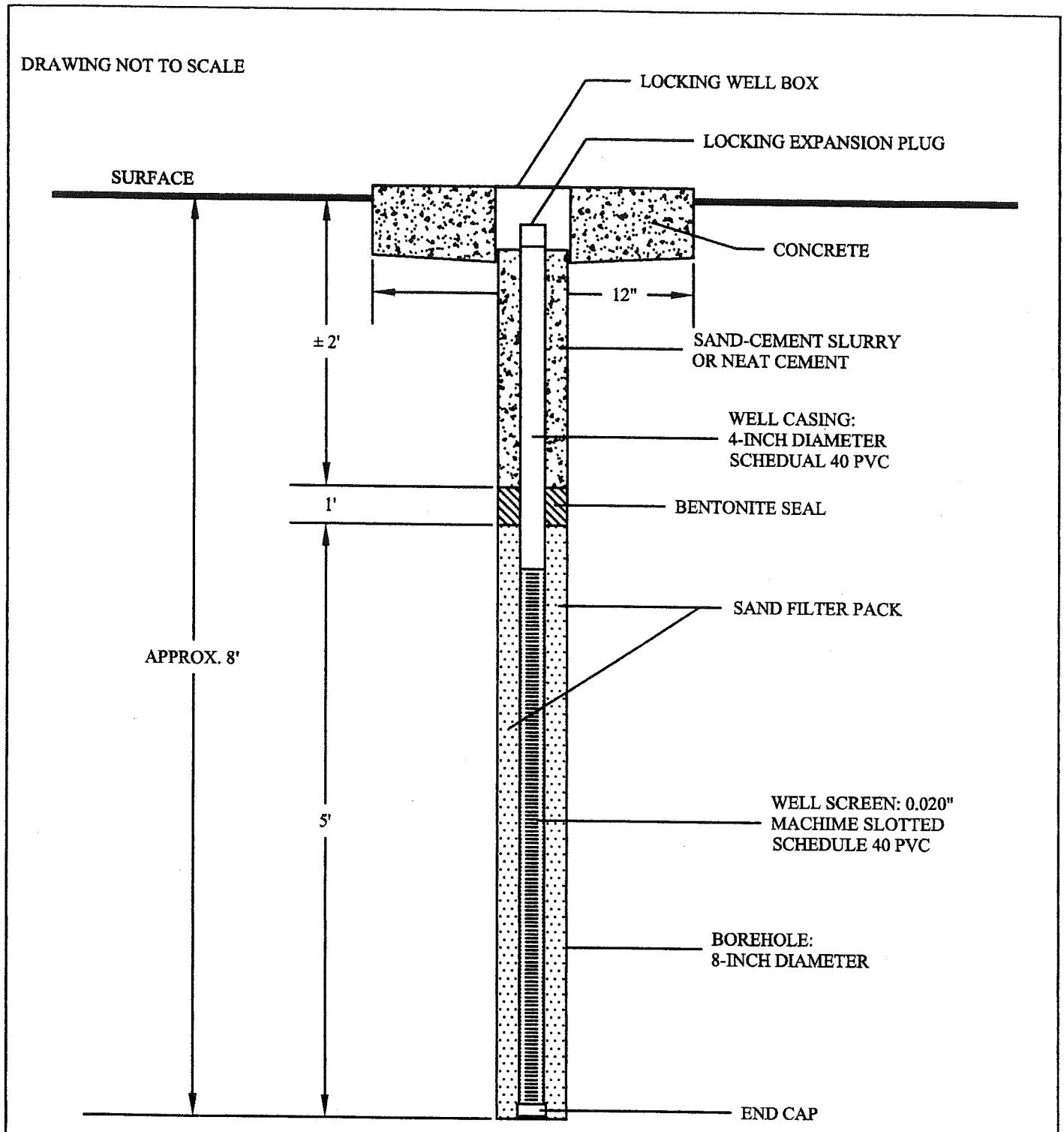



FIGURE 4
TYPICAL MONITORING WELL
DATE: 1/22/2002

Dhillger/dell/Tim/Monitor_Well

**ATTACHMENT 1**

Laboratory Analytical Reports from Phase II investigation

- North Coast Laboratories October 29, 2001 (Soil samples)
- North Coast Laboratories October 3, 2001 (Groundwater pit samples)

NORTH COAST
LABORATORIES LTD.

October 29, 2001

City of Arcata
736 F Street
Arcata, CA 95521-6211

Attn: R.C. Class

RE: Corp Yard, Ph II

Order No.: 0110277
Invoice No.: 19878
PO No.: 21159-002
ELAP No. 1247-Expires July 2002

**SAMPLE IDENTIFICATION**

| Fraction | Client Sample Description |
|---|---|
| 01A | 51 |
| 01B | 51 |
| 02A | 52 |
| 02B | 52 |
| 03A | 53 |
| 03B | 53 |
| 04A | 54 |
| 04B | 54 |
| 05A | 55 |
| 05B | 55 |
| 06A | 56 |
| 06B | 56 |
| 07A | 57 |
| 07B | 57 |
| 08A | 58 |
| 08B | 58 |
| 09A | 59 |
| 09B | 59 |
| 10A | 60 |
| 10B | 60 |
| 11A | 61 |
| 11B | 61 |
| 12A | 62 |
| 12B | 62 |
| 13A | 63 |
| 13B | 63 |
| 14A | 64 |
| 14B | 64 |

ND = Not Detected at the Reporting Limit

Limit = Reporting Limit

All solid results are expressed on a wet-weight basis unless otherwise noted.

**REPORT CERTIFIED BY**

Laboratory Supervisor(s)

QA Officer

Jesse G. Chaney, Jr.
Laboratory Director

TPH Diesel:
The LCS/LCSD recoveries were below the lower acceptance limits for diesel. The surrogate recoveries for the method blank and the LCS/LCSD were below the lower acceptance limit. These recoveries indicate that the sample results may be erroneously low. However, all of the sample surrogate recoveries were within acceptance limits indicating that only the quality control samples were effected.

Samples 54, 60 and 64 contain material similar to degraded or weathered diesel oil.

Samples 55, 61, 62 and 63 contain material in the diesel range of molecular weights, but the material does not exhibit the peak pattern typical of diesel oil.

Samples 51, 52, 55 and 57 contain material in the diesel range of molecular weights and beyond. This suggests the presence of an oil heavier than diesel.

Samples 56, 58 and 59 contain material in the diesel range of molecular weights and beyond. The samples also exhibit the peaks typical of diesel. This indicates the presence of diesel plus an oil heavier than diesel.

The surrogate for samples 54 and 60 could not be quantified due to sample dilutions.

Samples 61, 62, 63 and 64 contain material beyond the diesel range. This suggests the presence of an oil heavier than diesel. The amount of this material is not included in the results reported.

The surrogate for samples 52 and 53 were not quantifiable due to the sample matrix.

TPH-Gasoline:
The samples listed below do not present a peak pattern consistent with that of gasoline. However, the results reported represent the amount of mateiral in the gasoline range.
53 54 55 56 58 59 60 63

BTXE:
Some reporting limits were raised for the samples listed below due to matrix interference.
53 54 55 56 58 61 63 64

Sample 60 was diluted and the reporting limits were raised additionally due to matrix interference.

Suggest confirmation of the positive MTBE results by GCMS for the samples listed below.
53 54 55 56 57 61 63



NORTH COAST LABORATORIES
5680 West End Road • Arcata California 95521 • 707-822-4649 • FAX 707-822-6831
Printed on Recycled Paper

**Date:** 30-Oct-01
**WorkOrder:** 0110277

# ANALYTICAL REPORT

**Client Sample ID:** 51 **Received:** 10/10/01 **Collected:** 10/9/01 14:30
**Lab ID:** 0110277-01A

**Test Name:** BTEX **Reference:** EPA 8021B/5035

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| MTBE | ND | 0.050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Benzene | 0.66 | 0.12 | µg/g | 25 | 10/17/01 | 10/18/01 |
| Toluene | 2.4 | 0.12 | µg/g | 25 | 10/17/01 | 10/18/01 |
| Ethylbenzene | 0.50 | 0.12 | µg/g | 25 | 10/17/01 | 10/18/01 |
| m,p-Xylene | 1.5 | 0.12 | µg/g | 25 | 10/17/01 | 10/18/01 |
| o-Xylene | 0.71 | 0.12 | µg/g | 25 | 10/17/01 | 10/18/01 |
| Surrogate: Cis-1,2-Dichloroethylene | 112 | 53.9-135 | % Rec | 25 | 10/17/01 | 10/18/01 |

**Test Name:** TPH as Gasoline **Reference:** EPA 5035/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Gas | 21 | 1.0 | µg/g | 1.0 | 10/17/01 | 10/18/01 |

**Client Sample ID:** 51 **Received:** 10/10/01 **Collected:** 10/9/01 14:30
**Lab ID:** 0110277-01B

**Test Name:** TPH as Diesel **Reference:** EPA 3550/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Diesel | 11 | 1.0 | µg/g | 1.0 | 10/16/01 | 10/18/01 |
| Surrogate: N-Tricosane | 94.5 | 82.7-149 | % Rec | 1.0 | 10/16/01 | 10/18/01 |

**Client Sample ID:** 52 **Received:** 10/10/01 **Collected:** 10/9/01 14:40
**Lab ID:** 0110277-02A

**Test Name:** BTEX **Reference:** EPA 8021B/5035

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| MTBE | ND | 0.050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Benzene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Toluene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Ethylbenzene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| m,p-Xylene | 0.0063 | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| o-Xylene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Surrogate: Cis-1,2-Dichloroethylene | 102 | 53.9-135 | % Rec | 1.0 | 10/17/01 | 10/18/01 |

**Test Name:** TPH as Gasoline **Reference:** EPA 5035/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Gas | ND | 1.0 | µg/g | 1.0 | 10/17/01 | 10/18/01 |



NORTH COAST LABORATORIES
5680 West End Road • Arcata California 95521 • 707-822-4649 • FAX 707-822-6831
Printed on Recycled Paper

Date: 30-Oct-01
WorkOrder: 0110277

# ANALYTICAL REPORT

**Client Sample ID:** 52 **Received:** 10/10/01 **Collected:** 10/9/01 14:40
**Lab ID:** 0110277-02B

**Test Name:** TPH as Diesel **Reference:** EPA 3550/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Diesel | 32 | 1.0 | µg/g | 1.0 | 10/16/01 | 10/18/01 |
| Surrogate: N-Tricosane | N/Q | 82.7-149 | % Rec | 1.0 | 10/16/01 | 10/18/01 |

**Client Sample ID:** 53 **Received:** 10/10/01 **Collected:** 10/9/01 14:45
**Lab ID:** 0110277-03A

**Test Name:** BTEX **Reference:** EPA 8021B/5035

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| MTBE | 0.11 | 0.050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Benzene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Toluene | ND | 0.012 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Ethylbenzene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| m,p-Xylene | ND | 0.012 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| o-Xylene | ND | 0.010 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Surrogate: Cis-1,2-Dichloroethylene | 107 | 53.9-135 | % Rec | 1.0 | 10/17/01 | 10/18/01 |

**Test Name:** TPH as Gasoline **Reference:** EPA 5035/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Gas | 2.5 | 1.0 | µg/g | 1.0 | 10/17/01 | 10/18/01 |

**Client Sample ID:** 53 **Received:** 10/10/01 **Collected:** 10/9/01 14:45
**Lab ID:** 0110277-03B

**Test Name:** TPH as Diesel **Reference:** EPA 3550/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Diesel | 190 | 1.0 | µg/g | 1.0 | 10/16/01 | 10/18/01 |
| Surrogate: N-Tricosane | N/Q | 82.7-149 | % Rec | 1.0 | 10/16/01 | 10/18/01 |



NORTH COAST LABORATORIES
5680 West End Road • Arcata California 95521 • 707-822-4649 • FAX 707-822-6831
Printed on Recycled Paper

**Date:** 30-Oct-01
**WorkOrder:** 0110277

# ANALYTICAL REPORT

**Client Sample ID:** 54 **Received:** 10/10/01 **Collected:** 10/9/01 14:50
**Lab ID:** 0110277-04A

**Test Name:** BTEX **Reference:** EPA 8021B/5035

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| MTBE | 0.055 | 0.050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Benzene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Toluene | ND | 0.013 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Ethylbenzene | ND | 0.030 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| m,p-Xylene | ND | 0.020 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| o-Xylene | ND | 0.030 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Surrogate: Cis-1,2-Dichloroethylene | 94.8 | 53.9-135 | % Rec | 1.0 | 10/17/01 | 10/18/01 |

**Test Name:** TPH as Gasoline **Reference:** EPA 5035/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Gas | 150 | 10 | µg/g | 10 | 10/17/01 | 10/18/01 |

**Client Sample ID:** 54 **Received:** 10/10/01 **Collected:** 10/9/01 14:50
**Lab ID:** 0110277-04B

**Test Name:** TPH as Diesel **Reference:** EPA 3550/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Diesel | 2,400 | 100 | µg/g | 100 | 10/16/01 | 10/20/01 |
| Surrogate: N-Tricosane | N/Q | 82.7-149 | % Rec | 100 | 10/16/01 | 10/20/01 |

**Client Sample ID:** 55 **Received:** 10/10/01 **Collected:** 10/9/01 15:00
**Lab ID:** 0110277-05A

**Test Name:** BTEX **Reference:** EPA 8021B/5035

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| MTBE | 0.25 | 0.050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Benzene | 0.0053 | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Toluene | ND | 0.015 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Ethylbenzene | ND | 0.025 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| m,p-Xylene | ND | 0.030 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| o-Xylene | ND | 0.020 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Surrogate: Cis-1,2-Dichloroethylene | 123 | 53.9-135 | % Rec | 1.0 | 10/17/01 | 10/18/01 |

**Test Name:** TPH as Gasoline **Reference:** EPA 5035/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Gas | 18 | 1.0 | µg/g | 1.0 | 10/17/01 | 10/18/01 |



NORTH COAST LABORATORIES
5680 West End Road • Arcata California 95521 • 707-822-4649 • FAX 707-822-6831
Printed on Recycled Paper

**Date:** 30-Oct-01
**WorkOrder:** 0110277

# ANALYTICAL REPORT

**Client Sample ID:** 55 **Received:** 10/10/01 **Collected:** 10/9/01 15:00
**Lab ID:** 0110277-05B

**Test Name:** TPH as Diesel **Reference:** EPA 3550/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Diesel | 31 | 1.0 | µg/g | 1.0 | 10/16/01 | 10/18/01 |
| Surrogate: N-Tricosane | 129 | 82.7-149 | % Rec | 1.0 | 10/16/01 | 10/18/01 |

---

**Client Sample ID:** 56 **Received:** 10/10/01 **Collected:** 10/9/01 15:10
**Lab ID:** 0110277-06A

**Test Name:** BTEX **Reference:** EPA 8021B/5035

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| MTBE | 0.84 | 0.050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Benzene | 0.032 | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Toluene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Ethylbenzene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| m,p-Xylene | 0.0086 | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| o-Xylene | ND | 0.010 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Surrogate: Cis-1,2-Dichloroethylene | 106 | 53.9-135 | % Rec | 1.0 | 10/17/01 | 10/18/01 |

**Test Name:** TPH as Gasoline **Reference:** EPA 5035/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Gas | 2.5 | 1.0 | µg/g | 1.0 | 10/17/01 | 10/18/01 |

---

**Client Sample ID:** 56 **Received:** 10/10/01 **Collected:** 10/9/01 15:10
**Lab ID:** 0110277-06B

**Test Name:** TPH as Diesel **Reference:** EPA 3550/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Diesel | 66 | 1.0 | µg/g | 1.0 | 10/16/01 | 10/18/01 |
| Surrogate: N-Tricosane | 93.1 | 82.7-149 | % Rec | 1.0 | 10/16/01 | 10/18/01 |



NORTH COAST LABORATORIES
5680 West End Road • Arcata California 95521 • 707-822-4649 • FAX 707-822-6831
Printed on Recycled Paper

**Date:** 30-Oct-01
**WorkOrder:** 0110277

# ANALYTICAL REPORT

**Client Sample ID:** 57 **Received:** 10/10/01 **Collected:** 10/9/01 15:20
**Lab ID:** 0110277-07A

**Test Name:** BTEX **Reference:** EPA 8021B/5035

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| MTBE | 0.084 | 0.050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Benzene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Toluene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Ethylbenzene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| m,p-Xylene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| o-Xylene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Surrogate: Cis-1,2-Dichloroethylene | 100 | 53.9-135 | % Rec | 1.0 | 10/17/01 | 10/18/01 |

**Test Name:** TPH as Gasoline **Reference:** EPA 5035/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Gas | ND | 1.0 | µg/g | 1.0 | 10/17/01 | 10/18/01 |

**Client Sample ID:** 57 **Received:** 10/10/01 **Collected:** 10/9/01 15:20
**Lab ID:** 0110277-07B

**Test Name:** TPH as Diesel **Reference:** EPA 3550/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Diesel | 2.4 | 1.0 | µg/g | 1.0 | 10/16/01 | 10/18/01 |
| Surrogate: N-Tricosane | 108 | 82.7-149 | % Rec | 1.0 | 10/16/01 | 10/18/01 |

**Client Sample ID:** 58 **Received:** 10/10/01 **Collected:** 10/9/01 15:30
**Lab ID:** 0110277-08A

**Test Name:** BTEX **Reference:** EPA 8021B/5035

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| MTBE | ND | 0.050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Benzene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Toluene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Ethylbenzene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| m,p-Xylene | ND | 0.012 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| o-Xylene | ND | 0.016 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Surrogate: Cis-1,2-Dichloroethylene | 110 | 53.9-135 | % Rec | 1.0 | 10/17/01 | 10/18/01 |

**Test Name:** TPH as Gasoline **Reference:** EPA 5035/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Gas | 3.0 | 1.0 | µg/g | 1.0 | 10/17/01 | 10/18/01 |



NORTH COAST LABORATORIES
5680 West End Road • Arcata California 95521 • 707-822-4649 • FAX 707-822-6831
Printed on Recycled Paper

**Date:** 30-Oct-01
**WorkOrder:** 0110277

# ANALYTICAL REPORT

**Client Sample ID:** 58 **Received:** 10/10/01 **Collected:** 10/9/01 15:30
**Lab ID:** 0110277-08B

**Test Name:** TPH as Diesel **Reference:** EPA 3550/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Diesel | 59 | 1.0 | µg/g | 1.0 | 10/16/01 | 10/18/01 |
| Surrogate: N-Tricosane | 82.9 | 82.7-149 | % Rec | 1.0 | 10/16/01 | 10/18/01 |

**Client Sample ID:** 59 **Received:** 10/10/01 **Collected:** 10/9/01 15:40
**Lab ID:** 0110277-09A

**Test Name:** BTEX **Reference:** EPA 8021B/5035

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| MTBE | ND | 0.050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Benzene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Toluene | 0.0062 | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Ethylbenzene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| m,p-Xylene | 0.0067 | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| o-Xylene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Surrogate: Cis-1,2-Dichloroethylene | 101 | 53.9-135 | % Rec | 1.0 | 10/17/01 | 10/18/01 |

**Test Name:** TPH as Gasoline **Reference:** EPA 5035/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Gas | 1.3 | 1.0 | µg/g | 1.0 | 10/17/01 | 10/18/01 |

**Client Sample ID:** 59 **Received:** 10/10/01 **Collected:** 10/9/01 15:40
**Lab ID:** 0110277-09B

**Test Name:** TPH as Diesel **Reference:** EPA 3550/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Diesel | 72 | 1.0 | µg/g | 1.0 | 10/16/01 | 10/18/01 |
| Surrogate: N-Tricosane | 120 | 82.7-149 | % Rec | 1.0 | 10/16/01 | 10/18/01 |



NORTH COAST LABORATORIES
5680 West End Road • Arcata California 95521 • 707-822-4649 • FAX 707-822-6831
Printed on Recycled Paper

Date: 30-Oct-01
WorkOrder: 0110277

# ANALYTICAL REPORT

**Client Sample ID:** 60 **Received:** 10/10/01 **Collected:** 10/9/01 15:50
**Lab ID:** 0110277-10A

**Test Name:** BTEX **Reference:** EPA 8021B/5035

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| MTBE | ND | 2.0 | µg/g | 10 | 10/17/01 | 10/18/01 |
| Benzene | 6.2 | 0.50 | µg/g | 100 | 10/17/01 | 10/18/01 |
| Toluene | ND | 5.0 | µg/g | 100 | 10/17/01 | 10/18/01 |
| Ethylbenzene | 8.1 | 0.50 | µg/g | 100 | 10/17/01 | 10/18/01 |
| m,p-Xylene | 8.3 | 0.50 | µg/g | 100 | 10/17/01 | 10/18/01 |
| o-Xylene | ND | 3.0 | µg/g | 100 | 10/17/01 | 10/18/01 |
| Surrogate: Cis-1,2-Dichloroethylene | 111 | 53.9-135 | % Rec | 100 | 10/17/01 | 10/18/01 |

**Test Name:** TPH as Gasoline **Reference:** EPA 5035/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Gas | 790 | 50 | µg/g | 50 | 10/17/01 | 10/18/01 |

**Client Sample ID:** 60 **Received:** 10/10/01 **Collected:** 10/9/01 15:50
**Lab ID:** 0110277-10B

**Test Name:** TPH as Diesel **Reference:** EPA 3550/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Diesel | 2,800 | 100 | µg/g | 100 | 10/16/01 | 10/20/01 |
| Surrogate: N-Tricosane | N/Q | 82.7-149 | % Rec | 100 | 10/16/01 | 10/20/01 |

**Client Sample ID:** 61 **Received:** 10/10/01 **Collected:** 10/9/01 17:00
**Lab ID:** 0110277-11A

**Test Name:** BTEX **Reference:** EPA 8021B/5035

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| MTBE | 0.12 | 0.050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Benzene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Toluene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Ethylbenzene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| m,p-Xylene | ND | 0.012 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| o-Xylene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Surrogate: Cis-1,2-Dichloroethylene | 105 | 53.9-135 | % Rec | 1.0 | 10/17/01 | 10/18/01 |

**Test Name:** TPH as Gasoline **Reference:** EPA 5035/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Gas | ND | 1.0 | µg/g | 1.0 | 10/17/01 | 10/18/01 |



NORTH COAST LABORATORIES
5680 West End Road • Arcata California 95521 • 707-822-4649 • FAX 707-822-6831
Printed on Recycled Paper

**Date:** 30-Oct-01
**WorkOrder:** 0110277

# ANALYTICAL REPORT

**Client Sample ID:** 61 **Received:** 10/10/01 **Collected:** 10/9/01 17:00
**Lab ID:** 0110277-11B

**Test Name:** TPH as Diesel **Reference:** EPA 3550/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Diesel | 18 | 1.0 | µg/g | 1.0 | 10/16/01 | 10/20/01 |
| Surrogate: N-Tricosane | 114 | 82.7-149 | % Rec | 1.0 | 10/16/01 | 10/20/01 |

---

**Client Sample ID:** 62 **Received:** 10/10/01 **Collected:** 10/9/01 17:10
**Lab ID:** 0110277-12A

**Test Name:** BTEX **Reference:** EPA 8021B/5035

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| MTBE | ND | 0.050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Benzene | 0.0073 | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Toluene | 0.0070 | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Ethylbenzene | 0.0050 | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| m,p-Xylene | 0.015 | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| o-Xylene | 0.0078 | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Surrogate: Cis-1,2-Dichloroethylene | 101 | 53.9-135 | % Rec | 1.0 | 10/17/01 | 10/18/01 |

**Test Name:** TPH as Gasoline **Reference:** EPA 5035/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Gas | ND | 1.0 | µg/g | 1.0 | 10/17/01 | 10/18/01 |

---

**Client Sample ID:** 62 **Received:** 10/10/01 **Collected:** 10/9/01 17:10
**Lab ID:** 0110277-12B

**Test Name:** TPH as Diesel **Reference:** EPA 3550/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Diesel | 3.5 | 1.0 | µg/g | 1.0 | 10/16/01 | 10/20/01 |
| Surrogate: N-Tricosane | 104 | 82.7-149 | % Rec | 1.0 | 10/16/01 | 10/20/01 |



NORTH COAST LABORATORIES
5680 West End Road • Arcata California 95521 • 707-822-4649 • FAX 707-822-6831
Printed on Recycled Paper

**Date:** 30-Oct-01
**WorkOrder:** 0110277

# ANALYTICAL REPORT

**Client Sample ID:** 63 **Received:** 10/10/01 **Collected:** 10/9/01 17:20
**Lab ID:** 0110277-13A

**Test Name:** BTEX **Reference:** EPA 8021B/5035

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| MTBE | 3.3 | 0.50 | µg/g | 10 | 10/17/01 | 10/18/01 |
| Benzene | 0.10 | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Toluene | 0.0059 | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Ethylbenzene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| m,p-Xylene | ND | 0.010 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| o-Xylene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Surrogate: Cis-1,2-Dichloroethylene | 111 | 53.9-135 | % Rec | 1.0 | 10/17/01 | 10/18/01 |

**Test Name:** TPH as Gasoline **Reference:** EPA 5035/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Gas | 1.9 | 1.0 | µg/g | 1.0 | 10/17/01 | 10/18/01 |

**Client Sample ID:** 63 **Received:** 10/10/01 **Collected:** 10/9/01 17:20
**Lab ID:** 0110277-13B

**Test Name:** TPH as Diesel **Reference:** EPA 3550/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Diesel | 2.0 | 1.0 | µg/g | 1.0 | 10/16/01 | 10/20/01 |
| Surrogate: N-Tricosane | 127 | 82.7-149 | % Rec | 1.0 | 10/16/01 | 10/20/01 |

**Client Sample ID:** 64 **Received:** 10/10/01 **Collected:** 10/9/01 17:30
**Lab ID:** 0110277-14A

**Test Name:** BTEX **Reference:** EPA 8021B/5035

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| MTBE | ND | 0.050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Benzene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Toluene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Ethylbenzene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| m,p-Xylene | ND | 0.010 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| o-Xylene | ND | 0.0050 | µg/g | 1.0 | 10/17/01 | 10/18/01 |
| Surrogate: Cis-1,2-Dichloroethylene | 99.2 | 53.9-135 | % Rec | 1.0 | 10/17/01 | 10/18/01 |

**Test Name:** TPH as Gasoline **Reference:** EPA 5035/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Gas | ND | 1.0 | µg/g | 1.0 | 10/17/01 | 10/18/01 |



NORTH COAST LABORATORIES
5680 West End Road • Arcata California 95521 • 707-822-4649 • FAX 707-822-6831
Printed on Recycled Paper

**Date:** 30-Oct-01
**WorkOrder:** 0110277

# ANALYTICAL REPORT

**Client Sample ID:** 64
**Lab ID:** 0110277-14B

**Received:** 10/10/01 **Collected:** 10/9/01 17:30

**Test Name:** TPH as Diesel **Reference:** EPA 3550/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Diesel | 3.6 | 1.0 | µg/g | 1.0 | 10/16/01 | 10/18/01 |
| Surrogate: N-Tricosane | 113 | 82.7-149 | % Rec | 1.0 | 10/16/01 | 10/18/01 |



NORTH COAST LABORATORIES
5680 West End Road • Arcata California 95521 • 707-822-4649 • FAX 707-822-6831
Printed on Recycled Paper

North Coast Laboratories, Ltd.

**Date:** 29-Oct-01

**CLIENT:** City of Arcata
**Work Order:** 0110277
**Project:** Corp Yard, Ph II

# QC SUMMARY REPORT
## Method Blank

Sample ID **MB-5100** Batch ID: **5100** Test Code: **BTXES** Units: **µg/g** Analysis Date **10/17/01 7:29:25 PM** Prep Date **10/17/01**
Client ID: Run ID: **ORGC8_011017D** SeqNo: **200569**

| Analyte | Result | Limit | SPK value | SPK Ref Val | % Rec | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MTBE | ND | 0.050 | | | | | | | | | |
| Benzene | ND | 0.0050 | | | | | | | | | |
| Toluene | 0.003086 | 0.0050 | | | | | | | | | J |
| Ethylbenzene | ND | 0.0050 | | | | | | | | | |
| m,p-Xylene | ND | 0.0050 | | | | | | | | | |
| o-Xylene | ND | 0.0050 | | | | | | | | | |
| Cis-1,2-Dichloroethylene | 1.13 | 0.10 | 1.00 | 0 | 113% | 54 | 135 | 0 | | | |

Sample ID **MB-5100** Batch ID: **5100** Test Code: **TPHCGS** Units: **µg/g** Analysis Date **10/17/01 7:29:25 PM** Prep Date **10/17/01**
Client ID: Run ID: **ORGC8_011017C** SeqNo: **200507**

| Analyte | Result | Limit | SPK value | SPK Ref Val | % Rec | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPHC Gas | ND | 1.0 | | | | | | | | | |

Sample ID **MB-5090** Batch ID: **5090** Test Code: **TPHDIS** Units: **µg/g** Analysis Date **10/18/01 2:29:54 PM** Prep Date **10/16/01**
Client ID: Run ID: **ORGC5_011018A** SeqNo: **200878**

| Analyte | Result | Limit | SPK value | SPK Ref Val | % Rec | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPHC Diesel | ND | 1.0 | | | | | | | | | |
| N-Tricosane | 0.451 | 0.10 | 1.00 | 0 | 45.1% | 83 | 149 | 0 | | | S |

**Qualifiers:**
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

North Coast Laboratories, Ltd.

**Date:** 29-Oct-01

**CLIENT:** City of Arcata
**Work Order:** 0110277
**Project:** Corp Yard, Ph II

# QC SUMMARY REPORT
## Laboratory Control Spike

Sample ID **LCS-5100** Batch ID: **5100** Test Code: **BTXES** Units: **µg/g** Analysis Date **10/17/01 4:26:39 PM** Prep Date **10/17/01**
Client ID: Run ID: **ORGC8_011017D** SeqNo: **200567**

| Analyte | Result | Limit | SPK value | SPK Ref Val | % Rec | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MTBE | 0.4104 | 0.050 | 0.400 | 0 | 103% | 32 | 151 | 0 | | | |
| Benzene | 0.05923 | 0.0050 | 0.0500 | 0 | 118% | 50 | 139 | 0 | | | |
| Toluene | 0.06139 | 0.0050 | 0.0500 | 0.00309 | 117% | 69 | 130 | 0 | | | |
| Ethylbenzene | 0.05901 | 0.0050 | 0.0500 | 0 | 118% | 49 | 148 | 0 | | | |
| m,p-Xylene | 0.1163 | 0.0050 | 0.100 | 0 | 116% | 47 | 151 | 0 | | | |
| o-Xylene | 0.05841 | 0.0050 | 0.0500 | 0 | 117% | 69 | 135 | 0 | | | |
| Cis-1,2-Dichloroethylene | 1.22 | 0.10 | 1.00 | 0 | 122% | 54 | 135 | 0 | | | |

Sample ID **LCSD-5100** Batch ID: **5100** Test Code: **BTXES** Units: **µg/g** Analysis Date **10/17/01 5:03:45 PM** Prep Date **10/17/01**
Client ID: Run ID: **ORGC8_011017D** SeqNo: **200568**

| Analyte | Result | Limit | SPK value | SPK Ref Val | % Rec | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MTBE | 0.4194 | 0.050 | 0.400 | 0 | 105% | 32 | 151 | 0.410 | 2.18% | 20 | |
| Benzene | 0.05976 | 0.0050 | 0.0500 | 0 | 120% | 50 | 139 | 0.0592 | 0.888% | 53 | |
| Toluene | 0.06114 | 0.0050 | 0.0500 | 0.00309 | 116% | 69 | 130 | 0.0614 | 0.411% | 59 | |
| Ethylbenzene | 0.05991 | 0.0050 | 0.0500 | 0 | 120% | 49 | 148 | 0.0590 | 1.52% | 55 | |
| m,p-Xylene | 0.1178 | 0.0050 | 0.100 | 0 | 118% | 47 | 151 | 0.116 | 1.25% | 50 | |
| o-Xylene | 0.05918 | 0.0050 | 0.0500 | 0 | 118% | 69 | 135 | 0.0584 | 1.31% | 54 | |
| Cis-1,2-Dichloroethylene | 1.18 | 0.10 | 1.00 | 0 | 118% | 54 | 135 | 1.22 | 3.50% | 20 | |

Sample ID **LCS-5100-G** Batch ID: **5100** Test Code: **TPHCGS** Units: **µg/g** Analysis Date **10/17/01 5:40:46 PM** Prep Date **10/17/01**
Client ID: Run ID: **ORGC8_011017C** SeqNo: **200505**

| Analyte | Result | Limit | SPK value | SPK Ref Val | % Rec | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPHC Gas | 12.32 | 1.0 | 10.0 | 0 | 123% | 33 | 176 | 0 | | | |

**Qualifiers:**
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

**CLIENT:** City of Arcata
**Work Order:** 0110277
**Project:** Corp Yard, Ph II

# QC SUMMARY REPORT
## Laboratory Control Spike Duplicate

Sample ID **LCSD-5100-G** Batch ID: **5100** Test Code: **TPHCGS** Units: **µg/g** Analysis Date **10/17/01 6:17:15 PM** Prep Date **10/17/01**
Client ID: Run ID: **ORGC8_011017C** SeqNo: **200506**

| Analyte | Result | Limit | SPK value | SPK Ref Val | % Rec | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPHC Gas | 12.14 | 1.0 | 10.0 | 0 | 121% | 33 | 176 | 12.3 | 1.52% | 7 | |

Sample ID **LCS-5090** Batch ID: **5090** Test Code: **TPHDIS** Units: **µg/g** Analysis Date **10/18/01 1:39:31 PM** Prep Date **10/16/01**
Client ID: Run ID: **ORGC5_011018A** SeqNo: **200876**

| Analyte | Result | Limit | SPK value | SPK Ref Val | % Rec | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPHC Diesel | 6.810 | 1.0 | 10.0 | 0 | 68.1% | 83 | 123 | 0 | | | S |
| N-Tricosane | 0.663 | 0.10 | 1.00 | 0 | 66.3% | 83 | 149 | 0 | | | S |

Sample ID **LCSD-5090** Batch ID: **5090** Test Code: **TPHDIS** Units: **µg/g** Analysis Date **10/18/01 2:04:39 PM** Prep Date **10/16/01**
Client ID: Run ID: **ORGC5_011018A** SeqNo: **200877**

| Analyte | Result | Limit | SPK value | SPK Ref Val | % Rec | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPHC Diesel | 5.622 | 1.0 | 10.0 | 0 | 56.2% | 83 | 123 | 6.81 | 19.1% | 20 | S |
| N-Tricosane | 0.552 | 0.10 | 1.00 | 0 | 55.2% | 83 | 149 | 0.663 | 18.3% | 20 | S |

**Qualifiers:**
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

NORTH COAST LABORATORIES LTD.
5680 West End Road • Arcata • CA 95521-9202
707-822-4649 Fax 707-822-6831

# Chain of Custody

0110277

**LABORATORY NUMBER:**

Attention: R.C. CLASS
Results & Invoice to: DOBY CLASS
Address: 736 F. Street
ARCATA, CA 95521
Phone: 825-2173, 822-5957
Copies of Report to: Doby Class
Sampler (Sign & Print): R.C. CLASS

TAT: ☐ 24 Hr ☐ 48 Hr ☐ 5 Day ☐ 5–7 Day
☒ STD (2–3 Wk) ☐ Other:
PRIOR AUTHORIZATION IS REQUIRED FOR RUSHES

REPORTING REQUIREMENTS: State Forms ☐
Preliminary: FAX ☐ Verbal ☐ By: __/__/__
Final Report: FAX ☐ Verbal ☐ By: __/__/__

**PROJECT INFORMATION**
Project Number: CORP YARD
Project Name: CORP YARD PH II
Purchase Order Number: 21159-002

| LAB ID | SAMPLE ID | DATE | TIME | MATRIX* | PRESERVATIVE | CONTAINER | ANALYSIS: TPH DIESEL | ANALYSIS: TPH G, BTEX, MTBE |
|---|---|---|---|---|---|---|---|---|
| | 51 | 10/9/01 | 1430 | S | | 13 | X | X |
| | 52 | | 1440 | | | | X | X |
| | 53 | | 1445 | | | | X | X |
| | 54 | | 1450 | | | | X | X |
| | 55 | | 1500 | | | | X | X |
| | 56 | | 1510 | | | | X | X |
| | 57 | | 1520 | | | | X | X |
| | 58 | | 1530 | | | | X | X |
| | 59 | | 1540 | | | | X | X |
| | 60 | | 1550 | | | | X | X |

**CONTAINER CODES:** 1—½ gal. pl; 2—250 ml pl; 3—500 ml pl; 4—1 L Nalgene; 5—250 ml BG; 6—500 ml BG; 7—1 L BG; 8—1 L cg; 9—40 ml VOA; 10—125 ml VOA; 11—4 oz glass jar; 12—8 oz glass jar; 13—brass tube; 14—other

**PRESERVATIVE CODES:** a—$HNO_3$; b—HCl; c—$H_2SO_4$; d—$Na_2S_2O_3$; e—NaOH; f—$C_2H_3O_2Cl$; g—other

**SAMPLE CONDITION/SPECIAL INSTRUCTIONS**

Cold, intact

| RELINQUISHED BY (Sign & Print) | DATE/TIME | RECEIVED BY (Sign) | DATE/TIME |
|---|---|---|---|
| R. CHARLES CLASS | 10/10/01 1432 | MARTIN E. NELSON | 10/10/01 #32 |
| MARTIN E. NELSON MARTIN E. NELSON | 10/10/01 1505 | | 10/10/01 1505 |

**SAMPLE DISPOSAL**
☐ NCL Disposal of Non-Contaminated
☐ Return ☐ Pickup

**CHAIN OF CUSTODY SEALS Y/N/NA**
**SHIPPED VIA:** UPS Air-Ex Fed-Ex Bus (Hand)

***MATRIX:** DW=Drinking Water; Eff=Effluent; Inf=Influent; SW=Surface Water; GW=Ground Water; S=Soil; O=Other.

**ALL CONTAMINATED NON-AQUEOUS SAMPLES WILL BE RETURNED TO CLIENT**

NORTH COAST LABORATORIES LTD.
5680 West End Road • Arcata • CA 95521-9202
707-822-4649 Fax 707-822-6831

# Chain of Custody

LABORATORY NUMBER: 0110277

Attention: R.C. CLASS
Results & Invoice to: DOBY CLASS
Address: 736 F. Street
ARCATA, CA 95521
Phone: 825-2173, 822-5957
Copies of Report to: Doby Class
Sampler (Sign & Print): R.C. CLASS R.C. Class

TAT: ☐ 24 Hr ☐ 48 Hr ☐ 5 Day ☐ 5–7 Day
☒ STD (2–3 Wk) ☐ Other:
PRIOR AUTHORIZATION IS REQUIRED FOR RUSHES

REPORTING REQUIREMENTS: State Forms
Preliminary: FAX ☐ Verbal ☐ By: __/__/__
Final Report: FAX ☐ Verbal ☐ By: __/__/__

**CONTAINER CODES:** 1—½ gal. pl; 2—250 ml pl; 3—500 ml pl; 4—1 L Nalgene; 5—250 ml BG; 6—500 ml BG; 7—1 L BG; 8—1 L cg; 9—40 ml VOA; 10—125 ml VOA; 11—4 oz glass jar; 12—8 oz glass jar; 13—brass tube; 14—other

**PRESERVATIVE CODES:** a—$HNO_3$; b—HCl; c—$H_2SO_4$; d—$Na_2S_2O_3$; e—NaOH; f—$C_2H_3O_2Cl$; g—other

**PROJECT INFORMATION**
Project Number: CORP YARD
Project Name: CORP YARD PH II
Purchase Order Number: 21159 - 002

| LAB ID | SAMPLE ID | DATE | TIME | MATRIX* | CONTAINER | PRESERVATIVE | ANALYSIS: TPH DIESEL | ANALYSIS: TPH G, BTEX, mTBE |
|---|---|---|---|---|---|---|---|---|
| | 61 | 10/9/01 | 1700 | S | 13 | | X | X |
| | 62 | 10/9/01 | 1710 | | | | X | X |
| | 63 | 10/9/01 | 1720 | | | | X | X |
| | 64 | 10/9/01 | 1730 | | | | X | X |

**SAMPLE CONDITION/SPECIAL INSTRUCTIONS**
Cold, intact

| RELINQUISHED BY (Sign & Print) | DATE/TIME | RECEIVED BY (Sign) | DATE/TIME |
|---|---|---|---|
| R.C. CLASS R.C. CLASS | 10/10/01 1432 | MARTIN E. NELSON MARTIN E. NELSON | 10/10/01 1432 |
| MARTIN E. NELSON MARTIN E. NELSON | 10/10/01 1505 | [signature] | 10/10/01 1505 |

**SAMPLE DISPOSAL**
☐ NCL Disposal of Non-Contaminated
☐ Return ☐ Pickup

CHAIN OF CUSTODY SEALS Y/N/NA
SHIPPED VIA: UPS Air-Ex Fed-Ex Bus Hand

***MATRIX:** DW=Drinking Water; Eff=Effluent; Inf=Influent; SW=Surface Water; GW=Ground Water; S=Soil; O=Other.

**ALL CONTAMINATED NON-AQUEOUS SAMPLES WILL BE RETURNED TO CLIENT**

NORTH COAST
LABORATORIES LTD.

RECEIVED
OCT 05 2001
CITY OF ARCATA
PUBLIC WORKS DEPT.

October 03, 2001

City of Arcata
736 F Street
Arcata, CA 95521-6211

Attn: R.C. Class

RE: Corp Yard, Corp Yard PHII

Order No.: 0110013
Invoice No.: 19245
PO No.: 8910
ELAP No. 1247-Expires July 2002

**SAMPLE IDENTIFICATION**

| Fraction | Client Sample Description |
|---|---|
| 01A | Pit 1 |
| 01D | Pit 1 |
| 02A | Pit 2 |
| 02D | Pit 2 |
| 03A | Pit 3 |
| 03D | Pit 3 |
| 04A | Travel Blank |

ND = Not Detected at the Reporting Limit

Limit = Reporting Limit

All solid results are expressed on a wet-weight basis unless otherwise noted.

**REPORT CERTIFIED BY**

Laboratory Supervisor(s) | QA Officer | Jesse G. Chaney, Jr.
Laboratory Director

5680 West End Road Arcata California 95521-9202 707-822-4649 FAX 707-822-6831

Printed on Recycled Paper

Date: 03-Oct-01
WorkOrder: 0110013

# ANALYTICAL REPORT

**Client Sample ID:** Pit 1 **Received:** 10/1/01 **Collected:** 10/1/01 14:10
**Lab ID:** 0110013-01A

**Test Name:** BTEX **Reference:** EPA 8021B/5030

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| MTBE | ND | 3.0 | µg/L | 1.0 | | 10/2/01 |
| Benzene | ND | 0.50 | µg/L | 1.0 | | 10/2/01 |
| Toluene | ND | 0.50 | µg/L | 1.0 | | 10/2/01 |
| Ethylbenzene | ND | 0.50 | µg/L | 1.0 | | 10/2/01 |
| m,p-Xylene | ND | 0.50 | µg/L | 1.0 | | 10/2/01 |
| o-Xylene | ND | 0.50 | µg/L | 1.0 | | 10/2/01 |
| Surrogate: Cis-1,2-Dichloroethylene | 102 | 70-123 | % Rec | 1.0 | | 10/2/01 |

**Test Name:** TPH as Gasoline **Reference:** EPA 5030/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Gas | ND | 50 | µg/L | 1.0 | | 10/2/01 |

**Client Sample ID:** Pit 1 **Received:** 10/1/01 **Collected:** 10/1/01 14:10
**Lab ID:** 0110013-01D

**Test Name:** TPH as Diesel **Reference:** EPA 3510/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Diesel | 58 | 50 | µg/L | 1.0 | 10/2/01 | 10/3/01 |
| Surrogate: N-Tricosane | 136 | 69.9-145 | % Rec | 1.0 | 10/2/01 | 10/3/01 |

**Client Sample ID:** Pit 2 **Received:** 10/1/01 **Collected:** 10/1/01 14:15
**Lab ID:** 0110013-02A

**Test Name:** BTEX **Reference:** EPA 8021B/5030

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| MTBE | 3.3 | 3.0 | µg/L | 1.0 | | 10/2/01 |
| Benzene | ND | 0.50 | µg/L | 1.0 | | 10/2/01 |
| Toluene | ND | 0.50 | µg/L | 1.0 | | 10/2/01 |
| Ethylbenzene | ND | 0.50 | µg/L | 1.0 | | 10/2/01 |
| m,p-Xylene | ND | 0.50 | µg/L | 1.0 | | 10/2/01 |
| o-Xylene | ND | 0.50 | µg/L | 1.0 | | 10/2/01 |
| Surrogate: Cis-1,2-Dichloroethylene | 110 | 70-123 | % Rec | 1.0 | | 10/2/01 |

**Test Name:** TPH as Gasoline **Reference:** EPA 5030/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Gas | ND | 50 | µg/L | 1.0 | | 10/2/01 |



NORTH COAST LABORATORIES
5680 West End Road • Arcata, California 95521 • 707-822-4649 • FAX 707-822-6831
Printed on Recycled Paper

Date: 03-Oct-01

WorkOrder: 0110013

# ANALYTICAL REPORT

**Client Sample ID:** Pit 2 **Received:** 10/1/01 **Collected:** 10/1/01 14:15

**Lab ID:** 0110013-02D

**Test Name:** TPH as Diesel **Reference:** EPA 3510/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Diesel | 53 | 50 | µg/L | 1.0 | 10/2/01 | 10/3/01 |
| Surrogate: N-Tricosane | 81.7 | 69.9-145 | % Rec | 1.0 | 10/2/01 | 10/3/01 |

**Client Sample ID:** Pit 3 **Received:** 10/1/01 **Collected:** 10/1/01 14:20

**Lab ID:** 0110013-03A

**Test Name:** BTEX **Reference:** EPA 8021B/5030

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| MTBE | 9,800 | 300 | µg/L | 100 | | 10/2/01 |
| Benzene | 57 | 5.0 | µg/L | 10 | | 10/2/01 |
| Toluene | ND | 3.0 | µg/L | 1.0 | | 10/2/01 |
| Ethylbenzene | 3.0 | 0.50 | µg/L | 1.0 | | 10/2/01 |
| m,p-Xylene | ND | 1.2 | µg/L | 1.0 | | 10/2/01 |
| o-Xylene | ND | 0.50 | µg/L | 1.0 | | 10/2/01 |
| Surrogate: Cis-1,2-Dichloroethylene | 119 | 70-123 | % Rec | 100 | | 10/2/01 |

**Test Name:** TPH as Gasoline **Reference:** EPA 5030/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Gas | 870 | 500 | µg/L | 10 | | 10/2/01 |

**Client Sample ID:** Pit 3 **Received:** 10/1/01 **Collected:** 10/1/01 14:20

**Lab ID:** 0110013-03D

**Test Name:** TPH as Diesel **Reference:** EPA 3510/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Diesel | 140 | 50 | µg/L | 1.0 | 10/2/01 | 10/3/01 |
| Surrogate: N-Tricosane | 98.8 | 69.9-145 | % Rec | 1.0 | 10/2/01 | 10/3/01 |



NORTH COAST LABORATORIES
5680 West End Road • Arcata, California 95521 • 707-822-4649 • FAX 707-822-6831
Printed on Recycled Paper

**Date:** 03-Oct-01
**WorkOrder:** 0110013

# ANALYTICAL REPORT

**Client Sample ID:** Travel Blank **Received:** 10/1/01 **Collected:**
**Lab ID:** 0110013-04A

**Test Name:** BTEX **Reference:** EPA 8021B/5030

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| MTBE | ND | 3.0 | µg/L | 1.0 | | 10/2/01 |
| Benzene | ND | 0.50 | µg/L | 1.0 | | 10/2/01 |
| Toluene | ND | 0.50 | µg/L | 1.0 | | 10/2/01 |
| Ethylbenzene | ND | 0.50 | µg/L | 1.0 | | 10/2/01 |
| m,p-Xylene | ND | 0.50 | µg/L | 1.0 | | 10/2/01 |
| o-Xylene | ND | 0.50 | µg/L | 1.0 | | 10/2/01 |
| Surrogate: Cis-1,2-Dichloroethylene | 105 | 70-123 | % Rec | 1.0 | | 10/2/01 |

**Test Name:** TPH as Gasoline **Reference:** EPA 5030/GCFID

| Parameter | Result | Limit | Units | DF | Extracted | Analyzed |
|---|---|---|---|---|---|---|
| TPHC Gas | ND | 50 | µg/L | 1.0 | | 10/2/01 |



NORTH COAST LABORATORIES
5680 West End Road • Arcata, California 95521 • 707-822-4649 • FAX 707-822-6831
Printed on Recycled Paper

North Coast Laboratories, Ltd.

**Date:** 03-Oct-01

**CLIENT:** City of Arcata
**Work Order:** 0110013
**Project:** Corp Yard, Corp Yard PHII

# QC SUMMARY REPORT

## Method Blank

Sample ID **MBLK** Batch ID: **R13108** Test Code: **BTXEW** Units: **µg/L** Analysis Date **10/2/01 7:31:49 PM** Prep Date

Client ID: Run ID: **ORGC8_011002B** SeqNo: **196861**

| Analyte | Result | Limit | SPK value | SPK Ref Val | % Rec | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MTBE | ND | 3.0 | | | | | | | | | |
| Benzene | ND | 0.50 | | | | | | | | | |
| Toluene | ND | 0.50 | | | | | | | | | |
| Ethylbenzene | ND | 0.50 | | | | | | | | | |
| m,p-Xylene | ND | 0.50 | | | | | | | | | |
| o-Xylene | ND | 0.50 | | | | | | | | | |
| Cis-1,2-Dichloroethylene | 0.911 | 0.10 | 1.00 | 0 | 91.1% | 70 | 123 | 0 | | | |

Sample ID **MBLK** Batch ID: **R13107** Test Code: **TPHCGW** Units: **µg/L** Analysis Date **10/2/01 7:31:49 PM** Prep Date

Client ID: Run ID: **ORGC8_011002A** SeqNo: **196852**

| Analyte | Result | Limit | SPK value | SPK Ref Val | % Rec | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPHC Gas | ND | 50 | | | | | | | | | |

Sample ID **MB-5015** Batch ID: **5015** Test Code: **TPHDIW** Units: **µg/L** Analysis Date **10/3/01 10:55:54 AM** Prep Date **10/2/01**

Client ID: Run ID: **ORGC7_011003A** SeqNo: **197023**

| Analyte | Result | Limit | SPK value | SPK Ref Val | % Rec | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPHC Diesel | 30.74 | 50 | | | | | | | | | J |
| N-Tricosane | 45.9 | 0.10 | 50.0 | 0 | 91.8% | 70 | 145 | 0 | | | |

**Qualifiers:**

ND - Not Detected at the Reporting Limit

J - Analyte detected below quantitation limits

S - Spike Recovery outside accepted recovery limits

R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

North Coast Laboratories, Ltd.

**Date:** 03-Oct-01

**CLIENT:** City of Arcata
**Work Order:** 0110013
**Project:** Corp Yard, Corp Yard PHII

# QC SUMMARY REPORT

## Laboratory Control Spike

Sample ID **LCS** Batch ID: **R13108** Test Code: **BTXEW** Units: **µg/L** Analysis Date **10/2/01 8:44:20 PM** Prep Date

Client ID: Run ID: **ORGC8_011002B** SeqNo: **196862**

| Analyte | Result | Limit | SPK value | SPK Ref Val | % Rec | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MTBE | 42.47 | 3.0 | 40.0 | 0 | 106% | 51 | 135 | 0 | | | |
| Benzene | 5.346 | 0.50 | 5.00 | 0 | 107% | 48 | 130 | 0 | | | |
| Toluene | 5.218 | 0.50 | 5.00 | 0 | 104% | 63 | 121 | 0 | | | |
| Ethylbenzene | 5.245 | 0.50 | 5.00 | 0 | 105% | 67 | 129 | 0 | | | |
| m,p-Xylene | 10.55 | 0.50 | 10.0 | 0 | 106% | 64 | 135 | 0 | | | |
| o-Xylene | 5.267 | 0.50 | 5.00 | 0 | 105% | 78 | 118 | 0 | | | |
| Cis-1,2-Dichloroethylene | 1.11 | 0.10 | 1.00 | 0 | 111% | 70 | 123 | 0 | | | |

Sample ID **LCSD** Batch ID: **R13108** Test Code: **BTXEW** Units: **µg/L** Analysis Date **10/2/01 9:20:19 PM** Prep Date

Client ID: Run ID: **ORGC8_011002B** SeqNo: **196863**

| Analyte | Result | Limit | SPK value | SPK Ref Val | % Rec | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MTBE | 42.62 | 3.0 | 40.0 | 0 | 107% | 51 | 135 | 42.5 | 0.351% | 20 | |
| Benzene | 5.221 | 0.50 | 5.00 | 0 | 104% | 48 | 130 | 5.35 | 2.35% | 20 | |
| Toluene | 5.155 | 0.50 | 5.00 | 0 | 103% | 63 | 121 | 5.22 | 1.22% | 20 | |
| Ethylbenzene | 5.168 | 0.50 | 5.00 | 0 | 103% | 67 | 129 | 5.24 | 1.47% | 20 | |
| m,p-Xylene | 10.40 | 0.50 | 10.0 | 0 | 104% | 64 | 135 | 10.6 | 1.49% | 20 | |
| o-Xylene | 5.209 | 0.50 | 5.00 | 0 | 104% | 78 | 118 | 5.27 | 1.12% | 20 | |
| Cis-1,2-Dichloroethylene | 0.977 | 0.10 | 1.00 | 0 | 97.7% | 70 | 123 | 1.11 | 12.8% | 20 | |

Sample ID **LCS** Batch ID: **R13107** Test Code: **TPHCGW** Units: **µg/L** Analysis Date **10/2/01 9:56:09 PM** Prep Date

Client ID: Run ID: **ORGC8_011002A** SeqNo: **196853**

| Analyte | Result | Limit | SPK value | SPK Ref Val | % Rec | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPHC Gas | 531.9 | 50 | 500 | 0 | 106% | 66 | 141 | 0 | | | |

**Qualifiers:**

ND - Not Detected at the Reporting Limit

J - Analyte detected below quantitation limits

S - Spike Recovery outside accepted recovery limits

R - RPD outside accepted recovery limits

B - Analyte detected in the associated Method Blank

**CLIENT:** City of Arcata
**Work Order:** 0110013
**Project:** Corp Yard, Corp Yard PHII

# QC SUMMARY REPORT

## Laboratory Control Spike Duplicate

Sample ID LCSD | Batch ID: R13107 | Test Code: TPHCGW | Units: µg/L | Analysis Date 10/2/01 10:31:53 PM | Prep Date
Client ID: | Run ID: ORGC8_011002A | SeqNo: 196854

| Analyte | Result | Limit | SPK value | SPK Ref Val | % Rec | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPHC Gas | 519.2 | 50 | 500 | 0 | 104% | 66 | 141 | 532 | 2.42% | 34 | |

Sample ID LCS-5015 | Batch ID: 5015 | Test Code: TPHDIW | Units: µg/L | Analysis Date 10/3/01 10:09:03 AM | Prep Date 10/2/01
Client ID: | Run ID: ORGC7_011003A | SeqNo: 197021

| Analyte | Result | Limit | SPK value | SPK Ref Val | % Rec | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPHC Diesel | 355.1 | 50 | 500 | 30.7 | 64.9% | 59 | 142 | 0 | | | |
| N-Tricosane | 41.8 | 0.10 | 50.0 | 0 | 83.6% | 70 | 145 | 0 | | | |

Sample ID LCSD-5015 | Batch ID: 5015 | Test Code: TPHDIW | Units: µg/L | Analysis Date 10/3/01 10:32:26 AM | Prep Date 10/2/01
Client ID: | Run ID: ORGC7_011003A | SeqNo: 197022

| Analyte | Result | Limit | SPK value | SPK Ref Val | % Rec | LowLimit | HighLimit | RPD Ref Val | %RPD | RPDLimit | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPHC Diesel | 359.9 | 50 | 500 | 30.7 | 65.8% | 59 | 142 | 355 | 1.34% | 20 | |
| N-Tricosane | 43.2 | 0.10 | 50.0 | 0 | 86.3% | 70 | 145 | 41.8 | 3.23% | 20 | |

**Qualifiers:**
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

**North Coast Laboratories, Ltd.**

**Date:** *03-Oct-01*

**CLIENT:** City of Arcata
**Project:** Corp Yard, Corp Yard PHII
**Lab Order:** 0110013

## CASE NARRATIVE

TPH-Diesel:
Pit 1 and Pit 2 contain material in the diesel range of molecular weights and beyond. This suggests the presence of an oil heavier than diesel.

Pit 3 contains material in the diesel range of molecular weights, but the material does not exhibit the peak pattern typical of diesel oil.

All diesel results reported represent the amount of material in the diesel range of molecular weights only.

TPH-Gasoline:
Pit 3 does not present a peak pattern consistent with that of gasoline. However, the result reported represents the amount of material in the gasoline range.

BTXE:
Some reporting limits were raised for Pit 3 due to matrix interference.

Suggest confirmation of the positive MTBE results for Pit 2 and Pit 3 by GCMS.



NORTH COAST LABORATORIES
5680 West End Road · Arcata, California 95521 · 707-822-4649 · FAX 707-822-6831
Printed on Recycled Paper

NORTH COAST LABORATORIES LTD.
5680 West End Road • Arcata • CA 95521-9202
707-822-4649 Fax 707-822-6831

# Chain of Custody



LABORATORY NUMBER: 011013

Attention: R.C. CLASS
Results & Invoice to: DOBY CLASS
Address: 736 F. Street
ARCATA, CA
Phone: 825-2173 8225957
Copies of Report to: Doby Classe
Arcata Public Works
Sampler (Sign & Print): R.C. Class R. Class

TAT: [ ] 24 Hr [X] 48 Hr [ ] 5 Day [ ] 5–7 Day
[ ] STD (2–3 Wk) [ ] Other:
PRIOR AUTHORIZATION IS REQUIRED FOR RUSHES

REPORTING REQUIREMENTS: State Forms [ ]
Preliminary: FAX [ ] Verbal [ ] By: __/__/__
Final Report: FAX [ ] Verbal [ ] By: __/__/__

**PROJECT INFORMATION**
Project Number: CORP YARD
Project Name: CORP YARD PH II
Purchase Order Number:

| LAB ID | SAMPLE ID | DATE | TIME | MATRIX* | CONTAINER | PRESERVATIVE | ANALYSIS |
|---|---|---|---|---|---|---|---|
| | PIT 1 | 10/1/01 | 1410 | | 7 | b | TPH D - |
| | PIT 2 | 10/1/01 | 1415 | | 7 | b | TAH 6, BTEX MTBE |
| | PIT 3 | 10/1/01 | 1420 | | | | |

**CONTAINER CODES:** 1—½ gal. pl; 2—250 ml pl; 3—500 ml pl; 4—1 L Nalgene; 5—250 ml BG; 6—500 ml BG; 7—1 L BG; 8—1 L cg; 9—40 ml VOA; 10—125 ml VOA; 11—4 oz glass jar; 12—8 oz glass jar; 13—brass tube; 14—other

**PRESERVATIVE CODES:** a—$HNO_3$; b—HCl; c—$H_2SO_4$; d—$Na_2S_2O_3$; e—NaOH; f—$C_2H_3O_2Cl$; g—other

**SAMPLE CONDITION/SPECIAL INSTRUCTIONS**

+ TB

| RELINQUISHED BY (Sign & Print) | DATE/TIME | RECEIVED BY (Sign) | DATE/TIME |
|---|---|---|---|
| R. Class P. CHARLES CLASS | 10/1/01 1500 | | 10/1/01 1500 |
| | | | |
| | | | |

**SAMPLE DISPOSAL**
[ ] NCL Disposal of Non-Contaminated
[ ] Return [ ] Pickup

**CHAIN OF CUSTODY SEALS Y/N/NA**
**SHIPPED VIA:** UPS Air-Ex Fed-Ex Bus Hand

***MATRIX:** DW=Drinking Water; Eff=Effluent; Inf=Influent; SW=Surface Water; GW=Ground Water; S=Soil; O=Other.

**ALL CONTAMINATED NON-AQUEOUS SAMPLES WILL BE RETURNED TO CLIENT**

**ATTACHMENT 2**

Previous Investigations Analytical Results by SHN Consulting Engineers and Geologists and City of Arcata

- Table 1 Soil Analytical Results City of Arcata Corporation Yard June 1, 2000
- Table 2 Groundwater Analytical Results City of Arcata Corporation Yard June 1-2 2000
- Table 1 Soil Analytical Results City of Arcata Corporation Yard August 22, 2000
- Table 2 Groundwater Analytical Results City of Arcata Corporation Yard August 23, 2000
- Table 3 Pits 1,2& 3 Sidewall Samples Analytical Results City of Arcata Corporation Yard November 7, 2000
- Table 4 Pits 1,2& 3 Groundwater Grb Sample Results Arcata Corporation Yard November 7, 2000

## Table 1
## Phase II Sidewall and Bottom Samples Analytical Results
## October 9, 2001
City of Arcata Corporation Yard

| Sample Number | Sample Location | Sample Depth (ft) | TPHG (Gas) | TPHD (Diesel) | B (Benzene) | T (Toluene) | E (Ethylbenzene) | X (Xylene) | MTBE |
|---|---|---|---|---|---|---|---|---|---|
| 51 | Sidewall | 5 | 21 | 11 | 0.66 | 2.4 | 0.5 | 2.21 | <0.050 |
| 52 | Sidewall | 4 | <1.0 | 32 | <0.0050 | <0.0050 | <0.0050 | <0.0063 | <0.050 |
| 53 | Sidewall | 3 | 2.5 | 190 | <0.0050 | <0.0120 | <0.0050 | <0.0220 | <0.050 |
| 54 | Sidewall | 4 | 150 | 2400 | <0.0050 | <0.013 | <0.030 | <0.050 | 0.055 |
| 55 | Sidewall | 4 | 18 | 31 | 0.0053 | <0.015 | <0.025 | <0.050 | 0.25 |
| 56 | Sidewall | 4 | 2.5 | 66 | 0.032 | <0.0050 | <0.0050 | 0.0186 | 0.84 |
| 57 | Sidewall | 4 | <1.0 | 2.4 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | 0.084 |
| 58 | Sidewall | 5 | 3 | 59 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.050 |
| 59 | Sidewall | 4 | 1.3 | 72 | <0.0050 | 0.0062 | <0.0050 | 0.0067 | <0.050 |
| 60 | Sidewall | 4 | 790 | 2800 | 6.2 | <5.0 | 8 | 8.3 | <2.0 |
| 61 | Bottom | 5.5 | <1.0 | 18 | <0.0050 | <0.0050 | <0.0050 | <0.012 | 0.12 |
| 62 | Bottom | 5.5 | <1.0 | 3.5 | 0.0073 | 0.007 | 0.005 | 0.0228 | <0.050 |
| 63 | Bottom | 5.5 | 1.9 | 2 | 0.1 | 0.0059 | <0.0050 | <0.0150 | 3.3 |
| 64 | Bottom | 5 | <1.0 | 3.6 | <0.0050 | <0.0050 | <0.0050 | <0.010 | <0.050 |
| | | | | | | | | | |
| | (concentrations in micrograms/gram = | | | μ | g/g | | | | |

## Table 2
## Phase II Groundwater Pit Grab Samples Analytical Results
## October 3, 2001
City of Arcata Corporation Yard

| Sample Number | Sample Location | Sample Depth (ft) | TPHG (Gas) | TPHD (Diesel) | B (Benzene) | T (Toluene) | E (Ethylbenzene) | X (Xylene) | MTBE |
|---|---|---|---|---|---|---|---|---|---|
| Pit 1 | Pit 1 | | < 50 | 58 | <0.50 | <0.50 | <0.50 | <0.50 | < 3.0 |
| Pit 2 | Pit 2 | | < 50 | 53 | <0.50 | <0.50 | <0.50 | <0.50 | 3.3 |
| Pit 3 | Pit 3 | | 870 | 140 | 57 | < 3.0 | 3 | < 1.7 | 9800 |
| | (concentrations in micrograms/gram = | | | μ | g/L | | | | |

| | | |
|---|---|---|
| | TPHG = TPH as gasoline | Fuel Oxygenates include: |
| | TPHD = TPH as diesel | MTBE = Methyl Tert Butyl Ether |
| | B = Benzene | |
| | T = Toluene | |
| | E = Ethylbenzene | |

**TABLE 1**
**SOIL ANALYTICAL RESULTS**
**CITY OF ARCATA CORPORATION YARD**
**ARCATA, CALIFORNIA**
**JUNE 1, 2000**
**(in milligrams per kilogram = mg/kg)**

| SAMPLE LOCATION | SAMPLE DEPTH (feet) | TPHD | TPHG | B | T | E | m,pX | o,X | FUEL OXYGENATES | LEAD |
|---|---|---|---|---|---|---|---|---|---|---|
| WP-1[4] | 3-4 | **140**[3] | <4.0 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | ND | 20 |
| WP-2[4] | 3-4 | **88**[3] | <2.0 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | ND | 38 |
| WP-3 | 2-3 | <1.0 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND | 12 |
| WP-4[4] | 2.5-3.5 | **190**[3] | <4.0 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | **0.190**[1] | 130 |
| WP-5 | 5-6 | **49**[3] | **2.3** | <0.005 | **0.005** | <0.005 | **0.0057** | <0.005 | ND | 51 |
| WP-6 | 2.5-3.5 | <1.0 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND | 3.3 |
| WP-7[5] | 3-4 | **480** | **85** | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | ND | 8.0 |
| WP-8[5] | 3-4 | **1,700** | **610** | **5.6** | **0.860** | **9.8** | **11** | **0.770** | ND | 20 |
| WP-8 | 6.5-7.5 | **5.5** | **1.8** | **0.370** | **0.340** | **0.013** | **0.034** | **0.013** | ND | 6.9 |
| WP-9 | 3-4 | **12**[3] | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | **0.033**[2] | 25 |
| WP-10 | 3-4 | <1.0 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND | 5.7 |

TPHD--Total petroleum hydrocarbons as diesel
TPHG--TPH as gasoline
B--Benzene
T--Toluene
E--Ethylbenzene
m, p, o, X--meta, para, ortho Xylene

Fuel Oxygenates include Tertiary Butyl Alcohol (TBA), Methyl Tert Butyl Ether, (MTBE), Di-isopropyl Ether (DIPE), Ethyl Tert Butyl Ether (ETBE), and Tertiary Amyl Methyl Ether(TAME).

1. MTBE was detected at 0.190 mg/kg.
2. MTBE was detected at 0.033 mg/kg.
3. Diesel concentration includes some portion of heavier end organics that extend past the diesel range.
4. Reporting limits were increased due to sample foaming.
5. Reporting limits were increased due to high concentrations of target analysis.

**TABLE 2**
**GROUNDWATER ANALYTICAL RESULTS**
**CITY OF ARCATA CORPORATION YARD**
**ARCATA, CALIFORNIA**
**JUNE 1-2, 2000**
**(in micrograms per liter = ug/l)**

| SAMPLE LOCATION | TPHD | TPHG | B | T | E | m,pX | o,X | FUEL OXYGENATES | LEAD |
|---|---|---|---|---|---|---|---|---|---|
| WP-1 | **2,600**[7] | <250 | **1.4** | **2.8** | <1.0 | <1.0 | <1.0 | **150**[1] | <20 |
| WP-2[8] | **150** | <250 | <2.5 | <2.5 | <2.5 | <2.5 | <2.5 | ND | <20 |
| WP-3 | **160**[6] | <100 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | ND | <20 |
| WP-4[9] | **7,400** | **9,200** | <25 | <25 | <25 | <25 | <25 | **15,000**[2] | <20 |
| WP-5[8] | **2,400** | <250 | **3.5** | **6.0** | **3.1** | **15** | **6.9** | ND | <20 |
| WP-6 | <50 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | ND | <20 |
| WP-7 | NA | <250 | **1.4** | <1.0 | <1.0 | <1.0 | <1.0 | **74**[3] | <20 |
| WP-8 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| WP-9 | **7,100,000**[5] | **4,700** | **20** | <4.0 | <4.0 | <4.0 | <4.0 | **4,200**[4] | <20 |
| WP-10 | **120**[6] | <100 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | ND | <20 |

TPHD--Total petroleum hydrocarbons as diesel
TPHG--TPH as gasoline
B--Benzene
T--Toluene
E--Ethylbenzene
m, p, o, X--meta, para, ortho Xylene
Fuel Oxygenates include Tertiary Butyl Alcohol (TBA), Methyl Tert Butyl Ether (MTBE), Di-isopropyl Ether (DIPE), Ethyl Tert Butyl Ether (ETBE), and Tertiary Amyl Methyl Ether (TAME).

1. MTBE was detected at 150 ug/l, and TAME was detected at 5.3 ug/l.
2. MTBE was detected at 15,000 ug/l and TAME was detected at 290 ug/l.
3. MTBE was detected at 74 ug/l.
4. MTBE, TBA and TAME were detected at 4,200 ug/l, 590 ug/l, and 54 ug/l, respectively.
5. Contains material similar to degraded or weathered diesel oil.
6. Samples contain material in the diesel range of molecular weights, but the material does not exhibit the peak pattern typical of diesel oil.
7. Sample contains material in the diesel range of molecular weights and beyond. This suggests the presence of an oil heavier than diesel.
8. Reporting limits were increased due to sample foaming.
9. Reporting limits were increased due to high concentrations of target analysis.

**TABLE 1**
**SOIL ANALYTICAL RESULTS**
**CITY OF ARCATA CORPORATION YARD**
**ARCATA, CALIFORNIA**
**AUGUST 22, 2000**
**(in milligrams per kilogram = mg/kg)**

| SAMPLE LOCATION | SAMPLE DEPTH (feet) | TPHG | B | T | E | X | MTBE | FUEL OXYGENATES |
|---|---|---|---|---|---|---|---|---|
| WP-101 | 3.5-4 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND |
| WP-102 | 3.5-4 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND |
| WP-103 | 4-4.5 | <1.0 | <0.005 | <0.005 | <0.005 | **0.018** | <0.005 | ND |
| WP-104 | 4-4.5 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND |
| WP-105 | 3.5-4 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND |
| WP-106 | 3.5-4 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND |
| WP-107 | 3.5-4 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND |
| WP-108 | 3.5-4 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND |
| WP-109 | 11.5-12 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND |

TPHG--TPH as gasoline
B--Benzene
T--Toluene
E--Ethylbenzene
X—Total Xylenes

Fuel Oxygenates include Tertiary Butyl Alcohol (TBA), Methyl Tert Butyl Ether, (MTBE), Di-isopropyl Ether (DIPE), Ethyl Tert Butyl Ether (ETBE), and Tertiary Amyl Methyl Ether(TAME).

**TABLE 2**
**GROUNDWATER ANALYTICAL RESULTS**
**CITY OF ARCATA CORPORATION YARD**
**ARCATA, CALIFORNIA**
**AUGUST 23, 2000**
**(in micrograms per liter = ug/l)**

| SAMPLE LOCATION | TPHG | B | T | E | X | MTBE | FUEL OXYGENATES |
|---|---|---|---|---|---|---|---|
| WP-101 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | **Tert-Butanol = 5.9** |
| WP-102 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | ND |
| WP-103 | **120** | <0.50 | <0.50 | **0.50** | **3.6** | <0.50 | ND |
| WP-104 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | ND |
| WP-105 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | ND |
| WP-106 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | ND |
| WP-107 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | ND |
| WP-108 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | ND |
| WP-109 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | **0.76** | ND |

TPHG--TPH as gasoline
B--Benzene
T--Toluene
E--Ethylbenzene
X—Total Xylenes

Fuel Oxygenates include Tertiary Butyl Alcohol (TBA), Methyl Tert Butyl Ether, (MTBE), Di-isopropyl Ether (DIPE), Ethyl Tert Butyl Ether (ETBE), and Tertiary Amyl Methyl Ether(TAME).

## Table 3

### Pits 1, 2 & 3 Sidewall Soil Samples Analytical Results

**7-Nov-00**

City of Arcata Corporation Yard

| Sample Number | Sample Location | Sample Depth (ft) | TPHG (Gas) | TPHD (Diesel) | B (Benzene) | T (Toluene) | E (Ethylbenzene) | X (Xylene) | MTBE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1s | 2' | <1.0 | <1.0 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.050 |
| 2 | 2s | 2.5' | <1.0 | <1.0 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.050 |
| 3 | 3s | 3' | <1.0 | <1.0 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.050 |
| 4 | 4s | 3' | <1.0 | <1.0 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.050 |
| 5 | 5s | 3' | 2.6 | <1.0 | 0.017 | 0.19 | 0.035 | 0.07 | 0.67 |
| 6 | 6s | 3' | 3.8 | <1.0 | 0.0074 | 0.36 | 0.05 | 0.31 | 0.23 |
| 7 | 7s | 2.5' | <1.0 | <1.0 | <0.0050 | 0.013 | <0.0050 | 0.0064 | 0.4 |
| 8 | 8s | 2' | 1.5 | <1.0 | <0.0050 | 0.024 | 0.0058 | 0.0312 | 0.1 |
| 11 | 11s | 1' | 3.3 | 3.9 | 0.0058 | 0.1 | 0.035 | 0.259 | 0.91 |
| 12 | 12s | 3' | <1.0 | <1.0 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.050 |
| 13 | 13s | 2' | 2.9 | <1.0 | 0.033 | 0.31 | 0.034 | 0.176 | 1.4 |
| 14 | 14s | 1' | 1.1 | 210 | 0.01 | 0.0067 | <0.0050 | 0.0081 | <0.050 |
| 15 | 15s | 1' | <1.0 | <1.0 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.050 |
| 16 | 16s | 1.5' | 1.5 | 2.2 | <0.0050 | <0.0050 | 0.0057 | 0.007 | <0.050 |
| 17 | 17s | 2' | 500 | 1100 | <0.12 | <4.0 | 1.9 | 8.23 | <1.2 |
| 18 | 18s | 2' | 2.4 | 24 | 0.025 | 0.013 | <0.0050 | 0.0248 | <0.050 |
| 19 | 19s | 2' | 1.8 | 120 | 0.039 | 0.012 | 0.0092 | 0.023 | 0.68 |
| 20 | 20s | 2' | 1.7 | <1.0 | 0.094 | 0.019 | 0.039 | 0.054 | <0.050 |
| 21 | 21s | 3' | <1.0 | 1.2 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.050 |
| 22 | 22s | 4' | 20 | 20 | 8.30 | 0.11 | 0.062 | 0.136 | 0.05 |
| 23 | 23s | 4' | 1.9 | 2.5 | 0.019 | 0.033 | 0.022 | 0.059 | <0.050 |
| 24 | 24s | 3' | 3.9 | 1.5 | 5.5 | 0.011 | 0.0071 | 0.0141 | <0.050 |
| 25 | 25s | 4' | 99 | <1.0 | 5.500 | 0.01 | 0.01 | 0.014 | <0.050 |
| 26 | 26s | 3' | 24 | 2.6 | 0.970 | 0.370 | 0.900 | 4.300 | <0.050 |
| 27 | 27s | 4' | 20 | 23 | 0.370 | 0.110 | 0.700 | 0.695 | <0.5 |
| 28 | 28s | 6' | 2 | 45 | 0.0050 | 0.0050 | 0.0050 | 0.0050 | 0.050 |
| 29 | 29s | 6.5' | 4.8 | 14 | 3.10 | 0.0530 | 0.1200 | 0.1840 | 0.050 |
| | | | (in milligrams per kilogram = mg/Kg) | | | | | | |

## Table 4

### Pits 1, 2 & 3 Groundwater Grab Sample Results

**7-Nov-00**

City of Arcata Corporation Yard

| Sample Number | Sample Location | Sample Depth (ft) | TPHG (Gas) | TPHD (Diesel) | B (Benzene) | T (Toluene) | E (Ethylbenzene) | X (Xylene) | MTBE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1ws | | 1800 | N/A | 4.10 | 110 | 36 | 221 | 1200 |
| 2 | 2ws | | 4900 | N/A | 30 | 420 | 89 | 610 | 3300 |
| 3 | 3ws | | 5600 | <50 | 99 | <10 | <0.5 | 90 | 6500 |
| | | | (in micrograms per liter = ug/L) | | | | | | |

| | |
|---|---|
| TPHG = TPH as gasoline | Fuel Oxygenates include: |
| TPHD = TPH as diesel | MTBE = Methyl Tert Butyl Ether |
| B = Benzene | |
| T = Toluene | |
| E = Ethylbenzene | |
| X = Total Xylenes | |

Nine soil borings WP 101 – WP 109 were installed by direct push using a truck-mounted geo-probe. The soil borings were located on site in the general vicinity to the south and west of the source area. The soil boring locations are shown on Figure 2.

The soil samples were collected using continuous coring. A 1-3/4 inch diameter sample tube was driven into undisturbed soil at approximately 4-foot intervals. Following the sample retrieval, a portion of the sample was selected from each tube and tube ends were sealed using Teflon tape and plastic end caps. The samples were labeled regarding location depth, date and time analysis and initials. The soil samples were delivered to a California certified analytical laboratory under chain of custody. The analysis of soil samples included TPHG, TPHD, BTEX, and fuel oxygenates.

The soil borings were converted to temporary groundwater well points. The well points were used as a preliminary presence/absence and determine extent of contamination in the groundwater at the site. The locations are shown on Figure 2.

Well points were installed using 1-inch diameter slotted PVC with screens placed approximately 4 feet below the water table. The well points were measured for depth to water, and sampled using disposable tubing bailers. Groundwater samples were collected in accordance with laboratory protocol and transported under chain of custody to a certified analytical laboratory. Groundwater samples were analyzed for TPHG, TPHD, BTEX and fuel oxygenates. The soil boring/temporary well points were backfilled with betonite holeplug and brought to existing surface. The soil generated during the investigation is placed on-site in 5-gallon plastic buckets. Drilling tools were decontaminated and the well point purge water was disposed of through the Arcata Wastewater Treatment Plant.

## Laboratory Analysis

Soil samples submitted during the investigation were analyzed for TPHG, BTEX, MTBE and fuel oxygenates by utilizing EPA method number 8260B and TPHD EPA method 3550/gcfid.

The groundwater samples collected from the temporary well points were analyzed for TPHG, BTEX, MTBE and fuel oxygenates by utilizing EPA method number 8260B and for TPHD using EPA method 3510.

## Investigation Results

### Lithology

Underlying soils in the borings consist of silty gravel fill extending to approximately 2-feet below ground surface. 2-foot to 3-foot olive to orange/brown silty sand layers with some gravel. From approximately 3 to 8 feet below ground surface, soils were dark gray clayed silts with some gravel. Bay muds were encountered at approximately 8-feet below ground surface. Dark gray/brown bay muds (see attached boring logs included as attachment 2 by SHN Engineering Consultants).

Soil Analytical Results

Results of soil investigation demonstrated no significant TPHG, MTBE or fuel oxygenate contamination is present in the soils from borings WP 101 through WP 109. The soil sample from WP103 had total zylene concentrations of 0.018 mg/Kg.

Diesel and material with a similar molecular weight and heavier than diesel (possibly diesel oil) represents the majority of contamination at the site. Diesel contamination was detected in soil samples collected from WP 101, WP103, WP104, WP106 and WP108 at concentrations ranging from 12 to 810 mg/Kg. The analytical results for soil contamination are presented in Table 1 and the soil testing results are included as an attachment.

Groundwater Analytical Results

The results of the groundwater collected from the temporary well points indicates minor hydrocarbon contamination at WP103 located near the driveway in the Corporation Yard with detectible levels of TPHG and BTEX. TPHG was detected in WP103 at 120ug/L, ethyl benzene at 0.50ug/L and total xylenes at 3.6ug/L. MTBE and TPHD were detected in the groundwater sample collected at WP109. TPHD concentrations were 76 ug/L and MTBE at 0.76 ug/L. The fuel oxygenate Tert-Butanol was detected in groundwater sample collected from WP101 at a concentration of 5.9 ug/L. All other groundwater samples from the well points contain non-detectible constituents (refer to Table 2 for groundwater analytical results. Analytical reports are included as an Attachment.

## CONCLUSIONS

### Soil Contamination

Elevated concentrations of diesel, gasoline and BTEX were observed in the vicinity of the fuel island is demonstrated through the previous site investigations. The results from mw101 had the highest concentrations as TPHD at 810 mg/Kg.

### Groundwater Contamination

The greatest hydrocarbon concentrations in groundwater were observed in the vicinity of the fuel island well points WP101, WP103 and WP109 had detectible concentrations of TPHD, TPHG, BTEX and fuel oxygenates. These low levels are attributed to the sampling point and/or historical use of the Corporation Yard which has likely contributed low-level diesel throughout the site. Diesel concentrations from WP109 do not exhibit typical pattern of diesel indicating concentrations may have been due to presence of naturally occurring organic materials or other hydrocarbon materials of similar nature.

Fuel Leak Overexcavation November 2000

## INTRODUCTION

Between October 25th and October 30th, 2000, it is estimated that approximately 550 gallons of gasoline were released into the temporarily constructed wooden platform beneath a diesel and gasoline pump.

Based on the initial investigation of surface contamination, the gasoline spread through a portion of the Corporation Yard and exited via an 8-inch diameter pipe underneath a trail/walkway and entered a drainage course, which ultimately drains to Humboldt Bay.

Based upon further inspection and sampling performed on November 1, 2000, surface contamination extended approximately 125 feet down gradient from the source of the release. A hydrocarbon boom was placed down gradient in the drainage course and absorbent pads were used to remove as much visible gasoline stained water/soil as possible surrounding the spill area. It was decided that an over excavation of surface contaminated soils would be performed immediately.

Soils samples were collected in the vicinity of the initial release and down slope and a surface water sample was collected approximately 500 feet down gradient of the release, results are shown in Table 3.

The initial fuel release notification occurred on October 30th, at 9:15 a.m. reporting to the Humboldt County Division of Environmental Health. Supplemental information was submitted to the Humboldt County Division of Environmental Health on October 31st.

### Field Work

On November 1, 2000 excavation began in the area near Pit #1, at the outlet of the 8" pipe (see Figure 1). A containment site was constructed in an area which had previously been discussed with Chris Murray from the North Coast Regional Water Quality Control Board, on City property at the Corporation Yard. The containment cell was constructed of 4 – 6 inches of dirty sand underneath 10 mil. polyethylene plastic, 20 feet by 100 feet. On this day, approximately 40 yards of soil was over excavated from Pit #1 area. Obviously contaminated soils were over excavated. The limits of excavation were extended to soils which appeared to not have been impacted by the release.

November 2, 2000

The over excavation was continued approximately, 60 yards were over excavated on this day and placed onto a containment cell, and an additional containment cell, 20 by 100 feet was constructed next to the initial containment cell. Pit water from Pit #1 was evacuated using the City of Arcata Vactor truck and placed into the City's Corporation

Yard drainage system, which passes through an oil/water separator, and ultimately discharged to the oxidation ponds. This did not commence further after discussion with Vicki Frey of the Humboldt County Division of Environmental Health. We discussed that future purged water/product recovery would be placed in a suitable containment structure and/or 55 gallon drums.

November 3, 2000

Approximately 50 yards of soil was excavated on this day from Pit area #2 and Pit area #3. The soil was placed into the containment cells and approximately 50 gallons of water was bailed and placed into a 55 gallon drum.

November 4, 2000

An additional 50 yards of contaminated soil was excavated from the area in Pit #3. The excavation was extended to probable limits of gasoline impact resulting from the spill, based on surface staining and visible staining in the sub-soil. On this day, the bulk of the contaminated soil was removed from beneath the product pump areas and approximately 80 gallons of free product and gasoline/groundwater was collected by a bailer and placed into 55-gallon drums.

November 5, 2000

No over excavation occurred. Approximately 10 gallons of gasoline/water product was evacuated from Pit #3 from below the former pump island and placed into 55-gallon drums. The soil piles were covered based upon probability of rain showers that evening.

November 6, 2000

Approximately 40 yards of contaminated soil was removed from the most northerly portion of Pit #3 extending into the area of suspected diesel contamination from the previous piping failure at the old pump islands (see figure). Approximately 100 gallons of purged water was removed with the Vactor truck from Pit #1 and Pit #2 and placed into 55-gallon drums.

November 7, 2000

On this day, 29 soil samples were collected at approximately 20 foot intervals from the trench sidewalls and 1 per every 400 square feet of trench bottom. Soil samples were submitted for analysis of TPHG, TPHD, BTEX, and MTBE. Three sets of groundwater samples were collected for analysis of TPHG, BTEX and MTBE.

One groundwater sample was collected for analysis as diesel from pit #3. 6-inch diameter plastic water pipe perforated at six inch intervals was installed in Pit #1, Pit #2 and Pit #3 to create an extraction trench for future groundwater removal and remediation. Pit #1 had approximately 80 feet of line installed, covered by 6 – 12

inches of #3 drain rock covered with pea gravel. Pit #2, one 20-foot of 6-inch perforated pipe covered in the same manner. Pit #3 has a manifold collection system which gravity flows to the area beneath the former dispense island, consisting of approximately 60-feet of 6-inch diameter perforated pipe. All piping was covered with #3 drain rock, placed at grade in the trench bottom, and covered to the surface with pea gravel.

November 8, 2000

The pits were filled with pea gravel to the existing soil levels, except in Pit #3 which was left approximately 1-foot below grade. The site was graded to drain surface water away from the excavation Pit #3 and the fence was reinstalled along the trail.

November 10, 2000

The soil piles were levelled out to promote drainage off the piles and winterized with 6-mil PE sheeting and rubber tires along the base of the pile. A drainage ditch was excavated around the soil piles which directs all run-off to the marsh treatment system.

**Future Work**

Summer 2001

Corrective Actions

We proposed to install stand pipes through the concrete foundation of the aboveground storage tank secondary containment structures and "vacuum" the remaining fuel products into the collection manifold in pit #3 for removal, storage and testing in an aboveground 3500 gallon PE storage tank for testing. If water sample results are within the Arcata WWTP acceptable discharge limits of 25ppm as TPH gasoline the tank will be pumped into the WWTP headworks, if not aeration of the tank and/or dilution will be used to reduce the concentration to within acceptable limits.

Based on analytical results additional over excavation is warranted in the area of Pit #3 and beneath the secondary containment structure. Based on low to non-detectible results near pits 1 and 2 we believe the bulk of contamination was removed and will only warrant groundwater monitoring to determine if groundwater has been impacted.

## RECOMMENDATIONS

Source Removal

The City is proposing to construct a bus barn in the summer of 2002. We propose to do limited additional source removal as per SHN's previous recommendations to excavate approximately 500 cubic yards of soil within the vicinity and south of the existing fuel

island (see figure 2). The excavation limits are noted in the figure and would not extend below the depth of groundwater. The purpose of this excavation is to remove soils from the capillary zone which contain moderate to high hydrocarbon concentrations. This source removal will occur this summer when groundwater is at its lowest conditions and the soils will be characterized, stockpiled and remediated on-site utilizing bio-piles and/or composting within the area shown on figure 3. Following the over-excavation confirmation soil samples would be collected at approximately 1 sample per 400 square feet from the base of excavation and sidewall samples 1 per 20 linear feet. Samples would be analyzed for TPHG, TPHD, v-tex and MTBE as previously described in the report by SHN Consulting Engineers.

Groundwater Remediation/Recovery

We propose to install additional recovery trenches, piping in the over-excavation area which would allow for the City to extract the groundwater. Store it in the aboveground 3,500-gallon polyethylene tank and treat it through the Wastewater Treatment Plant if the levels are acceptable.

This trench would act as a remedial corrective action for the dissolved phase hydrocarbons following source removal.

Groundwater Monitoring Well Water Installation

Based on the analytical results from the proposed over-excavation and possible groundwater grab samples, monitoring wells are proposed to be installed on the site. We propose to install between 5 to 7 monitoring wells to monitor the extent of hydrocarbon contamination in the groundwater surrounding the suspected source area. The proposed monitoring wells are shown in figure _____.

The proposed monitoring well locations will be submitted under a follow-up report with the following over-excavation and confirmation sampling of the 500 cubic yards of material. The monitoring wells would be initially sampled for TPHD, TPHG, BTEX and MTBE.

Proposed Schedule

The proposed schedule for the over-excavation of 500 cubic yards of suspected contaminated soil is scheduled for the summer (August) )of 2001. The City will perform this work utilizing City staff. The City will install the groundwater collection recovery sump.

We look forward to your response and approval of this work plan for future over-excavation at the City of Arcata Corporation Yard. Please do not hesitate to call me at (707) 825-2173 if you have any questions or we can be of additional service.

Sincerely,

R. Charles (Doby) Class
Deputy Public Works Director

RCC:mlc

The City of Arcata has applied for a Coastal Development Permit for the excavation, stockpiling and remediation of contaminated soils to occur within the Corporation Yard on April 17, 2001. We are awaiting a response from the Coastal Commmision.

**TABLE 1**
**SOIL ANALYTICAL RESULTS, AUGUST 22, 2000**
**CITY OF ARCATA CORPORATION YARD, ARCATA, CALIFORNIA**
**(in milligrams per kilogram = mg/Kg)**

| SAMPLE LOCATION | SAMPLE DEPTH (feet) | TPHG | TPHD[3] | B | T | E | X | MTBE | FUEL OXYGENATES |
|---|---|---|---|---|---|---|---|---|---|
| WP-101 | 3.5-4 | <1.0 | 810[2] | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND |
| WP-102 | 3.5-4 | <1.0 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND |
| WP-103 | 4-4.5 | <1.0 | 12[1] | <0.005 | <0.005 | <0.005 | 0.018 | <0.005 | ND |
| WP-104 | 4-4.5 | <1.0 | 29[2] | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND |
| WP-105 | 3.5-4 | <1.0 | 56[2] | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND |
| WP-106 | 3.5-4 | <1.0 | 43[3] | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND |
| WP-107 | 3.5-4 | <1.0 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND |
| WP-108 | 3.5-4 | <1.0 | 21[2] | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND |
| WP-109 | 11.5-12 | <1.0 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | ND |

TPHG = TPH as gasoline
TPHD = TPH as diesel
B = Benzene
T = Toluene
E = Ethylbenzene
X = Total Xylenes

Fuel Oxygenates include.
TBA = Tertiary Butyl Alcohol
MTBE = Methyl Tert Butyl Ether
DIPE = Di-isopropyl Ether
ETBE = Ethyl Tert Butyl Ether
TAME = Tertiary Amyl Methyl Ether

1) Sample contains material similar to degraded or weathered diesel or diesel oil.
2) Sample contains material in the diesel range of molecular weights and beyond. Suggests presence of oil heavier than diesel.
3) All diesel results reported represent the amount of material in the diesel range of molecular weights only.

**TABLE 2**
**GROUNDWATER ANALYTICAL RESULTS, AUGUST 23, 2000**
**CITY OF ARCATA CORPORATION YARD, ARCATA, CALIFORNIA,**
**(in micrograms per liter = ug/L)**

| SAMPLE LOCATION | TPHG | TPHD | B | T | E | X | MTBE | FUEL OXYGENATES |
|---|---|---|---|---|---|---|---|---|
| WP-101 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | Tert-Butanol = 5.9 |
| WP-102 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | ND |
| WP-103 | 120 | <50 | <0.50 | <0.50 | 0.50 | 3.6 | <0.50 | ND |
| WP-104 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | ND |
| WP-105 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | ND |
| WP-106 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | ND |
| WP-107 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | ND |
| WP-108 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | ND |
| WP-109 | <50 | 76 | <0.50 | <0.50 | <0.50 | <0.50 | 0.76 | ND |

TPHG = TPH as gasoline
TPHD = TPH as diesel
B = Benzene
T = Toluene
E = Ethylbenzene
X = Total Xylenes

Fuel Oxygenates include:
TBA = Tertiary Butyl Alcohol
MTBE = Methyl Tert Butyl Ether
DIPE = Di-isopropyl Ether
ETBE = Ethyl Tert Butyl Ether
TAME = Tertiary Amyl Methyl Ether

mentioned, but it will help if an email correspondence from the RWQCB can be provided with specific items needed to close this site.

Thank you,
Erik

**Erik J. Nielsen, PG, CHG**
Principal Environmental Services




Civil Engineering, Environmental Services,
Geosciences, Planning, and Surveying

shn-engr.com (707) 441-8855

503-241-014

503-211-

MW-2

FORMER ABOVE GROUND FUEL STORAGE TANKS

S-4

MW-3

S-1

S-2

FORMER PUMP ISLANDS

MW-6

MW-4

S-3

MW-5

WP-10

503-241-013

503-211-00

## EXPLANATION

| | |
|---|---|
| MW-5 | MONITORING WELL LOCATION AND DESIGNATION |
| S-1 | AIR SPARGE RISER LOCATION AND DESIGNATION |
| WP-1 | SOIL BORING/TEMPORARY WELL POINT LOCATION AND DESIGNATION |
| | LIMIT OF EXCAVATION NOVEMBER 2000 |
| | LIMIT OF EXCAVATION OCTOBER 2001 |

SHN Consulting Engineers & Geologists, Inc.

City of Arcata Corp. Yard
600 South G Street
Arcata, California

August 2018

018080-200-ST

I:\Eureka\Projects\2018\018080-Arcata-Corp\200-LTC-Eng\Dwgs, SAVED: 8/6/2018 11:34 AM CNEWELL, PLOTTED: 8/14/2018 4:12 PM, CHRIS D. NEWELL


Arcata Marsh
Interpretive Center
Temporarily closed
S G St
Bridge
Arcata City Yard
S G St
S G St
S G St
ast Island of
Klopp Lake

# ATTACHMENT 18

City of Arcata. 2016. *Adopted Floodplain Ordinance.* Adopted 11/02/2016.

**ORDINANCE NO. 1479**

**AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF ARCATA AMENDING THE ARCATA MUNICIPAL CODE PERTAINING TO FLOOD HAZARD MITIGATION STANDARDS**

The City Council of the City of Arcata does ordain as follows:

Section 1: Title VII—Building Regulations, Chapter 4—Flood Hazard Mitigation Standards of the Arcata Municipal Code is hereby adopted as follows:

**TITLE VIII—Building Regulations**
**CHAPTER 4—Flood Hazard Mitigation Standards**

**SEC. 8400. Purpose.**

The provisions of this Chapter are intended to protect the public health, safety, and general welfare, and to minimize public and private losses due to flood conditions in specific areas by minimum floodplain standards designed:

A. To protect human life and health;

B. To minimize expenditure of public money for costly flood control projects;

C. To minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;

D. To minimize prolonged business interruptions;

E. To minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets and bridges located in areas of special flood hazard;

F. To help maintain a stable tax base by providing for the second use and development of areas of special flood hazard so as to minimize future flood blight areas;

G. To insure that potential buyers are notified that property is in an area of special flood hazard; and

H. To insure that those who occupy the areas of special flood hazard assume responsibility for their actions.

This Chapter also implements regulations to meet Federal Emergency Management Agency (FEMA) requirements for managing flood hazards.

**SEC. 8401. Definitions.** Unless a provision explicitly states otherwise, the following terms and phrases, as used in the Chapter, are defined as follows:

"**A zone**" means "Special flood hazard area," as defined herein.

"**Accessory structure**" means a structure that is either:

A. Solely for the parking of no more than 2 cars; or

B. A small, low cost shed for limited storage, less than 150 square feet and $1,500 in value.

"**Accessory use**" means a use which is incidental and subordinate to the principal use of the parcel of land on which it is located.

"**Alluvial fan**" means a geomorphologic feature characterized by a cone or fan-shaped deposit of boulders, gravel, and fine sediments that have been eroded from mountain slopes, transported by flood flows, and then deposited on the valley floors, and which is subject to flash flooding, high velocity flows, debris flows, erosion, sediment movement and deposition, and channel migration.

"**Apex**" means a point on an alluvial fan or similar landform below which the flow path of the major stream that formed the fan becomes unpredictable and alluvial fan flooding can occur.

**"Area of shallow flooding"** means a designated AO, AH or Zone on the Flood Insurance Rate Map (FIRM). The base flood depth ranges from one to three feet; a clearly defined channel does not exist; the path of flooding is unpredictable and indeterminate; and velocity flow may be evident. Such flooding is characterized by ponding or sheet flow.

"**Area of special flood hazard**" means "Special flood hazard area" as defined herein.

**"Base flood"** means a flood which has a one percent chance of being equaled or exceeded in any given year (also called the "100-year flood"). Base flood is the term used throughout this Chapter.

"**Base flood elevation**" (BFE) means the elevation shown on the Flood Insurance Rate Map for Zones AE, VE, and B and C that indicates the water surface elevation resulting from a flood that has a 1-percent or greater chance of being equaled or exceeded in any given year.

**"Basement"** means any area of a building having its floor subgrade—i.e. below ground level—on all sides.

**"Breakaway wall"** means any type of wall, whether solid or lattice, and constructed of concrete, masonry, wood, metal, plastic or any other suitable building material that is not part of the structural support of the building, and is designed to break away under abnormally high tides or wave action without causing any damage to the structural integrity of the building on which they are used or any building to which they might be carried by flood waters. A breakaway wall shall have a safe design loading resistance of not less than ten and no more than twenty pounds per square foot. The use of breakaway walls must be certified by a registered civil engineer or architect and shall meet the following conditions:

A. Breakaway wall collapse shall result from a water load less than that which would occur during the base flood; and
B. The elevated portion of the building shall not incur structural damage due to the effects of wind and water loads acting simultaneously in the event of the base flood.

**"Building**" means "Structure."

**"Coastal High Hazard Area"** means an area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources. It is an area subject to high velocity waters, including

coastal and tidal inundation or tsunamis. The area is designated on a Flood Insurance Rate Map (FIRM) as Zone VE, or V.

"**Development**" means any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

"**Encroachment**" means the advance or infringement of uses, plant growth, fill, excavation, buildings, permanent structures or development into a floodplain which may impede or alter the flow capacity of a floodplain.

**"Exception"** means a grant of relief from the requirements of this Chapter pursuant to Section 8406, which permits construction in a manner that would otherwise be prohibited by this Chapter.

"**Existing manufactured home park or subdivision**" means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed before November 4, 2016 .

"**Expansion to an existing manufactured home park or subdivision**" means the preparation of additional sites by the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads).

"**Flood, flooding, or flood water**" means:

A. A general and temporary condition of partial or complete inundation of normally dry land areas from the overflow of inland or tidal waters; the unusual and rapid accumulation or runoff of surface waters from any source; and/or mudslides (i.e., mudflows); and

B. The condition resulting from flood-related erosion.

**"Flood Boundary, and Floodway Map (FBFM)"** means the official map on which the Federal Emergency Management Agency or Federal Insurance Administration has delineated both the areas of special flood hazards and the floodway.

**"Flood Insurance Rate Map (FIRM)"** means the official map on which the Federal Emergency Management Agency or Federal Insurance Administration has delineated both the areas of special flood hazards and the risk premium zones applicable to the community.

**"Flood Insurance Study"** means the official report provided by the Federal Insurance Administration that includes flood profiles, the FIRM, the Flood Boundary and Floodway Map, and the water surface elevation of the base flood.

"**Floodplain or flood-prone area**" means any land area susceptible to being inundated by water from any source—see "Flooding."

"**Floodplain Administrator**" is the community official designated by title to administer and enforce the floodplain management regulations .

**“Floodplain management**” means the operation of an overall program of corrective and preventive measures for reducing flood damage and preserving and enhancing, where possible, natural resources in the floodplain, including but not limited to emergency preparedness plans, flood control works, flood plain management regulations and open space plans.

**“Floodplain management regulations”** means Chapter 4 of Title VIII of the Arcata Municipal Code and any zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances (such as grading ordinance and erosion control) and other applications of police power which control development in flood-prone areas. This term describes federal, state or local regulations in any combination, which provide standards for the purpose of flood loss and damage prevention and reduction.

**“Floodproofing”** means any combination of structural and non-structural additions, changes, or adjustments to structures which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures and their contents. For guidelines on dry and wet floodproofing, see FEMA Technical Bulletins TB 1-93, TB 3-93 and TB 7-93.

**“Floodway”** means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot. Also referred to as "Regulatory Floodway."

**“Floodway fringe”** means that area of the floodplain on either side of the "Regulatory Floodway" where encroachment may be permitted.

"**Fraud and victimization**" as related to Section 8406 of this Chapter, means that the variance granted must not cause fraud on or victimization of the public. In examining this requirement, the City of Arcata will consider the fact that every newly constructed building adds to government responsibilities and remains a part of the community for fifty to one-hundred years. Buildings that are permitted to be constructed below the base flood elevation are subject during all those years to increased risk of damage from floods, while future owners of the property and the community as a whole are subject to all the costs, inconvenience, danger, and suffering that those increased flood damages bring. In addition, future owners may purchase the property, unaware that it is subject to potential flood damage, and can be insured only at very high flood insurance rates.

**“Functionally Dependent Use”** means a use that cannot perform its intended purpose unless it is located or carried out in close proximity to water. The term includes only docking facilities, port facilities that are necessary for the loading and unloading of cargo or passengers, and ship building and ship repair facilities, but does not include long-term storage or related manufacturing facilities.

"**Governing body**" means the City Council of the City of Arcata.

"**Hardship**" as related to Section 8406 of this Chapter means the exceptional hardship that would result from a failure to grant the requested exception. The City of Arcata requires that the exception be unusual and peculiar to the property involved. Mere economic or financial hardship alone is not exceptional. Inconvenience, aesthetic considerations, physical handicaps, personal preferences, or the disapproval of one's neighbors likewise cannot, as a rule, qualify as an exceptional hardship. All of these problems can be resolved through other means without granting an exception, even if the alternative is more expensive, or requires the property owner to build elsewhere or put the parcel to a different use than originally intended.

**“Highest adjacent grade”** means the highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure.

"**Historic structure**" means any structure that is:

A. Listed individually in the National Register of Historic Places (a listing maintained by the Department of Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register;
B. Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district;
C. Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of Interior; or
D. Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either by an approved state program as determined by the Secretary of the Interior or directly by the Secretary of the Interior in states without approved programs.

"**Levee**" means a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control or divert the flow of water so as to provide protection from temporary flooding.

"**Levee system**" means a flood protection system which consists of a levee, or levees, and associated structures, such as closure and drainage devices, which are constructed and operated in accord with sound engineering practices.

"**Lowest floor**" means the lowest floor of the lowest enclosed area, including basement (see “Basement,” defined herein).

A. An unfinished or flood resistant enclosure below the lowest floor that is usable solely for parking of vehicles, building access or storage in an area other than a basement area, is not considered a building’s lowest floor provided it conforms to applicable non-elevation design requirements, including, but not limited to:

    1. The flood openings standard in Section 8405.A.5;
    2. The anchoring standards in Section 8405.A.1;
    3. The construction materials and methods standards in Section 8405.A.2; and
    4. The standards for utilities in Section 8405.B.

B. For residential structures, all subgrade enclosed areas are prohibited as they are considered to be basements (see “Basement” defined herein). This prohibition includes below-grade garages and storage areas.

"**Manufactured home**" means a structure, transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when attached to the required utilities. The term "manufactured home" does <u>not</u> include a "recreational vehicle".

"**Manufactured home park or subdivision**" means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

**“Mean Sea Level”** means for purposes of the National Flood Insurance Program, the National Geodetic Vertical Datum (NGVD) of 1929, the North American Vertical Datum (NAVD) of 1988, or other data, to which base flood elevations shown on a community's Flood Insurance Rate Map are referenced.

**“National Flood Insurance Program (NFIP)”** means the federal program that authorizes the sale of federally subsidized flood insurance in communities where such flood insurance is not available privately.

**“New construction”** means, for purposes of this Chapter, structures for which the "start of construction" commenced on or after the effective date of a floodplain management regulation adopted by this community.

"**New manufactured home park or subdivision**" means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after November 5, 2016.

"**Obstruction**" includes, but is not limited to, any dam, wall, wharf, embankment, levee, dike, pile, abutment, protection, excavation, channelization, bridge, conduit, culvert, building, wire, fence, rock, gravel, refuse, fill, structure, vegetation or other material in, along, across or projecting into any watercourse which may alter, impede, retard or change the direction and/or velocity of the flow of water, or due to its location, its propensity to snare or collect debris carried by the flow of water, or its likelihood of being carried downstream.

**“100-Year Flood”** means "base flood."

**“Primary frontal dune”** means a continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes immediately landward and adjacent to the beach and subject to erosion and overtopping from high tides and waves during major coastal storms. The inland limit of the primary frontal dune occurs at the point where there is a distinct change from a relatively mild slope.

“**Program deficiency**” means a defect in a community’s floodplain management regulations or administrative procedures that impairs effective implementation of those floodplain management regulations.

“**Public safety and nuisance”** means, for purposes related to Section 8406 of this Chapter, that the granting of a variance must not result in anything which is injurious to safety or health of an entire community or neighborhood, or any considerable number of persons, or unlawfully obstructs the free passage or use, in the customary manner, of any navigable lake, or river, bay, stream, canal, or basin.

**“Recreational vehicle”** means a vehicle which is:

A. Built on a single chassis;
B. 400 square feet or less when measured at the largest horizontal projection;
C. Designed to be self-propelled or permanently towable by a light-duty truck; and
D. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use.

"**Regulatory floodway**" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot.

**"Remedy a violation"** means to bring the structure or other development into compliance with State or local flood plain management regulations, or, if this is not possible, to reduce the impacts of its noncompliance. Ways that impacts may be reduced include protecting the structure or other affected development from flood damages, implementing the enforcement provisions of the Article or otherwise deterring future similar violations, or reducing Federal financial exposure with regard to the structure or other development.

**"Riverine"** means relating to, formed by, or resembling a river (including tributaries), street, brook, etc.

**"Sand dunes"** means naturally occurring accumulations of sand in ridges or mounds landward of the beach.

**"Special Flood Hazard Area (SFHA)"** means an area in the floodplain subject to a one percent or greater chance of flooding in a given year. It is shown on an FHBM or FIRM as Zones A, AE, V, VE or X.

**"Start of construction"** includes substantial improvement and other proposed new development, and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, rehabilitation, addition, placement, or other improvement was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for a basement, footings, piers, or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

**"Structure"** means a walled and roofed building that is principally above ground; this includes a gas or liquid storage tank or a manufactured home.

"**Substantial damage**" means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

"**Substantial improvement**" means any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the "start of construction" of the improvement. This term includes structures which have incurred "substantial damage," regardless of the actual repair work performed. The term does not, however, include either:

1. Any project for improvement of a structure to correct existing violations or state or local health, sanitary, or safety code specifications which have been identified by the local code

enforcement official and which are the minimum necessary to assure safe living conditions; or

2. Any alteration of a "historic structure," provided that the alteration will not preclude the structure's continued designation as a "historic structure."

The Floodplain Administrator shall utilize the FEMA publication: “Substantial Improvement/ Substantial Damage Desk Reference *FEMA P-758 / May 2010,”* as amended or replaced by additional FEMA publication for guidance in identifying substantial improvements..

"**Variance**" means a grant of relief from the requirements of this ordinance which permits construction in a manner that would otherwise be prohibited by this ordinance.

**“Violation”** means the failure of a structure or other development to be fully compliant with the community's flood plain management regulations. A structure or other development without the elevation certificate, other certifications, or other evidence of compliance required in this Article is presumed to be in violation until such time as that documentation is provided.

"**Water surface elevation**" means the height, in relation to the National Geodetic Vertical Datum (NGVD) of 1929, North American Vertical Datum (NAVD) of 1988, or other datum, of floods of various magnitudes and frequencies in the floodplains of coastal or riverine areas.

"**Watercourse**" means a lake, river, creek, stream, wash, arroyo, channel or other topographic feature on or over which waters flow at least periodically. Watercourse includes specifically designated areas in which substantial flood damage may occur.

**SEC. 8402. Applicability.**

**A. Basis for establishing areas of special flood hazards.** The areas of special flood hazard identified by the Federal Insurance Administration (FIA) of the Federal Emergency Management Agency (FEMA) in a scientific and engineering report entitled "Flood Insurance Study" for the City of Arcata dated November 5, 1997, and accompanying Flood Insurance Rate Maps (FIRMS), and the Humboldt County Flood Insurance Rate Map Index dated February 8, 1999, and Flood Insurance Study dated August 5, 1986 and Flood Boundary and Floodway Maps, and all subsequent amendments and/or revisions are hereby adopted by reference and declared to be a part of this Land Use Code, and this Chapter. This Flood Insurance Study and attendant mapping is the minimum area of applicability of this Chapter and may be supplemented by studies for other areas which allow implementation of this Chapter and which are recommended to the City of Arcata by the Flood Plain Administrator. The Flood Insurance Study is on file at the Engineering Department of the City of Arcata

**B. Compliance with Chapter required.** No structure or land shall hereafter be constructed, located, extended, converted, or altered without full compliance with the terms of this Chapter, and other applicable regulations including the City of Arcata Land Use Code (LUC). Violations of the provisions of this Chapter by failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with conditions) may constitute a misdemeanor, and be charged by the City Attorney as either an infraction or misdemeanor. Nothing herein shall prevent the City from taking lawful action as is necessary to prevent or remedy any violation.

**C. Abrogation and greater restrictions.** This Chapter is not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this Chapter and another regulation, easement, covenant, or deed restriction conflict or overlap, whichever imposes the more stringent restrictions shall prevail.

**D. Interpretation.** In the interpretation and application of this Chapter, all provisions shall be:

1. Considered as minimum requirements;

2. Liberally construed in favor of the governing body; and,

3. Deemed neither to limit nor repeal any other powers granted under state statutes.

**E. Warning and disclaimer of liability.** The degree of flood protection required by this Chapter is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Larger floods can and will occur on rare occasions. Flood heights may be increased by man-made or natural causes. This Chapter does not imply that land outside the areas of special flood hazards, or uses permitted within such areas will be free from flooding or flood damages. This Chapter shall not create liability on the part of the City of Arcata, any officer or employee thereof, the Federal Emergency Management Agency, or State of California, for any flood damages that result from reliance on this Chapter or any administrative decision lawfully made in compliance with this Chapter.

**SEC. 8403. Administration**.

**A. Designation of Floodplain Administrator.** The City Engineer is hereby appointed to administer, implement, and enforce this Chapter by granting or denying development permits in accordance with its provisions.

**B. Duties and responsibilities of Floodplain Administrator.** The Floodplain Administrator shall have the following duties and responsibilities.

1. Permit review**.** The Floodplain Administrator shall review all development permits to determine that:

    a) The permit requirements of this Chapter have been satisfied including determination of substantial improvement and substantial damage of existing structures;

    b) All other required state and federal permit requirements have been obtained;

    c) The site is reasonably safe from flooding;

    d) The proposed development does not adversely affect the carrying capacity of areas where base flood elevations have been determined but a floodway has not been designated. For purposes of this Chapter, "adversely affects" means that the cumulative effect of the proposed development when combined with all other existing and anticipated development will increase the water surface elevation of the base flood more than one foot at any point; and

    e) All Letters of Map Revision (LOMR's) for flood control projects are approved prior to the issuance of building permits. Building permits must not be issued based on Conditional Letters of Map Revision (CLOMR's). Approved CLOMR's allow construction of the proposed flood control project and land preparation as specified in the "start of construction" definition.

2. Notification of Other Agencies. Other agencies shall be notified as follows for the following circumstances:

   a) Alteration or relocation of a watercourse:

      (1) Notify adjacent communities and the California Department of Water Resources prior to alteration or relocation;

      (2) Submit evidence of such notification to the Federal Emergency Management Agency; and

      (3) Assure that the flood carry capacity within the altered or relocated portion of said watercourse is maintained.

   b) Base Flood Elevation changes due to physical alterations:

      (1) Within 6 months of information becoming available or project completion, whichever comes first, the Floodplain Administrator shall submit or assure that the permit applicant submits technical or scientific data to FEMA for a Letter of Map Revision (LOMR).

      (2) All LOMR's for flood control projects are approved prior to the issuance of building permits. Building Permits must not be issued based on Conditional Letters of Map Revision (CLOMR's). Approved CLOMR's allow construction of the proposed flood control project and land preparation as specified in the "start of construction" definition.

   Such submissions are necessary so that upon confirmation of those physical changes affecting flooding conditions, risk premium rates and floodplain management requirements are based on current data.

   c) Changes in Corporate Boundaries. Notify FEMA in writing whenever the corporate boundaries have been modified by annexation or other means and include a copy of the map of the community clearly delineating the new corporate limits.

3. Certifications**.** Obtain and maintain for public inspection and make available as needed the certifications required by Section 8405 (Standards for Flood Hazard Reduction).

4. Interpretations**.** Make interpretations where needed, as to the location of the boundaries of the areas of special flood hazards. Where there appears to be a conflict between a mapped boundary and actual field conditions, grade and base flood elevations shall be used to determine the boundaries of the special flood hazard area. The person contesting the location of the boundary shall be given a reasonable opportunity to appeal the interpretation provided in Section 8406 (Flood Standard Exceptions).

5. Base flood elevation data. When base flood elevation data has not been provided in accordance with Section 8402.A (Basis for establishing areas of special flood hazards), the Floodplain Administrator shall obtain, review, and reasonably utilize any base flood elevation and floodway data available from a federal or state agency, or other source, in the administration and review process.

**C. Enforcement.** Take action to remedy violations of this Chapter as specified in this Chapter or other applicable law.

**SEC. 8404. Permit Requirements.**

A Development Permit shall be obtained before construction or development within any area of special flood hazard identified in compliance with Section 8402.A (Basis for establishing areas of special flood hazards). Application for a Development Permit shall include:

A. Plans in duplicate, drawn to scale, showing:

1. Location, dimensions, and elevation of the area in question, existing or proposed structures, storage of materials and equipment and their location;
2. Proposed locations of water supply, sanitary sewer, and other utilities;
3. Grading information showing existing and proposed contours, any proposed fill, and drainage facilities;
4. Location of the regulatory floodway when applicable;
5. Base flood elevation information as specified in Section 8403.B.5;
6. Proposed elevation in relation to mean sea level, of the lowest floor (including basement) of all structures; and
7. Proposed elevation in relation to mean sea level to which any nonresidential structure will be floodproofed, as required in Section 8405.A.4.

B. Proposed elevation in relation to mean sea level, of the lowest floor (including basement) of all structures;

C. Proposed elevation in relation to mean sea level to which any structure will be floodproofed if required in Section 8405.A.4 (Elevation and floodproofing - Nonresidential construction), that is also in compliance with all applicable City regulations including those in the Land Use Code (LUC).

D. All appropriate certifications required by this Chapter;

E. Description of the extent to which any watercourse will be altered or relocated as a result of proposed development; and

F. Documentation of CEQA compliance for all discretionary projects.

**SEC. 8405. Standards for Flood Hazard Reduction**

**A. Construction standards.** The following standards apply in all areas of special flood hazards.

1. Anchoring.

   (a) All new construction and substantial improvements shall be anchored to prevent flotation, collapse or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy.

   (b) All manufactured homes shall meet the anchoring standards of 8405.D (Mobile homes, manufactured homes, and mobile home parks and subdivisions).

2. Construction materials and methods**.**

a) All new construction and substantial improvements shall be constructed with materials and utility equipment resistant to flood damage.
b) All new construction and substantial improvements shall be constructed using methods and practices that minimize flood damage.

c) All new construction and substantial improvements shall be constructed with electrical, heating, ventilation, plumbing and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.

d) Within Zones AH or AO, adequate drainage paths around structures on slopes to guide flood waters around and away from proposed structures are required.

3. Elevation and flood proofing—Residential construction**.** Upon completion of the structure, the elevation of the lowest floor, including basement, shall be certified by a registered civil engineer or licensed surveyor, and verified by the Building Inspector, to be properly elevated. The certification and verification shall be provided to the Floodplain Administrator.

All new construction or substantial improvements of residential structures shall have the lowest floor, including basement:

a) In AE Zones, elevated at least one foot above the base flood elevation.

b) In an AO Zone, elevated above the highest adjacent grade to a height at least one foot above the depth number specified in feet on the FIRM, or elevated at least 2 feet above the highest adjacent grade if no depth number is specified.

c) In an A Zone, without BFE's specified on the FIRM (unnumbered A Zone), elevated at least one foot above the base flood elevation, as determined under Section 9.60.050.B.5.

d) Manufactured homes shall also meet the standards in Subsection D.

4. Elevation and flood proofing—Nonresidential construction. Nonresidential construction, new or substantial Improvements, shall either be elevated to conform with Subsection A.3, above (Elevation and flood proofing—Residential construction), or:

a) Be flood proofed, together with attendant utility and sanitary facilities, below the elevation specified in Subsection A.3, so that the structure is watertight with walls substantially impermeable to the passage of water; and

b) Have structural components capable of resisting hydrostatic and hydrodynamic loads and effects of buoyancy, and;

c) Be certified by a registered civil engineer or licensed surveyor that the standards of this subsection are satisfied. The certification shall be provided to the Floodplain Administrator.

5. Flood Openings. All new construction and substantial improvements of structures with fully enclosed areas below the lowest floor (excluding basements) that are usable solely for parking of vehicles, building access or storage, and which are subject to flooding, shall be

designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for automatic entry and exit of floodwater. Designs for meeting this requirement must meet the following minimum criteria:

a) For non-engineered openings:

(1) Have a minimum of two openings on different sides having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding;
(2) The bottom of all openings shall be no higher than one foot above grade;
(3) Openings may be equipped with screens, louvers, valves or other coverings or devices provided that they permit the automatic entry and exit of floodwater; and
(4) Buildings with more than one enclosed area must have openings on exterior walls for each area to allow flood water to directly enter; or

b) Be certified by a registered civil engineer or architect.

6. Garages and low cost Accessory Structures.

a) Attached Garages.

(1) A garage attached to a residential structure, constructed with the garage floor slab below the BFE, must be designed to allow for the automatic entry of flood waters. See Subsection 8405.A.5. Areas of the garage below the BFE must be constructed with flood resistant materials. See Subsection 8405.A.2.

(2) A garage attached to a nonresidential structure must meet the above requirements or be dry floodproofed. For guidance on below grade parking areas, see FEMA Technical Bulletin TB-6.

b) Detached garages and accessory structures.

(1) "Accessory structures" used solely for parking (2 car detached garages or smaller) or limited storage (small, low-cost sheds), as defined in 8401, may be constructed such that its floor is below the base flood elevation (BFE), provided the structure is designed and constructed in accordance with the following requirements:

i. Use of the accessory structure must be limited to parking or limited storage;

ii. The portions of the accessory structure located below the BFE must be built using flood-resistant materials;

iii. The accessory structure must be adequately anchored to prevent flotation, collapse and lateral movement;

iv. Any mechanical and utility equipment in the accessory structure must be elevated or floodproofed to or above the BFE;

v. The accessory structure must comply with floodplain encroachment provisions in Subsection 8405.F; and

vi. The accessory structure must be designed to allow for the automatic entry of

flood waters in accordance with Subsection 8405.F.

(2) Detached garages and accessory structures not meeting the above standards must be constructed in accordance with all applicable standards in Section 8405.

**B. Utilities.** All new and replacement water supply and sanitary sewage systems shall be designed to prohibit the infiltration of flood waters into the system and discharge from systems into flood waters. On-site waste disposal systems shall be located to avoid impairment to them, or contamination from them during flooding.

**C. Subdivisions.**

1. All new subdivision proposals and other proposed development, including proposals for manufactured home parks and subdivisions, greater than 50 lots or 5 acres, whichever is the lesser, shall:

   a) Identify the Special Flood Hazard Areas (SFHA) and Base Flood Elevations (BFE).
   b) Identify the elevations of lowest floors of all proposed structures and pads on the final plans.
   c) If the site is filled above the base flood elevation, the following as-built information for each structure shall be certified by a Registered Civil Engineer or Licensed Land Surveyor and provided as part of an application for a Letter of Map Revision based on Fill (LOMR-F) to the Floodplain Administrator;

      (1) Lowest floor elevation.
      (2) Pad elevation.
      (3) Lowest adjacent grade.

2. All subdivision proposals and other proposed development shall be consistent with the need to minimize flood damage.
3. All subdivision proposals and other proposed development shall have public utilities and facilities such as sewer, gas, electrical and water systems located and constructed to minimize flood damage.
4. All subdivisions and other proposed development shall provide adequate drainage to reduce exposure to flood hazards.

**D. Mobile homes, manufactured homes, and mobile home parks and subdivisions.**

1. All manufactured homes that are placed or substantially improved on sites located: (1) outside of a manufactured home park or subdivision; (2) in a new manufactured home park or subdivision; (3) in an expansion to an existing manufactured home park or subdivision; or (4) in an existing manufactured home park or subdivision upon which a manufactured home has incurred "substantial damage" as the result of a flood, shall:

   a) Within Zones A, AH, and AE on the community's Flood Insurance Rate Map, be elevated on a permanent foundation such that the lowest floor of the manufactured home is elevated to or above the base flood elevation and be securely fastened to an adequately anchored foundation system to resist flotation, collapse, and lateral movement.

   b) Within Zones V, and VE on the community's Flood Insurance Rate Map, meet the requirements of Section 8405.G.

2. All manufactured homes to be placed or substantially improved on sites in an existing manufactured home park or subdivision within Zones A, AH, AE, V, and VE on the community's Flood Insurance Rate Map that are not subject to the provisions of Subsection 8405.D.1 will be securely fastened to an adequately anchored foundation system to resist flotation, collapse, and lateral movement, and be elevated so that either the:

    a) Lowest floor of the manufactured home is at or above the base flood elevation; or

    b) Manufactured home chassis is supported by reinforced piers or other foundation elements of at least equivalent strength that are no less than 36 inches in height above grade.

Upon the completion of the structure, the elevation of the lowest floor including basement shall be certified by a Registered Civil Engineer or Licensed Land Surveyor, and verified by the community building inspector to be properly elevated. Such certification and verification shall be provided to the Floodplain Administrator.

E. **Recreational vehicles.**

1. Each recreational vehicle placed on a site within Zones A, AH, and AE on the Flood Insurance Rate Map shall either:

    a) Be on the site for fewer than 180 consecutive days, and be fully licensed and ready for highway use. (A recreational vehicle is ready for highway use if it is on its wheels or jacking system, is attached to the site only by quick disconnect type utilities and security devices, and has no permanently attached additions), or

    b) Meet the permit requirements of Section 8404 (Permit Requirements), and the elevation and anchoring requirements for manufactured homes in Subsection D.

2. A recreational vehicle placed on sites within Zones V and VE on the Flood Insurance Rate Map shall comply with the requirements of Subsections F.1, and G.

**F. Floodways.** Within the areas of special flood hazard established in Section 8402.A (Applicability—Basis for establishing areas of special flood hazards), are areas designated as floodways. Since the floodway is an extremely hazardous area due to the velocity of flood waters which carry debris, potential projectiles, and erosion potential, the following provisions apply:

1. Prohibit encroachments, including fill, new construction, substantial improvements, and other development unless certification by a registered civil engineer is provided demonstrating that encroachments shall not result in any increase in flood levels during the occurrence of the base flood discharge.

2. If the requirements of this Subsection F are satisfied, all new construction and substantial improvements shall comply with all other applicable flood hazard reduction provisions of this Chapter.

Until a regulatory floodway is adopted, no new construction, substantial development, or other development (including fill) shall be permitted within Zones A and AE, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other development, will not increase the water surface elevation of the base flood more than 1 foot at any point within the City of

Arcata.

**G. Coastal High Hazard Areas.** Unless exempted by General Plan: 2020 policies PS-4b, PS-4g, and any other applicable City regulation or standard, it is the general policy of the City not to allow any development in the area identified as Coastal Flooding (V Zones) on the FIRM Map.

**H. Exceptions.** The improvement, repair, or rehabilitation of an existing residential building or structure, or an existing nonresidential building or structure built prior to May 2, 1983, where the cost of the improvement, repair, or rehabilitation does not equal or exceed 50 percent of the replacement cost of the structure shall not be subject to the standards and requirements of this Section. In all circumstances, exceptions may be made only in accordance with the requirements in Section 8406 (Flood Standard Exceptions), in compliance with Section 60.6 of the National Flood Insurance Program Regulations, Federal Emergency Management Agency, Federal Insurance Administration and in California Administrative Code Title 14 for Coastal Zone Areas.

**SEC. 8406. Flood Standard Exceptions.**

The issuance of an exception is for floodplain management purposes only. Insurance premium rates are determined by statute according to actuarial risk and will not be modified by the granting of an exception.

The variance criteria set forth in this section of the ordinance are based on the general principle of zoning law that variances pertain to a piece of property and are not personal in nature. A variance may be granted for a parcel of property with physical characteristics so unusual that complying with the requirements of this ordinance would create an exceptional hardship to the applicant or the surrounding property owners. The characteristics must be unique to the property and not be shared by adjacent parcels. The unique characteristic must pertain to the land itself, not to the structure, its inhabitants, or the property owners.

It is the duty of the City of Arcata to help protect its citizens from flooding. This need is so compelling and the implications of the cost of insuring a structure built below flood level are so serious that exceptions from the flood elevation or from other requirements in the flood ordinance are quite rare. The long term goal of preventing and reducing flood loss and damage can only be met if exceptions are strictly limited. Therefore, the exception guidelines provided in this ordinance are more detailed and contain multiple provisions that must be met before an exception can be properly granted. The criteria are designed to screen out those situations in which alternatives other than an exception are more appropriate.

Exceptions to Section 8405 (Standards for Flood Hazard Reduction) may be granted by the Floodplain Administrator in compliance with the following provisions.

**A. Notices and hearings.** The processing of a Flood Standard Exception shall occur in compliance with the provisions of Section 9.72.080 for Minor Use Permits.

**B. Factors to be considered.** In reviewing and deciding upon applications for Flood Standard Exceptions, the Floodplain Administrator shall consider all technical evaluations, all relevant factors, standards specified in other sections of this Chapter, and the:

1. Danger that materials may be swept onto other lands to the injury of others;

2. Dangers to life and property because of flooding or erosion damage;

3. Susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner.

4. Importance of the services provided by the proposed facility to the community;

5. Necessity to the facility of a waterfront location, where applicable;

6. Availability of alternative locations for the proposed use which are not subject to flooding or erosion damage;

7. Compatibility of the proposed use with existing and anticipated development;

8. Relationship of the proposed use to the comprehensive plan and floodplain management program for that area;

9. Safety of access to the property in time of flood for ordinary and emergency vehicles;

10. Expected heights, velocity, duration, rate of rise, and sediment transport of the flood waters expected at the site; and,

11. Costs of providing governmental services during and after flood conditions, including maintenance and repair of public utilities and facilities such as sewer, gas, electrical, and water system, and streets and bridges.

**C. Exception criteria.** Generally, a Flood Standard Exception may be issued for new construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, provided that the issues listed in Subsections B.1 through B.11 have been fully considered. As lot size increases beyond one-half acre, the technical justification required for issuing the Exception increases.

1. An Exception may be issued for the repair, rehabilitation, or restoration of a historic structure upon a determination that the proposed repair, rehabilitation, or restoration will not preclude the structure's continued designation as an historic structure and the exception is the minimum necessary to preserve the historic character and design of the structure.

2. An Exception shall not be issued within any designated floodway if any increase in flood levels during the base flood discharge would result.

3. An Exception shall only be issued upon a determination that the exception is the minimum necessary, considering the flood hazard, to afford relief.

4. An Exception shall only be issued upon:

    a) A showing of good and sufficient cause;

    b) A determination that failure to grant the exception would result in exceptional hardship to the applicant; and

    c) A determination that the granting of a exception will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws or ordinances.

5. An Exception may be issued for new construction and substantial improvements and for other development necessary for the conduct of a functionally dependent use provided that the above provisions of this Subsection C. are satisfied, and that the structure or other development is protected by methods that minimize flood damages during the base flood and create no additional threats to public safety.

**D. Conditions of approval.** Upon consideration of the factors in Subsection C., and the purposes of this Chapter, the Flood Plain Administrator may attach conditions to the granting of exceptions as it deems necessary to further the purposes of this Chapter.

**E. Notice to applicant.** An applicant to whom a Flood Standard Exception is granted shall be given written notice that the structure will be permitted to be built with a lowest floor elevation below the base flood elevation and that the cost of flood insurance will be commensurate with the increased risk resulting from the reduced lowest floor elevation. A copy of the notice shall be recorded by the Flood Plain Administrator in the office of the Humboldt County Recorder.

**F. Records.** The Flood Plain Administrator shall maintain the records of all appeal actions, including justification for their issuance, and report any exceptions to the Federal Insurance Administration upon request.

**SEC. 8407. Appeal**

Any permit applicant, or permit holder affected by any decision of the Floodplain Administrator, may file with the City Manager a written request for reconsideration within 10 days of such decision, action, or determination, setting forth in detail the facts supporting the applicant's request for reconsideration. The City Manager shall make a final ruling on the appeal within 15 days of the close of the meeting.

If the ruling made by the City Manager is unsatisfactory to the person requesting reconsideration, he/she may within 10 days after notification of the City Manager's action, file a written appeal to the City Council. The written appeal shall be heard by the Council within 60 days from the date of filing. The City Manager's decision, action, or determination shall remain in effect during such period of reconsideration.

Section 3: Severability. If any section, subsection, sentence, clause or phrase of this chapter is for any reason held to be invalid or unconstitutional, the decision shall not affect the validity of the remaining portions of the Chapter. The City Council hereby declares that it would have passed this Chapter, and each section, subsection, sentence, clause and phrase thereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses or phrases be declared invalid under law.

Section 4: This ordinance is exempt from the California Environmental Quality Act (CEQA) pursuant to Section 15061(b)(3) of the CEQA Guidelines, because it can be seen with certainty that there is no possibility that adoption of the ordinance may have a significant effect on the environment.

Section 5: The City Council finds that:

1. The Federal Emergency Management Agency (FEMA) has established the National Flood Insurance Program (NFIP) pursuant to the National Flood Insurance Act of 1968. The general purpose of the NFIP is both to offer primary flood insurance to properties with significant

flood risk, and to reduce flood risk through the application of local floodplain management standards.

2. Generally, local governments voluntarily participate in the NFIP to allow local property owners to have access to flood insurance. Participation requires the local government to adopt minimum floodplain standards. Participating communities that fail to maintain minimum floodplain standards can be put on probation or suspended from the NFIP, with the result that individuals cannot purchase NFIP flood insurance.

3. FEMA has revised its local flood insurance rate maps (FIRMs) establishing new minimum floodplain standards for NFIP participation effective November 4, 2016.

4. The City of Arcata's current floodplain standards will not meet the revised minimum standards required unless updated. In order for property owners to remain eligible for NFIP participation, the City must update its flood plain management standards through adoption of this Ordinance no later than November 4, 2016.

Based on the findings set forth herein, for the immediate preservation of the public peace, health or safety, this Ordinance shall go into effect and be in full force and operation upon its final passage and adoption, pursuant to Government Code Section 36937.

DATE: November 2, 2016

ATTEST: APPROVED:

/s/ Kara Newman
Deputy City Clerk, City of Arcata

/s/ Paul J. Pitino
Mayor, City of Arcata

**CLERK'S CERTIFICATE**

I hereby certify that the foregoing is a true and correct copy of Ordinance No. 1479 passed and adopted at a regular meeting of the City Council of the City of Arcata, County of Humboldt, State of California on the 2nd day of November, 2016, by the following vote:

AYES: **PITINO, ORNELAS, PEREIRA, WINKLER**

NOES: **NONE**

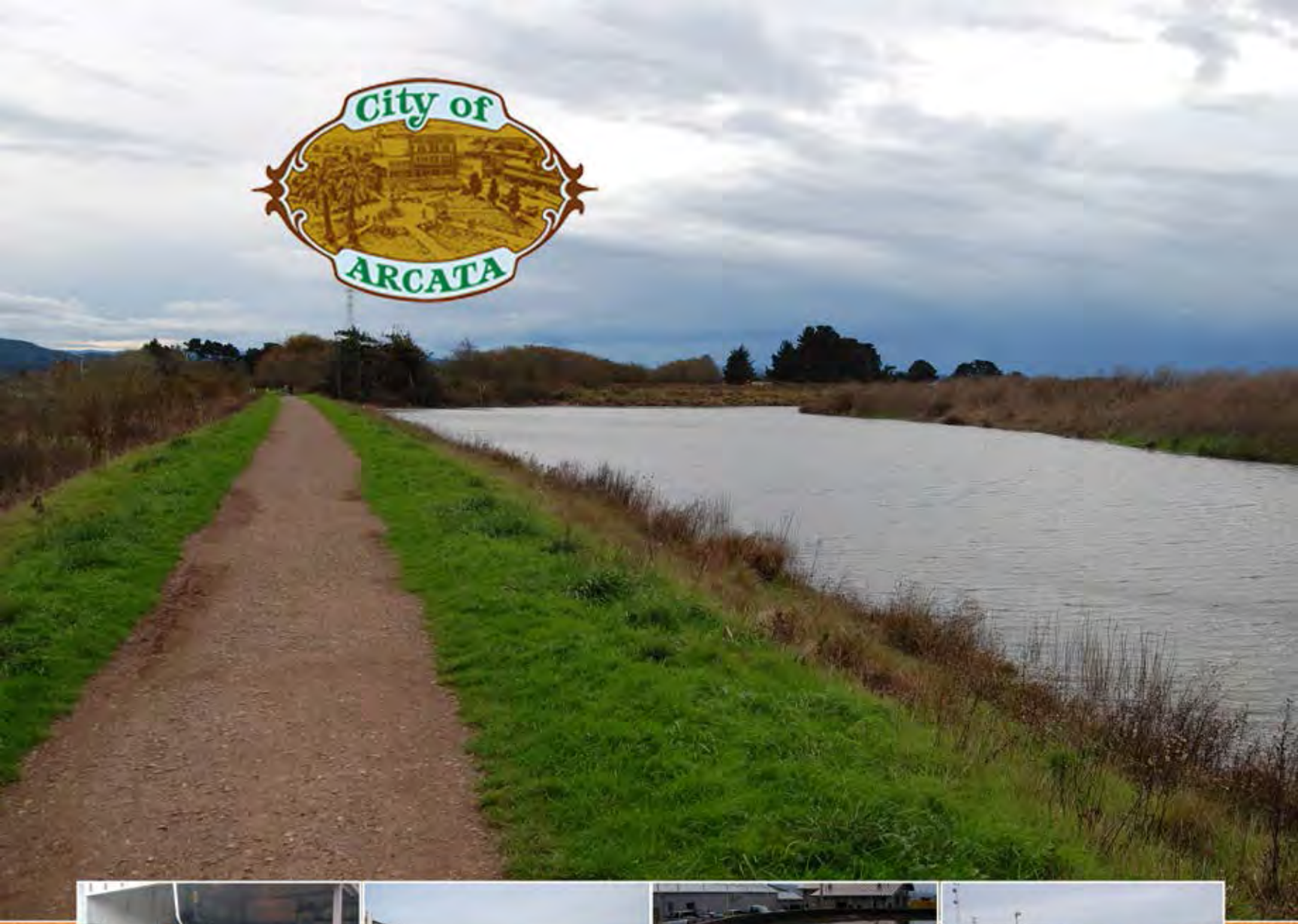
ABSENT: **WHEETLEY**

ABSTENTIONS: **NONE**

/s/ Kara Newman
Deputy City Clerk, City of Arcata

# ATTACHMENT 19

Carollo Engineers. 2016. *City of Arcata Facility Plan.* Revised July 2017.











City of Arcata

# Facility Plan

REVISED July 2017

LACO / carollo

# CITY OF ARCATA

## WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT

## FACILITY PLAN

**July 2017**




07/27/2017

**CITY OF ARCATA**

**WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT**

## TABLE OF CONTENTS

**Page No.**


Chapter 1 - Executive Summary ..... 1-1

1.1 INTRODUCTION ..... 1-1
1.1.1 History of Facilities and Improvements ..... 1-2
1.2 PLAN DEVELOPMENT AND REVIEW PROCESS ..... 1-4
1.2.1 Public Process and Review ..... 1-5
1.3 PERMIT COMPLIANCE ..... 1-6
1.4 EXISTING FACILITIES OVERVIEW ..... 1-9
1.4.1 Hydraulic Capacity ..... 1-9
1.4.2 Process Capacity ..... 1-10
1.5 CONDITION ASSESSMENT ..... 1-11
1.6 PHILOSOPHY IN DEVELOPING ALTERNATIVES AND CIP ..... 1-12
1.6.1 Summary of Common Improvements Needed ..... 1-13
1.7 SECONDARY TREATMENT ALTERNATIVES ..... 1-16
1.7.1 Preliminary Screening of Secondary Treatment Options ..... 1-16
1.7.2 Project Alternative Development ..... 1-19
1.7.3 Alternative Comparison and Recommendation ..... 1-23
1.8 NEXT STEPS AND IMPLEMENTATION SCHEDULE ..... 1-25

Chapter 2 - Regulatory Requirements and Permit Compliance ..... 2-1

2.1 INTRODUCTION ..... 2-1
2.2 PURPOSE ..... 2-1
2.3 BACKGROUND ..... 2-2
2.4 PERMIT COMPLIANCE HISTORY ..... 2-3
2.4.1 2004-2015 Compliance Review and Permit Violations ..... 2-5
2.5 CURRENT PERMIT COMPLIANCE REQUIREMENTS ..... 2-8
2.5.1 Water Quality Standards ..... 2-8
2.5.2 Flow Reconfiguration Project ..... 2-9
2.6 FUTURE REGULATORY CONSIDERATIONS ..... 2-10
2.7 MEETINGS WITH NORTH COAST RWQCB ..... 2-12
2.8 NORTH COAST RWQCB REPORT OF WASTE DISCHARGE SUBMITTAL ..... 2-12

Chapter 3 - Flow and Load Evaluation ..... 3-1

3.1 INTRODUCTION ..... 3-1
3.2 EXISTING FACILITY DESIGN FLOW AND LOADS ..... 3-1
3.3 INFLUENT FLOW EVALUATION ..... 3-2
3.4 INFLUENT LOAD EVALUATION ..... 3-3

Chapter 4 - Existing Facilities and Capacity Evaluation ..... 4-1

4.1 INTRODUCTION ..... 4-1
4.2 FACILITY OVERVIEW ..... 4-1
4.3 EXISTING FACILITIES DESCRIPTION ..... 4-1
4.3.1 Headworks ..... 4-4
4.3.2 Primary Clarifiers ..... 4-4
4.3.3 Influent Bypass Pumping ..... 4-4
4.3.4 Oxidation Ponds and Pond Pumping ..... 4-4
4.3.5 Treatment Wetlands and Effluent Pumping ..... 4-5
4.3.6 Disinfection ..... 4-5
4.3.7 Enhancement Wetlands ..... 4-5
4.4 EXISTING HYDRAULIC CAPACITY SUMMARY ..... 4-6
4.4.1 Existing Hydraulic Profile ..... 4-6
4.4.2 Influent Pumping ..... 4-6
4.4.3 Headworks ..... 4-7
4.4.4 Primary Treatment ..... 4-7
4.4.5 Oxidation Ponds ..... 4-7
4.4.6 Treatment Wetlands ..... 4-8
4.4.7 Secondary Effluent Pumping ..... 4-8
4.4.8 Chlorine Contact Basin ..... 4-9
4.4.9 Enhancement Wetlands ..... 4-10
4.4.10 Hydraulic Capacity Summary ..... 4-10
4.5 NATURAL SYSTEM TREATMENT CAPACITY EVALUATION ..... 4-12
4.5.1 Process Capacity Background ..... 4-12
4.5.2 BOD Loading Criteria ..... 4-12
4.5.3 Secondary Treatment Capacity Shortfall ..... 4-14
4.6 KEY FINDINGS AND RECOMMENDATIONS ..... 4-18

Chapter 5 - Condition Assessment ..... 5-1

5.1 INTRODUCTION ..... 5-1
5.2 PURPOSE ..... 5-2
5.3 APPROACH ..... 5-2
5.3.1 Asset Inventory ..... 5-2
5.3.2 Replacement Timing ..... 5-2
5.4 VISUAL CONDITION ASSESSMENT RESULTS ..... 5-4
5.4.1 Headworks ..... 5-5
5.4.2 Primary Clarifiers ..... 5-7
5.4.3 Oxidation Ponds ..... 5-8
5.4.4 Treatment Wetlands ..... 5-10
5.4.5 Enhancement Wetlands ..... 5-12
5.4.6 Disinfection ..... 5-14
5.4.7 Solids Handling and Treatment ..... 5-15
5.4.8 Plant Electrical and Controls ..... 5-16
5.5 SUMMARY OF PLANT CONDITIONS ..... 5-17
5.6 REFERENCES ..... 5-17

Chapter 6 - Alternatives ..... 6-1

6.1 INTRODUCTION ..... 6-1
6.2 BASIS FOR ALTERNATIVES ..... 6-1
6.3 SUMMARY OF COMMON IMPROVEMENTS NEEDED ..... 6-2
6.4 IDENTIFICATION OF SECONDARY TREATMENT OPTIONS ..... 6-4
6.4.1 Preliminary Screening of Secondary Treatment Options ..... 6-5
6.4.2 Further Screening of Parallel Secondary Treatment Options ..... 6-8
6.5 PROJECT ALTERNATIVE DEVELOPMENT AND COMPARISON ..... 6-10
6.5.1 Alternative Descriptions ..... 6-12
6.5.2 Comparison of Alternatives ..... 6-18
6.6 EXPANDED ALTERNATIVE ..... 6-19
6.6.1 Alternative 4 Upgraded Existing System with Parallel Treatment ..... 6-20
6.6.2 Alternative 4 Development ..... 6-22
6.6.3 Comparison of Alternative 3 and 4 ..... 6-24

Chapter 7 - Disinfection System Evaluation ..... 7-1

7.1 INTRODUCTION ..... 7-1
7.2 BACKGROUND ..... 7-1
7.3 PURPOSE ..... 7-1
7.4 DESIGN CRITERIA ..... 7-2
7.5 EXISTING DISINFECTION SYSTEM ..... 7-2
7.5.1 Chlorine Contact Basin ..... 7-3
7.5.2 Chlorine and Sulfur Dioxide Use and Impact ..... 7-5
7.6 PROPOSED ULTRAVIOLET LIGHT DISINFECTION ..... 7-5
7.6.1 UV System Sizing Criteria ..... 7-5
7.6.2 Proposed UV Equipment Selection ..... 7-10
7.6.3 UV Conceptual Flow Configuration and Layout ..... 7-11
7.6.4 UV System Costs ..... 7-15
7.6.5 UV System Procurement ..... 7-18
7.6.6 UV System Pretreatment ..... 7-20
7.7 EXISTING CHLORINE AND SULFUR DIOXIDE SYSTEM ..... 7-20
7.8 SUMMARY AND RECOMMENDATIONS ..... 7-21
7.9 REFERENCES ..... 7-22

Chapter 8 - Capital Improvements Program ..... 8-1

8.1 INTRODUCTION ..... 8-1
8.2 CIP DEVELOPMENT APPROACH ..... 8-1
8.2.1 Project Drivers and Prioritization ..... 8-1
8.2.2 Project Costs ..... 8-3
8.2.3 Project Implementation ..... 8-3
8.3 10-YEAR CIP ELEMENTS AND ALTERNATIVE COSTS ..... 8-3
8.3.1 UV Disinfection System Project ..... 8-6
8.3.2 Treatment Wetland No. 7 Construction Project ..... 8-7
8.3.3 Flow Reconfiguration Project ..... 8-7
8.3.4 Headworks R&R Projects ..... 8-8

8.3.5 Primary Clarifiers Replacement Project ..... 8-8
8.3.6 Wetlands Revegetation Projects ..... 8-8
8.3.7 Treatment Wetlands Pumping Configuration Project ..... 8-9
8.3.8 Oxidation Pond Improvements Projects ..... 8-9
8.4 10 TO 20-YEAR CIP ELEMENTS ..... 8-10
8.4.1 Sea Level Rise Project ..... 8-10
8.4.2 Plant Modernization Projects ..... 8-10
8.5 FINDINGS AND RECOMMENDATIONS ..... 8-11
8.6 CIP IMPLEMENTATION AND NEXT STEPS ..... 8-12

## LIST OF APPENDICES

APPENDIX A - NPDES Permit No. CA0022713, Order No. R1-2012-0031
(Not Included in Draft Report)
APPENDIX B - NPDES Discharge Violation Information 2012-2015
APPENDIX C - Flow and Load Data Analysis
APPENDIX D - Unit Process Flow Diagrams
APPENDIX E - Existing Hydraulic Profiles
APPENDIX F - Summary of Existing Secondary Effluent Pumping Capacities
APPENDIX G - Presentation Materials from the October and November 2015 Workshops
APPENDIX H - Process Area Photos
APPENDIX I - Detailed Asset Inventory and Rankings
APPENDIX J - Dr. Gearheart Notes on Treatment Wetlands
APPENDIX K - CIP Alternative Project Design Criteria
APPENDIX L - Summary of Chlorine and Sulfur Dioxide Chemical Use
APPENDIX M - UVT Data and Evaluation
APPENDIX N - 2011 Pilot UV Disinfection Test Report
APPENDIX O - UV Disinfection Equipment Proposals
APPENDIX P - Basis of Costs
APPENDIX Q - CIP Alternative Capital Cost Information
APPENDIX R - CIP Alternative Operation and Maintenance Cost Information
APPENDIX S - Presentations to City Council
APPENDIX T - Report of Waste Discharge (By City) January 2017
APPENDIX U - Performance Review Joe Middlebrooks February 2017
APPENDIX V – Public Meeting and Council Presentation – March and April 2017

## LIST OF TABLES


Table 1.1 AWTF Design Flow and Loads ..... 1-9
Table 1.2 BOD Capacity in Existing System ..... 1-11
Table 1.3 Secondary Processes Meeting Permit Discharge Requirements ..... 1-16
Table 1.4 Initial Screening of Pre, Parallel and Post Treatment Options ..... 1-17
Table 1.5 Secondary Treatment Options Evaluation of Non-Economic Factors ..... 1-18
Table 1.6 Secondary Treatment Options Evaluation of Economic Factors ..... 1-19
Table 1.7 Summary of Alternative Comparison for Non-Economic Factors ..... 1-23
Table 1.8 Cost Comparison of Treatment Alternatives ..... 1-24
Table 2.1 Summary of 2012 NPDES Requirements ..... 2-3
Table 2.2 Summary of NPDES Discharge Violations From 2013 to 2015(1) ..... 2-7
Table 3.1 AWTF Influent Permit Flow Summary ..... 3-1
Table 3.2 AWTF Design Flow and Loads per 1987 Drawings ..... 3-2
Table 3.3 Recommended Design Plant Influent Loads ..... 3-4
Table 4.1 AWTF Influent Permit Flow Summary ..... 4-1
Table 4.2 Influent Pumping Capacity Summary ..... 4-6
Table 4.3 Effluent Pumping Capacity Summary ..... 4-10
Table 4.4 Existing Flow Capacity Summary ..... 4-11
Table 4.5 BOD Treatment Capacity Shortfall Summary ..... 4-15
Table 5.1 Estimated OUL Based on Asset Category ..... 5-3
Table 5.2 Condition Ranking Scale ..... 5-4
Table 5.3 Summary of Process Area Rankings ..... 5-5
Table 6.1 Design Flow and Loads With 20% Growth Projection ..... 6-2
Table 6.2 Secondary Processes Meeting Permit Discharge Requirements ..... 6-5
Table 6.3 Initial Screening of Pre, Parallel and Post Treatment Options ..... 6-6
Table 6.4 Preliminary Design Criteria for Parallel Secondary Treatment Options ..... 6-9
Table 6.5 Secondary Treatment Options Evaluation of Non-Economic Factors ..... 6-9
Table 6.6 Secondary Treatment Options Evaluation of Economic Factors ..... 6-10
Table 6.7 Summary of Alternative Comparison for Non-Economic Factors ..... 6-19
Table 6.8 Comparison of Alternative 3 and 4 Elements ..... 6-25
Table 7.1 UV Effluent Disinfection System Design Criteria ..... 7-2
Table 7.2 UV System Sizing Design Criteria ..... 7-6
Table 7.3 Trojan UV3000Plus System Configurations(1) ..... 7-11
Table 7.4 Trojan UV Equipment and Construction Cost Comparison ..... 7-15
Table 7.5 Trojan UV O&M Cost Basis and Estimate ..... 7-17
Table 7.6 UV System Net Present Worth Summary ..... 7-18
Table 8.1 Cost Comparison of Treatment Alternatives ..... 8-6

## LIST OF FIGURES


Figure 1.1 Existing AWTF Facilities ..... 1-2
Figure 1.2 AWTF Ponds Provide Secondary Treatment ..... 1-3
Figure 1.3 AMWS Provides a Significant Community Benefit ..... 1-4
Figure 1.4 Triple Bottom Line Framework ..... 1-5
Figure 1.5 Proposed UV Disinfection ..... 1-7
Figure 1.6 AWTF Hydraulic Capacity ..... 1-10
Figure 1.7 AWTF Facility Condition Rating ..... 1-12
Figure 1.8 New and Existing Outfall Locations ..... 1-13
Figure 1.9 Treatment Wetlands will be improved ..... 1-15
Figure 1.10 Example of Proposed Oxidation Ditch Secondary Treatment ..... 1-19
Figure 1.11 Alternative 1 - Existing System Rehabilitation ..... 1-20
Figure 1.12 Alternative 2 - Existing System with Side Stream Treatment ..... 1-21
Figure 1.13 Alternative 3 - Existing System with Parallel Treatment ..... 1-22
Figure 1.14 Alternative 4 - Enhanced Natural System with Parallel Treatment ..... 1-23
Figure 1.15 Updated Implementation Schedule ..... 1-27
Figure 2.1 AWTF Reconfiguration and Outfall Locations ..... 2-4
Figure 3.1 Plant Influent BOD (Monthly Median), City and AMRI Data ..... 3-4
Figure 4.1 Existing ATWF Site Layout ..... 4-2
Figure 4.2 Existing ATWF Flow Schematic ..... 4-3
Figure 4.3 Plant Permit Performance At Lower Flows ..... 4-16
Figure 4.4 BOD Concentration (mg/L) Profile at AWTF (AMRI data, November 2015 at 1.5 mgd). ..... 4-16
Figure 4.5 Oxidation Pond 1 Influent BOD Loading (Monthly Median) ..... 4-17
Figure 4.6 Enhancement Wetlands Influent BOD Loading (Monthly Median) ..... 4-17
Figure 5.1 Original Arcata Wastewater Treatment Plant (Circa 1958) ..... 5-1
Figure 5.2 Treatment Wetlands (Circa 1989) ..... 5-11
Figure 6.1 Proposed Alternative 1 - Flow Schematic ..... 6-11
Figure 6.2 Proposed Alternative 2 - Flow Schematic ..... 6-13
Figure 6.3 Proposed Alternative 3 - Flow Schematic ..... 6-14
Figure 6.4 Proposed Alternative 4 - Flow Schematic ..... 6-21
Figure 6.5 Conceptual Facilities Site Plan ..... 6-26
Figure 6.6 Conceptual Aerial View of Improvements. (From City of Arcata) ..... 6-27
Figure 7.1 Chlorine Contact Basin Operational Modes ..... 7-4
Figure 7.2 UVT Data ..... 7-7
Figure 7.3 MS2/T1 Dose Ratio For UV Systems ..... 7-9
Figure 7.4 UV Disinfection System Conceptual Plan (35% UVT) ..... 7-12
Figure 7.5 UV Disinfection System Conceptual Section (35% UVT) ..... 7-13
Figure 7.6 Typical Canopy Roof Over UV Channels (Windsor, California) ..... 7-14
Figure 7.7 UV Disinfection System Conceptual Plan (55% UVT) ..... 7-16
Figure 8.1 Updated Implementation Schedule ..... 8-14

Chapter 1

# EXECUTIVE SUMMARY

## 1.1 INTRODUCTION

The Arcata Wastewater Treatment Facility (AWTF) is owned and operated by the City of Arcata (City), serving residents within the City limits and the unincorporated community of Glendale. The AWTF, shown in Figure 1.1, has been discharging to Humboldt Bay since about 1949. The AWTF currently discharges treated wastewater to Humboldt Bay in conjunction with enhanced treatment occurring in the Arcata Marsh Wildlife Sanctuary (AMWS), constructed freshwater wetlands adjacent to the treatment facility. Discharges are regulated by the North Coast Regional Water Quality Control Board (RWQCB) through application of National Pollutant Discharge Elimination System (NPDES) permit.

In 2012 the AWTF began operating under a new NPDES permit that specifically addressed several long-term issues regarding disinfection, treatment units, and outfalls. Due to past compliance problems, the new permit required changes be made to improve wastewater treatment, protect beneficial uses, increase energy efficiency, and reduce chemical usage, thereby reducing the potential for permit violations.

In response to the new permit requirements, the City initiated this Facility Plan and plant improvement project to address several issues:

- Ongoing NPDES permit violations and regulatory compliance.
- Need to repair or rehabilitate (R&R) aging infrastructure and address deferred maintenance.
- Providing reliable hydraulic and treatment capacity for both wet and dry weather flows now and in the future.

This facility plan provides overall direction for the current permit compliance project as well as a future Capital Improvements Program (CIP) needed to maintain the treatment facility assets, repair, and rehabilitate existing assets, and modernize the facility to meet current levels of service. This executive summary provides a brief overview of key findings and recommendations of the Facility Plan. For more detailed information, the reader is directed to the individual chapters of the Plan.

This facility plan was prepared by the LACO/Carollo Engineers team as part of the Wastewater Treatment Facility Improvements Project professional services.

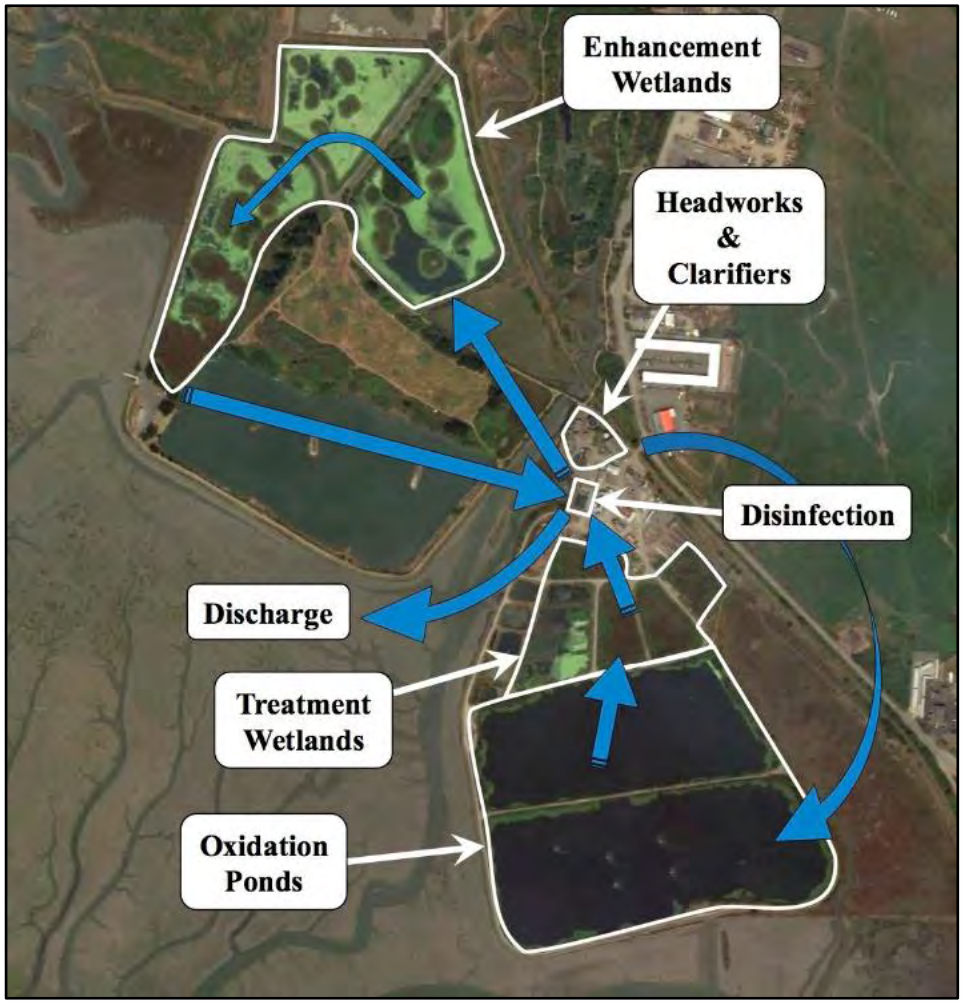



Figure 1.1 Existing AWTF Facilities

### 1.1.1 History of Facilities and Improvements

The original AWTF was constructed in the late 1950s. The AWTF has been upgraded throughout the years, with the last major upgrade project completed in the late 1980s. The project included a new headworks facility with screening and grit removal, a chlorine contact basin and chemical storage building, effluent pump stations and a new generator building. Since that project, smaller projects have included upgrades to the oxidation ponds, treatment and enhancement wetlands, digesters, pond aerators, chlorination/dechlorination system and the addition of a new standby generator. Generally the plant consists of these main elements:

- Influent pumps and preliminary treatment (screening and grit removal).
- Oxidation ponds, shown in Figure 1.2, and treatment wetlands that provide secondary treatment.

- Enhancement wetlands that provide polishing treatment in the AMWS.
- Chlorine contact basin that provides disinfection prior to discharge to Humboldt Bay.



Figure 1.2 AWTF Ponds Provide Secondary Treatment

The AWTF system relies heavily on land-based, natural treatment systems. This system has served the City well but has a number of drawbacks in that there is not sufficient room to further expand the natural treatment systems for additional capacity, and natural systems are inherently greatly affected by the weather (temperature and precipitation). As regulatory requirements have gotten more stringent over the years and with the initiation of mandatory minimum penalties in 2000, it has become more difficult to reliably meet permit compliance with the land-based natural system.

However, there is recognition that the facility as a whole, and the AMWS specifically, provides a tremendous community benefit. Not only do the residents of the area visit the marsh and its five miles of trails, but visitors come from far to see the wildlife that frequents the marsh. The Arcata Marsh Interpretative Center affords wetland and natural treatment educational opportunities for these visitors. Over 300 bird species have been observed using the marsh and it provides an important stop on the Pacific Flyway for migrating birds. A typical scene on a recreational trail is shown in Figure 1.3.



Figure 1.3 AMWS Provides a Significant Community Benefit

## 1.2 PLAN DEVELOPMENT AND REVIEW PROCESS

The City of Arcata, with its natural treatment system and the AMWS, are recognized as being leaders in sustainability and dedicated to being leaders in environmental progress. Established City Council goals that relate to this plan include (see 2015-16 Goals at http://www.cityofarcata.org/435/City-Council-Goals):

- Improving ***facilities and infrastructure*** to provide citizen safety and comfort.
- Providing ***environmental leadership*** to improve water resource management, increase local energy independence, strive towards zero waste and supporting ecosystem functions.
- Provide ***sustainable development*** by improving community services.
- Improve the quality of ***public services*** by improving communication with the public.
- Encourage ***citizen and community health*** by providing recreational opportunities, support essential human services, and encourage community participation.
- ***Prepare for future needs*** by providing leadership in developing adaption strategies for climate change and using best available science for future planning.

This Facility Plan strives to use these goals to help the City continue to provide wastewater services (an essential human service) in a safe manner that meets regulatory requirements and still provides the community benefits that is expected and loved.

To meet these goals for the facility plan as well as meeting Council goals, a triple bottom line approach of considering environmental, economic, and social impacts and benefits was established to use in considering alternatives and the overall direction of the plan. This is shown in Figure 1.4.

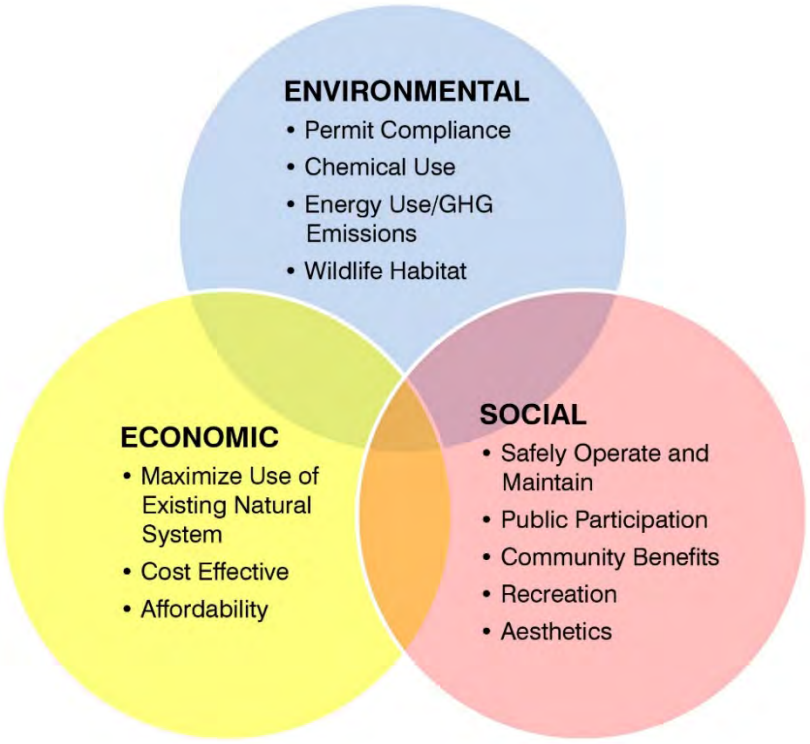



Figure 1.4 Triple Bottom Line Framework

### 1.2.1 Public Process and Review

Given the strong affiliation of the community and the college (Humboldt State University) with the AWTF and AMWS, it is critical that public input be provided into any proposed changes to the system. In order to get input, an Administrative Draft Facility Plan was presented to the City Staff and the Arcata Marsh Research Institute (AMRI) in September 2015. This original plan focused on needed repair and replacement, as well as permit compliance to replace the chlorination system with UV for the new outfall location in the brackish marsh. At this meeting, comments were received about concern over the process capacity being inadequate once chlorination was eliminated. At the time, process capacity was not in the scope of work. Following this input, the project team, along with the City and AMRI, did additional work and met in November 2015 to identify the capacity shortfall and alternatives to address this shortfall. Revised technical memorandums were distributed for City and AMRI review, and numerous conference calls were held to review technical work. In April 2016, a public workshop was held to present the findings and recommendations of the Draft Facility Plan, followed by a public Council Meeting on April 20th. At these meetings, significant discussion took place regarding the use of the existing natural system

and investing in improving it. This Facility Plan incorporates additional alternative evaluation and development to address many of these comments. The Facility Plan was presented on June 6 and June 13, 2016 at City Council Workshops.

Following the public meetings, City staff was able to meet with RWQCB staff June 27, 2016 to discuss the facility plan and the future NPDES permit. Based on feedback from the RWQCB, it was determined that the three alternatives identified in the draft facility plan would not completely meet the requirements of the RWQCB. Subsequently, City staff, AMRI and project team members met and developed a new alternative that would meet these requirements. The team proposed a new phased Alternative 4A/B in early 2017. The following steps were taken to arrive at a consensus alternative:

- The oxidation pond treatment improvements were reviewed and revised based on the review completed by an outside expert. The improvements were developed to improve the ponds systems ability to meet the anticipated discharge limits including the ability to remove ammonia.
- The City indicated a preference to phase in the parallel secondary treatment which will allow the benefits of the pond improvements to be incorporated into the sizing of the parallel secondary treatment improvements. A second oxidation ditch could be sized and constructed in a second phase, once the benefits of the oxidation pond upgrade were established.
- The flow schematic was updated to address the RWQCB requirements that all flows up to 5.9 mgd go through the enhancement wetlands based on the requirements of the Enclosed Bays and Estuaries Policy and to maintain existing and future treatment requirements.

This approach was reviewed during a public meeting on March 30, 2017 and a City Council meeting on April 19, 2017. The presentations from these meetings are included in Appendix V.

## 1.3 PERMIT COMPLIANCE

The AWTF must comply with regulatory requirements established by its NPDES permit. For this Facility Plan, the major regulatory requirements that affect the operation of the AWTF were reviewed along with the AWTF's compliance record. A summary of the permitting issues that affect the proposed Facility Plan is provided below:

- **Flow Reconfiguration.** The permit approves and now requires a new flow configuration and discharge point. With the new configuration, effluent flows will no longer discharge directly from the chlorine contact basin to Humboldt Bay through Outfall 001. Instead, disinfected enhancement wetlands effluent will discharge through the future Outfall 003, which will serve as the new point of compliance. Outfall 003 will be constructed in the brackish marsh at the north end of the Arcata

Bay section of Humboldt Bay. Permit compliance for the flow reconfiguration is required by December 1, 2016; the City plans to request for an extension.

- **Disinfection.** Since 2013 there have been approximately 21 violations of the permit for disinfection related incidents including disinfection by-products, chlorine residual, or adequate bacteria removal. The permit includes approval for construction of a new ultraviolet light (UV) disinfection system, in place of the existing chlorine disinfection system. UV-disinfected effluent will then discharge through the future Outfall 003. Permit compliance for UV disinfection is required by December 1, 2016; the City plans to request for an extension. Additional considerations for the new UV system include:
  - Implementation of UV disinfection (see Figure 1.5) would eliminate the disinfection by products; however, the existing natural treatment system has a very low UV transmittance, which impacts the sizing of the UV needed to meet disinfection requirements.



Figure 1.5 Proposed UV Disinfection

  - The existing use of chlorine provides chemical treatment of biochemical oxygen demand (BOD) and seasonal hydrogen sulfide. Eliminating use of the chlorine will result in a shortfall of BOD removal capacity by approximately 600 to 1000 pounds per day (ppd).

- **Wet Weather Flows.** The permit does not completely define flow reconfiguration for wet weather flows. It prohibits discharge of flows greater than 5.9 million gallons per day (mgd) through Outfall 003. Therefore, by default, the difference will either need to be stored in the oxidation ponds or discharged on an emergency basis through Outfall 001. At a meeting with the RWQCB on June 27, 2016 they indicated that bypasses were an issue. Additional consideration to this issue is required. The use of the oxidation ponds to intermittently store water during high wet weather flows has been incorporated into the plan.
- **Secondary Treatment.** Ongoing permit violations of plant effluent limits for BOD (at least 18 violations for Biochemical Oxygen Demand (BOD) in the last 2 years) and suspended solids (at least 20 violations for Total Suspended Solids (TSS) since 2013) indicate a need for additional secondary treatment capacity. This compliance history paired with the anticipated capacity shortfall after moving away from chlorine further supports the need for treatment beyond the capacity of the existing land-based natural system.
- **Dilution Credits.** The future Outfall 003 is currently being modelled to determine if dilution credits are justifiable for the new discharge point. If credits are allowed, the effluent toxicity testing should produce more favorable results.
- **Nutrients and Emerging Contaminants.** Nutrients such as nitrogen and phosphorus have been identified as potential issues. The North Coast RWQCB is currently reviewing limits for these constituents, and at the June 27, 2016 meeting with the RWQCB, it was made clear that the City would receive ammonia limits in its next NPDES permit in 2017. Other permittees in the North Coast Region (e.g., City of Ferndale and City of Eureka) have also received more restrictive limits for ammonia and nutrients in recent NPDES permit renewals. RWQCB staff indicated that the City of Eureka's June 2016 permit was a good example of likely limits for the AWTF.

  Constituents of Emerging Concern (CECs) include pharmaceuticals and personal care products, industrial chemicals present at low concentrations, and endocrine-disrupting chemicals. In general, these and other low-concentration contaminants have been identified as potential future issues for both effluent discharges and recycled water application. It was determined, however, that permitting around CECs would likely not take affect within the 20-year planning window for this Facility Plan.
- **Bacterial Quality of Humboldt Bay.** The bacterial quality of Humboldt Bay was noted as a particular concern in the RWQCB Water Quality Control Plan for the North Coast Region (Basin Plan) due to the location of several of California's most important commercial oyster farms in the northern lobe of the estuary known as Arcata Bay. The Basin Plan identifies stormwater runoff and point source discharges as having the greatest impact on water quality in Arcata Bay. The effluent limitations for fecal coliform bacteria for the new Outfall 003 were retained from the previous permit and reflect water quality objectives for protection of shellfish harvesting areas.

## 1.4 EXISTING FACILITIES OVERVIEW

The existing AWTF facilities include headworks, primary clarifiers, oxidation ponds, treatment wetlands, enhancement wetlands, and chlorine disinfection. Solids removed in the primary clarifiers are treated in anaerobic digesters and solids drying beds.

Evaluation of hydraulic and process capacity requires establishing design flow and loads. The design flows were based on the design flow. The loads were determined by using historical data sets and adding a 20 percent growth factor to the 90 percent percentile load to account for planned development under the General Plan. The City originally anticipated a 10 percent community growth which was incorporated into the Draft Facility Plan. After further discussion with the City at the Council meeting on June 13, 2016, community growth estimates have been revised to be 20 percent. Updates to incorporate this additional growth factor have been included in this Facility Plan to some extent, however, updates to sizing of the capacity projects and their cost estimates will be fully incorporated during preliminary design.

The design flows and loads are shown in Table 1.1.

**Table 1.1 AWTF Design Flow and Loads**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| | **Flow (mgd)** |
|---|---|
| Average Dry Weather Design Flow, mgd | 2.3 |
| Average Wet Weather Design Flow, mgd | 5.0 |
| Peak Wet Weather Design Flow, mgd | 5.9 |
| Peak Instantaneous Flow, mgd | 16.5 |
| Design Influent $BOD_5$ Load With 20% Growth, ppd | 4,800 |
| Design Influent TSS Load With 20% Growth, ppd | 6,910 |
| Design Influent Ammonia Load With 20% Growth, ppd | 1,060 |

### 1.4.1 Hydraulic Capacity

In general the existing hydraulic capacity of the plant is limited and needs to be modified to meet the permit requirements for the following elements:

- Influent pumps and headworks.
- Primary clarifiers.
- Treatment wetlands and treatment wetlands pumping.
- Enhancement wetlands and enhancement wetlands pumping.

The AWTF hydraulic capacity of unit processes is shown in Figure 1.6. Note that the wetlands capacity is based on pump stations rather than the wetlands, and therefore are

not rated on Figure 1.6. However, it has been noted that the treatment wetlands and enhancement wetlands perform best at steady, lower flows. For this reason, flows through the treatment and enhancement wetlands will be limited to 2.3 mgd. Hydraulic capacity upgrades including pump stations throughout the plant to provide a firm and reliable capacity up to the permitted wet weather flow of 5.9 mgd. During these peak wet flows, pond effluent is blended with wetland effluent prior to disinfection.

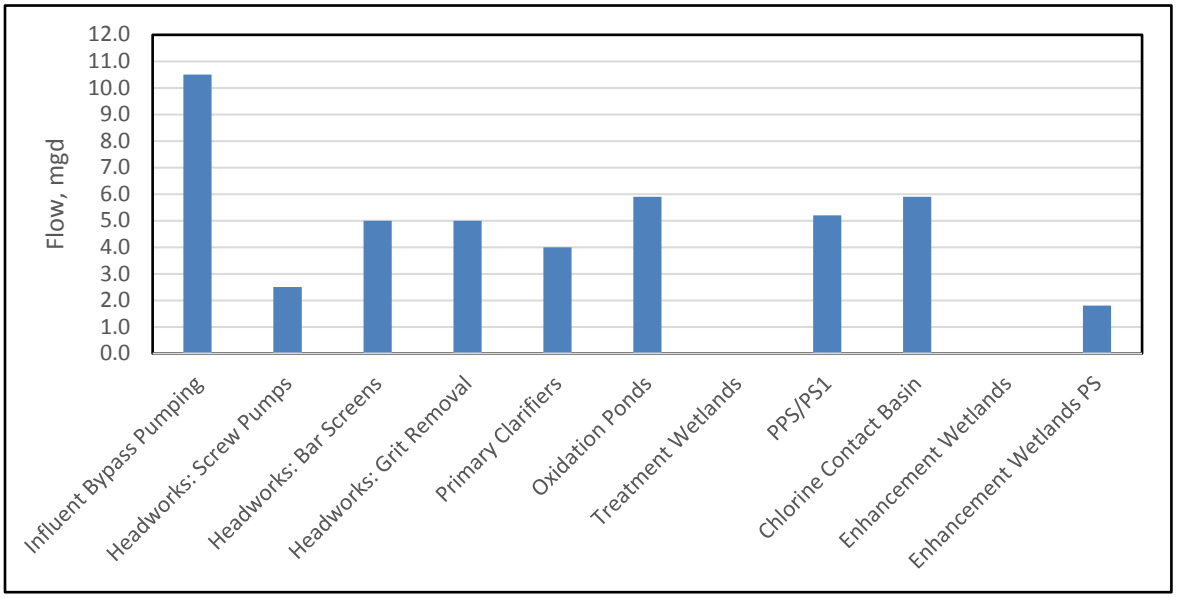



Figure 1.6 AWTF Hydraulic Capacity

### 1.4.2 Process Capacity

Using the design flow and loads presented in Table 1.1, a review of the existing facility process capacity found that secondary treatment capacity is limited for both BOD and ammonia removal. In the existing system, the oxidation ponds convert the organic load to solids and the wetlands remove the solids. These natural systems are impacted by loading, climate (including sunlight and temperature), and pond solids accumulation. Oxidation ponds, which utilize algae to provide oxygen, generally have a lower capacity to remove organics and nitrogen in the colder winter months when the amount of sunlight is limited.

Plant data confirmed that the natural system generally performed well during lower flow and warmer conditions. However, the treatment wetlands effluent regularly exceeded the permit solids level going into the AMWS enhancement wetlands, and subsequently into the chlorine contact basin prior to discharge. Plant data also showed that in higher flow, wet weather conditions, the system capacity, and permit requirements were exceeded regularly. When excess flow needs to be stored in the oxidation ponds, secondary treatment capacity within the ponds may also be diminished. In order to reduce the loading on the system and reliably meet the current permit requirements now and in the future, additional secondary treatment capacity will be required.

Using industry standards for allowable loading rates and removal rates, the capacity for BOD removal was determined for each process area, as shown in Table 1.2. The removal across each process can be added up for total removal expected. This total can be subtracted from the influent load to determine the capacity shortfall. Once the goal load for discharge is removed, the capacity shortfall is approximately 1,680 ppd of BOD as shown in Table 1.2. The allowable load for discharge is a little higher than the goal established for planning, however, the goal provides a factor of safety for reliable permit compliance.

**Table 1.2 BOD Capacity in Existing System**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| Process | BOD load removal, (ppd) | BOD load (ppd) remaining |
|---|---|---|
| Influent With 20% Growth | | 4,800 |
| Primary Clarifiers | 1,320 | 3,480 |
| Oxidation Ponds | 1,150 | 2,330 |
| Treatment Wetlands | 340 | 1,990 |
| Enhancement Wetlands | 120 | 1,870 |
| Disinfection | | none if UV |
| Discharge Goal at 10 mg/L | 190 | 1,680 |
| **BOD Capacity Shortfall** | | **1,680** |

This capacity shortfall sets the requirements for evaluating alternatives that could be used to improve or supplement treatment capacity.

## 1.5 CONDITION ASSESSMENT

As part of this Facility Plan, the AWTF facilities were evaluated for their overall condition. The purpose of the condition assessment is to document the existing facility conditions and help establish priorities for the City's wastewater treatment plant repair and rehabilitation (R&R) CIP. The findings from the condition assessment were incorporated into the CIP.

In May 2015 a condition assessment was performed to assess the current condition of existing structures and equipment and document observations made by plant staff. In general, the plant appears to have been maintained as much as the maintenance budget has allowed. However, findings from the assessment indicate that a majority of the mechanical equipment has exceeded its expected life, and that major structures are also starting to approach the end of their useful life. Finally, plant staff indicated that some capital and maintenance projects had been deferred, pending the outcome of this project.

That has meant that staff has struggled to meet permit limits and keep existing equipment operational, while normally it may have been replaced.

Figure 1.7 provides a summary of the overall condition assessment rankings by unit process. Any process with a ranking greater than 3 (fair) requires some attention and rehabilitation or replacement in the near future.

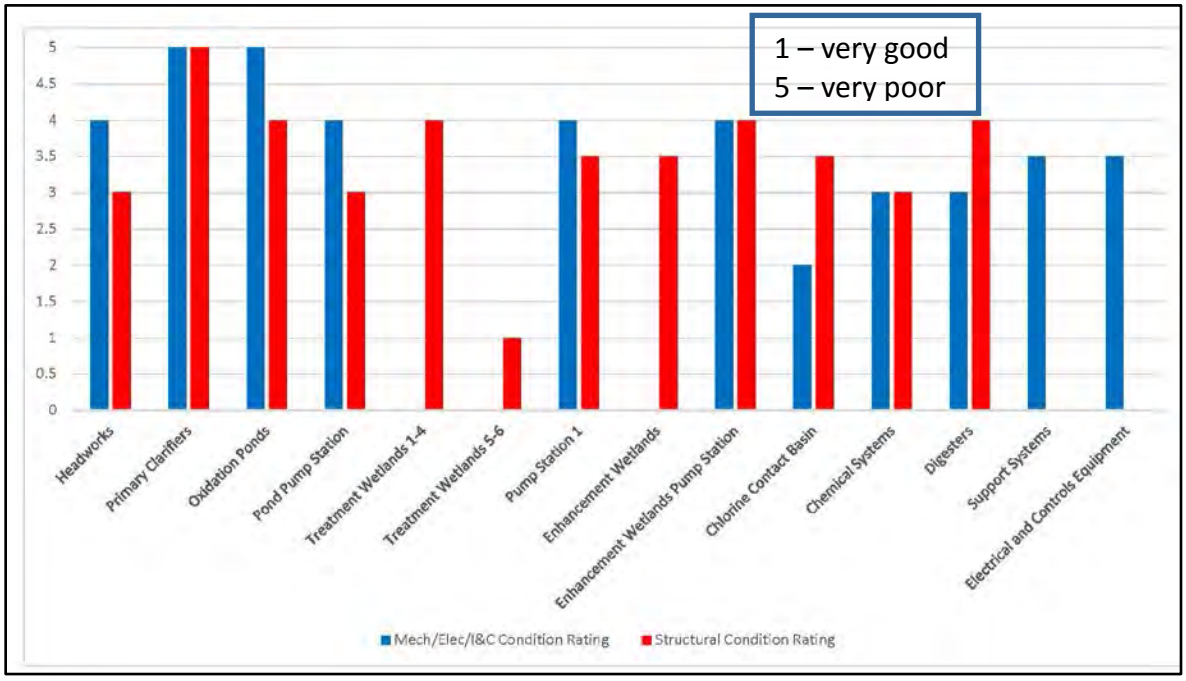



Figure 1.7 AWTF Facility Condition Rating

## 1.6 PHILOSOPHY IN DEVELOPING ALTERNATIVES AND CIP

Based on the findings of the existing facilities review of capacity and condition, paired with the need for permit compliance requires that the City develop a Capital Improvement Plan (CIP) to improve the system. This CIP must include a method to address the secondary capacity shortfall, which can be accomplished in a number of ways. The overall philosophy of the alternatives evaluation and CIP development can be summarized as follows:

- Achieve 100% Permit Compliance.
- Provide reliable capacity to meet current and General Plan future flow and loads.
- Maximize use of existing natural system.
- Address deferred maintenance.
- Address aging infrastructure.
- Provide optimal use of natural treatment system.

### 1.6.1 Summary of Common Improvements Needed

Based on the condition assessment and capacity evaluations, numerous facilities will need to be improved in the next ten years based on their expected useful life and current condition. In addition, there are many common elements needed for the new flow configuration.

#### 1.6.1.1 Permit Required Projects

The following common projects are required by the 2012 NPDES permit.

- **Outfall 003 and Flow Configuration**: The NPDES permit establishes a flow configuration to convert to a single pass disinfection system and discharge through a new outfall (Outfall 003) of 5.9 mgd. Piping, screening, pumps, and pump station modifications are required to switch to single pass flow through the system. The location of Outfall 003 is shown in Figure 1.8.




Figure 1.8 New and Existing Outfall Locations

- **UV Disinfection:** A new UV disinfection system will be constructed for disinfection of secondary effluent up to 5.9 mgd. The UV process will eliminate the disinfection by-product formation and permit violations that are occurring with the use of chlorine.

#### 1.6.1.2 Replace/Repair Aging Infrastructure

The following projects are needed to address aging infrastructure:

- **Headworks Improvements**: The recommended headworks improvement is to replace structural and mechanical assets due to age and condition, and to upsize the

capacity to handle design peak wet weather flow (PWWF) of 5.9 mgd. Replacing the headworks structure will also raise the hydraulic grade line at the start of the plant, allowing downstream facilities to flow by gravity and minimizing the need for additional pumping.

- **Primary Clarifiers**: The two primary clarifiers are currently rated at 4.0 mgd and 1.0 mgd each, and the visual condition assessment rated the average mechanical, electrical and I&C condition as very poor. The recommended improvement is to replace structural and mechanical assets due to age and condition. As part of this improvement the primary sludge and scum pumps would also be replaced.
- **Anaerobic Digesters and Sludge Heating/Mixing System**: The two anaerobic digesters are almost 60 years old. The external visual condition assessment rated the average structural condition as fair but the internal structural condition is unknown. The sludge heating and mixing system appears to be in good to fair condition. The recommended improvement is to improve structural and mechanical assets in phases.

#### 1.6.1.3 Address Deferred Maintenance and Maximize Existing Natural System

The following projects will restore the natural treatment processes:

- **Oxidation Pond Improvements**: Solids accumulation in the oxidation ponds is affecting treatment and hydraulic capacity. Between one to two feet of solids in each pond is anticipated needing dredging, dewatering, and disposal in order to return the ponds to original design intent. Reconfiguration of the pond transfer structures is recommended for better flow distribution and improvement of storage capacity.
- **Treatment Wetland Nos. 1 through 4 Solids and Vegetation Maintenance**: Solids accumulation and heavy vegetation growth in Treatment Wetland Nos. 1 through 4 is affecting treatment and hydraulic capacity. Some solids removal, regrading of the deep and shallow water zones, and vegetation replanting is anticipated in the four older treatment wetlands in order to return them to original design intent (Figure 1.9). No maintenance project is currently planned in Treatment Wetland Nos. 5 and 6 due to their recent construction.
- **Treatment Wetland 7**: Construction of new Treatment Wetland No. 7 is recommended. This project would convert an existing aquaculture pond into a new 2.3 acre treatment wetland, increasing the hydraulic capacity of the treatment wetlands from 1.8 mgd to 2.3 mgd. This project may require additional permitting requirements.



Figure 1.9 Treatment Wetlands will be improved

- **Enhancement Wetlands Improvements:** Solids accumulation and heavy vegetation growth in the enhancement wetlands is affecting treatment and hydraulic capacity. As Waters of the State, major regrading or any activities that significantly reduce water quality or habitat will not be allowed in the enhancement wetlands. Vegetation maintenance, new baffles, and new inlet/outlet structures will be completed in all three enhancement wetlands in order to improve treatment and hydraulic efficiency and capacity.

#### 1.6.1.4 Provide Reliable Capacity

The following projects address capacity limitations:

- **Pump Stations Improvements**: There are numerous pump stations that need replacement due to age and insufficient capacity. These include the emergency pond pump station, which should be modified for adding suction and discharge piping to allow the pump station to pump out of Pond 1 and into Pond 2 for Pond 1 storage control. Other pump station improvements included pond pump station and pump station 1, treatment wetlands No 4 pump station, treatment wetlands pump station 2 and the enhancement wetlands pump station.

- **Secondary Capacity Augmentation:** A secondary process capacity augmentation project is required to address the capacity shortfall of the existing processes, especially without the chemical treatment removal that occurs with the chlorination process that is being retired. The alternatives for this project are discussed in the next section.

## 1.7 SECONDARY TREATMENT ALTERNATIVES

Identification of secondary treatment options is needed to address the BOD capacity shortfall. This task was completed in phases. The first phase consists of a preliminary screening of new secondary treatment options to be used in conjunction with the existing natural system for pretreatment, parallel treatment, or post treatment. Any of these treatment options deemed feasible were further discussed and evaluated with the City.

### 1.7.1 Preliminary Screening of Secondary Treatment Options

There are several treatment processes that can be used to provide additional secondary treatment capacity, either alone or in combination with other processes, in order to achieve desired effluent water quality. Table 1.3 provides a list of secondary treatment processes that are commonly considered, along with the constituents they most commonly remove. Removal of ammonia and total nitrogen was considered for future flexibility in meeting ever increasingly stringent permit requirements. Based on the June 27, 2016 meeting with the RWQCB, it is expected that ammonia removal will be required in the 2017 NPDES permit.

**Table 1.3 Secondary Processes Meeting Permit Discharge Requirements Wastewater Treatment Facility Improvements Project City of Arcata**

| Process | Ability To Remove | | |
|---|---|---|---|
| | Organics (BOD)[1] | Ammonia[2] | Total Nitrogen[2] |
| **Suspended Growth** | | | |
| Activated Sludge (oxidation ditch) | √ | √ | √ |
| **Attached Growth** | | | |
| Trickling Filters | √ | | |
| Nitrifying Trickling Filters | | √ | |
| Denitrification Filters | | | √ |
| **Land Based Systems** | | | |
| Ponds (Aerated or Not) | √ | Summer only | |
| Vegetated Wetlands | √ | Limited | If nitrified before |
| Open water wetlands | √ | Some | If nitrified before |

Notes:
(1) Current permit discharge requirement.
(2) Anticipated future permit discharge requirement.

While there are variations of activated sludge processed such as Oxidation Ditch, Conventional Activated Sludge, Sequencing Batch Reactors, or a Membrane Bioreactor that adds a membrane filter, the biological treatment process is the same. Similarly, there are various attached growth processes that incorporate different types of media that the biological growth attaches to, but the treatment process is essentially the same.

In addition to the secondary processes presented above, there are some physical and chemical processes that could be considered. There are several approaches that could be taken with any additional treatment process: 1) pre-secondary treatment (pretreatment) by adding processes before the existing pond/wetlands system, 2) parallel secondary treatment, and 3) post-secondary treatment (post treatment, after the pond/wetlands). Each alternative considered needs to fit with a final UV disinfection step, as the City Council has affirmed several times the decision to move away from chlorine and instead use UV. Initial options that fall into each of these categories are shown in Table 1.4.

**Table 1.4 Initial Screening of Pre, Parallel and Post Treatment Options**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| | Treatment Option | Adds BOD capacity | Removes ammonia | Improves final UVT | Reliable | Move forward |
|---|---|---|---|---|---|---|
| **Pretreatment** | Chemically Enhanced Primary | < 400 ppd | No | No | Yes | No - high O&M cost |
| | Aeration | yes | limited | No | Yes | Yes |
| | Trickling Filter | yes | only if 2-stage | No | Yes | No |
| | Activated Sludge | Yes | Yes | No - TM degrades | Yes | No |
| **Parallel** | Additional Ponds/Wetlands | Yes | Summer only | No | Maybe | No - no room |
| | Rehabilitate Ponds/Wetlands | Yes - not enough | Summer only | No | Maybe | Yes |
| | Trickling Filter | Yes | only if 2-stage | No | Yes | Yes |
| | Activated Sludge | Yes | Yes | Yes | Yes | Yes |
| **Post Treatment** | Trickling Filter/Nitrifying Trickling filter | Yes | only if 2-stage | No | No - cold affects performance | No - not as flexible |
| | Submerged Biofilter | Not proven | Need to pilot | No | Unknown | No |
| | Ozone/Biological active Filtration | Yes | Maybe - must pilot | Not needed | Maybe - must pilot | No -Need to pilot |
| | Filtration | < 400 ppd | No | Maybe | Yes | No -Need to pilot |

Of the options considered, there are only a few that Carollo recommends carrying forward for a variety of reasons. Any process that requires piloting at the AWTF was eliminated to meet the accelerated schedule for permit compliance. Any process that is not yet a proven technology with full-scale installation experience was also eliminated early in the alternatives analysis. Several processes would not provide enough capacity (such as chemically enhanced primary treatment and filtration. Attached growth processes were considered less reliable and less flexible for meeting future ammonia and nutrient removal requirements. In addition, attached growth processes do not improve UV transmittance

(UVT), which makes UV disinfection more expensive. Additional pond and wetland processes require additional land and no land is available.

The options carried forward are:

- The viable pretreatment alternative to be further considered is aeration in Pond 2.
- The viable parallel treatment alternatives to be further considered are rehabilitation of the ponds/wetlands, trickling filters, and activated sludge.
- None of the post treatment alternatives will be further considered.

At the November 5 and 6, 2015 facility plan capacity workshop with the City staff and City consultant Bob Gearheart (with AMRI), a more detailed analysis of parallel secondary treatment options was discussed, including:

- Conventional activated sludge (CAS) aeration basins.
- Extended aeration activated sludge (oxidation ditch).
- Trickling filters.
- Modifying existing oxidation ponds to a Biolac system or aerated lagoons.

As discussed at the workshop, modifying the existing oxidation ponds to a Biolac system or aerated lagoons was deemed not feasible due to constructability issues with the berms and pond depths. During the November 2015 workshop, discussion of the treatment options included a number of considerations including performance, footprint, constructability, operation and maintenance requirements, and economic factors. A summary of the non-economic evaluation is outlined in Table 1.5. A summary of the economic evaluation is outlined in Table 1.6.

**Table 1.5 Secondary Treatment Options Evaluation of Non-Economic Factors**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| Option | Criteria Scale: 1 (least favorable) to 3 (most favorable) | | | | | |
|---|---|---|---|---|---|---|
| | **Safety** | **Meets Permit** | **Ease of O&M** | **Construct -ability** | **Reliability** | **Ammonia Removal** |
| Conventional Activated Sludge | 2 | 3 | 1 | 3 | 3 | 2 |
| Extended Aeration – Oxidation Ditch | 2 | 3 | 3 | 2 | 3 | 3 |
| Trickling Filters | 3 | 1 | 3 | 2 | 1 | 1 |

| Table 1.6 Secondary Treatment Options Evaluation of Economic Factors<br>Wastewater Treatment Facility Improvements Project<br>City of Arcata | | | | | | |
|---|---|---|---|---|---|---|
| | Criteria Scale: 1 (least favorable) to 3 (most favorable) | | | | | |
| Option | Construction Cost | Footprint | Operator Attention | Power Cost | Sludge Production | Maintenance Requirement |
| Conventional Activated Sludge | 3 | 3 | 1 | 1 | 1 | 1 |
| Extended Aeration – Oxidation Ditch | 2 | 1 | 2 | 2 | 2 | 3 |
| Trickling Filters | 1 | 2 | 3 | 3 | 3 | 2 |

Given the need to identify a system that is simple to operate, low maintenance and yet provides high reliability in meeting a high quality effluent, the preferred alternative was an extended aeration oxidation ditch process, shown in Figure 1.10. Compared to the oxidation ditch, conventional activated sludge requires greater operator attention and complexity; trickling filters do not provide as much reliability for treatment nor flexibility for future regulations; oxidation pond modifications have a greater risk of permit violations during long-term operation and do not allow for storage of peak wet weather flows in Pond 1.



Figure 1.10 Example of Proposed Oxidation Ditch Secondary Treatment

## 1.7.2 Project Alternative Development

The viable options identified in the screening process were further refined as project alternatives that address how the facility would perform as a system. Project alternatives consider facility-specific issues such as flow routing, hydraulic and treatment capacity of individual processes, and process improvement or replacement needs based on condition assessment. The goal of each project alternative is to provide a facility that maximizes use of the existing natural system while meeting treatment and permit compliance objectives.

Based on the findings of the preliminary and secondary screening as well as feedback received at presentations made to City Staff, the public and City Council in April 2016, three project alternatives were developed.

### 1.7.2.1 Alternative 1 - Existing System Rehabilitation

This alternative improves the existing natural treatment system with no supplemental secondary treatment process. This alternative does not provide the required capacity to meet the BOD capacity shortfall. In the past the shortfall was made up by use of chlorine for supplemental BOD removal. This alternative will not provide year-round nitrification removal, and therefore will not be able to meet the anticipated monthly average ammonia requirements. This alternative was conceptualized by AMRI and further evaluated by Carollo to meet treatment and permit compliance objectives. Pond solids would be removed, the treatment wetlands would be improved, and Treatment Wetlands No. 7 would be constructed. Aeration would be added to the ponds to provide some supplemental capacity, but a 1000 ppd BOD removal deficiency at 20 percent growth projection is still anticipated. Based on the feedback from the June 2016 meeting with the RWQCB, this alternative is no longer considered viable. The Alternative 1 flow schematic is shown in Figure 1.11.

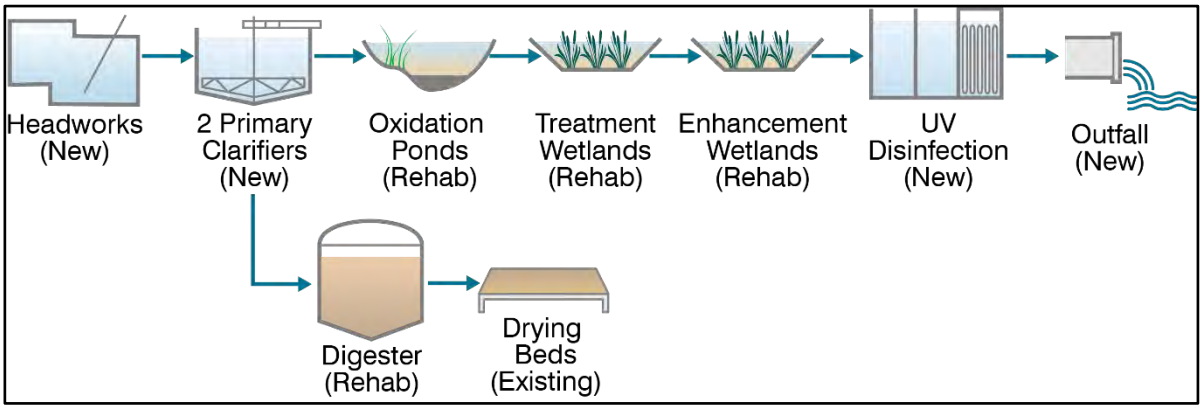



Figure 1.11 Alternative 1 - Existing System Rehabilitation

### 1.7.2.2 Alternative 2 - Existing System with Side-Stream Treatment

This alternative provides a side-stream secondary treatment process parallel to the ponds and treatment wetlands that returns flow upstream of the enhancement wetlands. The ponds and treatment wetlands would continue treating the majority of the plant influent flow and would be improved, just as in Alternative 1. The side-stream treatment process would treat a portion of the plant influent flow as needed for supplemental BOD and year-round partial nitrification treatment capacity. An oxidation ditch is the planned side-stream treatment technology and would be operated at approximately 0.5 mgd during dry weather and able to handle additional flows during wet weather or during periods of pond turnover. Both effluents would normally blend before passing through the enhancement wetlands and UV disinfection. Based on the feedback from the June 2016 meeting with the RWQCB, this

alternative is no longer considered viable. The Alternative 2 flow schematic is shown in Figure 1.12.

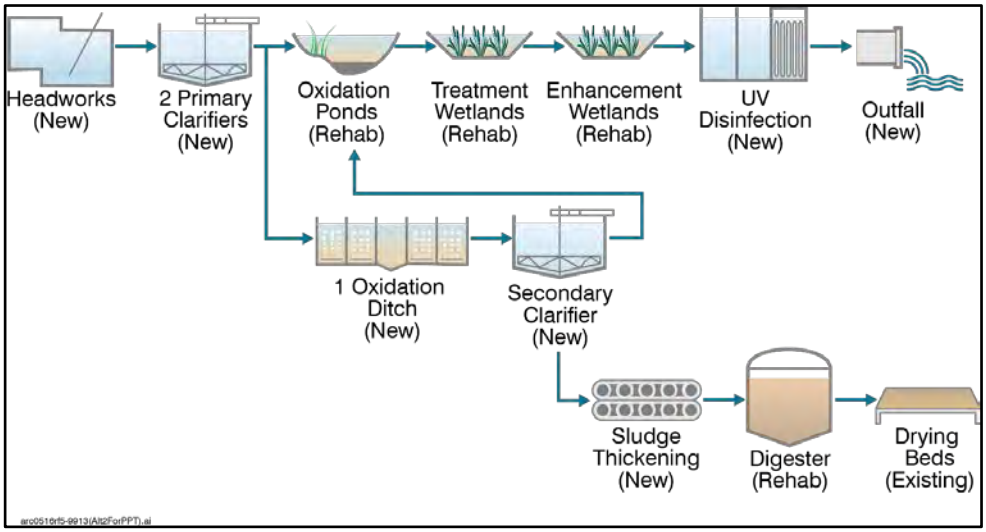



Figure 1.12 Alternative 2 - Existing System with Side Stream Treatment

### 1.7.2.3 Alternative 3 - Existing System with Parallel Treatment

This alternative provides a parallel secondary treatment process to the ponds, treatment wetlands, and enhancement wetlands. The natural system train and parallel process train would each treat a portion of the plant influent flow at variable percentages to provide a blended effluent meeting treatment objectives. The natural system would continue treating the majority of the plant influent flow up to available hydraulic and treatment capacity and would be improved, just as in Alternative 1 with the exception of the pond aerators, which are not necessary. The parallel process train, currently planned as oxidation ditches followed by secondary clarifiers, would provide BOD and year-round full nitrification treatment capacity to handle the remainder of the hydraulic capacity needs and to meet specific blended water quality requirements. The parallel process would be sized to turn down to 0.5 mgd in dry weather and be able to handle up to 4.1 mgd of wet weather flow. Natural system effluent and parallel process effluent would combine prior to UV disinfection. The higher quality water (higher UVT) produced by the oxidation ditch system and blended with the natural treatment system allows the UV disinfection system to be downsized. Based on the feedback from the June 2016 meeting with the RWQCB, this alternative is no longer considered viable. The Alternative 3 flow schematic is shown in Figure 1.13.

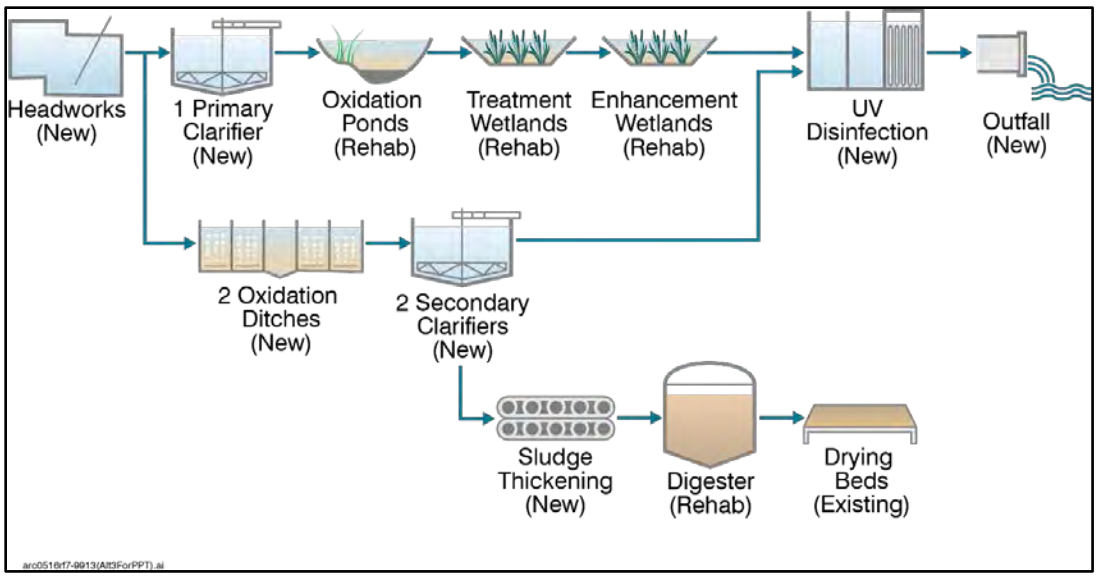



Figure 1.13 Alternative 3 - Existing System with Parallel Treatment

### 1.7.2.4 Alternative 4 – Enhanced Natural System with Parallel Treatment

As noted above, a new alternative 4 was developed to address the upcoming nutrient removal requirements, and the need for plant effluent flows to be routed through the enhancement wetlands. This alternative provides both an upgrade to the existing pond / wetland treatment system and a parallel secondary treatment process. The natural system train and parallel process train would each treat a portion of the plant influent flow at variable percentages to provide a blended effluent meeting treatment objectives. The natural system would continue treating the majority of the plant influent flow up to available hydraulic and treatment capacity. The parallel process train, currently planned as oxidation ditches followed by secondary clarifiers, would provide BOD and year-round full nitrification treatment capacity to handle the remainder of the hydraulic capacity needs and to meet specific blended water quality requirements. Natural system effluent and parallel process effluent would be combined prior to UV disinfection and discharge through the enhancement wetlands to the new brackish marsh outfall. The Alternative 4 flow schematic is shown in Figure 1.14.

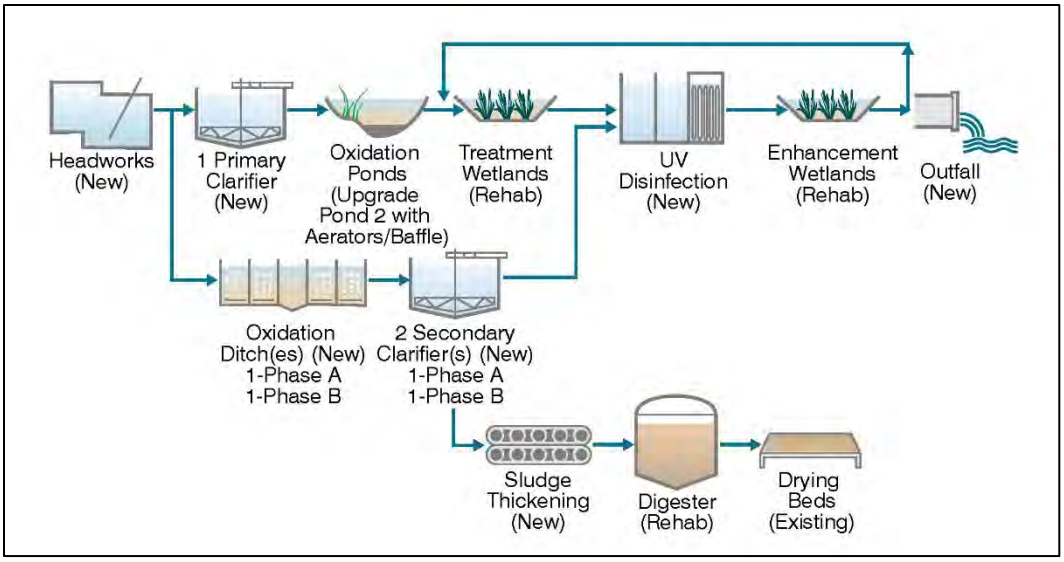



Figure 1.14 Alternative 4 - Enhanced Natural System with Parallel Treatment

### 1.7.3 Alternative Comparison and Recommendation

A comparison of the alternatives using non-economic factors is summarized in Table 1.7.

**Table 1.7 Summary of Alternative Comparison for Non-Economic Factors**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| Alternative | Criteria Scale: 1 (least favorable) to 4 (most favorable) | | | | |
|---|---|---|---|---|---|
| | Meets Permit | Ease of O&M | Construct-ability | Reliability | Ammonia Removal |
| 1. Existing System Rehabilitation | 1 | 4 | 1 | 1 | 1 |
| 2. Existing System with Side-stream Treatment | 2 | 1 | 2 | 2 | 2 |
| 3. Existing System with Parallel Treatment | 3 | 3 | 3 | 4 | 4 |
| 4 Enhanced natural system with parallel treatment | 4 | 2 | 4 | 3 | 3 |

The alternatives are also compared based on economic criteria (project cost, operation and maintenance cost, and overall lifecycle cost) as shown in Table 1.8. Costs presented in this Facility Plan are project costs and include construction, engineering, legal, administrative, and permitting costs, as well as estimating contingencies. The costs are presented in 2016 dollars and are based on a San Francisco Engineering News Record Construction Cost Index. Costs are not escalated to future years. Cost estimates presented in the Draft Facility Plan were developed based on 10 percent community growth that was originally anticipated by the City. Cost estimate updates to reflect the 20 percent growth projection are shown with an additional 10 percent of the original secondary and solids costs.

Alternative 4, Enhanced natural system with a parallel secondary treatment process, provides the highest rankings for permit compliance, and constructability. It is ranked second with respect to reliability and future compliance with ammonia removal (which may also help reduce effluent toxicity), only due to the reliance on the existing oxidation pond upgrades. Alternative 4 is anticipated to meet the requirements of the Enclosed Bays and Estuaries Policy by treating the full flow to 5.9 mgd through the enhancement wetland. This alternative is anticipated to have the highest capital cost and nearly the highest operation costs. This alternative would eventually require the largest footprint in the treatment plant, although the second oxidation ditch might be smaller if the pond improvements are successful.

**Table 1.8 Cost Comparison of Treatment Alternatives**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| Alt. | Description | Total Project Cost With 10% Growth(1) | Total Project Cost With 20% Growth(1,4) | O&M Cost | | Lifecycle Cost(3,4) |
|---|---|---|---|---|---|---|
| | | | | Annual(2) | Present Worth(3) | |
| 1 | Existing System Rehabilitation | $35.1 | $35.2 | $0.67 | $5.7 | $40.9 |
| 2 | Existing System Rehabilitation with Side-stream Treatment | $44.7 | $45.7 | $0.75 | $6.4 | $52.1 |
| 3 | Existing System Rehabilitation with Parallel Treatment | $43.8 | $45.5 | $0.43 | $3.7 | $49.2 |
| 4 | Enhanced natural system with parallel treatment | -- | $52.4 | $0.78 | $13.6 | $66.1 |

Notes:
(1) Costs are based on 2016 dollars, in millions, using SFENR construction cost index.
(2) Annual O&M costs include only differential O&M costs, and do not include O&M costs which are common to all alternatives (such as influent pumping).
(3) Lifecycle cost is total project cost plus present worth value of annual O&M costs. Annual O&M costs were converted to present worth value based on 3 percent inflation rate, 6 percent discount rate, and 10-year analysis period.
(4) Estimated total project cost and lifecycle cost is updated with additional anticipated growth subsequent to the June 13, 2016 Council meeting. Additional cost for 20% growth projection based on adding 10% to secondary and solids costs.

Alternative 3, rehabilitation of the existing natural system with a parallel secondary treatment process, provides highest ranking with respect to ammonia removal (which may also help reduce effluent toxicity), and the second highest rankings for permit compliance, operations and maintenance, constructability, and reliability. Alternative 3 is anticipated to meet current permit requirements for enhancement through advanced secondary treatment with nitrification, providing full BOD treatment capacity without disinfection byproduct violations, as well as meeting future ammonia permit limits year-round. It appears it will not meet all permit requirements, because it does not meet the requirements of the Enclosed Bays and Estuaries Policy. This alternative is anticipated to be lower in capital cost than

Alternative 2 or 4 as some project elements can be eliminated or decreased. This alternative is anticipated to require the largest footprint in the treatment plant.

Alternative 1, rehabilitation of the existing natural system, fairs poorly because the BOD treatment capacity is limited in the existing natural system and therefore creates risk for permit violations. Additionally, during construction of the improvements to Alternative 1, there is a higher risk of violations due to additional stress on an already under-capacity system. Project elements to increase BOD treatment capacity include sludge removal in Ponds 1 and 2, adding aerators to Pond 2, and construction of Treatment Wetland No. 7; however, even with these improvements there will be a BOD treatment capacity shortfall with the elimination of chlorine. This would result in permit violations and mandatory minimum penalties. Increasing the growth projection from 10 to 20 percent increases the BOD treatment capacity shortfall, which will be difficult to address in Alternative 1 without an additional secondary treatment process. Furthermore, future ammonia permit limits may not be met year-round with Alternative 1 without an additional nitrification process. Per discussions with the RWQCB, effluent discharge bypassing enhancement is a violation of permit requirements. Alternative 1 currently requires up to 3.6 mgd to bypass the Enhancement Wetlands due to capacity limitations, which does not meet permit objectives.

In Alternative 2, the BOD treatment capacity shortfall would be supplemented by the side-stream secondary treatment process of one oxidation ditch and one secondary clarifier. Increasing the growth projection from 10 to 20 percent increases the BOD treatment capacity shortfall, which could be addressed in Alternative 2 by increasing capacity in the oxidation ditch, or adding a second unit. Alternative 2 also does not meet current permit requirements for enhancement In addition, this alternative is anticipated to have slightly higher capital cost as it requires the most project elements.

Based on these comparisons, both economic and non-economic, Carollo and LACO recommend proceeding with preliminary design of Alternative 4 with options to phase the implementation.

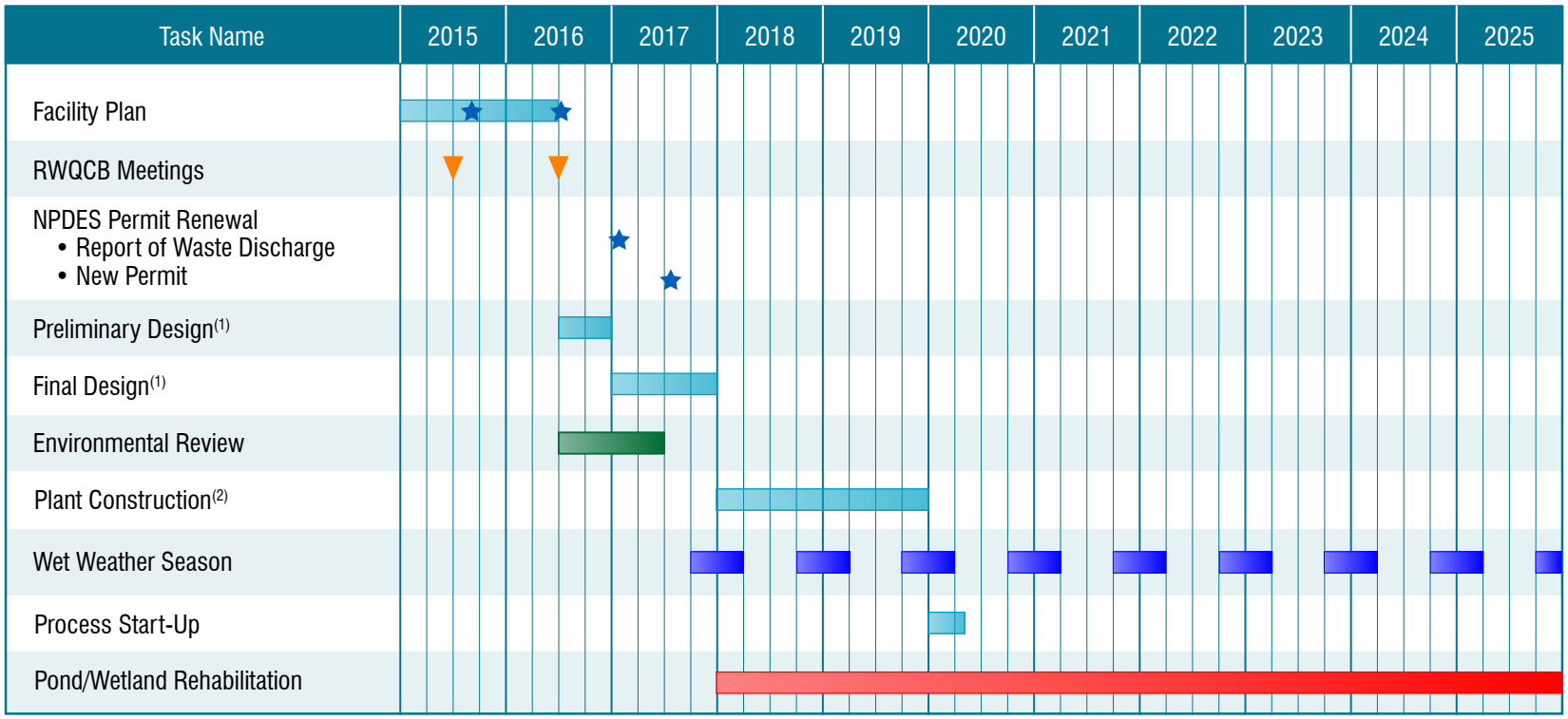
## 1.8 NEXT STEPS AND IMPLEMENTATION SCHEDULE

The AWTF will undergo a number of changes over the next 20 years in order to both meet permit requirements and address the ongoing needs of maintaining this vital City asset. The recommended project as outlined above will meet permit requirements, address R&R needs, and address capacity for the AWTF including the following:

- Preliminary and final design
- A Report of Waste Discharge was submitted to the RWQCB in January 2017 to start permit renewal. A new NPDES permit is expected in 2017.
- Environmental review and permitting.
- Funding Application Process for State Revolving Fund program for loans and grants.

- Bidding and award.
- Construction and start up.

A preliminary implementation schedule is shown in Figure 1.15. The schedule has been extended to account for the need to get the current facility plan approved, and then complete preliminary and final design. Construction (of the majority of the mechanical and structural elements) is shown in 2019 through 2021, with final commissioning and startup in late 2021. The construction will cover the dry weather periods of both 2019/2020 and 2020/2021, and should allow for all the work to be completed while maintaining the existing plant in operation. Wet weather periods are also shown in the schedule as construction during these periods is difficult. The Pond and Wetlands rehabilitation is shown as a separate line item as these projects may be performed by City staff as opposed to a contractor and due to the extended construction time expected. The wetlands in particular will take longer to rehabilitate due to the need to regrade during dry season, plant and let the plants get established (approximately a 2 year cycle before performing as expected).




NOTES:

(1) To be finalized after completion of the Facility Plan.

(2) Construction schedule is preliminary, constraints TBD.

# UPDATED IMPLEMENTATION SCHEDULE

FIGURE 1.15

CITY OF ARCATA

*WASTEWATER TREATMENT PLANT IMPROVEMENTS PROJECT*

carollo

# REGULATORY REQUIREMENTS AND PERMIT COMPLIANCE

## 2.1 INTRODUCTION

The City of Arcata (City) owns the wastewater collection, treatment, and disposal facilities that serve approximately 16,800 residents, including 8,000 students, in the service area (City and the unincorporated community of Glendale). The Arcata Wastewater Treatment Facility (AWTF) is located at 600 South G Street in Arcata, Humboldt County, California. The AWTF in its varying forms has been discharging to Humboldt Bay since about 1949. The AWTF currently discharges treated wastewater to Humboldt Bay in conjunction with enhanced treatment occurring in the Arcata Marsh Wildlife Sanctuary (AMWS), which are constructed freshwater wetlands adjacent to the treatment facility.

The AWTF is recognized around the world for providing sustainable treatment with community and environmental benefits. Within the City's sustainability goals and initiatives that impact environmental, economic, and social realms ("triple bottom line"), National Pollutant Discharge Elimination System (NPDES) permit compliance is at the core of each category. Permit compliance protects the environment, reduces economic risk from violation penalties, and promotes a safe community.

The AWTF provides primary and secondary treatment followed by disinfection. Primary treatment facilities include influent pumping, mechanical bar screens, grit removal, and primary clarifiers. Primary solids are sent to anaerobic digesters, sludge drying beds, and sludge composting. Secondary treatment is accomplished through two oxidation ponds in series, followed by six treatment marshes operating in parallel. Currently, secondary effluent is disinfected with chlorine gas and dechlorinated with sulfur dioxide prior to discharge. Under the existing flow configuration, for about 9 months every year, a portion of the treated effluent is sent to the AMWS for enhanced treatment while the remainder is discharged to Humboldt Bay via Outfall 001. Effluent out of the AMWS is returned to the chlorine contact basin for a second step of disinfection and dechlorination. The result is disinfected secondary effluent that does not receive all the enhancement benefits of the AMWS and is chlorinated multiple times, increasing the opportunity for formation of disinfection byproducts above water quality objectives.

## 2.2 PURPOSE

The purpose of this chapter is to:

- Discuss compliance history of the AWTF leading up to the current NPDES permit, including review of available compliance data in the last three years to identify current permit issues.
- Review the current NPDES permit compliance requirements.

- Discuss potential future permit requirements in the State and for Humboldt Bay dischargers.

## 2.3 BACKGROUND

Adopted on May 16, 1974, Resolution No. 74-43, known as the Enclosed Bays and Estuaries Policy, prohibits the discharge of municipal wastewater and industrial process water to enclosed bays and estuaries “unless the discharge enhances the quality of the receiving water above that which would occur in the absence of the discharge.” The Enclosed Bays and Estuaries Policy enhancement criteria is defined as, "…(1) Full uninterrupted protection of all beneficial uses which could be made of the receiving water body in the absence of all point source discharge(s) along with (2) a demonstration by the applicant that the discharge, through the creation of new beneficial uses or fuller realization, enhances water quality for those beneficial uses which could be made of the receiving water in the absence of all point source discharges..."

In 1983, the Regional Water Board adopted Resolution No. 83-9, granting the City of Arcata a waiver, as defined in Chapter I, Paragraph A of the Bays and Estuaries Policy, permitting continued [Humboldt] Bay discharge. Resolution No. 83-9 found that the marsh disposal alternative meets the definition of enhancement set forth in State Board Order No. 79-20 because the waste would achieve secondary treatment standards, create no adverse impacts to present beneficial uses and the discharge would create new beneficial uses and wildlife habitat. As a result, the AMWS is an integral part of the AWTF and a valued part of the Arcata community providing numerous non-contact recreation and educational opportunities.

In 2012, the AWTF began operating under a new National Pollutant Discharge Elimination System (NPDES) permit that specifically addressed several long-term issues regarding disinfection, treatment units, and outfalls. The new permit enabled changes to be made to improve wastewater treatment, protect beneficial uses, increase energy efficiency, reduce chemical usage, and reduce the potential for permit violations. The NPDES Permit (No. CA0022713) and Waste Discharge Requirements Order (No. R1-2012-0031) were issued by the North Coast Regional Water Quality Control Board (RWQCB), and became effective on August 1, 2012. The permit was subsequently modified in 2015. The permit will be up for renewal on August 1, 2017.

The permit approves a new flow configuration and discharge point. Effluent flows will no longer discharge directly to Humboldt Bay (Outfall 001), but will be discharged after enhanced treatment in the AMWS. The new point of compliance and outfall (Outfall 003) will be to the brackish marsh adjacent to the AMWS, which discharges into a slough at the

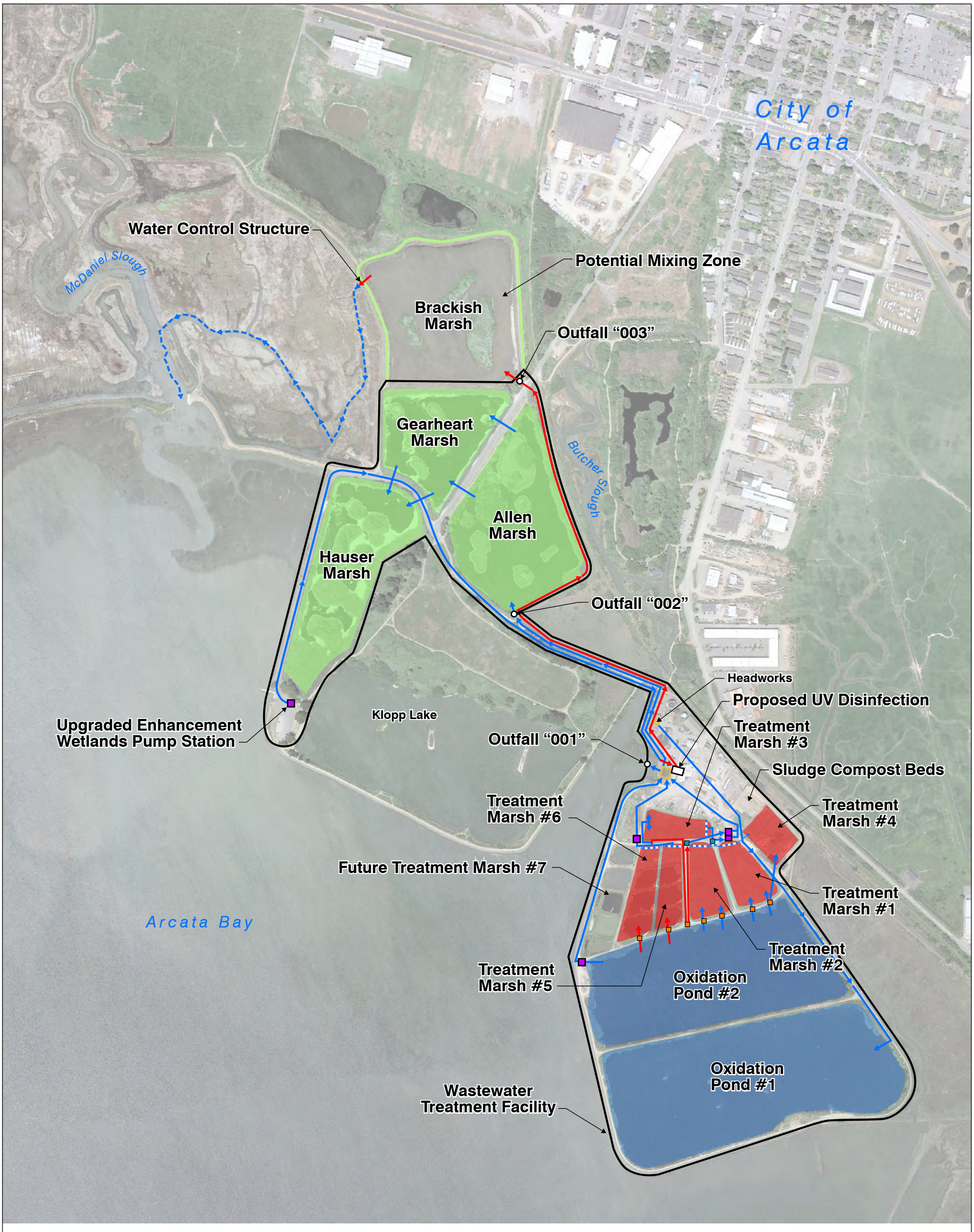
north end of the Arcata Bay portion of Humboldt Bay. The permit also includes approval of a new disinfection process using ultraviolet light (UV) disinfection facilities prior to Outfall 003. Until the improvements are complete, the AWTF is operating under interim effluent limits for discharge to Outfall 001, which are essentially the same as the final compliance requirements for Outfall 003. Discharge requirements for the intermediate discharge point to the AMWS (Outfall 002) are also noted in the permit. The location of the facilities and outfalls are shown in Figure 2.1. The major water quality standards established in the NPDES permit are shown in Table 2.1. The NPDES/WDR permit is included in Appendix A for a complete list of required standards.

**Table 2.1 Summary of 2012 NPDES Requirements**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| Constituent | Average Monthly | Average Weekly | Max Daily |
|---|---|---|---|
| Flow, mgd | 2.3 average dry weather<br>5.0 average wet weather<br>5.9 peak wet weather | | |
| **Outfall 001 - Humboldt Bay (Final/Interim limits)** | | | |
| $BOD_5$, mg/L | 45/30 | 65/45 | |
| TSS, mg/L | 66/30 | 95/45 | |
| Fecal Coliform MPN/100 ml | 14 | | 43 |
| Dichlorobromomethane, ug/l | 0.56 | | 1.12 |
| **Outfall 003 - Brackish Marsh** | | | |
| $BOD_5$, mg/L | 30 | 45 | |
| TSS, mg/L | 30 | 45 | |
| Fecal Coliform MPN/100 ml | 14 | | 43 |
| **Outfall 002 - AMWS** | | | |
| $BOD_5$, mg/L | 45 | 65 | |
| TSS, mg/L | 66 | 95 | |

## 2.4 PERMIT COMPLIANCE HISTORY

Since the original plant design, the regulatory climate and enforcement world has significantly changed. Mandatory minimum penalties were implemented by the State Water Resources Control Board (SWRCB) in 1999, and began to be enforced in 2006. Today, the




**LEGEND**

- Pump Station
- Existing Flow Schematic
- Proposed Flow Schematic

EXISTING PONDS

- AMWS Enhancement Marshes
- Oxidation Ponds
- Treatment Marsh
- Brackish Marsh
- Wastewater Treatment Facility

N

0 300 600 Feet

# AWTF RECONFIGURATION AND OUTFALL LOCATIONS

FIGURE 2.1

CITY OF ARCATA
*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

carollo

arc0516rf12-9913.ai

regulatory climate is increasingly stringent. Occasional permit non-compliance is no longer acceptable to the SWRCB, environmental conservation groups, or the general public.

The mission of the SWRCB is:

> ***To preserve, enhance, and restore the quality of California's water resources and drinking water for the protection of the environment, public health, and all beneficial uses, and to ensure proper water resource allocation and efficient use, for the benefit of present and future generations.***

The SWRCB and the nine RWQCBs are charged with protecting water quality. Doing so requires regular updates to regulatory requirements based on the latest research and data. As a result, NPDES permits are consistently getting more stringent over time.

### 2.4.1 2004-2015 Compliance Review and Permit Violations

A review of available information from 2004 to 2015 was conducted to understand the history of permit compliance and permit violations at the AWTF.

Based on review of the 2012 permit and input from the City, a history of permit violations from 2004 to 2011 are summarized:

- On June 12, 2008, the North Coast RWQCB issued Administrative Civil Liability (ACL) Order No. R1-2008-0048 to the Permittee assessing a civil liability of $104,000 for violations of Order No. R1-2004-0036 for the period from June 22, 2004, to March 31, 2007. Most violations of waste discharge requirements in this time period were related to discharges of biochemical oxygen demand (BOD), total suspended solids (TSS), percent removal, coliform bacteria, copper, and cyanide, and for sewer system overflows. A portion of the liability is being held in abeyance pending resolution of legal matters, a portion has been paid to the State Water Pollution Cleanup and Abatement Account, and a portion was suspended pending satisfactory completion of a Supplemental Environmental Project and two collection system projects proposed by the Permittee.
- On May 19, 2010, an ACL Compliant was issued to the Permittee for five sanitary sewer overflows and copper effluent violations. ACL sought for the alleged violations totaled $83,300.
- In 2011, Mandatory Minimum Penalties (MMPs) of $9,000 were assessed for percent removal, coliform bacteria, and copper violations.

The 2013 and 2014 Annual Wastewater Treatment Reports for the AWTF were briefly reviewed to identify any potential compliance issues for Outfall 001. The 2014 report noted 27 incidences of non-compliance issues for the Outfall 001 requirements including:

- Effluent limit violations on 18 occasions, including 1 noncompliant sample for disinfection, 1 noncompliant sample for BOD removal, and several excursions of

effluent TSS. It was noted that weather, and the current drought have impacted the plant operation, and may have been a contributing issue for the TSS violations.

- A brief excursion in the disinfection of the final effluent in August 2014 for up to 10 minutes resulted in incomplete disinfection. This resulted in effluent fecal coliform counts of 49 MPN/100ml.
- One chronic whole effluent toxicity test in March 2014 that appeared to indicate effluent toxicity.
- Exceedances of the plant effluent copper requirement have historically been an issue. Seven times the monthly average was exceeded and twice the daily maximum was exceeded. However, according to plant staff, these exceedances have, for the most part, been resolved due to the fact that water effects ratios (WERs) have been applied to the effluent copper limitations for Outfalls 001 and 002. It is anticipated that a WER will also be applied to Outfall 003. Therefore these have not been included in the 18 violations counted above.
- Exceedances of the Dichlorobromomethane limit twice for daily maximum and twice for monthly maximum in July and October 2014.

In 2013, there were 22 effluent limit violations for Outfall 001. Most of these were similar to the issues reported in the 2014 Annual Report.

On June 15, 2015 the State Board Office of Enforcement conducted an inspection of City wastewater facilities under the Statewide General Waste Discharge Requirements for Sanitary Sewer Systems to assist the Regional Board in enforcement action. Although the inspection was primarily conducted for compliance with the sanitary sewer system permit, the inspectors also reviewed a handful of NPDES discharge violations during the inspection and indicated that they would be reviewing violations since June 2012 for enforcement action including assessment of Mandatory Minimum Penalties (MMPs). Table 2.2 summarizes the violations by year and location from 2013 to 2015. Appendix B shows all of the violations that have occurred since the last ACL was issued.

Although MMPs are not being assessed for violations at Outfall 002 since the AMWS receiving water is not designated a water of the United States, water quality compliance at Outfall 002 is still crucial. Violations of discharge standards at Outfall 002 could be subject to discretionary penalties. A review of the 2013 and 2014 annual reports indicate 13 exceedances of discharge specifications for Outfall 002 (10 for copper and 3 for BOD).

Exceedance of the copper effluent limit was addressed in a Water Effects Ratio (WER) study submitted to the Regional Board in December of 2012, and a modified permit was issued in November 2014. The State Board has indicated that MMPs will be assessed for the period that the WER was under review.

The City projects that the pending ACL for violations since June 2012 may total greater than $200,000, with no administrative action for violations at Outfall 002.

**Table 2.2 Summary of NPDES Discharge Violations From 2013 to 2015[1]**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| Year | Compliance Location | Number of Violations | Parameter | CIP Project Addressing Violation |
|---|---|---|---|---|
| 2013 | Outfall 001 | 3 | Total Suspended Solids[2] | Secondary Treatment, Hydraulic Capacity |
| | | 5 | Dichlorobromomethane | UV |
| | | 4 | Chronic Toxicity | Uncertain[3] |
| | | 1 | pH | UV, Secondary Treatment |
| 2014 | Outfall 001 | 15 | Total Suspended Solids[2] | Secondary Treatment, Hydraulic Capacity |
| | | 4 | Dichlorobromomethane | UV |
| | | 2 | Chronic Toxicity | TBD - Mixing Zone Dilution Credit |
| | | 1 | pH | UV, Secondary Treatment |
| | | 1 | Chlorine | UV |
| | | 1 | Fecal Coliform | UV |
| | Outfall 002 | 5 | Biological Oxygen Demand[4] | Secondary Treatment |
| 2015 | Outfall 001 | 2 | Total Suspended Solids[2] | Secondary Treatment, Hydraulic Capacity |
| | | 8 | Dichlorobromomethane | UV |
| | | 2 | Chronic Toxicity | Uncertain[3] |
| | Outfall 002 | 13 | Biological Oxygen Demand[4] | Secondary Treatment |
| | | 2 | Chlorine | UV |

Notes:

(1) Summary table excludes copper violations which have been addressed by the WER and subsequent modified permit in November 2014. Non-water quality violations including deficient reporting, deficient monitoring, and order conditions are also excluded.
(2) Total Suspended Solids (TSS) violations include concentration, loading, and/or percent removal parameters.
(3) A mixing zone dilution credit (if granted) at the new outfall location or the addition of conventional secondary treatment may help with compliance.
(4) Biological Oxygen Demand (BOD) violation of concentration.

## 2.5 CURRENT PERMIT COMPLIANCE REQUIREMENTS

The 2012 NPDES permit outlines the approved AWTF flow reconfiguration upgrade, including the use of UV disinfection upstream of the new discharge point (Outfall 003). The new flow configuration and discharge point will replace the existing configuration which discharges directly to Humboldt Bay at Outfall 001. The new discharge point will allow for mixing and controlled discharge of freshwater into the wetlands and tidal section of Arcata Bay. The compliance schedule adopted with the permit for the new discharge point and disinfection system includes the following milestones:

- New discharge point and UV disinfection system shall be completed prior to December 1, 2016. An updated compliance schedule will be discussed later in Chapter 8, Capital Improvements Program.
- RWQCB shall be notified 30 days prior to the use of Outfall 003.
- Prior to operation of the new UV disinfection system, the City shall provide written verification of the UV disinfection system capacity based on National Water Research Institute (NWRI) validation testing.
- Prior to operation of the new UV disinfection system, the City shall provide an operation and maintenance plan detailing how the system complies with NWRI guidelines (Note that the NWRI guidelines do not apply to effluent disinfection as they were written specifically for reuse standards and further discussion with the RWQCB will be required).

### 2.5.1 Water Quality Standards

The current NPDES permit recognizes the transition from the current Outfall 001 to the proposed Outfall 003, but essentially requires the same effluent limits for both interim (current) conditions and final compliance. The effluent discharge requirements for final compliance are summarized in Tables 5 and 6 of the NPDES permit, and limits for the interim condition are summarized in Table 7 of the NPDES permit. For reference, the NPDES permit is provided as Appendix A. A flow reconfiguration and disinfection upgrade project is proposed in order to meet these effluent standards, as the City has indicated that permit compliance is crucial.

Since 2012 there have been approximately 20 violations of the permit for disinfection by-products (dichlorobromomethane), at least one violation for chlorine residual, and at least one violation for coliform (bacteria). Implementation of UV disinfection would eliminate the disinfection by products; however, the existing natural treatment system has a very low UV transmittance, which impacts the sizing of the UV needed to meet disinfection requirements. The main indicator of the level of disinfection will be the Fecal Coliform criteria:

- Average monthly - 14 MPN/100 ml.
- Maximum daily - 43 MPN/100 ml.

Ongoing permit violations of plant effluent limits for biological oxygen demand (BOD) (at least 12 violations for BOD in the last 2 years) and suspended solids (at least 21 violations for total suspended solids (TSS) since 2012) indicate a need for additional secondary treatment capacity beyond that of the existing natural system.

### 2.5.2 Flow Reconfiguration Project

As previously discussed, a portion of the of the disinfected secondary effluent is currently routed to the AMWS enhancement wetlands, returned to the chlorine contact basin (CCB) for a second step of chlorine disinfection and dechlorination, and discharged through Outfall 001. One feature of the flow reconfiguration project is that the future configuration will be based on the enhancement wetlands flows being brought back to the AWTF for blending with treatment wetlands effluent prior to disinfection and discharge. All plant flows up to 5.9 million gallons per day (mgd) will be routed to UV disinfection prior to discharge through Outfall 003.

The flow reconfiguration as described in the permit places the UV system downstream of the enhancement wetlands, right before the new discharge compliance point at the brackish marsh. A second option was initially considered for this initial planning study, which is to place the UV disinfection system after the Allen and Hauser wetlands, but upstream of the Gearheart wetland. This configuration would allow for a final buffer before discharge to the brackish marsh. This buffer in the Gearheart wetland would provide a safety factor in case of any issues with the UV system including equipment failure or power outage. Any issue with the UV system could trigger the closing of the final effluent gate to the brackish marsh outfall (003) and subsequent containment of any undisinfected effluent. Provisions could be included in the plant improvement project for a portable pump to be purchased and available to pump the contents of the Gearheart marsh back to the pond system for retreatment, if needed. This concept of a safety factor was also discussed at the initial meeting with the North Coast RWQCB. However, this alternate configuration is not recommended due the following factors:

- The original concept retains a single point of compliance downstream of all enhancement wetlands.
- The original concept provides the benefit of the longer detention time through the complete wetland system prior to discharge.
- The return of any undisinfected flow would require significant pumping to drain the Gearheart Wetland of undisinfected effluent.
- The revised flow reconfiguration concept would require modifications to the existing wetlands transfer structures, which would add cost to the project.

- The new brackish marsh discharge will provide additional protection if the existing tide gate is modified in a future project to provide isolation of the effluent discharge.

Therefore, the flow reconfiguration with UV immediately upstream of Outfall 003 is recommended.

## 2.6 FUTURE REGULATORY CONSIDERATIONS

The current permit will be open for renewal in 2017, and could include additional discharge requirements or other provisions. The following list outlines future regulatory issues that should be considered in planning and future design for the AWTF:

- **Nutrients.** Nutrients such as nitrogen and phosphorus have been identified as potential issues. The North Coast RWQCB is currently reviewing limits for these constituents, and they will probably be added to future discharge permits. Ammonia discharge standards in freshwater have been regulated by the EPA since 2013. North Coast dischargers are beginning to be regulated for ammonia and nitrogen discharge standards. The City of Ferndale has an ammonia limit of 1.0 milligrams per liter (mg/L) and a nitrate limit of 10 mg/L in their current permit requirement. They are however an inland stream discharger.

  The City of Eureka originally was permitted as an ocean discharge and their NPDES permit used an ammonia limit (as nitrogen) of 0.6 mg/L as the Basin Plan water quality objective. Due to the dilution credit granted Eureka, the resulting effluent limit was not prohibitive. However, Eureka just received a new permit in June 2016, which eliminated their dilution credit, and determined that they were a Humboldt Bay (estuarine) discharger and as such would be required to meet bay discharge standards. Their new permit includes effluent limits on ammonia, with an average monthly ammonia limit of 4.1 mg/L ammonia (as nitrogen), and a daily limit of 10 mg/L ammonia (as nitrogen). In addition, it was determined that the discharge was subject to the Enclosed Bays and Estuaries Policy, which requires a finding of enhancement in order to allow a bay discharge.

  Arcata's current NPDES permit requires monitoring for total ammonia and nitrate to determine the assimilative capacity of the receiving water for these nutrients and to generate background data for these constituents for a future Reasonable Potential Analysis.

- **Wet Weather Flows.** The permit does not completely define the flow reconfiguration for peak wet weather flows. It prohibits discharge of flows greater than 5.9 mgd to new Outfall 003. Therefore, flows above 5.9 mgd must be either stored in the ponds and wetlands or discharged on an emergency basis to existing Outfall 001. In the latter case, the existing chlorine and sulfur dioxide gas system would need to remain on-line and be used for disinfection of wet weather flows. Once the new UV system is on-line, additional improvements to the existing disinfection and dechlorination

systems might be considered to meet any future permit requirements. Since the City has already taken significant steps to address and reduce inflow and infiltration while wet weather peak flows have persisted, handling of wet weather flow will require additional definition and potentially additional improvements to meet permit compliance.

- **Dilution Credits.** New Outfall 003 is currently being modelled to determine if any dilution credits might be justifiable for the AWTF effluent discharge. If dilution credits are allowed, then the effluent toxicity lab results might be more favorable and exhibit a lower number of failed tests.
- **pH.** The pH of the AWTF is influenced by the natural treatment system; the pH has dipped at times during "split basin" mode of operation, when the AMWS flows are returned to the chlorine contact basin. It is generally thought that the chlorination / dechlorination process is responsible for the lowered pH so this might only be a future issue for wet weather flows. The effluent pH will also impact the ammonia toxicity of the effluent. Any process changes should allow for pH control.
- **Emerging Contaminants.** Constituents of emerging concern (CECs) are pharmaceuticals and personal care products, industrial chemicals present at low concentrations, and chemicals that may affect hormone status ("endocrine disruptors.") In general these and other low concentration contaminants have been identified as potential future issues both for effluent discharges and recycled water production. Most of the research work to date has consisted of limited monitoring, especially for recycled water and drinking water supplies. The fate of these contaminants in a natural system is not clearly understood and therefore may require monitoring by the RWQCB in a future permit revision. It was determined, however, that permitting around CECs would likely not take affect within the 20-year planning window for this Facility Plan.
- **Bacterial Quality of Humboldt Bay.** The bacterial quality of Humboldt Bay was noted as a particular concern in the RWQCB Water Quality Control Plan for the North Coast Region (Basin Plan) due to the location of several of California's most important commercial oyster farms in the northern lobe of the estuary known as Arcata Bay. The shellfish harvest areas are classified by the California Department of Health Services according to several criteria, including their proximity to pollutant sources and the Department's knowledge that such areas are (or are not) of suitable sanitary quality. The Basin Plan identifies stormwater runoff and point source discharges as having the greatest impact on water quality in Arcata Bay. The Basin Plan noted that anytime there was a storm of more than a half inch of rainfall, the bacterial quality was impacted and shellfish harvesting was prohibited. The effluent limitations for fecal coliform bacteria for the new Outfall 003 were retained from the previous permit and reflect water quality objectives for protection of shellfish harvesting areas.

## 2.7 MEETINGS WITH NORTH COAST RWQCB

An initial meeting was held with the RWQCB staff to discuss the project in June 2015. The project objectives and NPDES permit requirements were reviewed during the meeting. A subsequent meeting took place on June 27, 2016. At that time the Wastewater Treatment Facility Improvements project draft Facility Plan was reviewed, and current NPDES permit requirements were discussed with the RWQCB.

The main points from the discussion were:

- Board staff wants to see bypass of flows greater than 5.9 mgd eliminated, including I&I reduction to reduce peak flows and reduce total volume to be stored.
- UV disinfection design criteria were discussed and it was proposed that UV disinfection will be based on a minimum UVT of 35 percent. City needs input on design dose and disinfection objectives, including coliform or virus reduction,
- Board staff indicated a requirement to have the total flow receive treatment through the enhancement wetlands. They noted that the Enclosed Bays and Estuaries Policy requires enhancement of the receiving water as a condition of discharge, including polishing of the effluent. The City and City's consultant noted that enhancement wetlands do not have the capacity for 5.9 mgd peak wet weather flow, and no land is available for additional wetland construction.
- Board staff indicated that Arcata could expect an ammonia limit in their next permit (in 2017) similar to Eureka, based on the similar Humboldt Bay discharge. The City will be required to do a Reasonable Potential Analysis (RPA) to develop the limit based on salinity, pH and other factors at the point of discharge. Board staff noted that they were no longer considering the bay a drinking water source, so nitrates (or total nitrogen) reduction was not required.

Implementation schedule was discussed, and Board staff indicated that since the NPDES permit expires in July 2017, a Report of Waste discharge should be filed at least 6 months before the permit expiration (by January 2017).

## 2.8 NORTH COAST RWQCB REPORT OF WASTE DISCHARGE SUBMITTAL

After the June 2016 Facility Plan was submitted to the City, the City prepared and submitted a Report of Waste Discharge (ROWD) to the RWQCB in January 2017. The submittal of the ROWD is the first step in the renewal of the facilities discharge permit (NPDES). A copy of the required ROWD forms and supplemental ROWD information is included in Appendix T. The ROWD information outlined the hydraulic and treatment capacity issues and provided a schedule for compliance. In addition, it included a proposed UV disinfection dose of either 35 or 50 mJ/cm$^2$ depending on the disinfection criteria for the discharge. The second request related to the disinfection system was the request for split compliance for disinfection compliance indicator organism. The City requested that the

disinfection criteria should be applied just downstream of the UV disinfection process (Outfall 002), prior to discharge to the enhancement wetlands. All other compliance parameters would be achieved downstream of the enhancement wetlands (Outfall 003).

At the date of this revision, the RWQCB had not made any comments on the ROWD, or the supplemental information, and an updated permit is not expected until later in 2017.

# FLOW AND LOAD EVALUATION

## 3.1 INTRODUCTION

This chapter discusses the plant influent flow and load the Arcata Wastewater Treatment Facility (AWTF) was designed for, as well as the flow and loads that are expected over the 20- year planning horizon.

## 3.2 EXISTING FACILITY DESIGN FLOW AND LOADS

The AWTF currently treats municipal wastewater from the City of Arcata to meet treatment standards and discharge requirements established by the North Coast Regional Water Quality Control Board (RWQCB). These requirements are outlined in the City's National Pollutant Discharge Elimination System (NPDES) permit, which was last renewed in 2012.

Table 3.1 provides a summary of the current plant permitted influent flows in million gallons per day (mgd).

**Table 3.1 AWTF Influent Permit Flow Summary**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| | Flow (mgd) |
|---|---|
| Average Dry Weather Design Flow | 2.3 |
| Average Wet Weather Design Flow | 5.0 |
| Peak Wet Weather Design Flow | 5.9 |
| Peak Instantaneous Flow | 16.5 |

According to the 1987 "City of Arcata Wastewater Treatment Plant Modifications" record drawings, the AWTF was designed for an average annual plant influent biochemical oxygen demand (BOD) loading of 4,100 pounds per day and total suspended solids (TSS) loading of 3,400 pounds per day for a design population of 19,056 in 1992. This loading was originally designed for the existing primary treatment facility and for secondary treatment provided by "sedimentation and stabilization" Oxidation Pond Nos. 1 through 3 (total of 49 acres) and a shallow "marsh" (4 acres), followed by the enhancement wetlands (30 acres). The treatment wetlands (TWs) were constructed sometime after the 1987 modifications project in phases that occupied a portion of Oxidation Pond 3. The last phase, TW Nos. 5 and 6, were constructed in 2012 from the remainder of Oxidation Pond 3.

The 1987 design average annual plant influent flow of 2.3 mgd and design maximum month plant influent flow of 5.9 mgd correspond to the permitted average dry weather flow and permitted peak wet weather flow, respectively (see Table 3.2).

| Table 3.2 AWTF Design Flow and Loads per 1987 Drawings<br>Wastewater Treatment Facility Improvements Project<br>City of Arcata | |
|---|---|
| | **Design criteria** |
| Average Annual Design Flow, mgd | 2.3 |
| Maximum Month Design Flow, mgd | 5.9 |
| Influent Average Annual $BOD_5$, ppd | 4,100 |
| Influent Average Annual TSS, ppd | 3,400 |
| Design Population | 19,056 |

The State Department of Finance population estimate for the City of Arcata in January 2015 was 18,085, and for January 2016 was 18,695 (including Glendale connections). The influent flows and loads have changed since 1987 due to conservation efforts in recent years and changing characteristics of the community, such as the growth of food industries such as microbreweries. It is important when developing a facility plan to consider the current loading as well as the potential for future changes.

During development of the Draft Facility Plan, anticipated community growth has been a discussion item that needs to be finalized. The City originally anticipated a 10 percent growth in the community based on the General Plan's redevelopment plans and planned growth at Humboldt State University. For the purposes of the Draft Facility Plan evaluation, a 10 percent growth was originally assumed. After further discussion with the City at the Council meeting on June 13, 2016, followed by input from the City's Community Director, the community growth is anticipated to be 20 percent from now through buildout. Updates in the Final Facility Plan address this additional growth factor. Due to the conservation efforts seen in recent years, the growth is primarily anticipated to impact influent loading to the WWTP, and will not change the design flows.

## 3.3 INFLUENT FLOW EVALUATION

The following daily influent flow data sets were provided to Carollo by both the City and the City's consultant, Arcata Marsh Research Institute (AMRI):

- Plant Influent (Point 1) flow from January 1988 to December 2015, provided by AMRI.
- Plant Influent (Point 1) flow from January 2003 to September 2015, provided by the City.

A comparison of the two flow data sets indicated that the data was of the same origin and originally collected by the City. The flow data was plotted and the percentile flows were tabulated. For influent flow from January 1988 to December 2015, the permitted design peak wet weather flow of 5.9 mgd corresponds to between a 98th and 99th percentile, and the permitted design average dry weather flow of 2.3 mgd corresponds to a 68th percentile.

For influent flow from January 2003 to September 2015, the permitted design peak wet weather flow of 5.9 mgd corresponds to a 99th percentile and the permitted design average dry weather flow of 2.3 mgd corresponds to a 77th percentile. For both data sets, the permitted design average wet weather flow of 5.0 mgd corresponds to a 97th percentile.

The data was also analyzed for duration of high influent peak flow periods. Within the period of record, the two highest peak flow durations occurred at the beginning and the end of December 1996. During each of these periods, plant influent flows higher than 5.9 mgd occurred for an average of 8 consecutive days, corresponding to about 71 to 76 million gallons (MG) of total influent flow. The flow data for these periods is included in Appendix C.

## 3.4 INFLUENT LOAD EVALUATION

The following influent concentration data sets were provided to Carollo by both the City and AMRI:

- Plant Influent (Point 1) BOD from January 1988 to December 2015, provided by AMRI.
- Plant Influent (Point 1) BOD from July 2003 to September 2015, provided by the City.
- Plant Influent (Point 1) TSS from January 1988 to December 2015, provided by AMRI.
- Plant Influent (Point 1) TSS from July 2003 to October 2015, provided by the City.
- Plant Influent (Point 1) Ammonia ($NH_3$) from February 2011 to August 2013, provided and collected by AMRI.
- Plant Influent (Point 1) $NH_3$ from April 2013 to December 2015, provided by the City.

A comparison of the concentration data sets provided by the City and AMRI indicated noticeable variability between the data sets. The City indicated that the data they provided is compliance data sent to the Regional Board, and directed Carollo to primarily use the City data for analysis despite a shorter period of record than for the AMRI data. Data from the entire period of record (by City and AMRI) was used for comparison with City data.

The daily influent BOD, TSS and NH3 concentration and corresponding flow data were used to calculate daily influent loads. The 90th percentile concentrations and loads were then calculated. Carollo recommends using 90th percentile loads as the basis of design for evaluating capacity of existing facilities and for sizing new secondary treatment processes. To evaluate treatment capacity of secondary treatment facilities, BOD load is the primary design parameter. BOD load was evaluated two ways: actual 90th percentile load, and a calculated equivalent load based on 90th percentile concentration at a design flow.

For City data from 2003 to 2015, the actual 90th percentile BOD load is 4,000 pounds per day (ppd), which is shown in Table 3.3. This value appears reasonable compared with the

observed monthly median influent BOD load over the entire period of record, as seen in Figure 3.1. For City data from 2003 to 2015, the calculated load based on a 90th percentile BOD concentration of 280 mg/L is too conservative. At the permitted design average dry weather flow of 2.3 mgd, the calculated equivalent load would be 5370 lb/d, which is much higher than the observed monthly median influent BOD load for the entire period of record. The recommended loads for TSS and ammonia are also listed in Table 3.1 and were developed from the same actual data.

The recommended design plant influent loads are summarized in Table 3.3.

**Table 3.3 Recommended Design Plant Influent Loads**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| Constituent | 90th Percentile Influent Load (1), ppd | Design Influent Load With 10% Growth (2), ppd | Design Influent Load With 20% Growth (3), ppd |
|---|---|---|---|
| BOD | 4,000 | 4,400 | 4,800 |
| TSS | 5,760 | 6,340 | 6,910 |
| $NH_3$ | 880 | 970 | 1,060 |

Notes:
(1) Based on City daily sample data from 2003 to 2015 for BOD and TSS, and from 2013 to 2015 for $NH_3$.
(2) Assumed City of Arcata growth projection in Draft Facility Plan.
(3) Assumed City of Arcata growth projection in Final Facility Plan per June 13, 2016 City Council meeting.

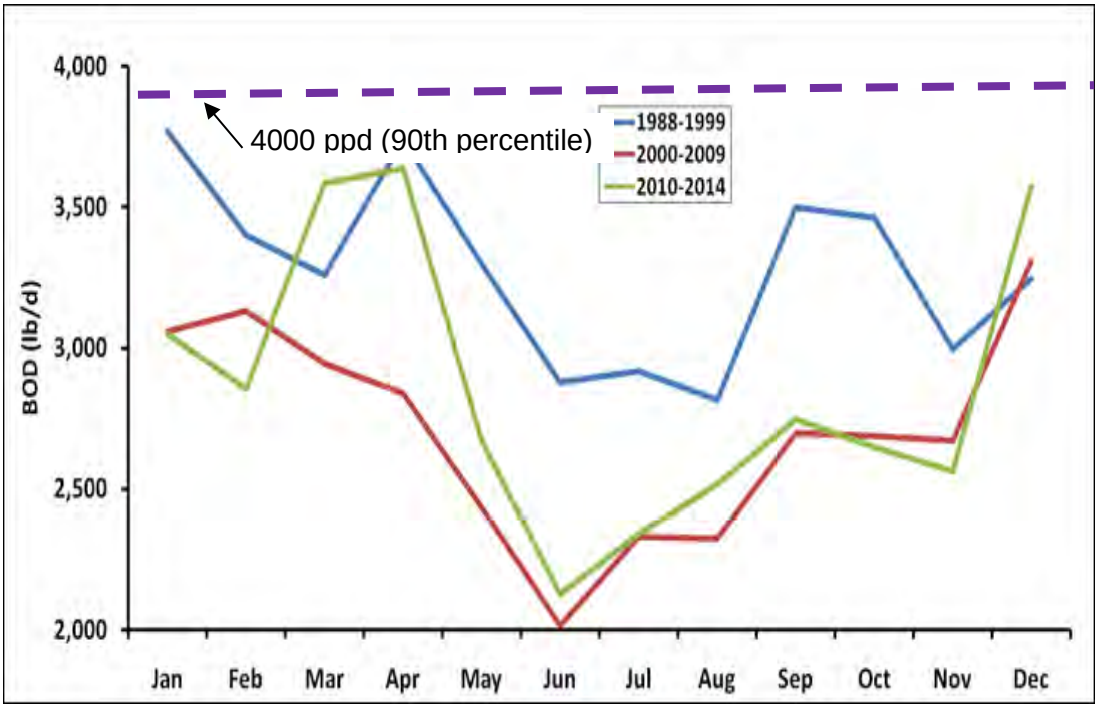



Figure 3.1 Plant Influent BOD (Monthly Median), City and AMRI Data

Plots of the influent data are included in Appendix C.

# EXISTING FACILITIES AND CAPACITY EVALUATION

## 4.1 INTRODUCTION

This chapter provides an overview of the existing facilities at the Arcata Wastewater Treatment Facility (AWTF) and includes the following sections:

- An existing facilities description summarizing the general function and configuration of the treatment facilities at the AWTF.
- A capacity assessment summarizing the hydraulic and treatment capacities of the major liquid treatment unit processes at the AWTF.

## 4.2 FACILITY OVERVIEW

In order to maintain compliance with the discharge permit, municipal waste from the City of Arcata is treated through a series of unit processes at the AWTF. Figures 4.1 and 4.2 show the site layout and unit process flow schematic for the ATWF, respectively. Table 4.1 provides a summary of the current plant permit influent flows in million gallons per day (mgd). Appendix D includes process flow diagrams for the AWTF facilities (from *AWTF Operations and Maintenance Manual*).

**Table 4.1 AWTF Influent Permit Flow Summary**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| | **Flow (mgd)** |
|---|---|
| Average Dry Weather Design Flow | 2.3 |
| Average Wet Weather Design Flow | 5.0 |
| Peak Wet Weather Design Flow | 5.9 |
| Peak Instantaneous Flow | 16.5 |

## 4.3 EXISTING FACILITIES DESCRIPTION

The following sections provide a brief description of the existing flow configuration and hydraulic treatment capacity of the AWTF.




**LEGEND**

**Existing Ponds**

- AMWS Enhancement Wetlands
- Oxidation Ponds
- Treatment Marsh
- Brackish Marsh
- Wastewater Treatment Facility

**AWTF Facilities**

1. Main Office
2. Influent Storm Pump
3. Influent Screw Pumps
4. Bar Screens

**AWTF Facilities** (Continued)

5. Grit Chamber
6. Primary Clarifiers
7. Primary Anaerobic Digester
8. Secondary Settling Digester
9. Sludge Drying Beds
10. Generator Building
11. Boiler Room
12. Chlorine Storage Building
13. Chlorine Contact Basin

N

0 300 600 Feet

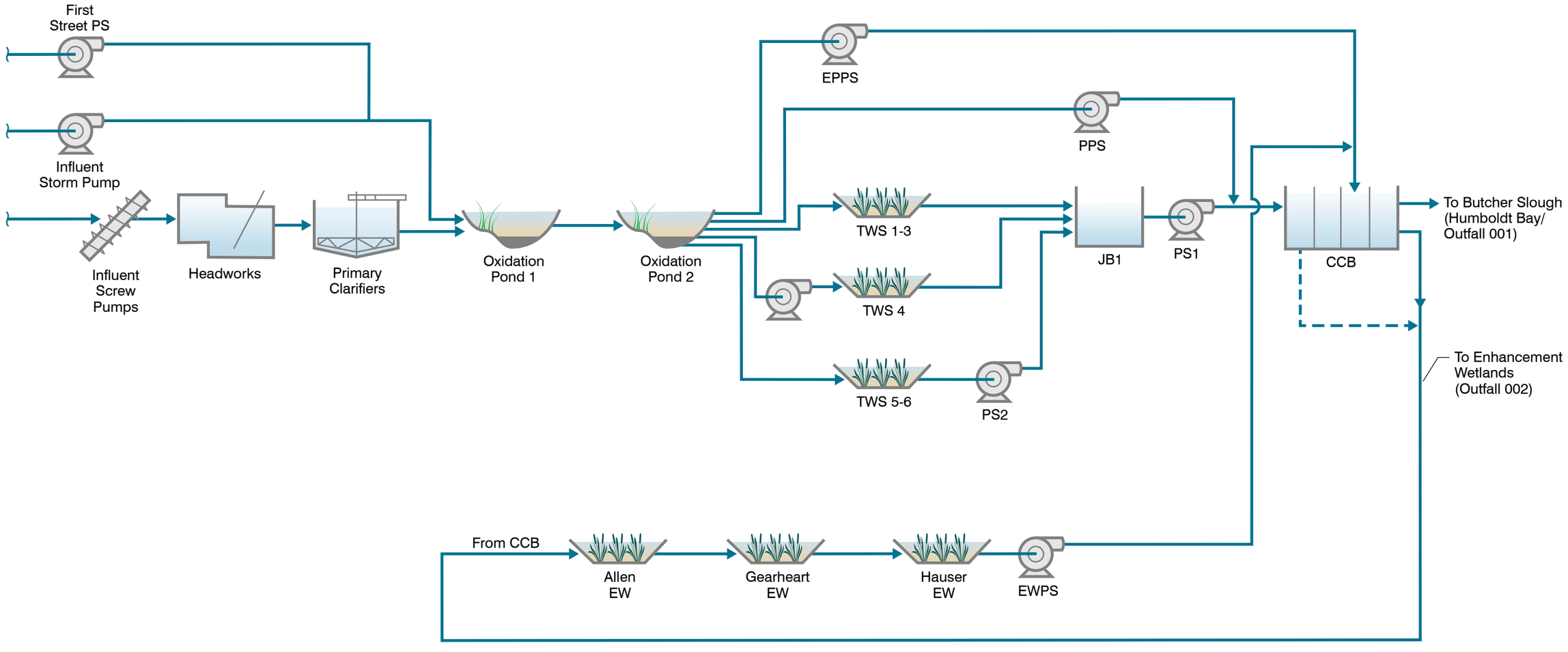
# EXISTING AWTF SITE LAYOUT

FIGURE 4.1

CITY OF ARCATA
*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

carollo

arc0516rf14-9913.ai




## EXISTING AWTF FLOW SCHEMATIC

FIGURE 4.2

CITY OF ARCATA

*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

arc0915f3-9913.ai

carollo

### 4.3.1 Headworks

The headworks facility provides screening and grit removal of raw sewage that is pumped from the service area. The headworks facility is comprised of the following:

- Two 2.5-mgd Archimedes screw pumps.
- Two 5.0-mgd mechanically-cleaned bar screens that drop screenings into a single belt conveyor for transport to a roll-off bin.
- A parshall flume for flow metering.
- A grit removal system including a horizontal-flow grit chamber with grit pumping and grit classification.

### 4.3.2 Primary Clarifiers

The primary treatment facilities consist of two primary clarifiers, with a total treatment capacity of 5.0 mgd. Flow from the headworks is split to the primary clarifiers after grit removal:

- Clarifier No. 1 has a 26-foot diameter and a design treatment capacity of 1.0 mgd. It is fed by a 12-inch diameter influent pipeline.
- Clarifier No. 2 has a 60-foot diameter and a design treatment capacity of 4.0 mgd. It is fed by a 24-inch diameter influent pipeline.

The clarifiers are center-feed, peripheral-withdrawal type clarifiers. In the clarifiers, suspended solids gradually settle to the bottom of the tanks as primary sludge. Mechanical scrapers collect settled sludge and skimmer arms collect floatable scum in the primary clarifiers. Three primary sludge pumps pump solids from the bottom of the primary clarifiers to the primary anaerobic digester. Scum collected on the surface of the primary clarifiers passes through a liquid/solid separator and the scum solids are transferred to a roll-off bin for disposal.

### 4.3.3 Influent Bypass Pumping

Influent flows greater than the 5.0 mgd headworks capacity bypass both the headworks facility and primary clarifiers and are pumped, via the First Street Pump Station (located offsite) and the Influent Storm Pump (at the Headworks), directly to the oxidation ponds. These pumps provide peak wet weather flow capacity and redundancy for the headworks screw pumps.

### 4.3.4 Oxidation Ponds and Pond Pumping

Primary effluent and influent bypass flows are conveyed by gravity to two facultative oxidation ponds for secondary treatment and stabilization. Secondary treatment is provided through a series of both biological and chemical reactions in both aerobic and anaerobic environments within the ponds. The two oxidation ponds have a total surface area of

46 acres (ac) and a total storage and treatment volume of 89 million gallons (MG). The normal mode of operation is in series, where primary effluent is routed to Oxidation Pond 1 and then flows by gravity through transfer structures to Oxidation Pond 2. Pond influent and effluent piping is also set up to operate in parallel if needed.

Dry weather effluent from Oxidation Pond 2 typically flows by gravity to the treatment wetlands for further secondary treatment. Flow in excess of the treatment wetlands capacity is piped to the wet well of the Pond Pump Station (PPS) for discharge to the chlorine contact basin (CCB). In high wet-weather flow scenarios, the Emergency Pond Pump Station (EPPS) can also be used. These pump stations are described in further detail in the capacity evaluation section of this chapter.

### 4.3.5 Treatment Wetlands and Effluent Pumping

Effluent from the oxidation ponds flows by gravity to Treatment Wetlands 1 through 3 and 5 through 6 for further secondary treatment. A small portion of the oxidation pond effluent is also pumped to Treatment Wetland 4, a shallow pilot wetland cell. The 9.7 acres of treatment wetlands reportedly have a capacity to treat 3.3 mgd, which is based on a minimum hydraulic retention time (HRT) of 4 days. Each treatment wetland has one or two influent distribution boxes with manually-adjustable weir gates that are set to control the flow split from the oxidation ponds. The treatment wetlands are currently operated in parallel.

Treatment wetlands effluent is pumped to the CCB for disinfection. There are two main pump stations that collect flow from the treatment wetlands for pumping to the CCB and enhancement wetlands: the wetlands Pump Station 1 (PS1), and the wetlands Pump Station 2 (PS2). These are described in further detail in the capacity evaluation section of this chapter.

### 4.3.6 Disinfection

Effluent from the ponds or treatment wetlands is pumped to the CCB. Disinfected effluent flows by gravity to either the enhancement wetlands or is discharge to Humboldt Bay. Currently all pond and treatment wetland flows go through the CCB, in either a split or combined mode, described in more detail in Chapter 7. The design capacity of the CCB is 5.9 mgd based on a 30 minutes of contact time.

### 4.3.7 Enhancement Wetlands

The Enhancement Wetlands are hydraulically limited to 1.7 mgd, which is the capacity of the Enhancement Wetlands Pump Station (EWPS). The AWTF operates three enhancement wetlands in series that have a total surface area of 33 acres and approximately 22 MG of storage. Enhancement wetlands effluent is currently pumped back to the CCB via the EWPS for disinfection and discharge.

## 4.4 EXISTING HYDRAULIC CAPACITY SUMMARY

This section provides a summary of the existing hydraulic capacity for the liquid treatment facilities at the AWTF. A summary of the existing process treatment capacity evaluation is discussed later in this chapter.

### 4.4.1 Existing Hydraulic Profile

The existing plant hydraulic profile was summarized as part of the undated AWTF Operations and Maintenance Manual project. For reference, these profiles are provided in Appendix E.

### 4.4.2 Influent Pumping

There are several influent pump stations serving the AWTF:

- **First Street Pumps.** The First Street Pumps are variable speed, natural-gas driven pumps that are used when influent flow to the treatment plant is greater than 5.0 mgd (capacity of headworks and primary clarifiers). Each of the pumps has a design capacity of 5.5 mgd.
- **Influent Storm Pump.** The Influent Storm Pump is a variable speed, diesel pump that diverts influent flow greater than 5.0 mgd from the headworks influent wet well directly to the oxidation ponds. The Influent Storm Pump has a capacity of 5.0 mgd.
- **Influent Screw Pumps.** The Influent Archimedes Screw Pumps each have the capacity to lift 2.5 mgd from the headworks influent wet well to the headworks bar screens.

Table 4.2 summarizes the firm influent pumping capacity.

**Table 4.2 Influent Pumping Capacity Summary**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| Pump Station | Firm Capacity (mgd) |
|---|---|
| Influent Bypass Pumping[(1)] | 10.5 |
| Headworks Influent Screw Pumps[(2)] | 2.5 |

Notes:
(1) Combined firm pumping capacity of the First Street Pumps and the Influent Storm Pump. Assumes the largest unit is out of service.
(2) Assumes the largest unit is out of service.

While it appears that there is sufficient influent pumping capacity, much of the influent flow would need to be bypassed around the headworks and primary clarifiers if one of the screw pumps is taken out of service. Upsizing the screw pumps would increase the reliability of the preliminary and primary treatment facilities. The screw pumps could either be replaced

in kind or with another type of pump. Plant staff has indicated a preference for submersible pumps.

### 4.4.3 Headworks

With the exception of the influent screw pumps, the headworks facility appears to have sufficient hydraulic capacity to accommodate the original design flow of 5.0 mgd:

- **Bar Screens.** There are two bar screens and each screen was originally designed to handle 5.0 mgd. The actual channel hydraulic capacity was not evaluated.
- **Grit Chamber.** There is one grit chamber that was originally designed to handle flow up to 5.0 mgd. However, plant staff has indicated that the unit has difficulty handling wet weather flows, so the current capacity is less than 5.0 mgd. There is no redundancy (which is not uncommon), so channel isolation gates are used to shut off flow to the grit chamber if maintenance is required.
- **Grit Pumping.** There are two grit pumps (one duty, one standby). Each pump has the capacity to transfer 200 gallons per minute (gpm) of grit slurry from the bottom of the grit chamber to the grit classifier, which is sufficient to accommodate the original 5.0-mgd design flow.
- **Grit Classification.** There is a single grit classifier, so maintenance would require shutting down flow to the grit chamber. If this is operationally problematic, a redundant classifier could be installed as part of a headworks rehabilitation project.

### 4.4.4 Primary Treatment

The two primary clarifiers have a total surface area of approximately 3,400 square feet (sf). In most cases, only primary clarifier No. 2 is used. At the design flow rate of 5.0 mgd, the overflow rate through primary clarifier No. 2 was calculated to be approximately 1,770 gallons per day per square foot (gpd/sf), which is much lower than the industry-standard recommendation of 3,000 gpd/sf at peak wet weather flow. However, plant staff has indicated that removal rates and process performance drops significantly at flow rates greater than 4.2 mgd.

### 4.4.5 Oxidation Ponds

Effluent from the primary clarifiers flows by gravity in a 30-inch pipeline to the oxidation ponds, which are normally operated in series. Plant staff has indicated that the transfer structures between Oxidation Ponds 1 and 2 cause a hydraulic bottleneck during wet weather events. To relieve this bottleneck, the oxidation ponds are operated in a modified parallel mode when the influent bypass pumping is initiated. Additionally, as a fail-safe to mitigate the potential for overflow of Oxidation Pond 1, a spillway was constructed in the berm shared with Oxidation Pond 2. The ponds have a total volume of 89 million gallons (MG) and an average constructed depth of 5.5 feet. At the PWWF of 5.9 mgd when the ponds are empty of sludge, they have 14 days of detention time. The peak flow detention

time may be insufficient depending on the plant loading, season, and weather. At the average flow of 2.3 mgd when the ponds are empty of sludge, the oxidation pond detention time is over 35 days, which should be sufficient for secondary treatment.

Due to deferred sludge maintenance over the last 30 years, current estimates of solids buildup in the ponds range from one to two feet in each pond. Assuming an average solids buildup of 1.5 feet, the peak flow detention time at 5.9 mgd is 10 days and the average flow detention time at 2.3 mgd is 26 days.

### 4.4.6 Treatment Wetlands

Effluent from the oxidation ponds flows by gravity to the treatment wetlands, which are operated in parallel. Per information provided in the AWTF Operations and Maintenance (O&M) Manual, the weirs in the distribution boxes are manually adjusted to maintain the desired flow split through the six treatment wetlands. These adjustments are made on a regular basis, although the flow split is difficult to maintain, since each set of treatment wetlands can treat a different flow rate.

Treatment Wetland Nos. 1 through 6 have a total volume of 13.2 MG and an average operating depth of 3.8 feet when empty of solids or vegetation. At the PWWF of 5.9 mgd, they have 2.0 days of detention time, which is reportedly considered insufficient for treatment capacity. A more typical design value for wetlands systems is on the order of four days, which is approximately 3.0 mgd.

Due to deferred sludge and vegetation maintenance over the last 30 years, operating depth is assumed to be reduced. The City and AMRI report that reliable treatment capacity of Treatment Wetland Nos. 1 through 6 is typically about 1.8 mgd. In order to manage this capacity deficiency, flows greater than 1.8 mgd to 5.9 mgd can be pumped around the treatment wetlands.

### 4.4.7 Secondary Effluent Pumping

The effluent pump stations pump secondary-treated effluent from the oxidation ponds, the treatment wetlands, or the enhancement wetlands for discharge into the CCB. A summary of the measured effluent pumping capacities is provided in Appendix F.

#### 4.4.7.1 PPS and PS1

The PPS and PS1 are sited adjacent to each other, within a common structure. The pump station wet well has an interior divider wall with an isolation gate. When the gate is open, the pumps are supplied via a common wet well. During normal operation, however, the slide gate is closed and the two wet wells are hydraulically isolated from one another.

In the normal mode of operation, the PPS lifts flow from Oxidation Pond 2 to the CCB, and consists of three 1.8-mgd pumps, with a firm pumping capacity of 2.9 mgd. PS1 lifts flow

from Treatment Wetlands 1 through 4 to the CCB and consists of three 1.2-mgd pumps with a firm capacity of 2.3 mgd.

#### 4.4.7.2 EPPS

The EPPS lifts flow from Oxidation Pond 2 to the CCB. The EPPS is typically operated to supplement the capacity of the PPS during extremely high flow scenarios. The EPPS consists of two 3.6-mgd pumps, one duty, and one standby.

#### 4.4.7.3 PS2

PS2 was originally piped to lift flow from Treatment Wetlands 5 and 6 to the CCB. However, pumping directly to the CCB has shown to disrupt the flow-paced chlorine injection system. In order to correct this problem, temporary piping was installed to re-route the discharge from the CCB to Junction Box 1, which flows by gravity into the wet well of PS1. PS2 consists of two 1.7-mgd pumps, one duty, and one standby.

#### 4.4.7.4 EWPS

The EWPS (also known as the Hauser Pump Station) lifts effluent from the Hauser Enhancement Wetland to the CCB. The EWPS consists of three 1.5-mgd pumps and originally had a firm pumping capacity of approximately 3.0 mgd. However, the pumps are failing and the most recent testing indicated a firm pumping capacity of 1.2 mgd. Two of the pumps are controlled with variable frequency drives (VFDs) and the third is fixed speed.

The pumps are operating at the end of the pump curves, which is not ideal and may be one of the reasons for operational issues with this pump station. Additionally, the pump curve is not in alignment with measured flow values, which indicates that the pump impellers have experienced some wear and are not operating on their published curves.

#### 4.4.7.5 Effluent Pumping Summary

Table 4.3 summarizes the effluent pumping capacity.

### 4.4.8 Chlorine Contact Basin

Effluent from the oxidation ponds and treatment wetlands is pumped to the CCB via the PPS and PS1. In wet weather conditions, the EPPS is also used to lift flow to the CCB. At the flow rate of 5.9 mgd, flow through the CCB has a contact time of 30 minutes, which is typically sufficient for effluent discharge.

The main points of the hydraulic analysis include the following:

- The estimated hydraulic detention time is based on combined basin mode in the CCB with no return flow from the Enhancement Wetlands.
- The CCB effluent weir sets the elevation in the basin and is not submerged at 5.9 mgd.

- There is very little head loss through the CCB.

**Table 4.3 Effluent Pumping Capacity Summary**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| Pump Station | Firm Capacity[1] (mgd) |
|---|---|
| PPS | 2.9 |
| PS1 | 2.3 |
| EPPS[2] | 3.6 |
| PS2[3] | 1.7 |
| EWPS | 1.2 |

Notes:
(1) Assumes the largest unit is out of service.
(2) The EPPS is only operated during periods of peak wet weather and was not included in the overall secondary effluent pumping capacity per the City's request.
(3) PS2 does not discharge directly to the CCB, so the capacity was not included in the overall secondary effluent pumping capacity.

### 4.4.9 Enhancement Wetlands

Disinfected treatment wetlands effluent flows by gravity in a 30-inch pipeline from the CCB to the enhancement wetlands, which are typically operated in series. A hydraulic capacity analysis was completed by AMRI in order to better understand the feasibility of the flow reconfiguration project.

The main points of the AMRI hydraulic analysis include the following:

- Treatment wetlands effluent flows by gravity through the chlorine contact basin and the enhancement wetlands to the EWPS wet well, which serves as the downstream control point. As discussed above, the EWPS pumps effluent back to the CCB for further disinfection and discharge through Outfall 001.
- Most of the head loss in this portion of the hydraulic profile occurs at the sharp-crested weirs in the distribution boxes and junction structures. Weir elevations were taken from the 1984 drawings and should be confirmed.
- There do not appear to be any hydraulic capacity bottlenecks in between the chlorine contact basin and the EWPS wet well at the modeled PWWF of 5.9 mgd.

### 4.4.10 Hydraulic Capacity Summary

Table 4.4 provides a summary of the existing hydraulic capacity at the AWTF.

The main hydraulic capacity limitations or bottlenecks are the following areas:

- Headworks pumps - lack redundancy.

- The single Primary clarifier limits capacity at peak flows.
- Treatment wetlands and effluent pump stations lack capacity to accommodate permit peak flows.
- Enhancement wetland effluent pumps station lack capacity to accommodate permit peak flows.
- There is concern that the enhancement wetlands would not provide any treatment at flows greater than 2.3 mgd.

**Table 4.4 Existing Flow Capacity Summary**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| Unit Process | Hydraulic Capacity (mgd) |
|---|---|
| Influent Bypass Pumping(1) | 10.5 |
| Headworks: Pumping(1) | 2.5 |
| Headworks: Bar Screens(2) | 5.0 |
| Headworks: Grit Removal(2) | 5.0 |
| Primary Clarifiers(2)(3) | 4.0 |
| Oxidation Ponds(4) | 5.9 |
| Treatment Wetlands(5) | 2.3 |
| Pond and Treatment Wetlands Effluent Pumping(6) | 5.2 |
| Chlorine Contact Basin | 5.9 |
| Enhancement Wetlands | 2.3 |
| Enhancement Wetlands Pumping(7) | 1.8 |

Notes:
(1) Assumes largest pump is out of service.
(2) Influent flow in excess of 5.0 mgd is bypassed around the headworks facility and primary clarifiers and routed directly to the oxidation ponds.
(3) Capacity based on a single primary clarifier.
(4) Capacity is based on 15-day detention time.
(5) Flow in excess of 2.3 mgd is pumped directly from Oxidation Pond 2 to the Chlorine Contact Basin.
(6) The sum of the capacities of three PS1 pumps and two PPS pumps in parallel, which is the firm pumping capacity under the current operational arrangement. The PS2 pumping capacity was not considered because it does not discharge directly to the CCB.
(7) Flow in excess of 1.8 mgd design capacity is discharged from the CCB, through Outfall 001 and into Humboldt Bay.

## 4.5 NATURAL SYSTEM TREATMENT CAPACITY EVALUATION

### 4.5.1 Process Capacity Background

The existing treatment processes at the City of Arcata Wastewater Treatment Facility (WWTF) were constructed in 1987, with some facility improvements since then including conversion of one oxidation pond to treatment wetlands. The need for a comprehensive approach to facility improvements was first addressed during the initial development of this facility plan project in September 2015. During review with the City, it was noted that the WWTF may have a secondary treatment capacity shortfall that impacts the ability to reliably meet permit requirements. The treatment capacity shortfall was initially reviewed with City staff during a phone conference on October 29, 2015, and then addressed in a follow-up workshop on November 5 and 6, 2015. The presentation from that phone conference and the workshop presentation are included in Appendix G.

Several indications point to the need for evaluating secondary treatment capacity. As discussed in Chapter 2, the plant has experienced operational issues related with treatment capacity, including NPDES discharge violations of both BOD and TSS. Treatment capacity, as well as hydraulic capacity and detention time, have likely been impacted by 30 years of solids accumulation. Deferred vegetation maintenance in the wetland system (treatment wetlands and enhancement wetlands) has also impacted the ability for the wetlands to remove solids and maintain optimum flow capacity.

The City is planning an operational conversion of the natural system to a single-pass flow mode to pass up to 2.3 mgd through the enhancement wetlands, as well as a disinfection process change from chlorination to UV disinfection. In addition, recent UV transmittance (UVT) data collected for this project indicated that the natural system has a low UVT at certain times of the year which substantially increases the UV disinfection cost.

This section summarizes the analysis of available plant flow and constituent concentration data for evaluating current secondary treatment capacity at the WWTF. Plant data analysis was used both to confirm existing WWTF treatment capacity and to provide the basis of design for new and upgraded plant processes recommended for the WWTF Improvements Project. Conceptual design criteria recommendations for new and upgraded plant processes are discussed in Chapter 6, Alternatives.

### 4.5.2 BOD Loading Criteria

The basis for evaluating current treatment capacity of the existing natural system was determined by analyzing a combination of design criteria and available plant data, and confirmed by discussions with City staff and AMRI.

Typical wastewater treatment BOD loading criteria in a natural system varies depending on a variety of factors including the treatment purpose, climate (sunlight and temperature), solids accumulation, vegetation management, and short circuiting. The primary treatment

purpose of oxidation ponds are to remove organic loading (BOD and ammonia), while the primary treatment purpose of treatment wetlands are to remove solids. The enhancement wetlands provide effluent polishing prior to Bay discharge, as well as additional benefits such as wildlife habitat creation and recreation.

Published values for design BOD loading in an oxidation pond can range from 35 to 125 ppd/acre due to a variety of climates and facility conditions ("Natural System for Waste Management and Treatment," Reed et al). For Northern California, Carollo recommends an oxidation pond loading criteria of 25 ppd/acre for non-aerated ponds, which has been confirmed at Napa Sanitation District and other Northern California facilities. This loading level has been confirmed to provide an effluent that can meet an average monthly effluent discharge limit of 30 milligrams per liter (mg/L) $BOD_5$ and 30 mg/L TSS. The AWTF Oxidation Ponds 1 and 2 have a total of 46 acres and an average depth of 5.5 ft. Aerated ponds typically have a minimum of 6.5 feet depth (2 m; Reed et al). Pond 1 has eight mechanical aerators that are in poor condition and several have not been used for a number of years; Pond 2 does not have aerators. Based on a 25 pounds per day (ppd) BOD/acre design criteria, maximum BOD loading to the oxidation ponds should be 1,150 ppd without aerators.

Published values for design BOD loading in a constructed wetland depends on whether the wetlands are fully vegetated or open water free water surface (FWS) type ("Manual - Constructed Wetlands Treatment of Municipal Wastewaters Constructed," U.S. EPA, September 2000). For a fully vegetated FWS wetland, maximum BOD loading of 35 ppd/acre (40 kg/ha-d) is recommended if a secondary effluent BOD standard of 30 mg/L is to be met. For an open water FWS wetland, maximum BOD loading ranges from 40 to 54 ppd (45 to 60 kg/ha-d). The AWTF treatment wetlands were designed primarily for solids removal and only Treatment Wetlands 1 and 2 have depths greater than 4 feet, which is typically necessary for open water surface FWS wetlands. Treatment Wetlands 1-6 have a total of 9.7 acres, not including emergent vegetation. Based on a 35 ppd BOD/acre design criteria, maximum BOD loading to Treatment Wetlands Nos. 1 through 6 should be 340 ppd. In the future, if 2.3 acres of Treatment Wetlands 7 is constructed, maximum BOD loading to Treatment Wetlands 1 through 7 should be 420 ppd.

Historically, the three Enhancement Wetlands (EWs) in conjunction with the chlorine contact basin have been providing year-round supplemental BOD and TSS treatment capacity, despite not being designed for those functions. Solids have been accumulating in the EWs for almost 30 years while percent removal of BOD has been diminishing with time. This phenomenon has been observed and analyzed by both the City and AMRI over the last 10 years. It is suspected that an internal load is increasing due to breakdown of accumulated material, reducing the treatment potential of the EWs. The EWs are designated Waters of the State which are regulated by State Water Board Resolution No. 2008-0026 to protect all waters of the State from dredge and fill activities. The City has indicated that vegetation maintenance and baffle installation will be allowed activities, which

could help with treatment capacity and improvement of short circuiting issues. Current EW BOD treatment capacity is estimated by AMRI to be about 120 ppd, but may decrease in the future without solids removal.

### 4.5.3 Secondary Treatment Capacity Shortfall

The 10 percent growth projection developed in the Draft Facility Plan results in a design influent loading of 4,400 ppd. The design criterion for the existing primary clarifiers is 30 percent BOD removal (1987 Record Drawings). This is also a typical design criteria for new primary clarifiers. This results in an Oxidation Pond influent loading of 3,080 ppd BOD. Subtracting out the anticipated BOD removal in the Oxidation Ponds (1,150 ppd), Treatment Wetlands Nos. 1 through 6 (340 ppd), Enhancement Wetlands (120 ppd), and meeting an Outfall 002 effluent discharge limit goal of 30 mg/L (575 ppd at 2.3 mgd) results in a BOD treatment capacity shortfall of 895 ppd at Outfall 002. Meeting an Outfall 003 effluent discharge goal of 10 mg/L (192 ppd at 2.3 mgd) results in a predicted BOD treatment capacity shortfall of 1,280 ppd at Outfall 003. Note that this capacity shortfall analysis assumes the natural system is performing optimally with routine solids and vegetation maintenance conducted. With deferred maintenance of the natural system over the last 30 years, the predicted BOD treatment capacity shortfall is 1,280 ppd. Future construction of Treatment Wetland No. 7 could reduce the shortfall by 80 ppd and addition of aerators to Pond 2 could reduce the shortfall by approximately 600 ppd, leaving a BOD treatment capacity shortfall of at least 600 ppd at Outfall 003. This analysis is summarized in Table 4.5.

Following this evaluation in the Draft Facility Plan, the City revised its growth estimate to a 20 percent growth projection, which increases the BOD treatment capacity shortfall from 600 ppd to 1000 ppd even with additional Pond 2 aeration and construction of Treatment Wetland No. 7.

Independently, AMRI provided the City an analysis of a secondary treatment capacity shortfall of 1,150 to 2,017 ppd BOD during higher flow and higher BOD loading months of the year, in "AWTF Treatment Capacity Evaluation and Additional Treatment Recommendations," September 2015.

It has been documented that the plant is currently treating the BOD treatment capacity shortfall, inadvertently, by use of chlorine during combined basin operating mode (chlorinating both TW and EW effluents in the Chlorine Contact Basin), which is required about nine months every year (typically during wet weather seasons). Chlorine is a strong oxidizer and typically reduces the organics and BOD level to permit requirements. The City has the ability to increase chlorine dosage as needed. However, disinfection byproducts maybe created from the oxidation reaction, leading to violations of dichlorobromomethane. This is one reason the City has decided to limit the use of chlorine and switch to UV for disinfection.

**Table 4.5 BOD Treatment Capacity Shortfall Summary**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| Unit Process | Estimated BOD Removal (ppd) | Remaining BOD At 10% Growth (ppd) | Remaining BOD At 20% Growth (ppd) |
|---|---|---|---|
| Plant Influent | N/A | 4,400 | 4,800 |
| Primary Clarifiers(1) | 1,320 | 3,080 | 3,480 |
| Oxidation Ponds(2) | 1,150 | 1,930 | 2,330 |
| Treatment Wetlands Nos. 1-6(3) | 340 | 1,590 | 1,990 |
| Enhancement Wetlands(4) | 120 | 1,470 | 1,870 |
| Outfall 003 Discharge Goal @ 10 mg/L | 192 | 1,280 | 1,680 |
| BOD Shortfall | | 1,280 | 1,680 |
| Additional Pond 2 Aeration | 600 | 680 | 1,080 |
| Adding Treatment Wetland No. 7(3) | 80 | 600 | 1,000 |

Notes:
(1) Assumes 30% BOD removal in Primary Clarifiers.
(2) Assumes 25 ppd/acre removal in Oxidation Ponds, at 46 acres total for both ponds.
(3) Assumes 35 ppd/acre removal in Treatment Wetlands, at 9.7 acres in TW 1-6 and 2.3 acres in future TW 7.
(4) Capacity estimated by AMRI based on current removal.

Plant data confirms that the natural system without chlorine generally performs well at lower flow conditions. Figure 4.3 shows a typical example of this, that at a plant influent flow of 1.4 mgd (September 2015), BOD removal was primarily achieved in the oxidation ponds, and TSS removal was primarily achieved in the treatment wetlands. Plant influent BOD at this time was less than 3500 ppd.

Figure 4.4 shows that at plant influent flow of 1.5 mgd when operating in combined basin mode, some BOD removal occurred in the Oxidation Ponds and Treatment Wetlands No. 6, and a significant amount of BOD removal occurred due to chlorination prior to the Enhancement Wetlands. A decrease in 100 mg/L BOD corresponds to 1,250 ppd BOD removal due to chlorination. The City and AMRI analyzed the BOD and chlorine consumption data from 2009 to 2015 and confirmed that during this time while operating in combined basin mode, an average of 730 ppd of BOD removal was achieved by chlorine usage, while peak BOD removal periods could reach 1000 ppd or higher.

In comparison, influent BOD loading in the spring (typically from January through April) is generally greater than 3,500 ppd of BOD. These months also correspond to higher plant influent flows. The higher plant influent loading corresponds to a higher influent loading of the oxidation ponds beyond recommended loading criteria. As shown in Figure 4.5,

Oxidation Pond 1 influent BOD loading from 2010 to 2015 is between 35 and 50 ppd/acre (monthly median). Furthermore, higher flows in the wet weather season (generally October to May) result in reduced treatment capacity in the oxidation ponds and the treatment wetlands due to decreased detention time, shifting additional loading to the enhancement wetlands. As seen in Figure 4.6, BOD loading to the Enhancement Wetlands during the wet weather season has been increasing over the last 25 years. Vegetation growth and solids accumulation in the wetland system over the last 30 years impacts the capacity shortfall.

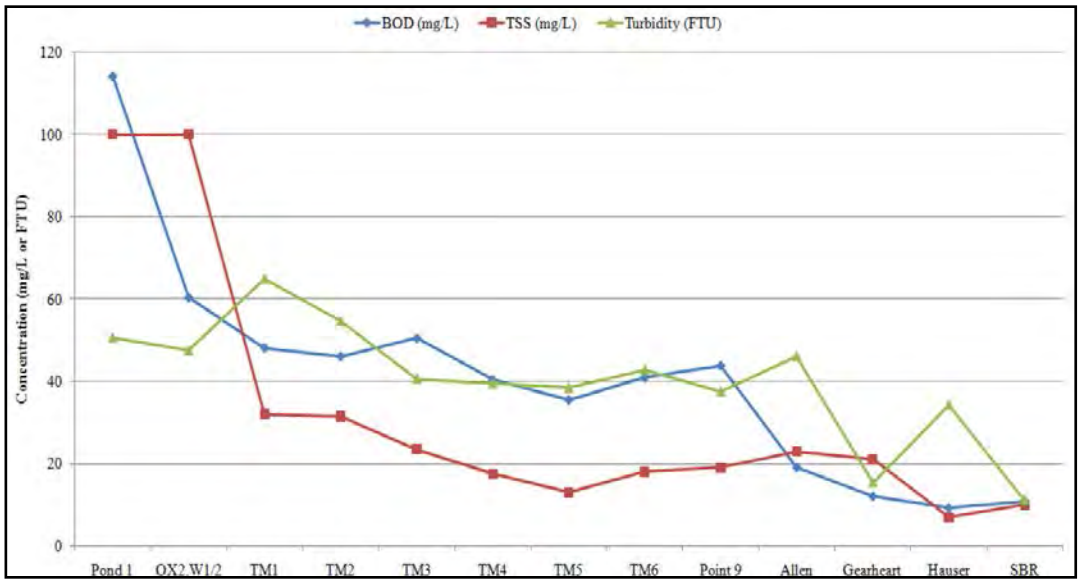



Figure 4.3 Plant Permit Performance At Lower Flows

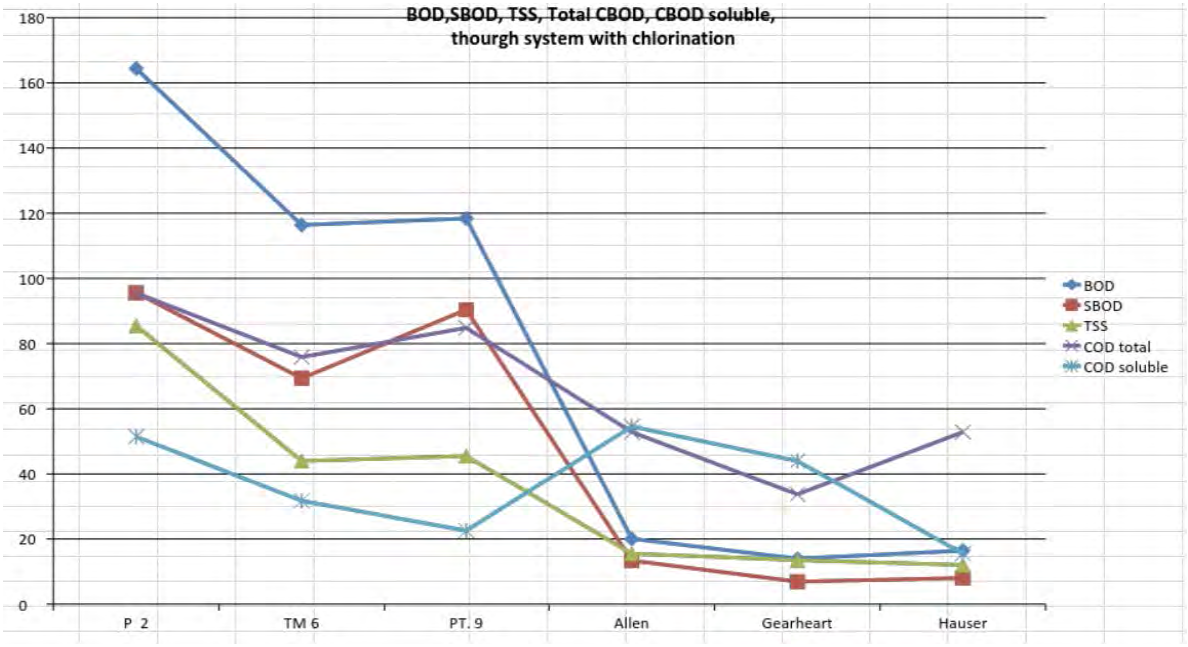



Figure 4.4 BOD Concentration (mg/L) Profile at AWTF (AMRI data, November 2015 at 1.5 mgd).

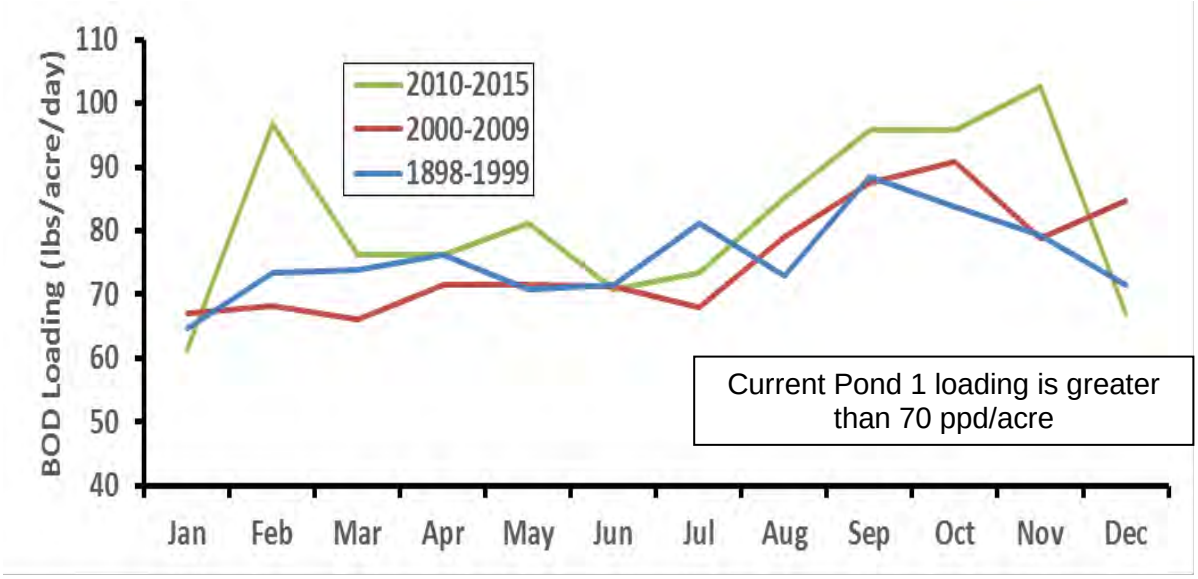



Figure 4.5 Oxidation Pond 1 Influent BOD Loading (Monthly Median)

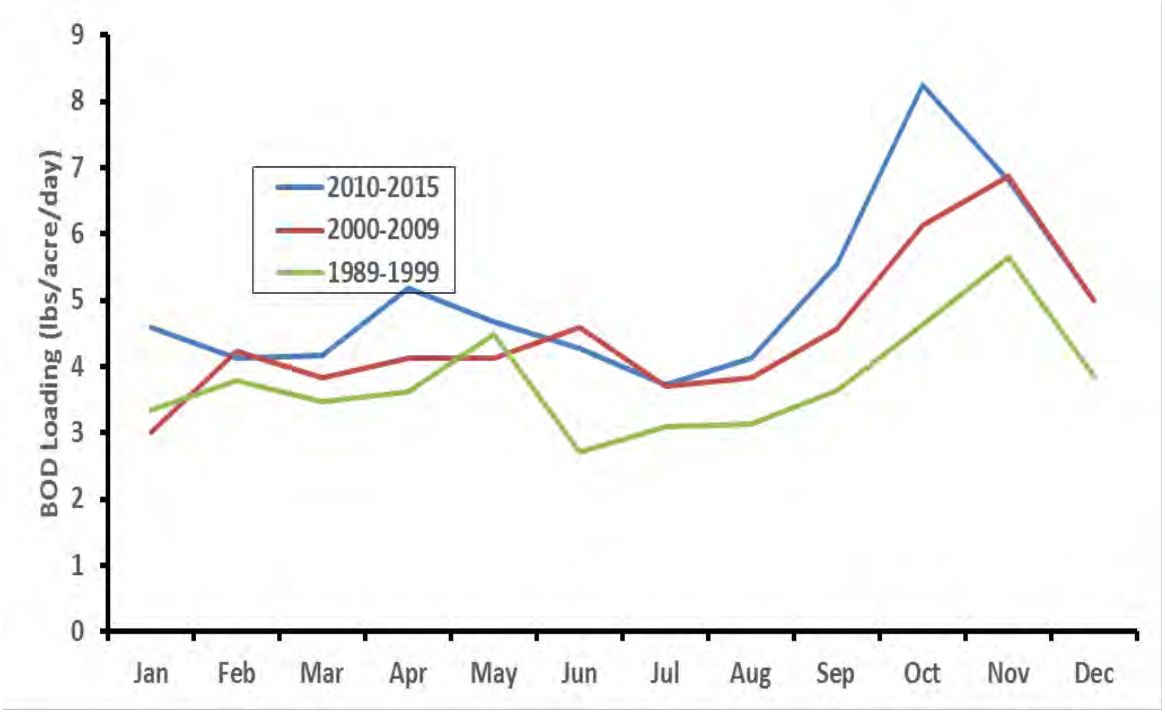



Figure 4.6 Enhancement Wetlands Influent BOD Loading (Monthly Median)

## 4.6 KEY FINDINGS AND RECOMMENDATIONS

The key findings and recommendations from the capacity evaluation include the following:

- **Headworks.** The reliable headworks capacity should be increased to 5.9 mgd to minimize the need to bypass preliminary and primary treatment. The following modifications would be required:
  - Replace the two existing 2.5-mgd screw pumps with two new 5.9-mgd pumps. The pumps could either be replaced in kind or replaced with submersible pumps. Pump selection should be completed during the pre-design phase of the project.
  - Evaluate replacement of the grit chamber with a new vortex grit chamber, which could handle a wider range of flows.
- **Pond and Treatment Wetlands Effluent Pump Stations.** This appears to be an operationally-intensive area of the AWTF, with multiple pump stations and changing weir elevations into and out of the treatment wetlands. Recommend that the treatment wetland pump stations be consolidated in an effort to simplify operations while adding operational flexibility. It is proposed that PS1 be upgraded to pump treatment wetlands flow to enhancement wetlands, with pond pump station remaining for peak wet weather flows.
- **Additional Secondary Treatment.** The BOD treatment capacity shortfall outlined in Table 4.5 needs to be addressed in facility planning and capital improvement program project alternatives. As noted above, addition of aerators in Pond 2 will and addition of Treatment Wetland No. 7 will improve the secondary treatment capacity of the facility, but a deficit of 1000 ppd is still anticipated with a 20 percent growth projection.

Chapter 5

# CONDITION ASSESSMENT

## 5.1 INTRODUCTION

The original Arcata Wastewater Treatment Facility (AWTF) was constructed in the late 1950s. A photo of the original plant is shown in Figure 5.1. The AWTF has been upgraded throughout the years, with the last major upgrade project completed in 1986 (CH2M HILL 1984). The project included a new headworks facility with screening and grit removal, a chlorine contact basin and chemical storage building, effluent pump stations and a new generator building. Since that project, smaller projects have included upgrades to the oxidation ponds, treatment and enhancement wetlands, digesters, pond aerators, and the addition of a standby generator.



Figure 5.1 Original Arcata Wastewater Treatment Plant (Circa 1958)

In May 2015, a condition assessment was performed to assess the current condition of existing structures and equipment and document observations made by plant staff. In general, the plant appears to have been maintained as much as the maintenance budget has allowed. However, findings from the assessment indicate that a majority of the mechanical equipment has exceeded its expected life, and that major structures are also starting to approach the end of their useful life. Finally, plant staff indicated that some capital and maintenance projects had been deferred, pending the outcome of this project. That has meant that staff has struggled to meet permit limits and keep as much of the

existing facilities equipment operational as possible even though it should have been replaced.

## 5.2 PURPOSE

The purpose of the condition assessment is to document the existing facility conditions and help establish priorities for the City's wastewater treatment plant repair and rehabilitation (R&R) capital improvements program (CIP). The findings outlined in this chapter will be incorporated into the CIP presented in Chapter 6.

## 5.3 APPROACH

The approach used to assess the condition of the assets at the AWTF is described in the following sections.

### 5.3.1 Asset Inventory

An "asset" is generally defined as a complete physical component of a facility that enables service to be provided, is critical to plant operation, and/or has a value greater than $10,000. Below-ground assets (process piping) were not evaluated. Above-ground assets include structures, as well as mechanical, electrical, and instrumentation and controls (I&C) equipment and devices.

The AWTF assets were organized into a spreadsheet by unit process. The spreadsheet was configured to provide a complete summary of the asset inventory, including: asset description, design criteria, installation year (if known) and condition ranking. The ranking, estimates of remaining life and replacement costs will be used in Chapter 6 to develop the R&R CIP for the treatment facilities.

The asset inventory was developed using the 1984 CH2M HILL WWTP Modification Drawings (CH2M HILL, 1984), the 2003 Wastewater Treatment Plant Evaluation (SHN 2003) and the City's undated Operations and Maintenance (O&M) manual. The main process areas are shown on Figure 4.1 in Chapter 4.

### 5.3.2 Replacement Timing

#### 5.3.2.1 Original Useful Life

The expected life or Original Useful Life (OUL) is the number of years an asset is expected to be in service as a function of asset type (i.e., mechanical, structural, or electrical). It is used to aid in the determination of the remaining life of an asset. The OUL estimates for different types of assets are presented in Table 5.1.

| Table 5.1 Estimated OUL Based on Asset Category<br>Wastewater Treatment Facility Improvements Project<br>City of Arcata | | |
|---|---|---|
| **Asset Category** | | **Original Useful Life[(1)]** |
| Civil/Sitework | | 50 |
| **Structural** | | |
| | General/Other | 50 |
| | Concrete | 50 |
| | Fiberglass | 25 |
| | Steel | 25 |
| | Plastic | 10 |
| **Mechanical** | | |
| | General/Other | 20 |
| | Valves | 20 |
| | Pumps - Wastewater | 15 |
| | Chemical Equipment | 15 |
| | Coolers/Air Conditioners/Fans | 15 |
| **Electrical** | | |
| | General/Other | 30 |
| | Motor Control Centers | 30 |
| | Variable Frequency Drives | 15 |
| **Instrumentation** | | **10** |

Note:
(1) These values are selected based on a combination of the IIMM, Edition 2006, USEPA guides, other industry references, and Carollo experience.

These OULs were estimated based on industry standard guidelines published by the American Water Works Association (AWWA), the Water Environment Federation (WEF), and the American Society of Civil Engineers (ASCE). The International Infrastructure Management Manual (IIMM) and Carollo's internal discipline-specific experience were also referenced.

#### 5.3.2.2 Condition Scoring System and Remaining Life

The remaining life of an asset is important because this helps determine project prioritization for the development of the R&R CIP. Two factors contributed to the determination of the remaining life of each asset:

- The year of equipment installation.
- Field notes taken during the visual condition assessment.

After the site visit, the assets were evaluated and the condition of each asset was ranked on a one-through-five ranking scale, based on the IIMM. In the IIMM, condition is expressed in terms of the amount of repair needed to bring an asset to like-new condition. The definitions for the one-through-five condition ranking system from the IIMM are shown in Table 5.2. During and after the site assessment, the Carollo/LACO team asked questions and requested additional information regarding maintenance and performance history, documented design criteria, installation date, and typical condition parameters that could be used to standardize the procedure for future assessments. The assessments were visual assessments only and did not include diagnostic testing or entry into confined spaces.

**Table 5.2 Condition Ranking Scale**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| Ranking[1] | Description[1] | Percentage of Asset Requiring Rehabilitation[1][2] |
|---|---|---|
| 1 | Very good condition. | 0% |
| 2 | Good, only minor defects. | 10% |
| 3 | Fair to poor condition, maintenance required to return to accepted level of service. | 20% |
| 4 | Poor, requires rehabilitation. | 40% |
| 5 | Very poor or failed, asset unserviceable. | 90% |

Notes:
(1) Adapted from the International Infrastructure Management Manual. The IIMM manual is produced by a not-for-profit organization in New Zealand that develops asset management best practice publications (See http://www.nams.org.nz/).
(2) "Percentage of asset requiring rehabilitation" is that percentage of the value of the asset needed to return the asset to a condition ranking of one.

Assets that were identified to be in need of replacement within the 20-year planning horizon were incorporated into the asset inventory, which forms the backbone of the R&R CIP. Assets in good condition and that will not need to be replaced within the next 20 years will not be included in the R&R CIP.

## 5.4 VISUAL CONDITION ASSESSMENT RESULTS

The results of the ranking for each process area are summarized in Table 5.3 and outlined in more detail in the descriptions below. Pictures of the main process areas, including structures and equipment, are included in Appendix H, and are used to illustrate the process area ratings. An asset inventory with rankings is in included in Appendix I.

| Table 5.3 Summary of Process Area Rankings<br>Wastewater Treatment Facility Improvements Project<br>City of Arcata | | | |
|---|---|---|---|
| **Process** | **Average Condition - Mech./Elec./I&C** | **Average Condition - Structural** | **Average Remaining Mech./ Structural Useful Life** |
| Headworks | 4 - Poor | 3 - Fair | <5 / 20 |
| Primary Clarifiers | 5 - Very Poor | 5 - Very Poor | <5 / <5 |
| Oxidation Ponds | 5 - Very Poor | 4 - Poor | 10 / 30 |
| Pond Pump station | 4- Poor | 3 - Fair | <5 / 10 |
| Treatment Wetlands 1 to 4 | NA | 4 - Poor | Varies |
| Treatment Wetlands 5 & 6 | NA | 1- Very Good | |
| Pump Station 1 | 4 - Poor | 3 - Fair to 4 Poor | <5 / 20 |
| Enhancement Wetlands | NA | 4 - Poor | Varies |
| Enhancement Wetland PS | 4 - Poor | 4 - Poor | <5 / 10 |
| Chlorine Contact Basin | 2 - Good | 3 - Fair to 4 Poor | 10 / 20 |
| Chemical System | 3 - Fair | 3 - Fair | <10 / 20 |
| Digesters | 3 - Fair | 4 - Poor | 10 / <5 |
| Support Systems | 3 - Fair | NA | <5 / 10 |
| Electrical and Control Systems | 3 - Fair to 4 - Poor | NA | <5 / NA |

### 5.4.1 Headworks

The headworks facility consists of influent pumping, screening, flow measurement, and grit removal. The headworks were constructed in the 1984 project (CH2M HILL 1984). Overall, the headworks are in need of a major upgrade due to the condition of the equipment, which is approximately 30 years old and rated as poor.

#### 5.4.1.1 Influent Pumping

The influent screw pumps were rated as poor to very poor. Although the pumps are operational, they may be close to failure, based on the age, and observed condition. The pumps are open trough, Archimedean screw type units, which have a capacity of 2.5 million gallons per day (mgd) each. Redundancy is provided by a diesel driven bypass pump that can pump from the influent raw sewage wet well directly to the oxidation ponds. In addition, the First Street Pump Station can pump wet weather flows directly to the oxidation ponds.

The influent screw pumps are near or at the end of their life, and will likely require major maintenance if they are not replaced in the near term. For the purposes of this project, it was assumed that the pumps would be replaced with similar units, although the type of pump should be evaluated during predesign. Plant staff has indicated a preference for

submersible pumps, and may be interested in a retrofit for the headworks pumps with submersible units. When the pumps are replaced it is recommended that a redundant pump be provided.

#### 5.4.1.2 Influent Bar Screens

The influent bar screens were rated as poor to very poor and are worn beyond their service life. In addition, the bar spacing is wider than current standards, and will allow stringy rag type material to pass and collect in downstream processes. Like most California facilities, the plant staff is starting to see an increase in disposable baby wipes in the influent flow, which accumulate in the primary clarifiers and digesters, leading to additional maintenance. Each bar screen is sized for the full plant flow and, therefore, has sufficient redundancy. The screening conveyor is worn and has no redundancy.

A screenings washer/compactor was previously installed in order to reduce the water and fecal matter in the screenings. The unit subsequently failed and was removed by plant staff after mechanical failure. The failed unit will need to be replaced in order to achieve the required dry solids and pass the "paint test" required for disposal of the screening material.

#### 5.4.1.3 Flow measurement

The influent flow is measured in a parshall flume using an ultrasonic level sensor. Based on limited observations, the condition of the parshall flume insert is rated as fair. The measurement range of the flume should be verified in future predesign to confirm that it is operational for the range of dry and wet weather flows. The condition of the instrumentation was not observed. The flow measurement was reportedly upgraded prior to the 2003 Plant Evaluation.

#### 5.4.1.4 Grit Removal

The overall grit removal system was rated as poor and the tank was rated as very poor. It consists of a flat bottom, shallow grit separation tank, grit pumps, and a grit cyclone-classifier unit. This type of grit removal tank is no longer recommended and has been replaced in most installations. It generally has poor performance and has limited functionality for plants that experience a wide range of flows, such as the AWTF. It should be replaced during any headworks rehabilitation work. The grit handling system is similar to the equipment that would be specified and provided today. In general, all components have been well maintained, but are beyond their service life, and rated poor to very poor. While the grit pumps have adequate redundancy, they should be replaced. The grit cyclone/classifier was replaced in 2003. It has had major component replacement and appears to be nearing the end of its service life (15 years).

#### 5.4.1.5 Miscellaneous Headworks Components

The miscellaneous headworks components, including gates used for flow isolation and distribution, were rated as poor. They are original and are either at the end of useful life or

have failed. Staff has noted that some gates have failed or are stuck and cannot be operated.

#### 5.4.1.6 Headworks Structure

The headworks structure appeared to be visually in good shape based on the 30-year life and was given a fair rating. Based on review of the original construction drawings, it was noted that the structure is pile supported, and appears to have been designed based on the industry practice and code at that time for design and construction.

#### 5.4.1.7 Headworks Electrical/Controls

The headworks electrical system is fed from a single motor control center A (MCC A) in the generator building. The controls for all equipment were designed to provide monitoring and alarms at the control panel in the operations building. The equipment condition and service life is described further in the Plant Electrical and Controls section below.

### 5.4.2 Primary Clarifiers

The plant has two primary clarifiers:

- Clarifier No. 1: 26-foot diameter unit.
- Clarifier No. 2: 60-foot diameter unit.

Generally, Clarifier No. 2 is used continuously and Clarifier No. 1 is used intermittently for peak wet weather flows. The units seem sufficient for the design flows, although the peak loading rates may result in reduced performance. Overall the units are rated as poor to very poor, especially based on age.

#### 5.4.2.1 Clarifier Mechanism

The age of the clarifier sludge collector mechanism in Clarifier No. 2 is unknown. It appears older and reportedly is in need of major rehabilitation or replacement. The clarifier sludge collector mechanism in Clarifier No. 1 appears newer, and is not used very often, and is therefore in better shape. The drive type and age of each drive is unknown. The coating for the mechanism in unit No. 2 has failed and was reportedly failing in 2002. The Clarifier No. 2 mechanism is rated as very poor. Reportedly a large crack is visible in the center column when the unit is out of service. The Clarifier No. 1 unit is rated as poor due to its observed condition. The structures are rated as very poor based on their age.

#### 5.4.2.2 Sludge Pumping

The primary sludge pumps are progressing cavity type pumps. The age of the primary sludge pumps is unknown. Corrosion was observed on the bases. At least one pump has been rebuilt in the last 10 years. The high pressure shutoff switches on the pumps are functional, but very old. These are rated as fair to poor.

#### 5.4.2.3 Scum Pumps and Scum System

The scum pumps and scum collector/concentrator are approximately 15 years old. They are rated as fair to poor condition.

#### 5.4.2.4 Primary Clarifier Structure

The Clarifier No. 1 structure appears to have been built around 1957 based on records provided by the City that indicate piles for the structure were driven around that time. Clarifier No. 2 was added later, although the date is unknown. Both units are shown in drawings dated 1971. The condition of both units is poor to very poor based on the age, concrete corrosion and cracking of the effluent launders. The walkways and handrail on Clarifier No. 1 do not meet current codes for worker safety. The interior coating on both units has failed and exposed the concrete to sulfide corrosion at the water surface. The structure will need to be replaced when the mechanism is replaced due to age and requirements to meet current building codes.

### 5.4.3 Oxidation Ponds

The oxidation ponds have been in service since the plant was originally put in service in the 1950s. Originally there was one large pond, and later it was subdivided into Ponds 1, 2, and 3. The ponds are shown as one large pond in the 1979 Winzler and Kelly Project (WK, 1979). There is little documentation on pond construction, except that they were formed from native materials, likely using cut and fill construction methods.

The ponds have the following physical characteristics:

- **Pond No. 1.** Average operating depth is 4 to 6 feet, area is approximately 24 acres, and the total volume is 46 million gallons (MG).
- **Pond No. 2.** Average operating depth is 4 to 6 feet, area is approximately 22 acres, and the total volume is 43 MG.

With the exception of effluent pumping and aerators, there is very little equipment in the oxidation ponds. Flow enters Pond No. 1 from the primary clarifiers, and is transferred by gravity to Pond No. 2. The transfer structures are generally overflow structures with only manual weirs. Recently, the transfer structures from Pond No. 2 to treatment wetlands Nos. 5 and 6 have been upgraded with automated weirs that are controlled based on pond level. The oxidation ponds are rated as very poor for mechanical equipment and very poor for structural condition.

The ponds reportedly operate at a depth of 4 to 6 feet. The actual depth and therefore the volume is reportedly impacted by biosolids or sludge accumulation. The amount of sludge in the ponds is difficult to estimate, although the most recent survey indicates that solids range from 6-inches to 3 feet, and average about 10 to 12 inches over the area of the ponds. Since the ponds are fairly shallow, the impact of solids accumulation can be significant. Accumulated sludge in the ponds can lead to degradation of effluent quality,

especially due to pond turn-over events that re-suspend solids in the water, and reduction in pond detention times.

The overall process performance of the oxidation ponds is evaluated elsewhere in this report. The main process concern has been the treatment capacity of this process once the plant is reconfigured to a one pass system. The ponds provide the secondary process for the AWTF, especially biochemical oxygen demand (BOD) removal. The pond treatment process should be evaluated together with the treatment wetlands to ensure that permit requirements can be meet with this process at the design flowrates. Reported issues include potential short circuiting in pond No. 2 from inlet to outlets, low BOD removal from ponds during certain times of the year, and variable pond outlet nitrogen concentrations. In addition, algae production in the ponds contributes to total suspended solids (TSS) increase in the pond effluent.

#### 5.4.3.1 Pond Aerators

Eight mechanical pond aerators are located in Pond No. 1, based on recent satellite photography. Note that the O&M manual mistakenly indicates they are located in Pond No. 2. The aerator controls were upgraded in 2008, when dissolved oxygen control was added to save energy. The existing units are in poor condition, and several have not been used for a number of years.

The 2003 plant evaluation indicated that four aerators were located in Pond No. 1, and several additional aerators were yet to be installed. The overall purpose and use of the aerators should be clarified, since aerator installation can be costly due to the electrical improvements required to support aerator installation.

The aerators are the type with a propeller that creates vacuum and discharges air into the pond surface. These units are inefficient and generally used in ponds that require little aeration, and some mixing. The pond aerators could be replaced with horizontal type units that will improve aeration and mixing. They could be used to create flow patterns that reduce and prevent short circuiting. The location and size of the replacement units can be defined in subsequent predesign work. The condition of the aerator electrical service is not known, although some of the transformers reportedly may need replacement.

#### 5.4.3.2 Pond Pump Station (PPS)

The PPS pulls from Pond No. 2 and discharges to the chlorine contact basin (CCB). It was built as part of the 1984 upgrade project and shares a common wall with Pump Station 1 (PS1), which is discussed later in this chapter. The wet well of the two pump stations can either be separated or combined via an isolation slide gate on the interior wall of the structure. The pump station structure is in fair condition, and has had some corrosion.

The vertical turbine pumps appear to be in poor to very poor condition, and are at the end of their service life. These pumps need to be replaced. The type and size of the replacement pumps should be reviewed during the next predesign phase of work.

The condition of the electrical service for these units and the controls is unknown. It has been suggested that these pumps should be retrofit with variable frequency drives (VFDs) in order to vary the pump speed and capacity and control wet well level.

#### 5.4.3.3 Emergency Pond (2) Pump Station (EPPS)

The EPPS provides for a failsafe operation, and can pump directly from Pond No. 2 to the CCB. The pumps are self-priming centrifugal type units. Staff reported that the emergency pumps and piping were refurbished in 1996 and are rated as fair. The complete scope of the rehabilitation is unknown, but the units appear to be ready for service.

### 5.4.4 Treatment Wetlands

The treatment wetlands (TWs) have very little mechanical equipment or structures. Each wetland has one or two inlet structures, or in one case an inlet pump station, from Pond No. 2. The treatment wetlands were first planted and brought on line at different dates, and therefore are at different levels of maturity. The condition of each wetland is outlined below:

- TW Nos. 1 and 2 were first created by building berms in the 1984 modifications project. Average depth is approximately 4 feet. It is not known when they were planted, but the vegetation in both cells appears mature, very dense and reportedly has become so thick, that most of the vegetation is floating. In addition, these cells were never graded, or leveled, and reportedly the east side of TW No. 1 is deeper. Based on this report and visual observations, the condition is rated as poor to very poor, and is in need of a major vegetation management removal and replanting project. These cells appear to be fed from Pond No. 2 from two inlet structures per TW.
- TW No. 3 was created sometime after 1 and 2, and has fairly dense, floating vegetation. While it is not as dense or overgrown as 1 and 2, it is also rated poor due to the lack of grading and open water for reaeration. It should be scheduled for vegetation management once 1 and 2 have been graded, revegetated, and are back online. This cell is feed from a single inlet structure from Pond No. 2.
- TW No. 4 appears to have been built in the location of the sludge drying beds shown in the 1984 project. This cell is fairly shallow, less than 3 feet, and is fairly densely planted. A portion of this cell has floating plants as well. It is feed from a single pump, located in the eastern TW 1 inlet structure. It has been used as a pilot and demonstration cell over the years. It should be deepened if it is to be used as a treatment wetland. Otherwise it can be maintained as a pilot cell. This wetland was not rated based on it use as a demonstration wetland.

  TW Nos. 5 and 6 were constructed in 2012 from Pond No. 3 (Figure 5.2) and brought online in 2013. These TWs were designed with a series of deep settling zones, followed by intermediate depth zones to be covered by floating wetland plants similar to the other TWs, followed by shallow zones with rooted wetland plants such as bull

rush. The shallow zones help to distribute flow, while the deeper zones allow for some reaeration. The cells are divided using interlocking vinyl sheet piling. The vegetation is fairly dense, but there is some deeper, more open water, less dense areas in the beginning and middle of each cell. These cells are fed directly from Pond No. 2, from single inlet structures. The grading and planting conceptual design is shown in Appendix J, based on correspondence from Dr. Robert Gearheart. These cells are rated as fair to good and should have ongoing vegetation maintenance to maintain this rating.



Figure 5.2 Treatment Wetlands (Circa 1989)

- TW No. 7 has been planned since the creation of TW Nos. 5 and 6. It is recommended that TW No. 7 be constructed fairly soon. Once constructed, it will provide additional treatment capacity and will allow for other cells to be removed from service for replanting.

The overall process performance of the treatment wetlands is evaluated elsewhere in this report. The main process concern has been the hydraulic capacity of this process once the plant is reconfigured to a one pass system, especially at the design flowrates. The process should be evaluated together with the oxidation ponds to ensure that permit requirements can be meet with this process at the design flowrates. Reported treatment issues with the treatment wetlands include short circuiting from inlet to outlet, uneven flow distribution

between treatment wetlands, and low effluent dissolved oxygen levels in conjunction with hydrogen sulfide generation. In addition, some wetland cells may be underperforming compared to others, due to the short circuiting and dense vegetation. The older treatment wetlands 1 to 4 are rated as poor due to deferred maintenance and inconsistent configuration, and treatment wetlands 5 and 6 are rated as very good based on the recent construction.

#### 5.4.4.1 Pump Station 1

Pump Station No. 1 (PS1) receives flow from TW Nos. 1 through 4 and discharges to the CCB. It was constructed as part of the 1984 project. The equipment in the pump station was rated as poor and the structure as fair to poor. The vertical turbine type pumps are at the end of their life and need to be replaced. These could possibly be replaced with submersible type pumps, which can be evaluated during the predesign stage of the project.

The condition of the structural and electrical is unknown. Currently the pumps operate in an off/on mode, based on level, with a lead lag and standby pumps. Two of the pumps have VFDs in order to vary the pump speed and capacity to control wet well level.

#### 5.4.4.2 Pump Station 2

Pump Station No. 2 (PS2) receives flow from TW Nos. 5 and 6 and was originally constructed to discharge directly to the CCB, but are now redirected back to Junction Box 1 which conveys flow to Pump Station 1. This pump station was originally constructed in 1990s by City staff to serve Oxidation Pond 3 storm flows and then repurposed for TW Nos. 5 and 6 in 2012. Therefore, the pumps are older and maybe at the end of their life. Pump station hydraulics should be reviewed during predesign to confirm the capacity still matches the required capacity, since the flow has been redirected. Reportedly the pump station is shallow and would need to be deeper in order to handle design gravity wet weather flows flow from the wetlands. The structure was completed by plant staff, and is not pile supported as required. The pumps are rated as poor and the structure as poor to failed.

The condition of the structural and electrical is unknown. Based on the O&M manual these pumps have VFDs and can be controlled to maintain wet well level.

#### 5.4.4.3 Inlet and Outlet Structures

The condition of the inlet and outlet structures for the TWs was reviewed briefly during the site inspection. They appear to be in fair condition given their age.

### 5.4.5 Enhancement Wetlands

The enhancement wetlands are the main feature of the Arcata Marsh and Wildlife Sanctuary (AMWS). The AMWS consists of three freshwater wetlands: Allen, Gearheart, and Hauser enhancement marshes or wetlands. The wetlands receive treatment wetlands effluent that is regulated to be equivalent to a secondary treated wastewater effluent. The

wetlands provide polishing of the treatment wetlands effluent while providing habitat for a diverse number of organisms, and recreation opportunities.

#### 5.4.5.1 Enhancement Wetlands

The enhancement wetlands (EWs) were constructed from native materials in much the same manner as the TWs. They operate in series, connected by a series of effluent lines, with inlet and outlet structures. The EWs were not surveyed in detail for this report, but previous reports were reviewed to determine if there were any improvements that had been identified for the wetland operation. The main feature noted was the potential for short circuiting, based on the vegetation and construction of channels that may lead to reduced detention time. Therefore the EWs are rated as poor, and improvements that maximize the hydraulic detention time are included in the capital improvement program.

The overall process performance of the enhancement wetlands is evaluated elsewhere in this report. The main process concern has been the hydraulic capacity of this process once the plant is reconfigured to a one pass system, especially at the design flowrates. The process should be evaluated together with the treatment wetlands to ensure that permit requirements can be meet with this process at the design flowrates. Reported treatment issues with the enhancement wetlands include short circuiting from inlet to outlet and low effluent dissolved oxygen levels in conjunction with hydrogen sulfide generation. In addition, algae production in the wetlands may contribute to TSS increase in the enhancement wetland effluent. Therefore they are rated at fair to poor based on deferred maintenance, flow short circuiting, and transfer structure issues.

#### 5.4.5.2 Enhancement Wetlands Effluent (Hauser) Pump Station

The Enhancement Wetlands Pump Station (EWPS) or Hauser PS was constructed as part of the 1984 plant modifications. It consists of three vertical turbine pumps located in a concealed wet well in the public access area of the AMWS. The pumps were rated as poor and will need to be replaced to provide the capacity for the new flow configuration. The use of the existing wet well will be further reviewed as part of the preliminary design for the UV disinfection and flow reconfiguration project.

In general the structure appears to be in fair to poor condition based on the age. The structure is pile supported, and does not appear to have any settlement issues. The way the pumps were concealed makes the PS maintenance difficult, and contributes to the poor rating. Three large hatches were placed over the vertical turbine pumps, so they could be removed, but the space is a confined space with limited access. Other types of pumps including submersible type might be considered to allow for ease of maintenance, and to reduce the access issues.

The pump station intake or inlet structure includes two inlets that draw at different elevations from the Hauser wetland. One inlet is clogged and has not worked for over a decade. These combine in an inlet box into a single inlet line into the PS wet well. The 16-

inch inlet lines will need to be checked to confirm they provide the required capacity for the flow reconfiguration. The inlet structure is also pile supported. Plant staff has added a manual coarse screen in the outlet from the box to remove larger debris before it enters the wet well. The need for an automated screen will be reviewed in predesign.

The PS discharges to the existing CCB, for disinfection prior to discharge at Outfall 001. The piping will be retained for future diversion to the existing outfall if needed. New piping and valves will be added to allow discharge to the new UV disinfection facility and then gravity flow to Outfall 003.

### 5.4.6 Disinfection

The existing disinfection system consists of the CCB, chlorine storage and feed building and associated equipment. The system was constructed in the 1984 improvements project. The conditions of the major elements are outlined below.

#### 5.4.6.1 CCB

The CCB consists of two 4-pass basins that can be operated in series or combined modes. The basin is a pile supported, cast in place concrete structure with concrete masonry block divider walls. The structure condition appeared to be fair to poor based on the age of construction, and the divider wall construction. The divider walls are reinforced grout filled walls that may not have structural capacity for a seismic event. The handrail was observed to be in good condition. The condition of the isolation gates and appurtenances is poor with some gates that are difficult to operate. The chemical induction mixers and mechanical equipment are nearly 20 years old and rated as fair.

#### 5.4.6.2 Chemical Storage and Feed Facilities

The disinfection chemical storage and feed system is based on ton cylinder liquid chlorine (CL2) and sulfur dioxide (SO2) tanks. The tanks are connected in parallel to provide sufficient capacity. The condition of the system was not assessed in detail since it was assumed it would be phased out, or operated intermittently once the new UV system was implemented. It was noted that the current ton cylinder storage building was in fairly good shape, and might be repurposed for other uses once the system is off-line. It could be used for a liquid chemical system. It consists of a pile supported slab with CMU walls, and fairly tall peaked roof open building structure.

#### 5.4.6.3 Miscellaneous Chlorine Disinfection Facilities

The miscellaneous facilities and their condition are noted below:

- Chemical residual analyzers - fair condition.
- CCB sample pumps replaced on a regular basis using disposable units - fair condition.

- CCB gates - poor condition.
- Chlorine and Sulfur dioxide induction mixers are newer and are rated as good.

## 5.4.7 Solids Handling and Treatment

The solids handling and treatment facilities include primary and secondary digesters; digester mixing and heating facilities; sludge drying beds and compost operation; and digester gas handling. The condition of these facilities is outlined below.

### 5.4.7.1 Digesters Structure

The digesters were constructed as part of the original plant in the late 1950s. The primary digester was upgraded in the 1984 project, including increasing the overall height. Floating gas holder roofs were added at that time as well. The condition of the digester structure appears to be poor, although they have not been inspected by a structural engineer. The condition of the dome roof is unknown, but it is known that has been inspected and the exterior recoated as some point. The condition of the covers interior was not observed, although the 2003 plant evaluation also recommended an inspection and coating if required. Due to the lack of redundancy, this inspection may be difficult, and therefore has been put off by plant staff.

Staff noted that the digesters have been cleaned recently, in both 2002 and 2014. No reports were available on the condition of the digesters once they were cleaned.

### 5.4.7.2 Digester Mixing and Heating

The heating and mixing system for Digester No. 1 was upgraded in 2002 (Rotamix nozzles) and in 2013 (new mixing nozzles and mixing / recirculation pumps). The condition of this equipment appears to be good to fair. The boiler was reportedly replaced in 1998 or 1999. Issues with the existing digester gas piping were noted in the 2003 plant evaluation, and should be confirmed.

### 5.4.7.3 Sludge Drying Beds

The sludge drying beds were built as part of the 1984 project. These beds were covered with a canopy type roof. The condition of these original drying beds was rated as fair. Plant staff noted that additional drying beds could be used, or replaced with mechanical dewatering equipment.

#### 5.4.7.4 Compost Operation

The components of the sludge and green waste compost process were not reviewed during the condition assessment and plant site walk.

### 5.4.8 Plant Electrical and Controls

The plant electrical and control systems are generally in fair to poor shape due the age of the equipment. Reportedly buried conduit has deteriorated in many locations, and now is just bare wire. Reportedly, the wire and cabling is need of replacement as well. The majority of the electrical equipment and control systems are the original equipment installed as part of the 1984 project.

The plant control system is outdated and does not provide some of the current labor saving features that are found in almost all systems today. These include:

- Remote operation. Currently, most equipment must be controlled at the process area only, and little if any equipment may be remotely operated.
- Remote access. This would allow alarm conditions to be reviewed by the facility manager without having to visit the plant.
- Data collection and logging. This would aid in monthly reporting and maintenance planning.
- Compatibility with new controls. Currently, new equipment with programmable logic controller (PLC) based controls cannot be integrated into the existing system.
- The system does not have the ability to integrate the collection system monitoring and control systems.

The rating of the major system components is noted below:

- Power Distribution - The MCC equipment was installed in the 1984 project, and is mostly original. The main plant MCC equipment is located in the standby generator building. The equipment including MCCs and transfer switch is in fair condition.
- Standby Generator - The plant main standby generator was replaced by staff in a recent in-house project. The installation looks good, and is reportedly working well. The unit is 250-kW. The new unit is in good condition. An older, smaller, 150-kW unit is available as a backup, although its condition is unknown.
- Plant power feed - The condition of the plant power feeder from the utility was not reviewed, although plant staff has noted the main transformer is old. Staff reportedly tests the oil in each transformer in order to anticipate transformer failure and replacement needs.

## 5.5 SUMMARY OF PLANT CONDITIONS

Overall the plant assets and equipment is in fair to poor condition. While this will not be a surprise to plant and City staff, it does indicate a need to complete a comprehensive update the existing capital improvement plan to bring the assets into better ratings. Therefore, in addition to the current project to meet the conditions of the discharge permit, ongoing projects will be required to rehabilitate the aging infrastructure and maintain the ability to meet permit requirements. The recommended CIP is provided as Chapter 6.

## 5.6 REFERENCES


- CH2M Hill 1984 - Wastewater Treatment Plant Modifications 1984.
- WK 1997 - Winzler and Kelly 1997.
- SHN 2003 - 2000/2002 Wastewater Treatment Plant Evaluation 2003.
- O&M - Arcata Wastewater Treatment Facility Operation and Maintenance Manual ND.

# ALTERNATIVES

## 6.1 INTRODUCTION

Based on the findings of the previous chapters, there is a need to develop and evaluate alternatives that meet current and future treatment objectives and permit compliance requirements. Drivers for these alternatives include:

- Current permit requirements (new flow configuration with enhancement requirement and UV implementation).
- Ongoing permit violations.
- Need to repair/rehabilitate aging infrastructure.
- Deferred maintenance of the existing ponds and wetlands system including build-up of solids and materials causing an internal load.
- Identified shortfall in secondary treatment capacity with elimination of chlorine.
- Future regulations on ammonia/nutrients.
- Future sea level rise and flooding concerns.

This chapter describes the project options considered and the methodology for selection of recommended alternatives that best meet the multiple goals of the City.

## 6.2 BASIS FOR ALTERNATIVES

The design flow and loads were determined in Chapter 2 and are shown in Table 6.1. These loads include a 20 percent growth factor over existing 90th percentile loads. This allows for confidence in sizing facilities to be able to meet permit requirements in most conditions that will be seen by the Arcata Wastewater Treatment Facility (AWTF).

All alternatives should provide reliable treatment capacity for design load, provide flexibility to meet future regulatory requirements (such as ammonia removal), and must be able to fit on the existing site since additional bay fill is not permitted and additional land is not available near the AWTF. Furthermore, as discussed in the June 27, 2016 meeting with the RWQCB, the Enclosed Bays and Estuaries Policy requires effluent enhancement prior to discharge; bypassing enhancement is no longer acceptable based on current permit requirements.

It is recognized that the existing natural land based system is a point of pride in the community and heralded as a model of sustainable, land-based treatment. Therefore, it is desirable to continue using the pond and wetland system to the best of their abilities and to

improve them through solids removal and vegetation management to increase their reliability.

| **Table 6.1 Design Flow and Loads With 20% Growth Projection Wastewater Treatment Facility Improvements Project City of Arcata** | |
|---|---|
| Average Dry Weather Design Flow, mgd | 2.3 |
| Peak Wet Weather Design Flow, mgd | 5.9 |
| Design Influent $BOD_5$ Load, ppd | 4,800 |
| Design Influent TSS Load, ppd | 6,910 |
| Design Influent Ammonia Load, ppd | 1,060 |

## 6.3 SUMMARY OF COMMON IMPROVEMENTS NEEDED

Based on the findings of Chapter 5, Condition Assessment, numerous facilities will need to be improved based on their expected useful life and current condition. In addition, there are many common elements needed for the new flow configuration. Common elements for all alternatives include:

- **Headworks Improvements**: The headworks are currently rated at 5.0 million gallons per day (mgd) and the visual condition assessment rated the average mechanical, electrical and I&C condition as poor. The recommended headworks improvement is to replace structural and mechanical assets due to age and condition, and to upsize the capacity to handle design peak wet weather flow (PWWF) of 5.9 mgd. Replacing the headworks structure will also raise the hydraulic grade line at the start of the plant, allowing downstream facilities to flow by gravity and minimizing the need for additional pumping.

- **Primary Clarifiers**: The two primary clarifiers are currently rated at 4.0 mgd and 1.0 mgd each, and the condition assessment rated the mechanical, structural, electrical and I&C condition as very poor, especially based on their age. The recommended improvement is to replace structural and mechanical assets due to age and condition. The capacity of the primary clarifiers will vary depending on the project alternative requirements.

- **Primary Sludge and Scum Pumps**: The age of the primary sludge pumps are unknown and the scum pumps are 15 years old. Visual condition assessment rated the average mechanical, electrical and I&C condition as fair to poor. The recommended improvement is to replace the primary sludge and scum pumps due to condition along with the primary clarifiers. The capacity of the primary sludge and scum pumps will vary depending on the project alternative requirements.

- **Oxidation Pond Nos. 1 and 2 Solids Removal and Transfer Structure Reconfiguration**: Solids accumulation in the oxidation ponds is affecting treatment and hydraulic capacity. Up to one foot of solids in each pond is anticipated needing dredging, dewatering, and disposal in order to return the ponds to original design intent. Reconfiguration of the pond transfer structures is recommended for better flow distribution and improvement of storage capacity.

- **Emergency Pond Pump Station**: The existing pump station has a firm capacity of 3.6 mgd and pumps peak wet weather flows above 5.9 mgd from Oxidation Pond No. 2 to the chlorine contact basin, for discharge through Outfall 001. Plant staff reported that the pumps are older, but in good condition due to low operating hours. Recommended improvements include adding suction and discharge piping to allow the pump station to pump out of Pond 1 and into Pond 2 for Pond 1 storage control; pump rehabilitation is not anticipated to be needed.

- **Treatment Wetland Nos. 1 through 4 Solids and Vegetation Maintenance**: Solids accumulation and heavy vegetation growth in Treatment Wetland Nos. 1 through 4 is affecting treatment and hydraulic capacity. Solids and vegetation removal, regrading of the deep and shallow water zones, and vegetation replanting is anticipated in the four older treatment wetlands in order to return them to original design intent. No maintenance project is currently planned in Treatment Wetland Nos. 5 and 6 due to their recent construction. Treatment Wetland No. 4 will require substantial regrading to deepen and provide the same capacity as the other treatment wetlands.

- **Treatment Wetland No. 4 Influent Pumps and Treatment Wetlands Pump Station 2**: These pumps will need to be further evaluated during preliminary design to determine whether pump replacement is required or whether pumps can be demolished with rehabilitation of the other treatment wetlands improvements.

- **Enhancement Wetlands Improvements:** Solids accumulation and heavy vegetation growth in the enhancement wetlands is affecting treatment and hydraulic capacity. As Waters of the State, major regrading or any activities that significantly reduce water quality or habitat will not be allowed in the enhancement wetlands. Vegetation maintenance, new baffles, and new inlet/outlet structures is anticipated in all three enhancement wetlands in order to improve treatment and hydraulic efficiency and capacity.

- **Pond Pump Station/Pump Station 1**: Pond Pump Station has an existing firm capacity of 2.9 mgd and Pump Station 1 (Treatment Wetland PS) has an existing firm capacity of 2.3 mgd. The visual condition assessment of both pump stations rated the average mechanical, electrical and I&C condition as poor (score of 4), and structural condition as fair to poor (score of 3 and 4). The recommended improvement is to replace mechanical assets due to age and condition and to upgrade the combined

wet well in order to improve flow by gravity upstream. The new capacity of each pump station will vary depending on the project alternative requirements.

- **Enhancement Wetlands (Hauser) Pump Station:** Enhancement Wetlands Pump Station originally had a firm capacity of 3.0 mgd, but recent pump capacity tests have derated the capacity to 1.2 mgd. The visual condition assessment of both pump stations rated the average structural, mechanical, electrical and I&C condition as poor (score of 4). The recommended improvement is to replace mechanical assets due to age and condition. The new capacity of the pump station and capacity of the discharge pipe to the new UV system will vary depending on the project alternative requirements. In general, it is agreed by the City, AMRI, and Carollo that the Enhancement Wetlands will perform best at steady lower flows. Holding the flow to 2.3 mgd for Alternatives 1, 2 and 3 was recommended. However this should be considered again during preliminary design given the RWQCB position (stated at the 6/27/16 meeting) that all flow must pass through the enhancement wetlands to meet the definition of enhancement. Further inspection of the existing 16-inch pump station discharge piping during Preliminary Design is also recommended to confirm condition and any rehabilitation required. Based on the most recent alternative (No. 4), it is recommended that the pump station be sized for up to 5.9 mgd.

- **Anaerobic Digesters and Sludge Heating/Mixing System**: The two anaerobic digesters are almost 60 years old. The external visual condition assessment rated the average structural condition as fair but the internal structural condition is unknown. The sludge heating and mixing system appears to be in good to fair condition. The recommended improvement is to improve structural and mechanical assets in phases. The required project elements and recommended implementation schedule will vary depending on the project alternative requirements.

- **Outfall 003**: New Outfall 003 at the Brackish Marsh and effluent piping from the UV disinfection system will be sized for 5.9 mgd.

- **UV Disinfection:** A new UV disinfection system will be constructed for disinfection of secondary effluent up to 5.9 mgd. The design criteria of the UV system will vary depending on the project alternative requirements. UV disinfection is further discussed in Chapter 7, Disinfection Alternatives.

## 6.4 IDENTIFICATION OF SECONDARY TREATMENT OPTIONS

Identification of secondary treatment options is needed to address the secondary treatment capacity shortfall. This task was completed in phases. The first phase consists of a preliminary screening of new secondary treatment options to be used in conjunction with the existing natural system for pretreatment, parallel treatment, or post treatment. Any of these treatment options deemed feasible were further discussed and evaluated with the City.

### 6.4.1 Preliminary Screening of Secondary Treatment Options

There are several treatment processes that can be used to provide additional secondary treatment capacity, either alone or in combination with other processes, in order to achieve desired effluent water quality. Table 6.2 provides a list of secondary treatment processes that are commonly considered, along with the constituents they most commonly remove.

**Table 6.2 Secondary Processes Meeting Permit Discharge Requirements Wastewater Treatment Facility Improvements Project City of Arcata**

| Process | Ability To Remove | | |
|---|---|---|---|
| | Organics (BOD)[1] | Ammonia[2] | Total Nitrogen[2] |
| **Suspended Growth** | | | |
| Activated Sludge | √ | √ | √ |
| **Attached Growth** | | | |
| Trickling Filters | √ | | |
| Nitrifying Trickling Filters | | √ | |
| Denitrification Filters | | | √ |
| **Land Based Systems** | | | |
| Ponds (Aerated or Not) | √ | Summer only | |
| Vegetated Wetlands | √ | limited | If nitrified before |
| Open Water Wetlands | √ | Some | If nitrified before |

Notes:
(1) Current permit discharge requirement.
(2) Anticipated future permit discharge requirement.

While there are variations of activated sludge processed such as oxidation ditch, conventional activated sludge, sequencing batch reactors, or a membrane bioreactor that adds a membrane filter, the biological treatment process is the same. Similarly, there are various attached growth processes that incorporate different types of media that the biological growth attaches to, but the treatment process is essentially the same.

In addition to the secondary processes presented above, there are some physical and chemical processes that could be considered. There are several approaches that could be taken with any additional treatment process: 1) pre-secondary treatment (pretreatment) by adding processes before the existing pond/wetlands system, 2) parallel secondary treatment, and 3) post-secondary treatment (post treatment, after the pond/wetlands). Each alternative considered needs to fit with a final UV disinfection step, as the City Council has affirmed several times the decision to move away from chlorine and instead use UV. Initial options that fall into each of these categories are shown in Table 6.3.

Of the options considered, there are only a few that Carollo recommends carrying forward for a variety of reasons, as discussed below. Any process that requires piloting at the

AWTF was eliminated to meet the accelerated schedule for permit compliance. Any process that is not yet a proven technology with full-scale installation experience was also eliminated early in the alternatives analysis.

**Table 6.3 Initial Screening of Pre, Parallel and Post Treatment Options Wastewater Treatment Facility Improvements Project City of Arcata**

| | Treatment Option | Adds BOD Capacity | Removes Ammonia | Improves Final UVT | Reliable | Move Forward |
|---|---|---|---|---|---|---|
| Pretreatment | Chemically Enhanced Primary | < 400 ppd | No | No | Yes | No - high O&M cost |
| | Aeration | yes | limited | No | Yes | Yes |
| | Trickling Filter | yes | only if 2-stage | No | Yes | No |
| | Activated Sludge | Yes | Yes | No - TM degrades | Yes | No |
| Parallel | Additional Ponds/Wetlands | Yes | Summer only | No | Maybe | No - no room |
| | Rehabilitate Ponds/Wetlands | Yes - not enough | Summer only | No | Maybe | Yes |
| | Trickling Filter | Yes | only if 2-stage | No | Yes | Yes |
| | Activated Sludge | Yes | Yes | Yes | Yes | Yes |
| Post Treatment | Trickling Filter/Nitrifying Trickling filter | Yes | only if 2-stage | No | No - cold affects performance | No - not as flexible |
| | Submerged Biofilter | Not proven | Need to pilot | No | Unknown | No |
| | Ozone/Biological active Filtration | Yes | Maybe - must pilot | Not needed | Maybe - must pilot | No -Need to pilot |
| | Filtration | < 400 ppd | No | Maybe | Yes | No -Need to pilot |

Pretreatment:

- Chemical pretreatment in the primaries would add a significant operations cost with only an additional 10 percent removal of BOD across the primaries, which does not meet the shortfall.
- The existing Pond 1 aerators could remove BOD if they were functioning and designed for the appropriate conditions (e.g. pond depth, location). In the new flow routing, Pond 1 will be used for both treatment and storage at peak wet weather flows. Therefore, the use of aerators in Pond 1 is not recommended due to variable operating depth. Pond 2 will be used for only treatment, and thus adding aerators to Pond 2 will be considered.

- Trickling filters, while a proven and effective treatment process, are poor processes upstream of UV, and do not have the flexibility to remove ammonia or nitrogen unless more than one unit is installed in series.
- Activated sludge upstream of the existing natural system would improve water quality, but to be most effective as pretreatment it would have to be sized for the full flow which would require a high O&M cost due to aeration requirements. One disadvantage is that improved UV Transmittance (UVT) from activated sludge effluent would degrade across the existing natural system.

Parallel Treatment:

- Additional ponds or wetlands could provide the needed BOD treatment; however, land is not available for building new ponds or wetlands sufficient to meet the capacity shortfall. As Waters of the State, the AMWS cannot be modified to function as treatment wetlands since significant regrading would be required to create alternating deep and vegetated zones. Additional ponds or wetlands would not provide year-round ammonia or nitrogen removal, since the natural removal process is dependent on temperature and sunlight.
- Trickling filters, while a proven and effective treatment process, are poor processes upstream of UV, and do not have the flexibility to remove ammonia or nitrogen unless put in series. However they were carried through the initial screening.
- Activated Sludge processes provide both BOD and ammonia/nutrient removal and provide the most flexibility for additional treatment. As parallel treatment the process could be sized for a portion of the full flow which would reduce O&M cost due to aeration requirements.

Post Treatment:

- A weakness of any attached growth process (trickling filters or nitrifying trickling filters) is that they are sensitive to temperature. If the ponds and wetlands are located upstream of an attached growth process, the system will have unreliable performance in the winter months. Additionally, ammonia removal in attached growth processes has been shown to be difficult following ponds and wetlands (e.g. City of Stockton). In the summer months while ponds are reducing ammonia, the biological organisms are being starved, leading to violations in the fall when additional treatment is needed. Additionally, lightly loaded trickling filters (e.g. nitrifying trickling filters) are prone to attracting snails that strip the biological process from the media. Additional operations expenses are required to control the snails.
- A submerged biofilter is another attached growth process that was considered. However, it is our opinion that the same ammonia starving issue that happens with nitrifying trickling filters and potential poor performance in the cold months will likely happen with submerged biofilters.

- Biological active filtration paired with ozone has shown the ability to produce high quality water. However, it is unknown how such a process would perform on pond/wetland effluent. This process would require piloting. From experience at other installations, the process can be fairly expensive. In addition, the use of ozone requires special operation training and attention. Therefore, this alternative is not considered further.
- Filtration is a common process to add after secondary treatment to produce a high quality water. However, filtration following pond/wetland processes has been shown to be more difficult, requiring much lower loading rates (more filters) and high chemical (coagulant) doses in Cities of Napa, Sunnyvale, and Stockton. Additionally, it is only likely to reduce BOD by approximately 20 milligrams per liter (mg/L) or less than 400 ppd. Pilot testing would be required to determine the UVT after filtration as well as the acceptable filter loading rate and coagulant dose.

Summary of Initial Screening:

- The viable pretreatment alternative to be further considered is aeration in Pond 2.
- The viable parallel treatment alternatives to be further considered are rehabilitation of the ponds/wetlands, trickling filters, and activated sludge.
- None of the post treatment alternatives will be further considered.

### 6.4.2 Further Screening of Parallel Secondary Treatment Options

At the November 5 and 6, 2015 facility plan capacity workshop with the City staff and City consultant Bob Gearheart (with AMRI), a more detailed analysis of parallel secondary treatment options was discussed, including:

- Conventional activated sludge (CAS) aeration basins.
- Extended aeration activated sludge (oxidation ditch).
- Trickling filters.
- Modifying existing oxidation ponds to a Biolac system or aerated lagoons.

As discussed at the workshop, modifying the existing oxidation ponds to a Biolac system or aerated lagoons was deemed not feasible due to constructability issues with the berms and pond depths. For workshop discussion purposes, preliminary design criteria were presented for the remainder of the options in order to present comparative information. Hence, preliminary design criteria were developed based on flow design criteria shown in Table 6.4. These preliminary design criteria are outlined in Table 6.4. Note that following the November 2015 workshop, additional City flow and load data was provided to Carollo in order to further refine the load design criteria to the values presented in Table 6.4.

During the November 2015 workshop, discussion of the treatment options included a number of considerations including performance, footprint, constructability, operation and maintenance requirements, and economic factors. A summary of the non-economic

evaluation is outlined in Table 6.5. A summary of the economic evaluation is outlined in Table 6.6. At the workshop, the preferred secondary treatment process selected by the City was an extended aeration oxidation ditch. The information presented in the workshop is included in Appendix G.

**Table 6.4 Preliminary Design Criteria for Parallel Secondary Treatment Options Wastewater Treatment Facility Improvements Project City of Arcata**

| Item | Option | | |
|---|---|---|---|
| | Conventional Activated Sludge | Oxidation Ditch | Trickling Filters |
| Primary Clarifiers - Quantity & Diameter(1) | 2 @ 40 ft | N/A | 2 @ 40 ft |
| Aeration Basins - Quantity & Volume | 2 @ 0.23 MG | 2 @ 1.44 MG | N/A |
| Trickling Filters - Quantity, Height & Diameter | N/A | N/A | 2 @ 20 ft high, 60 ft diameter |
| Secondary Clarifiers - Quantity & Diameter | 2 @ 70 ft | 2 @ 70 ft | 2 @ 70 ft |
| Effluent BOD (mg/L) | 10 | 20 | 30 |
| Effluent TSS (mg/L) | 10 | 20 | 30 |
| Effluent Ammonia (mg/L) | Same as influent(2) | <1 | Same as influent(2) |

Notes:

(1) Primary clarifiers are not a required process upstream of the oxidation ditch alternative; however, they may be recommended with project alternatives depending on flow configuration requirements.

(2) In this analysis, additional volume for nitrification was not included with CAS or trickling filters; nitrification in an oxidation ditch can be achieved without additional volume.

**Table 6.5 Secondary Treatment Options Evaluation of Non-Economic Factors Wastewater Treatment Facility Improvements Project City of Arcata**

| Option | Criteria Scale: 1 (least favorable) to 3 (most favorable) | | | | | |
|---|---|---|---|---|---|---|
| | Safety | Meets Permit | Ease of O&M | Construct -ability | Reliability | Ammonia Removal |
| Conventional Activated Sludge | 2 | 3 | 1 | 3 | 3 | 2 |
| Extended Aeration – Oxidation Ditch | 2 | 3 | 3 | 2 | 3 | 3 |
| Trickling Filters | 3 | 1 | 3 | 2 | 1 | 1 |

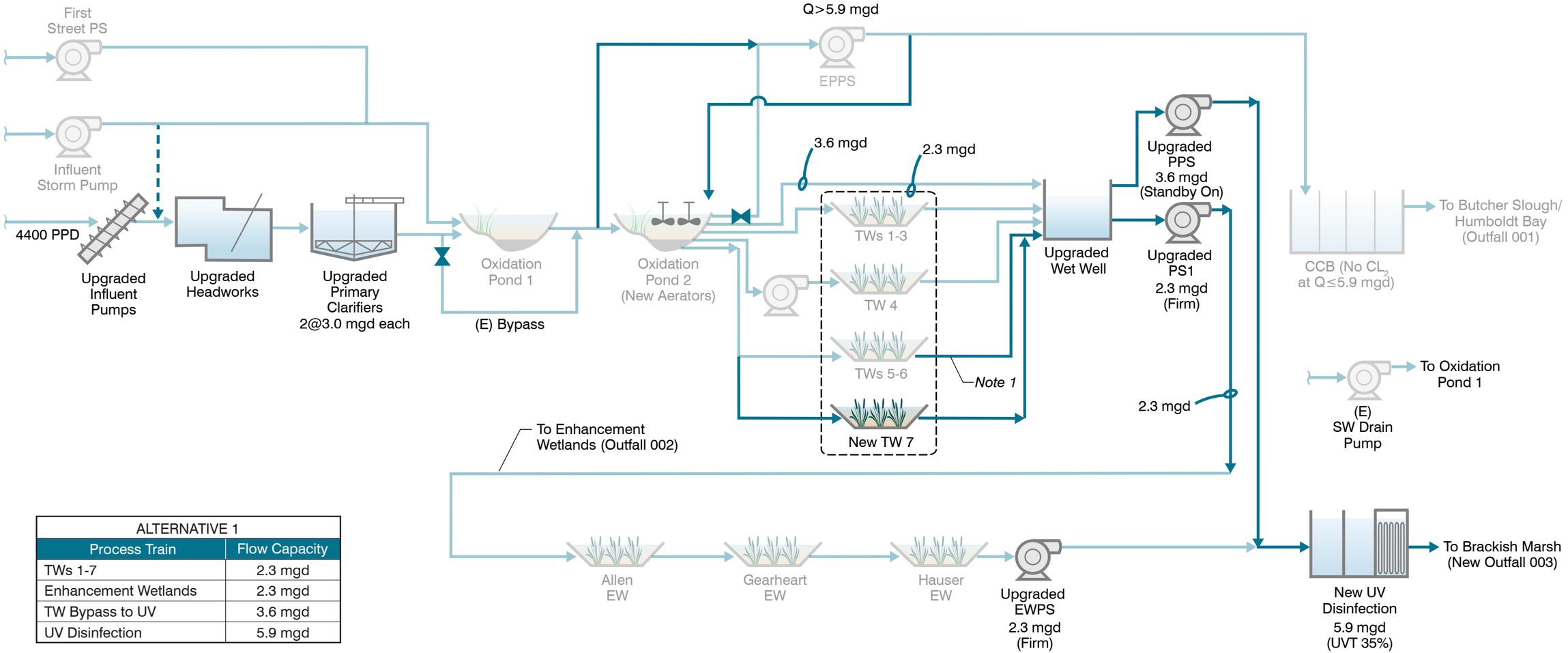
| Table 6.6 Secondary Treatment Options Evaluation of Economic Factors Wastewater Treatment Facility Improvements Project City of Arcata | | | | | | |
|---|---|---|---|---|---|---|
| | Criteria Scale: 1 (least favorable) to 3 (most favorable) | | | | | |
| Option | Construction Cost | Footprint | Operator Attention | Power Cost | Sludge Production | Maintenance Requirement |
| Conventional Activated Sludge | 3 | 3 | 1 | 1 | 1 | 1 |
| Extended Aeration – Oxidation Ditch | 2 | 1 | 2 | 2 | 2 | 3 |
| Trickling Filters | 1 | 2 | 3 | 3 | 3 | 2 |

## 6.5 PROJECT ALTERNATIVE DEVELOPMENT AND COMPARISON

The most viable options identified in the screening process were further refined as project alternatives that address how the facility would perform as a system, since system performance affects the viability of any one process. Project alternatives consider facility-specific issues such as flow routing, hydraulic and treatment capacity of individual processes, and process improvement or replacement needs based on condition assessment. The goal of each project alternative is to provide a facility that maximizes use of the existing natural system while meeting treatment and permit compliance objectives.

Based on the findings of the preliminary and secondary screening as well as feedback received at presentations made to City Staff, the public and City Council in April 2016, three project alternatives were originally developed:

- Alternative 1, Existing System Rehabilitation. This alternative improves the existing natural treatment system with no supplemental secondary treatment process. This alternative does not provide the required capacity to meet the BOD capacity shortfall. In the past the shortfall was made up by use of chlorine for supplemental BOD removal. This alternative will not provide year-round nitrification removal. This alternative was conceptualized by AMRI and further evaluated by Carollo to meet treatment and permit compliance objectives. Aeration would be added to the ponds and Treatment Wetland No. 7 would be constructed to provide some supplemental capacity, but a 1000 ppd BOD removal deficiency at 20 percent growth projection is still anticipated. The Alternative 1 flow schematic is shown in Figure 6.1.
- Alternative 2, Existing System with Side-stream Treatment. This alternative provides a side-stream secondary treatment process parallel to the ponds and treatment wetlands that returns flow upstream of the enhancement wetlands. The ponds and treatment wetlands would continue treating the majority of the plant influent flow. The side-stream treatment process would treat a portion of the plant influent flow as needed for supplemental BOD and year-round partial nitrification treatment capacity. Both effluents would normally blend before passing through the enhancement




| ALTERNATIVE 1 | |
|---|---|
| Process Train | Flow Capacity |
| TWs 1-7 | 2.3 mgd |
| Enhancement Wetlands | 2.3 mgd |
| TW Bypass to UV | 3.6 mgd |
| UV Disinfection | 5.9 mgd |

*Notes:*
*1. Eliminate Pump Station 2 and upgrade PPS/PS1 Wet Well to allow flow by gravity from TWs 5-6.*

LEGEND
- New Piping
- Existing Piping
- Normally Closed Valve

**PROPOSED ALTERNATIVE 1 FLOW SCHEMATIC**

FIGURE 6.1

CITY OF ARCATA
*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

arc0516rf9-9913.ai

wetlands and UV disinfection. The Alternative 2 flow schematic is shown in Figure 6.2.

- Alternative 3, Existing System with Parallel Treatment. This alternative provides a parallel secondary treatment process to the ponds, treatment wetlands, and enhancement wetlands. The natural system train and parallel process train would each treat a portion of the plant influent flow at variable percentages to provide a blended effluent meeting treatment objectives. The natural system would continue treating the majority of the plant influent flow up to available hydraulic and treatment capacity. The parallel process train, currently planned as oxidation ditches followed by secondary clarifiers, would provide BOD and year-round full nitrification treatment capacity to handle the remainder of the hydraulic capacity needs and to meet specific blended water quality requirements. Natural system effluent and parallel process effluent would combine prior to UV disinfection. The Alternative 3 flow schematic is shown in Figure 6.3.

## 6.5.1 Alternative Descriptions

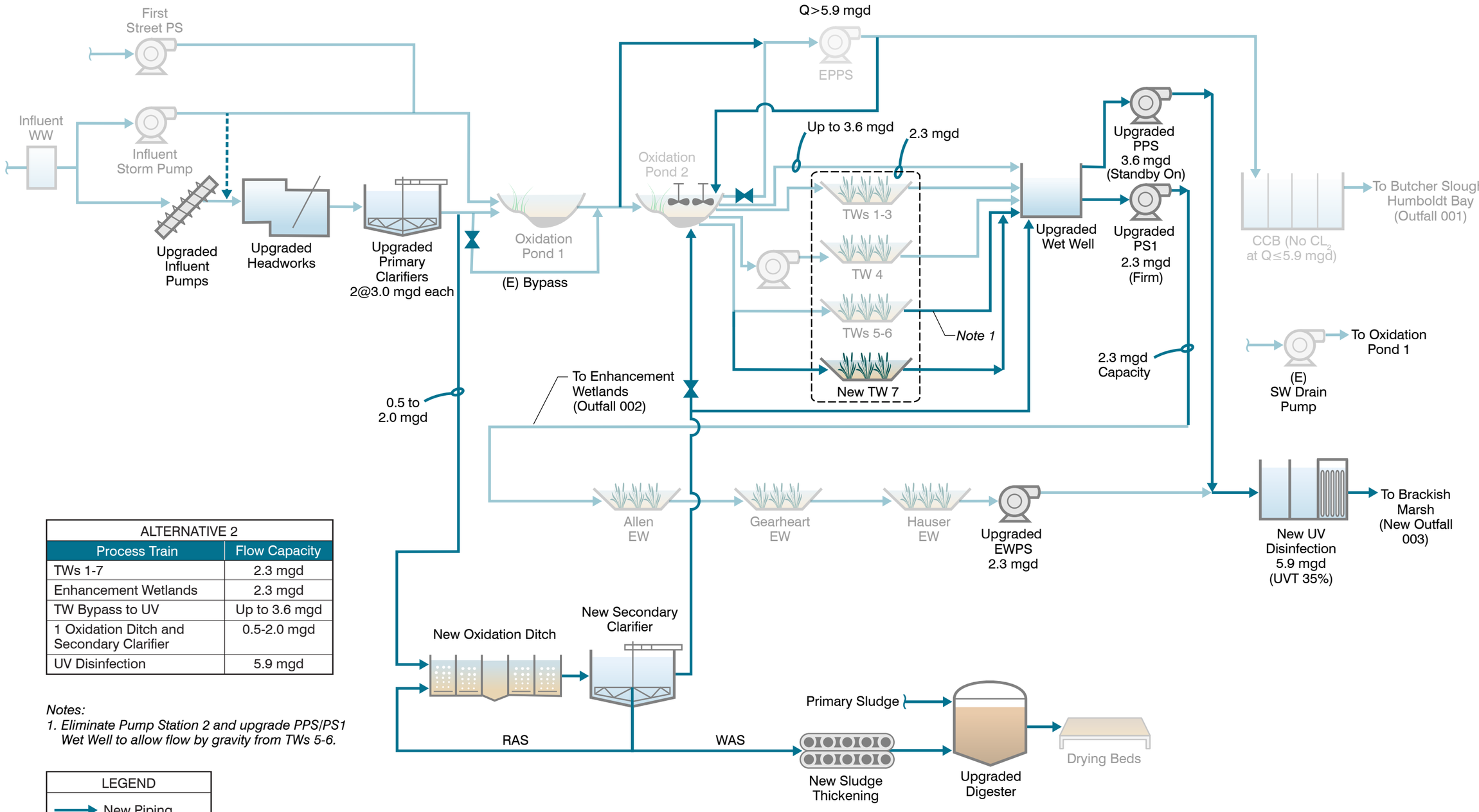
Descriptions for each project alternative are described in detail below, and a comparison of their design criteria is summarized in Appendix K.

### 6.5.1.1 Alternative 1 - Existing System Rehabilitation

In Alternative 1, the oxidation ponds would normally handle up to 5.9 mgd, with wet weather flows greater than 5.9 mgd stored in Oxidation Pond 1, or in an emergency, sent to the existing chlorine contact basin for disinfection and discharge through existing Outfall 001. Flow to the treatment wetlands would be limited to 2.3 mgd with new Treatment Wetland No. 7 online; flows in excess of 2.3 mgd would bypass the treatment wetlands and be blended with treatment wetlands effluent prior to being sent to the enhancement wetlands. Any excess blended flows would be routed directly to the influent side of the new UV disinfection and blended with the enhanced wetlands effluent. Disinfected effluent would be discharged through new Outfall 003.

Alternative 1 includes the following elements:

- Headworks improvements rated at 5.9 mgd.
- Replace existing primary clarifiers with two new primary clarifiers rated at 3.0 mgd each. This sizing would allow process redundancy at the design average flow condition of 2.3 mgd, with overall capacity for the design PWWF condition of 5.9 mgd. Replace existing primary sludge and scum pumps with new pumps sized for two new 3.0 mgd primary clarifiers.
- Emergency Pond Pump Station improvements, oxidation ponds improvements, Treatment Wetland Nos 1 through 4 maintenance, evaluation of Treatment Wetland No. 4 influent pumps and Pump Station 2, and enhancement wetlands improvements are recommended as previously described in Section 1.3.




| ALTERNATIVE 2 | |
|---|---|
| Process Train | Flow Capacity |
| TWs 1-7 | 2.3 mgd |
| Enhancement Wetlands | 2.3 mgd |
| TW Bypass to UV | Up to 3.6 mgd |
| 1 Oxidation Ditch and Secondary Clarifier | 0.5-2.0 mgd |
| UV Disinfection | 5.9 mgd |

*Notes:*
1. *Eliminate Pump Station 2 and upgrade PPS/PS1 Wet Well to allow flow by gravity from TWs 5-6.*

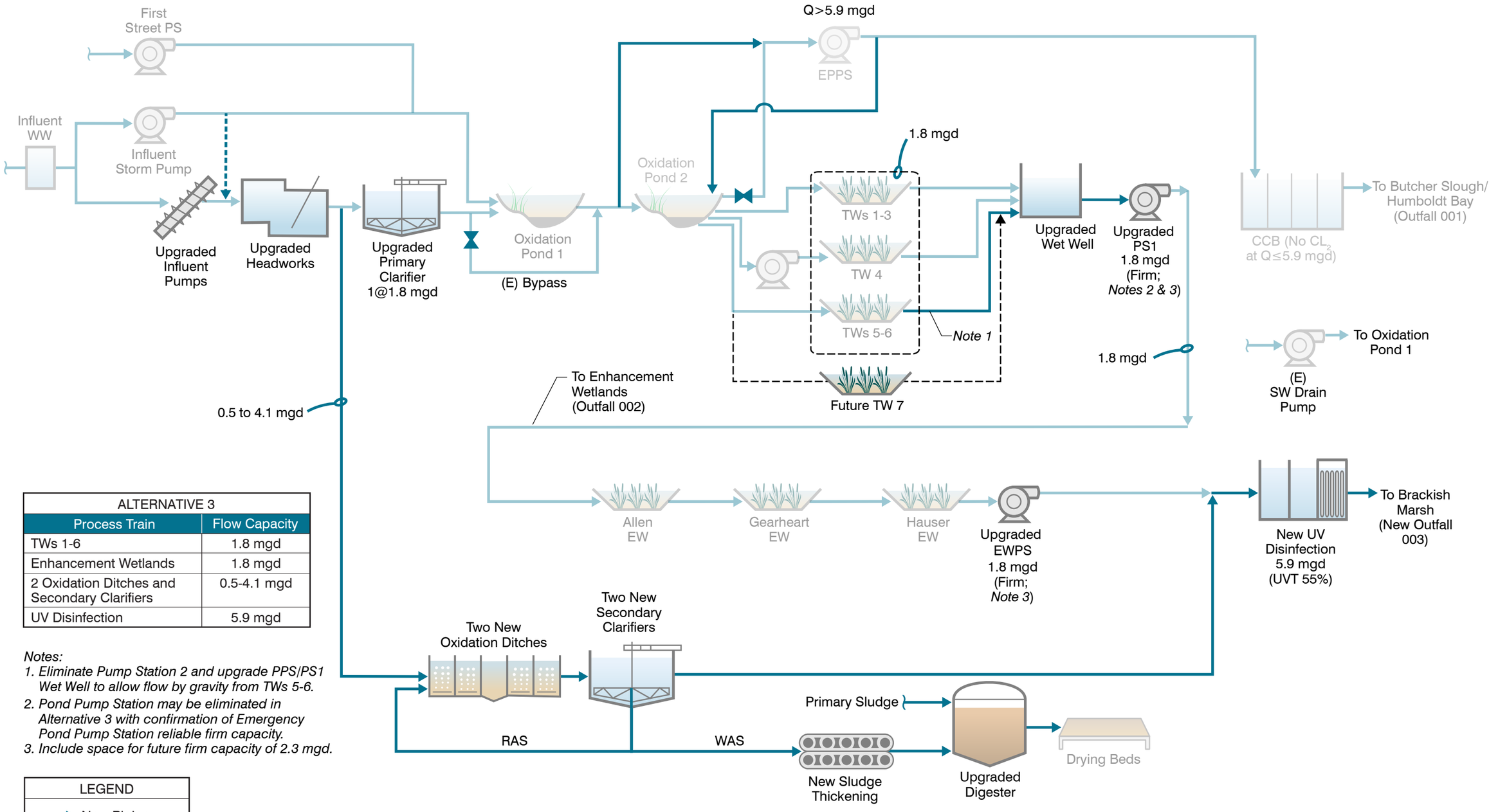
LEGEND
- New Piping
- Existing Piping
- Normally Closed Valve

# PROPOSED ALTERNATIVE 2 FLOW SCHEMATIC

FIGURE 6.2

CITY OF ARCATA
*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

arc0516rf10-9913.ai




| ALTERNATIVE 3 | |
|---|---|
| Process Train | Flow Capacity |
| TWs 1-6 | 1.8 mgd |
| Enhancement Wetlands | 1.8 mgd |
| 2 Oxidation Ditches and Secondary Clarifiers | 0.5-4.1 mgd |
| UV Disinfection | 5.9 mgd |

*Notes:*
1. *Eliminate Pump Station 2 and upgrade PPS/PS1 Wet Well to allow flow by gravity from TWs 5-6.*
2. *Pond Pump Station may be eliminated in Alternative 3 with confirmation of Emergency Pond Pump Station reliable firm capacity.*
3. *Include space for future firm capacity of 2.3 mgd.*

LEGEND
- New Piping
- Existing Piping
- Normally Closed Valve

# PROPOSED ALTERNATIVE 3 FLOW SCHEMATIC

FIGURE 6.3

CITY OF ARCATA
*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

arc0516rf11-9913.ai

- New Oxidation Pond No. 2 aerators are recommended to improve aeration and mixing while preventing short circuiting. The eight existing propeller-type mechanical aerators in Pond No. 1 are in poor condition and several have not been used for a number of years. New mechanical aerators (horizontal type) are recommended to be installed in Pond No. 2 to improve pond mixing, reduce short circuiting, and provide additional BOD treatment capacity of Pond No. 2 by 600 ppd.
- Construction of new Treatment Wetland No. 7 is recommended. This project would convert an existing aquaculture pond into a new 2.3-acre treatment wetland, increasing the hydraulic capacity of the treatment wetlands from 1.8 mgd to 2.3 mgd. As discussed in Chapter 4, constructing Treatment Wetland No. 7 is anticipated to increase the BOD treatment capacity of the treatment wetlands from 340 ppd to 420 ppd.
- The recommended Treatment Wetlands Pump Station 1 improvement is to replace the existing 2.3-mgd firm capacity pumps with new 2.3-mgd firm capacity pumps due to age and condition. This sizing matches the anticipated capacity of the treatment wetlands after construction of Treatment Wetland No. 7. The recommended Pond Pump Station improvement is to replace the existing 2.9-mgd firm capacity pumps with new pumps due to age and condition so that the pump station will have 3.6 mgd capacity with the standby pump running. Improvement of the combined wet well is also recommended so that Treatment Wetland Nos. 5 and 6 can flow by gravity into the pump station, eliminating Pump Station 2.
- The recommended Enhancement Wetlands (Hauser) Pump Station improvement is to replace the existing 1.2-mgd firm capacity pumps with new 2.3-mgd firm capacity pumps to match the new flow routing capacity through the enhancement wetlands. Additional pump station improvements include adding a mechanical bar screen on the pump station inlet and strainers on the discharge line.
- Upgrade and reconfiguration of the sludge digestion system is recommended to accommodate additional primary sludge associated with increasing primary clarifier capacity. Project elements will be refined during preliminary design but may include digester cover rehabilitation and digester tank modifications.
- New UV disinfection system sized for 35 percent UVT as described in Chapter 7.

#### 6.5.1.2 Alternative 2 - Existing System with Side-stream Treatment

In Alternative 2, plant influent flow up to 5.9 mgd would be routed to the primary clarifiers before splitting to either the natural system train (oxidation ponds and treatment wetlands) or the side-stream secondary treatment train. Normally flows up to 2.3 mgd would be treated by the oxidation ponds and Treatment Wetland Nos. 1 through 7, while minimum flow (i.e. 0.5 mgd) would be treated by the side-stream secondary treatment train. Effluent from the side-stream treatment could be brought back into the treatment wetlands to take advantage of denitrification that would occur, or could be blended with treatment wetlands

effluent, depending on operational needs. During pond turnover or other seasonal periods when the natural system capacity is limited, the side-stream secondary treatment train could be ramped up to handle up to 2.0 mgd. The two secondary effluents would be combined and 2.3 mgd sent to the enhancement wetlands. Any flows greater than 2.3 mgd would be blended with enhancement wetlands effluent and then disinfected with the new UV system. Disinfected effluent up to 5.9 mgd would be discharged through new Outfall 003. Wet weather flows above 5.9 mgd would be stored in Oxidation Pond 1, or in an emergency sent to the existing chlorine contact basin for disinfection and discharge through existing Outfall 001.

The facility improvements for Alternative 2 are similar to Alternative 1, with the exception of the following:

- Construct a side-stream secondary treatment process to handle the BOD treatment capacity shortfall and provide partial nitrification. Currently the recommended process for Alternative 2 is one new oxidation ditch and one new secondary clarifier sized for 2.0 mgd capacity, with the ability to turn flow down to 0.5 mgd. If Alternative 2 proceeds into Preliminary Design, the hydraulic and treatment capacity requirements can be refined.
- New Oxidation Pond No. 2 aerators are also recommended in Alternative 2 to improve aeration and mixing while preventing short circuiting, while reducing the treatment capacity required by the side-stream secondary treatment process.
- Upgrade and reconfiguration of the sludge digestion system is recommended to accommodate additional sludge associated with the new secondary treatment project. Project elements will be refined during preliminary design but may include digester cover rehabilitation, digester tank modifications, and heater/boiler upgrade.
- New secondary sludge thickening equipment will be required to accommodate additional sludge associated with the new secondary treatment project. Currently the project element includes one gravity belt thickener sized for sludge from one 2.0 mgd oxidation ditch and secondary clarifier.

#### 6.5.1.3 Alternative 3 - Existing System with Parallel Treatment

In Alternative 3, the natural system (oxidation ponds, treatment wetlands, and enhancement wetlands) would normally handle up to 1.8 mgd year-round. The basis of this capacity is maintaining reliable year-round treatment and permit compliance based on existing design criteria and operational experience. Plant influent flow above 1.8 mgd and less than 5.9 mgd would be routed to the new parallel secondary treatment train. The two secondary effluents would be blended prior to disinfection with the new UV system and discharge through new Outfall 003. Blending proportions could be adjusted to achieve desired effluent water quality. Wet weather flows above 5.9 mgd would be stored in Oxidation Pond 1, or in an emergency sent to the existing chlorine contact basin for disinfection and discharge through existing Outfall 001.

The facility improvements for Alternative 3 are similar to Alternatives 1 and 2, with the exception of the following:

- Replace existing primary clarifiers with one new primary clarifier rated at 1.8 mgd. This sizing would match the hydraulic capacity of the treatment wetlands and enhancement wetlands without providing standby capacity, though space could be provided for future addition of a second clarifier. The primary clarifier capacity in Alternative 3 is smaller than in Alternatives 1 and 2 because oxidation ditches do not require upstream treatment with primary clarifiers. This Alternative would also replace existing primary sludge and scum pumps with new pumps sized for the new 1.8 mgd primary clarifier.
- Oxidation Pond No. 2 aerators are not required with Alternative 3.
- Construction of new Treatment Wetland No. 7 is not required as part of the 10-year CIP for Alternative 3, but is a recommended future project for overall reliability.
- For Alternative 3, the recommended Pond Pump Station improvement is to replace the existing 2.9-mgd firm capacity pumps with new 1.8-mgd firm capacity pumps. Improvement of the wet well is also recommended so that Treatment Wetland Nos. 5-6 can flow by gravity into the pump station, eliminating Pump Station 2. In Alternative 3, Treatment Wetlands Pump Station 1 may be eliminated since flows above 1.8 mgd (Treatment Wetlands hydraulic and treatment capacity) would first be routed to the parallel secondary treatment train, with peak wet weather flows above 5.9 mgd routed via the Emergency Pond Pump Station.
- For Alternative 3, the recommended Enhancement Wetlands (Hauser) Pump Station improvement is to replace the existing 1.2-mgd firm capacity pumps with new 1.8-mgd firm capacity pumps to match the flow routing capacity through the enhancement wetlands. Additional pump station improvements include adding a mechanical bar screen on the pump station inlet and strainers on the discharge line.
- New UV disinfection system sized for 55 percent UVT as described in Chapter 7.
- Construct a parallel secondary treatment process to handle the design influent BOD load and provide full nitrification for up to 4.1 mgd. Currently the recommended process for Alternative 3 is two new oxidation ditches and two new secondary clarifiers, each sized for 2.0 mgd capacity with the ability to turn flow down to 0.5 mgd. If Alternative 3 proceeds into Preliminary Design, the hydraulic and treatment capacity requirements can be refined.
- Upgrade and reconfiguration of the sludge digestion system is recommended to accommodate additional sludge associated with the new larger secondary treatment project. Project elements will be refined during preliminary design but may include digester cover rehabilitation, digester tank modifications, and heater/boiler upgrade.

- New secondary sludge thickening equipment will be required to accommodate additional sludge associated with the new secondary treatment project. Currently the project element includes one gravity belt thickener sized for sludge from two 2.0 mgd oxidation ditches and two secondary clarifiers.

### 6.5.2 Comparison of Alternatives

The three alternatives each have advantages and disadvantages from economic and non-economic factors. The economic factors (project cost and operations/maintenance cost) and project implementation considerations will be further discussed in Chapter 8, Capital Improvements Program. Non-economic advantages and disadvantages of the three alternatives are:

- Alternative 1 - Existing System Rehabilitation: BOD treatment capacity is limited in the existing natural system. Project elements to increase BOD treatment capacity include sludge removal in Ponds 1 and 2, adding aerators to Pond 2, and construction of Treatment Wetland No. 7; however, even with these improvements there will be a BOD treatment capacity shortfall with the elimination of chlorine. This would result in permit violations and mandatory minimum penalties. Increasing the growth projection from 10 to 20 percent increases the BOD treatment capacity shortfall, which will be difficult to address in Alternative 1 without an additional secondary treatment process. Furthermore, future ammonia and total nitrogen permit limits may not be met year-round with Alternative 1 without an additional nitrification process. As previously discussed, effluent discharge bypassing enhancement is a violation of permit requirements. Alternative 1 currently requires up to 3.6 mgd to bypass the Enhancement Wetlands due to capacity limitations, which does not meet permit objectives.
- Alternative 2 - Existing System with Side-stream Treatment: Like Alternative 1, project elements to increase natural system BOD treatment capacity in Alternative 2 include sludge removal in Ponds 1 and 2, adding aerators to Pond 2, and construction of Treatment Wetland No. 7; however, a BOD treatment capacity shortfall would be supplemented by the side-stream secondary treatment process of one oxidation ditch and one secondary clarifier. Increasing the growth projection from 10 to 20 percent increases the BOD treatment capacity shortfall, which could be addressed in Alternative 2 by increasing capacity in the oxidation ditch. Alternative 2 is anticipated to meet current permit requirements for enhancement through advanced secondary treatment with nitrification, providing full BOD treatment capacity without disinfection byproduct violations, as well as meeting future ammonia and total nitrogen permit limits year-round. However, this alternative is anticipated to be the highest capital cost as it requires the most project elements.
- Alternative 3 - Existing System with Parallel Treatment: In Alternative 3, sludge removal in Ponds 1 and 2 is recommended to increase natural system hydraulic capacity and BOD treatment capacity. The natural system will still provide a baseload

secondary treatment, but the addition of the parallel secondary treatment process of two oxidation ditches and two secondary clarifiers means that Pond 2 aerators would not be needed. Treatment Wetland No. 7 is still recommended for construction in the 10-year CIP to improve reliability. Increasing the growth projection from 10 to 20 percent increases the BOD treatment capacity shortfall, which could be addressed in Alternative 3 by increasing capacity in one or both oxidation ditches. Alternative 3 is anticipated to meet current permit requirements for enhancement through advanced secondary treatment with nitrification, providing full BOD treatment capacity without disinfection byproduct violations, as well as meeting future ammonia and total nitrogen permit limits year-round. This alternative is anticipated to be lower in capital cost than Alternative 2 as some project elements can be eliminated or decreased. This alternative is anticipated to require the largest footprint in the treatment plant.

- The advantages and disadvantages of the alternatives are summarized in Table 6.7.

**Table 6.7 Summary of Alternative Comparison for Non-Economic Factors Wastewater Treatment Facility Improvements Project City of Arcata**

| Alternative | Criteria Scale: 1 (least favorable) to 3 (most favorable) | | | | |
|---|---|---|---|---|---|
| | Meets Permit (Enhancement and No Bypass) | Ease of O&M | Construct -ability | Reliability | Meets Future Ammonia Removal |
| 1. Existing System Rehabilitation | 1 | 3 | 1 | 1 | 1 |
| 2. Existing System with Side-stream Treatment | 2 | 1 | 2 | 2 | 2 |
| 3. Existing System with Parallel Treatment | 3 | 2 | 3 | 3 | 3 |

## 6.6 EXPANDED ALTERNATIVE

After the facility plan was finalized in June 2016, the City met with the North Coast Regional Water Quality Control Board (RWQCB) to discuss the Facility Plan and NPDES permit requirements on June 27, 2016. In response to feedback received at that meeting from the RWQCB, additional work was identified in order to complete the facility planning phase and to guide the City in selection of a preferred project alternative. Specifically, the feedback received from the RWQCB included the following:

- Enhancement of flows up to the 5.9 mgd peak wet weather capacity is a permit requirement in accordance with the Enclosed Bays and Estuaries Policy (State Water Board Resolution No. 74-43).
- The City will receive ammonia limits in the next NPDES permit in 2017. The RWQCB indicated that limits similar to those given to Eureka would be likely.

- Bypass of wet weather flows is an issue requiring further consideration.

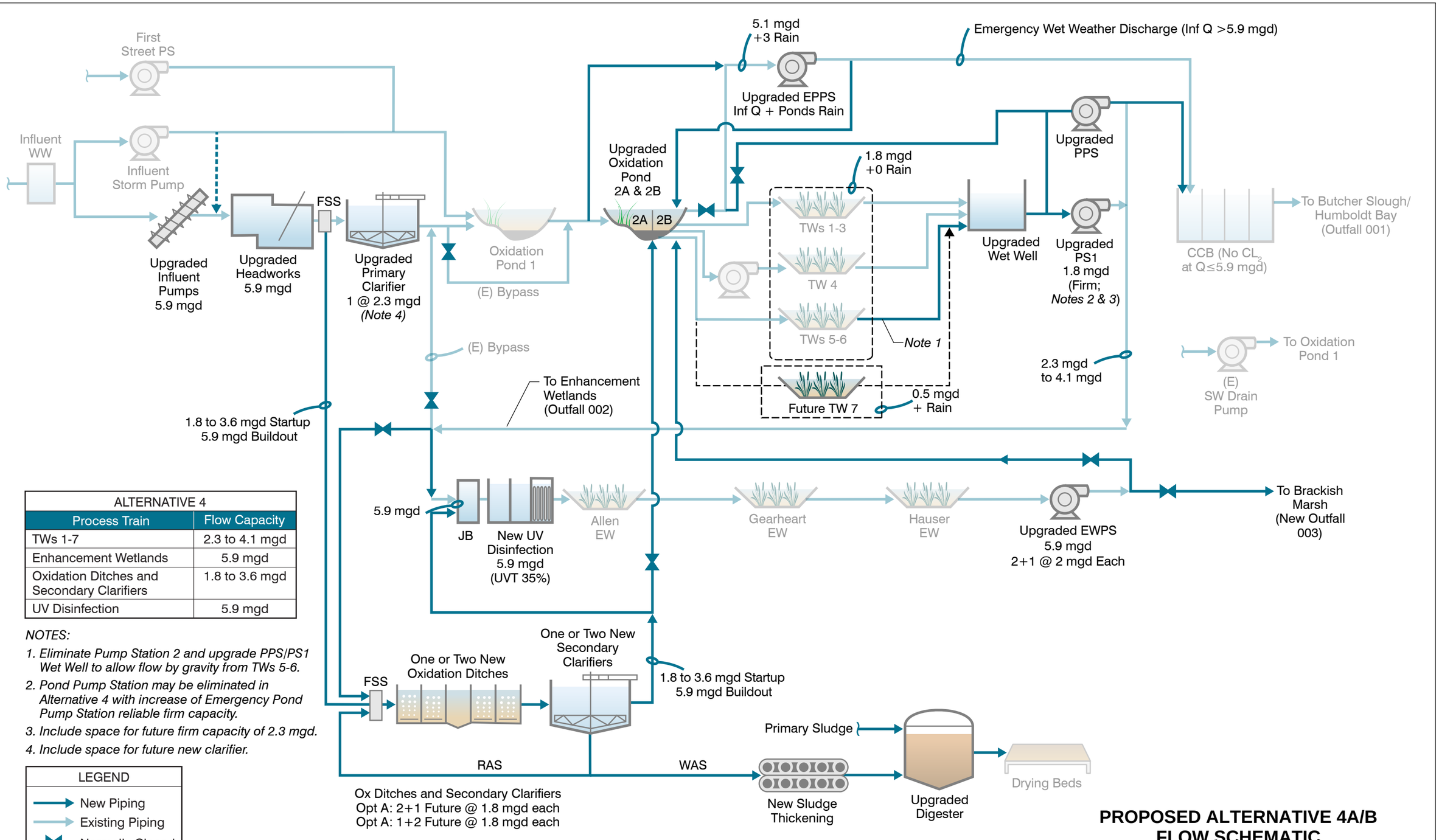
Accordingly, a new project Alternatives No. 4, was developed, to meet these additional objectives. Based on the feedback by the RWQCB, the original Alternatives 1-3 would not meet the requirements anticipated in the new NPDES permit.

### 6.6.1 Alternative 4 Upgraded Existing System with Parallel Treatment

This alternative provides both an upgrade to the existing pond / wetland treatment system and a parallel secondary treatment process. The natural system train and parallel process train would each treat a portion of the plant influent flow at variable percentages to provide a blended effluent meeting treatment objectives. The natural system would continue treating the majority of the plant influent flow up to available hydraulic and treatment capacity. The parallel process train, currently planned as oxidation ditches followed by secondary clarifiers, would provide BOD and year-round full nitrification treatment capacity to handle the remainder of the hydraulic capacity needs and to meet specific blended water quality requirements. Natural system effluent and parallel process effluent would combine prior to UV disinfection. The Alternative 4 flow schematic is shown in Figure 6.4.

The following assumptions for Alternative No. 4 were made:

- All flows up to 5.9 mgd will be routed through the Enhancement Wetlands. Hydraulic optimization of flow routing through the Enhancement Wetlands may be accomplished in parallel mode rather than the existing series mode, which will be further evaluated during preliminary design.
- The City will need to comply with year-round ammonia effluent discharge limits in the next NPDES permit in 2017. Assumed that limits will be similar to City of Eureka's that were adopted in June 2016: average monthly total ammonia nitrogen of 4.1 mg/L, and maximum daily total ammonia nitrogen of 10 mg/L.
- Emergency wet weather discharge for flows above 5.9 mgd needs to be addressed.
- Currently permitted facility design instantaneous peak wet weather flow of 16.5 mgd needs to be addressed.
- Rainfall accumulation and discharge for the natural system (oxidation ponds, treatment wetlands, and enhancement wetlands) needs addressed.
- Locating the new UV Disinfection System upstream of the Enhancement Wetlands is preferred, for the following reasons:
  - Moves point of compliance upstream of the Enhancement Wetlands; split compliance or a phased approach may need to be considered. Limited ability to perform maintenance in the Enhancement Wetlands as Waters of the State could diminish future water quality (and hence UV disinfection capability).
  - Facility hydraulic profile starting at the headworks could be lowered (construction and operations and maintenance [O&M] cost savings).




| ALTERNATIVE 4 | |
|---|---|
| **Process Train** | **Flow Capacity** |
| TWs 1-7 | 2.3 to 4.1 mgd |
| Enhancement Wetlands | 5.9 mgd |
| Oxidation Ditches and Secondary Clarifiers | 1.8 to 3.6 mgd |
| UV Disinfection | 5.9 mgd |

*NOTES:*

1. *Eliminate Pump Station 2 and upgrade PPS/PS1 Wet Well to allow flow by gravity from TWs 5-6.*
2. *Pond Pump Station may be eliminated in Alternative 4 with increase of Emergency Pond Pump Station reliable firm capacity.*
3. *Include space for future firm capacity of 2.3 mgd.*
4. *Include space for future new clarifier.*

LEGEND

- New Piping
- Existing Piping
- Normally Closed Valve

# PROPOSED ALTERNATIVE 4A/B FLOW SCHEMATIC

FIGURE 6.4

CITY OF ARCATA
*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

arc0617rf1-9913.ai

  - Flow configuration requires shorter flow routing with one bridge crossing (not two), resulting in construction and O&M cost savings.

- Recently collected plant UVT data suggests that UVT of Treatment Wetlands effluent is anticipated to be lower than originally thought (35 percent in Alternative 4; 55 percent in Alternative 3).

### 6.6.2 Alternative 4 Development

Alternative 4 was developed to meet the requirements of the RWQCB, and the assumptions listed above. During follow-up review with the City and AMRI, this alternative was further developed to allow for phased implementation depending on the level of treatment provided by upgrades proposed for the exiting oxidation ponds.

#### 6.6.2.1 Oxidation Pond Upgrades

As part of the development of Alternative 4, the City conducted an independent review of the oxidation pond's ability to meet the future discharge requirements. The review was conducted by a pond treatment expert with the purpose to study potential upgrades of the existing ponds to address the expected requirements of the RWQCB. The Pond Improvements study is included in Appendix U. The main recommendations from the study are outlined below:

- Pond 1 can be used for wet weather equalization. Facilities should be installed to control the depth in Pond 1.
- Pond 2 should be divided into 2 cells of equal volume and designed as partial mix aerated ponds. A baffle wall between the two sections would reduce short circuiting. The concept proposed in the review was to divide the ponds diagonally using interlocking plastic sheet pile. The influent section (2A) would be in the southwest portion of pond 2 section, and the effluent section would be in the northeast section.
- Aerators would be added to Pond 2A and 2B. The concept proposed in the review was to install ten 15 HP aerators in each section of pond 2 for a total of 300 HP. The aerators would be operated to maintain dissolved oxygen in the ponds.
- Provide alkalinity addition for the pond process to meet the requirements of ammonia removal (nitrification). Pond pH should be maintained at 7 in Pond 2A/2B using the alkalinity addition.

The recommended aeration would provide the ability to meet permit limits during low flow months, but may be compromised during higher wet weather flows and colder months. The report noted that predicted ammonia removal, between 4 to 6 mg/l, could be achieved at 2.3 mgd at temperatures down to 6 degrees C. Therefore the recommended pond improvements have some risk in meeting a permit requirement of 4 mg/L.

The exact configuration of the pond improvements will be finalized during the design phase of the project, although enough detail was developed in order to develop budget costs for

the recommended improvements. In addition, the original pond improvements including removal of pond solids, and transfer structure modifications are still required.

#### 6.6.2.2 Alternative 4 Elements

In Alternative 4, the natural system (oxidation ponds, treatment wetlands, and enhancement wetlands) would normally handle dry weather flows of 1.8 mgd and up to 2.3 mgd during peak wet weather flows. The basis of this capacity is maintaining reliable year-round treatment and permit compliance based on existing design criteria and operational experience. Plant influent flow above 2.3 mgd and less than 5.9 mgd would be routed to the new parallel secondary treatment train. The two secondary effluents would be blended prior to disinfection with the new UV system and discharge through new Outfall 003. Blending proportions could be adjusted to achieve desired effluent water quality. Wet weather flows above 5.9 mgd would be stored in Oxidation Pond 1, or in an emergency sent to the existing chlorine contact basin for disinfection and discharge through existing Outfall 001.

The proposed elements and flow schematic for Alternative 4 are shown in the Figure 6.4. During the development of this alternative it was decided to phase the construction of alternative 4, into Phase 4A and 4B.

The main features of Alternative No. 4 are outlined below:

- Headworks replacement rated at 5.9 mgd.
- Replace existing primary clarifier with a new unit rated at 2.3 mgd. In addition, space will be reserved for a future unit.
- Upgraded oxidation pond 2 as outlined above, including the creation of 2 partial mixed aerated cells.
- Emergency pond pump station improvements including piping to pump out pond 1 prior to wet weather.
- Construction of Treatment Wetlands No.7.
- Upgrades to pond pump station and pump station 1 to provide capacity and replace aging pumps.
- Construct a parallel secondary treatment process, in two phases:
  - Phase 4A would include one oxidation and secondary clarifier sized for a raw sewage flow of 1.8 mgd.
  - Phase 4B would include a second oxidation and secondary clarifier sized for a raw sewage flow of 1.8 mgd.
  - The size of the Phase 4B treatment capacity could be adjusted based on the results of the pond improvements and the ability of the ponds to meet permit limits.

- New UV disinfection system sized for a flow of 5.9 mgd at 35 percent UVT, as described in Chapter 7.
- Upgrades to the digesters, similar to alternative 3.
- New secondary sludge thickening equipment as noted in alternative 3.
- New or upgraded enhancement wetland pump station sized for a flow of 5.9 mgd. Pump station would pump directly to the new brackish marsh (outfall 003).

#### 6.6.2.3 Alternative 4 Phasing

The development of Alternative 4 considered phasing of the alternative to reduce the initial capital costs and increased operating costs. Phase 4A would include all the improvements except only one oxidation ditch and secondary clarifier would be constructed. Provisions would be included to add a second oxidation ditch and secondary clarifier in Phase 4B. The phased approach would allow the City to complete the upgrades to the existing oxidation ponds, then quantify the treatment capacity of the upgraded oxidation ponds.

#### 6.6.2.4 Alternative 5

Alternative 5 was developed to provide the City with the costs for an alternative to Alternative 4 that did not include pond modifications. It is based on three oxidation ditches and secondary clarifiers. This alternative was not considered, and was developed only for comparison of capital and operating costs.

### 6.6.3 Comparison of Alternative 3 and 4

A comparison of expanded Alternative 4 with the original Alternative 3 (with two oxidation ditches and two secondary clarifiers) is outlined in Table 6.8.

The three main difference between Alternative 3 and 4 include:

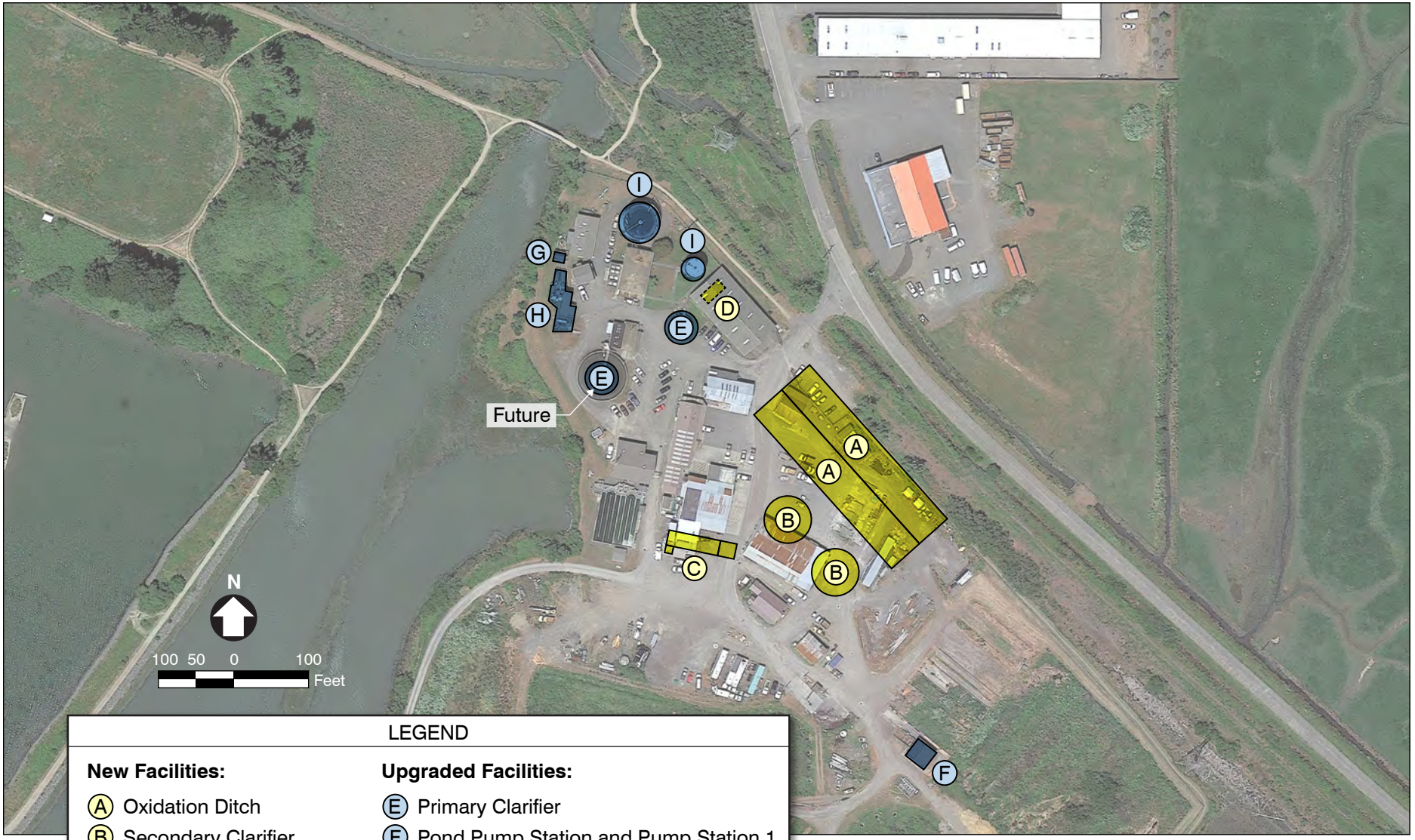
- Oxidation pond improvements in Alternative 4 are substantial in terms of costs, both capital and maintenance.
- UV system in Alternative 4 would be designed for lower UVT and higher dose, increasing costs.
- Enhancement wetlands pump station in Alternative 4 would be sized for flows up to 5.9 mgd.

Alternative 3 and 4 are anticipated to require the largest footprint in the treatment plant. A conceptual facilities site plan for these alternative is shown in Figure 6.5.

**Table 6.8 Comparison of Alternative 3 and 4 Elements**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| Process Area | Alternative 3 Design Criteria | Alternative 4 Design Criteria | Advantages | Disadvantages | Comment |
|---|---|---|---|---|---|
| Oxidation Pond Improvement | Not required | Aerators sized for BOD and ammonia removal (300 HP) | Increase the ability to meet ammonia removal requirements. | Higher power costs and higher maintenance costs | Improvements may still not meet permit requirements year round |
| Oxidation Ditches and Secondary Clarifiers | 0.5 to 4.1 mgd | 1.8 to 3.6 mgd | Ability to meet anticipated year-round ammonia removal requirements | Larger footprint; Higher construction cost | Element will be phased |
| UV Disinfection | 55% UVT; 35 $mJ/cm^2$ (1) | 35% UVT; 50 $mJ/cm^2$ (1) | Keeps UV at plant; ability to meet disinfection requirements at all blending ratios | Larger footprint (additional lamps); Higher construction and O&M cost | Higher dose anticipated with higher pond to oxidation ditch blending ratio |
| Primary Clarifiers | 1.8 mgd | 2.3 mgd | Provides capacity up to treatment capacity of Treatment Wetlands (after future No. 7 online) | Larger footprint; Higher construction cost | Maintain space for a second redundant unit in future |
| Enhancement Wetlands (Hauser) Pump Station | 1.8 mgd | 5.9 mgd + Rainfall | Meets requirements of Enclosed Bays and Estuaries Policy and provides wet weather discharge | Larger footprint (additional pumps); Higher construction and O&M cost | Design for future sea level rise |
| Pump Station 1 | 1.8 mgd | Up to 2.3 mgd + Rainfall | Provides discharge capacity up to treatment capacity of Treatment Wetlands and wet weather discharge | Larger footprint (additional pumps); Higher construction and O&M cost | Will no longer pump directly to Chlorine Contact Basin |
| Emergency Pond Pump Station | Not evaluated | Influent flow to Natural System + Rainfall | Allows for wet weather storage in Oxidation Pond No. 1 and emergency wet weather discharge | Larger footprint (additional pumps); Higher construction and O&M cost | Emergency wet weather discharge via Chlorine Contact Basin and Outfall 001 only for flows > 5.9 mgd |

Note:
(1) Additional analysis required to confirm that dose meets virus reduction concerns of RWQCB. Plant UVT data should continue to be collected and any seasonal variations, including differences in Enhancement Wetlands effluent and Treatment Wetlands effluent, should continue to be monitored.




LEGEND

**New Facilities:**

- (A) Oxidation Ditch
- (B) Secondary Clarifier
- (C) UV System and Effluent PS
- (D) Gravity Belt Thickener

**Upgraded Facilities:**

- (E) Primary Clarifier
- (F) Pond Pump Station and Pump Station 1
- (G) Influent Storm Pump
- (H) Influent Pumps and Headworks
- (I) Digester and Sludge Dewatering

Note: Alternative 3 shown due to largest facility footprints required.

# CONCEPTUAL FACILITIES SITE PLAN

FIGURE 6.4

CITY OF ARCATA
*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

carollo

arc0516rf13-9913.ai

The City developed an aerial view of the Alternative 4 facilities that outline the area of the existing corporation yard that would be used for the new parallel secondary treatment facilities. This is shown on Figure 6.6.

Figure 6.6 Conceptual Aerial View of Improvements. (From City of Arcata)




The costs of these alternatives are outlined in Chapter 8.

Chapter 7

# DISINFECTION SYSTEM EVALUATION

## 7.1 INTRODUCTION

This chapter provides an overview of the existing and proposed disinfection facilities at the Arcata Wastewater Treatment Facility (AWTF) and includes the following:

- Existing facilities description summarizing the general function and configuration of the chlorine and sulfur dioxide disinfection/dechlorination facilities at the AWTF.
- Proposed ultraviolet (UV) light disinfection facility evaluation and design criteria for the two treatment system alternatives.
- Summary and recommendations for the proposed UV disinfection system.

## 7.2 BACKGROUND

The City of Arcata operates the AWTF, which consists of headworks with screening and grit removal, primary clarification, oxidation ponds and treatment wetlands secondary treatment and polishing enhancement wetlands. Discharges from the AWTF are currently regulated by the National Pollutant Discharge Elimination System (NPDES) Order No. R1-2012-0031, which became effective on August 1, 2012, and will expire on July 31, 2017.

The beneficial uses of the receiving bay include habitat for shorebirds, waterfowl, raptors, and migratory birds, oyster farming, and recreational use. The complete list of beneficial uses is included in the NPDES Permit, Appendix A Table F-3 (Facility Plan Appendix A).

The existing secondary effluent is first disinfected and then discharged to the enhancement wetlands, then returned to the plant for a second disinfection step before discharge to Humboldt Bay (Outfall 001). The discharge permit outlines a disinfection and flow configuration upgrade that is based on a once-through flow system, with UV disinfection following the enhancement wetlands, and then discharge to a new discharge point at the brackish marsh (Outfall 003).

## 7.3 PURPOSE

The purpose of this evaluation is to provide a description of alternative UV effluent disinfection systems including sizing, equipment selection, conceptual layout, construction, and operation costs, and proposed implementation plan. The existing chlorine disinfection system is also described, and the impact on effluent treatment is outlined. The alternative disinfection projects are included in Chapter 6 and the capital improvements program described in Chapter 8 of this report.

## 7.4 DESIGN CRITERIA

The effluent disinfection system design criteria based on the current NPDES permit are listed In Table 7.1. The effluent limitations for fecal coliform bacteria at new Outfall 003 to Humboldt Bay were retained from the previous permit. These limitations, which are described below, reflect water quality objectives for bacteria established by the Basin Plan for protection of shellfish harvesting areas. The Basin Plan criteria are based on recommendations of the National Shellfish Sanitation Program for shellfish growing areas that are affected by point source discharges.

The NPDES permit requires that treated wastewater discharged to Humboldt Bay meet the following fecal coliform bacteria criteria:

- The median fecal coliform concentration shall not exceed a Most Probable Number (MPN) of 14 organisms per 100 mL in a calendar month.
- Not more than 10 percent of samples collected in a 30-day period shall exceed an MPN of 43 organisms per 100 mL.

**Table 7.1 UV Effluent Disinfection System Design Criteria**
**Wastewater Treatment Plant Improvements Project**
**City of Arcata**

| Indicator Organism | Unit | Value |
|---|---|---|
| Fecal coliform | MPN/100 ml | 14(1), 43(2) |
| **Flow** | | |
| Annual average dry weather | mgd | 2.3 |
| Average wet weather(3) | mgd | 5.0 |
| Maximum month(3) | mgd | 5.9 |
| Peak hour wet weather(4) | mgd | 16.5 |

Notes:
(1) Monthly Median.
(2) Not more than 10% of samples collected in a 30-day period shall exceed 43 MPN/100mL.
(3) UV effluent disinfection system capacity limit.
(4) Overall facility capacity limit including storage, UV disinfection, and wet weather discharge system.

## 7.5 EXISTING DISINFECTION SYSTEM

Treatment equivalent to secondary treatment is accomplished using two oxidation ponds followed by six treatment wetlands. Detention time in the AWTF, prior to Allen, Gearheart and Hauser enhancement wetland, is approximately 40 days during average dry weather design flow periods when the system is well-maintained. Currently, effluent is disinfected with chlorine and dechlorinated with sulfur dioxide prior to discharge. Under the existing AWTF configuration, treated effluent from the AWTF can be combined with effluent from the AMWS, disinfected, and split, flowing by gravity either to Humboldt Bay or again through

the AMWS. The result is disinfected secondary effluent, but not all effluent receives the benefit of enhanced wetland treatment through the AMWS before discharge to Humboldt Bay. In this mode of disinfection, effluent may actually be chlorinated multiple times, increasing the opportunity to form disinfection byproducts at levels above water quality objectives.

The existing disinfection system, including chlorine ($Cl_2$) gas disinfection followed by sulfur dioxide ($SO_2$) gas dechlorination, was constructed in 1984. Two banks of three one-ton $Cl_2$ gas cylinders are connected in parallel to provide a duty and standby supply of $Cl_2$ gas for disinfection. The chlorine gas feeders receive both a flow and residual signal for gas pacing and control. Gas induction units installed at the chlorine contact basin provide vacuum to transfer gas to the wastewater flow while providing mixing.

The 2003 plant evaluation (SHN 2003) noted that the system was near its maximum capacity to handle peak wet weather flows. At that time, measures were recommended to reduce chlorine use. It was noted that any capacity increases or upgrades of the existing gas systems would trigger the need to comply with current National Fire Protection Association (NFPA) standards.

### 7.5.1 Chlorine Contact Basin

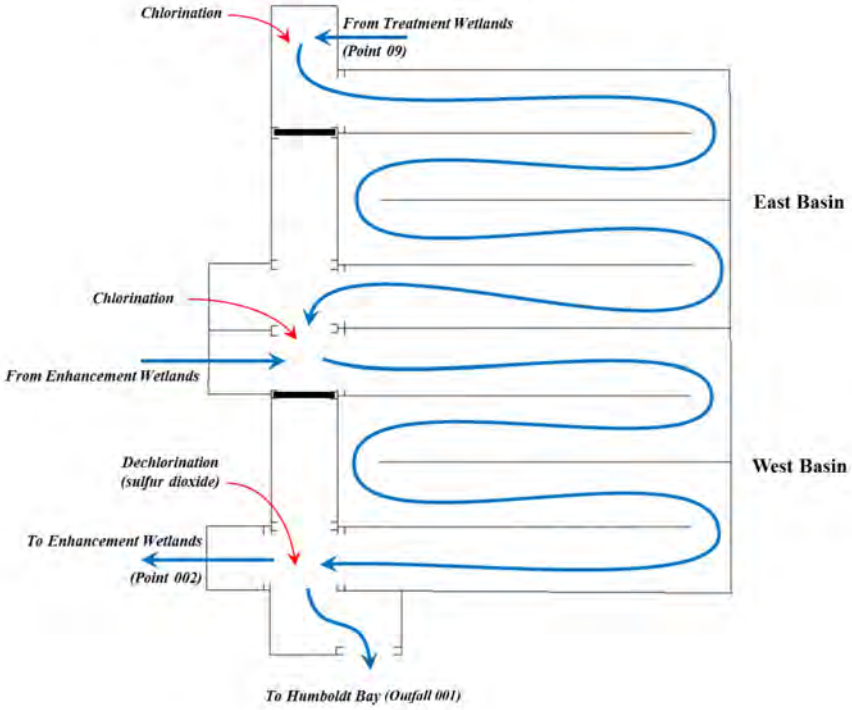
The existing disinfection system includes a chlorine contact basin (CCB) constructed in 1984. The basin can operate as one or two tanks, labelled the east and west basins in the plant O&M manual. The approximate volume for each basin is 185,400 gallons. The detention time at 2.3 million gallons per day (mgd) is listed as 58 minutes, while the detention time at 5.9 mgd is listed as 30 minutes.

The plant operates the basin in two modes: Split or Combined Mode, which is shown schematically in Figure 7.1.

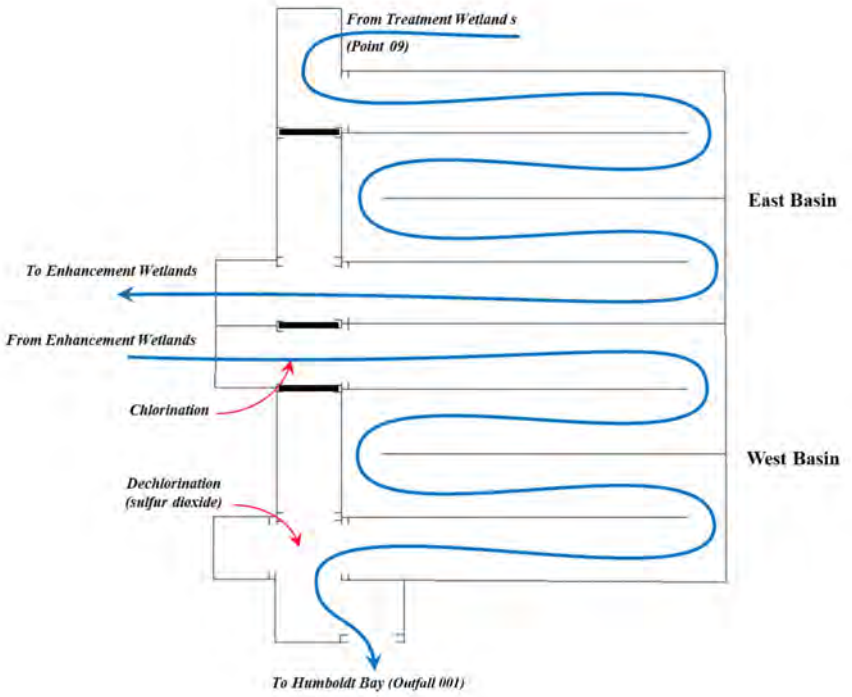
In the combined mode, flow from the treatment wetlands enter the east side, and is dosed with chlorine at the entrance to this first section. The flow then joins with the flow returned from the enhancement wetlands, mixed, and dosed a second time with chlorine. The combined flow is dechlorinated, then is split to return a portion of the flow to the enhancement wetlands, with the rest of the flow going to discharge through Outfall 001.

In split mode, flow from the treatment wetlands enters the east side, is not dosed with chlorine, and then goes to the enhancement wetlands. The return flow from the enhancement wetlands is dosed with chlorine for a first time as it enters the west basin section, then goes through the basin, is dechlorinated, and discharged to Outfall 001.

The combined mode is the normal operating mode, especially when flows exceed the capacity of the enhancement wetlands effluent pump station. This mode is especially important during wet weather flows. The split mode is used during low flows, or dry




COMBINED MODE




SPLIT MODE

## CHLORINE CONTACT BASIN OPERATIONAL MODES

FIGURE 7.1

CITY OF ARCATA
*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

carollo

arc0915f6-9913.ai

weather. It has the advantage of reducing the chlorine usage to the amount needed to disinfect the flow at Outfall 001 and reducing the potential formation of disinfection by-products.

### 7.5.2 Chlorine and Sulfur Dioxide Use and Impact

The AWTF currently uses approximately 225 pounds per day (ppd) of chlorine and 160 ppd of sulfur dioxide for disinfection and dechlorination, based on 2014 data. The daily average chemical use by month for the last 5 years is included in Appendix L. Chlorination also appears to impact water quality by reducing effluent BOD and suspended solids. Information from the City and AMRI indicate that at times the BOD reduction can range from 700 to 1400 ppd.

## 7.6 PROPOSED ULTRAVIOLET LIGHT DISINFECTION

Ultraviolet (UV) light disinfection has been proposed for the AWTF discharge based on a series of pilot tests conducted by the City and the Arcata Marsh Research Institute (AMRI). The current Waste Discharge and NPDES permit provides general requirements for replacing the existing chlorination disinfection system with a UV system. The proposed UV system design requirements for the three project alternatives are outlined in this Section.

### 7.6.1 UV System Sizing Criteria

The UV system sizing criteria is listed in Table 7.2. The basis for the dose is outlined below:

#### 7.6.1.1 Design UVT

A design UVT of 35 percent was originally recommended for the UV system sizing based on a review of the available data collected to date. The original pilot UVT data is summarized in the project memorandum included in Appendix M. The UVT may seem low compared to filtered secondary effluent, but is consistent with effluent expected from other wetlands or natural systems.

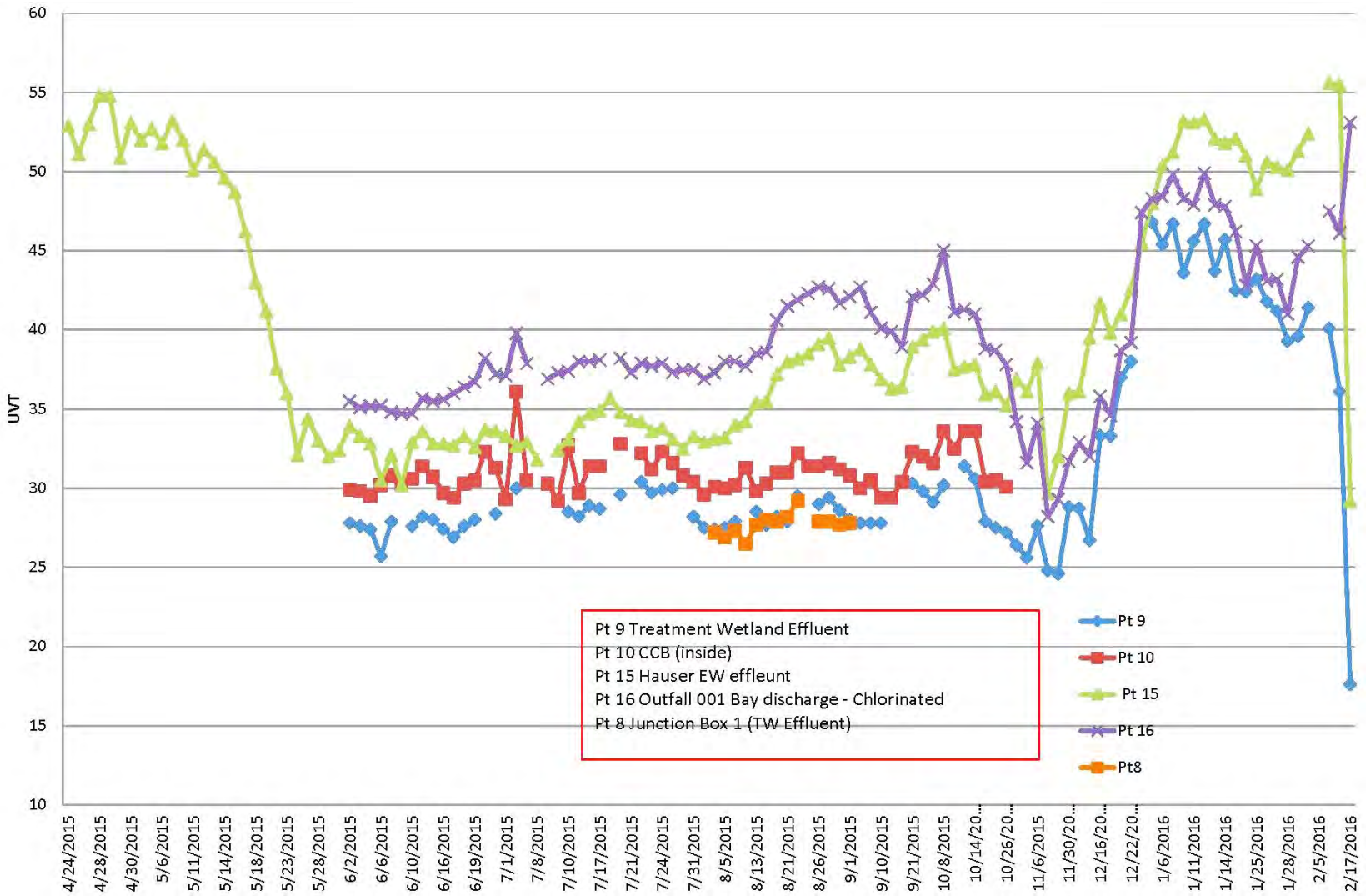
Plant staff purchased a UVT meter in April 2015 and started to collect UVT data across the plant including the treatment and enhancement wetlands effluents. It was recommended that UVT sampling be continued to establish a long term history of UVT. This is especially important because it was projected that the UVT would vary seasonally. Based on the longer detention times during summer dry weather flows, it was thought that the effluent would have lower UVT levels as more organic materials decay in the wetlands and release humic type compounds. In the winter it was thought that the organic material would be diluted with rain water that falls on the system. The lower detention times due to the higher wet weather flows may also reduce the concentration of material.

| Table 7.2 UV System Sizing Design Criteria<br>Wastewater Treatment Plant Improvements Project<br>City of Arcata | | |
|---|---|---|
| **Indicator Organism** | **Unit** | **Value** |
| Fecal coliform[1] | MPN/100 mL | 14[2], 43[3] |
| **Flow** | | |
| Annual average | mgd | 2.3 |
| Maximum month[4] | mgd | 5.9 |
| **UV Transmittance (UVT)** | | |
| Alternatives 1, 2, and 4 | % | 35 |
| Alternative 3 | % | 55 |
| **Dose[5]** | | |
| Alternatives 1 and 2 | $mJ/cm^2$ | Minimum T1 dose: 17 $mJ/cm^2$.<br>Minimum MS2 dose: 35 $mJ/cm^2$ [6]. |
| Alternative 3 and 4 | $mJ/cm^2$ | Minimum T1 dose: N/A [7].<br>Minimum MS2 dose: 50 $mJ/cm^2$ [6]. |

Notes:
(1) Shellfish Harvesting Waters, EPA Quality Criteria for Water, 1986.
(2) Monthly Median.
(3) Not more than 10% of samples collected in a 30-day period shall exceed the listed value.
(4) UV facility capacity.
(5) The typical recommended test organism used for validating UV systems is MS2 coliphage (MS2) to mimic polio virus; however, using MS2 validation data for disinfection of bacteria results in potential under dosing since bacteria (coliforms) react differently to UV disinfection than MS2. Some UV manufacturers have performed validation work using proven bacteria surrogates such as T1 coliphage (T1).
(6) Additional analysis required to confirm that dose meets virus reduction concerns of RWQCB.
(7) Fecal coliform reduction required for Alternative 3 may exceed reliable T1 validation reduction.

The data collected to date is shown in Figure 7.2. In general, the pond/wetland system UVT is fairly low, around 30 to 35 percent in the dry months, and around 45 to 55 percent in the wet months. The higher UVT may possibly be due to dilution of the soluble humic material which would raise the UVT in the wet months.

An alternative UV system design has been proposed for Alternative 3 based on a blended effluent concept, where the lower wetland effluent (UVT 35%) would be blended with the higher oxidation ditch secondary treatment process effluent (estimated UVT of 65%). The blending is envisioned during the dry weather, lower flow periods of the year. The resulting blended effluent UVT is estimated at a minimum of 55 percent. The other design criteria including the peak flow of 5.9 million gallons per day (mgd), a dose of 35 millijoules per square centimeter ($mJ/cm^2$), with 50 percent redundancy, remain the same. The higher UVT results in a reduction in lamps from 528 to 336 and a corresponding reduction in power demand from 136 to 84 kW.




# UVT DATA

FIGURE 7.2

CITY OF ARCATA

*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

carollo

arc0516rf19-9913.ai

As noted in Chapter 2, at the June 27, 2016 meeting with the RWQCB, UV disinfection design criteria was proposed to be based on a minimum UVT of 35 percent regardless of the Alternative.

#### 7.6.1.2 Design Dose

The selection of the design UV dose is outlined below. The current permit lists the required minimum dose as 50 mJ/cm$^2$ which was may have been based on protection of the bay oyster farming operation. The first criterion for a design dose is that the discharge must provide bacteria reduction, specifically to meet the fecal coliform level required in the discharge permit. In an initial meeting with the RWQCB, Arcata City staff, LACO and Carollo (June 23, 2015), RWQCB staff indicated a specific concern about virus kill. The discussion focused on the disinfection of coliphage, but without any specific effluent target. In the meeting with the RWQCB on June 27, 2016, there was discussion about a future virus reduction requirement. Virus reduction would require a higher design UV dose than for bacteria reduction alone. The City will need additional input from the State (RWQCB and Division of Drinking Water) on the design dose and disinfection objectives during preliminary design. The design dose discussion that follows is based on the current permit requirement for bacteria (fecal coliform) reduction. Design dose will need to be revised during preliminary design when additional information is provided by the State.

To properly size a UV system, the dose must be determined for each target organism (bacteria and/or virus, in this case). Different organisms (e.g., bacteria, virus, and protozoa) have measurably different sensitivities to UV disinfection. For example, viruses tend to be more resistant to UV disinfection than bacteria. Much of the UV system validation work that has been completed to date has been for water reuse applications in California, where virus inactivation is the primary goal. For these applications, the ideal and recommended test organism is MS2 coliphage (MS2); however, using MS2 validation data for disinfection of bacteria results in potential under dosing since bacteria (coliforms) react differently to UV disinfection than MS2. Some manufacturers (Calgon Carbon, Ozonia, and Wedeco) have performed validation work using proven bacteria surrogates such as T1 coliphage (T1). For cases where manufacturers have not validated their system based on T1, MS2 validations can be allowed with some degree of conservatism. To account for the difference between the dose-response curves of the organisms, higher dose levels will be specified for systems validated with MS2. Based on systems that have been validated by Carollo using both MS2 and T1, the ratio between the two varies depending on the UVT and the reactor efficiency.

Figure 7.3 below shows the MS2/T1 dose ratio for two different UV reactors that range between 1.63 and 2.06 at this project's design UVT of 35 percent. For the higher MS2/T1 ratio of 2.06, a T1 dose of 1.0 mJ/cm$^2$ is equivalent to an MS2 dose of 2.06 mJ/cm$^2$.

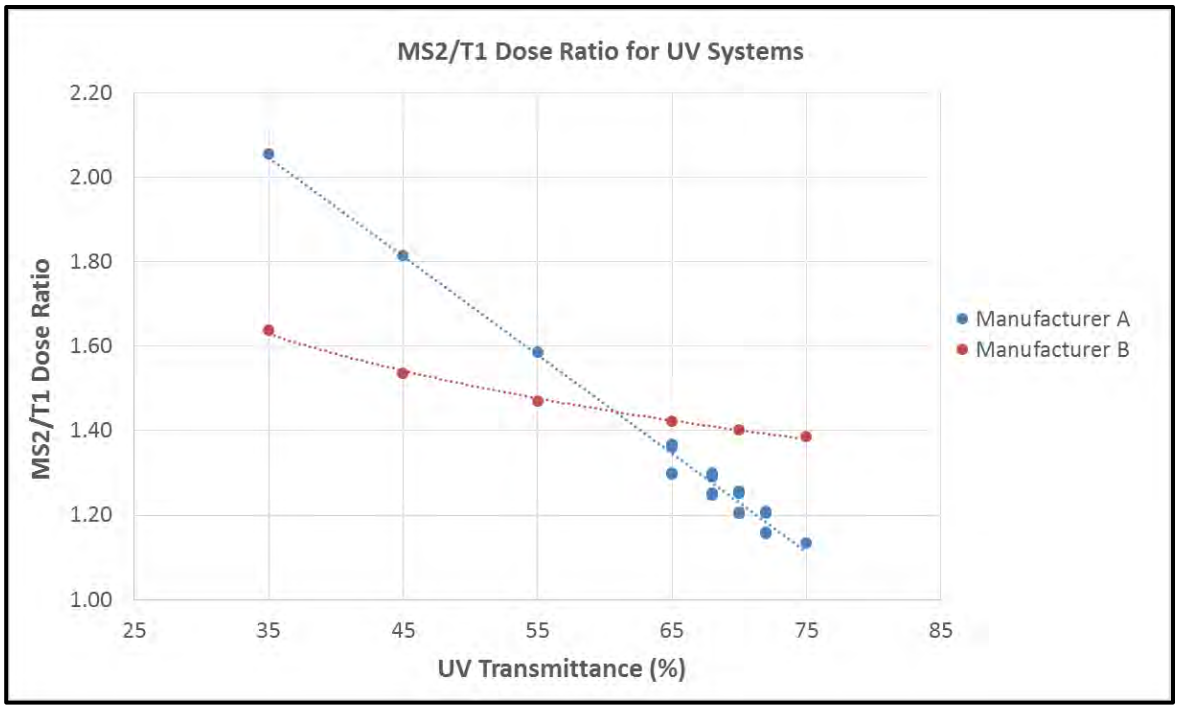



Figure 7.3 MS2/T1 Dose Ratio For UV Systems

The first step is to address the permit limits. The permit requirement for this project is a median fecal coliform concentration that should not exceed 14 MPN per 100 ml on a monthly basis and a daily limit that should not exceed more than 10 percent of samples exceeding 43 MPN per 100 mL. Previous UV studies of the Arcata Marsh have indicated the maximum marsh effluent fecal coliform concentration is in the 10,000 MPN per 100 mL range. Therefore, the UV system is required to provide a minimum 2.85 log reduction of fecal coliform to meet the permit limit of 14 to treat effluent from the natural system (Alternatives 1 and 2). Typically, Carollo's recommended sizing approach is to design a UV system to disinfect fecal coliform to approximately one log below the permit limit; however, due to this project's already low permit limit, a half log will be added as a safety factor. This level of conservatism has worked well for our clients and provides plant staff greater flexibility when operating the UV system.

Using T1 as a surrogate for fecal coliform, and knowing that T1 has a similar UV sensitivity as fecal coliform, the proper dose for 2.85 log reduction of coliform can be determined. T1 has a UV sensitivity of 5 mJ/cm$^2$/log inactivation; a fecal coliform log inactivation of 3.35 (2.85 + 0.50 safety factor) thus represents a T1 dose of 16.75 mJ/cm$^2$. Converting this T1 dose to a MS2 dose using the MS2/T1 ratio of 2.06 from above, the validated MS2 dose will be 34.5 mJ/cm$^2$. Therefore, the specified MS2 dose for an equivalent log inactivation of fecal coliform is 35 mJ/cm$^2$.

For Alternative 3, a similar dose analysis is required for blended effluents from the natural system and the oxidation ditch/secondary clarifier treatment train. The fecal coliform concentration from the oxidation ditch/secondary clarifier effluent may be as high as

2,000,000 MPN per 100 mL range. Depending on the blending ratio, a typical fecal concentration from the blended effluents might be 1,000,000 MPN per 100 mL with a UVT of 50 to 55%. The dose analysis for this scenario results in a fecal coliform log inactivation of 5.35 (4.85 plus 0.50 safety factor) for a T1 design dose of 27.11 mJ/cm$^2$. However, T1 validation is generally limited to 5 log inactivation as anything above this is not reliable. Hence, for Alternative 3 an equivalent MS2 design dose of 50 mJ/cm$^2$ is specified.

The second step of the dose analysis is to address the RWQCB concerns regarding virus kill. As part of preliminary design, the dose necessary to reduce indigenous virus (measured as coliphage) in the UV effluent should be determined. This would be done with a collimated beam test on the Arcata enhancement marsh effluent, at dose values dependent on the desired test organism. There are two types of native coliphage in effluent, F-specific and somatic). F-specific (F+) coliphage has a similar UV sensitivity to MS2; therefore, recommended dose levels are 0, 5, 10, 15, 20, 30 and 40 mJ/cm$^2$. Somatic coliphage has a similar UV sensitivity to T1; therefore, recommended dose levels are 0, 2.5, 5, 7.5, 10, 15 and 20 mJ/cm$^2$.

#### 7.6.1.3 Equipment Reliability

Equipment reliability must also be considered when designing a UV system since the regulatory standards for shellfish harvesting waters are stringent. The industry standard reference for UV is the National Water Research Institute (NWRI) Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (UV Guidelines), Third Edition. This document recommends a standby bank per channel or standby channel be installed to ensure that the specified UV dose is provided under worst-case conditions with one bank of lamps out of service. For this project we recommend one standby bank for the single channel design.

### 7.6.2 Proposed UV Equipment Selection

Several UV manufacturers have had their equipment validated to UVT levels down to 35 percent and lower and can be used for this application. The equipment selected for evaluation in this Facility Plan was the Trojan UV3000Plus system. It was successfully tested in 2011 during a pilot study conducted by Trojan, AMRI, and plant staff. The Pilot Study Report is included in Appendix N, and indicated that the fecal coliform requirement could be meet with a dose as low as 20 mJ/cm$^2$. The method used to calculate the dose during the pilot study is proprietary and is based on a March 2012 Validation report for low UVT applications. The validation report was reviewed as part of this study.

A number of dose levels were reviewed to determine the recommended equipment configuration for this Facility Plan. A summary of the configuration is included in Table 7.3, for dose levels of 35, 50, and 100 (mJ/cm$^2$).

| Table 7.3 Trojan UV3000Plus System Configurations[(1)] Wastewater Treatment Facility Improvements Project City of Arcata | | | | |
|---|---|---|---|---|
| | **Design Parameters** | | | |
| Minimum UV Transmittance | 35% | 55% | 35% | 35% |
| Minimum MS2 Dose (mJ/cm$^2$) | 35 | 35 | 50 | 100 |
| **Configuration:** | | | | |
| Number of Channels | 1 | 2 | 1 | 2 |
| Number of Duty Banks/Channel | 2 | 2 | 3 | 8 |
| Number of Standby Banks/Channel | 1 | 1 | 1 | 0 |
| Number of UV Modules/Bank | 22 | 7 | 20 | 26 |
| Number of Lamps/UV Module | 8 | 8 | 8 | 8 |
| **Total Number of Lamps** | **528** | **336** | **640** | **1664** |
| **Total Power Consumption (kW)** | **136** | **87** | **165** | **429** |

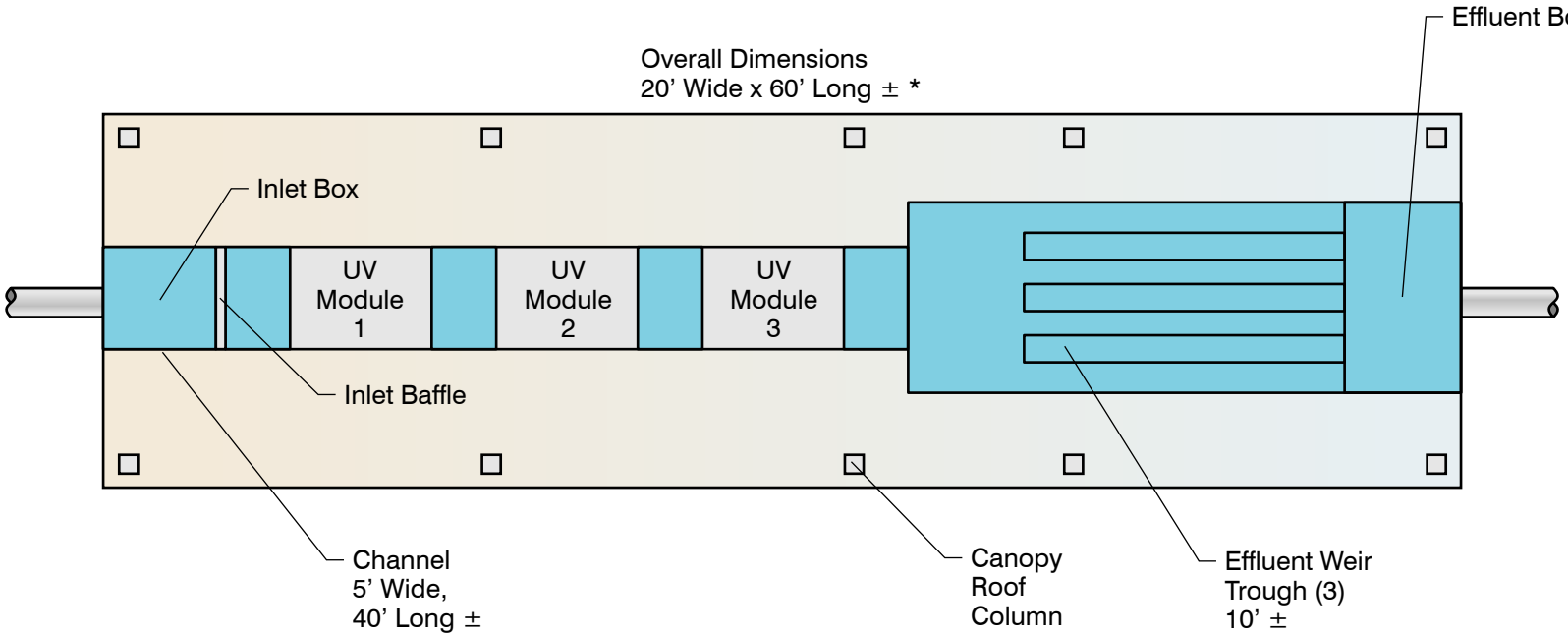
Notes:
(1) Design assumes an End of Lamp Life Factor of 0.90 and a Fouling Factor of 0.95.

### 7.6.3 UV Conceptual Flow Configuration and Layout

The concept envisioned by the City during the pilot testing and outlined in the NPDES permit is to disinfect the Hauser Marsh effluent using UV disinfection, prior to discharge to the new outfall 003 at the brackish marsh. It was originally proposed that the system would be located at the outlet of the Hauser enhancement wetland. Based on the review of this location it was decided that the new UV system would be located on the plant site adjacent to the CCB. This will allow the system to match the industrial look of the existing facilities and provide additional security.

#### 7.6.3.1 Conceptual Layout for 35% UVT

The conceptual plan and section for the 35 percent UVT alternative is shown on Figures 7.4 and 7.5 to illustrate the UV system design. The conceptual plan is based on the Trojan proposal for 35 mJ/cm$^2$ dose with redundancy. If a dose of 50 mJ/cm$^2$ is required the facility then it will require an additional UV equipment bank, a longer overall channel, and a larger footprint.




NOTE:

* Small electrical enclosure will also be required (6' x 6' ±).

## UV DISINFECTION SYSTEM CONCEPTUAL PLAN (35% UVT)

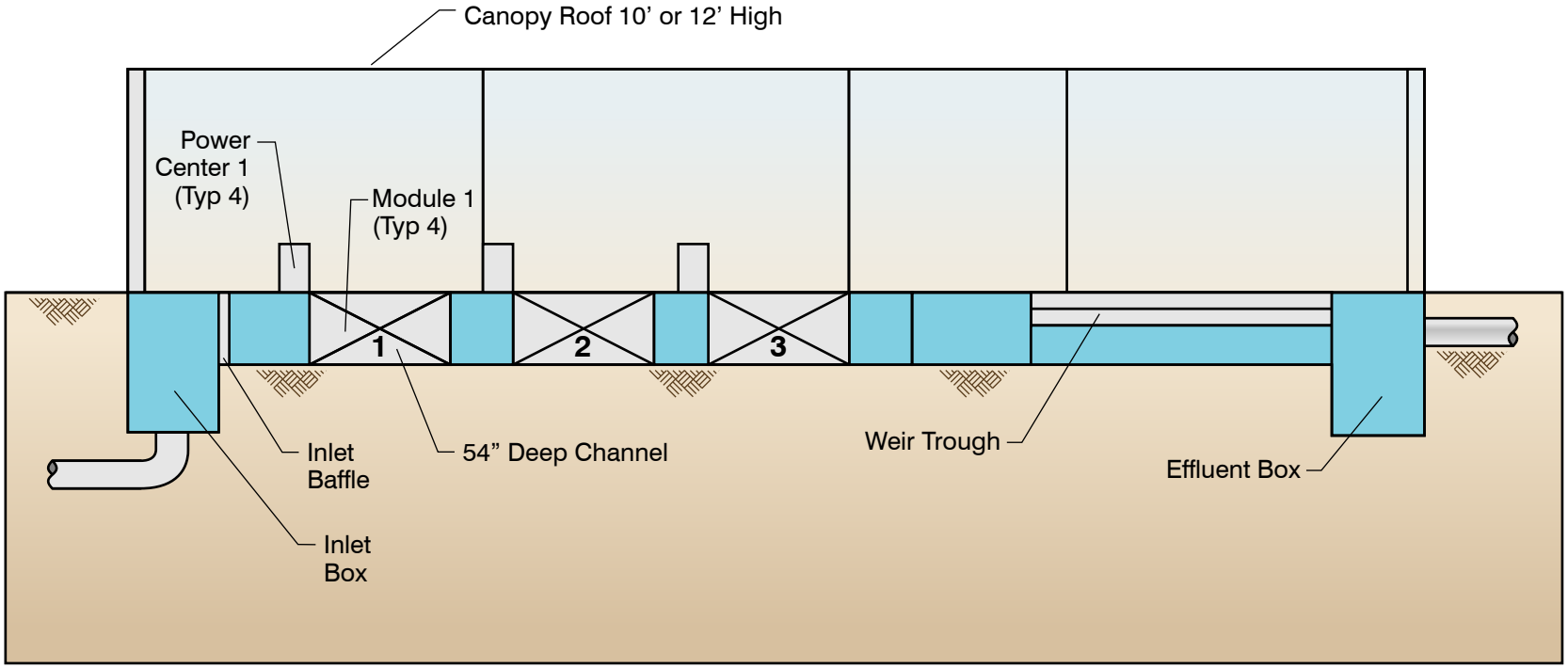
FIGURE 7.4

CITY OF ARCATA

*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

carollo

arc0516rf15-9913.ai




# UV DISINFECTION SYSTEM CONCEPTUAL SECTION

FIGURE 7.5

CITY OF ARCATA
*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

carollo

arc0516rf16-9913.ai

The concept shows a single 5 feet wide channel with three banks (2 duty and 1 standby) system. The influent flow would be pumped into the channel in an inlet box, and should include a flow distribution baffle (not shown). The flow will pass the three reactor banks and flow over the effluent finger weirs. A total weir length of approximately 60 to 70 feet will be required to minimize the water surface fluctuation (1-inch maximum) during average to peak flows. The preliminary overall dimensions are shown on the plan. On each side of the channel, a walkway will be provided for access and maintenance. The Section, Figure 7.5, illustrates one concept for the protection of the facility with a sloped canopy type roof for sun and rain protection over the walkways and channel. The entire area could be enclosed with a guard rail type barrier, which would allow worker protection at a lower cost. It could also be fully enclosed in a structure at additional cost. A photograph of a similar UV system in an operating plant shows the canopy roof over UV channels on Figure 7.6. The architecture and alternatives for enclosure will be reviewed during preliminary design.



Figure 7.6 Typical Canopy Roof Over UV Channels (Windsor, California)

The UV equipment maintenance would be completed using a rolling gantry type crane to lift the modules or banks from the channels. The specific Trojan reactor has an effective sleeve cleaning system, but additional cleaning of the modules and the channel is needed. Modules would be removed for cleaning on a weekly to monthly (or longer) frequency, depending upon site-specific conditions. The major equipment maintenance, including bulb replacement, would be completed on an annual basis. Channel cleaning requires high pressure washing to remove algae and debris. Therefore open access to the channel will be required with the equipment removed and storage adjacent to the channel.

A small electrical and control building would also be required. The size for electrical enclosure might be in the range of 6 feet square. If a 150 to 180 kW standby generator is required, the size might double. The electrical and standby requirements will be finalized in preliminary design.

#### 7.6.3.2 Conceptual Layout for 55% UVT

The UV facility conceptual layout was updated for the projected 55 percent UVT, and will be smaller than for 35 percent due to the decrease in the number of lamps. The updated design is based on a 2 channel system. Each channel will have a capacity of up to 2.95 mgd. Therefore during most of the year, only one channel will be in service at a time. A two channel design will allow for channel and equipment maintenance. An updated layout for 55 percent UVT is shown on Figure 7.7.

### 7.6.4 UV System Costs

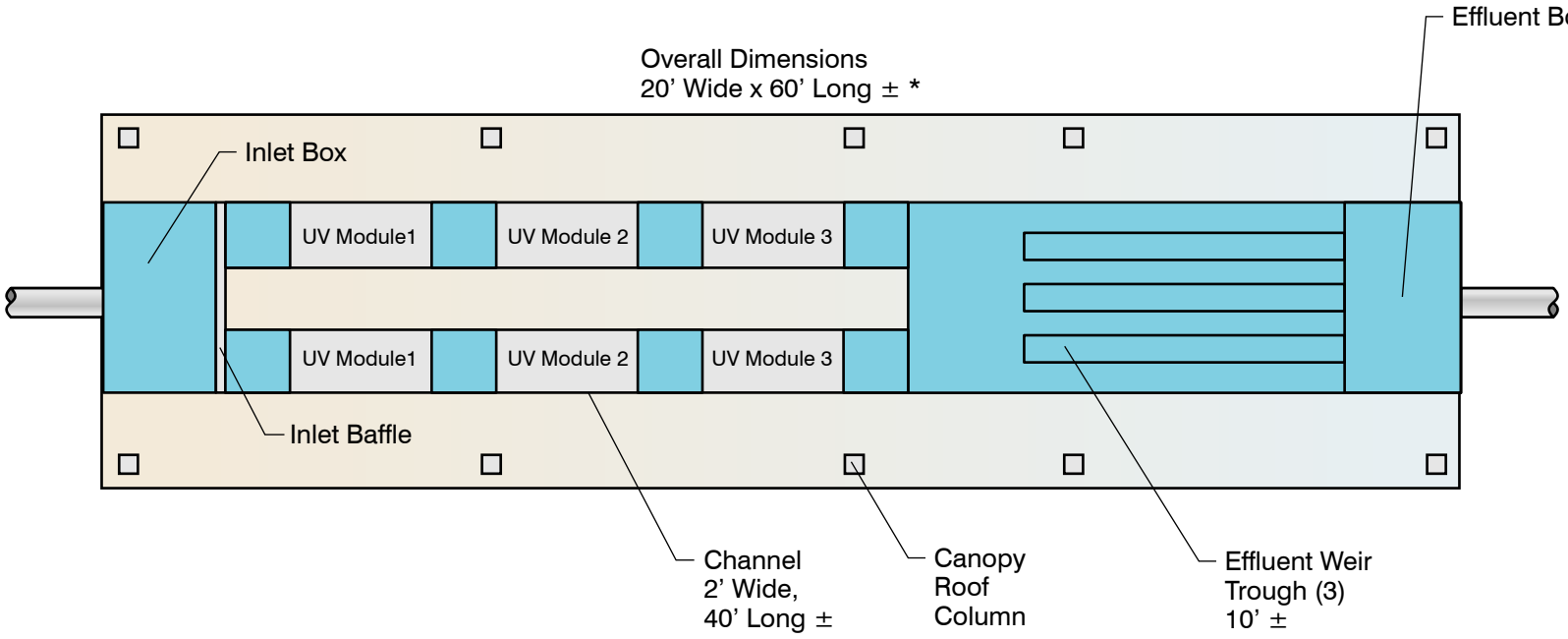
The UV equipment cost to meet the 35 or 50 mJ/cm$^2$ dose at 35 or 55 percent UVT, with or without redundancy, is outlined in Table 7.4. The cost is based on budget proposals from Trojan for the UV3000Plus system. These costs illustrate the increasing cost with redundancy and with higher dose. The estimated construction cost is based on recent experience for standalone system projects where the costs range from 3 to 5 times the equipment cost.

**Table 7.4 Trojan UV Equipment and Construction Cost Comparison**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| Item | 35 mJ/cm$^2$ Dose No Redundancy | 35 mJ/cm$^2$ Dose With Redundancy | 50 mJ/cm$^2$ Dose With Redundancy | 35 mJ/cm$^2$ Dose With Redundancy |
|---|---|---|---|---|
| UVT, percent | 35 | 35 | 35 | 55 |
| UV Disinfection Equipment Cost | 800,000 | $1,090,000 | $1,310,000 | $786,000 |
| **Total Construction Costs:** | | | | |
| Low range (3 times equipment) | $2,400,0000 | $3,270,000 | $3,930,000 | $2,360,000 |
| High range (5 times equipment) | $4,000,000 | $5,450,000 | $6,550,000 | $3,930,000 |

Note:
(1) Equipment sizing is based on an End of Lamp Life Factor of 0.90 and a Fouling Factor of 0.95.

For reference, the equipment cost for a 100 mJ/cm$^2$ dose is approximately 2.5 times the cost for a 50 mJ/cm$^2$ system with redundancy. This higher dose is normally only required for a tertiary recycled water application with high incidence of public contact.




NOTE:

* Small electrical enclosure will also be required (6' x 6' ±).

# UV DISINFECTION SYSTEM CONCEPTUAL PLAN (55% UVT)

FIGURE 7.7

CITY OF ARCATA

*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

carollo

arc0516rf17-9913.ai

The updated Trojan proposal lists the equipment cost for a UVT of 55% at $785,500 with redundancy. The estimated construction cost will be 3 to 5 times the equipment cost, and range from $2,360,000 to $3,930,000 using the same installation cost factors. This reduces the cost by $910,000 to $1,520,000 for the higher UVT.

Preliminary estimates of operating costs were prepared for the 35 and 50 mJ/cm$^2$ dose levels with redundancy, and are outlined in Table 7.5. The assumptions for the costs are included in the table and are based on our analysis of the system and input from Trojan.

**Table 7.5 Trojan UV O&M Cost Basis and Estimate**
**Wastewater Treatment Facility Improvements Project**
**City of Arcata**

| Description | 35 mJ/cm$^2$ Dose at 35% UVT | 50 mJ/cm$^2$ Dose at 35% UVT | 35 mJ/cm$^2$ Dose at 55% UVT |
|---|---|---|---|
| UVT, percent | 35 | 35 | 55 |
| Lamp Replacement | $250 | $250 | $250 |
| Ballast Replacement | $400 | $400 | $400 |
| Wiper Replacement | $15 | $15 | $15 |
| Quartz Sleeve Replacement | $80 | $80 | $80 |
| Chemical Usage | $300 | $300 | $300 |
| UV Sensor Replacement | $1,000 | $1,000 | $1,000 |
| Interest Rate | 6.00% | | |
| Project Life, years | 15 | | |
| Electricity Rate (kWh) | $0.10 | | |
| Labor Rate (per hour) | $50.00 | | |
| Annual Parts and Replacement Cost | $112,000 | $113,000 | $47,700 |
| Annual Labor Cost | $29,600 | $34,100 | $25,200 |
| Annual Energy Cost | $67,800 | $92,300 | $29,500 |
| **Total Annual Cost** | **$209,000** | **$239,000** | **$102,000** |

Note: All costs are based on redundant equipment

The difference in annual O&M cost between the lower and higher dose values of 35 and 50 mJ/cm$^2$ is only $23,100, and is predominately due to the higher energy use at the 50 mJ/cm$^2$ dose. The higher dose system has 112 more UV lamps (21 percent) compared to the 35 mJ/cm$^2$ system. Using the O&M cost basis in Table 7.5, the life cycle costs were calculated for both systems. The operating cost of the system at 55 percent UVT is substantially less than at 35 Percent UVT, by over $107,000 per year. A comparison of the life cycle cost at the different UVTs is shown on Table 7.6. The higher UVT has a lower life cycle cost by over $2,000,000.

| Table 7.6 UV System Net Present Worth Summary<br>Wastewater Treatment Facility Improvements Project<br>City of Arcata | | | | |
|---|---|---|---|---|
| **Equipment** | **Equipment Cost[(1)]** | **Estimated Construction Cost[(2)]** | **Annual O&M Cost** | **Present Worth Life Cycle Cost[(3)]** |
| 35 mJ/cm$^2$ Dose @ 35% UVT | $1,090,000 | $4,360,000 | $209,000 | $6,390,000 |
| 35 mJ/cm$^2$ Dose @ 55% UVT | $785,000 | $3,140,000 | $102,200 | $4.130,000 |
| Difference | $305,000 | $1,220,000 | $107,800 | $2,270,000 |
| 50 mJ/cm$^2$ Dose @ 35% UVT | $1,310,000 | $5,240,000 | $239,000 | $7,560,000 |
| 35 mJ/cm$^2$ Dose @ 35% UVT | $1,090,000 | $4,360,000 | $209,000 | $6,390,000 |
| Difference | $220,000 | $880,000 | $30,000 | **$1,170,000** |

Notes:
(1) Based on redundant equipment and facilities.
(2) Based on 4 times the equipment cost.
(3) Life cycle based on 15 years and 6 percent interest.

## 7.6.5 UV System Procurement

The UV system will be included in the final design for the flow reconfiguration / disinfection improvements project. UV system equipment procurement can be can be implemented in a number of ways. The alternatives are reviewed below at a high level for consideration by the City. The method of UV system procurement will be reviewed with the City and selected during preliminary design.

### 7.6.5.1 Sole Source Design and Bid

In this option, a single design is prepared and bid based on a single manufacture/supplier's product. In some cases, owners and designers have selected one supplier to provide an equipment supply bid without a competitive process. This has been done in limited cases where the supplier's equipment provides some unique feature that is critical to the project. This might include, matching existing equipment, or some patented feature that is important to the success of the project, such as the method of sleeve cleaning, or pilot results that provide critical benefits. Based on the characteristics of the Trojan equipment, with patented cleaning system, and successful pilot testing results, this could be considered by the City. Depending of the City's plan for funding, this would still need to be approved by the funding source, such as State Revolving Loan Fund (SRF).

### 7.6.5.2 Traditional Design and Bid

The traditional design and bid format is complicated when bidding UV disinfection equipment due to the different configurations offered by different UV equipment supplier or manufacturers. When UV equipment designs were first being considered, this was the preferred method of procurement. The designer would design the facility around one

supplier, including structural, mechanical, and electrical designs. In general the UV disinfection equipment was specified based on a performance specification allowing competitive bidding. The issue with this approach was that the equipment supplied sometimes required very different structural, mechanical, and electrical designs. Even when the contractor was required to take the differences into consideration in the bid, items were sometimes missed or left out for alternative UV systems. In some cases this has resulted in disputes and change orders.

To avoid this issue, designers have prepared multiple designs around two or three suppliers, providing in some cases, two or three complete UV system designs. This was costly to the owner, since the designer had three times the effort, especially for structural, and electrical design components. In most cases the General Contractor selected the equipment based on cost alone, and the owner had no say in equipment selection.

One variation on this approach is to base bid the one manufacture that is used in the development of the bid documents. The general contractor provides a cost for installing one base bid with the pre-selected supplier's equipment, and provides the added or deductive cost for supplying other equipment. This provides the Owner with the differences in the cost of construction for different alternative suppliers. This can help to cut down on changes, but forces the contractor to determine all the extra costs for the alternative equipment, including design revisions.

#### 7.6.5.3 Evaluated Bid for UV Equipment

One solution that designers and owners now follow to avoid the issues with the traditional design approach, is an evaluated bid for UV equipment. The designer and owner first issue a package for bidding the UV disinfection equipment based on approximately a 30 percent design, and a performance based specification. The bid forms require not only the capital cost bid, but guaranteed power cost, lamp replacement costs, and chemical cost (if required). The results of the bid would then be used to complete a present worth analysis for each bidder. The bidder with the lowest present worth (or best overall value) would be selected. The owner would then contract with the supplier for the UV equipment supply based on this selection. In most cases the selected supply also includes an allowance for working with the owner and designer to complete the design. Then the installation could be bid to a general contractor based on the selected equipment supplier and design requirements. The equipment cost bid is then included in the general contractors bid, and is assigned to the General Contractor by the Owner once a General Contractor is selected. Carollo has used this approach on a number of UV installations, and generally has had good experience with the overall approach. In most cases it has resulted in a good installation bid, and allows the UV supplier to be part of the design team. This approach also helps to ensure that no details are missed in the design. In addition, it provides a system that has the best value to the Owner.

In an evaluated bid format, other factors can also be used in ranking a suppliers bid. These could be addressed in a weighting process and could include the following:

- Suppliers warranty and warranty terms.
- Proximity to factory authorized service center.
- Number of installation of the type proposed for owner.
- Recent installation issues or claims against the supplier.
- Validation experience.
- Regulatory acceptance of the technology if new or improved.

### 7.6.6 UV System Pretreatment

The Hauser enhancement wetland will require pretreatment including coarse screening and medium fine screening prior to the UV process.

The Hauser pump station modifications will include a coarse screen at the inlet structure to remove larger debris and vegetation prior to pumping. This will protect both the pumps and the UV system. An automatically cleaned type bar screen is proposed to facilitate operation. The type of bar screen and appropriate enclosure will be reviewed during preliminary design.

The pump station modifications should also include some type of protection for downstream UV system such as a strainer downstream of the pump station to remove material especially stringy algae and other organic material. The strainer will be sized to provide 200 to 500 micron strainer with automatic cleaning. The type of strainer best suited for wetland effluent including algae and vegetation solids will be reviewed during preliminary design.

## 7.7 EXISTING CHLORINE AND SULFUR DIOXIDE SYSTEM

The City of Arcata will phase out the existing chlorine and sulfur dioxide gas system as the primary disinfection process after the implementation of the new UV system. The existing system could still remain as a backup to the UV and for peak wet weather flow disinfection. This will require that the plant maintain the system and store chlorine and sulfur dioxide ton cylinders on site, especially during wet weather. It has been reported in the City's 2011 Risk Management Prevention Plan (RMPP), that the AWTF has been handling chlorine for over 25 years and has never experienced a release. As noted in the plan, the plant, on average, has fifteen (1 ton) chlorine cylinders on site. Typically six (6) cylinders are on-line and nine (9) are in storage. In addition, there are also six (6) sulfur dioxide containing cylinders on-site, with two (2) cylinders on-line and four (4) in storage. As part of the RMPP evaluation, plant staff determined that due to an annual average chlorine consumption of 1.5 - 2.0 tons per week, chemical supplier location (500 miles away), delivery delays due to road

conditions and effluent disinfection requirements, that the amount of on-site chemical was necessary. While the amount of chemical stored on-site in this scenario can be reduced once the UV system is online, chlorine and sulfur dioxide will still need to be stored on-site, and ready for use during wet weather.

The system could be retrofit to a liquid chemical system for use during wet weather or as a redundant system to the new UV system. Note that this system would only be used for disinfection for the existing Outfall 001.

The reason to retrofit the system is to reduce the overall potential risk from the ton chlorine cylinder system. Commonly sodium hypochlorite and sodium bisulfite are used to retrofit gas systems. The benefit of using the liquid chemical is lower potential for release of hazardous gas, and a fairly simple chemical dosing system. The downside is that these chemicals are less stable, and degrade over time. Typically the hypochlorite is supplied as 15 to 25 percent and bisulfite as 15 to 45 percent. These can degrade over time to less than 10 percent strength in a matter of weeks. For example, depending on the temperature a 15 percent hypochlorite solution can degrade in half in 60 to 100 days.

The chemicals would be stored in high density polyethylene tanks. The tanks could be located in the existing chlorine gas storage area, with slight modifications to provide containment. Chemical metering pumps could be installed adjacent to the tanks, and used to pump chemical solution directly to the existing CCB. The existing chemical induction units could be reused for this application.

## 7.8 SUMMARY AND RECOMMENDATIONS

The proposed UV effluent disinfection system for the ATWF is outlined in this chapter.

The following items need to be reviewed or finalized during preliminary design:

- Final system sizing based on the expected design UVT: 35 or 55 percent.
- Final design dose based on collimated beam test on the Arcata enhancement marsh effluent and based on feedback from State on requirements to be protective of shellfish.
- UV system facility design requirements including the need for an enclosure or other type of weather protection and architectural treatment.
- Power supply and back-up power requirements.
- Procurement method and basis of design for equipment (sole source or other).
- Enhancement wetland (Hauser) pump station pretreatment equipment selection.

## 7.9 REFERENCES

SHN 2003 - 2000/2002 Wastewater Treatment Plant Evaluation, February 2003, SHN Consulting Engineers & Geologists Inc.

# CAPITAL IMPROVEMENTS PROGRAM

## 8.1 INTRODUCTION

This chapter presents alternative capital improvements programs (CIP) for the City of Arcata Wastewater Treatment Facility (AWTF), as well as a summary of the associated project and operating costs. The 10-year CIP is a preliminary estimate of the City's required capital expenses over the next 10 years for alternative approaches to address permit and regulatory requirements, capacity limitations, rehabilitation, and repair (R&R) needs. Additional projects are identified in project elements for a second 10-year CIP (10 to 20-year CIP) that should be considered to address modernization and sea level rise requirements. It is an update to the preliminary 2014 wastewater CIP prepared by City staff, and the draft CIP presented in the original facility plan prepared in September 2015. This CIP is intended to assist the City in planning future budgets and making financial decisions for the City wastewater treatment infrastructure needs.

## 8.2 CIP DEVELOPMENT APPROACH

In an effort to distribute spending throughout the 20-year planning period, individual projects were identified and prioritized based on need and an acceptable approach to phasing the work. Three 10-year CIP treatment alternatives were prepared to provide the City with different options that provide different levels of risk for meeting NPDES permit requirements. The project drivers, the project prioritization approach, projects risks, and the project implementation strategy for the CIP projects are discussed below.

The five treatment alternative projects were described in Chapter 6, and include:

- Alternative 1 - Existing System Rehabilitation.
- Alternative 2 - Existing System Rehabilitation with Side-stream Treatment.
- Alternative 3 - Existing System Rehabilitation with Parallel Treatment.
- Alternative 4A/B – Existing System Rehabilitation with Oxidation Pond Treatment improvements and Phased Parallel Treatment.
- Alternative 5 – Existing System Rehabilitation with New Secondary Treatment.

### 8.2.1 Project Drivers and Prioritization

The AWTF CIP is comprised of five types of projects. These projects, including the methodology used for prioritization, are described in the following bullets.

- Permit and Regulatory Projects. The regulatory projects are those required by the current National Pollutant Discharge Elimination System (NPDES) permit and that address ongoing permit violations, including:

  - Major disinfection upgrades for conversion from chlorine gas to ultraviolet light (UV) disinfection.
  - Flow reconfiguration from a two-pass to a single-pass system to handle flows up to the permitted discharge flow of 5.9 million gallons per day (mgd).
  - Capacity upgrade of the Enhancement Wetlands (Hauser) Pump Station for the new discharge point, and to handle flows up to 5.9 mgd through the enhancement wetlands (EW) (Alternative 4 and 5).
  - Construction of a new outfall (Outfall 003) for the new discharge point into the brackish marsh.

  The permit requires that these upgrades be brought online prior to December 1, 2016, which will be impossible for the City to meet. A more realistic compliance schedule is that some of these projects could be brought online by the end of 2021, but full rehabilitation of the wetlands (which is proposed under every alternative) will require a longer schedule and would likely not be complete until 2025. This alternative compliance schedule will need to be approved by the Regional Water Quality Control Board (RWQCB). Initial discussions were held June 27, 2016 with the RWQCB, where they acknowledged the need for additional implementation time.

- Capacity Projects. The capacity projects provide both hydraulic capacity in the flow reconfiguration project and secondary treatment capacity to meet capacity shortfall. The basis of design for the treatment capacity projects accommodate the projected growth expected by Arcata. As previously discussed, the City originally anticipated a 10 percent community growth which was incorporated into the Draft Facility Plan. After further discussion with the City at the Council meeting on June 13, 2016, community growth estimates have been revised to be 20 percent. Updates to incorporate this additional growth factor have been included in this Facility Plan to some extent, however, updates to sizing of the capacity projects and their cost estimates, will be fully incorporated during preliminary design.
- R&R Projects. The R&R projects were developed using information compiled during the condition assessment. The remaining useful life was estimated for all of the major assets at the AWTF. Replacement costs for structures and equipment with life expectancies of less than 20 years were grouped by unit process and incorporated into the CIP spreadsheet. These projects were mainly included in the 10-year CIP alternatives, although a few are spread out in the 10 to 20-year CIP timeframe to distribute spending.
- Modernization Projects: The modernization projects will increase energy efficiency and help to reduce labor costs by optimizing plant operations. One example is replacing the existing control system with a more modern supervisory control and data acquisition (SCADA) system. These generally have a lower priority, and are included in the 10 to 20-year CIP, given the more immediate plant needs and limited available funding.

- Sea Level Rise Projects: The sea level rise projects represent a placeholder for any additional projects required to address future sea level rise including additional flood protection levees or raising existing pond and wetland berm levees to protect critical infrastructure. These projects are considered more long-term, and are included in the 10 to 20-year CIP.

### 8.2.2 Project Costs

Costs presented in this Facility Plan are total project costs and include construction, engineering, legal, administrative, and permitting costs, as well as estimating contingencies. The costs are presented in today's dollars. Costs are not escalated to future years.

The costs used in the CIP program for the City of Arcata are developed based on preliminary budget costs for individual equipment times a project cost factor, or cost curve information for a unit process such as a primary clarifier.

The methodology for development of the construction and project cost factors is outlined in Appendix P.

Cost estimates presented in this chapter were developed based on 10 percent community growth that was originally anticipated by the City. Cost estimate updates to reflect the additional 10 percent growth factor are shown as an additional 10 percent of the original cost estimate.

### 8.2.3 Project Implementation

Project implementation activities can include predesign planning, final design, environmental permitting, project funding, bidding and award, construction, and commissioning. Project duration is a function of project complexity, which generally increases as a function of project cost.

Annual CIP costs were estimated for the 10-year CIP alternatives and the 20-year planning horizon using the project drivers defined above and the project durations established for each CIP project.

## 8.3 10-YEAR CIP ELEMENTS AND ALTERNATIVE COSTS

As discussed in Chapter 6, three different treatment capacity alternatives were reviewed. These treatment alternatives include UV facilities of different sizing as described in Chapter 7, but does not include the potential requirement to design for lower UVT or higher dose in all alternatives as discussed at the June 27, 2016 meeting with the RWQCB. At the June 27, 2016 meeting with the RWQCB, it was made clear that the City would be getting ammonia limits in its next NPDES permit in 2017. RWQCB staff indicated that the recent City of Eureka's June 2016 permit was a good example of likely limits. While it was suspected that ammonia limits may be coming, the alternatives were not originally set up to

remove ammonia to monthly average limits in the 4 milligrams per liter (mg/L) range (Eureka levels). This new information means that only Alternative 3, which was designed to provide ammonia removal for up to 4 mgd, is likely to be able to meet this future requirement year round. The existing system can meet low ammonia levels in the summer months, but not during the colder winter months. The RWQCB also indicated that bypass of flows around the treatment and enhancement wetlands did not meet the intention and definition of enhancement. The existing system relies on bypasses during wet flows to prevent degradation of effluent quality. The difference in each treatment alternative estimated capital and project cost is outlined below:

- Alternative 1 includes only additional pond aerators to address plant capacity. It does not provide adequate treatment capacity for the projected design loads and therefore has the risk of permit violations. This alternative also does not provide for additional treatment to meet future ammonia reduction requirements that are expected in the 2017 permit (per 6/27/16 meeting with RWQCB). The operations and maintenance (O&M) costs include an estimate of ongoing permit violation penalties. The common elements outlined above including the permit required flow reconfiguration are included in the alternative costs. The UV system for this alternative is sized based on the lower UVT from the wetland effluent. In addition, the primary clarifiers are sized for the total plant design flow.
- Alternative 2 include additional treatment capacity including single oxidation ditch and secondary clarifier. The side-stream treatment will address the capacity shortfall, and provide partial ammonia removal. The side stream flows are combined with the pond/treatment wetland flows prior to the enhancement wetlands for up to a total capacity of 5.9 mgd. The common elements outlined above, including the permit required flow reconfiguration, are included in the alternative costs. The UV system for this alternative is sized based on the lower UVT from the wetland effluent. In addition, the primary clarifiers are sized larger for the total plant design flow. This alternative includes additional solids handling and thickening equipment for the additional solids generated by the side-stream treatment, prior to digestion in the existing digester.
- Alternative 3 includes additional treatment capacity including two oxidation ditches and secondary clarifiers. The parallel treatment will address the capacity shortfall, and provides ammonia removal. The parallel flows are combined with the pond/treatment and enhancement wetland flows prior to the new UV disinfection system for up to a total capacity of 5.9 mgd. The common elements outlined above including the permit required flow reconfiguration are included in the alternative costs. The UV system for this alternative is sized based on the higher UVT from the blended effluent. In addition, the primary clarifiers are sized smaller for only the pond and wetland plant design flow. This alternative includes additional solids handling and thickening equipment for the additional solids generated by the parallel treatment, prior to digestion in the existing digester.

- Alternative 4A/B includes additional treatment capacity including phasing in two oxidation ditches and secondary clarifiers. Phase A would include one oxidation ditch/secondary clarifier and oxidation pond treatment improvements, while Phase 4B would add a second oxidation ditch and secondary clarifier. The pond improvements with the parallel treatment additions will address the capacity shortfall, and provides ammonia removal, in a phased manner. The parallel flows are combined with the pond/treatment and treatment wetland flows prior to the new UV disinfection system for up to a total capacity of 5.9 mgd. The UV effluent flow would be routed through the enhancement wetlands, then to the new outfall (003) discharge. The common elements outlined above, including the permit required flow reconfiguration, are included in the alternative costs. The UV system for this alternative is sized based on the lower UVT from the blended effluent, since the ratio of the blend is unknown. In addition, the primary clarifier is sized smaller for only the pond and wetland plant design flow. This alternative includes additional solids handling and thickening equipment for the additional solids generated by the parallel treatment, prior to digestion in the existing digester.
- Alternative 5 was developed for comparison of project and operating costs. It would include the same facilities as Alternative 4A/B, except a third oxidation ditch would be constructed in lieu of the oxidation pond treatment improvements.

Descriptions for the major 10-year CIP projects listed in the new CIP are provided below. The 10-year CIP project, O&M and life-cycle costs are outlined in Table 8.1. A breakdown of construction and project cost estimates by project alternative for the proposed 10-year CIP is outlined in Appendix Q. The O&M cost projections are outlined in Appendix R. Based on the revised growth projection of 20 percent instead of 10 percent used in the Draft Facility Plan, costs have been revised for an additional 10 percent cost added to the cost of secondary and solids costs for each alternative.

Alternative 1 has the lowest lifecycle cost due to the lowest project cost, although it has higher projected O&M costs. Alternative 1 also has the highest risk of ongoing permit violations due to the treatment capacity shortfall, seasonal challenges in meeting future ammonia removal requirements, and the need to rely on bypass operations to meet secondary treatment standards.

Alternative 3 has the next lowest lifecycle cost, with higher project cost than Alternative 1 and the lowest O&M costs. Alternative 3 also has the lowest potential for permit violations due to its ability to meet treatment capacity and future ammonia removal requirements, as well as its ability to provide treatment/enhancement without requiring bypass operations.

Alternative 2 with the side-stream treatment alternative has the highest lifecycle costs due to the highest project and O&M costs. Alternative 2 also has a lower potential for permit violations than Alternative 1 due to its ability to meet treatment capacity and potentially

meet future ammonia removal requirements (although this would need to be confirmed), as well as provide treatment/enhancement without requiring bypass operations.

**Table 8.1 Cost Comparison of Treatment Alternatives Wastewater Treatment Facility Improvements Project City of Arcata**

| Alt. | Description | Total Project Cost With 10% Growth[1] | Total Project Cost With 20% Growth[1,4] | O&M Cost | | Lifecycle Cost[3,4] |
|---|---|---|---|---|---|---|
| | | | | Annual[2] | Present Worth[3] | |
| 1 | Existing System Rehabilitation | $35.1 | $35.2 | $0.67 | $11.7 | $46.9 |
| 2 | Existing System Rehabilitation with Side-stream Treatment | $44.7 | $45.7 | $0.76 | $13.3 | $58.0 |
| 3 | Existing System Rehabilitation with Parallel Treatment | $43.8 | $45.5 | $0.43 | $7.6 | $51.3 |
| 4 A/B | Existing System Rehabilitation with Oxidation Pond Treatment and Phased Parallel Treatment | -- | $52.4 | $0.78 | $13.6 | $66.1 |
| 5 | Existing System Rehabilitation with Parallel Treatment | -- | $51.8 | $0.75 | $13,1 | $65.0 |

Notes:
(1) Costs are based on 2016 dollars, in millions, using the SFENR construction cost index.
(2) Annual O&M costs include only differential O&M costs, and do not include O&M costs which are common to all alternatives (such as influent pumping).
(3) Lifecycle cost is total project cost plus present worth value of annual O&M costs. Annual O&M costs were converted to present worth value based on 3 percent inflation rate, 6 percent discount rate, and 25-year analysis period.
(4) Estimated total project cost and lifecycle cost is updated with additional anticipated growth subsequent to the June 13, 2016 Council meeting. Additional cost for the 20% growth projection is based on adding 10% to the secondary and solids costs.

Alternative 4A/B has the highest lifecycle costs, and is only slightly higher than Alternative 5 due to the costs of the pond treatment additions. The annual O&M costs for alternative 4A/B are the highest of all alternatives, although they are similar to alternative 2. They are high due to the cost of pond aeration coupled with the oxidation ditch aeration.

### 8.3.1 UV Disinfection System Project

The UV disinfection system project (ID No. 1) will replace the existing chlorine gas disinfection system as the main disinfection process for the plant. The existing disinfection system will be retained for treatment of peak wet weather flows, and can also serve as a temporary back up should the UV be out of service. The project was proposed to the

Regional Water Quality Control Board (RWQCB) and made a requirement of the current discharge permit, and is ranked as the highest priority project. A more complete description of this project element is included in Chapter 7. The design UVT for the new UV disinfection system will be lower for Alternatives 1 and 2 (35%) and will result in higher equipment and construction costs. The design UVT for the new UV disinfection system for Alternative 3 is projected to be higher for the blended parallel system (55%) and will result in lower equipment and construction costs. The design UVT for Alternative 4A/B was reduced to 35% based on the potential ratio of pond to oxidation ditch effluent. However, the design criteria for UVT and UV dose will need to be finalized during preliminary design with additional input from the State to provide adequate protection for the shellfish beneficial use.

### 8.3.2 Treatment Wetland No. 7 Construction Project

The construction of Treatment Wetland No. 7 (ID No. 3) is required to increase the capacity of the treatment wetland process and allow for treatment wetlands to be removed from service for revegetation. It is a priority based on achieving the permit required flow reconfiguration project. This element is common to Alternatives 1 and 2.

### 8.3.3 Flow Reconfiguration Project

The flow reconfiguration project (ID No. 4) will allow the plant to treat flows up to 5.9 mgd in a single pass mode of operations, with a new discharge outfall to an existing brackish marsh that flows to Arcata Bay. This project was proposed to the RWQCB to improve the overall treatment process and is included in the current permit. The project includes four main elements outlined below:

- New piping to discharge UV disinfection effluent directly to the new outfall, sized for a capacity of 5.9 mgd.
- Replacement of the existing Enhancement Wetlands (Hauser) Pump Station with a higher capacity, more reliable pump station for discharge of enhancement wetlands effluent to the new UV disinfection process that will flow by gravity to the new outfall. Note the firm capacity varies between Alternatives 1 and 2, at 2.3 mgd and Alternative 3 at 1.8 mgd.
- Construction of a new discharge or outfall (Outfall 003) to the brackish marsh, for effluent disposal to the Arcata Bay portion of Humboldt Bay.
- Upgrade of the existing treatment wetlands pump stations (PS) 001 with higher capacity at 2.3 mgd, more reliable pump station for discharge of the treatment wetlands effluent to the enhancement wetlands in Alternatives 1 and 2 (ID Nos. 17 and 18). The capacity would only be updated to a capacity of 1.8 for Alternative 3.

### 8.3.4 Headworks R&R Projects

The short-term R&R projects address the aging headworks infrastructure. These projects are critical because the headworks facility has the potential to fail and create multiple problems ranging from overflows in the collection system to conveyance of screening and grit to downstream process. This set of projects include new influent pumps, new screens, a new grit tank, new grit handling equipment, and all the associated facilities for a complete and reliable headworks process. Specific project elements are outlined below.

- New influent pumps sized to handle a peak capacity of 5.9 mgd to replace the existing screw pumps. The existing pumps can handle a capacity of 5.0 mgd, with an emergency diesel driven pump providing backup. The existing pumps are at the end of their useful life and could fail in the near future. It has been noted that submersible type pumps should be considered for the replacement (ID No. 10).
- New bar screens for existing headworks, with associated screenings conveyor and screening washer compactor (ID No. 11).
- New grit removal structure and associated grit handling and treatment equipment. A new vortex grit removal system is proposed to improve grit removal over the range of flows treated at the plant (ID No. 12).

### 8.3.5 Primary Clarifiers Replacement Project

The existing primary treatment facilities contain some of the oldest assets at the AWTF. The primary clarifier replacement project includes replacement of both the larger and smaller units with one or two identical units each sized for the design wet weather flow of 2.3 mgd (ID No. 13). The second unit will provide redundancy, as well as provide for peak hour wet weather flows up to the 5.9 mgd design flow in Alternatives 1 and 2. In Alternative 3, one 1.8-mgd primary clarifier is proposed because oxidation ditches do not require upstream treatment with primary clarifiers. New support facilities including replacement sludge pumps would be provided. (ID No. 14.) In Alternative 4, a single Primary Clarifier is proposed with the same capacity as the treatment wetlands. Space would be reserved for an additional primary clarifier if required in the future.

### 8.3.6 Wetlands Revegetation Projects

The treatment wetlands revegetation projects (ID Nos. 26 and 27) are included in the ATWF CIP in order to recognize that the natural wetland process requires maintenance, although much different than mechanical equipment or structural maintenance. Wetlands require ongoing vegetation management, both on an annual basis and a recurring basis as the wetlands mature, especially the wetland plants. The revegetation project includes replanting and regrading of the oldest treatment wetland cells No. 1 to No 4 (ID No. 26). This work can be started once wetland cell No. 7 is created. Then, on a recurring basis, wetland cells can be removed from service and rehabilitated. Note that the concept for the rehabilitation is to remove from service, stop influent flows and dry the cell out as much as possible, remove

all vegetation, regrade, then replant, slowly introducing wastewater to sustain the plant growth. It is expected that this may take up to three years per cell.

The enhancement wetlands also require vegetation management, and therefore should be included in the ongoing vegetation management program (ID No. 27), in order to maximize their service life prior to a complete revegetation. This element also includes flow improvements including baffles, and upgraded inlet/outlet structures.

In addition, vegetation management should be completed on all cells on a seasonal basis. This will include removal of trees and shrubs, or other non-wetland plants from wetlands cells.

### 8.3.7 Treatment Wetlands Pumping Configuration Project

The existing treatment wetland pump stations are at the end of their life for the installed mechanical equipment, and therefore require R&R. In addition, the existing pump station configuration has been based on adding pump stations as new wetland cells are added. Pump Station 1 was added when cells 1 and 2 first went into service. Then PS No. 2 was repurposed when cells 5 and 6 were added. The overall capacity of the treatment wetlands pump station would be upgraded to 2.3 mgd for alternatives 1 and 2 and only to 1.8 mgd for alternative 3.(ID Nos. 17 and 18).

### 8.3.8 Oxidation Pond Improvements Projects

There are three oxidation pond improvement projects included in the CIP, in addition, a significant O&M project to remove/reduce the existing solids built up in the ponds is required to maintain proper operation. Descriptions for these projects are provided in the following sections. These projects can either be combined as a single larger project or implemented separately.

#### 8.3.8.1 Pump Station R&R Projects

The oxidation ponds provide the initial step in the secondary treatment process. Therefore these ponds are critical in meeting permit requirements. The pond pump station and the emergency pond pump station (EPPS) provide a positive means to convey flows from the ponds to the chlorine contact basin during periods of high wet weather flows. These should be rehabilitated as needed during the pond improvements projects. The pond pump station is upgraded (ID No. 19) in Alternatives 1 and 2 to 3.6 mgd capacity. The EPPS is in fairly good shape since it has not been used very often, so it will require less work than the other pump stations. In all alternatives, the EPPS piping will be modified to allow its use in pumping down Pond 1 to increase the available storage volume during peak wet-weather flows (ID No. 19).

#### 8.3.8.2 Pond Transfer Structures and Piping Project

In addition, modification of the oxidation pond transfer structures and piping will be required to allow for a more controlled conveyance of flows to the treatment wetlands and to provide the flexibility to store a portion of the peak wet weather flows in the ponds (ID No. 20).

#### 8.3.8.3 Original Aerator Replacement Project

The original pond aerator replacement project element was part of Alternative 1 and 2. Originally new horizontal aerators would be provided in Pond 2 for additional pond treatment capacity and assist in short circuit reduction in the shallow oxidation pond. Aerators may not be needed during the warmer, sunnier months from spring to fall, as the natural algae will aerate the pond content. The production of dissolved oxygen in the ponds by the algae assists natural bacteria in the ponds in breaking down the soluble and particulate wastes in the influent wastewater. During the colder, winter months, when natural sunlight is limited, aerators may be required to supplement the algae to provide dissolved oxygen (ID No. 24).

#### 8.3.8.4 Revised Aerator Upgrade for Alternative 4

The revised pond treatment upgrade would create a two cell partially mixed aerated lagoon. FRP baffle wall would be added to separate Pond 2 into 2 equal volume cells. The baffle wall would be placed diagonally across the pond in order to improve short circuiting from the inlet to outlet of the pond. New aerators would be placed in both cells of Pond No. 2. The exact number and size would be finalized in design, but it was estimated that up to twenty – 15 horsepower units would be required to meet the pond aeration demands. Aerators would only be run as needed, as described above. During the summer they may not be needed, but would be required during the colder, winter period of the year.

## 8.4 10 TO 20-YEAR CIP ELEMENTS

### 8.4.1 Sea Level Rise Project

Another pond project has been identified based on the projected sea level rise in the Arcata area. The pond berms and levees may need to be raised in order to avoid flooding during king (of flood) tides. This project may or may not fall within the 20-year planning window, based on current projections (ID No. 25). It is included as a long-term project in the CIP as a placeholder.

### 8.4.2 Plant Modernization Projects

Two main plant modernization projects were identified as part of the condition assessment.

#### 8.4.2.1 Control System / SCADA Improvements

The plant control system should be upgraded to a modern SCADA system (ID No. 35N). This will allow the plant staff to maximize their effort, without having to visit any piece of

equipment or pump station for normal operations and alarm troubleshooting. This project can be implemented across the entire plant in one project, or can be implemented, one process area at a time or as part of each project described above. The latter approach will require that planning for the entire system be completed so that the pieces are integrated as they are implemented individually.

#### 8.4.2.2 Lab and Control Building

The lab and control buildings should be upgraded (ID No. 30) during the 20-year CIP program to allow for upgrades including the SCADA upgrade. In addition, the building may require modifications to avoid flooding by sea level rise. This project is included as a placeholder in order so that it may be updated as additional requirements are determined.

## 8.5 FINDINGS AND RECOMMENDATIONS

The CIP alternatives presented in this chapter provide several approaches to the City CIP for the wastewater division of the Public Works Department. The alternative 10-year CIP projects and priorities are outlined to meet current permit requirements and near term R&R needs, and have different risks in reliably meeting the permit requirement. The longer term R&R needs, plant modernization requirements, and addressing sea level rise impacts would be part of a 10 to 20-year CIP program. The CIP needs to be integrated with existing capital improvements budgets and funding sources in order to meet the needs of the community and preserve this vital City asset.

The 10-year CIP should be reviewed by City staff and council and adopted by the Environmental Services and Public Works Departments. The permit-required CIP projects should be completed within the next 3 to 7 years, with the remainder of the projects implemented as soon as funds are available.

Presentations describing the CIP alternatives were made to City Council on April 20, June 6, and June 13, 2016. Presentation materials from these meetings are in Appendix S.

A meeting with the RWQCB discussing the CIP alternatives was conducted on June 27, 2016, during which the Board indicated that operational bypass of flows greater than 5.9 mgd should be eliminated. As discussed previously, the RWQCB also indicated that the City would be subject to ammonia reduction limitations in the next NPDES permit in 2017.

Based on economic and non-economic factors, Carollo and LACO originally recommended proceeding with preliminary design of Alternative 3. Alternative 3 is the only option that can reliably meet the future ammonia limit, while also providing adequate secondary treatment capacity to meet current permit requirements. Alternative 3 has the second lowest lifecycle cost, with slightly higher project cost than Alternative 1 but the lowest O&M costs. Alternative 3 has the lowest potential for permit violations of the three options due to its ability to meet treatment capacity and future ammonia removal requirements. It also could provide treatment/enhancement without requiring bypass operations, although it is not

consistent with the Enclosed Bays and Estuaries Policy for flows up to 5.9 mgd that must flow through the enhancement wetlands. And like all the other alternatives, the existing wetlands systems are still utilized and rehabilitated under Alternative 3.

Follow-up review and development of Alternative 4A/B was completed in early 2017 based on feedback from the RWQCB regarding future permit requirements.

The following steps were taken to arrive at the consensus alternative:

- The oxidation pond treatment improvements were reviewed and revised based on the review completed by an outside expert. The improvements were developed to meet the anticipated discharge limits including the ability to remove ammonia.
- The City indicated a preference to phase in the parallel secondary treatment which will allow the benefits of the pond improvements to incorporate into the project. Therefore the second oxidation ditch could be constructed in a second phase, once the benefits of the oxidation pond upgrade could be established.

Based on these comparisons, both economic and non-economic, Carollo and LACO recommend proceeding with preliminary design of Alternative 4. It is the only alternative that will meet the RWQCB requirements enhancement.

This approach was reviewed during a public meeting on March 30, 2017 and at a council meeting on April 19, 2017. The presentations from these meetings are included in Appendix V. At that time the council provided direction to City staff to proceed with Alternative 4A/B design, to complete applications for state revolving loan funding (loans and grants) and to start the environmental review of the project impacts.

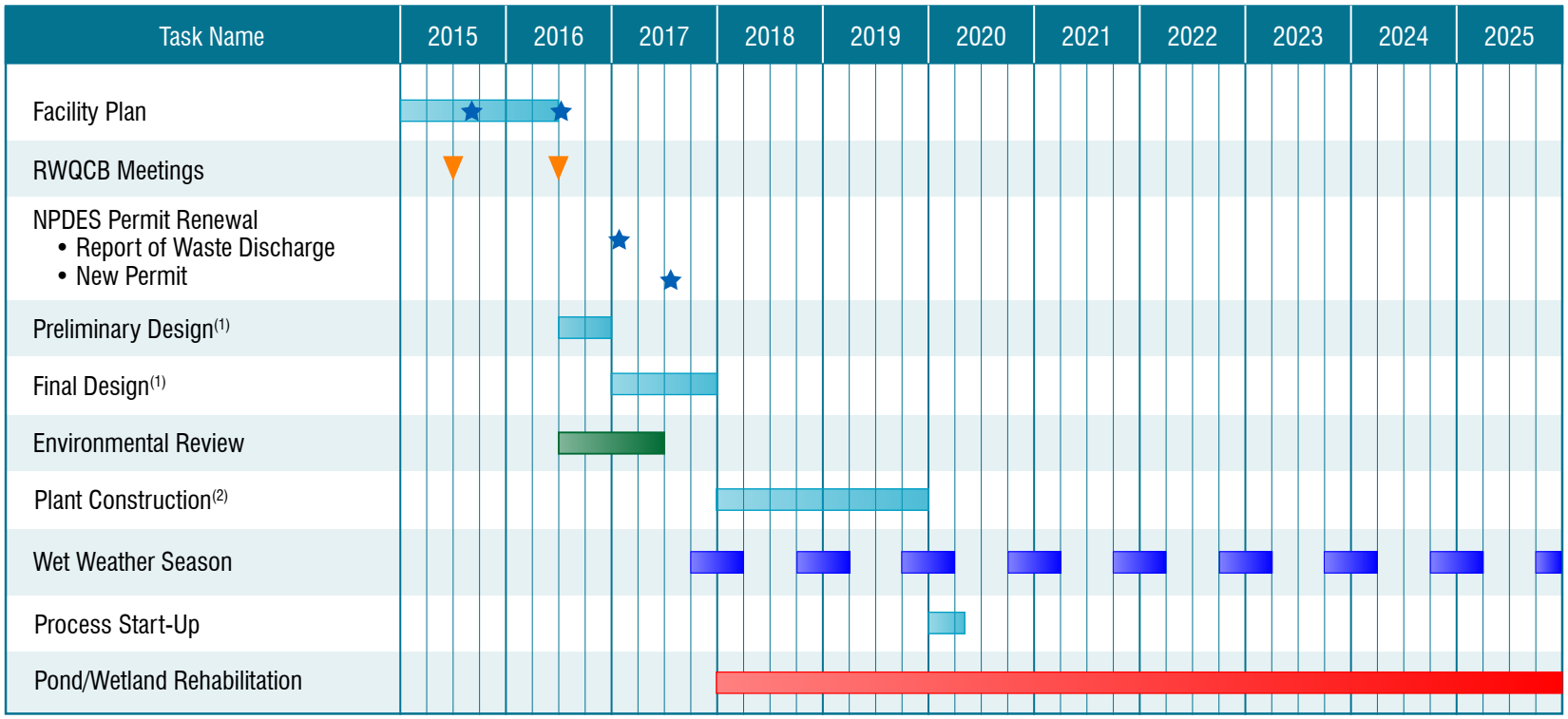
## 8.6 CIP IMPLEMENTATION AND NEXT STEPS

Implementation of the recommended project in this Facility Plan will require a significant amount of funding, time and effort for the City of Arcata. There are several key elements that should be considered in moving forward with implementation of this recommended CIP. These elements are included in the implementation schedule shown in Figure 8.1:

- CEQA / Environmental Review:
  - Approach and appropriate level of environmental review for overall plan and individual projects.
  - Proceed with CEQA for projects to be implemented in the near term.
- Funding and Financing:
  - Consider pursuing State Revolving Fund (SRF) loans to help pay for the proposed CIP improvement projects.
  - Develop a financial plan to determine the rate impacts of these projects.
  - Implement rate increases as required to fund the ongoing CIP requirements.

  - Research small and disadvantaged community funding sources for wastewater treatment project funding.
  - Proposition 1 Coastal Commission Grant - City should consider investigating obtaining grant funds to pay for sea level rise projects under the Proposition 1 Coastal Conservation Grant.
- RWQCB Discussions and NPDES Permit:
  - A Draft Report of Waste Discharge was submitted to the RWQCB by January 2017 to start permit renewal process. The RWQCB were requested to confirm UV design dose and disinfection objectives, including coliform or virus reduction.
  - Issuance of a new NPDES permit is expected sometime after the current permit expiration in July 2017.

The schedule in Figure 8.1 shows preliminary design starting in mid-2017 and final design beginning in the middle of 2018. Construction (of the majority of the mechanical and structural elements) is shown in 2019 to 2021, with final commissioning and startup in late 2021 and early 2022. The construction will cover the dry weather periods of both 2019 and 2020, and should allow for all the work to be completed while maintaining the existing plant in operation. Wet weather periods are also shown in the schedule as construction during these periods is difficult. The Pond and Wetlands rehabilitation is shown as a separate line item as these projects may be performed by City staff as opposed to a contractor and due to the extended construction time expected. The wetlands in particular will take longer to rehabilitate due to the need to regrade during dry season, plant and let the plants get established (approximately a 2-year cycle before performing as expected).




NOTES:

(1) To be finalized after completion of the Facility Plan.

(2) Construction schedule is preliminary, constraints TBD.

# UPDATED IMPLEMENTATION SCHEDULE

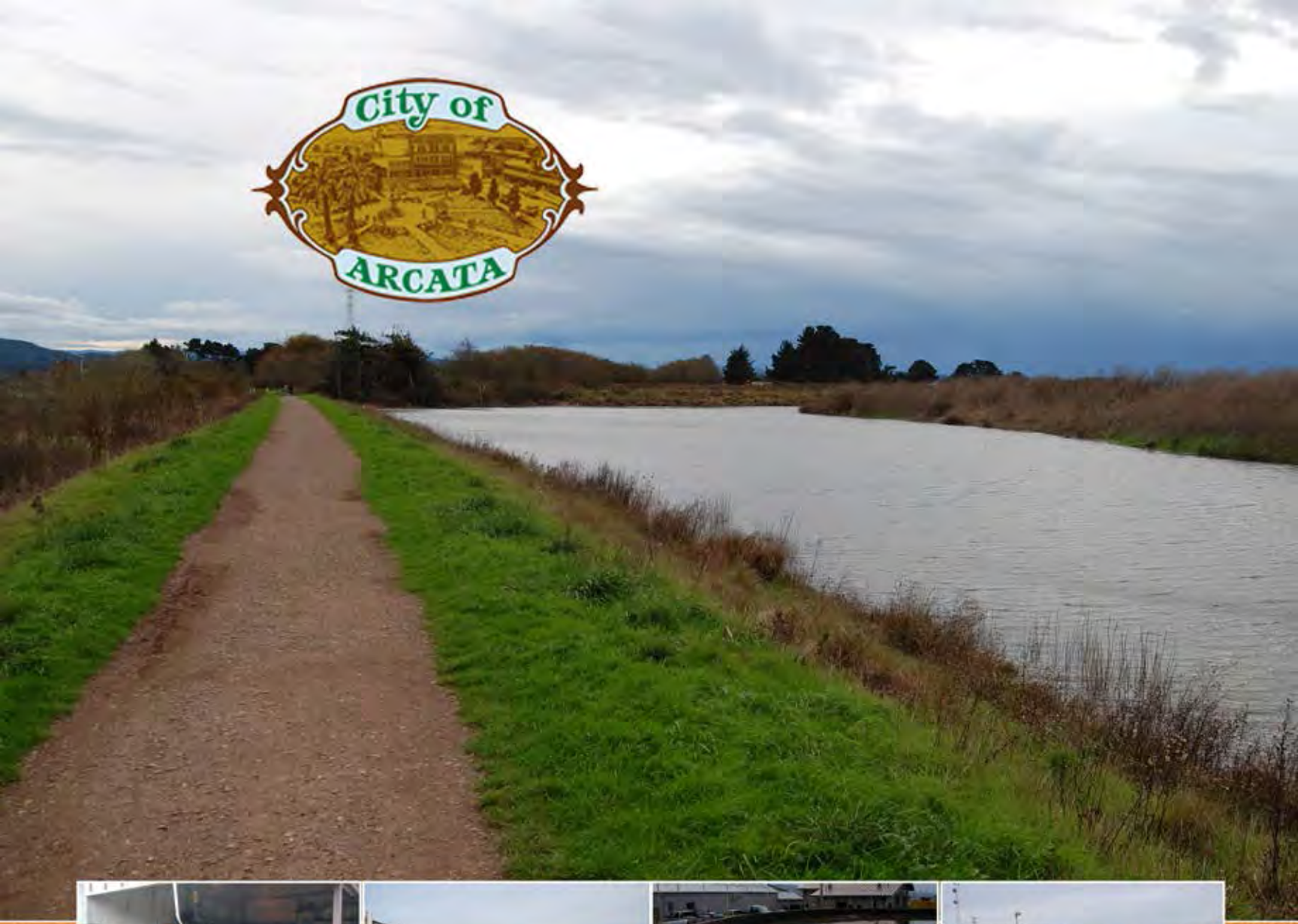
FIGURE 8.1

CITY OF ARCATA

*WASTEWATER TREATMENT PLANT IMPROVEMENTS PROJECT*

carollo

arc0616f2-9913.ai











City of Arcata

# Facility Plan Appendices

REVISED July 2017

LACO / carollo

# CITY OF ARCATA

## WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT

## FACILITY PLAN

### JULY 2017




07/27/2017

**CITY OF ARCATA**

**WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT**

## LIST OF APPENDICES


APPENDIX A - NPDES Permit No. CA0022713, Order No. R1-2012-0031

APPENDIX B - NPDES Discharge Violation Information 2012-2015

APPENDIX C - Flow and Load Data Analysis

APPENDIX D - Unit Process Flow Diagrams

APPENDIX E - Existing Hydraulic Profiles

APPENDIX F - Summary of Existing Secondary Effluent Pumping Capacities

APPENDIX G - Presentation Materials from the October and November 2015 Workshops

APPENDIX H - Process Area Photos

APPENDIX I - Detailed Asset Inventory and Rankings

APPENDIX J - Dr. Gearheart Notes on Treatment Wetlands

APPENDIX K - CIP Alternative Project Design Criteria

APPENDIX L - Summary of Chlorine and Sulfur Dioxide Chemical Use

APPENDIX M - UVT Data and Evaluation

APPENDIX N - 2011 Pilot UV Disinfection Test Report

APPENDIX O - UV Disinfection Equipment Proposals

APPENDIX P - Basis of Costs

APPENDIX Q - CIP Alternative Capital Cost Information

APPENDIX R - CIP Alternative Operation and Maintenance Cost Information

APPENDIX S - Presentations to City Council

APPENDIX T - Report of Waste Discharge (By City) January 2017

APPENDIX U - Performance Review Joe Middlebrooks February 2017

APPENDIX V – Public Meeting and Council Presentation – March and April 2017

# APPENDIX A – NPDES PERMIT NO. CA0022713, ORDER NO. R1-2012-0031

**ORDER NO. R1-2012-0031**
**NPDES NO. CA0022713**
**WDID NO. 1B82114OHUM**

# WASTE DISCHARGE REQUIREMENTS FOR THE CITY OF ARCATA MUNICIPAL WASTEWATER TREATMENT FACILITY

The following Permittee is subject to waste discharge requirements as set forth in this Order:

**Table 1. Permittee Information**

| | |
|---|---|
| **Permittee** | City of Arcata |
| **Name of Facility** | Arcata Wastewater Treatment Facility (WWTF) |
| **Facility Address** | 600 South G Street |
| | Arcata, CA 95521 |
| | Humboldt County |
| The U.S. Environmental Protection Agency (USEPA) and the Regional Water Quality Control Board have classified this discharge as a major discharge. | |

Discharges by the City of Arcata from the Outfalls identified below are subject to waste discharge requirements as set forth in this Order.

**Table 2. Discharge Location**

| Discharge Point/Outfall | Effluent Description | Discharge Point Latitude | Discharge Point Longitude | Receiving Water |
|---|---|---|---|---|
| 001 | secondary/equivalent to secondary treated wastewater | 40° 51' 18" N | 124° 5' 26.124" W | Humboldt Bay |
| 002 | equivalent to secondary treated wastewater | 40° 51' 29" N | 124° 5' 31.2504" W | Arcata Marsh Wildlife Sanctuary |
| 003 | secondary treated wastewater | 40° 51' 40" N | 124° 5' 37" W | Brackish Marsh, Humboldt Bay |

**Table 3. Administrative Information**

| | |
|---|---|
| This Order was adopted by the Regional Water Quality Control Board on: | June 7, 2012 |
| This Order shall become effective on: | August 1, 2012 |
| This Order shall expire on: | July 31, 2017 |
| The Permittee shall file a Report of Waste Discharge in accordance with title 23, California Code of Regulations, as application for issuance of new waste discharge requirements no later than: | 180 days prior to the Order expiration date (January 27, 2017) |

IT IS HEREBY ORDERED, that Order No. R1-2004-0036 is rescinded upon the effective date of this Order except for enforcement purposes, and, in order to meet the provisions contained in division 7 of the Water Code (commencing with section 13000) and regulations adopted thereunder, and the provisions of the federal Clean Water Act (CWA) and regulations and guidelines adopted thereunder, the Permittee shall comply with the requirements in this Order.

I, Matthias St. John, Executive Officer, do hereby certify that this Order with all attachments is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, North Coast Region, on June 7, 2012.

_____

Matthias St. John, Executive Officer

## Table of Contents

I. Facility Information ..... 4
II. Findings ..... 4
III. Discharge Prohibitions ..... 5
IV. Effluent Limitations and Discharge Specifications ..... 6
A. Effluent Limitations ..... 6
B. Discharge Specifications ..... 10
C. Land Discharge Specifications and Reclamation Specifications ..... 11
V. Receiving Water Limitations ..... 11
A. Surface Water Limitations ..... 11
B. Groundwater Limitations ..... 13
VI. Provisions ..... 13
A. Standard Provisions ..... 13
B. Monitoring and Reporting Program (MRP) Requirements ..... 14
C. Special Provisions ..... 14
VII. Compliance Determination ..... 27

## List of Tables

Table 1. Permittee Information ..... 1
Table 2. Discharge Location ..... 1
Table 3. Administrative Information ..... 2
Table 4. Facility Information ..... 4
Table 5. Effluent Limitations for Outfall 001 (Humboldt Bay) ..... 6
Table 6. Effluent Limitations for Outfall 003 (Brackish Marsh/Humboldt Bay) ..... 8
Table 7. Interim Effluent Limitations for Outfall 001 (Humboldt Bay) ..... 9
Table 8. Discharge Specifications for Outfall 002 (AMWS) ..... 10

## List of Attachments

Attachment A – Definitions ..... A-1
Attachment B – Facility Map ..... B-1
Attachment C – Existing Configuration Flow Schematic ..... C-1
Attachment C – Upgraded Configuration Flow Schematic ..... C-2
Attachment D – Standard Provisions ..... D-1
Attachment E – Monitoring and Reporting Program ..... E-1
Attachment F – Fact Sheet ..... F-1

## I. Facility Information

The following Permittee is subject to waste discharge requirements as set forth in this Order.

**Table 4. Facility Information**

| | |
|---|---|
| **Permittee** | City of Arcata |
| **Name of Facility** | Arcata Wastewater Treatment Facility |
| **Facility Address** | 600 South G Street |
| | Arcata, CA 95521 |
| | Humboldt County |
| **Facility Contact, Title, Phone Number** | Karen Diemer, Deputy Director, Environmental Services, (707) 825-8184 |
| **Mailing Address** | 736 F Street, Arcata, CA 95521 |
| **Type of Facility** | Publicly Owned Treatment Works |
| **Facility Design Flow** | 2.3 million gallons per day (mgd) (average dry weather design flow)<br>5.0 mgd (average wet weather design flow)<br>5.9 mgd (peak wet weather design flow)<br>16.5 mgd (wet weather $Q_{max}$) |

## II. Findings

The California Regional Water Quality Control Board, North Coast Region (hereinafter the Regional Water Board), finds:

**A. Basis and Rationale for Requirements.** The Regional Water Board developed the requirements in this Order based on information submitted as part of the application for permit renewal submitted by the City of Arcata (hereinafter the City or Permittee), monitoring data submitted during the term of the Permittee's previous Order, and other available information. The Fact Sheet (Attachment F) contains facility information, legal authorities, and rationale for Order requirements. The Fact Sheet as well as Attachments A through E are hereby incorporated into this Order and constitute part of the Findings for this Order.

**B. Background.** The City is currently discharging pursuant to Order No. R1-2004-0036 and National Pollutant Discharge Elimination System (NPDES) Permit No. CA0022713. The Permittee submitted a Report of Waste Discharge, dated February 21, 2007, and applied for an NPDES permit renewal to discharge secondary treated wastewater from the Arcata waste water treatment facility (WWTF). The Permittee submitted an amended Report of Waste Discharge on December 15, 2011, incorporating a new primary point of discharge. The application was deemed complete on February 7, 2012.

**C. Facility Description.** The Permittee owns wastewater collection, treatment, and disposal facilities that serve a population of approximately 16,800 in the City of Arcata and the unincorporated community of Glendale. Additional background and facility information is provided in the Fact Sheet. Attachment B provides a map of the area around the facility. Attachment C provides a flow schematic of the facility.

**D. Monitoring and Reporting.** Section 122.48 requires that all NPDES permits specify requirements for recording and reporting monitoring results. Water Code sections 13267 and 13383 authorize the Regional Water Board to require technical and monitoring reports. The Monitoring and Reporting Program establishing monitoring and reporting requirements to implement federal and State requirements for the Arcata WWTF is provided in Attachment E.

## III. Discharge Prohibitions

**A.** The discharge of waste to Humboldt Bay is prohibited unless the discharge is consistent with State Board Order No. 79-20 and Regional Water Board Resolution 83-9.

**B.** The discharge of any waste not disclosed by the Permittee or not within the reasonable contemplation of the Regional Water Board is prohibited.

**C.** Creation of pollution, contamination, or nuisance, as defined by Section 13050 of the California Water Code is prohibited.

**D.** The discharge of sludge or digester supernatant is prohibited, except as authorized under section VI.C.5.c of this Order (Sludge Disposal and Handling Requirements).

**E.** The discharge of untreated or partially treated waste (receiving a lower level of treatment than described in section II. B of the Fact Sheet) from anywhere within the collection, treatment, or disposal systems is prohibited, except as provided for in Prohibition III. I and in Attachment D, Standard Provision G (Bypass).

**F.** Any sanitary sewer overflow (SSO) that results in a discharge of untreated or partially treated wastewater to (a) waters of the State, (b) groundwater, or (c) land that creates pollution, contamination, or nuisance, as defined in Water Code section 13050 (m) is prohibited.

**G.** The discharge of waste at any point not described in Finding II. B of the Fact Sheet, Prohibition III.I., or otherwise not authorized by this or another permit issued by the State Water Board or another Regional Water Board is prohibited.

**H.** The mean daily dry weather flow of waste through the treatment plant in excess of 2.3 mgd measured daily and averaged over a calendar month is prohibited.

**I.** The Discharge of treated effluent at Outfall 001 is prohibited, other than that portion of the flow exceeding peak flows of 5.9 mgd. [1]

## IV. Effluent Limitations and Discharge Specifications

### A. Effluent Limitations

#### 1. Final Effluent Limitations – Outfall 001 (Humboldt Bay)

a. The Permittee shall maintain compliance with the following final effluent limitations at Outfall 001, with compliance measured at Monitoring Location EFF-001, as described in the attached MRP. These limitations apply only to flows allowed in accordance with Prohibition III.I.

**Table 5. Effluent Limitations for Outfall 001 (Humboldt Bay)**

| Parameter | Units | Effluent Limitations | | |
|---|---|---|---|---|
| | | Average Monthly[2] | Average Weekly[3] | Maximum Daily |
| $BOD_5$ | mg/L | 45 | 65 | --- |
| | lbs/day [4] | 863 | 1304 | --- |
| TSS | mg/L | 66 | 95 | --- |
| | lbs/day 4 | 1266 | 1822 | --- |
| Settleable Solids | mL/L | 0.1 | --- | 0.2 |
| Fecal Coliform | MPN/100ml | 14[5] | | 43[6] |
| Chlorine, Total Residual | mg/L | 0.01 | | 0.02 |
| pH | s.u. | 6.0 – 9.0 at all times | | |
| Copper | µg/L | 2.9 | --- | 5.8 |

[1] This Prohibition will take effect upon activation of the new disinfection system and implementation of discharges at Discharge Point 003, but no later than December 1, 2016.

[2] Compliance with average monthly effluent limitations shall be based on averages derived from measurements in the calendar month.

[3] Compliance with average weekly effluent limitations shall be based on averages derived from measurements in the calendar week (i.e., Sunday through Saturday).

[4] Mass-based limitations are based on the dry weather design flow of the WWTF of 2.3 mgd. During wet weather periods, when influent flow exceeds the dry weather design flow rate, mass emission limitations shall be calculated using the concentration-based effluent limitations and the actual daily average effluent flow rate (not to exceed the average wet weather design flow rate of 5.0 mgd ).

[5] Median.

[6] Not more than 10% of samples collected in a 30-day period shall exceed the daily maximum.

**Table 5. Effluent Limitations for Outfall 001 (Humboldt Bay)**

| Parameter | Units | Effluent Limitations | | |
|---|---|---|---|---|
| | | Average Monthly[2] | Average Weekly[3] | Maximum Daily |
| Cyanide | µg/L | 0.5 | --- | 1.0 |
| 2,3,7,8-TCDD Equivalents | µg/L | $1.3 \times 10^{-8}$ | --- | $2.6 \times 10^{-8}$ |
| Carbon Tetrachloride | µg/L | 0.25 | --- | 0.50 |
| Dichlorobromomethane | µg/L | 0.56 | --- | 1.12 |
| Bis(2-Ethylhexyl)Phthalate | µg/L | 1.8 | --- | 3.6 |

b. **Percent Removal:** The average monthly percent removal of $BOD_5$ and TSS shall not be less than 65 percent. Percent removal shall be based on the difference between weekly influent and effluent concentrations, as measured at Monitoring Locations INF-001 and EFF-001, averaged over each calendar month.

c. **Acute Toxicity:** There shall be no acute toxicity in treated wastewater discharged to Humboldt Bay. The Permittee will be considered compliant with this limitation when the survival of aquatic organisms in a 96-hour bioassay of undiluted effluent complies with the following.

i. Minimum for any one bioassay: 70 percent survival

ii. Median for any three or more consecutive bioassays: at least 90 percent survival

Compliance with this effluent limitation shall be determined in accordance with section V.A of the Monitoring and Reporting Program (Attachment E).

**2. Final Effluent Limitations – Outfall 003 (Brackish Marsh/Humboldt Bay)**

a. Thirty (30) days prior to initiation of the upgraded WWTF configuration, including use of the ultraviolet disinfection system, described under Finding II.B of the Fact Sheet, the Permittee shall submit written notification to the Executive Officer declaring the intent to operate and discharge using the upgraded configuration of the WWTF. Upon activation of the new configuration, the Permittee shall maintain compliance with the following effluent limitations at Outfall 003, with compliance measured at Monitoring Location EFF-003, as described in the attached MRP.

**Table 6. Effluent Limitations for Outfall 003 (Brackish Marsh/Humboldt Bay)**

| Parameter | Units | Effluent Limitations | | |
|---|---|---|---|---|
| | | Average Monthly[2] | Average Weekly[3] | Maximum Daily |
| $BOD_5$ | mg/L | 30 | 45 | --- |
| | lbs/day [4] | 575 | 863 | --- |
| TSS | mg/L | 30 | 45 | --- |
| | lbs/day [4] | 575 | 863 | --- |
| Settleable Solids | mL/L | 0.1 | --- | 0.2 |
| Fecal Coliform | MPN/100ml | 14[5] | | 43[6] |
| pH | s.u. | 6.0 – 9.0 at all times | | |
| Copper | µg/L | 2.9 | --- | 5.8 |
| Cyanide | µg/L | 0.5 | --- | 1.0 |
| 2,3,7,8-TCDD Equivalents | µg/L | 1.3 x 10-8 | --- | 2.6 x 10-8 |
| Carbon Tetrachloride | µg/L | 0.25 | --- | 0.50 |
| Bis(2-Ethylhexyl)Phthalate | µg/L | 1.8 | --- | 3.6 |

b. **Percent Removal:** The average monthly percent removal of $BOD_5$ and TSS shall not be less than 85 percent. Percent removal shall be based on the difference between weekly influent and effluent concentrations, as measured at Monitoring Locations INF-001 and EFF-003, averaged over each calendar month.

c. **Acute Toxicity:** There shall be no acute toxicity in treated wastewater discharged to Humboldt Bay. The Permittee will be considered compliant with this limitation when the survival of aquatic organisms in a 96-hour bioassay of undiluted effluent complies with the following.

   i. Minimum for any one bioassay: 70 percent survival

   ii. Median for any three or more consecutive bioassays: at least 90 percent survival

Compliance with this effluent limitation shall be determined in accordance with section V.A of the Monitoring and Reporting Program (Attachment E).

### 3. Interim Effluent Limitations – Outfall 001 (Humboldt Bay)

a. Until the activation of the upgraded WWTF configuration or December 1, 2016, whichever is sooner, the Permittee shall maintain compliance with the following interim effluent limitations at Outfall 001, with compliance measured at Monitoring Location EFF-001, as described in the attached MRP.

**Table 7. Interim Effluent Limitations for Outfall 001 (Humboldt Bay)**

| Parameter | Units | Effluent Limitations | | |
|---|---|---|---|---|
| | | Average Monthly[2] | Average Weekly[3] | Maximum Daily |
| $BOD_5$ | mg/L | 30 | 45 | --- |
| | lbs/day [4] | 575 | 863 | --- |
| TSS | mg/L | 30 | 45 | --- |
| | lbs/day [4] | 575 | 863 | --- |
| Settleable Solids | mL/L | 0.1 | --- | 0.2 |
| Fecal Coliform | MPN/100ml | 14[5] | | 43[6] |
| Chlorine, Total Residual | mg/L | 0.01 | | 0.02 |
| pH | s.u. | 6.0 – 9.0 at all times | | |
| Copper | µg/L | 2.9 | --- | 5.8 |
| Cyanide | µg/L | 0.5 | --- | 1.0 |
| 2,3,7,8-TCDD Equivalents | µg/L | $1.3 \times 10^{-8}$ | --- | $2.6 \times 10^{-8}$ |
| Carbon Tetrachloride | µg/L | 0.25 | --- | 0.50 |
| Dichlorobromomethane | µg/L | 0.56 | --- | 1.12 |
| Bis(2-Ethylhexyl)Phthalate | µg/L | 1.8 | --- | 3.6 |

b. **Percent Removal:** The average monthly percent removal of $BOD_5$ and TSS shall not be less than 85 percent. Percent removal shall be based on the difference between weekly influent and effluent concentrations, as measured at Monitoring Locations INF-001 and EFF-001, averaged over each calendar month.

c. **Acute Toxicity:** There shall be no acute toxicity in treated wastewater discharged to Humboldt Bay. The Permittee will be considered compliant with this limitation when the survival of aquatic organisms in a 96-hour bioassay of undiluted effluent complies with the following.

i. Minimum for any one bioassay: 70 percent survival

ii. Median for any three or more consecutive bioassays: at least 90 percent survival

Compliance with this effluent limitation shall be determined in accordance with section V.A of the Monitoring and Reporting Program (Attachment E).

## B. Discharge Specifications

### 1. Discharge Specifications – Outfall 002 (AMWS)

a. The Permittee shall maintain compliance with the following final discharge specifications at Outfall 002, with compliance measured at Monitoring Location EFF-002, as described in the attached MRP.

**Table 8. Discharge Specifications for Outfall 002 (AMWS)**

| Parameter | Units | Discharge Specifications | | |
|---|---|---|---|---|
| | | Average Monthly[3] | Average Weekly[4] | Maximum Daily |
| $BOD_5$ | mg/L | 45 | 65 | --- |
| TSS | mg/L | 66 | 95 | --- |
| pH | s.u. | 6.0 – 9.0 at all times | | |
| Settleable Solids | mL/L | 0.1 | --- | 0.2 |
| Copper | ug/L | 4.7 | --- | 9.5 |
| Chlorine, Total Residual[a] | mg/L | 0.01 | | 0.02 |

[a] Limitations for chlorine residual apply at all times. However, upon activation of the upgraded configuration, in the absence of chlorine usage prior to Discharge Point 002, it is assumed that there will be no chlorine residual at this discharge location.

### 2. Disinfection Process Requirements for Ultraviolet (UV) Disinfection System

Upon completion and testing of the UV disinfection system, the Permittee shall operate the UV disinfection to maintain compliance with bacteria Effluent Limitations at Outfall 003.

a. Prior to initial discharge at Outfall 003 the Permittee shall submit to the Executive Officer a copy of a letter from the UV supplier showing written acceptance of the UV system capacity for the Arcata WWTF, based upon the National Water Research Institute validation testing from the CDPH for the UV disinfection system supplied for the Arcata WWTF.

b. Prior to initial discharge at Outfall 003 the Permittee shall submit to the Executive Officer and CDPH, an operations and maintenance plan detailing how compliance with the National Water Research Institute's guidelines will be assured at all times.

c. The UV disinfection system shall be operated in accordance with an appropriate operations and maintenance plan.

### C. Land Discharge Specifications and Reclamation Specifications

This section of the Order is not applicable to discharges from the City of Arcata Wastewater Treatment Plant, as treated wastewater is not reclaimed nor applied to land for the purpose of disposal.

## V. Receiving Water Limitations

### A. Surface Water Limitations

Receiving water limitations are based on water quality objectives contained in the Basin Plan and are a required to be addressed as part of this Order. However, a receiving water condition not in conformance with the limitation is not necessarily a violation of this order. Compliance with receiving water limitations shall be measured at monitoring locations described in the MRP (Attachment E). The Regional Water Board may require an investigation to determine cause and culpability prior to asserting a violation has occurred.

Discharges from the Arcata WWTF to Humboldt Bay shall not cause the following in the receiving waters:

1. The discharge shall not cause the dissolved oxygen concentration of the receiving water (Humboldt Bay) to violate the following objectives established by Table 3-1 of the Basin Plan.

    - 6.0 mg/L, minimum in any sample
    - 6.2 mg/L, 90 percent lower limit (90 percent or more of the monthly mean dissolved oxygen concentrations in a calendar year shall be greater than or equal to 6.2 mg/L)
    - 7.0 mg/L, 50 percent lower limit (50 percent or more of the monthly mean dissolved oxygen concentrations in a calendar year shall be greater than or equal to 7.0 mg/L)

2. As established by Table 3-1 of the Basin Plan, the discharge shall not cause the pH of receiving waters to be depressed below natural background levels nor raised above 8.5. Within this range, the discharge shall not cause the pH of the receiving waters to be changed at any time more than 0.2 units from that which occurs naturally.

3. The discharge shall not cause turbidity of receiving waters to be increased more than 20 percent above naturally occurring background levels.

4. The discharge shall not cause receiving waters to contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.

5. The discharge shall not cause receiving waters to contain floating materials, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses.

6. The discharge shall not cause receiving waters to contain taste or odor producing substances in concentrations that impart undesirable tastes or odors to fish flesh or other edible products of aquatic origin, that cause nuisance, or that adversely affect beneficial uses.

7. The discharge shall not cause coloration of receiving waters that causes nuisance or adversely affects beneficial uses.

8. The discharge shall not contain suspended material in concentrations that result in deposition of material in receiving waters that cause nuisance or adversely affect beneficial uses.

9. The discharge shall not cause or contribute concentrations of biostimulants to the receiving water that promote objectionable aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses.

10. The discharge shall not cause receiving waters to contain toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in humans, plants, animals, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration, or other appropriate methods, as specified by the Regional Water Board.

11. The natural receiving water temperature shall not be altered unless it can be demonstrated to the satisfaction of the Regional Water Board that such alteration in temperature does not adversely affect beneficial uses. The discharge shall not cause an increase of the receiving water by more than 5º F above natural receiving water temperature.

12. The discharge shall not cause an individual pesticide or combination of pesticides to be present in concentrations that adversely affect beneficial uses. The discharge must not cause bioaccumulation of pesticide, fungicide, wood treatment chemical, or other toxic pollutant concentrations in bottom sediments or aquatic life to levels which are harmful to human health. The discharge shall not cause the receiving waters to contain concentrations of pesticides in excess of the limiting concentrations in excess of the limiting concentrations established as Maximum Contaminant Levels by the Department of Health Services in title 22, Division 4, Chapter 15, section 64444 of the California Code of Regulations.

13. The discharge shall not cause receiving waters to contain oils, greases, waxes, or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause nuisance, or that otherwise affect beneficial uses.

14. The discharge shall not cause concentrations of chemical constituents to occur in excess of the limiting concentrations established as Maximum Contaminant Levels by the Department of Health Services in title 22, Division 4, Chapter 15, Articles 4 and 5.5 of the California Code of Regulations.

### B. Groundwater Limitations

The storage, use or disposal of wastewater or recycled water shall not cause or contribute to a statistically significant degradation of groundwater quality, cause exceedance of applicable water quality objectives or create adverse impacts to beneficial uses of groundwater.

## VI. Provisions

### A. Standard Provisions

1. **Federal Standard Provisions.** The Permittee shall comply with all applicable Standard Provisions included in Attachment D of this Order.

2. **Regional Water Board Standard Provisions.** The Permittee shall comply with the following Regional Water Board standard provisions.

   a. Failure to comply with provisions or requirements of this Order, or non-compliance with other applicable laws or regulations governing discharges from this facility, may subject the Permittee to administrative or civil liabilities, criminal penalties, and/or other enforcement remedies to ensure compliance. Additionally, certain instances of non-compliance may subject the Permittee to civil or criminal enforcement from appropriate local, state, or federal law enforcement entities.

   b. In the event the Permittee does not comply or will be unable to comply for any reason, with any prohibition, interim or final effluent limitation, reclamation specification, or receiving water limitation of this Order, the Permittee shall notify the Regional Water Board orally[7] within 24 hours of

[7] Oral reporting means direct contact with a Regional Water Board staff person. The oral report may be given in person or by telephone. After business hours, oral contact must be made by calling the State Office of Emergency Services at (800) 852-7550 or the Regional Water Board spill officer at (707) 576-2220.

having knowledge of such noncompliance and shall confirm this notification in writing within 5 days, unless the Regional Water Board waives confirmation. The written notification shall state the nature, time, duration, and cause of noncompliance, and shall describe the measures being taken to remedy the current noncompliance and to prevent recurrence, including, where applicable, a schedule of implementation. Other noncompliance requires written notification, as described above, at the time of the normal monitoring report.

## B. Monitoring and Reporting Program (MRP) Requirements

The Permittee shall comply with the MRP, and future revisions thereto, in Attachment E of this Order.

## C. Special Provisions

### 1. Reopener Provisions

a. **Standard Revisions.** Conditions that necessitate a major modification of a permit are described in title 40, Code of Federal Regulations[8] section 122.62, which include the following:

i. When standards or regulations on which the permit was based have been changed by promulgation of amended standards or regulations or by judicial decision. Therefore, if revisions of applicable water quality standards are promulgated or approved pursuant to Section 303 of the CWA or amendments thereto, the Regional Water Board will revise and modify this Order in accordance with such revised standards.

ii. When new information that was not available at the time of permit issuance would have justified different permit conditions at the time of issuance.

b. **Reasonable Potential .** This provision allows the Regional Water Board to modify, or revoke and reissue, this Order if present or future investigations demonstrate that the Permittee governed by this Permit is causing or contributing to excursions above any applicable priority pollutant criterion or objective, or adversely impacting water quality and/or the beneficial uses of receiving waters.

[8] All further statutory references are to title 40 of the Code of Federal Regulations unless otherwise indicated.

c. **Whole Effluent Toxicity.** This Order requires the Permittee to investigate the causes of, and identify corrective actions to reduce or eliminate effluent toxicity through a TRE. This Order may be reopened to include a numeric chronic toxicity limitation, a new acute toxicity limitation, and/or a limitation for a specific toxicant identified in the TRE. Additionally, if a numeric chronic toxicity water quality objective or a new statewide implementation procedure is adopted by the State Water Board, this Order may be reopened.

d. **303(d)-Listed Pollutants.** This provision allows the Regional Water Board to reopen this Order to modify existing effluent limitations or add effluent limitations or other requirements for pollutants that are the subject of any future TMDL action.

e. **Water Effects Ratios (WERs) and Metal Translators.** This provision allows the Regional Water Board to reopen this Order if future studies undertaken by the Permittee provide new information and justification for applying a water effects ratio or metals translator to a water quality objective for one or more priority pollutants.

f. **Nutrients.** This Order establishes monitoring requirements for total nitrate and monitoring requirements for the effluent and receiving water for nutrients (i.e., ammonia, nitrate, and phosphorus). This provision allows the Regional Water Board to reopen this Order if future monitoring data indicates the need for effluent limitations for any of these parameters.

g. **Receiving Water Standards.** This provision allows the Regional Water Board to reopen this Order if future monitoring data indicates that the discharge has caused a violation of any applicable water quality standard for receiving waters adopted by the Regional Water Board or the State Water Board, as required by the federal Clean Water Act and regulations adopted thereunder.

## 2. Special Studies, Technical Reports and Additional Monitoring Requirements

### a. Whole Effluent Toxicity.

In addition to a limitation for whole effluent acute toxicity, the MRP of this Order requires routine monitoring for whole effluent chronic toxicity to determine compliance with the Basin Plan's narrative water quality objective for toxicity. As established by the MRP, if either of the effluent limitations for acute toxicity is exceeded (a single sample with less than 70% survival or a three sample median of less than 90% survival) or a

chronic toxicity monitoring trigger of either a single sample maximum of 2.0 TUc or a three sample median of 1.0 TUc (where TUc = 100/NOEC)[9] is exceeded, the Permittee shall conduct accelerated monitoring as specified in section V. of the MRP.

Results of accelerated toxicity monitoring will indicate a need to conduct a Toxicity Reduction Evaluation (TRE), if toxicity persists; or it will indicate that a return to routine toxicity monitoring is justified because persistent toxicity has not been identified by accelerated monitoring. TREs shall be conducted in accordance with the TRE Workplan prepared by the Permittee pursuant to Section VI.C.2.b of this Order, below.

b. **Toxicity Reduction Evaluations (TRE) Workplan.**

If not already submitted, the Permittee shall prepare and submit to the Regional Water Board Executive Officer a TRE Workplan **within 180 days** of the effective date of this Order. Upon approval, this plan shall be reviewed and updated as necessary in order to remain current and applicable to the discharge and discharge facilities. The workplan shall describe the steps the Permittee intends to follow if toxicity is detected, and should include at least the following items:

i. A description of the investigation and evaluation techniques that would be used to identify potential causes and sources of toxicity, effluent variability, and treatment system efficiency.

ii. A description of the facility's methods of maximizing in-house treatment efficiency and good housekeeping practices to ensure control of potential sources.

iii. If a toxicity identification evaluation (TIE) is necessary, an indication of the person who would conduct the TIEs (i.e., an in-house expert or an outside contractor).

c. **Toxicity Reduction Evaluations (TRE).**

The TRE shall be conducted in accordance with the following:

i. The TRE shall be initiated within 30 days of the date of completion of the accelerated monitoring test, required by Section V of the MRP, observed to exceed either the acute or chronic toxicity parameter.

[9] This Order does not allow any credit for dilution for the chronic condition. Therefore, a TRE is triggered when the effluent exhibits a pattern of toxicity at 100% effluent.

ii. The TRE shall be conducted in accordance with the Permittee's workplan.

iii. The TRE shall be in accordance with current technical guidance and reference material including, at a minimum, the USEPA manual EPA/833B 99/002.

iv. The TRE may end at any stage if, through monitoring results, it is determined that there is no longer toxicity observed.

v. The Permittee may initiate a TIE as part of the TRE process to identify the cause(s) of toxicity. As guidance, the Permittee shall use the USEPA acute and chronic manuals, EPA/600/6-91/005F (Phase I), EPA/600/R-92/080 (Phase II), and EPA-600/R-92/081 (Phase III).

vi. As toxic substances are identified or characterized, the Permittee shall continue the TRE by determining the source(s) and evaluating alternative strategies for reducing or eliminating the substances from the discharge. All reasonable steps shall be taken to reduce toxicity to levels consistent with chronic toxicity parameters.

vii. Many recommended TRE elements accompany required efforts of source control, pollution prevention, and storm water control programs. TRE efforts should be coordinated with such efforts. To prevent duplication of efforts, evidence of complying with requirements of recommendations of such programs may be acceptable to comply with requirements of the TRE.

viii. The Regional Water Board recognizes that chronic toxicity may be episodic and identification of a reduction of sources of chronic toxicity may not be successful in all cases. Consideration of enforcement action by the Regional Water Board will be based in part on the Permittee's actions and efforts to identify and control or reduce sources of consistent toxicity.

**d. Arcata Marsh Wildlife Sanctuary (AMWS) Evaluation.**

**By November 1, 2012,** the Permittee shall prepare and submit for Executive Officer approval, a workplan for ongoing evaluation of the beneficial uses identified by the Regional Water Board under section III of the Fact Sheet for the AMWS. The workplan shall be developed in accordance with guidance from, but not limited to 1) *Methods for Evaluating Wetland Condition; 2) Study Design for Monitoring Wetlands*, EPA-822-R-02-015, *Methods for Evaluating Wetland Condition: Developing an Invertebrate Index of Biological d. of the proposed Order*

*has been modified to Integrity for Wetlands.* Office of Water, U.S. Environmental Protection Agency, Washington, DC. EPA-822-R-02-019, and 3) *Methods for Evaluating Wetland Condition: Using Amphibians in Bioassessments of Wetlands.* Office of Water, U.S. Environmental Protection Agency, Washington, DC. EPA-822-R-02-022, standard acceptable assessment tools and be of sufficient scope to demonstrate that the discharge of treated wastewater at Outfall 002 is protective of the beneficial uses of the AMWS. The workplan shall include, but not be limited to, an ongoing study to determine the following:

i. Overall ecological condition of AMWS using biological assessments;

ii. Nutrient levels/enrichment of the AMWS;

iii. Whether AMWS condition is improving, degrading, or staying the same over time;

iv. Seasonal patterns in AMWS conditions;

v. System stressors and associated thresholds (ie. how much the AMWS system can be disturbed without causing unacceptable changes in wetland system quality or degradation of beneficial uses).

The findings from these studies will be used for adaptive management to ensure the AMWS retains maximum treatment function while protecting beneficial uses.

## 3. Best Management Practices and Pollution Prevention

### a. Pollutant Minimization Program (PMP)

The Permittee shall, as required by the Executive Officer, develop and conduct a PMP as further described below when there is evidence (e.g., sample results reported as detected, but not quantified (DNQ) when the effluent limitation is less than the method detection limit (MDL), sample results from analytical methods more sensitive than those methods required by this Order, presence of whole effluent toxicity, health advisories for fish consumption, results of benthic or aquatic organism tissue sampling) that a priority pollutant is present in the effluent above an effluent limitation and either:

i. A sample result is reported as DNQ and the effluent limitation is less than the RL; or

ii. A sample result is reported as ND and the effluent limitation is less than the MDL, using definitions described in Attachment A and reporting protocols described in MRP section X.B.4.

The PMP shall include, but not be limited to, the following actions and submittals acceptable to the Regional Water Board:

iii. An annual review and semi-annual monitoring of potential sources of the reportable priority pollutant(s), which may include fish tissue monitoring and other bio-uptake sampling;

iv. Quarterly monitoring for the reportable priority pollutant(s) in the influent to the wastewater treatment system;

v. Submittal of a control strategy designed to proceed toward the goal of maintaining concentrations of the reportable priority pollutant(s) in the effluent at or below the effluent limitation;

vi. Implementation of appropriate cost-effective control measures for the reportable priority pollutant(s), consistent with the control strategy; and

vii. An annual status report that shall be submitted as part of the Annual WWTF Report due March 1st to the Regional Water Board and shall include:

(a) All PMP monitoring results for the previous year;

(b) A list of potential sources of the reportable priority pollutant(s);

(c) A summary of all actions undertaken pursuant to the control strategy; and

(d) A description of actions to be taken in the following year.

**4. Construction, Operation and Maintenance Specifications**

a. The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the Permittee to achieve compliance with this Order. Proper operation and maintenance includes adequate laboratory quality control and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems that are installed by the Permittee only when necessary to achieve compliance with the conditions of this Order. (section 122.41(e))

b. The Permittee shall maintain an updated Operation and Maintenance (O&M) Manual for the Facility. The Permittee shall update the O&M Manual, as necessary, to conform to changes in operation and maintenance of the Facility. The O&M Manual shall be readily available to operating personnel onsite and for review by state or federal inspectors. The O&M Manual shall include the following.

i. Description of the Facility's table of organization showing the number of employees, duties and qualifications and plant attendance

schedules (daily, weekends and holidays, part-time, etc.). The description should include documentation that the personnel are knowledgeable and qualified to operate the treatment facility so as to achieve the required level of treatment at all times.

ii. Detailed description of safe and effective operation and maintenance of treatment processes, process control instrumentation and equipment.

iii. Description of laboratory and quality assurance procedures.

iv. Process and equipment inspection and maintenance schedules.

v. Description of safeguards to assure that, should there be reduction, loss, or failure of electric power, the Permittee will be able to comply with requirements of this Order.

vi. Description of preventive (fail-safe) and contingency (response and cleanup) plans for controlling accidental discharges, and for minimizing the effect of such events. These plans shall identify the possible sources (such as loading and storage areas, power outage, waste treatment unit failure, process equipment failure, tank and piping failure) of accidental discharges, untreated or partially treated waste bypass, and polluted drainage.

**5. Special Provisions for Municipal Facilities (POTWs Only)**

a. **Wastewater Collection Systems**

i. **Statewide General WDRs for Sanitary Sewer Systems**

On May 2, 2006, the State Water Board adopted State Water Board Order No. 2006-003-DWQ, Statewide General WDRs for Sanitary Sewer Systems. Order No. 2006-0003-DWQ requires all public agencies that currently own or operate sanitary sewer systems to apply for coverage under the General WDRs. The deadline for existing dischargers to apply for coverage under State Water Board Order No. 2006-003-DWQ was November 6, 2006. On February 20, 2008, the State Water Board adopted Order No. WQ 2008-0002-EXEC Adopting Amended Monitoring and Reporting Requirements for Statewide General Waste Discharge Requirements for Sanitary Sewer Systems. The Permittee shall maintain coverage under, and is separately subject to the requirements and enforcement of Order Nos. 2006-0003-DWQ and WQ-2008-0002-EXEC, and any future revisions thereto for operation of its wastewater collection system, which are not incorporated by reference herein.

ii. **Standard Provisions Applicable**

In addition to the coverage obtained under Order No. 2006-0003, the Permittee's collection system is part of the treatment system that is subject to this Order. As such, pursuant to federal regulations, the Permittee must properly operate and maintain its collection system [section 122.41(e)], report any non-compliance [section 122.41(l)(6) and (7)], and mitigate any discharge from the collection system that might violate this Order [section 122.41(d)].

iii. **Spills and Sanitary Sewer Overflows**

(a) The Permittee shall take all feasible steps to stop spills and sanitary sewer overflows (SSOs) as soon as possible. All reasonable steps should be taken to collect spilled material and protect the public from contact with wastes or waste-contaminated soil or surfaces.

(b) The Permittee shall report orally and in writing to the Regional Water Board staff all SSOs and unauthorized spills of waste. Spill notification and reporting shall be conducted in accordance with section X.E of the Monitoring and Reporting Program.

b. **Pretreatment of Industrial Waste**

i. The City shall be responsible and liable for the performance of all Control Authority pretreatment requirements contained in 40 CFR Part 403, including any subsequent regulatory revisions to Part 403. Where Part 403 or subsequent revision places mandatory actions upon the City as the Control Authority, but does not specify a timetable for completion of the actions, the City shall complete the required actions within six months from the issuance date of this permit or the effective date of the Part 403 revisions, whichever comes later. For violations of pretreatment requirements, the City shall be subject to enforcement actions, penalties, fines and other remedies by the U.S. Environmental Protection Agency (EPA) or other appropriate parties, as provided in the Act. EPA may initiate enforcement action against a nondomestic user for noncompliance with applicable standards and requirements as provided in the Act.

ii. The City shall enforce the requirements promulgated under sections 307(b), 307(c), 307(d) and 402(b) of the Act with timely, appropriate and effective enforcement actions. The City shall cause all nondomestic users subject to federal categorical standards to achieve compliance no later than the date specified in those requirements or, in the case of a new nondomestic user, upon commencement of the discharge.

iii. The City shall perform the pretreatment functions as required in 40 CFR Part 403 including, but not limited to:

(a) Implement the necessary legal authorities as provided in 40 CFR Part 403.8(f)(1);

(b) b. Enforce the pretreatment requirements under 40 CFR Part 403.5 and 403.6;

(c) c. Implement the programmatic functions as provided in 40 CFR Part 403.8(f)(2); and

(d) d. Provide the requisite funding and personnel to implement the pretreatment program as provided in 40 CFR Part 403.8(f)(3).

iv. The City shall submit annually a report to EPA Pacific Southwest Region, and the State describing its pretreatment activities over the previous year. In the event the City is not in compliance with any conditions or requirements of this permit, then the City shall also include the reasons for noncompliance and state how and when the City shall comply with such conditions and requirements. This annual report shall cover operations from January 1 through December 31 and is due on February 28 of each year. The report shall contain, but not be limited to, the following information:

(a) A summary of analytical results from representative, flow proportioned, 24-hour composite sampling of the POTW's influent and effluent performed with the techniques prescribed in 40 CFR Part 136 for those pollutants EPA has identified under section 307(a) of the Act, which are known or suspected to be discharged by nondomestic users. This will consist of an annual full priority pollutant scan, with quarterly samples analyzed only for those pollutants detected in the full scan Sampling and analysis for specific industrial users may be modified pursuant to federal pretreatment regulations at 40 CFR 12(e)(2), which allows a an industrial user to forego sampling of a pollutant regulated by the categorical pretreatment standard if the industrial user demonstrates that the pollutant is neither present in the discharge nor expected to be present in the discharge. The City is not required to sample and analyze for asbestos. Sludge sampling and analysis are covered in the sludge section of this permit. The City shall also provide any influent or effluent monitoring data performed with the techniques prescribed in 40 CFR Part 136 for non-priority pollutants which the City believes may be causing or contributing to interference or pass through.

(b) A discussion of Upset, Interference, or Pass Through incidents, if any, at the treatment plant which the City knows or suspects were caused by nondomestic users of the POTW system. The discussion shall include the reasons why the incidents occurred, the corrective actions taken and, if known, the name and address of the nondomestic user(s) responsible. The discussion shall also include a review of the applicable pollutant limitations, if any, to determine whether any additional limitations, or changes to existing requirements, may be necessary to prevent pass through or interference;

(c) An updated list of the City's significant industrial users (SIUs) including their names and addresses, and a list of deletions, additions, and SIU name changes keyed to the previously submitted list. The City shall provide a brief explanation for each change. The list shall identify the SIUs subject to federal categorical standards by specifying which set(s) of standards are applicable to each SIU. The list shall also indicate which SIUs are subject to local limitations;

(d) The City shall characterize the compliance status of each SIU by providing a list or table which includes the following information:

(i) Name of the SIU;

(ii) Category, if subject to federal categorical standards;

(iii) The type of wastewater treatment or control processes in place;

(iv) The number of samples taken by the POTW during the year;

(v) The number of samples taken by the SIU during the year;

(vi) For an SIU subject to discharge requirements for total toxic organics, whether all required certifications were provided;

(vii) A list of the standards violated during the year. Identify whether the violations were for categorical standards or local limits;

(viii) Whether the facility is in significant noncompliance (SNC) as defined at 40 CFR 403.12(f)(2)(vii) at any time during the year; and

(ix) A summary of enforcement or other actions taken by the City during the year to return the SIU to compliance. Describe the type of action, final compliance date, and the amount of fines

and penalties collected, if any. Describe any proposed actions for bringing the SIU into compliance;

(a) A brief description of any programs the City implements to reduce pollutants from nondomestic users that are not classified as SIUs;

(b) A brief description of any significant changes in operating the pretreatment program which differ from the previous year including, but not limited to, changes concerning the program's administrative structure, local limits, monitoring program or monitoring frequencies, legal authority, enforcement policy, funding levels, or staffing levels;

(c) A summary of the annual pretreatment budget, including the cost of pretreatment program functions and equipment purchases; and

(d) A summary of activities to involve and inform the public of the program including a copy of the newspaper notice, if any, required under 40 CFR 403.8(f)(2)(vii).

v. The City shall submit a semiannual SIU noncompliance status report to EPA Pacific Southwest Region, and the State. The report shall cover the period of January 1 through June 30, and shall be submitted by July 31. The report shall contain:

(a) The name and address of all SIUs which violated any discharge or reporting requirements during the report period;

(b) A description of the violations including whether any discharge violations were for categorical standards or local limits;

(c) A description of the enforcement or other actions that were taken by the City to remedy the noncompliance; and

(d) The status of active enforcement and other actions taken by the City in response to SIU noncompliance identified in previous reports.

c. **Sludge Disposal and Handling Requirements**

i. Sludge, as used in this document, means the solid, semisolid, and liquid residues removed during primary, secondary, or advanced wastewater treatment processes. Solid waste refers to grit and screenings generated during preliminary treatment. Biosolids refers to sludge that has been treated, tested, and shown to be capable of being beneficially and legally used pursuant to federal and State regulations

as a soil amendment for agriculture, silviculture, horticulture, and land reclamation activities.

ii. All collected sludges and other solid waste removed from liquid wastes shall be removed from screens, sumps, ponds, and tanks as needed to ensure optimal plant operation and disposed of in accordance with applicable federal and State regulations.

iii. The use and disposal of biosolids are separately required to comply with all the requirements in Part 503, which are enforceable by the USEPA, not the Regional Water Board. If during the life of this Order, the State accepts primacy for implementation of Part 503, the Regional Water Board may also initiate enforcement where appropriate.

iv. Sludge or biosolids that are disposed of in a municipal solid waste landfill or used as landfill daily cover shall separately meet the applicable requirements of Part 258, which are not incorporated by reference into this Order. In the annual self-monitoring report, the Permittee shall include the amount of sludge or biosolids disposed of, and the landfill(s) which received the sludge or biosolids.

v. The Permittee shall take all reasonable steps to prevent and minimize any sludge use or disposal contrary to the requirements of this Order that has a likelihood of adversely affecting human health or the environment.

vi. Solids and sludge treatment, storage, and disposal or reuse shall not create a nuisance, such as objectionable odors or flies, and shall not result in groundwater contamination.

vii. Solids and sludge treatment and storage sites shall have facilities adequate to divert surface water runoff from adjacent areas, to protect the boundaries of the site from erosion, and to prevent drainage from the treatment and storage site. Adequate protection is defined as protection from at least a 100-year storm.

viii. The discharge of sewage sludge, biosolids, and other waste solids shall not cause waste material to be in a position where it is, or can be, conveyed from the treatment and storage sites and deposited in the waters of the state.

ix. The beneficial use of biosolids by application to land as soil amendment is not covered or authorized by this Order. If applicable, for the discharge of biosolids from the wastewater treatment plant, the Permittee shall seek separate authorization to discharge under the requirements of the State Water Resources Control Board Water Quality Order No. 2004-0012–DWQ General Waste Discharge Requirements for the Discharge of Biosolids to Land or Use as a Soil Amendment In Agricultural, Silvicultural, Horticultural, and Land

Reclamation Activities (General Order), or other WDRs issued by the Regional Water Board, which are not incorporated by reference into this Order.

d. **Operator Certification**

Supervisors and operators of municipal WWTFs shall possess a certificate of appropriate grade in accordance with title 23, Cal. Code of Regs, section 3680. The State Water Board may accept experience in lieu of qualification training. In lieu of a properly certified WWTF operator, the State Water Board may approve use of a water treatment facility operator of appropriate grade certified by CDPH where water reclamation is involved.

e. **Adequate Capacity**

If the WWTF or effluent disposal areas will reach capacity within 4 years, the Permittee shall notify the Regional Water Board. A copy of such notification shall be sent to appropriate local elected officials, local permitting agencies, and the press. Factors to be evaluated in assessing reserve capacity shall include, at a minimum, (1) comparison of the wet weather design flow with the highest daily flow[10], and (2) comparison of the average dry weather design flow with the lowest monthly flow. The Permittee shall demonstrate that adequate steps are being taken to address the capacity problem. The Permittee shall submit a technical report to the Regional Water Board showing how flow volumes will be prevented from exceeding capacity, or how capacity will be increased, within 120 days after providing notification to the Regional Water Board, or within 120 days after receipt of Regional Water Board notification, that the WWTP will reach capacity within 4 years. The time for filing the required technical report may be extended by the Regional Water Board. An extension of 30 days may be granted by the Executive Officer, and longer extensions may be granted by the Regional Water Board itself. [CCR Title 23, section 2232]

**6. Other Special Provisions**

a. **Storm Water.** For the control of storm water discharged from the site of the WWTF, if applicable, the Permittee shall seek separate authorization to discharge under the requirements of the State Water Board's Water Quality Order 97-03-DWQ, NPDES General Permit No. CAS000001, Waste Discharge Requirements for Discharges of Storm Water

[10] Wet weather design flow will be included in a WWTF capacity assessment once the upgraded configuration is complete and Discharge Point 003 is in use.

Associated with Industrial Activities Excluding Construction Activities (or subsequent renewed versions of the General Permit), which is not incorporated by reference into this Order.

b. **Engineering and Antidegradation Analysis for Proposed Increased Wet Weather Treatment Capacity.** The treatment facility's current, documented, average wet weather treatment capacity is 5.0 mgd. Before the Regional Water Board can consider an increase in this figure, the Permittee shall submit an Engineering and Antidegradation Analysis, which (1) describes the hydraulic and treatment capacities of significant components of the WWTF and its associated collection system, (2) identifies the flow or treatment limiting component(s) of the WWTF and the collection system, (3) characterizes historical wet weather flows to the WWTF (frequency, duration, flow), (4) provides an analysis of impacts to the receiving water(s) resulting from the incremental increase in flow volume and mass of pollutants discharged, and (5) provides an antidegradation analysis to document consistency, or not, with applicable State and federal antidegradation regulations, guidance, and policy.

### 7. Compliance Schedules

Not Applicable.

## VII. Compliance Determination

Compliance with the effluent limitations contained in section IV of this Order will be determined as specified below.

### A. General.

Compliance with effluent limitations for priority pollutants shall be determined using sample reporting protocols defined in the MRP of this Order. For purposes of reporting and administrative enforcement by the Regional and State Water Boards, the Permittee shall be deemed out of compliance with effluent limitations if the concentration of the priority pollutant in the monitoring sample is greater than the effluent limitation and greater than or equal to the reporting level (RL). For purposes of reporting and administrative enforcement by the Regional and State Water Boards, the Permittee shall be deemed out of compliance with effluent limitations if the concentration of 2,3,7,8-TCDD Equivalents in the monitoring sample is greater than the effluent limitation and greater than or equal to the reported minimum level (ML).

### B. Multiple Sample Data.

When determining compliance with an AMEL for priority pollutants, and more than one sample result is available, the Permittee shall compute the arithmetic mean

unless the data set contains one or more reported determinations of "Detected, but Not Quantified" (DNQ) or "Not Detected" (ND). In those cases, the Permittee shall compute the median in place of the arithmetic mean in accordance with the following procedure.

1. The data set shall be ranked from low to high, ranking the reported ND determinations lowest, DNQ determinations next, followed by quantified values (if any). The order of the individual ND or DNQ determinations is unimportant.

2. The median value of the data set shall be determined. If the data set has an odd number of data points, then the median is the middle value. If the data set has an even number of data points, then the median is the average of the two values around the middle unless one or both of the points are ND or DNQ, in which case the median value shall be the lower of the two data points where DNQ is lower than a value and ND is lower than DNQ.

**C. Average Monthly Effluent Limitation (AMEL).**

If the average (or when applicable, the median determined by subsection B above for multiple sample data) of daily discharges over a calendar month exceeds the AMEL for a given parameter, this will represent a single violation, though the Permittee will be considered out of compliance for each day of that month for that parameter (e.g., resulting in 31 days of non-compliance in a 31-day month). If only a single sample is taken during the calendar month and the analytical result for that sample exceeds the AMEL, the Permittee will be considered out of compliance for that calendar month. The Permittee will only be considered out of compliance for days when the discharge occurs. For any one calendar month during which no sample (daily discharge) is taken, no compliance determination can be made for that calendar month.

**D. Average Weekly Effluent Limitation (AWEL).**

If the average (or when applicable, the median determined by subsection B above for multiple sample data) of daily discharges over a calendar week exceeds the AWEL for a given parameter, this will represent a single violation, though the Permittee will be considered out of compliance for each day of that week for that parameter, resulting in 7 days of non-compliance. If only a single sample is taken during the calendar week and the analytical result for that sample exceeds the AWEL, the Permittee will be considered out of compliance for that calendar week. The Permittee will only be considered out of compliance for days when the discharge occurs. For any one calendar week during which no sample (daily discharge) is taken, no compliance determination can be made for that calendar week.

**E. Maximum Daily Effluent Limitation (MDEL).**

If a daily discharge (or when applicable, the median determined by subsection B, above, for multiple sample data of a daily discharge) exceeds the MDEL for a given parameter, the Permittee will be considered out of compliance for that parameter for that 1 day only within the reporting period. For any 1 day during which no sample is taken, no compliance determination can be made for that day.

**F. Instantaneous Minimum Effluent Limitation.**

If the analytical result of a single grab sample is lower than the instantaneous minimum effluent limitation for a parameter, the Permittee will be considered out of compliance for that parameter for that single sample. Non-compliance for each sample will be considered separately (e.g., the results of two grab samples taken within a calendar day that both are lower than the instantaneous minimum effluent limitation would result in two instances of non-compliance with the instantaneous minimum effluent limitation).

**G. Instantaneous Maximum Effluent Limitation.**

If the analytical result of a single grab sample is higher than the instantaneous maximum effluent limitation for a parameter, the Permittee will be considered out of compliance for that parameter for that single sample. Non-compliance for each sample will be considered separately (e.g., the results of two grab samples taken within a calendar day that both exceed the instantaneous maximum effluent limitation would result in two instances of non-compliance with the instantaneous maximum effluent limitation).

## ATTACHMENT A – DEFINITIONS

**Arithmetic Mean ($\mu$),** also called the average, is the sum of measured values divided by the number of samples. For ambient water concentrations, the arithmetic mean is calculated as follows:

Arithmetic mean = $\mu = \Sigma x / n$ where: $\Sigma x$ is the sum of the measured ambient water concentrations, and n is the number of samples.

**Average Monthly Effluent Limitation (AMEL):** the highest allowable average of daily discharges over a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month.

**Average Weekly Effluent Limitation (AWEL):** the highest allowable average of daily discharges over a calendar week (Sunday through Saturday), calculated as the sum of all daily discharges measured during a calendar week divided by the number of daily discharges measured during that week.

**Bioaccumulative** pollutants are those substances taken up by an organism from its surrounding medium through gill membranes, epithelial tissue, or from food and subsequently concentrated and retained in the body of the organism.

**Carcinogenic** pollutants are substances that are known to cause cancer in living organisms.

**Coefficient of Variation (CV)** is a measure of the data variability and is calculated as the estimated standard deviation divided by the arithmetic mean of the observed values.

**Daily Discharge:** Daily Discharge is defined as either: (1) the total mass of the constituent discharged over the calendar day (12:00 am through 11:59 pm) or any 24-hour period that reasonably represents a calendar day for purposes of sampling (as specified in the permit), for a constituent with limitations expressed in units of mass or; (2) the unweighted arithmetic mean measurement of the constituent over the day for a constituent with limitations expressed in other units of measurement (e.g., concentration).

The daily discharge may be determined by the analytical results of a composite sample taken over the course of one day (a calendar day or other 24-hour period defined as a day) or by the arithmetic mean of analytical results from one or more grab samples taken over the course of the day.

For composite sampling, if 1 day is defined as a 24-hour period other than a calendar day, the analytical result for the 24-hour period will be considered as the result for the calendar day in which the 24-hour period ends.

**Detected, but Not Quantified (DNQ)** are those sample results less than the RL, but greater than or equal to the laboratory's MDL.

**Dilution Credit** is the amount of dilution granted to a discharge in the calculation of a water quality-based effluent limitation, based on the allowance of a specified mixing zone. It is calculated from the dilution ratio or determined through conducting a mixing zone study or modeling of the discharge and receiving water.

**Effluent Concentration Allowance (ECA)** is a value derived from the water quality criterion/objective, dilution credit, and ambient background concentration that is used, in conjunction with the coefficient of variation for the effluent monitoring data, to calculate a long-term average (LTA) discharge concentration. The ECA has the same meaning as waste load allocation (WLA) as used in USEPA guidance (Technical Support Document For Water Quality-based Toxics Control, March 1991, second printing, EPA/505/2-90-001).

**Enclosed Bays** means indentations along the coast that enclose an area of oceanic water within distinct headlands or harbor works. Enclosed bays include all bays where the narrowest distance between the headlands or outermost harbor works is less than 75 percent of the greatest dimension of the enclosed portion of the bay. Enclosed bays include, but are not limited to, Humboldt Bay, Bodega Harbor, Tomales Bay, Drake's Estero, San Francisco Bay, Morro Bay, Los Angeles-Long Beach Harbor, Upper and Lower Newport Bay, Mission Bay, and San Diego Bay. Enclosed bays do not include inland surface waters or ocean waters.

**Estimated Chemical Concentration** is the estimated chemical concentration that results from the confirmed detection of the substance by the analytical method below the ML value.

**Estuaries** means waters, including coastal lagoons, located at the mouths of streams that serve as areas of mixing for fresh and ocean waters. Coastal lagoons and mouths of streams that are temporarily separated from the ocean by sandbars shall be considered estuaries. Estuarine waters shall be considered to extend from a bay or the open ocean to a point upstream where there is no significant mixing of fresh water and seawater. Estuarine waters included, but are not limited to, the Sacramento-San Joaquin Delta, as defined in Water Code section 12220, Suisun Bay, Carquinez Strait downstream to the Carquinez Bridge, and appropriate areas of the Smith, Mad, Eel, Noyo, Russian, Klamath, San Diego, and Otay rivers. Estuaries do not include inland surface waters or ocean waters.

**Inland Surface Waters** are all surface waters of the State that do not include the ocean, enclosed bays, or estuaries.

**Instantaneous Maximum Effluent Limitation:** the highest allowable value for any single grab sample or aliquot (i.e., each grab sample or aliquot is independently compared to the instantaneous maximum limitation).

**Instantaneous Minimum Effluent Limitation:** the lowest allowable value for any single grab sample or aliquot (i.e., each grab sample or aliquot is independently compared to the instantaneous minimum limitation).

**Maximum Daily Effluent Limitation (MDEL)** means the highest allowable daily discharge of a pollutant, over a calendar day (or 24-hour period). For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the daily discharge is calculated as the arithmetic mean measurement of the pollutant over the day.

**Mean Daily Dry Weather Influent Flow** is the average daily flow measured during the calendar month, which, based on flow measurement, is shown to be the lowest flow of the calendar year.

**Median** is the middle measurement in a set of data. The median of a set of data is found by first arranging the measurements in order of magnitude (either increasing or decreasing order). If the number of measurements ($n$) is odd, then the median = $X_{(n+1)/2}$. If $n$ is even, then the median = $(X_{n/2} + X_{(n/2)+1})/2$ (i.e., the midpoint between the $n/2$ and $n/2+1$).

**Method Detection Limit (MDL)** is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero, as defined in title 40 of the Code of Federal Regulations, Part 136, Attachment B, revised as of July 3, 1999.

**Minimum Level (ML)** is the concentration at which the entire analytical system must give a recognizable signal and acceptable calibration point. The ML is the concentration in a sample that is equivalent to the concentration of the lowest calibration standard analyzed by a specific analytical procedure, assuming that all the method specified sample weights, volumes, and processing steps have been followed.

**Mixing Zone** is a limited volume of receiving water that is allocated for mixing with a wastewater discharge where water quality criteria can be exceeded without causing adverse effects to the overall water body.

**Not Detected (ND)** are those sample results less than the laboratory's MDL.

**Ocean Waters** are the territorial marine waters of the State as defined by California law to the extent these waters are outside of enclosed bays, estuaries, and coastal lagoons. Discharges to ocean waters are regulated in accordance with the State Water Board's California Ocean Plan.

**Persistent** pollutants are substances for which degradation or decomposition in the environment is nonexistent or very slow.

**Pollutant Minimization Program (PMP)** means waste minimization and pollution prevention actions that include, but are not limited to, product substitution, waste stream recycling, alternative waste management methods, and education of the public and businesses. The goal of the PMP shall be to reduce all potential sources of a priority pollutant(s) through pollutant minimization (control) strategies, including pollution prevention measures as appropriate, to maintain the effluent concentration at or below the water quality-based effluent limitation. Pollution prevention measures may be particularly appropriate for persistent bioaccumulative priority pollutants where there is evidence that beneficial uses are being impacted. The Regional Water Board may consider cost effectiveness when establishing the requirements of a PMP. The completion and implementation of a Pollution Prevention Plan, if required pursuant to Water Code section 13263.3(d), shall be considered to fulfill the PMP requirements.

**Pollution Prevention** means any action that causes a net reduction in the use or generation of a hazardous substance or other pollutant that is discharged into water and includes, but is not limited to, input change, operational improvement, production process change, and product reformulation (as defined in Water Code section 13263.3). Pollution prevention does not include actions that merely shift a pollutant in wastewater from one environmental medium to another environmental medium, unless clear environmental benefits of such an approach are identified to the satisfaction of the State or Regional Water Board.

**Reporting Level (RL)** is the ML (and its associated analytical method) chosen by the Permittee for reporting and compliance determination from the MLs included in this Order. The MLs included in this Order correspond to approved analytical methods for reporting a sample result that are selected by the Regional Water Board either from Appendix 4 of the SIP in accordance with section 2.4.2 of the SIP or established in accordance with section 2.4.3 of the SIP. The ML is based on the proper application of method-based analytical procedures for sample preparation and the absence of any matrix interferences. Other factors may be applied to the ML depending on the specific sample preparation steps employed. For example, the treatment typically applied in cases where there are matrix-effects is to dilute the sample or sample aliquot by a factor of ten. In such cases, this additional factor must be applied to the ML in the computation of the RL.

**Satellite Collection System** is the portion, if any, of a sanitary sewer system owned or operated by a different public agency than the agency that owns and operates the wastewater treatment facility that a sanitary sewer system is tributary to.

**Source of Drinking Water** is any water designated as municipal or domestic supply (MUN) in a Regional Water Board Basin Plan.

**Standard Deviation ($\sigma$)** is a measure of variability that is calculated as follows:

$$\sigma = (\sum[(x - \mu)^2]/(n - 1))^{0.5}$$

where:

$x$ is the observed value;

$\mu$ is the arithmetic mean of the observed values; and

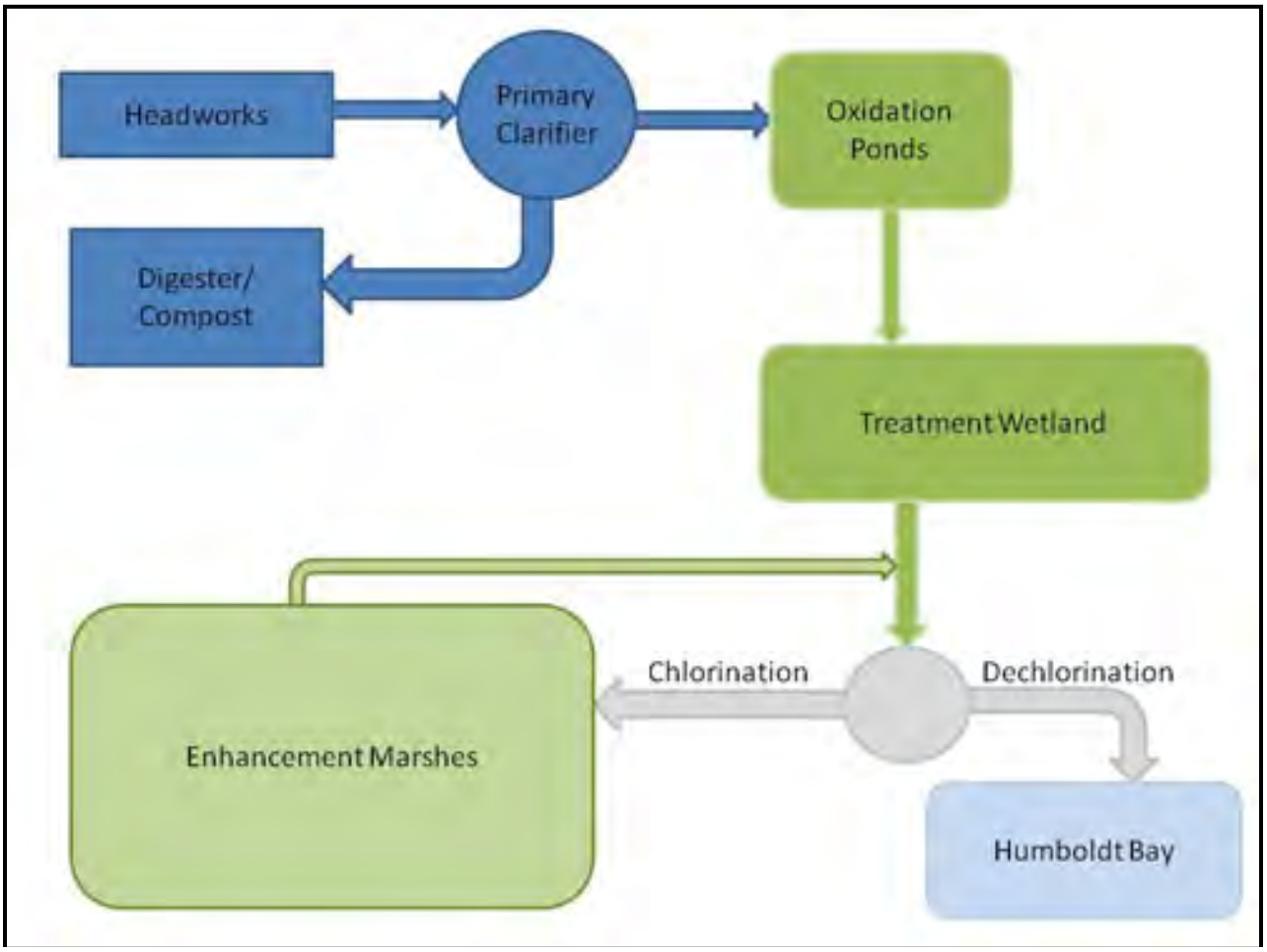
$n$ is the number of samples.

**Toxicity Reduction Evaluation (TRE)** is a study conducted in a step-wise process designed to identify the causative agents of effluent or ambient toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in toxicity. The first steps of the TRE consist of the collection of data relevant to the toxicity, including additional toxicity testing, and an evaluation of facility operations and maintenance practices, and best management practices. A Toxicity Identification Evaluation (TIE) may be required as part of the TRE, if appropriate. (A TIE is a set of procedures to identify the specific chemical(s) responsible for toxicity. These procedures are performed in three phases (characterization, identification, and confirmation) using aquatic organism toxicity tests.)

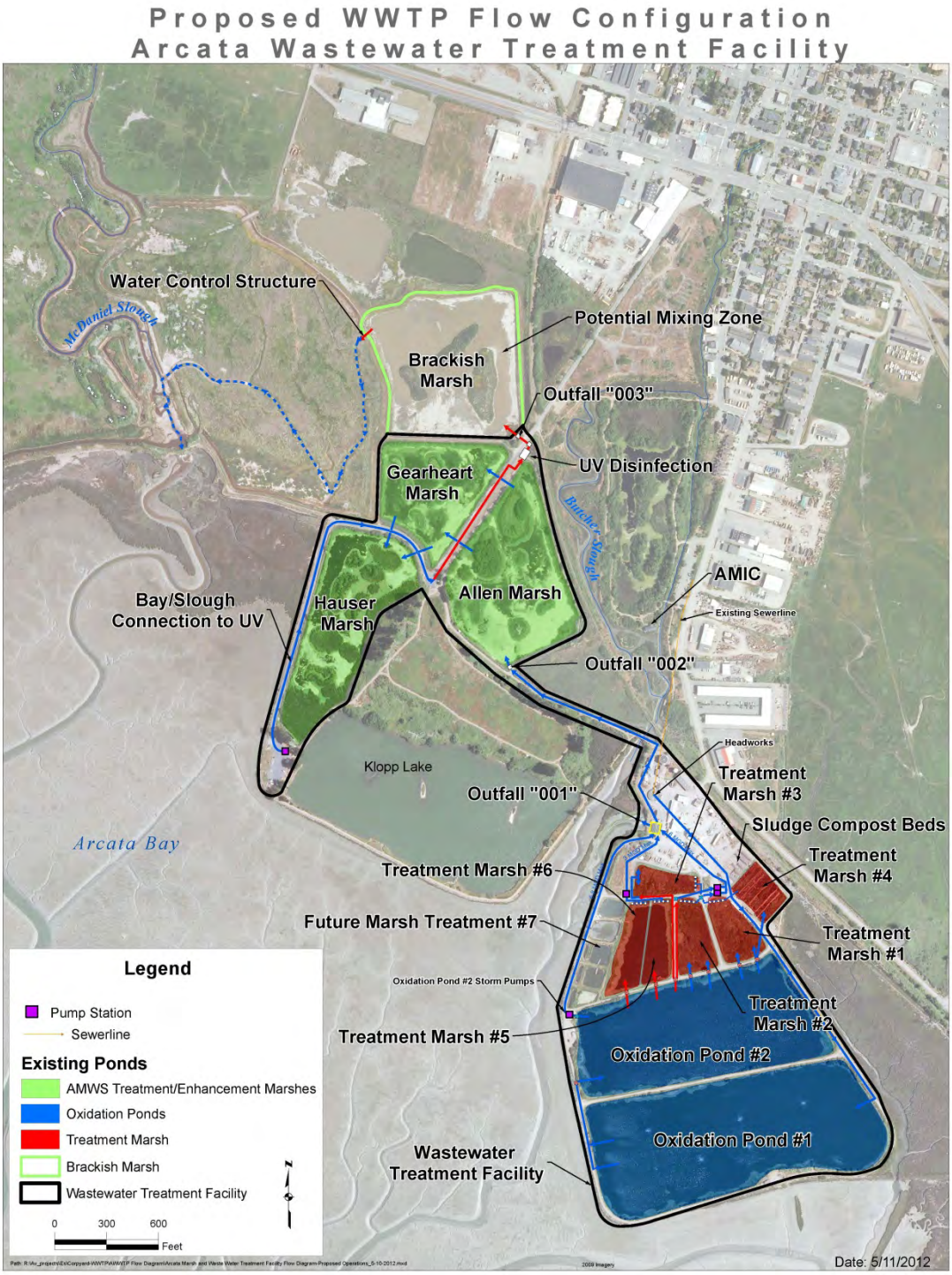
## ATTACHMENT B – FACILITY MAP



## ATTACHMENT C – EXISTING CONFIGURATION FLOW SCHEMATIC



## ATTACHMENT C – UPGRADED CONFIGURATION FLOW SCHEMATIC



# ATTACHMENT D – STANDARD PROVISIONS

## I. STANDARD PROVISIONS – PERMIT COMPLIANCE

A. Duty to Comply

1. The Permittee must comply with all of the conditions of this Order. Any noncompliance constitutes a violation of the Clean Water Act (CWA) and the California Water Code and is grounds for enforcement action, for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application. (40 C.F.R. § 122.41(a).)

2. The Permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the CWA for toxic pollutants and with standards for sewage sludge use or disposal established under Section 405(d) of the CWA within the time provided in the regulations that establish these standards or prohibitions, even if this Order has not yet been modified to incorporate the requirement. (40 C.F.R. § 122.41(a)(1).)

B. Need to Halt or Reduce Activity Not a Defense

It shall not be a defense for a Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this Order. (40 C.F.R. § 122.41(c).)

C. Duty to Mitigate

The Permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this Order that has a reasonable likelihood of adversely affecting human health or the environment. (40 C.F.R. § 122.41(d).)

D. Proper Operation and Maintenance

The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the Permittee to achieve compliance with the conditions of this Order. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems that are installed by a Permittee only when necessary to achieve compliance with the conditions of this Order. (40 C.F.R. § 122.41(e).)

E. Property Rights

1. This Order does not convey any property rights of any sort or any exclusive privileges. (40 C.F.R. § 122.41(g).)

2. The issuance of this Order does not authorize any injury to persons or property or invasion of other private rights, or any infringement of state or local law or regulations. (40 C.F.R. § 122.5(c).)

F. Inspection and Entry

The Permittee shall allow the Regional Water Board, State Water Board, United States Environmental Protection Agency (USEPA), and/or their authorized representatives (including an authorized contractor acting as their representative), upon the presentation of credentials and other documents, as may be required by law, to (40 C.F.R. § 122.41(i); Wat. Code, § 13383):

1. Enter upon the Permittee's premises where a regulated facility or activity is located or conducted, or where records are kept under the conditions of this Order (40 C.F.R. § 122.41(i)(1));

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this Order (40 C.F.R. § 122.41(i)(2));

3. Inspect and photograph, at reasonable times, any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Order (40 C.F.R. § 122.41(i)(3)); and

4. Sample or monitor, at reasonable times, for the purposes of assuring Order compliance or as otherwise authorized by the CWA or the Water Code, any substances or parameters at any location. (40 C.F.R. § 122.41(i)(4).)

G. Bypass

1. Definitions

a. “Bypass” means the intentional diversion of waste streams from any portion of a treatment facility. (40 C.F.R. § 122.41(m)(1)(i).)

b. “Severe property damage” means substantial physical damage to property, damage to the treatment facilities, which causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production. (40 C.F.R. § 122.41(m)(1)(ii).)

2. Bypass not exceeding limitations. The Permittee may allow any bypass to occur which does not cause exceedances of effluent limitations, but only if it is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions listed in Standard Provisions – Permit Compliance I.G.3, I.G.4, and I.G.5 below. (40 C.F.R. § 122.41(m)(2).)

3. Prohibition of bypass. Bypass is prohibited, and the Regional Water Board may take enforcement action against a Permittee for bypass, unless (40 C.F.R. § 122.41(m)(4)(i)):

   a. Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage (40 C.F.R. § 122.41(m)(4)(i)(A));

   b. There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that occurred during normal periods of equipment downtime or preventive maintenance (40 C.F.R. § 122.41(m)(4)(i)(B)); and

   c. The Permittee submitted notice to the Regional Water Board as required under Standard Provisions – Permit Compliance I.G.5 below. (40 C.F.R. § 122.41(m)(4)(i)(C).)

4. The Regional Water Board may approve an anticipated bypass, after considering its adverse effects, if the Regional Water Board determines that it will meet the three conditions listed in Standard Provisions – Permit Compliance I.G.3 above. (40 C.F.R. § 122.41(m)(4)(ii).)

5. Notice

   a. Anticipated bypass. If the Permittee knows in advance of the need for a bypass, it shall submit a notice, if possible at least 10 days before the date of the bypass. (40 C.F.R. § 122.41(m)(3)(i).)

   b. Unanticipated bypass. The Permittee shall submit notice of an unanticipated bypass as required in Standard Provisions - Reporting V.E below (24-hour notice). (40 C.F.R. § 122.41(m)(3)(ii).)

H. Upset

Upset means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed

treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation. (40 C.F.R. § 122.41(n)(1).)

1. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology based permit effluent limitations if the requirements of Standard Provisions – Permit Compliance I.H.2 below are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review. (40 C.F.R. § 122.41(n)(2).).

2. Conditions necessary for a demonstration of upset. A Permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs or other relevant evidence that (40 C.F.R. § 122.41(n)(3)):

   a. An upset occurred and that the Permittee can identify the cause(s) of the upset (40 C.F.R. § 122.41(n)(3)(i));

   b. The permitted facility was, at the time, being properly operated (40 C.F.R. § 122.41(n)(3)(ii));

   c. The Permittee submitted notice of the upset as required in Standard Provisions – Reporting V.E.2.b below (24-hour notice) (40 C.F.R. § 122.41(n)(3)(iii)); and

   d. The Permittee complied with any remedial measures required under Standard Provisions – Permit Compliance I.C above. (40 C.F.R. § 122.41(n)(3)(iv).)

3. Burden of proof. In any enforcement proceeding, the Permittee seeking to establish the occurrence of an upset has the burden of proof. (40 C.F.R. § 122.41(n)(4).)

## II. STANDARD PROVISIONS – PERMIT ACTION

A. General

This Order may be modified, revoked and reissued, or terminated for cause. The filing of a request by the Permittee for modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any Order condition. (40 C.F.R. § 122.41(f).)

B. Duty to Reapply

If the Permittee wishes to continue an activity regulated by this Order after the expiration date of this Order, the Permittee must apply for and obtain a new permit. (40 C.F.R. § 122.41(b).)

C. Transfers

This Order is not transferable to any person except after notice to the Regional Water Board. The Regional Water Board may require modification or revocation and reissuance of the Order to change the name of the Permittee and incorporate such other requirements as may be necessary under the CWA and the Water Code. (40 C.F.R. § 122.41(l)(3); § 122.61.)

## III. STANDARD PROVISIONS – MONITORING

A. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. (40 C.F.R. § 122.41(j)(1).)

B. Monitoring results must be conducted according to test procedures under Part 136 or, in the case of sludge use or disposal, approved under Part 136 unless otherwise specified in Part 503 unless other test procedures have been specified in this Order. (40 C.F.R. § 122.41(j)(4); § 122.44(i)(1)(iv).)

## IV. STANDARD PROVISIONS – RECORDS

A. Except for records of monitoring information required by this Order related to the Permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by Part 503), the Permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this Order, and records of all data used to complete the application for this Order, for a period of at least three (3) years from the date of the sample, measurement, report or application. This period may be extended by request of the Regional Water Board Executive Officer at any time. (40 C.F.R. § 122.41(j)(2).)

B. Records of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements (40 C.F.R. § 122.41(j)(3)(i));
2. The individual(s) who performed the sampling or measurements (40 C.F.R. § 122.41(j)(3)(ii));
3. The date(s) analyses were performed (40 C.F.R. § 122.41(j)(3)(iii));

4. The individual(s) who performed the analyses (40 C.F.R. § 122.41(j)(3)(iv));
5. The analytical techniques or methods used (40 C.F.R. § 122.41(j)(3)(v)); and
6. The results of such analyses. (40 C.F.R. § 122.41(j)(3)(vi).)

C. Claims of confidentiality for the following information will be denied (40 C.F.R. § 122.7(b)):

1. The name and address of any permit applicant or Permittee (40 C.F.R. § 122.7(b)(1)); and
2. Permit applications and attachments, permits and effluent data. (40 C.F.R. § 122.7(b)(2).)

## V. STANDARD PROVISIONS – REPORTING

A. Duty to Provide Information

The Permittee shall furnish to the Regional Water Board, State Water Board, or USEPA within a reasonable time, any information which the Regional Water Board, State Water Board, or USEPA may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Order or to determine compliance with this Order. Upon request, the Permittee shall also furnish to the Regional Water Board, State Water Board, or USEPA copies of records required to be kept by this Order. (40 C.F.R. § 122.41(h); Wat. Code, § 13267.)

B. Signatory and Certification Requirements

1. All applications, reports, or information submitted to the Regional Water Board, State Water Board, and/or USEPA shall be signed and certified in accordance with Standard Provisions – Reporting V.B.2, V.B.3, V.B.4, and V.B.5 below. (40 C.F.R. § 122.41(k).)

2. All permit applications shall be signed by either a principal executive officer or ranking elected official. For purposes of this provision, a principal executive officer of a federal agency includes: (i) the chief executive officer of the agency, or (ii) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of USEPA). (40 C.F.R. § 122.22(a)(3).).

3. All reports required by this Order and other information requested by the Regional Water Board, State Water Board, or USEPA shall be signed by a person described in Standard Provisions – Reporting V.B.2 above, or by a duly authorized representative of that person. A person is a duly authorized representative only if:

a. The authorization is made in writing by a person described in Standard Provisions – Reporting V.B.2 above (40 C.F.R. § 122.22(b)(1));

b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.) (40 C.F.R. § 122.22(b)(2)); and

c. The written authorization is submitted to the Regional Water Board and State Water Board. (40 C.F.R. § 122.22(b)(3).)

4. If an authorization under Standard Provisions – Reporting V.B.3 above is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Standard Provisions – Reporting V.B.3 above must be submitted to the Regional Water Board and State Water Board prior to or together with any reports, information, or applications, to be signed by an authorized representative. (40 C.F.R. § 122.22(c).)

5. Any person signing a document under Standard Provisions – Reporting V.B.2 or V.B.3 above shall make the following certification:

   "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations." (40 C.F.R. § 122.22(d).)

C. Monitoring Reports

1. Monitoring results shall be reported at the intervals specified in the Monitoring and Reporting Program (Attachment E) in this Order. (40 C.F.R. § 122.22(l)(4).)

2. Monitoring results must be reported on a Discharge Monitoring Report (DMR) form or forms provided or specified by the Regional Water Board or State

Water Board for reporting results of monitoring of sludge use or disposal practices. (40 C.F.R. § 122.41(l)(4)(i).)

3. If the Permittee monitors any pollutant more frequently than required by this Order using test procedures approved under Part 136 or, in the case of sludge use or disposal, approved under Part 136 unless otherwise specified in Part 503, or as specified in this Order, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR or sludge reporting form specified by the Regional Water Board. (40 C.F.R. § 122.41(l)(4)(ii).)

4. Calculations for all limitations, which require averaging of measurements, shall utilize an arithmetic mean unless otherwise specified in this Order. (40 C.F.R. § 122.41(l)(4)(iii).)

D. Compliance Schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this Order, shall be submitted no later than 14 days following each schedule date. (40 C.F.R. § 122.41(l)(5).)

E. Twenty-Four Hour Reporting

1. The Permittee shall report any noncompliance that may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the Permittee becomes aware of the circumstances. A written submission shall also be provided within five (5) days of the time the Permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance. (40 C.F.R. § 122.41(l)(6)(i).)

2. The following shall be included as information that must be reported within 24 hours under this paragraph (40 C.F.R. § 122.41(l)(6)(ii)):

   a. Any unanticipated bypass that exceeds any effluent limitation in this Order. (40 C.F.R. § 122.41(l)(6)(ii)(A).)

   b. Any upset that exceeds any effluent limitation in this Order. (40 C.F.R. § 122.41(l)(6)(ii)(B).)

3. The Regional Water Board may waive the above-required written report under this provision on a case-by-case basis if an oral report has been received within 24 hours. (40 C.F.R. § 122.41(l)(6)(iii).)

F. Planned Changes

The Permittee shall give notice to the Regional Water Board as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required under this provision only when (40 C.F.R. § 122.41(l)(1)):

1. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in section 122.29(b) (40 C.F.R. § 122.41(l)(1)(i)); or

2. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants that are not subject to effluent limitations in this Order. (40 C.F.R. § 122.41(l)(1)(ii).)

3. The alteration or addition results in a significant change in the Permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan. (40 C.F.R.§ 122.41(l)(1)(iii).)

G. Anticipated Noncompliance

The Permittee shall give advance notice to the Regional Water Board or State Water Board of any planned changes in the permitted facility or activity that may result in noncompliance with General Order requirements. (40 C.F.R. § 122.41(l)(2).)

H. Other Noncompliance

The Permittee shall report all instances of noncompliance not reported under Standard Provisions – Reporting V.C, V.D, and V.E above at the time monitoring reports are submitted. The reports shall contain the information listed in Standard Provision – Reporting V.E above. (40 C.F.R. § 122.41(l)(7).)

I. Other Information

When the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Regional Water Board, State Water Board, or USEPA, the

Permittee shall promptly submit such facts or information. (40 C.F.R. § 122.41(l)(8).)

## VI. STANDARD PROVISIONS – ENFORCEMENT

A. The Regional Water Board is authorized to enforce the terms of this permit under several provisions of the Water Code, including, but not limited to, sections 13385, 13386, and 13387.

## VII. ADDITIONAL PROVISIONS – NOTIFICATION LEVELS

### A. Publicly-Owned Treatment Works (POTWs)

All POTWs shall provide adequate notice to the Regional Water Board of the following (40 C.F.R. § 122.42(b)):

1. Any new introduction of pollutants into the POTW from an indirect discharger that would be subject to sections 301 or 306 of the CWA if it were directly discharging those pollutants (40 C.F.R. § 122.42(b)(1)); and

2. Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of adoption of the Order. (40 C.F.R. § 122.42(b)(2).)

3. Adequate notice shall include information on the quality and quantity of effluent introduced into the POTW as well as any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW. (40 C.F.R. § 122.42(b)(3).)

# ATTACHMENT E – MONITORING AND REPORTING PROGRAM

## Table of Contents

I. General Monitoring Provisions ..... E-2
II. Monitoring Locations ..... E-3
III. Influent Monitoring Requirements ..... E-3
A. Monitoring Location INF-001 ..... E-3
IV. Effluent Monitoring Requirements ..... E-4
A. Monitoring Locations EFF-001 and EFF-003 ..... E-4
B. Monitoring Location EFF-002 ..... E-5
V. Whole Effluent Toxicity Testing Requirements ..... E-6
A. Acute Toxicity Testing ..... E-6
B. Chronic Toxicity Testing ..... E-8
C. Chronic Toxicity Reporting ..... E-10
VI. Land Discharge Monitoring Requirements ..... E-12
VII. Reclamation Monitoring Requirements ..... E-12
VIII. Receiving Water Monitoring Requirements ..... E-12
A. Monitoring Location AMWS ..... E-12
B. Monitoring Locations RSW-001, RSW-002, etc. ..... E-12
IX. Other Monitoring Requirements ..... E-13
A. Disinfection Process Monitoring for UV Disinfection System ..... E-13
X. Reporting Requirements ..... E-13
A. General Monitoring and Reporting Requirements ..... E-13
B. Self Monitoring Reports (SMRs) ..... E-14
C. Discharge Monitoring Reports (DMRs) ..... E-16
D. Other Reports ..... E-17

## List of Tables

Table E-1. Test Methods and Minimum Levels for Priority Pollutants ..... E-2
Table E-2. Monitoring Station Locations ..... E-3
Table E-3. Influent Monitoring ..... E-4
Table E-4. Effluent Monitoring, Monitoring Location EFF-001 and/or EFF-003 ..... E-4
Table E-5. Effluent Monitoring, Monitoring Location EFF-002 ..... E-5
Table E-6. Receiving Water Monitoring Requirements Brackish Marsh ..... E-12
Table E-7. Monitoring Periods and Reporting Schedule ..... E-14

## ATTACHMENT E – MONITORING AND REPORTING PROGRAM (MRP)

Title 40 of the Code of Federal Regulations section 122.48 requires that all National Pollutant Discharge Elimination System (NPDES) permits specify monitoring and reporting requirements. California Water Code (Water Code) sections 13267 and 13383 also authorize the Regional Water Quality Control Board (Regional Water Board) to require technical and monitoring reports. This MRP establishes monitoring and reporting requirements, which implement the federal and California regulations.

## I. GENERAL MONITORING PROVISIONS

**A.** Composite samples may be taken by a proportional sampling device approved by the Executive Officer or by grab samples composited in proportion to flow. In compositing grab samples, the sampling interval shall not exceed 1 hour.

**B.** If the Permittee monitors any pollutant more frequently than required by this Order, using test procedures approved by title 40, Part 136, or as specified in this Order, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the monthly and annual discharger monitoring reports.

**C.** Laboratories analyzing monitoring samples shall be certified by the Department of Public Health (DPH; formerly the Department of Health Services), in accordance with the provision of Water Code section 13176, and must include quality assurance/quality control data with their reports.

**D.** Compliance and reasonable potential monitoring analyses shall be conducted using commercially available and reasonably achievable detection limits that are lower than the applicable effluent limitation. If no ML value is below the effluent limitation, the lowest ML shall be selected as the RL. Table E-1 lists the test methods the Permittee may use for compliance and reasonable potential monitoring to analyze priority pollutants with effluent limitations.

**Table E-1. Test Methods and Minimum Levels for Priority Pollutants**

| CTR # | Constituent | Types of Analytical Methods Minimum Levels (µg/L) | | | | |
|---|---|---|---|---|---|---|
| | | GC[a] | GCMS[b] | ICPMS[c] | SPGFAA[d] | Colorimetric |
| 6 | Copper | --- | --- | 0.5 | 2 | --- |
| 14 | Cyanide | --- | --- | --- | --- | 5 |
| 16 | 2,3,7,8 TCDD (dioxin TEQ) | The Permittee shall use USEPA Method 1613 | | | | |
| 21 | Carbon Tetrachloride | 0.5 | --- | --- | --- | --- |
| 27 | Dichlorobromomethane | 0.5 | --- | --- | --- | --- |
| 68 | Bis(2-Ethylhexyl)Phthalate | --- | 5 | --- | --- | --- |

[a] Gas Chromatography, [b] Gas Chromatography/Mass Spectroscopy, [c] Inductively Coupled Plasma/ Mass Spectroscopy, [d] Stabilized Platform Graphite Furnace Atomic Absorption

## II. MONITORING LOCATIONS

The Permittee shall establish the following monitoring locations to demonstrate compliance with the effluent limitations, discharge specifications, and other requirements in this Order.

**Table E-2. Monitoring Station Locations**

| Discharge Point/Outfall Location | Monitoring Location | Monitoring Location Description |
|---|---|---|
| --- | INF-001 | Location where representative samples of wastewater can be collected prior to treatment and following all significant input of wastewater to the treatment system. |
| 001 | EFF-001 | Location where representative samples of treated wastewater, to be discharged to Humboldt Bay at Outfall 001, can be collected at a point after treatment, including chlorination/dechlorination, and before contact with the receiving water. |
| 002 | EFF-002 | Location where representative samples of treated wastewater, to be discharged to the Arcata Marsh Wildlife Sanctuary (AMWS) at Outfall 002, can be collected before contact with the receiving water. |
| --- | AMWS | Areas throughout the Arcata Marsh Wildlife Sanctuary representative of various wetland conditions in accordance with the Special Study Required under Order Section VI.C.2.d |
| 003 | EFF-003 | Location where representative samples of treated wastewater, to be discharged to Humboldt Bay at Outfall 003, can be collected at a point after treatment, including UV disinfection, and before contact with the receiving water. |
| --- | RSW-001, etc. | Receiving Water Location(s) within the brackish marsh representative of various zones of mixing within the marsh. |

## III. INFLUENT MONITORING REQUIREMENTS

### A. Monitoring Location INF-001

1. The Permittee shall monitor influent to the wastewater treatment plant at Monitoring Location Name INF-001 as follows.

**Table E-3. Influent Monitoring**

| Constituent | Reporting Units | Sample Type | Minimum Sampling Frequency | Required Analytical Method |
|---|---|---|---|---|
| $BOD_5$ | mg/L | 24-hr composite | Weekly [1] | Standard Methods |
| TSS | mg/L | 24-hr composite | Weekly [1] | Standard Methods |
| Flow [2] | MGD | Continuous | Continuous | Meter |

## IV. EFFLUENT MONITORING REQUIREMENTS

### A. Monitoring Locations EFF-001 and EFF-003

1. The Permittee shall monitor treated wastewater to be discharged to Humboldt Bay prior to contact with receiving water at Monitoring Locations EFF-001 and/or EFF-003 as appropriate, based upon active discharge from either or both locations as follows:

**Table E-4. Effluent Monitoring, Monitoring Location EFF-001 and/or EFF-003**

| Parameter | Reporting Units | Sample Type | Minimum Sampling Frequency | Required Analytical Method |
|---|---|---|---|---|
| Flow [2] | mgd | Continuous | Continuous | Meter |
| $BOD_5$ | mg/L | 24-hr composite | Weekly | SM 5210 B |
| TSS | mg/L | 24-hr composite | Weekly | SM 2540 D |
| Settleable Solids | mL/L/hr | Grab | Daily | SM 2540 F |
| Fecal Coliform Bacteria | MPN | Grab | Weekly | Standard Methods |
| pH | s.u. | Grab | Daily | 40 CFR 136 |
| Chlorine Residual | mg/L | Grab | Continuous | Standard Methods |
| Copper | µg/L | Grab | Monthly[3] | 40 CFR 136 |
| Hardness, Total (as $CaCO_3$) [4] | mg/L | Grab | Monthly[3] | Standard Methods |
| Cyanide | µg/L | Grab | Monthly[3] | 40 CFR 136 |
| TCDD Equivalents | pg/L | Grab | Quarterly[3] | Method 1613 |
| Carbon Tetrachloride | µg/L | Grab | Quarterly[3] | 40 CFR 136 |
| Dichlorobromomethane | µg/L | Grab | Quarterly[3] | 40 CFR 136 |

[1] Monitoring of $BOD_5$ and TSS in influent shall coincide with monitoring of these parameters in effluent. For compliance determination, weekly and monthly averages will be based on the calendar weeks (Sunday through Saturday) and months.

[2] For each month, the Permittee shall report the maximum daily and mean daily flow rates.

[3] When Discharge Point 001 is used for high flows exceeding 5.9 mgd, effluent monitoring at EFF-001 shall be conducted annually.

[4] Monitoring for hardness shall be conducted concurrently with effluent sampling for copper.

**Table E-4. Effluent Monitoring, Monitoring Location EFF-001 and/or EFF-003**

| Parameter | Reporting Units | Sample Type | Minimum Sampling Frequency | Required Analytical Method |
|---|---|---|---|---|
| Bis(2-Ethylhexyl)Phthalate | µg/L | Grab | Quarterly[3] | 40 CFR 136 |
| Acute Toxicity [5] | % Survival | 24-hr composite | Quarterly[3] | 40 CFR 136 |
| Chronic Toxicity [5] | TUc | Grab | Quarterly[3] | 40 CFR 136 |
| Chronic Toxicity (narrative) | Passed/ Triggered[6] | | | --- |
| CTR Pollutants [7] | µg/L | Grab | Annually | 40 CFR 136 |
| Title 22 Pollutants [8] | µg/L | Grab | 2x / permit cycle | 40 CFR 136 |
| Nitrate Nitrogen | mg/L N | Grab | Quarterly[3] | 40 CFR 136 |
| Ammonia Nitrogen | mg/L N | Grab | Quarterly[3] | 40 CFR 136 |
| Phosphorus, Total | mg/L P | Grab | concurrent with special study | 40 CFR 136 |

## B. Monitoring Location EFF-002

1. The Permittee shall monitor treated wastewater to be discharged to the AMWS at Monitoring Location EFF-002 as follows.

**Table E-5. Effluent Monitoring, Monitoring Location EFF-002**

| Parameter | Reporting Units | Sample Type | Minimum Sampling Frequency | Required Analytical Method |
|---|---|---|---|---|
| Flow [2] | mgd | Continuous | Continuous | Meter |
| $BOD_5$ | mg/L | 24-hr composite | Weekly | SM 5210 B |

[5] Whole effluent acute and chronic toxicity shall be monitored in accordance with the requirements of section V of this Monitoring and Reporting Program.

[6] The Permittee shall include reporting regarding compliance with the narrative toxicity objective in Receiving Water Limitation V.A.10 by reporting whether the chronic toxicity test "passed" or failed in relation to the chronic toxicity trigger of 2 TUc or a three sample median of 1 TUc (where TUc =100/NOEC). For narrative chronic toxicity reporting, "Passed" shall be reported when chronic toxicity effluent results do not trigger accelerated testing (e.g., a result of ≤ 1TUc = 100/NOEC). "Triggered" shall be reported when chronic toxicity effluent results trigger accelerated testing by exceeding the chronic toxicity trigger of 2 TUc = 100/NOEC or a three sample median of >1TUc.

[7] CTR pollutants are those pollutants identified in the California Toxics Rule at title 40 section 131.38.

[8] The title 22 pollutants are those pollutants for which the Department of Health Services has established Maximum Contaminant Levels (MCLs) at title 22, Division 4, Chapter 15, sections 64431 (Inorganic Chemicals) and 64444 (Organic Chemicals) of the California Code of Regulations.

**Table E-5. Effluent Monitoring, Monitoring Location EFF-002**

| Parameter | Reporting Units | Sample Type | Minimum Sampling Frequency | Required Analytical Method |
|---|---|---|---|---|
| TSS | mg/L | 24-hr composite | Weekly | SM 2540 D |
| Settleable Solids | mL/L/hr | Grab | Daily | SM 2540 F |
| pH | s.u. | Grab | Daily | 40 CFR 136 |
| Copper | µg/L | Grab | Monthly | 40 CFR 136 |
| Acute Toxicity | % Survival | 24-hr composite | concurrent with special study | concurrent with special study |

## V. WHOLE EFFLUENT TOXICITY TESTING REQUIREMENTS

The three species selection process will be implemented upon the City's activation of the new disinfection system and implementation of discharges at Discharge Point 003. During the interim period, whole effluent toxicity testing will be performed with the most sensitive species identified during the most recent three species selection testing.

### A. Acute Toxicity Testing

The Permittee shall conduct whole effluent acute toxicity testing to determine compliance with the effluent limitation for acute toxicity established by section IV. A. 1 of the Order.

1. **Test Frequency**. The Permittee shall conduct acute WET testing in accordance with the schedule established by this MRP, as summarized in section IV.A.1. and Table E-4, above.

2. **Sample Type**. For 96-hour static renewal or 96-hour static non-renewal testing, the effluent samples shall be 24-hr composite, representative of the volume and quality of the discharge from the facility, and collected at monitoring Location EFF-001 and EFF-003.

3. **Test Species**. Test species for acute WET testing at EFF-001 and EFF-003, where the discharge is to an estuarine environment, shall be an invertebrate, (percent survival and growth), and a vertebrate, (percent survival and growth), for at least the first two suites of tests conducted within 12 months after the effective date of the Order. After this screening period, monitoring shall be conducted using the most sensitive species. At least one time every five years, the Permittee shall re-screen with the two species identified above and continue routine monitoring with the most sensitive species. Species selected for testing shall be from the following table:

| Species | Common Name |
|---|---|
| A. bahia | Mysids |
| T. pseudonana | Brown algae |
| C. variegatus | Sheepshead minnows |
| E. estuarius | Pill bugs |
| M. beryllina | Inland silverside |
| C. dubia | Water fleas |
| C. dilutus | Fly larvae |
| C. fluminea | Freshwater clam |
| D. magna | Daphnia |
| D. pulex | Daphnia |
| H. azteca | Side swimmers |
| L. variegatus | Freshwater polycheate |
| P. promelas | Fatheads |
| S. capricornutum | Green algae |
| A. abdida | Amphipod |
| A. affinis | Topsmelt |
| C. gigas | Oysters |
| H. costata | Mysids |
| H. rufiscens | Red abalone |
| M. edulis | Mussels |
| M. pyrifera | Kelp |
| N. arenaceodentata | Polycheate |

4. **Test Methods**. The presence of acute toxicity shall be estimated as specified in *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms* (USEPA Report No. EPA-821-R-02-012, 5th edition or subsequent editions), or other methods approved by the Executive Officer.

5. **Test Dilutions.** Acute WET tests on effluent samples collected at Monitoring Locations EFF-001 and EFF-003, shall be conducted using a series of five dilutions of 12.5, 25, 50, 75, and 100 percent effluent. Dilution and control waters shall be receiving water samples collected beyond the influence of the discharges. Standard dilution water may be used if the above source exhibits toxicity.

6. **Test Failure.** If an acute toxicity test does not meet all test acceptability criteria, as specified in the test method, the Permittee shall re-sample and re-test as soon as possible, not to exceed 7 days following notification of test failure.

7. **Accelerated Monitoring.** If the result of any acute toxicity test fails to meet the single test minimum limitation (70 percent survival), and the testing meets all test acceptability criteria, the Permittee shall take two more samples, one within 14 days and one within 21 days following receipt of the initial sample result. If any one of the additional samples do not comply with the three sample median minimum limitation (90 percent survival), the Permittee shall initiate a Toxicity Reduction Evaluation (TRE) in accordance with section VI. C. 2. a of the Order. If the two additional samples are in compliance with the acute toxicity requirement and testing meets all test acceptability criteria, then a TRE will not be required. If the discharge stops before additional samples can be collected, the Permittee shall contact the Executive Officer within 21 days with a plan to demonstrate compliance with the effluent limitation.

8. **Notification.** The Permittee shall notify the Regional Water Board in writing 14 days after the receipt of test results exceeding the acute toxicity effluent limitation. The notification will describe actions the Permittee has taken or will take to investigate and correct the cause(s) of toxicity. It may also include a status report on any actions required by this Order, with a schedule for actions not yet completed. If no actions have been taken, the reasons shall be given.

9. **Reporting**. Test results for acute toxicity tests shall be reported according to section 12 (Report Preparation) of *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms* or in an equivalent format that clearly demonstrates that the Permittee is in compliance with effluent limitations, and other permit requirements.

## B. Chronic Toxicity Testing

The Permittee shall conduct chronic toxicity testing to demonstrate compliance with the Basin Plan's water quality objective for toxicity. The Permittee shall meet the following chronic toxicity testing requirements:

1. **Test Frequency**. The Permittee shall conduct chronic WET testing at EFF-001 and/or EFF-003 in accordance with the schedule established by this MRP, as summarized in section IV.A.1. and Table E-4, above.

2. **Sample Type.** For 96-hour static renewal or 96-hour static non-renewal testing, effluent samples from Monitoring Locations EFF-001 and/or Eff-003 shall be grab samples that are representative of the volume and quality of the discharge from the facility. For toxicity tests requiring renewals, grab samples collected on consecutive days are required.

3. **Test Species.** Test species for chronic WET testing at EFF-001 and/or EFF-003, where the discharge is to an estuarine environment, shall be a vertebrate,

(percent survival and growth), an invertebrate (percent survival and growth), and a plant, (germination and germ-tube length test) in accordance with the species identified in the table contained in section V.A.3. above. Initial testing for the first two suites of tests, shall be conducted with a vertebrate, an invertebrate, and a plant species, and thereafter, monitoring can be reduced to the most sensitive species. At least once every five years, the Permittee shall rescreen once with the three species listed above, and continue to monitor with the most sensitive species.

4. **Test Methods.** The presence of chronic toxicity shall be estimated as specified in USEPA's Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Water to Freshwater Organisms (USEPA Report No. EPA-821-R-02-013 or Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms EPA-821-R-02-014 or subsequent editions).

5. **Test Dilutions.** The chronic toxicity test shall be conducted using a series of at least five dilutions and a control. The series shall consist of the following dilution series: 12.5, 25, 50, 75, and 100 percent, and a control. Control and dilution water shall be receiving water collected at an appropriate location upstream of the discharge point. Laboratory water may be substituted for receiving water, as described in the USEPA test methods manual, upon approval by the Executive Officer. If the dilution water used is different from the culture water, a second control using culture water shall be used.

6. **Reference Toxicant.** If organisms are not cultured in-house, concurrent testing with a reference toxicant shall be conducted. Where organisms are cultured in-house, monthly reference toxicant testing is sufficient. Reference toxicant tests also shall be conducted using the same test conditions as the effluent toxicity tests (e.g., same test duration, etc.).

7. **Test Failure.** If either the reference toxicant test or the chronic toxicity test does not meet all test acceptability criteria, as specified in the test method, the Permittee shall re-sample and re-test as soon as possible, not to exceed 7 days following notification of test failure.

8. **Notification.** The Permittee shall notify the Regional Water Board in writing 14 days after the receipt of test results, which indicate the exceedance of the monitoring "trigger" for chronic toxicity.

9. **Accelerated Monitoring Requirements.** If the result of any chronic toxicity test exceeds either monitoring "trigger" of 1.0 TUc as a three-sample median, or 2.0 TUc as a single sample maximum, as specified in section VI.C.2.a. of the Order, and the testing meets all test acceptability criteria, the Permittee shall initiate

accelerated monitoring. Accelerated monitoring shall consist of four additional samples – with one test conducted approximately every week over a four week period. Testing shall commence within 14 days of receipt of initial sample results which indicated an exceedance of the chronic toxicity "trigger." If the discharge will cease before the additional samples can be collected, the Permittee shall contact the Executive Officer within 21 days with a plan to address elevated levels of chronic toxicity in effluent and/or receiving water. The following protocol shall be used for accelerated monitoring and TRE implementation:

a. If the results of four consecutive accelerated monitoring tests do not exceed the single sample maximum chronic toxicity "trigger" of 2.0 TUc, the Permittee may cease accelerated monitoring and resume regular chronic toxicity monitoring. However, if there is adequate evidence of a pattern of effluent toxicity, the Regional Water Board's Executive Officer may require that the Permittee initiate a TRE.

b. If the source(s) of the toxicity is easily identified (i.e. temporary plant upset), the Permittee shall make necessary corrections to the facility and shall continue accelerated monitoring until four (4) consecutive accelerated tests do not exceed the monitoring "trigger." Upon confirmation that the chronic toxicity has been removed, the Permittee may cease accelerated monitoring and resume regular chronic toxicity monitoring.

c. If the result of any accelerated toxicity test exceeds the monitoring "trigger", the Permittee shall cease accelerated monitoring and initiate a TRE to investigate the cause(s) and identify corrective actions to reduce or eliminate the chronic toxicity. Within thirty (30) days of notification by the laboratory of the test results exceeding the monitoring "trigger" during accelerated monitoring, the Permittee shall submit a TRE Action Plan to the Regional Water Board including, at minimum:

    i. Specific actions the Permittee will take to investigate and identify the cause(s) of toxicity, including a TRE WET monitoring schedule;

    ii. Specific actions the Permittee will take to mitigate the impact of the discharge and prevent the recurrence of toxicity; and

    iii. A schedule for these actions.

## C. Chronic Toxicity Reporting

1. **Routine Reporting**. Test results for chronic WET tests shall be reported according to the appropriate acute and chronic guidance manuals and this

Monitoring and Reporting Program and shall be attached to the self-monitoring report. Test results shall include, at a minimum, for each test:

a. sample date(s)
b. test initiation date
c. test species
d. end point values for each dilution (e.g., number of young, growth rate, percent survival)
e. NOEC value(s) in percent effluent
f. IC15, IC25, IC40, and IC50 values (or EC15, EC25…etc.) in percent effluent
g. TUc values (100/NOEC)
h. Mean percent mortality (±s.d.) after 96 hours in 100 percent effluent (if applicable)
i. NOEC and LOEC values for reference toxicant test(s)
j. IC50 or EC50 value(s) for reference toxicant test(s)
k. Available water quality measurements for each test (e.g., pH, DO, temperature, conductivity, hardness, salinity, ammonia)
l. Statistical methods used to calculate endpoints.

2. **Quality Assurance Reporting.** Because the permit requires sub-lethal hypothesis testing endpoints from methods 1000.0, 1002.0, and 1003.0 in the test methods manual titled *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms* (EPA-821-R-02-013, 2002 or most recent edition), with-in test variability must be reviewed for acceptability and variability criteria (upper and lower PMSD bounds) must be applied, as directed under section 10.2.8 – *Test Variability* of the test methods manual. Under section 10.2.8, the calculated PMSD for both reference toxicant test and effluent toxicity test results must be compared with the upper and lower PMSD bounds variability criteria specified in Table 6 – *Variability Criteria (Upper and Lower PMSD Bounds) for Sublethal Hypothesis Testing Endpoints Submitted Under NPDES Permits*, following the review criteria in paragraphs 10.2.8.2.1 through 10.2.8.2.5 of the test methods manual. Based on this review, only accepted effluent toxicity test results shall be reported.

3. **Compliance Summary**: The results of the chronic toxicity testing shall be provided in the most recent self-monitoring report and shall include a summary table organized by test species, type of test (survival, growth or reproduction) and monitoring frequency (routine, accelerated or TRE) of toxicity data from at least three of the most recent samples. The final report shall clearly demonstrate

that the Permittee is in compliance with effluent limitations and other permit requirements.

## VI. LAND DISCHARGE MONITORING REQUIREMENTS

This section is not applicable to the Arcata WWTF.

## VII. RECLAMATION MONITORING REQUIREMENTS

This section is not applicable to the Arcata WWTF.

## VIII. RECEIVING WATER MONITORING REQUIREMENTS

### A. Monitoring Location AMWS

Monitoring of the AMWS shall be implemented in accordance with the workplan approved by the Executive Officer developed in accordance with section VI.C.2.d of the Order. Monitoring results required in accordance with the approved plan shall be submitted annually, by March 1 each year.

### B. Monitoring Locations RSW-001, RSW-002, etc.

1. The Permittee shall monitor the receiving water at the following locations: RSW-001, RSW-002, etc. as follows.

**Table E-6. Receiving Water Monitoring Requirements Brackish Marsh**

| Parameter | Units | Sample Type | Minimum Sampling Frequency | Required Analytical Method |
|---|---|---|---|---|
| Dissolved Oxygen | mg/L | Grab | Monthly | 40 CFR 136 |
| pH | s.u. | Grab | Monthly | 40 CFR 136 |
| Turbidity | NTU | Grab | Monthly | SM 2130 B |
| Temperature | ºC | Grab | Monthly | 40 CFR 136 |
| Hardness | mg/L $CaCO_3$ | Grab | Monthly | 40 CFR 136 |
| Specific Conductance | µmhos/cm | Grab | Monthly | 40 CFR 136 |
| Total Dissolved Solids | mg/L | Grab | Monthly | SM 2540 C |
| Salinity | ppt | Grab | Monthly | Standard Methods |
| Nitrate | mg/L | Grab | Monthly | 40 CFR 136 |
| Floatables/discoloration | --- | Visual | Monthly | -- |
| CTR Priority Pollutants | µg/L | Grab | Annually | 40 CFR 136 |
| Title 22 Pollutants | µg/L | Grab | 2x / permit cycle | 40 CFR 136 |

## IX. OTHER MONITORING REQUIREMENTS

### A. Disinfection Process Monitoring for UV Disinfection System

Upon completion and approval of the UV disinfection system, the following monitoring requirements must be implemented.

1. **Monitoring.** The UV transmittance of the effluent from the UV disinfection system shall be monitored continuously and recorded. The operation UV dose shall be calculated from UV transmittance, UV intensity, turbidity, and exposure time, using lamp age and sleeve fouling factors.

2. **Reporting.** The Permittee shall report daily average and lowest daily transmittance and operational UV dose on its monthly monitoring reports. If the UV transmittance falls below 65 percent or UV dose falls below 50 $mJ/cm^2$, the event shall be reported to the Regional Water Board by telephone within 24 hours and documented in a narrative description to accompany the applicable routine monthly self monitoring report.

## X. REPORTING REQUIREMENTS

### A. General Monitoring and Reporting Requirements

**1.** The Permittee shall comply with all Standard Provisions (Attachment D) related to monitoring, reporting, and recordkeeping.

**2. Schedules of Compliance.** If applicable, the Permittee shall submit all reports and documentation required by compliance schedules that are established by this Order. Such reports and documentation shall be submitted to the Regional Water Board on or before each compliance date established by this Order. If noncompliance is reported, the Permittee shall describe the reasons for noncompliance and a specific date when compliance will be achieved. The Permittee shall notify the Regional Water Board when it returns to compliance with applicable compliance dates established by schedules of compliance.

**3. Special Study.** The Permittee shall submit all reports and documentation required by the special study established by this Order. Such reports and documentation shall be submitted to the Regional Water Board on or before each compliance date established by the Order. If noncompliance is reported, the Permittee shall describe the reasons for noncompliance and a specific date when compliance will be achieved. The Permittee shall notify the Regional Water Board when it returns to compliance with applicable compliance dates.

## B. Self Monitoring Reports (SMRs)

1. The Permittee shall submit electronic Self-Monitoring Reports (eSMRs) using the State Water Board's California Integrated Water Quality System (CIWQS) Program Web site (http://www.waterboards.ca.gov/ciwqs/index.html). The CIWQS Web site will provide additional directions for SMR submittal in the event there will be service interruption for electronic submittal. The Permittee shall maintain sufficient staffing and resources to ensure it submits eSMRs that are complete and timely. This includes provision of training and supervision of individuals (e.g., Permittee personnel or consultant) on how to prepare and submit eSMRs.

2. The Permittee shall report in the SMR the results for all monitoring specified in this MRP under sections III through IX. The Permittee shall submit monthly SMRs including the results of all required monitoring using USEPA-approved test methods or other test methods specified in this Order. If the Permittee monitors any pollutant more frequently than required by this Order, the results of this monitoring shall be included in the calculations and reporting of the data submitted in the SMR.

3. **All monitoring results shall be submitted in conjunction with monthly SMRs due the first day of the second month following sample collection**. Monitoring periods for all required monitoring shall be completed according to the following schedule:

**Table E-7. Monitoring Periods and Reporting Schedule**

| Sampling Frequency | Monitoring Period Begins On | Monitoring Period |
|---|---|---|
| Continuous | Permit effective date | All |
| Daily | Permit effective date | (Midnight through 11:59 PM) or any 24-hour period that reasonably represents a calendar day for purposes of sampling. |
| Weekly | Sunday following permit effective date or on permit effective date if on a Sunday | Sunday through Saturday |
| Monthly | First day of calendar month following permit effective date or on permit effective date if that date is first day of the month | 1st day of calendar month through last day of calendar month |
| Quarterly | First day of calendar quarter following permit effective date or on permit effective date if that date is first day of the month | January 1 through March 31<br>April 1 through June 30<br>July 1 through September 30<br>October 1 through December 31 |
| Annually | January 1 following permit effective date | January 1 through December 31 |
| 2x / Permit Cycle | December 1, 2016 | Once on incoming tide, once on outgoing tide. |

4. **Reporting Protocols.** The Permittee shall report with each sample result the applicable reported Minimum Level (ML) and the current Method Detection Limit (MDL), as determined by the procedure in Part 136.

   The Permittee shall report the results of analytical determinations for the presence of chemical constituents in a sample using the following reporting protocols:

   a. Sample results greater than or equal to the reported ML shall be reported as measured by the laboratory (i.e., the measured chemical concentration in the sample).

   b. Sample results less than the RL, but greater than or equal to the laboratory's MDL, shall be reported as "Detected, but Not Quantified," or DNQ. The estimated chemical concentration of the sample shall also be reported.

      For the purposes of data collection, the laboratory shall write the estimated chemical concentration next to DNQ as well as the words "Estimated Concentration" (may be shortened to "Est. Conc."). The laboratory may, if such information is available, include numerical estimates of the data quality for the reported result. Numerical estimates of data quality may be percent accuracy (+ a percentage of the reported value), numerical ranges (low to high), or any other means considered appropriate by the laboratory.

   c. Sample results less than the laboratory's MDL shall be reported as "Not Detected," or ND.

   d. Permittees are to instruct laboratories to establish calibration standards so that the ML value (or its equivalent if there is differential treatment of samples relative to calibration standards) is the lowest calibration standard. At no time is the Permittee to use analytical data derived from extrapolation beyond the lowest point of the calibration curve.

5. The Permittee shall submit SMRs in accordance with the following requirements:

   a. The Permittee shall arrange all reported data in a tabular format. The data shall be summarized to clearly illustrate whether the facility is operating in compliance with interim and/or final effluent limitations. The Permittee is not required to duplicate the submittal of data that is entered in a tabular format within CIWQS. When electronic submittal of data is required and CIWQS does not provide for entry into a tabular format within the system, the Permittee shall electronically submit the data in a tabular format as an attachment.

b. The Permittee shall attach a cover letter to the SMR. The information contained in the cover letter shall clearly identify any non-compliance with the requirements of the Order; discuss corrective actions taken or planned; and the proposed time schedule for corrective actions. Identified non-compliance must include a description of the requirement that was not complied with and a description of the noncompliance.

c. SMRs must be submitted to the Regional Water Board, signed and certified as required by the Standard Provisions (Attachment D), to the CIWQS Program Web site (http://www.waterboards.ca.gov/ciwqs/index.html). In the event that paper submittal of SMRs is required, the Discharge shall submit the SMR to the address listed below:

Regional Water Quality Control Board
North Coast Region
5550 Skylane Blvd., Suite A
Santa Rosa, CA 95403

## C. Discharge Monitoring Reports (DMRs)

1. As described in Section X.B.1 above, at any time during the term of this permit, the State or Regional Water Board may notify the Permittee to electronically submit SMRs that will satisfy federal requirements for submittal of Discharge Monitoring Reports (DMRs). Until such notification is given, the Permittee shall submit DMRs in accordance with the requirements described below.

2. DMRs must be signed and certified as required by the standard provisions (Attachment D). The Permittee shall submit the original DMR and one copy of the DMR to the address listed below:

| STANDARD MAIL | FEDEX/UPS/ OTHER PRIVATE CARRIERS |
|---|---|
| State Water Resources Control Board<br>Division of Water Quality<br>c/o DMR Processing Center<br>PO Box 100<br>Sacramento, CA 95812-1000 | State Water Resources Control Board<br>Division of Water Quality<br>c/o DMR Processing Center<br>1001 I Street, 15th Floor<br>Sacramento, CA 95814 |

3. All discharge monitoring results must be reported on the official USEPA pre-printed DMR forms (EPA Form 3320-1). Forms that are self-generated will not be accepted unless they follow the exact same format of EPA Form 3320-1.

## D. Other Reports

1. The Permittee shall report the results of any special studies, acute and chronic toxicity testing, TRE/TIE, and Pollution Minimization Plan required by Special Provisions – VI.C.2 and 3 of this Order. The Permittee shall report the progress in satisfaction of compliance schedule dates specified in Special Provisions – VI.C.7 of this Order. The Permittee shall submit reports with the first monthly SMR scheduled to be submitted on or immediately following the report due date in compliance with SMR reporting requirements described in subsection X.B. above.

2. Annual Report. The Permittee shall submit an Annual Report to the Regional Water Board for each calendar year. The report shall be submitted by March 1st of the following year. The report shall, at a minimum, include the following:

    a. Both tabular and, where appropriate, graphical summaries of the monitoring data and disposal records from the previous year. If the Permittee monitors any pollutant more frequently than required by this Order, using test procedures approved under title 40, section 136 or as specified in this Order, the results of this monitoring shall be included in the calculation and report of the data submitted SMR.

    b. A comprehensive discussion of the facility's compliance (or lack thereof) with all effluent limitations and other requirements of this Order, and the corrective actions taken or planned, which may be needed to bring the discharge into full compliance with the Order.

**ATTACHMENT F – FACT SHEET**

## Table of Contents

I. Permit Information ..... F-3
II. Facility Description ..... F-4
A. Background ..... F-4
B. Description of Wastewater and Biosolids Treatment or Controls ..... F-6
C. Discharge Points and Receiving Waters ..... F-7
D. Summary of Existing Requirements and Self-Monitoring Report (SMR) Data ..... F-8
E. Compliance Summary ..... F-9
F. Planned Changes ..... F-9
III. Applicable Plans, Policies, and Regulations ..... F-9
A. Legal Authorities ..... F-10
B. California Environmental Quality Act (CEQA) ..... F-10
C. State and Federal Regulations, Policies, and Plans ..... F-10
D. Impaired Water Bodies on CWA 303(d) List ..... F-14
E. Other Plans, Polices and Regulations ..... F-15
F. Provisions and Requirements Implementing State Law ..... F-15
IV. Rationale For Effluent Limitations and Discharge Specifications ..... F-16
A. Discharge Prohibitions ..... F-16
B. Technology-Based Effluent Limitations and Discharge Specifications ..... F-19
C. Water Quality-Based Effluent Limitations (WQBELs) ..... F-26
D. Final Effluent Limitations ..... F-37
E. Interim Effluent Limitations ..... F-41
F. Land Discharge Specifications ..... F-41
G. Reclamation Specifications ..... F-41
V. Rationale for Receiving Water Limitations ..... F-41
A. Surface Water ..... F-41
B. Groundwater ..... F-41
VI. Rationale for Monitoring and Reporting Requirements ..... F-42
A. Influent Monitoring ..... F-42
B. Effluent Monitoring ..... F-42
C. Whole Effluent Toxicity Testing Requirements ..... F-43
D. Receiving Water Monitoring ..... F-43
E. Other Monitoring Requirements ..... F-44
VII. Rationale for Provisions ..... F-44
A. Standard Provisions ..... F-44
B. Regional Water Board Standard Provisions ..... F-45
C. Special Provisions ..... F-45
VIII. Public Participation ..... F-50

A. Notification of Interested Parties ..... F-50
B. Written Comments ..... F-50
C. Public Hearing ..... F-50
D. Waste Discharge Requirements Petitions ..... F-51
E. Information and Copying ..... F-51
F. Register of Interested Persons ..... F-51
G. Additional Information ..... F-51

## List of Tables

Table F-1. Facility Information ..... F-3
Table F-2. Historic Effluent Limitations and Monitoring Data ..... F-8
Table F-3. Basin Plan Beneficial Uses ..... F-11
Table F-4. Technology-Based Effluent Limitations ..... F-22
Table F-5. Summary of RPA Results – Humboldt Bay ..... F-31
Table F-6. Summary of RPA Results – AMWS ..... F-32
Table F-7. Determination of Long Term Averages ..... F-33
Table F-8. Determination of Final WQBELs Based on Aquatic Life Criteria ..... F-33
Table F-9. Determination Final WQBELs Based on Human Health Criteria ..... F-34
Table F-10. Summary of Water Quality-Based Effluent Limitations ..... F-34
Table F.11. Summary of Acute Toxicity Test Results ..... F-35

## ATTACHMENT F – FACT SHEET

As described in section II of this Order, this Fact Sheet includes the legal requirements and technical rationale that serve as the basis for the requirements of this Order.

This Order has been prepared under a standardized format to accommodate a broad range of discharge requirements for dischargers in California. Only those sections or subsections of this Order that are specifically identified as "not applicable" have been determined not to apply to this Permittee. Sections or subsections of this Order not specifically identified as "not applicable" are fully applicable to this Permittee.

## I. PERMIT INFORMATION

The following table summarizes administrative information related to the facility.

**Table F-1. Facility Information**

| | |
|---|---|
| **WDID** | 1B82114OHUM |
| **Permittee** | City of Arcata |
| **Name of Facility** | City of Arcata Wastewater Treatment Facility (WWTF) |
| **Facility Address** | 600 S. G Street<br>Arcata, CA 95521<br>Humboldt County |
| **Facility Contact, Title and Phone** | Karen Diemer, Deputy Director,<br>(707)822-2200 |
| **Authorized Person to Sign and Submit Reports** | Karen Diemer, Deputy Director,<br>(707)822-2200 |
| **Mailing Address** | 736 F Street, Arcata, CA 95521 |
| **Billing Address** | 736 F Street, Arcata, CA 95521 |
| **Type of Facility** | Publicly Owned Treatment Works (POTW) |
| **Major or Minor Facility** | Major |
| **Threat to Water Quality** | 1 |
| **Complexity** | A |
| **Pretreatment Program** | Y |
| **Reclamation Requirements** | N/A |
| **Facility Permitted Flow** | 2.3 million gallons per day (mgd) (average dry weather flow) |
| **Facility Design Flow** | 2.3 million gallons per day (mgd) (average dry weather design flow)<br>5.0 mgd (average wet weather design flow)<br>5.9 mgd (peak wet weather design flow)<br>16.5 mgd (wet weather $Q_{max}$) |
| **Watershed** | Eureka Plain Hydrologic Unit |
| **Receiving Water** | Humboldt Bay and Arcata Marsh Wildlife Sanctuary |
| **Receiving Water Type** | Estuarine and Freshwater Wetlands |

**A.** The City of Arcata (hereinafter City or Permittee) owns and operates the Arcata Wastewater Treatment Facility, a publicly-owned treatment works (POTW).

For the purposes of this Order, references to the "discharger" or "permittee" in applicable federal and State laws, regulations, plans, or policy are held to be equivalent to references to the Permittee herein.

**B.** The wastewater treatment facility (WWTF) discharges treated wastewater to Humboldt Bay in conjunction with enhanced treatment occurring in the Arcata Marsh Wildlife Sanctuary (AMWS), constructed freshwater wetlands adjacent to the treatment facility. Discharges from the WWTF are currently regulated by Regional Water Board Order No. R1-2004-0036, which was adopted on June 22, 2004, and expired on June 22, 2009, but has been administratively extended until this order takes effect.

**C.** The Permittee filed a Report of Waste Discharge and submitted an application for renewal of its Waste Discharge Requirements (WDRs) and National Pollutant Discharge Elimination System (NPDES) permit on February 19, 2007. The Permittee submitted an amended Report of Waste Discharge on December 15, 2011, incorporating a new primary point of discharge. The application was deemed complete on February 7, 2012.

## II. FACILITY DESCRIPTION

The City owns the wastewater collection, treatment, and disposal facilities that serve approximately 16,800 people in the City of Arcata and the unincorporated community of Glendale. The WWTF is located at 600 South G Street in Arcata, Humboldt County, California. The City of Arcata WWTF in its varying forms has been discharging to Humboldt Bay since about 1949.[1]

### A. Background

Adopted on May 16, 1974, Resolution No. 74-43, known as the Bays and Estuaries Policy, prohibits the discharge of municipal wastewater and industrial process water to enclosed bays and estuaries "unless the discharge enhances the quality of the receiving water above that which would occur in the absence of the discharge."[2] The Bays and Estuaries Policy enhancement criteria is defined as, "…(1) Full uninterrupted protection of all beneficial uses which could be made of the receiving

---

[1] City of Arcata, Pilot Study, draft Environmental Impact Report, July, 1979.

[2] State Water Resources Control Board, Water Quality Control Policy For The Enclosed Bays and Estuaries of California, May 1974

water body in the absence of all point source discharge(s) along with (2) a demonstration by the applicant that the discharge, through the creation of new beneficial uses or fuller realization, enhances water quality for those beneficial uses which could be made of the receiving water in the absence of all point source discharges..."[3]

In the fall of 1974, the City of Arcata first began to pursue an exemption from the Bays and Estuaries Policy, and in the spring of 1977, the City brought forward a project consisting of a marsh treatment process with a discharge to Humboldt Bay.[4]

In 1979, after holding a fact-finding hearing, State Water Board issued Order 79-20, interpreting the provision of the Bays and Estuaries Policy that provided for an exemption from the discharge of municipal wastewater into an enclosed bay, such as Humboldt Bay. In that decision, the State Board concluded that there was a reasonable probability that the discharge of secondary, disinfected and dechlorinated effluent into Humboldt Bay, together with a treatment process which either created new beneficial uses or resulted in a fuller realization of existing beneficial uses, such as the marsh treatment process proposed by Arcata, could enhance the receiving water quality. The State Board further concluded that enhancement required: (1) full secondary treatment, with disinfection and dechlorination, of sewage discharges; (2) compliance with any additional NPDES permit requirements issued by the Regional Board to protect beneficial uses; and (3) the fuller realization of existing beneficial uses or the creation of new beneficial uses either by or in conjunction with a wastewater treatment project.[5] A pilot project funded by the State Water Resources Control Board in 1981 was designed and implemented by the City to demonstrate the effectiveness of wetland treatment in meeting water quality treatment standards. The final report from this pilot was accepted by the Regional Board[6][7].

In 1983, the Regional Water Board adopted Resolution No. 83-9, granting the City of Arcata a waiver, as defined in Chapter I, Paragraph A of the Bays and Estuaries Policy, permitting continued [Humboldt] Bay discharge. Resolution No. 83-9 found

---

3 State Water Resources Control Board, Bill Dendy Memorandum to Regional Water Board Executive Officer David Joseph, October 21, 1974

4 City of Arcata, draft Wastewater Treatment, Water Reclamation, and Ocean Ranching, April 18, 1977

5 State Board Order No. 79-20, May 17, 1979

6 Gearheart, R.A.,B. Finney, S. Wilbur, J. Williams, D. Hill, and S. Sundberg, City of Arcata Marsh Pilot Project, Effluent Quality Results System Design Management, Project No: C-06-2270, State of California Water Resources Control Board, Sacramento, CA, 1983.

7 Gearheart, R.A., S. Wilbur, H. Holbrook, and M. Ives, City of Arcata Marsh Pilot Project, Wetland Bacteria Speciation and Harvesting Effect on Water Quality, Project No: 3-154-500-0, State of California Water Resources Control Board, Sacramento, CA, 1983.

that the marsh disposal alternative meets the definition of enhancement set forth in State Board Order No. 79-20 because the waste would achieve secondary treatment standards, create no adverse impacts to present beneficial uses and the discharge would create new beneficial uses and wildlife habitat.[8]

As constructed, the AMWS consists of three freshwater wetlands: Allen, Gearheart, and Hauser Marshes. These created marshes receive equivalent to secondary treated wastewater, provide enhanced treatment for discharges to Humboldt Bay, and create new beneficial uses, which would not exist in the absence of the discharge. The AMWS marshes (wetlands) provide enhanced water quality treatment while hosting a variety of cold water aquatic organisms and vegetation creating an extraordinary habitat for shorebirds, waterfowl, raptors and migratory birds. As a result, the AMWS is an integral part of the WWTF and a valued part of the Arcata community providing numerous non-contact recreation and educational opportunities.

## B. Description of Wastewater and Biosolids Treatment or Controls

1. **Existing Treatment Configuration.** Primary wastewater treatment is accomplished with mechanical bar screens, a grit removal chamber, and two primary clarifiers. Primary solids are sent to two anaerobic digesters, sludge drying beds, and a sludge composting operation. Influent flows above 5.0 mgd are diverted around primary treatment directly to the oxidation ponds.

   Secondary treatment is accomplished using two oxidation ponds 22.4 and 17.3 acres in size respectively. A third oxidation pond (3.6 acres) has recently been converted into two treatment marshes to complement the existing four 2-acre treatment marshes, totaling six treatment marshes. Detention time in the WWTF, prior to enhanced treatment in the AMWS, is approximately 39 days during average dry weather design flow periods. Currently, effluent is disinfected with chlorine and dechlorinated with sulfur dioxide prior to discharge. Under the existing WWTF configuration, treated effluent from the WWTF is continuously commingled with effluent from the AMWS, disinfected and split, flowing by gravity either to Humboldt Bay or again through the AMWS. The result is disinfected secondary effluent, but not all effluent receives the benefit of enhanced treatment through the AMWS before discharge to Humboldt Bay and some effluent may actually be chlorinated multiple times increasing the opportunity to form disinfection byproducts above water quality objectives.

[8] Regional Water Board, Resolution 83-9, July 28, 1983

2. **Upgraded Treatment Configuration.** Under the upgraded WWTF configuration, waste will continue to enter the system through the headworks receiving primary and biosolids treatment comprised of mechanical bar screens, grit removal, two clarifiers, two anaerobic digesters, drying beds, and composting. Initial biological treatment also still be accomplished in the two oxidation ponds and 6 treatment marshes (4 treatment marshes are currently online; marshes 5 and 6 were constructed in 2011 and will be fully operational in 2013). The oxidation pond effluent flows to the six treatment marshes, which operate in parallel.

   Equivalent to secondary treated effluent will discharge at Outfall No. 002 to the AMWS for enhanced water quality treatment consistent with Resolution Nos. 79-20 and 83-9. Water flows through Allen, Gearheart and Hauser marshes in succession. At the design average dry weather flow, detention time in the AMWS will be approximately 60 days and results in full standard secondary treated effluent. The Permittee plans to construct a new ultraviolet (UV) disinfection system at the end of Hauser marsh. Key components of enhanced treatment provided by the AMWS are settling and clarification. Placement of the new UV disinfection system after AMWS treatment is fundamental to the efficiency and dependability of the new system, because UV disinfection relies upon transmission of the ultraviolet light throughout the water column. Although not contemplated at the time of adoption, the Regional Water Board finds the application of UV disinfection consistent with Resolution Nos. 79-20 and 83-9. Final engineering designs for the City's proposed UV disinfection system will be forwarded to the Regional Water Board upon completion. Within the effective period of this Order, treated effluent will be discharged immediately after UV disinfection through Outfall No. 003 into Humboldt Bay via the brackish marsh, which was constructed in 2008. Final designs for an attenuated/diffused discharge will also be completed and submitted to the Regional Water Board prior to flow being diverted to Outfall No. 003.

   The upgraded WWTF configuration will result in overall improvements to effluent quality discharged to Humboldt Bay because effluent will no longer be commingled; therefore all effluent of at least up to 5.9 MGD will receive enhanced treatment through the AMWS. In addition, chlorination will no longer be the primary form of disinfection so formation of disinfection byproducts will be greatly diminished. Treated effluent from Outfall No. 003 will enter Humboldt Bay in a diffuse manor due to the tidal mixing within the brackish marsh and subsequent flow though tidal marshes. The overall end result of the upgraded WWTF will be higher quality water entering Humboldt Bay.

## C. Discharge Points and Receiving Waters

In conformance with State Board Order No. 79-20, and Regional Water Board, Resolution 83-9, the facility discharges to Humboldt Bay, a water of the United

States, in conjunction with enhanced treatment and the creation of beneficial uses associated with the AMWS, a fresh water marsh system. Humboldt Bay receiving water is estuarine.

## D. Summary of Existing Requirements and Self-Monitoring Report (SMR) Data

Effluent limitations contained in the existing Order for discharges from Outfall 001 and Outfall 002 (Monitoring Locations EFF-001 and EFF-002) and representative monitoring data retrieved from monthly Self-Monitoring Reports from the term of the previous Order are summarized as follows:

**Table F-2. Historic Effluent Limitations and Monitoring Data**

| Parameter | Units | Effluent Limitation | | | Monitoring Data (From 6/2004– To 11/2011) | | |
|---|---|---|---|---|---|---|---|
| | | Average Monthly | Average Weekly | Maximum Daily | Highest Average Monthly Discharge | Highest Average Weekly Discharge | Highest Daily Discharge |
| **Outfall 001** | | | | | | | |
| $BOD_5$ | mg/L | 30 | 45 | 60 | 20 | 20 | 24 |
| Percent Removal, BOD | % | ≥ 85 | --- | --- | Minimum – 77% Removal | | |
| TSS | mg/L | 30 | 45 | 60 | 34 | 30 | 42 |
| Percent Removal, TSS | % | ≥ 85 | --- | --- | Minimum – 59% Removal[9] | | |
| Oil and Grease | mg/L | --- | --- | --- | <5 | --- | <5 |
| Fecal Coliform Bacteria | MPN/100 mLs | 14[10] | --- | 43[11] | <2 | --- | 4 |
| pH | s.u. | 6.0 - 9.0 at all times | | | Minimum – 6.0 Maximum – 7.1 | | |
| Settleable Solids | mL/L/hr | 0.1 | --- | 0.2 | 0.0 | --- | 0.2 |
| Acute Toxicity | % Survival | One sample minimum – 70%<br>Three sample median – 90% | | | Minimum – 95% Survival | | |
| Copper | µg/L | 2.8 | --- | 5.7 | 11 | --- | 11 |
| Zinc | µg/L | 47 | --- | 95 | 33 | --- | 33 |
| Cyanide | µg/L | 0.5 | --- | 1.0 | 4.3 | --- | 4.3 |
| **Outfall 002** | | | | | | | |
| $BOD_5$ | mg/L | 30 | 45 | 60 | 20 | 20 | 24 |
| TSS | mg/L | 30 | 45 | 60 | 34 | 30 | 42 |
| Total Coliform Bacteria | MPN/100 mLs | 23[2] | | 230 | 30 | --- | 1,600 |

[9] This value represents the lowest reported value of the minimum percent removal of the pollutant. The Permittee violated the minimum percent removal requirement once during the permit term (May 2005).

[10] Expressed as a 30-day median.

[11] Not more than 10 percent of samples collected in a 30-day period shall exceed 43 MPN/100 ml.

**Table F-2. Historic Effluent Limitations and Monitoring Data**

| Parameter | Units | Effluent Limitation | | | Monitoring Data (From 6/2004– To 11/2011) | | |
|---|---|---|---|---|---|---|---|
| | | Average Monthly | Average Weekly | Maximum Daily | Highest Average Monthly Discharge | Highest Average Weekly Discharge | Highest Daily Discharge |
| pH | s.u. | 6.0 - 9.0 at all times | | | Minimum – 6.0 Maximum – 7.1 | | |
| Settleable Solids | mL/L/hr | 0.1 | --- | 0.2 | 0.0 | --- | 0.2 |

Based on an analysis of data for the period from June 2004 through June 2008, oil and grease results were all reported as non-detect. The Regional Water Board has determined that because the pollutant has not been detected in the effluent discharged from the facility during the permit term, monitoring for the pollutant is no longer necessary and monitoring requirements have been eliminated from this Order.

### E. Compliance Summary

On June 12, 2008, the Regional Water Board issued Administrative Civil Liability Order No. R1-2008-0048 to the Permittee assessing a civil liability of $104,000 for violations of Order No. R1-2004-0036 for the period from June 22, 2004, to March 31, 2007. Most violations of WDRs in this time period were related to discharges of BOD, TSS, percent removal, coliform bacteria, copper, and cyanide and for sewer system overflows (SSOs). A portion of the liability is being held in abeyance pending resolution of legal matters, a portion has been paid to the State Water Pollution Cleanup and Abatement Account, and a portion was suspended pending satisfactory completion of a Supplemental Environmental Project and two collection system projects proposed by the Permittee. On May 19, 2010, an Administrative Civil Liability Compliant was issued to the Permittee for five sanitary sewer overflows that resulted in mandatory penalties for copper effluent violations. Administrative civil liability sought for the alleged violations totaled $83,300.

### F. Planned Changes

Planed changes at the WWTF include once through flow configuration and installation of a UV system prior to discharge at Outfall 003 as described under section II.B.2. of this Fact Sheet.

## III. APPLICABLE PLANS, POLICIES, AND REGULATIONS

The requirements contained in this Order are based on the requirements and authorities described in this section. This section provides supplemental information, where appropriate, for the plans, policies, and regulations relevant to the discharge.

## A. Legal Authorities

This Order is issued pursuant to section 402 of the federal Clean Water Act (CWA) and implementing regulations adopted by the U.S. Environmental Protection Agency (USEPA) and chapter 5.5, division 7 of the California Water Code (Water Code), commencing with section 13370. It shall serve as a NPDES permit for point source discharges from this facility to Humboldt Bay surface waters. This Order also serves as WDRs pursuant to article 4, chapter 4, division 7 of the Water Code (commencing with section 13260) for discharges from this facility to AMWS and proviso V.B Groundwater.

## B. California Environmental Quality Act (CEQA)

Under Water Code section 13389, this action to adopt an NPDES permit is exempt from the provisions of CEQA, Public Resources Code sections 21100 through 21177. CEQA Guidelines Exemption 1 for Existing Facilities (Cal. Code of Regs., tit. 14, §15301) applies to "… the operation, repair, maintenance, permitting, leasing, licensing, or minor alteration of existing public or private structures, facilities, mechanical equipment, or topographical features, involving negligible or no expansion of use beyond that existing at the time of the lead agency's determination…" The environmental baseline for this action is considered the WWTF that existed upon adoption of this Order. Board action with regard to existing facilities is categorically exempt from the requirements of CEQA. The physical upgrades to the existing WWTF (i.e., construction of the UV system and diffused outfall in the brackish marsh) fall within the scope of minor alterations to existing public structures and facilities.

## C. State and Federal Regulations, Policies, and Plans

1. **Water Quality Control Plans.** The Regional Water Board adopted a *Water Quality Control Plan for the North Coast Region* (hereinafter Basin Plan) that designates beneficial uses, establishes water quality objectives, and contains implementation programs and policies to achieve those objectives for all waters addressed through the plan. In addition, the Basin Plan implements State Water Resources Control Board (State Water Board) Resolution No. 88-63, which establishes State policy that all waters, with certain exceptions, should be considered suitable or potentially suitable for municipal or domestic supply. Beneficial uses established by the Basin Plan for receiving waters for discharges from the Arcata Wastewater Treatment Facility - Humboldt Bay (an estuarine environment) and the Arcata Marsh Wildlife Sanctuary (a fresh water marsh system), are presented in Table F-3.

**Table F-3. Basin Plan Beneficial Uses**

| Outfall | Receiving Water | Beneficial Uses |
|---|---|---|
| 001 and 003 | Humboldt Bay | **Existing:**<br>MUN - Municipal and Domestic Supply<br>AGR - Agricultural Supply<br>IND - Industrial Service Supply<br>FRSH - Freshwater Replenishment<br>NAV - Navigation<br>REC-1 - Water Contact Recreation<br>REC -2 - Non-Contact Water Recreation<br>COMM - Commercial and Sport Fishing<br>AQUA - Aquaculture<br>COLD - Cold Freshwater Habitat<br>MAR - Marine Habitat<br>WILD - Wildlife Habitat<br>RARE - Preservation of Rare, Threatened, or Endangered Species<br>MIGR - Migration of Aquatic Organisms<br>SPWN - Spawning, Reproduction, and/or Early Development<br>SHELL - Shellfish Harvesting<br>EST - Estuarine Habitat<br>CUL - Native American Culture<br>**Potential:**<br>POW - Hydropower Generation<br>PRO – Industrial Process Supply |
| 002 | AWMS | **Existing:**<br>REC -2 - Non-Contact Water Recreation<br>COLD - Cold Freshwater Habitat<br>WILD - Wildlife Habitat<br>WET – Wetland Habitat<br>WQE – Water Quality Enhancement |

The MUN beneficial use has not been designated for the AMWS, which exempts "water in systems designed or modified to collect or treat municipal or industrial wastewaters… provided that the discharge from such systems is monitored to assure compliance with all relevant water quality objectives as required by the Regional Boards." Requirements of this Order implement the Basin Plan and Resolution No. 88-63 (as revised by Resolution No. 2006-0008).

2. **Thermal Plan.** The State Water Board adopted the *Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Water and Enclosed Bays and Estuaries of California* (Thermal Plan) on May 18, 1972, and amended this plan on September 18, 1975. This plan contains temperature objectives for surface waters. Requirements of this Order implement the Thermal Plan.

3. **National Toxics Rule (NTR) and California Toxics Rule (CTR).** USEPA adopted the NTR on December 22, 1992, and later amended it on May 4, 1995 and November 9, 1999. About forty criteria in the NTR applied in California. On May 18, 2000, USEPA adopted the CTR. The CTR promulgated new toxics criteria for California and, in addition, incorporated the previously adopted NTR criteria that were applicable in the state. The CTR was amended on February 13, 2001. These rules contain water quality criteria for priority pollutants.

4. **State Implementation Policy.** On March 2, 2000, the State Water Board adopted the *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California* (State Implementation Policy or SIP). The SIP became effective on April 28, 2000 with respect to the priority pollutant criteria promulgated for California by the USEPA through the NTR and to the priority pollutant objectives established by the Regional Water Board in the Basin Plan. The SIP became effective on May 18, 2000 with respect to the priority pollutant criteria promulgated by the USEPA through the CTR. The State Water Board adopted amendments to the SIP on February 24, 2005 that became effective on July 13, 2005. The SIP establishes implementation provisions for priority pollutant criteria and objectives and provisions for chronic toxicity control. Requirements of this Order implement the SIP.

5. **Compliance Schedules and Interim Requirements.** In general, an NPDES permit must include final effluent limitations that are consistent with CWA section 301 and with title 40, Code of Federal Regulations[12] section 122.44(d). There are exceptions to this general rule. The State Water Board's *Policy for Compliance Schedules in National Pollutant Discharge Elimination System Permits* (Compliance Schedule Policy), which was adopted on April 15, 2008 (State Water Board Resolution No. 2008-0025) and became effective on August 27, 2008, allows compliance schedules for new, revised, or newly interpreted water quality objectives or criteria, or in accordance with a TMDL. All compliance schedules must be as short as possible, and may not exceed 10 years from the effective date of the adoption revision or new interpretation of the applicable water quality objective or criterion, unless a TMDL allows a longer schedule. The Regional Water Board, however, is not required to include a compliance schedule, but may adopt a Cease and Desist Order pursuant to Water Code section 13301 or a Time Schedule Order pursuant to Water Code section 13300 where it finds that the discharger is violating or threatening to violate the permit. The Regional Water Board will consider the merits of each case in determining whether it is appropriate to include a compliance schedule in a permit, and,

[12] All further statutory references are to title 40 of the Code of Federal Regulations unless otherwise indicated.

consistent with the Compliance Schedule Policy, should consider the feasibility of achieving compliance, and must impose a schedule that is as short as possible to achieve compliance with the effluent limit based on the objective or criteria.

The Compliance Schedule Policy and the SIP do not allow compliance schedules for priority pollutants beyond May 18, 2010, except for new or more stringent priority pollutant criteria adopted by USEPA after December 17, 2008.

Where a compliance schedule for a final effluent limitation exceeds 1 year, the Order must include interim numeric limitations for that constituent or parameter, interim milestones and compliance reporting within 14 days after each interim milestone. The permit may also include interim requirements to control the pollutant, such as pollutant minimization and source control measures. This Order does not include compliance schedules, but does apply interim effluent limitations for Outfall 001 through November 30, 2016, or until activation of the upgraded WWTF configuration, whichever is sooner.

6. **Alaska Rule.** On March 30, 2000, USEPA revised its regulation that specifies when new and revised state and tribal water quality standards (WQS) become effective for CWA purposes [section 131.21, 65 Fed. Reg. 24641 (April 27, 2000)]. Under the revised regulation (also known as the Alaska Rule), new and revised standards submitted to USEPA after May 30, 2000, must be approved by USEPA before being used for CWA purposes. The final rule also provides that standards already in effect and submitted to USEPA by May 30, 2000, may be used for CWA purposes, whether or not approved by USEPA.

7. **Antidegradation Policy.** Section 131.12 requires that the State water quality standards include an antidegradation policy consistent with the federal policy. The State Water Board established California's antidegradation policy in State Water Board Resolution No. 68-16. Resolution No. 68-16 has been deemed to be consistent with the federal antidegradation policy where the federal policy applies under federal law. Resolution No. 68-16 requires that existing water quality be maintained unless degradation is justified based on specific findings. The Basin Plan implements, and incorporates by reference, both the State and federal antidegradation policies. The permitted discharge must be consistent with the antidegradation provision of section 131.12 and State Water Board Resolution No. 68-16. As discussed in detail in section IV.D.2. of this Fact Sheet, the permitted discharge is consistent with the antidegradation provision of section 131.12 and State Water Board Resolution No. 68-16.

8. **Anti-Backsliding Requirements.** Sections 402(o)(2) and 303(d)(4) of the CWA and federal regulations at section 122.44(l) prohibit backsliding in NPDES permits. These anti-backsliding provisions require that effluent limitations in a reissued permit must be as stringent as those in the previous permit, with some

exceptions in which limitations may be relaxed. Some effluent limitations in this Order have been removed or are less stringent than those in the previous Order. As discussed in detail in section IV.D.1. of this Fact Sheet, removal or relaxation of effluent limitations is consistent with the anti-backsliding requirements of the CWA and federal regulations.

9. **Endangered Species Act.** This Order does not authorize an act that results in the taking of a threatened or endangered species or any act that is now prohibited, or becomes prohibited in the future, under either the California Endangered Species Act (Fish and Game Code sections 2050 to 2097) or the Federal Endangered Species Act (16 U.S.C.A sections 1531 to 1544). This Order requires compliance with effluent limits, receiving water limits, and other requirements to protect the beneficial uses of waters of the State. The Permittee is separately responsible for meeting all requirements of the applicable Endangered Species Act.

## D. Impaired Water Bodies on CWA 303(d) List

Section 303(d) of the federal CWA requires states to identify waterbodies that do not meet water quality standards and are not supporting their beneficial uses after implementation of technology-based effluent limitations on point sources. Each state must submit an updated list, the 303(d) List of Impaired Waterbodies, to USEPA by April of each even numbered year. In addition to identifying the waterbodies that are not supporting beneficial uses, the 303(d) list also identifies the pollutant or stressor causing impairment and establishes a schedule for developing a control plan to address the impairment. The USEPA requires the Regional Water Board to develop total maximum daily loads (TMDLs) for each 303(d) listed pollutant and water body contaminant. TMDLs establish the maximum quantity of a given pollutant that can be added to a water body from all sources without exceeding the applicable water quality standard for that pollutant and determine wasteload allocations (the portion of a TMDL allocated to existing and future point sources) for point sources and load allocations (the portion of a TMDL attributed to existing and future nonpoint sources) for nonpoint sources.

In October 2011, the USEPA provided final approval of the 303(d) list of impaired water bodies prepared by the State. The list identifies Humboldt Bay (Eureka Plan Hydrologic Unit) as impaired by dioxin toxic equivalents and polychlorinated biphenyls (PCBs). Pursuant to CWA section 303(d), when the Regional Water Board adopts TMDLs to address impairing pollutants in 303(d) listed waters, NPDES permits will implement those TMDLs. TMDLs establish the maximum quantity of a given pollutant that can be added to a water body from all sources without exceeding the applicable water quality standard for that pollutant and determine wasteload allocations (the portion of a TMDL allocated to existing and future point sources) for point sources and load allocations (the portion of a TMDL attributed to existing and future nonpoint

sources) for nonpoint sources. The Regional Water Board expects to adopt TMDLs for dioxin toxic equivalents and PCBs for Humboldt Bay by 2019.

## E. Other Plans, Polices and Regulations

1. **Storm Water.** All areas within the treatment facility drain to two storm drain inlets on the property where storm water is routed to the headworks. The State Water Board Water Quality Order No. 97-03-DWQ, NPDES General Permit No. CAS000001, Waste Discharge Requirements for Discharges of Storm Water Associated with Industrial Activities Excluding Construction Activities, does not require facilities to obtain coverage if storm water is captured and treated and/or disposed of within the facility's NPDES permitted process wastewater or if storm water is disposed of to evaporation ponds, percolation ponds, or combined sewer systems.

2. **Sanitary Sewer Systems.** On May 2, 2006, the State Water Board adopted State Water Board Order No. 2006-0003-DWQ, *Statewide General WDRs for Sanitary Sewer Systems.* The general permit is applicable to all "federal and state agencies, municipalities, counties, districts, and other public entities that own or operate sanitary sewer systems greater than one mile in length that collect and/or convey untreated or partially treated wastewater to a publicly owned treatment facility in the State of California." The purpose of the general permit is to promote the proper and efficient management, operation, and maintenance of sanitary sewer systems and to minimize the occurrences and impacts of sanitary sewer overflows. Section VI.C.5.a of the Order requires the Permittee must be separately covered under Order No. 2006-0003-DWQ.

3. **Discharge of Biosolids to Land.** On July 22, 2004, the State Water Board adopted State Water Board Order No. 2004-0012-DWQ, *General Waste Discharge Requirements for the Discharge of Biosolids to Land for Use as a Soil Amendment in Agricultural, Silvicultural, Horticultural, and Land Reclamation Activities*. The general waste discharge requirements establish standards for agronomic applications and the use of biosolids as a soil amendment or fertilizer in agriculture, forestry, and surface mining reclamation, and include provisions to mitigate significant environmental impacts. The Order requires the Permittee must be separately covered under Order No. 2004-0012-DWQ or other appropriate WDRs for the discharge of biosolids from the wastewater treatment plant. Section VI.C.5.c. of the Order requires the Permittee to seek coverage for biosolids management and disposal or reuse.

## F. Provisions and Requirements Implementing State Law.

The requirements under Discharge Specifications and other sections of this Order (e.g., groundwater requirements) are included to implement State law only;

consequently, violations of these requirements are not subject to the enforcement remedies that are available for NPDES violations.

## IV. RATIONALE FOR EFFLUENT LIMITATIONS AND DISCHARGE SPECIFICATIONS

The CWA requires point source dischargers to control the amount of conventional, non-conventional, and toxic pollutants that are discharged into the waters of the United States. The control of pollutants discharged is established through effluent limitations and other requirements in NPDES permits. There are two principal bases for effluent limitations in the Code of Federal Regulations: section 122.44(a) requires that permits include applicable technology-based limitations and standards; and section 122.44(d) requires that permits include water quality-based effluent limitations to attain and maintain applicable numeric and narrative water quality criteria to protect the beneficial uses of the receiving water.

### A. Discharge Prohibitions

1. **Discharge Prohibition III.A.** The discharge of waste to Humboldt Bay is prohibited unless the discharge conforms to State Board Order No. 79-20 and Regional Water Board, Resolution 83-9.

   This prohibition is modified from the the prohibition contained in the previous Order (Order No. R1-2004-0036). The previous order contained a prohibition which stated, "[t]he discharge of waste to Humboldt Bay (Arcata Bay) is prohibited unless it is done in conjunction with the Arcata Marsh and Wildlife Sanctuary." Both the former and revised version of this prohibition, in part, justify an exception to State Water Board Resolution No. 74-43 (*Water Quality Control Policy for Enclosed Bays and Estuaries of California*) allowing the continued discharge from the Arcata WWTF to Humboldt Bay "only when a discharge enhances the quality of the receiving water above that which would occur in the absence of the discharge." Resolution No. 83-9 acknowledged that the discharge of treated wastewater in through the AMWS met the definition of "enhancement" as established by State Water Board Order WQ 79-20. Discharge Prohibition III. A ensures that this enhancement project will be continued and allows the Regional Water Board to continue to recognize an exception to State Water Board Resolution No. 74-43 for the Arcata WWTF.

2. **Discharge Prohibition III.B.** The discharge of any waste not disclosed by the Permittee or not within the reasonable contemplation of the Regional Water Board is prohibited.

   This prohibition is based on the Basin Plan, the previous Order, and State Water Board Order WQO No. 2002-0012 regarding the petition of WDRs Order No. 01-072 for the East Bay Municipal Utility District and Bay Area Clean Water

Agencies. In State Water Board Order No. WQO 2002-0012, the State Water Board found that this prohibition is acceptable in orders, but should be interpreted to apply only to constituents that are either not disclosed by the Permittee, or are not reasonably anticipated to be present in the discharge, but have not been disclosed by the Permittee. It specifically does not apply to constituents in the discharge that do not have "reasonable potential" to exceed water quality objectives.

The State Water Board has stated that the only pollutants not covered by this prohibition are those which were "disclosed to the permitting authority and … can be reasonably contemplated." [In re the Petition of East Bay Municipal Utilities District et al., (State Water Board, 2002) Order No. WQO 2002-0012, p. 24] In that Order, the State Water Board cited a case which held the Permittee is liable for the discharge of pollutants "not within the reasonable contemplation of the permitting authority ….whether spills or otherwise…" [Piney Run Preservation Assn. v. County Commissioners of Carroll County, Maryland (4th Cir. 2001) 268 F. 3d 255, 268.] Thus the State Water Board authority provides that, to be permissible, the constituent discharged (1) must have been disclosed by the Permittee and (2) can be reasonably contemplated by the Regional Water Board.

Whether or not the Permittee reasonably contemplates the discharge of a constituent is not relevant. What matters is whether the Permittee disclosed the constituent to the Regional Water Board or whether the presence of the pollutant in the discharge can otherwise be reasonably contemplated by the Regional Water Board at the time of Order adoption.

3. **Discharge Prohibition III.C.** Creation of pollution, contamination, or nuisance, as defined by Section 13050 of the Water Code is prohibited.

   This prohibition is retained from the previous Order and is based on section 13050 of the Water Code.

4. **Discharge Prohibition III.D.** The discharge of sludge or digester supernatant is prohibited, except as authorized under section VI.C.5.c. (Solids Disposal and Handling Requirements, section VI.C.5.c of the Order.)

   This prohibition is is retained from the previous Order (Order No. R1-2004-0036) and is based in restrictions on the disposal of sewage sludge found in federal regulations [Part 503 (Biosolids), Part 527 and Part 258] and title 27 of the California Code of Regulations (CCR).

5. **Discharge Prohibition III.E.** The discharge of untreated or partially treated waste from anywhere within the collection, treatment, or disposal systems is

prohibited, except as provided for in Prohibition III. I. and in Attachment D, Standard Provisions (Bypass).

This prohibition has been retained from the previous Order and is based on the Basin Plan to protect beneficial uses of the receiving water from unpermitted discharges, and the intent of the Water Code sections 13260 through 13264 relating to the discharge of waste to waters of the State without filing for and being issued an Order. This prohibition applies to spills not related to sanitary sewer overflows (SSOs) and other unauthorized discharges of wastewater within the collection, treatment, and disposal facilities. The discharge of untreated or partially treated wastewater from the collection, treatment, or disposal facility represents an unauthorized bypass pursuant to section 122.41(m) or an unauthorized discharge which poses a threat to human health and/or aquatic life, and therefore is explicitly prohibited by this Order.

6. **Discharge Prohibition III.F.** Any SSO that results in a discharge of untreated or partially treated wastewater to (a) waters of the State, (b) groundwater, or (c) land that creates pollution, contamination, or nuisance, as defined in Water Code section 13050(m) is prohibited.

   This prohibition applies to spills related to SSOs and is based on State standards, including section 13050 of the Water Code and the Basin Plan. This prohibition is consistent with the States' antidegradation policy as specified in State Water Board Resolution No. 68-16 (*Statement of Policy with Respect to Maintaining High Quality of Water in California*) in that the prohibition imposes conditions to prevent impacts to water quality, the degradation of water quality, negative effects on receiving water beneficial uses, and lessening of water quality beyond that prescribed in State Water Board or Regional Water Board plans and policies.

   Statewide General Waste Discharge Requirements for Sanitary Sewer Systems. Order No. 2006-0003-DWQ prohibits SSOs that result in the discharge of untreated or partially treated wastewater to waters of the United States and SSOs that cause a nuisance, compared to Prohibition III.E. of this Order, which prohibits SSO discharges that create nuisance or pollution to waters of the state, groundwater, and land for a more complete protection of human health. This prohibition (Prohibition III.F) is stricter than the prohibitions stated in State Water Board Order 2006-003-DWQ because high groundwater is prevalant in the North Coast Region, and many areas of this region rely on groundwater as a drinking water source. This prohibition protects the region's groundwater resources and is consistent with antidegradation policies.

7. **Discharge Prohibition III.G.** The discharge of waste at any point not described in Finding II.B of the Fact Sheet, Prohibition III.I., or otherwise not authorized by

this or another permit issued by the State Water Board or another Regional Water Board is prohibited.

This prohibition allows the Permittee to discharge waste only in accordance with WDRs. It is based on sections 301 and 402 of the federal CWA and section 13263 of the Water Code.

8. **Discharge Prohibition III.H.** The mean daily dry weather flow of waste through the treatment plant in excess of 2.3 mgd measured over a calander month is prohibited.

   This prohibition is based on the permitted flow and dry weather design flow of the WWTF.

9. **Discharge Prohibition III.I**. The Discharge of treated effluent at Outfall 001, is prohibited other than that portion of the flow exceeding peak flows of 5.9 mgd.[13]

   This prohibition is new and is based on Resolution No. 83-9, in which the Regional Water Board acknowleged that the discharge of treated wastewater through the AMWS met the definition of "enhancement" as established by State Water Board Order WQ 79-20. Discharge Prohibition III. I. ensures that water quality is enhanced by treatment through AMWS to the fullest extent possible prior to discharge to Humboldt Bay.

## B. Technology-Based Effluent Limitations and Discharge Specifications

### 1. Scope and Authority

The CWA requires that technology-based effluent limitations be established based on several levels of controls:

**a.** Best practicable treatment control technology (BPT) represents the average of the best performance by plants within an industrial category or subcategory. BPT standards apply to toxic, conventional, and non-conventional pollutants.

**b.** Best available technology economically achievable (BAT) represents the best existing performance of treatment technologies that are economically

[13] This Prohibition will take effect upon activation of the new disinfection system and implementation of discharges at Discharge Point 003, but no later than December 1, 2016.

achievable within an industrial point source category. BAT standards apply to toxic and non-conventional pollutants.

**c.** Best conventional pollutant control technology (BCT) represents the control from existing industrial point sources of conventional pollutants including BOD, TSS, fecal coliform, pH, and oil and grease. The BCT standard is established after considering the "cost reasonableness" of the relationship between the cost of attaining a reduction in effluent discharge and the benefits that would result, and also the cost effectiveness of additional industrial treatment beyond BPT.

**d.** New source performance standards (NSPS) represent the best available demonstrated control technology standards. The intent of NSPS guidelines is to set limitations that represent state-of-the-art treatment technology for new sources.

The Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) established the minimum performance requirements for POTWs [defined in section 304(d)(1)]. Section 301(b)(1)(B) of that Act requires that such treatment works must, as a minimum, meet effluent limitations based on secondary treatment as defined by the USEPA Administrator.

Based on this statutory requirement, USEPA developed secondary treatment regulations, which are specified in section 133. These technology-based regulations apply to all municipal wastewater treatment plants and identify the minimum level of effluent quality attainable by secondary treatment in terms of biochemical oxygen demand ($BOD_5$), total suspended solids (TSS), and pH.

Following publication of the secondary treatment regulations, legislative history indicates that Congress was concerned that USEPA had not "sanctioned" the use of certain biological treatment techniques that were effective in achieving significant reductions in $BOD_5$ and TSS for secondary treatment. Therefore to prevent unnecessary construction of costly new facilities, Congress included language in the 1981 amendment to the Construction Grants statues [Section 23 of Pub. L. 97-147] that required USEPA to provide allowance for alternative biological treatment technologies such as trickling filters or waste stabilization ponds. In response to this requirement, definition of secondary treatment was modified on September 20, 1984 and June 3, 1985, and published in the revised secondary treatment regulations contained in section 133.105. These regulations allow alternative limitations for facilities using trickling filters and waste stabilization ponds that meet the requirements for

"equivalent to secondary treatment." Equivalent to secondary treatment limitations allow *up to* 45 mg/L (monthly average) and *up to* 65 mg/L (weekly average) for $BOD_5$ and TSS.

Therefore, POTWs that use waste stabilization ponds, identified in section 133.103, as the principal process for secondary treatment and whose operation and maintenance data indicate that the TSS values specified in the equivalent to secondary regulations cannot be achieved, can qualify to have their minimum levels of effluent quality for TSS adjusted upwards.

Furthermore, in order to address the variations in facility performance due to geographic, climatic, or seasonal conditions in different States, the Alternative State Requirements (ASR) provision contained in section 133.105(d) was written. ASR allows States the flexibility to set permit limitations above the maximum levels of 45 mg/L (monthly average) and 65 mg/L (weekly average) for TSS from lagoons. However, before ASR limitations for suspended solids can be set, the effluent must meet the BOD limitations as prescribed by section 133.102(a). Presently, the maximum TSS value set by the State of California for lagoon effluent is 95 mg/L. This value corresponds to a 30-day consecutive average or an average over duration of less than 30 days.

Regulations promulgated in section 125.3(a)(1) require technology-based effluent limitations for municipal Permittees to be placed in NPDES permits based on secondary treatment standards or equivalent to secondary treatment standards. In order to be eligible for equivalent to secondary limitations, a POTW must meet all of the following criteria:

a. The principal treatment process must be either a trickling filter or waste stabilization pond.

b. The effluent quality consistently achieved, despite proper operations and maintenance, is in excess of 30 mg/L $BOD_5$ and TSS.

c. Water quality is not adversely affected by the discharge. (section 133.101(g).)

   The treatment works as a whole provides significant biological treatment such that a minimum 65 percent reduction of $BOD_5$ is consistently attained (30-day average).

## 2. Applicable Technology-Based Limitations and Specifications

Technology-based limitations established by the Order are summarized in Table F-4 below; and derivation of these limits is discussed in the following text.

**Table F-4. Technology-Based Effluent Limitations**

| Parameter | Units | Effluent Limitations | | |
|---|---|---|---|---|
| | | Average Monthly | Average Weekly | Maximum Daily |
| **Outfall 001 Interim Limitations** | | | | |
| $BOD_5$ | mg/L | 30 | 45 | --- |
| | lbs/day | 575 | 863 | --- |
| TSS | mg/L | 30 | 45 | --- |
| | lbs/day | 575 | 863 | --- |
| $BOD_5$ and TSS Removal | 85 percent (minimum) | | | |
| pH | s.u. | 6.0 – 9.0 at all times | | |
| Settleable Solids | mL/L | 0.1 | --- | 0.2 |
| **Outfall 001 Final Limitations** | | | | |
| $BOD_5$ | mg/L | 45 | 65 | --- |
| | lbs/day | 863 | 1304 | --- |
| TSS | mg/L | 66 | 95 | --- |
| | lbs/day | 1266 | 1822 | --- |
| $BOD_5$ and TSS Removal | 65 percent (minimum) | | | |
| pH | s.u. | 6.0 – 9.0 at all times | | |
| Settleable Solids | mL/L | 0.1 | --- | 0.2 |
| **Outfall 002 Final Specifications** | | | | |
| $BOD_5$ | mg/L | 45 | 65 | |
| TSS | mg/L | 66 | 95 | |
| pH | s.u. | 6.0 – 9.0 at all times | | |
| Settleable Solids | mL/L | 0.1 | --- | 0.2 |
| **Outfall 003 Final Limitations** | | | | |
| $BOD_5$ | mg/L | 30 | 45 | --- |
| | lbs/day | 575 | 863 | --- |
| TSS | mg/L | 30 | 45 | --- |
| | lbs/day | 575 | 863 | --- |
| $BOD_5$ and TSS Removal | 85 percent (minimum) | | | |
| pH | s.u. | 6.0 – 9.0 at all times | | |
| Settleable Solids | mL/L | 0.1 | --- | 0.2 |

a. **$BOD_5$ and TSS Effluent Limitations and Specifications:** In its application for permit renewal (February 19, 2007), the Permittee requested the establishment of effluent limitations for $BOD_5$ and TSS based on equivalent to secondary standards. The Regional Water

Board has determined, however, that effluent limitations based on standard secondary treatment standards from the previous permit will be retained until the upgraded configuration is in place, because the WWTF has demonstrated sufficient compliance with these limitations under the existing configuration.

The City of Arcata uses waste stabilization ponds as the principal process providing significant biological treatment of municipal wastewater. In accordance with section 133.101, a facility that consists of a pond or a trickling filter system and cannot meet the secondary standards after proper operation and maintenance may be allowed to meet treatment equivalent to secondary limits. Under the upgraded WWTF configuration, all wastewater will flow through Outfall 002 to the AMWS and ultimately Outfall 003 to Humboldt Bay, except on rare occasions when the portion of flow exceeding 5.9 mgd is allowed to discharge at Outfall 001. Sampling at the location known as Pt. 9 represents the quality of effluent prior to enhanced treatment through the AMWS. Analysis was done with the Pt. 9 data from 2009 through 2011 to determine the 95$^{th}$ percentile value for the 30-day averages of BOD and TSS. The 95$^{th}$ percentile of 30-day averages for the 3-year period are BOD 78 mg/L and TSS 66 mg/L.

The City of Arcata effluent concentrations for BOD and TSS that are consistently achievable, based on the 95th percentile value, exceed the minimum level for standard secondary treated effluent. Therefore, the Permittee is eligible for alternative limits for treatment equivalent to secondary for Outfall 001 (under the upgraded configuration criteria) and Outfall 002. The maximum equivalent to secondary requirement for BOD concentration by wastewater treatment ponds provides for a 30-day TSS effluent limitation up to 45 mg/L. Because the 95th percentile effluent value of 78 mg/L exceeds the maximum of 45 mg/L, 45 mg/L is established in this permit as the average monthly final BOD effluent limitation. The alternative state requirement for TSS concentration by wastewater treatment ponds in California provides for a 30-day TSS effluent limitation up to 95 mg/L. Therefore, the 95th percentile effluent value of 66 mg/L is established in this permit as the average monthly final TSS effluent limitation.

Average weekly effluent limitations for BOD and TSS have also been established in the Order as required by section 122.45(d)(2), which states that effluent limitations for POTWs must be expressed as average weekly and average monthly limitations unless impracticable. In accordance with section 133.101, the average weekly limitations were

calculated by multiplying the average monthly limitations by 1.5 to obtain a result of 68 mg/L for BOD. Because the maximum equivalent to secondary requirement for BOD concentration by wastewater treatment ponds provides for a weekly BOD effluent limitation up to 65 mg/L exceeding the value of 68 mg/L, 65 mg/L is established in this permit as the average weekly final BOD effluent limitation. The average weekly TSS limitation would be calculated by multiplying the average monthly limitation of 66 mg/L by 1.5 to obtain a result of 99 mg/L, which is greater than is allowable by the ASR for California; therefore in application of equivalent to secondary standards, this permit includes the maximum allowable concentration of 95 mg/L for the TSS weekly limitation. Technology-based limitations equivalent to secondary for Outfall 002 will be implemented under section IV.B. Discharge Specifications of this Order.

Equivalent to secondary treatment is consistent with WQ Order No. 79-20 because the revised secondary treatment regulations contained in section 133.105, published September 20, 1984 and June 3, 1985, determined that the revised standards were equivalent to the secondary standards for those WWTF meeting the technological requirements, as described above.

Full secondary treatment standards have been retained for Outfall 001 under the existing configuration and applied to Outfall 003, because the available data indicates that these standards can be met after enhanced wastewater treatment associated with the AMWS. Under Resolution No. 83-9, adopted in July 1983, the Regional Water Board granted a continued exception to the Bays and Estuaries Policy for the discharge from City of Arcata, recognizing that operation and design of the City's WWTF met the State Water Board's definition of enhancement in WQ Order No. 79-20. Water Quality Order No. WQ 79-20, the State Water Board clarified that enhancement requires secondary treatment, compliance with all NPDES permit requirements established by the Regional Water Board and the creation of new beneficial uses or the fuller realization of existing beneficial uses. As discussed in section II.A of this Fact Sheet, beneficial uses of the AMWS include water quality enhancement. Under the new configuration of the WWTF, all wastewater up to 5.9 mgd will pass through the AMWS, receiving the benefit of enhanced treatment and therefore, this Order imposes full secondary treatment effluent limitations at Outfall 003 into Humboldt Bay at the brackish marsh.

**b. Percent Removal:** Standard secondary treatment standards and equivalent to secondary treatment standards at Part 133 set respective

minimum standards of 85% and 65% removal for $BOD_5$ and TSS. The minimum standard of 85% removal has been retained from the previous permit and applied to Outfall 001 (under the existing configuration) and applied to Outfall 003 because standard secondary treatment can be achieved for discharges to Humboldt Bay in association with enhanced treatment in AMWS. The equivalent to secondary minimum standard has been applied to Outfall 001 only for those rare occasions when the portion of flow exceeding 5.9 mgd is allowed to discharge directly to Humboldt Bay receiving water.

c. **pH:** The secondary treatment regulations at Part 133 apply to the discharge and require that pH be maintained between 6.0 and 9.0 standard units. Limitations for pH have been retained from the previous permit.

d. **Daily Maximum Effluent Limitations for BOD and TSS:** Daily maximum effluent limitations for $BOD_5$ and TSS are not retained as these limitations may not provide the most representative measure of compliance given the long retention time of the WWTF.

e. **Mass-based Effluent Limitations:** Mass-based effluent limitations for $BOD_5$ and TSS are retained for discharges to Humboldt Bay and are based on the facility design flow. The Regional Water Board has determined that mass based limitations, in addition to concentration based limitations, for $BOD_5$ and TSS are appropriate and consistent with EPA recommendations ensuring that dilution will not be used as a substitute for treatment and that the overall quantity of waste discharged does not increase beyond that allowed in accordance with the permitted flow. Inclusion of mass limitations is consistent with NPDES regulations at section 122.45 (f)(2), which do not preclude the simultaneous use of mass and concentration based limitations, while expressing a preference for mass based limitations.

The Clean Water Act explicitly permits the inclusion of both mass and concentration limits for the same pollutants. Section 122.44(f)(2) states: "Pollutants limited in terms of mass additionally may be limited in terms of other units of measurement, and the permit shall require the permittee to comply with both limitations." The use of both mass and concentration-based limitations is essential to protecting water quality. The US EPA has stressed the importance of using both mass-based and concentration-based limitations in tandem, stating its belief "that most permit limitations standards and prohibitions must be expressed quantitatively in terms of mass in order to preclude the use of dilution as

a substitute for treatment." 44 Fed. Reg. 32864-32865. For example, unless a flow limit is included in an NPDES permit, the design capacity of a POTW could be increased by re-rating, which would allow an increase in overall discharge of pollutants without triggering a permit modification or antidegradation analysis.

**f. Settleable Solids Effluent Limitations:** Effluent limitations for settleable solids are retained from the previous permit. Settleable solids generally constitute 40 to 65 percent of the suspended solids in domestic wastewaters and are measured volumetrically by quiescent settling of a one liter sample for one hour in an Imhoff cone (and are therefore expressed as mLs/L/hr). Method SM 2540F for the analysis of settleable solids describes a lower limit of measurement of settleable solids at 0.1 mL/L/hr, and therefore, the monthly average limitation established by this Order, reflects, in effect, a non-detectable (100 percent removal efficiency) level of settleable solids in the discharge. The Regional Water Board has determined based upon best professional judgment (BPJ) that secondary treatment and/ or equivalent to secondary treatment should remove settleable solids to non-detect levels, and therefore effluent limitations for this parameter are necessary to evaluate efficient operation of the treatment facility in addition to ensuring protection of aquatic life from adverse impacts of settleable material in the discharge. The Regional Water Board will continue to include limitations for settleable solids in all permits for municipal wastewater treatment plants in the North Coast Region.

## C. Water Quality-Based Effluent Limitations (WQBELs)

### 1. Scope and Authority

Section 301(b) of the CWA and section 122.44(d) require that permits include limitations more stringent than applicable federal technology-based requirements where necessary to achieve applicable water quality standards. This Order contains requirements more stringent than secondary treatment requirements that are necessary to meet Basin Plan requirements and applicable water quality standards for protection of beneficial uses.

Section 122.44(d)(1)(i) mandates that permits include effluent limitations for all pollutants that are or may be discharged at levels that have the reasonable potential to cause or contribute to an exceedance of a water quality standard, including numeric and narrative objectives within a standard. A reasonable potential analysis (RPA) demonstrated reasonable potential for discharges from the Arcata WWTF to cause or contribute to exceedances of applicable water quality criteria for copper, cyanide, 2,3,7,8 TCDD equivalents,

carbon tetrachloride, dichlorobromomethane, and bis(2-ethylhexyl)phthalate associated with discharges to Humboldt Bay. In addition, data analysis shows reasonable potential for copper to exceed criteria for the protection of aquatic life associated with AMWS.

Where reasonable potential has been established for a pollutant, but there is no numeric criterion or objective for the pollutant, water quality-based effluent limitations (WQBELs) must be established using: (1) USEPA criteria guidance under CWA section 304(a), supplemented where necessary by other relevant information; (2) an indicator parameter for the pollutant of concern; or (3) a calculated numeric water quality criterion, such as a proposed state criterion or policy interpreting the state's narrative criterion, supplemented with other relevant information, as provided in section 122.44(d)(1)(vi).

The process for determining reasonable potential and calculating WQBELs when necessary is intended to protect the beneficial uses of the receiving water as specified in the Basin Plan, and achieve applicable water quality objectives and criteria that are contained in other state plans and policies, or any applicable water quality criteria contained in the CTR and NTR.

**2. Applicable Beneficial Uses and Water Quality Criteria and Objectives**

a. **Beneficial Uses.** Beneficial use designations for receiving waters for discharges from the Arcata WWTF are discussed in Finding III.C. of this Fact Sheet.

b. **Basin Plan Water Quality Objectives.** In addition to the specific water quality objectives indicated above, the Basin Plan contains narrative objectives for color, tastes and odors, floating material, suspended material, settleable material, oil and grease, biostimulatory substances, sediment, turbidity, pH, dissolved oxygen, bacteria, temperature, toxicity, pesticides, chemical constituents, and radioactivity that apply to inland surface waters, enclosed bays, and estuaries. For waters designated for use as domestic or municipal supply (MUN), the Basin Plan establishes as applicable water quality criteria the Maximum Contaminant Levels (MCLs) established by the Department of Public Health for the protection of public water supplies at title 22 of the California Code of Regulations section 64431 (Inorganic Chemicals) and section 64444 (Organic Chemicals).

Water quality criteria contained in the Basin Plan, including title 22 MCLs, are applicable to Humboldt Bay Outfall 001 and Outfall 003. Basin Plan criteria applicable to the beneficial uses created in the AMWS have been applied to Outfall 002.

c. **State Implementation Plan (SIP), CTR and NTR**. Water quality criteria and objectives applicable to receiving water are established by the California Toxics Rule (CTR), established by the UPEPA at section 131.38; and the National Toxics Rule (NTR), established by the USEPA at section 131.36. Criteria for most of the 126 priority pollutants are contained within the CTR and the NTR. Further, water quality criteria for the protection of freshwater aquatic life apply to Outfall 002 and, because Humboldt Bay is an estuarine environment, the more stringent of fresh and marine water quality criteria are applicable to Outfall 001 and Outfall 003.

## 3. Determining the Need for WQBELs

NPDES regulations at section 122.44 (d) require effluent limitations to control all pollutants which are or may be discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above any State water quality standard. Further, the Basin Plan at section 3 p. 3-4, requires that "[a]ll waters shall be maintained free of toxic substances in concentrations that are toxic to …aquatic life".

### a. Non-Priority Pollutants

i. **Fecal Coliform Bacteria:** Effluent limitations for fecal coliform bacteria for discharges to Humboldt Bay are retained from the previous permit. These limitations, which are described below, reflect water quality objectives for bacteria established by the Basin Plan for protection of shellfish harvesting areas. The Basin Plan criteria are based on recommendations of the National Shellfish Sanitation Program for shellfish growing areas that are affected by point source discharges.

Treated wastewater discharged to Humboldt Bay shall not contain concentrations of fecal coliform bacteria exceeding the following limitations.

(a) The median concentration shall not exceed a Most Probable Number (MPN) of 14 organisms per 100 mL in a calendar month, and

(b) Not more than 10 percent of samples collected in a calendar month shall exceed an MPN of 43 organisms per 100 mL.

ii. **Chlorine:** The Basin Plan establishes a narrative water quality objective for toxicity, stating that "[a]ll waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic

life." The Regional Water Board considers any chlorinated discharge as having the reasonable potential to cause or contribute to exceedances of this water quality objective for toxicity, and therefore, the Order establishes effluent limitations for chlorine.

USEPA has established the following criteria for chlorine-produced oxidants for protection of fresh water aquatic life. [Quality Criteria for Water 1986 (The Gold Book, 1986, EPA 440/5/-86-001)]

| Chronic Criterion | Acute Criterion |
|---|---|
| 0.011 mg/L | 0.019 mg/L |

The water quality criteria recommended by USEPA are, in effect, non-detectable concentrations by the common amperometric analytical method used for the measurement of chlorine, and therefore, in order to meet the Basin Plan's narrative water quality objective for toxicity, the Regional Water Board is establishing effluent limitations for chlorine that require concentrations of chlorine in the effluent at the point of discharge protective of aquatic life, which will apply at all times when chlorine is used within the system..

**b. Priority Pollutants**

The SIP establishes procedures to implement water quality criteria from the NTR and CTR and for priority, toxic pollutant objectives established in the Basin Plan. The implementation procedures of the SIP include methods to determine reasonable potential (for pollutants to cause or contribute to excursions above State water quality standards) and to establish numeric effluent limitations, if necessary, for those pollutants showing reasonable potential.

The SIP Section 1.3 requires the Regional Board to use all available, valid, relevant, and representative receiving water and effluent data and information to conduct a reasonable potential analysis (RPA). For this Order, the Regional Water Board has performed RPAs for discharges to Humboldt Bay, the AMWS, and the brackish marsh. The RPA for Humboldt Bay and the brackish marsh applies to estuarine environments, and therefore applies the more stringent of applicable fresh or marine water quality criteria. Effluent data generated during monitoring events on December 30, 2005 and May 3, 2006 at Outfall 001 and on September 9, 2009 and January 27, 2010 at Pt. 9 were used for RPAs.

Some freshwater water quality criteria are hardness-dependent; i.e., as hardness decreases, the toxicity of certain metals increases and the

applicable water quality criteria become correspondingly more stringent. Receiving water hardness data were not available for Humboldt Bay or the brackish marsh in the vicinity of the outfalls. These are estuarine environments which are tidally influenced. Depending on the tide and season, theses receiving waters may range from a predominantly fresh water/low hardness environment to a predominantly marine, high hardness environment. Because receiving water hardness data was not available for the RPA for Outfall 001 or Outfall 003, Regional Water Board used a hardness value of 400 mg/L, which is the default high value for use in the RPA, as established in the CTR at section 131.38 (c) (4) (i). This value may not be protective in all circumstances, and as receiving water hardness data is generated, the permit may be reopened to incorporate additional or more restrictive limitations, if necessary.

Because the AMWS is created through Outfall 002 effluent, effluent hardness data was analyzed to determine a hardness value for use in the RPA for that outfall. An effluent hardness value of 66 mg/L $CaCO_3$ was the minimum hardness value reported in 29 acute toxicity tests conducted on the effluent between September 2004 and October 2007.

To conduct the RPAs, Regional Water Board staff identified the maximum observed effluent (MEC) and background (B) concentrations for each priority, toxic pollutant from effluent and receiving water data provided by the Permittee, and compared this information to the most stringent applicable water quality criterion (C) for each pollutant from the NTR, CTR, and the Basin Plan. Section 1.3 of the SIP establishes three triggers for a finding of reasonable potential.

**Trigger 1.** If the MEC is greater than C, there is reasonable potential, and an effluent limitation is required.

**Trigger 2.** If B is greater than C, and the pollutant is detected in effluent (MEC > ND), there is reasonable potential, and an effluent limitation is required.

**Trigger 3.** After a review of other available and relevant information, a permit writer may decide that a WQBEL is required. Such additional information may include, but is not limited to: the facility type, the discharge type, solids loading analyses, lack of dilution, history of compliance problems, potential toxic impact of the discharge, fish tissue residue data, water quality and beneficial uses of the receiving water, CWA 303 (d) listing for the pollutant, and the presence of endangered or threatened species or their critical habitat.

The RPA for discharges to Humboldt Bay (which includes the brackish marsh) demonstrated reasonable potential to cause or contribute to exceedances of applicable water quality criteria for bis(2-ethylhexyl)phthalate, copper, cyanide, TCDD equivalents, carbon tetrachloride, and dichlorobromomethane. The RPA for discharges at Outfall 002 demonstrated reasonable potential for copper. The following tables summarizes the RPA for each priority, toxic pollutant that has been measured in effluent in samples collected on December 30, 2005, May 3, 2006 and /or September 9, 2009 and January 27, 2010. No other pollutants with applicable, numeric water quality criteria from the NTR, CTR, and the Basin Plan (which includes the title 22 MCLs for protection of drinking water supplies in Humboldt Bay) were measured above non-detect (ND) concentrations.

**Table F-5. Summary of RPA Results – Humboldt Bay**

| CTR # | Priority Pollutants | C or Most Stringent WQO/WQC (µg/L) | MEC or Minimum DL (µg/L)[14] | RPA Result | Reason |
|---|---|---|---|---|---|
| 2 | Arsenic | 36 | 0.96 | No | MEC<C & B is ND |
| 5a | Chromium (III) | 50 | 1 | No | MEC<C & B is ND |
| 6 | Copper | 3.7 | 7.5 | **Yes** | MEC>C |
| 7 | Lead | 8.5 | 0.59 | No | MEC<C & B is ND |
| 8 | Mercury | 0.050 | 0.0067 | No | ;MEC<C & B is ND |
| 9 | Nickel | 8 | 3.7 | No | MEC<C & B is ND |
| 11 | Silver | 2.2 | 0.1 | No | MEC<C & B is ND |
| 12 | Thallium | 1.7 | 0.01 | No | MEC<C & B is ND |
| 13 | Zinc | 86 | 8 | No | MEC<C & B is ND |
| 14 | Cyanide | 1.0 | 4.3 | **Yes** | MEC>C |
| 16 | 2,3,7,8 TCDD | 1.3E-08 | 5.77E-07 | **Yes** | MEC>C |
| 21 | Carbon Tetrachloride | 0.25 | 0.3 | **Yes** | MEC>C |
| 23 | Chlorodibromomethane | 0.40 | 0.2 | No | MEC<C & B is ND |
| 26 | Chloroform | No Criteria | 8 | Uo | No Criteria |
| 27 | Dichlorobromomethane | 0.56 | 1.2 | **Yes** | MEC>C |
| 34 | Methyl Bromide | 48 | 2.9 | No | MEC<C & B is ND |
| 36 | Methylene Chloride | 4.7 | 0.18 | No | MEC<C & B is ND |
| 39 | Toluene | 150 | 3.8 | No | MEC<C & B is ND |
| 68 | Bis(2-Ethylhexyl)Phthalate | 1.8 | 6.6 | **Yes** | MEC>C |
| 77 | 1,4-Dichlorobenzene | 5.0 | 0.06 | No | MEC<C & B is ND |

[14] The Maximum Effluent Concentration (MEC) or maximum background concentration (B) is the actual detected concentration unless it is preceded by "<", in which case the value shown is the minimum detection level as the analytical result was reported as not detected (ND).

**Table F-6. Summary of RPA Results – AMWS**

| CTR # | Priority Pollutants | C or Most Stringent WQO/WQC (µg/L) | MEC or Minimum DL (µg/L)[7] | RPA Result | Reason |
|---|---|---|---|---|---|
| 2 | Arsenic | 50 | 0.96 | No | MEC<C & B is ND |
| 5a | Chromium (III) | 50 | 0.54 | No | MEC<C & B is ND |
| 6 | Copper | 6.5 | 7.3 | **Yes** | MEC>C |
| 7 | Lead | 1.6 | 0.57 | No | MEC<C & B is ND |
| 8 | Mercury | 0.05 | No Criteria | Uo | No Criteria |
| 9 | Nickel | 37 | 4.4 | No | MEC<C & B is ND |
| 13 | Zinc | 84 | 4.4 | No | MEC<C & B is ND |
| 68 | Bis(2-Ethylhexyl)Phthalate | 1.8 | No Criteria | Uo | No Criteria |

### 4. WQBEL Calculations

Final WQBELs have been determined using the methods described in Section 1.4 of the SIP.

**Step 1:** To calculate the effluent limits, an effluent concentration allowance (ECA) is calculated for each pollutant found to have reasonable potential using the following equation, which takes into account dilution and background concentrations:

ECA = C + D (C – B), where

C = the applicable water quality criterion (adjusted for receiving water hardness and expressed as the total recoverable metal, if necessary)
D = dilution credit (here D= 0, as the discharge does not qualify for a dilution credit)
B = background concentration

Here, no credit for dilution is allowed at either outfall, which results in the ECA being equal to the applicable criterion (ECA = C).

**Step 2:** For each ECA based on an aquatic life criterion/objective (copper and cyanide), the long term average discharge condition (LTA) is determined by multiplying the ECA by a factor (multiplier), which adjusts the ECA to account for effluent variability. The multiplier depends on the coefficient of variation (CV) of the data set and whether it is an acute or chronic criterion/objective. Table 1 of the SIP provides pre-calculated values for the multipliers based on the values of the CV. When the data set contains less than 10 sample results (as for the Arcata WWTF), or when 80 percent or more of the data set is reported as non-detect (ND), the CV is set equal to 0.6. Derivation of the multipliers is presented in Section 1.4 of the SIP.

From Table 1 of the SIP, the ECA multipliers for calculating LTAs at the 99$^{th}$ percentile occurrence probability are 0.321 (acute multiplier) and 0.527 (chronic multiplier). The LTAs are determined as follows in Table F-11.

**Table F-7. Determination of Long Term Averages**

| Pollutant | ECA | | ECA Multiplier | | LTA (µg/L) | |
|---|---|---|---|---|---|---|
| | Acute | Chronic | Acute | Chronic | Acute | Chronic |
| **Outfall 001 and Outfall 003** | | | | | | |
| **Copper** | 5.8 | 3.7 | 0.32 | 0.53 | 1.86 | 1.97 |
| **Cyanide** | 1 | 1 | 0.32 | 0.53 | 0.32 | 0.53 |

**Step 3:** WQBELs, including an average monthly effluent limitation (AMEL) and a maximum daily effluent limitation (MDEL) are calculated using the most limiting (lowest) LTA. The LTA is multiplied by a factor that accounts for averaging periods and exceedance frequencies of the effluent limitations, and for the AMEL, the effluent monitoring frequency. Here, the CV is set equal to 0.6, and the sampling frequency is set equal to 4 (n = 4). The 99$^{th}$ percentile occurrence probability was used to determine the MDEL multiplier and a 95$^{th}$ percentile occurrence probability was used to determine the AMEL multiplier. From Table 2 of the SIP, the MDEL multiplier is 3.11, and the AMEL multiplier is 1.55. Final WQBELs for copper and cyanide are determined as follows.

**Table F-8. Determination of Final WQBELs Based on Aquatic Life Criteria**

| Pollutant | LTA (µg/L) | MDEL Multiplier | AMEL Multiplier | MDEL (µg/L) | AMEL (µg/L) |
|---|---|---|---|---|---|
| **Outfall 001 and Outfall 003** | | | | | |
| **Copper** | 1.86 | 3.11 | 1.55 | 5.8 | 2.9 |
| **Cyanide** | 0.327 | 3.11 | 1.55 | 1.0 | 0.5 |
| **Outfall 002** | | | | | |
| **Copper** | 3.04 | 3.11 | 1.55 | 9.5 | 4.7 |

Final effluent limits presented above for copper at Outfall 001 and Outfall 003 are based on a receiving water hardness of 400 mg/L. Final effluent limits presented above for copper at Outfall 002 are based on a receiving water hardness of 66 mg/L.

**Step 4**: When the most stringent water quality criterion/objective is a human health criterion/objective (as for bis(2-ethylhexyl)phthalate, TCDD equivalents, carbon tetrachloride, and dichlorobromomethane), the AMEL is set equal to the ECA. From Table 2 of the SIP, when CV = 0.6 and n = 4, the MDEL multiplier at the 99$^{th}$ percentile occurrence probability equals 3.11, and the AMEL multiplier at the 95$^{th}$ percentile occurrence probability equals 1.55. The MDEL for protection of human health is calculated by multiplying the ECA by the ratio of the MDEL multiplier to the AMEL

multiplier. Final WQBELs for TCDD equivalents, carbon tetrachloride, and dichlorobromomethane at Outfalls 001 and 003 are determined as follows.

**Table F-9. Determination Final WQBELs Based on Human Health Criteria**

| Pollutant | ECA (µg/L) | MDEL/AMEL | MDEL (µg/L) | AMEL (µg/L) |
|---|---|---|---|---|
| TCDD Equivalents | 1.3E-08 | 2.01 | 1.3E-08 | 2.6E-08 |
| Carbon Tetrachloride | 0.25 | 2.01 | 0.25 | 0.50 |
| Dichlorobromomethane | 0.56 | 2.01 | 0.56 | 1.12 |
| Bis(2-Ethylhexyl)Phthalate | 1.8 | 2.01 | 3.6 | 1.8 |

A summary of WQBELs established by the Order is given in the table below.

**Table F-10. Summary of Water Quality-Based Effluent Limitations**

| Parameter | Units | Effluent Limitations | |
|---|---|---|---|
| | | Average Monthly | Maximum Daily |
| **Outfall 001 and Outfall 003** | | | |
| Copper | µg/L | 2.9 | 5.8 |
| Cyanide | µg/L | 0.5 | 1.0 |
| TCDD Equivalents | µg/L | $1.3 \times 10^{-8}$ | $2.6 \times 10^{-8}$ |
| Carbon Tetrachloride | µg/L | 0.25 | 0.50 |
| Dichlorobromomethane[15] | µg/L | 0.56 | 1.12 |
| Bis(2-Ethylhexyl)Phthalate | µg/L | 1.8 | 3.6 |
| Chlorine, Total Residual[16] | mg/L | 0.01 | 0.02 |
| Fecal Coliform | MPN/100ml | 14[17] | 43[18] |
| **Outfall 002** | | | |
| Copper | µg/L | 4.7 | 9.5 |

## 5. Whole Effluent Toxicity (WET)

Effluent limitations for whole effluent, acute and chronic toxicity, protect the receiving water from the aggregate effect of a mixture of pollutants that may be present in effluent. There are two types of WET tests – acute and chronic. An acute toxicity

[15] Dichlorobromomethane is not applied to discharges at Outfall 003 because, dichlorobromomethane is a byproduct of chlorination and when Outfall 003 is in use, disinfection will be accomplished using ultraviolet technology.

[16] Chlorine Residual applies to discharges at Outfall 001 when chlorination is used to treat the effluent.

[17] Median.

[18] Not more than 10% of samples collected in a 30-day period shall exceed the daily maximum.

test is conducted over a short time period and measures mortality. A chronic test is conducted over a longer period of time and may measure mortality, reproduction, and/or growth. The Basin Plan establishes a narrative water quality objective for toxicity, requiring that all waters be maintained free of toxic substances in concentrations that are lethal to, or produce other detrimental responses in aquatic organisms. Detrimental responses may include, but are not limited to, decreased growth rate, decreased reproductive success of resident or indicator species, and/or significant alterations in population, community ecology, or receiving water biota. The previous Order included an effluent limitation for acute toxicity at Outfall 001 in accordance with the Basin Plan, which requires that the average survival of test organisms in undiluted effluent for any three consecutive 96-hour bioassay tests be at least 90 percent, with no single test having less than 70 percent survival. A summary of acute toxicity test results for survival of rainbow trout (*O. mykiss*) in 100 percent effluent at Outfall 001 for the period from September 2004 to October 2007 is provided in the following table.

**Table F.11. Summary of Acute Toxicity Test Results**

| Date | Percent Survival | Date | Percent Survival |
|---|---|---|---|
| 9/21/2004 | 100 | 8/21/2006 | 100 |
| 11/30/2004 | 100 | 10/9/2006 | 100 |
| 3/15/2005 | 95 | 3/21/2007 | 100 |
| 6/21/2005 | 100 | 4/9/2007 | 100 |
| 9/26/2005 | 100 | 9/17/2007 | 100 |
| 6/26/2006 | 100 | 10/22/2007 | 100 |

In addition to the Basin Plan requirements, section 4 of the SIP states that chronic toxicity limitations are required in permits for all discharges that will cause, have the reasonable potential to cause, or contribute to chronic toxicity in receiving waters. The previous Order included monitoring requirements for chronic toxicity at Outfall 001; effluent limitations were not included.

The Permittee initiated chronic toxicity testing using three species in 2005: topsmelt (*Atherinops affinis*), bay mussel (*Mytilus edulis*), and giant kelp (*Macrocystis pyrifera*). In the third quarter 2005, the effluent sample exhibited some toxicity affecting the giant kelp. The effects on the giant kelp also appeared in the fourth quarter of 2005, and first and second quarters of 2006. In the third quarter 2006, brown algae (*Thalassiosira pseudonana*) was used and showed no toxicity. Bay mussels showed no toxicity in second quarter 2005 and second and third quarters 2006.

The Permittee's chronic toxicity testing results collected during the term of the previous permit are summarized in the table below. A result of 1 or >1 indicates no increased toxicity beyond the control sample.

**Table F-12. Chronic Toxicity Testing Summary Results.**

| Date | Chronic Toxicity Results[19] – Growth and Development (TUc) | | | | | |
|---|---|---|---|---|---|---|
| | *P. promelas* | *S. capricornutum* | *A. affinis* | *M. edulis* | *M. pyrifera* | *T. pseudonana* |
| 9/26/2005 | --- | --- | 1 | 1 | > 1 | --- |
| 11/14/2005 | --- | --- | 1 | 1 | > 1 | --- |
| 3/17/2006 | --- | --- | --- | > 1 | > 1 | --- |
| 6/26/2006 | --- | --- | --- | 1 | 1 | --- |
| 7/27/2006 | --- | --- | --- | 1 | --- | 1 |
| 10/9/2006 | --- | --- | --- | --- | --- | 1 |
| 3/21/2007 | 1 | 1 | --- | --- | --- | --- |
| 4/9/2007 | --- | > 1 | --- | --- | --- | --- |
| 6/25/2007 | 1 | 1 | --- | --- | --- | --- |

The receiving waters at Outfall 001 and Outfall 003 are estuarine and depending on tide and time of year, may range from a predominantly freshwater environment to a predominantly marine environment. Therefore, the Permittee when collecting samples for toxicity, shall also determine the characteristics of the receiving water at the time of sampling to ensure the proper test species and method are implemented to determine if the toxicity of the effluent from Outfalls 001 and 003 are described in detail in section V of the Monitoring and Reporting Program (Attachment E).

A chronic toxicity effluent limitation has not been included in the Order because the collected data does not indicate that the effluent has reasonable potential to cause, or contribute to chronic toxicity in receiving waters. This Order specifies the use of a numeric trigger for accelerated monitoring and implementation of a Toxicity Reduction Evaluation (TRE) in the event that persistent toxicity is detected. Attachment E of this Order requires annual chronic WET monitoring for demonstration that the discharge does not have the potential to cause, or contribute to chronic toxicity in the receiving water.

Section V.C.1.g of the MRP requires TUc to be calculated as 100/NOEC, where NOEC is the no observed effect concentration, for purposes of compliance with the effluent limitation. Although the federal requirements may provide for flexibility in

[19] In the Toxicity Report for Third and Fourth Quarters 2005, the Permittee indicated the bay mussel (*M.edulis*) was the most sensitive species. In the Toxicity Report for the Fourth Quarter 2006, the Permittee indicated their intent to begin three species screening with freshwater organisms.

determining how to calculate TUc for compliance purposes (e.g., 100/NOEC, 100/IC25, 100/EC25), USEPA Region IX recommends that effluent limitations and triggers be based on the NOEC when the permit language and chronic toxicity testing methods incorporate important safeguards that improve the reliability of the NOEC. These safeguards include the use of a dilution series (testing of a series of effluent concentrations) to verify and quantify a dose-response relationship and a requirement to evaluate specific performance criteria in order to determine the sensitivity of each chronic toxicity test. The goal is to demonstrate that each test is sensitive enough to determine whether or not the effluent is toxic or not.

The use of 100/IC25 or 100/EC25 as methods for calculating chronic toxicity are point estimates that automatically allow for a 25 percent effect before calling an effluent "toxic." The Basin Plan has a narrative objective for toxicity that requires that "all waters be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life." Allowance of a possible 25 percent effect would not meet the Basin Plan's narrative toxicity requirement. In addition, California has historically used the NOEC to regulate chronic toxicity for ocean discharges, thus it is fitting that the same method be used to regulate chronic toxicity in inland surface water discharges.

If sampling of the discharge demonstrates a pattern of toxicity exceeding the trigger, the Permittee is required to initiate a TRE, in accordance with an approved TRE work plan to determine whether the discharge is contributing chronic toxicity to the receiving water. Special Provision VI.C.2.a. requires the Permittee to submit to the Regional Water Board and maintain a TRE Work Plan for approval by the Executive Officer, to ensure the Permittee has a plan to immediately move forward with the initial tiers of a TRE, in the event effluent toxicity is encountered in the future. The provision includes requirements for TRE initiation if a pattern of toxicity is demonstrated.

## D. Final Effluent Limitations

### 1. Satisfaction of Anti-Backsliding Requirements

This Order does not retain from the previous permit, the 85 percent removal, concentration or mass-based requirements for $BOD_5$ and TSS applied to final effluent limitations at Outfall 001. Neither does this Order retain the $BOD_5$ or TSS concentration based effluent specifications at Outfall 002. In their place, this Order establishes 65 percent removal and performance based limitations for $BOD_5$ and TSS requirements for discharges conforming to Prohibition III.I. The previous requirements were consistent with the minimum level of effluent quality attainable by standard secondary treatment, established at section 133.102; whereas the 65 percent removal and alternative $BOD_5$ and TSS requirements are consistent with the minimum level of effluent quality attainable

by facilities meeting criteria for “treatment equivalent to secondary” established at section 133.105.

Facility specific criteria satisfies the anti-backsliding exceptions at both section 122.44 (l)(i)(A) and section 122.44 (l)(i)(B)(1). Section 122.44 (l)(i)(A) allows a permit to contain less stringent effluent limitations when material and substantial alterations or additions to the permitted facility occurred after permit issuance that justify the application of a less stringent effluent limitation. Section 122.44 (l)(i)(B)(1) allows a permit to contain less stringent effluent limitations when information is available that was not available at the time of permit issuance and that information would have justified the application of a less stringent effluent limitation at the time of permit issuance. In establishing equivalent to secondary requirements, the Regional Water Board has reviewed water quality monitoring data collected during the term of the previous permit from Pt. 9. The data shows that under the upgraded configuration required to take effect during the term of this Order, the minimum level of effluent quality attainable prior to polishing within the AMWS is consistent with treatment equivalent to secondary. Standard secondary treatment limitations have been retained as interim limitations at Outfall 001 until the upgrade and applied to Outfall 003 (the primary discharge point) under the upgraded configuration.

The daily maximum effluent limitations for BOD5 and TSS have been omitted from this Order. This relaxation of effluent limitations is consistent with the anti-backsliding requirements of the CWA and federal regulations. This permit change is governed by section 122.44(l)(i)(B)(1). Daily maximum limits are not necessary at this facility because BOD5 and TSS samples collected since 2006 demonstrate that the treated effluent routinely complied with the daily maximum effluent limitations. Daily maximum effluent limitations for BOD5 and TSS are not retained as these limitations are not specifically required under section 122.45(d)(2) and may not provide the most representative measure of compliance given the long retention time of the WWTF. Further, daily maximum limits are not specifically required to meet the minimum level of effluent quality that must be attained by the application of secondary treatment or equivalent to secondary treatment.

Although the Daily maximum limitations for BOD5 and TSS have been removed from this Order, the more stringent weekly and monthly requirements for those parameters have been retained. If future monitoring shows exceedances of these limitations, staff will evaluate the need to reinstate the daily maximum effluent limitation for BOD5 and TSS.
Effluent limitations for zinc and oil and grease have been removed from this Order because data did not demonstrate reasonable potential to cause or contribute to an excursion above the respective water quality criteria for zinc or

oil and grease. The relaxation of effluent limitations is consistent with the anti-backsliding requirements of the CWA and federal regulations, based on the consideration of new information (i.e., discharge monitoring reports and RPA).

This Order does not retain total coliform limitations at Outfall 002 from the previous permit. This relaxation of effluent limitations is consistent with the anti-backsliding requirements of the CWA and federal regulations, based on the consideration of new information provided by the Humboldt County Director of Environmental Health, contained in Attachment G, which indicates that application of disinfection at the exit from the AMWS rather than the entrance will not threaten public health or wellbeing. Fecal coliform limitations applicable to Humboldt Bay for the protection of shellfish and human health have been retained.

**2. Satisfaction of Antidegradation Policy**

Pursuant to the Antidegradation Policy, the lowering of water quality can be allowed only if beneficial uses are protected, and if there is a maximum benefit to the people of the state. Discharges regulated in accordance with this Order are for a publically owned treatment works (POTW). The increased costs of additional treatment that would otherwise be required to remove additional BOD5 and TSS beyond equivalent to secondary criteria prior to treatment within AMWS are not in the best interest of the public given that beneficial uses will still be protected; therefore the allowance of an incremental increase in degradation is found to be in the best interest to the people of the state.

The activities allowed in accordance with these modifications to the waste discharge requirements apply to existing facilities. Further, this Order permits only those discharges of waste that have received a minimum of equivalent to secondary treatment. Discharges from the WWTF will be required to maintain protection of the beneficial uses of the receiving waters and comply with applicable provisions of the Basin Plan. As described under section II.B.2. of this Fact Sheet, discharges regulated in accordance with this Order for the upgraded WWTF configuration will result in higher quality effluent discharges to Humboldt Bay than under the existing conditions.

**3. Stringency of Requirements for Individual Pollutants**

This Order contains both technology-based and water quality-based effluent limitations for individual pollutants. The technology-based effluent limitations consist of restrictions on BOD5, TSS, and pH. Restrictions on these pollutants are discussed in section IV.B of this Fact Sheet. This Order's technology-based pollutant restrictions are not more stringent than the minimum, applicable federal technology-based requirements.

Water quality-based effluent limitations (WQBELs) have been scientifically derived to implement water quality objectives that protect beneficial uses. Both the beneficial uses and the water quality objectives have been approved pursuant to federal law and are the applicable federal water quality standards. To the extent that toxic pollutant water quality-based effluent limitations were derived from the CTR, the CTR is the applicable standard pursuant to section 131.38. The scientific procedures for calculating the individual water quality-based effluent limitations for priority pollutants are based on the CTR-SIP, which was approved by USEPA on May 18, 2000. Most beneficial uses and water quality objectives contained in the Basin Plan were approved under state law and submitted to and approved by USEPA prior to May 30, 2000. Any water quality objectives and beneficial uses submitted to USEPA prior to May 30, 2000, but not approved by USEPA before that date, are nonetheless "applicable water quality standards for purposes of the CWA" pursuant to section 131.21(c)(1). Specifically, this Order includes effluent limitations for fecal coliform, chlorine residual, copper, cyanide, 2,3,7,8-TCDD equivalents, carbon tetrachloride, dichlorobromomethane, and bis(2-ethylhexyl)phalate that are necessary to meet numeric objectives or protect beneficial uses. The rationale for including these limitations is explained in Section IV.C.3.

Collectively, this Order's restrictions on mass and individual pollutants are no more stringent than required to implement the requirements of the CWA. However, to the extent any are more stringent than the CWA, the Regional Water Board has considered the factors in Water Code section 13263, including the provisions of Water Code section 13241, in establishing these requirements.

As indicated throughout this Fact Sheet, the effluent limitations established by this Order have been developed to protect beneficial uses of water identified in the Basin Plan for Humboldt Bay, tributaries thereto, and the wetland specific beneficial uses of the AMWS, all of which are contained within the Humboldt Bay hydrographic unit. Of the various potential pollutant sources contributing to water quality conditions within Humboldt Bay, the effluent limitations required by this Order provide reasonably achievable control factors for the WWTF contribution(s). Further, the Regional Water Board is not aware of any costs, required of the City to meet effluent limitations in this Order, which are beyond the scope of those 1) necessary to achieve upgrades proposed by the City, and/or 2) similar to costs undertaken by POTWs of similar or lessor size within the region. This Order does not authorize the use of recycled water; nor do these requirements accommodate any expansion for additional housing development, beyond which, the City may have been granted in previous Orders.

### E. Interim Effluent Limitations

Interim effluent limitations for Outfall 001 established in Section IV.A.3 of the Order are effective until activation of the upgraded WWTF configuration through November 30, 2016, whichever is sooner.

### F. Land Discharge Specifications

This section of the standardized permit is not applicable to the Arcata WWTF.

### G. Reclamation Specifications

This section of the standardized permit is not applicable to the Arcata WWTF.

## V. RATIONALE FOR RECEIVING WATER LIMITATIONS

### A. Surface Water

CWA section 303(a-c) requires states to adopt water quality standards, including criteria where they are necessary to protect beneficial uses. The Regional Water Board adopted water quality criteria as water quality objectives in the Basin Plan. The Basin Plan states that "[t]he numerical and narrative water quality objectives define the least stringent standards that the Regional [Water] Board will apply to regional waters in order to protect the beneficial uses." The Basin Plan includes numeric and narrative water quality objectives for various beneficial uses and water bodies. This Order contains Receiving Surface Water Limitations based on the Basin Plan numerical and narrative water quality objectives for biostimulatory substances, bacteria, chemical constituents, color, dissolved oxygen, floating material, oil and grease, pH, pesticides, radioactivity, sediment, settleable material, suspended material, tastes and odors, temperature, toxicity, and turbidity.

### B. Groundwater

1. The beneficial uses of the underlying ground water are municipal and domestic supply, industrial service supply, industrial process supply, agricultural supply, and freshwater replenishment to surface waters.

2. State Water Board Resolution No. 68-16, requires, in part, that whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality water will be maintained until it is demonstrated to the state that any changes will be consistent with maximum benefit to the people of the state, will not unreasonably affect beneficial uses of such water, and will not result in water quality less than prescribed in the policies.

## VI. RATIONALE FOR MONITORING AND REPORTING REQUIREMENTS

Section 122.48 requires that all NPDES permits specify requirements for recording and reporting monitoring results. Water Code sections 13267 and 13383 authorize the Regional Water Board to require technical and monitoring reports. The Monitoring and Reporting Program (MRP), Attachment E of this Order, establishes monitoring and reporting requirements to implement federal and state requirements. The following provides the rationale for the monitoring and reporting requirements contained in the MRP for this facility.

### A. Influent Monitoring

Influent monitoring requirements for $BOD_5$ and TSS are retained from the previous permit and are necessary to determine compliance with the technology based limitations for percent removal. Influent monitoring for flow is required to assess WWTF loading.

### B. Effluent Monitoring

1. Effluent monitoring requirements for flow, $BOD_5$, TSS, settleable solids, fecal coliform bacteria, pH, chlorine residual, copper, total hardness, cyanide, 2,3,7,8-TCDD equivalents, carbon tetrachloride, dichlorobromomethane, bis(2-ethylhexyl)phthalate, and acute and chronic toxicity are necessary to detemine compliance with triggers, prohibitions, effluent limitations, and/or discharge specifications established by the Order.

2. Quarterly monitoring requirements for nutrients (ammonia nitrogen, nitrate nitrogen,) in the effluent have been established because nitrogen and phosporous containing compounds are a common component of domestic wastewaters and can have a directly toxic and/or detrimental biostimulatory effect on receiving waters. The Regional Water Board is including such monitoring requirements in the discharge permits of most POTWs in the North Coast Region to evaluate the need for effluent limitations for these pollutants.

3. Annual monitoring requirements for the 126 priority pollutants identified in the California Toxics Rule at section 131.38. CTR pollutants (CTR Pollutants) and the title 22 pollutants for which the Department of Health Services has established Maximum Contaminant Levels (MCLs) at title 22, Division 4, Chapter 15, sections 64431 (Inorganic Chemicals) and 64444 (Organic Chemicals) of the California Code of Regulations is required to evaluate reasonable potential for those pollutants to be present in the discharge at concentrations that may adversely impact beneficial uses of the receiving water.

**4.** Oil and grease monitoring has been discontinued because all discharge monitoring data reported during the permit term has been non-detect; there is no demonstration of reasonable potential for this parameter.

## C. Whole Effluent Toxicity Testing Requirements

Whole effluent toxicity (WET) limitations and monitoring protect the receiving water quality from the aggregate effect of a mixture of pollutants in the effluent. Acute toxicity testing measures mortality in 100 percent effluent over a short test period, and chronic toxicity testing is conducted over a longer time period and may measure mortality, reproduction, and/or growth. This Order includes effluent limitations and monitoring requirements for acute toxicity; as well as monitoring requirements for chronic toxicity to determine compliance with the Basin Plan's narrative water quality objective for toxicity.

## D. Receiving Water Monitoring

**1.** Arcata Marsh Wildlife Sanctuary (AMWS)

The AMWS is a created wetland, with unique beneficial uses including non-contact water recreation, cold freshwater habitat, wildlife habitat, wetland habitat, and enhanced treatment of wastewater. Monitoring of the AMWS is required to evaluate the health and performance of the AMWS and demonstrate that the discharge of non-disinfected equivalent to secondary treated wastewater at Outfall 002 is protective of the beneficial uses of the AMWS.

**2.** Brackish Marsh

Receiving water monitoring requirements for dissolved oxygen pH, turbidity, temperature, conductivity, total dissolved solids, salinity, nitrate, floatables/discoloration, and CTR priority pollutants are retained from the previous permit, as established in the Revised Monitoring and Reporting Program (revised July 17, 2007), but applied to the primary final discharge point in the brackish marsh rather than the larger area of Humboldt Bay. Further, this Order establishes monthly monitoring for hardness in the receiving water.

**Temperature:** Monitoring of receiving water temperature is retained to assess the impact, if any, on the temperature of the receiving waters.

**Hardness:** Because the toxicity of certain metals is hardness dependent (i.e., as hardness decreases, metals toxicity increases), monitoring of hardness in the receiving water is required on a monthly basis to allow calculation of water quality objectives and effluent limitations that are hardness dependent.

Monitoring of hardness in the receiving water should coincide with compliance monitoring for the hardness dependent metal with effluent limitations (copper) established by this Order.

**Nutrients.** Monitoring requirements for total ammonia, nitrate is required to characterize the assimilative capacity of the receiving water for these nutrients, to determine the impact of the discharge on the receiving water with respect to these parameters, and to generate background data for these constituents for future reasonable potential analyses.

**CTR Pollutants.** Water quality criteria for the CTR pollutants are applicable to Humboldt Bay, and therefore characterization of background conditions is necessary to assess impacts of the discharge. In addition, reasonable potential analyses, conducted in accordance with procedures established by the SIP, require characterization of background levels of the toxic pollutants.

**Title 22 Pollutants.** Water quality criteria for the title 22 pollutants are applicable to Humboldt Bay, and therefore characterization of background conditions is necessary to assess impacts of the discharge.

**3. Groundwater.**

The Order does not establish groundwater monitoring requirements.

## E. Other Monitoring Requirements

Disinfection Process Monitoring for UV Disinfection System**.** This Order establishes operations monitoring for the UV disinfection system. These monitoring requirements are established to document proper operations and maintenance of the disinfection system for the upgraded WWTF configuration. This monitoring is intended to ensure adherence to proper standards for UV light dosage are implemented, adequate disinfection occurs, and maintain required bacterial monitoring at a weekly frequency..

# VII. RATIONALE FOR PROVISIONS

## A. Standard Provisions

Standard Provisions, which apply to all NPDES permits in accordance with section 122.41, and additional conditions applicable to specified categories of permits in accordance with section 122.42, are provided in Attachment D. The Permittee must comply with all applicable standard provisions and with those additional conditions that are applicable under section 122.42.

Section 122.41(a)(1) and (b) through (n) establish conditions that apply to all State-issued NPDES permits. These conditions must be incorporated into the permits either expressly or by reference. If incorporated by reference, a specific citation to the regulations must be included in the Order. Section 123.25(a)(12) allows the state to omit or modify conditions to impose more stringent requirements. In accordance with section 123.25, this Order omits federal conditions that address enforcement authority specified in sections 122.41(j)(5) and (k)(2) because the enforcement authority under the Water Code is more stringent. In lieu of these conditions, this Order incorporates by reference Water Code section 13387(e).

## B. Regional Water Board Standard Provisions

In addition to the Federal Standard Provisions (Attachment D), the Permittee shall comply with the Regional Water Board Standard Provisions provided in Standard Provisions VI.A.2.

1. Order Provision VI.A.2.a identifies the State's enforcement authority under the Water Code, which is more stringent than the enforcement authority specified in the federal regulations [e.g. sections 122.41(j)(5) and (k)(2)].

2. Order Provision VI.A.2.b requires the Permittee to notify Regional Water Board staff, orally and in writing, in the event that the Permittee does not comply or will be unable to comply with any Order requirement. This provision requires the Permittee to make direct contact with a Regional Water Board staff person.

## C. Special Provisions

### 1. Reopener Provisions

**a. Standard Revisions (Special Provisions VI.C.1.a).** Conditions that necessitate a major modification of a permit are described in section 122.62, which include the following:

i. When standards or regulations on which the permit was based have been changed by promulgation of amended standards or regulations or by judicial decision. Therefore, if revisions of applicable water quality standards are promulgated or approved pursuant to Section 303 of the CWA or amendments thereto, the Regional Water Board will revise and modify this Order in accordance with such revised standards.

ii. When new information that was not available at the time of permit issuance would have justified different permit conditions at the time of issuance.

**b. Reasonable Potential (Special Provisions VI.C.1.b).** This provision allows the Regional Water Board to modify, or revoke and reissue, this Order if present or future investigations demonstrate that the Permittee governed by this Permit is causing or contributing to excursions above any applicable priority pollutant criterion or objective, or adversely impacting water quality and/or the beneficial uses of receiving waters.

**c. Whole Effluent Toxicity (Special Provisions VI.C.1.c).** This Order requires the Permittee to investigate the causes of, and identify corrective actions to reduce or eliminate effluent toxicity through a TRE. This Order may be reopened to include a numeric chronic toxicity limitation, a new acute toxicity limitation, and/or a limitation for a specific toxicant identified in the TRE. Additionally, if a numeric chronic toxicity water quality objective or implementation policy is adopted by the State Water Board, this Order may be reopened to include those procedures and/ or a numeric chronic toxicity limitation based on the new objective(s).

**d. 303(d)-Listed Pollutants (Special Provisions VI.C.1.d).** This provision allows the Regional Water Board to reopen this Order to modify existing effluent limitations or add effluent limitations for pollutants that are the subject of any future TMDL action.

**e. Water Effects Ratios (WERs) and Metal Translators (Special Provisions VI.C.1.e).** This provision allows the Regional Water Board to reopen this Order if future studies undertaken by the Permittee provide new information and justification for applying a water effects ratio or metal translator to a water quality objective for one or more priority pollutants.

**2. Special Studies and Additional Monitoring Requirements**

**a. Toxicity Reduction Evaluations (Special Provisions VI.C.2.a-c).**

The SIP requires the use of short-term chronic toxicity tests to determine compliance with the narrative toxicity objectives for aquatic life in the Basin Plan. Attachment E of this Order requires chronic toxicity monitoring for demonstration of compliance with the narrative toxicity objective.

In addition to WET monitoring, this provision requires the Permittee to submit to the Regional Water Board, if one has not already been submitted, a TRE Work Plan for approval by the Executive Officer, to ensure the Permittee has a plan to immediately move forward with the initial tiers of a TRE, in the event effluent toxicity is encountered in the future. The TRE is initiated by evidence of a pattern of toxicity demonstrated through the

additional effluent monitoring provided as a result of an accelerated monitoring program.

**b. Arcata Marsh Wetland Sanctuary (AMWS) Evaluation (Special Provision VI.C.2.d).**

A special study is necessary to develop an appropriate monitoring and reporting plan for the AMWS. No approved plan is currently in place to provide adequate evaluation of the health and performance of the AMWS. Once in place, the approved plan will provided the basis for protection of beneficial uses in the AMWS.

**3. Best Management Practices and Pollution Prevention**

Provision VI.C.3.a is included in this Order as required by section 2.4.5 of the SIP. The Regional Water Board includes standard provisions in all NPDES permits requiring development of a Pollutant Minimization Program when there is evidence that a toxic pollutant is present in the effluent at a concentration greater than an applicable effluent limitation.

**4. Construction, Operation, and Maintenance Specifications**

Section 122.41(e) requires proper operation and maintenance of permitted wastewater systems and related facilities to achieve compliance with permit conditions. An up-to-date operation and maintenance (O&M) manual, as required by Provision VI.C.4.b of the Order, is an integral part of a well-operated and maintained facility.

**5. Special Provisions for Municipal Facilities (POTWs Only)**

**a. Wastewater Collection Systems**

i. **Statewide General WDRs for Sanitary Sewer Systems.** The State Water Board issued General Waste Discharge Requirements for Sanitary Sewer Systems, Water Quality Order No. 2006-0003-DWQ (General Order) on May 2, 2006. The General Order requires public agencies that own or operate sanitary sewer systems with greater than 1 mile of pipes or sewer lines to enroll for coverage under the General Order. The General Order requires agencies to develop sanitary sewer management plans (SSMPs) and report all SSOs, among other requirements and prohibitions.

Furthermore, the General Order contains requirements for operation and maintenance of collection systems and for reporting and mitigating sanitary sewer overflows. Inasmuch that the Permittee's collection

system is part of the system that is subject to this Order, certain standard provisions are applicable as specified in Provisions VI.A.2.b and VI.C.5 of the Order. The Permittee must separately comply with both this Order, and with the General Order, which is not incorporated by reference into this Order. The Permittee and public agencies that are discharging wastewater into the facility were required to obtain enrollment for regulation under the General Order by December 1, 2006. The Permittee has enrolled under the General Order as required.

All NPDES permits for POTWs currently include federally required standard conditions to mitigate discharges (section 122.41(d)), to report non-compliance (section 122.41(1)(6) and (7)), and to properly operate and maintain facilities (section 122.41(e)). This provision is consistent with these federal requirements.

ii. **Sanitary Sewer Overflows.** This Order includes provisions (Provision VI.C.5.(a)(2), and Attachment D subsection I.C., I.D, V.E, and V.H.) to ensure adequate and timely notifications are made to the Regional Water Board and appropriate local, state, and federal authorities in case of sewage spills. In addition, as an Enrollee under General Order No. 2006-0003-DWQ, the Permittee is separately required to report SSOs to an online SSO database administered through the California Integrated Water Quality System (CIWQS) and via telefax when the online SSO database is not available. Detailed notification and reporting requirements for SSOs and sewage spills are specified in Attachment E subsection E (Monitoring and Reporting Program). The goal of these provisions is to ensure appropriate and timely response by the Permittee to SSOs to protect public health and water quality.

**b. Pretreatment of Industrial Waste (Provision VI.C.5.b).**

This provision is based on 40 CFR Part 403, (General Pretreatment Regulations for Existing and New Sources of Pollution.)

**c. Sludge Disposal and Handling Requirements (Provision VI.C.5.c).**

The disposal or reuse of wastewater treatment screenings, sludges, or other solids removed from the liquid waste stream is regulated by 40 CFR Parts 257, 258, 501, and 503, and the State Water Board promulgated provisions of title 27, California Code of Regulations. The Permittee has indicated that that all screenings, sludges, and solids removed from the liquid waste stream are currently disposed of off-site at a municipal solid waste landfill in accordance with all applicable regulations. See Fact Sheet section II.A for more detail.

**d. Operator Certification (Provision VI.C.5.d).**

This provision requires the WWTF to be operated by supervisors and operators who are certified as required by title 23, California Code of Regulations, section 3680 and is retained from the previous permit.

**e. Adequate Capacity (Provision VI.C.5.e).**

The goal of this provision is to ensure appropriate and timely planning by the Permittee to ensure adequate capacity for the protection of public health and water quality. This provision is retained from the previous permit.

**f. Statewide General WDRs for Discharge of Biosolids to Land (Provision VI.C.5.f).**

This provision requires the Permittee to separately comply with the State's regulations relating to the discharge of biosolids to the land. The discharge of biosolids through land application is not regulated under this Order. Instead, the Permittee is required to obtain separate coverage under the State Water Board Order No. 2004-0012-DWQ, General Waste Discharge Requirements for the Discharge of Biosolids to Land as a Soil Amendment in Agricultural, Silvicultural, Horticultural, and Land Reclamation Activities (General Order). Coverage under the General Order, as opposed to coverage under this NPDES permit or individual WDRs, implements a consistent statewide approach to regulating this waste discharge.

**6. Other Special Provisions**

a. **Storm Water.** For the control of storm water discharged from the site of the wastewater treatment plant, the Discharge must separately seek coverage under the State Water Board's Water Quality Order 97-03-DWQ, if applicable.

b. **Engineering and Antidegration Analysis for Proposed Increased Wet Weather Treatment Capacity**. If the Permittee seeks to increase the permitted flow, the Permittee shall submit an analysis to document that that figure is an accurate representation of the capacity of wastewater collection and treatment components and to ensure that such an increase is consistent, or not, with applicable State and federal antidegradation regulations, guidance, and policy.

**7. Compliance Schedules**

This section is not applicable to the Arcata WWTF.

## VIII. PUBLIC PARTICIPATION

The California Regional Water Quality Control Board, North Coast Region (Regional Water Board) is considering the issuance of waste discharge requirements (WDRs) that will serve as a National Pollutant Discharge Elimination System (NPDES) permit for the City of Arcata Wastewater Treatment Facility. As a step in the WDR adoption process, the Regional Water Board staff has developed tentative WDRs. The Regional Water Board encourages public participation in the WDR adoption process.

### A. Notification of Interested Parties

The Regional Water Board has notified the Permittee and interested agencies and persons of its intent to prescribe waste discharge requirements for the discharge and has provided them with an opportunity to submit their written comments and recommendations. Notification was provided through the following posting on the Regional Water Board's Internet site at: http://www.waterboards.ca.gov/northcoast/public_notices/public_hearings/npdes_permits_and_wdrs.shtml on March 12, 2012.

### B. Written Comments

The staff determinations are tentative until the final Order is adopted by the Regional Water Board. Interested persons are invited to submit written comments concerning these tentative WDRs. Comments must be submitted either in person or by mail to the Executive Office at the Regional Water Board at the address above on the cover page of this Order.

To be fully responded to by staff and considered by the Regional Water Board, written comments must have been received at the Regional Water Board offices by 5:00 p.m. on **April 12, 2012**

### C. Public Hearing

The Regional Water Board will hold a public hearing on the tentative WDRs during its regular Board meeting on the following date and time and at the following location:

| | |
|---|---|
| Date: | June 7, 2012 |
| Time: | 9:00 AM |
| Location: | Willow Creek Community Services District<br>Kimtu Cookhouse/Lodge<br>135 Willow Road<br>Willow Creek, California |

Interested persons are invited to attend. At the public hearing, the Regional Water Board will hear testimony, if any, pertinent to the discharge, WDRs, and permit. Oral testimony will be heard; however, for accuracy of the record, important testimony should be in writing. When adopting this Order, the Regional Water Board, in the above referenced public meeting, heard and considered all comments pertaining to the discharge.

**Please be aware that dates and venues may change**. Our Web address is http://www.waterboards.ca.gov/northcoast where you can access the current agenda for changes in dates and locations.

### D. Waste Discharge Requirements Petitions

Any aggrieved person may petition the State Water Resources Control Board to review the decision of the Regional Water Board regarding the final WDRs. The petition must be submitted within 30 days of the Regional Water Board's action to the following address:

State Water Resources Control Board
Office of Chief Counsel
P.O. Box 100, 1001 I Street
Sacramento, CA 95812-0100

### E. Information and Copying

The Report of Waste Discharge (ROWD), related documents, tentative effluent limitations and special provisions, comments received, and other information are on file and may be inspected at the address above at any time between 8:30 a.m. and 4:45 p.m., Monday through Friday. Copying of documents may be arranged through the Regional Water Board by calling 707-576-2220.

### F. Register of Interested Persons

Any person interested in being placed on the mailing list for information regarding the WDRs and NPDES permit should contact the Regional Water Board, reference this facility, and provide a name, address, and phone number.

### G. Additional Information

Requests for additional information or questions regarding this order should be directed to Lisa Bernard at 707-576-2677 or lbernard@waterboards.ca.gov.

# APPENDIX B – NPDES DISCHARGE VIOLATIONS 2012-2015

APPENDIX B. NPDES DISCHARGE VIOLATIONS 2012-2015
WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT
CITY OF ARCATA

| Violation ID | Occurred Date | Violation Type | (-) Violation Description | Corrective Action |
|---|---|---|---|---|
| 1002471 | 12/19/2015 | DMON | A single sample was collected for compliance with weekly monitoring requirements. | laboratory error the sample was analyzed for E. coli using the Quanti-Tray method. The result of the Quanti-Tray test was Total Coliform < 1.0 MPN/100 mL and E. coli < 1.0 MPN/100 ml. It can be reasoned that since fecal coliform is a total coliform that the result for fecal coliform is the same as the result for total coliform (1.0 MPN/100 mL). However, since the Quanti-Tray method is not approved for use in fecal coliform testing this result is not reported in the December 2015 SMR. The contract laboratory was contacted and the testing error was reviewed. |
| 999429 | 10/31/2015 | CAT1 | Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Monthly Average limit is 45 mg/L and reported value was 54 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | A seasonal increase in BOD typically occurs in the fall due to a variety of factors in the natural treatment system. Under normal combined-basin operational mode effluent to Outfall-002 is treated with chlorine for disinfection and sulfur dioxide for dechlorination. Chlorination provides a small amount of BOD removal upstream of Outfall-002 and is advantageous in keeping the effluent from exceeding the discharge specifications for BOD. The City determined that it was beneficial to continue operating the treatment plant in single-pass mode through October in order to collect data to help us plan for future treatment plant upgrades where single pass mode will be the normal operation. During this time, the City was actively making operational decisions to achieve compliance with the discharge specifications for BOD at Outfall-002. Operational changes made to the treatment system, including chlorination of treatment marsh effluent upstream of Outfall-002, were somewhat successful at lowering BOD values at Outfall-002; however, discharge specifications were still exceeded. The City returned to combined-basin operation on October 30, 2015 in order to achieve improved water quality at Outfall-002 and to prepare for winter weather conditions. |
| 999431 | 10/31/2015 | CAT1 | Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Weekly Average limit is 65 mg/L and reported value was 66 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | A seasonal increase in BOD typically occurs in the fall due to a variety of factors in the natural treatment system. Under normal combined-basin operational mode effluent to Outfall-002 is treated with chlorine for disinfection and sulfur dioxide for dechlorination. Chlorination provides a small amount of BOD removal upstream of Outfall-002 and is advantageous in keeping the effluent from exceeding the discharge specifications for BOD. The City determined that it was beneficial to continue operating the treatment plant in single-pass mode through October in order to collect data to help us plan for future treatment plant upgrades where single pass mode will be the normal operation. During this time, the City was actively making operational decisions to achieve compliance with the discharge specifications for BOD at Outfall-002. Operational changes made to the treatment system, including chlorination of treatment marsh effluent upstream of Outfall-002, were somewhat successful at lowering BOD values at Outfall-002; however, discharge specifications were still exceeded. The City returned to combined-basin operation on October 30, 2015 in order to achieve improved water quality at Outfall-002 and to prepare for winter weather conditions. |
| 999430 | 10/31/2015 | CAT2 | Chlorine, Total Residual Monthly Average limit is 0.01 % and reported value was 0.05 % at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | chlorine was applied to treatment marsh effluent to treat approximately one-half of the historic chlorine demand. A continuous chlorine analyzer was configured to monitor total residual chlorine (TRC) in the first half of the contact basin prior to discharge at Outfall-002. A high chlorine alarm level was set at 0.5 mg/l Cl2 based on the assumption that TRC remaining at the monitoring point would have enough contact time to react out before discharge at Outfall-002. Daily grab samples were collected at Outfall-002 to confirm that chlorine was not present in Effluent-002 for compliance with TRC monitoring requirements. On 10/29/2015 the on-call operator responded to a high chlorine alarm. At 01:55 a.m. the chlorine analyzer was detecting a 0.7 mg/L Cl2 half way through the first pass of the contact basin and the TRC at Outfall-002 was 0.00 mg/L indicating that the chlorination rate was still well below chlorine demand. The chlorine feed rate was reduced by 10 lbs/day and the chlorine analyzer was set to high alarm at 0.8 mg/L. On 10/30/2015 at 11:32 a.m. a routine grab sample was collected and analyzed for TRC at Outfall-002 with a result of 0.32 mg/L Cl2. The chlorine feed rate was reduced. A grab sample was collected at Outfall-002 and analyzed at for TRC 11:55 a.m. to confirm the results of the previous sample analysis; TRC was measured at 0.31 mg/L Cl2. After confirming the results of the titration discharge at Outfall-002 was |
| 1002472 | 10/31/2015 | CAT2 | Dichlorobromomethane Monthly Average limit is 0.56 ug/L and reported value was 3.2 ug/L at EFF-001. | the effluent limit throughout the compliance period. Dichlorobromomethane is a common disinfection byproduct and may be a result of chlorinating wastewater for disinfection. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV as the primary disinfectant no later than December 1, 2016. |
| 999428 | 10/30/2015 | CAT2 | Chlorine, Total Residual Maximum Daily (MDEL) limit is 0.02 mg/L and reported value was 0.32 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | chlorine was applied to treatment marsh effluent to treat approximately one-half of the historic chlorine demand. A continuous chlorine analyzer was configured to monitor total residual chlorine (TRC) in the first half of the contact basin prior to discharge at Outfall-002. A high chlorine alarm level was set at 0.5 mg/l Cl2 based on the assumption that TRC remaining at the monitoring point would have enough contact time to react out before discharge at Outfall-002. Daily grab samples were collected at Outfall-002 to confirm that chlorine was not present in Effluent-002 for compliance with TRC monitoring requirements. On 10/29/2015 the on-call operator responded to a high chlorine alarm. At 01:55 a.m. the chlorine analyzer was detecting a 0.7 mg/L Cl2 half way through the first pass of the contact basin and the TRC at Outfall-002 was 0.00 mg/L indicating that the chlorination rate was still well below chlorine demand. The chlorine feed rate was reduced by 10 lbs/day and the chlorine analyzer was set to high alarm at 0.8 mg/L. On 10/30/2015 at 11:32 a.m. a routine grab sample was collected and analyzed for TRC at Outfall-002 with a result of 0.32 mg/L Cl2. The chlorine feed rate was reduced. A grab sample was collected at Outfall-002 and analyzed at for TRC 11:55 a.m. to confirm the results of the previous sample analysis; TRC was measured at 0.31 mg/L Cl2. After confirming the results of the titration discharge at Outfall-002 was |
| 1002473 | 10/28/2015 | CAT2 | Dichlorobromomethane Daily Maximum limit is 1.12 ug/L and reported value was 3.2 ug/L. | the effluent limit throughout the compliance period. Dichlorobromomethane is a common disinfection byproduct and may be a result of chlorinating wastewater for disinfection. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV as the primary disinfectant no later than December 1, 2016. |
| 998559 | 8/31/2015 | CAT2 | Dichlorobromomethane Monthly Average limit is 0.56 ug/L and reported value was 5.5 ug/L at EFF-001. | Historical performance indicates that dichlorobromomethane occurs occasionally but not consistently, indicating that it is unlikely that dichlorobromomethane levels remained above the effluent limit throughout the compliance period. Dichlorobromomethane is a common disinfection byproduct and may be a result of chlorinating wastewater for disinfection. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. |
| 998558 | 8/20/2015 | CAT2 | Dichlorobromomethane Daily Maximum limit is 1.12 ug/L and reported value was 5.5 ug/L at EFF-001. | Historical performance indicates that dichlorobromomethane occurs occasionally but not consistently, indicating that it is unlikely that dichlorobromomethane levels remained above the effluent limit throughout the compliance period. Dichlorobromomethane is a common disinfection byproduct and may be a result of chlorinating wastewater for disinfection. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. |
| 995335 | 7/31/2015 | CAT1 | Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Monthly Average limit is 45 mg/L and reported value was 55 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | for disinfection and sulfur dioxide for dechlorination. This treatment provides a small amount of BOD removal upstream of Outfall-002 and is advantageous in keeping the effluent from exceeding the discharge specifications for BOD at Outfall-002. After switching from combined-basin into split-basin mode on 5/7/2015 Effluent-002 BOD spiked. The spike in BOD can likely be attributed to natural processes and the effluent not being chlorinated and dechlorinated. The City has determined that it is beneficial to continue operating the treatment plant in single-pass mode in order to collect data which will help us plan for future treatment plant upgrades where single pass mode will be the normal operation. During this time, the City is actively making operational decisions to achieve compliance with the discharge specifications for BOD at Outfall-002. Improvements to water quality typically take 2-3 weeks to manifest after an operational change is made to the natural treatment system. We continue to carefully monitor the water quality of Effluent-002 and make operational decisions that protect water quality. |
| 995334 | 7/29/2015 | DMON | The BOD sample collected at Outfall-002 on 7/29/2015 was analyzed past the official hold time due to insufficient oxygen depletion during the initial analysis. | The BOD sample collected at Outfall-002 on 7/29/2015 was analyzed past the official hold time due to insufficient oxygen depletion during the initial analysis. The sample was split and also analyzed in-house for process control purposes. The result of the in-house analysis was 45 mg/L as compared to the result of 41 mg/L obtained by the contract laboratory when the same sample was analyzed past the hold time. The result obtained by the contract laboratory for the sample run past the hold time was accepted as a reportable value. |

APPENDIX B. NPDES DISCHARGE VIOLATIONS 2012-2015
WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT
CITY OF ARCATA

| | | | | |
|---|---|---|---|---|
| 995333 | 7/18/2015 | CAT1 | Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Weekly Average limit is 65 mg/L and reported value was 68 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | The City has determined that it is beneficial to continue operating the treatment plant in single-pass mode in order to collect data which will help us plan for future treatment plant upgrades where single pass mode will be the normal operation. During this time, the City is actively making operational decisions to achieve compliance with the discharge specifications for BOD at Outfall-002. Improvements to water quality typically take 2-3 weeks to manifest after an operational change is made to the natural treatment system. We continue to carefully monitor the water quality of Effluent-002 and make operational decisions that protect water quality. |
| 994041 | 7/14/2015 | Deficient Reporting | Several BOD and TSS percent removal calculations submitted to the Regional Water Quality Control Board between August 2013 and May 2015 are incorrect. NPDES permit CA0022713 calls for BOD and TSS percent removal to be calculated based on concentration. A recent audit conducted by the State Water Resources Control Board highlighted the fact that some of the BOD and TSS percent removal calculations submitted were based on mass-loading. A letter notifying the Regional Water Quality Control Board of the reporting errors was emailed to Justin Smith, RWQCB on 7/16/2015. A copy of the aforementioned letter is included in this SMR as an attachment. | BOD and TSS percent removal reporting errors occurred due to the improper use of an out-dated reporting template used by the City to calculate compliance statistics. While it is normal to check all reports for transcription errors prior to reporting, the quality control check rarely includes review of the formulas which auto-populate data for reporting purposes. The City implemented a plan to ensure that the correct reporting template is used by operational staff. The plan included staff training, deleting out-dated templates and files from computers, and a review of the formulas programmed into templates. Corrected percent removal data is reported in the attached letter Correction to Percent Removal Data Submitted Letter. It is important to note that the error did not result in any noncompliance being unreported. We are pleased to report that the corrected data shows that the City was in compliance with BOD percent removal requirements in December 2014 and with TSS percent removal requirements in February 2015, which had both previously been reported as noncompliance. |
| 994042 | 6/30/2015 | CAT1 | Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Monthly Average limit is 45 mg/L and reported value was 80 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | BOD fluctuates in the natural treatment system due to a variety of environmental factors. High levels of nitrogenous BOD in the effluent of some treatment units is typical during late spring/early summer due to the presence of ammonia (from decomposing solids) and nitrifying bacteria in the treatment unit. Under normal combined-basin operational mode effluent to Outfall-002 is treated with chlorine for disinfection and sulfur dioxide for dechlorination. This treatment provides a small amount of BOD removal upstream of Outfall-002 and is advantageous in keeping the effluent from exceeding the discharge specifications for BOD at Outfall-002. After switching from combined-basin into split-basin mode on 5/7/2015 Effluent-002 BOD spiked. The spike in BOD can likely be attributed to natural processes and the effluent not being chlorinated and dechlorinated. The City has determined that it is beneficial to continue operating the treatment plant in single-pass mode in order to collect data which will help us plan for future treatment plant upgrades where single pass mode will be the normal operation. During this time, the City is actively making operational decisions to achieve compliance with the discharge specifications for BOD at Outfall-002. Improvements to water quality typically take 2-3 weeks to manifest after an operational change is made to the natural treatment system. We continue to carefully monitor the water quality of Effluent-002 and make operational decisions that protect water quality. |
| 994040 | 6/27/2015 | CAT1 | Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Weekly Average limit is 65 mg/L and reported value was 78 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | BOD fluctuates in the natural treatment system due to a variety of environmental factors. High levels of nitrogenous BOD in the effluent of some treatment units is typical during late spring/early summer due to the presence of ammonia (from decomposing solids) and nitrifying bacteria in the treatment unit. Under normal combined-basin operational mode effluent to Outfall-002 is treated with chlorine for disinfection and sulfur dioxide for dechlorination. This treatment provides a small amount of BOD removal upstream of Outfall-002 and is advantageous in keeping the effluent from exceeding the discharge specifications for BOD at Outfall-002. After switching from combined-basin into split-basin mode on 5/7/2015 Effluent-002 BOD spiked. The spike in BOD can likely be attributed to natural processes and the effluent not being chlorinated and dechlorinated. The City has determined that it is beneficial to continue operating the treatment plant in single-pass mode in order to collect data which will help us plan for future treatment plant upgrades where single pass mode will be the normal operation. During this time, the City is actively making operational decisions to achieve compliance with the discharge specifications for BOD at Outfall-002. Improvements to water quality typically take 2-3 weeks to manifest after an operational change is made to the natural treatment system. We continue to carefully monitor the water quality of Effluent-002 and make operational decisions that protect water quality. |
| 994039 | 6/20/2015 | CAT1 | Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Weekly Average limit is 65 mg/L and reported value was 73 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | BOD fluctuates in the natural treatment system due to a variety of environmental factors. High levels of nitrogenous BOD in the effluent of some treatment units is typical during late spring/early summer due to the presence of ammonia (from decomposing solids) and nitrifying bacteria in the treatment unit. Under normal combined-basin operational mode effluent to Outfall-002 is treated with chlorine for disinfection and sulfur dioxide for dechlorination. This treatment provides a small amount of BOD removal upstream of Outfall-002 and is advantageous in keeping the effluent from exceeding the discharge specifications for BOD at Outfall-002. After switching from combined-basin into split-basin mode on 5/7/2015 Effluent-002 BOD spiked. The spike in BOD can likely be attributed to natural processes and the effluent not being chlorinated and dechlorinated. The City has determined that it is beneficial to continue operating the treatment plant in single-pass mode in order to collect data which will help us plan for future treatment plant upgrades where single pass mode will be the normal operation. During this time, the City is actively making operational decisions to achieve compliance with the discharge specifications for BOD at Outfall-002. Improvements to water quality typically take 2-3 weeks to manifest after an operational change is made to the natural treatment system. We continue to carefully monitor the water quality of Effluent-002 and make operational decisions that protect water quality. |
| 994043 | 6/13/2015 | CAT1 | Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Weekly Average limit is 65 mg/L and reported value was 70 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | BOD fluctuates in the natural treatment system due to a variety of environmental factors. High levels of nitrogenous BOD in the effluent of some treatment units is typical during late spring/early summer due to the presence of ammonia (from decomposing solids) and nitrifying bacteria in the treatment unit. Under normal combined-basin operational mode effluent to Outfall-002 is treated with chlorine for disinfection and sulfur dioxide for dechlorination. This treatment provides a small amount of BOD removal upstream of Outfall-002 and is advantageous in keeping the effluent from exceeding the discharge specifications for BOD at Outfall-002. After switching from combined-basin into split-basin mode on 5/7/2015 Effluent-002 BOD spiked. The spike in BOD can likely be attributed to natural processes and the effluent not being chlorinated and dechlorinated. The City has determined that it is beneficial to continue operating the treatment plant in single-pass mode in order to collect data which will help us plan for future treatment plant upgrades where single pass mode will be the normal operation. During this time, the City is actively making operational decisions to achieve compliance with the discharge specifications for BOD at Outfall-002. Improvements to water quality typically take 2-3 weeks to manifest after an operational change is made to the natural treatment system. We continue to carefully monitor the water quality of Effluent-002 and make operational decisions that protect water quality. |

APPENDIX B. NPDES DISCHARGE VIOLATIONS 2012-2015
WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT
CITY OF ARCATA

| | | | | |
|---|---|---|---|---|
| 994038 | 6/6/2015 | CAT1 | Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Weekly Average limit is 65 mg/L and reported value was 99 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | BOD fluctuates in the natural treatment system due to a variety of environmental factors. High levels of nitrogenous BOD in the effluent of some treatment units is typical during late spring/early summer due to the presence of ammonia (from decomposing solids) and nitrifying bacteria in the treatment unit. Under normal combined-basin operational mode effluent to Outfall-002 is treated with chlorine for disinfection and sulfur dioxide for dechlorination. This treatment provides a small amount of BOD removal upstream of Outfall-002 and is advantageous in keeping the effluent from exceeding the discharge specifications for BOD at Outfall-002. After switching from combined-basin into split-basin mode on 5/7/2015 Effluent-002 BOD spiked. The spike in BOD can likely be attributed to natural processes and the effluent not being chlorinated and dechlorinated. The City has determined that it is beneficial to continue operating the treatment plant in single-pass mode in order to collect data which will help us plan for future treatment plant upgrades where single pass mode will be the normal operation. During this time, the City is actively making operational decisions to achieve compliance with the discharge specifications for BOD at Outfall-002. Improvements to water quality typically take 2-3 weeks to manifest after an operational change is made to the natural treatment system. We continue to carefully monitor the water quality of Effluent-002 and make operational decisions that protect water quality. |
| 992445 | 5/31/2015 | CAT1 | Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Monthly Average limit is 45 mg/L and reported value was 88 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | BOD fluctuates in the natural treatment system due to a variety of environmental factors. High levels of nitrogenous BOD in the effluent of some treatment units is typical during late spring/early summer due to the presence of ammonia (from decomposing solids) and nitrifying bacteria in the treatment unit. Under normal combined-basin operational mode effluent to Outfall-002 is treated with chlorine for disinfection and sulfur dioxide for dechlorination. This treatment provides a small amount of BOD removal upstream of Outfall-002 and is advantageous in keeping the effluent from exceeding the discharge specifications for BOD at Outfall-002. After switching from combined-basin into split-basin mode on 5/7/2015 Effluent-002 BOD spiked. The spike in BOD can likely be attributed to the effluent not being chlorinated and dechlorinated. The City has determined that it is beneficial to continue operating the treatment plant in single-pass mode in order to collect data which will help us plan for future treatment plant upgrades where single pass mode will be the normal operation. During this time, the City is actively making operational decisions to achieve compliance with the discharge specifications for BOD at Outfall-002. Improvements to water quality typically take 2-3 weeks to manifest after an operational change is made to the natural treatment system. We continue to carefully monitor the water quality of Effluent-002 and make operational decisions that protect water quality. |
| 992446 | 5/30/2015 | CAT1 | Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Weekly Average limit is 65 mg/L and reported value was 120 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | BOD fluctuates in the natural treatment system due to a variety of environmental factors. High levels of nitrogenous BOD in the effluent of some treatment units is typical during late spring/early summer due to the presence of ammonia (from decomposing solids) and nitrifying bacteria in the treatment unit. Under normal combined-basin operational mode effluent to Outfall-002 is treated with chlorine for disinfection and sulfur dioxide for dechlorination. This treatment provides a small amount of BOD removal upstream of Outfall-002 and is advantageous in keeping the effluent from exceeding the discharge specifications for BOD at Outfall-002. After switching from combined-basin into split-basin mode on 5/7/2015 Effluent-002 BOD spiked. The spike in BOD can likely be attributed to the effluent not being chlorinated and dechlorinated. The City has determined that it is beneficial to continue operating the treatment plant in single-pass mode in order to collect data which will help us plan for future treatment plant upgrades where single pass mode will be the normal operation. During this time, the City is actively making operational decisions to achieve compliance with the discharge specifications for BOD at Outfall-002. Improvements to water quality typically take 2-3 weeks to manifest after an operational change is made to the natural treatment system. We continue to carefully monitor the water quality of Effluent-002 and make operational decisions that protect water quality. |
| 992448 | 5/23/2015 | CAT1 | Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Weekly Average limit is 65 mg/L and reported value was 140 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | BOD fluctuates in the natural treatment system due to a variety of environmental factors. High levels of nitrogenous BOD in the effluent of some treatment units is typical during late spring/early summer due to the presence of ammonia (from decomposing solids) and nitrifying bacteria in the treatment unit. Under normal combined-basin operational mode effluent to Outfall-002 is treated with chlorine for disinfection and sulfur dioxide for dechlorination. This treatment provides a small amount of BOD removal upstream of Outfall-002 and is advantageous in keeping the effluent from exceeding the discharge specifications for BOD at Outfall-002. After switching from combined-basin into split-basin mode on 5/7/2015 Effluent-002 BOD spiked. The spike in BOD can likely be attributed to the effluent not being chlorinated and dechlorinated. The City has determined that it is beneficial to continue operating the treatment plant in single-pass mode in order to collect data which will help us plan for future treatment plant upgrades where single pass mode will be the normal operation. During this time, the City is actively making operational decisions to achieve compliance with the discharge specifications for BOD at Outfall-002. Improvements to water quality typically take 2-3 weeks to manifest after an operational change is made to the natural treatment system. We continue to carefully monitor the water quality of Effluent-002 and make operational decisions that protect water quality. |
| 992447 | 5/16/2015 | CAT1 | Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Weekly Average limit is 65 mg/L and reported value was 83 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | BOD fluctuates in the natural treatment system due to a variety of environmental factors. High levels of nitrogenous BOD in the effluent of some treatment units is typical during late spring/early summer due to the presence of ammonia (from decomposing solids) and nitrifying bacteria in the treatment unit. Under normal combined-basin operational mode effluent to Outfall-002 is treated with chlorine for disinfection and sulfur dioxide for dechlorination. This treatment provides a small amount of BOD removal upstream of Outfall-002 and is advantageous in keeping the effluent from exceeding the discharge specifications for BOD at Outfall-002. After switching from combined-basin into split-basin mode on 5/7/2015 Effluent-002 BOD spiked. The spike in BOD can likely be attributed to the effluent not being chlorinated and dechlorinated. The City has determined that it is beneficial to continue operating the treatment plant in single-pass mode in order to collect data which will help us plan for future treatment plant upgrades where single pass mode will be the normal operation. During this time, the City is actively making operational decisions to achieve compliance with the discharge specifications for BOD at Outfall-002. Improvements to water quality typically take 2-3 weeks to manifest after an operational change is made to the natural treatment system. We continue to carefully monitor the water quality of Effluent-002 and make operational decisions that protect water quality. |
| 992689 | 4/30/2015 | CAT2 | Dichlorobromomethane Monthly Average limit is 0.56 ug/L and reported value was 2.5 ug/L at EFF-001. | Historical performance indicates that dichlorobromomethane occurs occasionally but not consistently, indicating that it is unlikely that dichlorobromomethane levels remained above the effluent limit throughout the compliance period. Dichlorobromomethane is a common disinfection byproduct and may be a result of chlorinating wastewater for disinfection. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV as the primary disinfectant no later than December 1, 2016. |
| 991483 | 4/29/2015 | DMON | This deficient monitoring violation applies to a single BOD sample collected at INF-001 on 4/29/2015. | The BOD sample collected on 4/29/2015 at monitoring location INF-001 was analyzed past to the official hold time due to anomalous test results of the initial analysis. The contract laboratory indicated that the result of the initial analysis was much lower than is typically seen in an influent sample during a dry weather period. Result of the subsequent analysis, although analyzed past the hold time, was accepted by the City as reportable since the result obtained by the contract laboratory mirrored the BOD result obtained by our in-house laboratory analysis of the same sample. The result of the BOD sample analyzed by the contract laboratory on 5/8/2015 was 200 mg/L while the in-house laboratory analysis of the same sample, analyzed on 4/30/2015, was 198 mg/L. |
| 992687 | 4/7/2015 | CAT2 | Dichlorobromomethane Daily Maximum limit is 1.12 ug/L and reported value was 2.5 ug/L at EFF-001. | Historical performance indicates that dichlorobromomethane occurs occasionally but not consistently, indicating that it is unlikely that dichlorobromomethane levels remained above the effluent limit throughout the compliance period. Dichlorobromomethane is a common disinfection byproduct and may be a result of chlorinating wastewater for disinfection. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV as the primary disinfectant no later than December 1, 2016. |

APPENDIX B. NPDES DISCHARGE VIOLATIONS 2012-2015
WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT
CITY OF ARCATA

| | | | | |
|---|---|---|---|---|
| 990184 | 3/11/2015 | CTOX | Chronic Toxicity Single Sample Maximum limit is 2.0 TUc and reported value was 8 TUc at EFF-001. | Results of the first week of accelerated monitoring indicated that the City should cease accelerated monitoring and initiate a Toxicity Reduction Evaluation. However, subsequent testing shows that the effluent is back in compliance with numeric and narrative chronic toxicity conditions. A letter regarding chronic toxicity is included as an attachment to this SMR. |
| 990182 | 2/28/2015 | CAT2 | Dichlorobromomethane Monthly Average limit is 0.56 ug/L and reported value was 1.6 ug/L at EFF-001. | Historical performance indicates that dichlorobromomethane occurs occasionally but not consistently, indicating that it is unlikely that dichlorobromomethane levels remained above the effluent limit throughout the compliance period. Dichlorobromomethane is a common disinfection byproduct and may be a result of chlorinating wastewater for disinfection. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV as its primary disinfectant no later than December 1, 2016. |
| 990185 | 2/18/2015 | CAT2 | Dichlorobromomethane Maximum Daily (MDEL) limit is 1.12 ug/L and reported value was 1.6 ug/L at EFF-001. | Historical performance indicates that dichlorobromomethane occurs occasionally but not consistently, indicating that it is unlikely that dichlorobromomethane levels remained above the effluent limit throughout the compliance period. Dichlorobromomethane is a common disinfection byproduct and may be a result of chlorinating wastewater for disinfection. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV as its primary disinfectant no later than December 1, 2016. |
| 993131 | 2/14/2015 | CAT1 | Total Suspended Solids (TSS) Weekly Average limit is 1200 lb/day and reported value was 1400 lb/day at EFF-001. | |
| 993133 | 2/14/2015 | CAT1 | Total Suspended Solids (TSS) Weekly Average limit is 45 mg/L and reported value was 47 mg/L at EFF-001. | |
| 990183 | 2/9/2015 | CTOX | Chronic Toxicity 3-Sample Median limit is 0 Pass/Fail (Pass = 0, Fail = 1) and reported value was 1 Pass/Fail (Pass = 0, Fail = 1) at EFF-001. | Results for chronic WET testing in the first quarter of 2015 showed that there were no significant reductions in survival at the 100% effluent concentration resulting in 1 TUc for survival (where TUc =100/NOEC). However, there was a significant reduction in reproduction at the 100% effluent concentration; the reproduction NOEC was 75% effluent, resulting in a 1.3 TUc. The results of the Quarter 1 2015 chronic WET resulted in a 3-sample median >1.0 TUc for the reproduction test, a violation of the narrative condition in the NPDES permit and triggering accelerated monitoring. Accelerated monitoring was initiated on 3/11/2015 in accordance with the requirements of NPDES Permit CA0022713/Order No. R1-2012-0031, Attachment E, Provision V.B.9. A detailed report on chronic toxicity testing and accelerated monitoring is included as an attachment to this SMR. |
| 1001930 | 12/31/2014 | CAT1 | Total Suspended Solids (TSS) Monthly Average limit is 30 mg/L and reported value was 37 mg/L at EFF-001. | |
| 993132 | 12/31/2014 | CAT1 | Total Suspended Solids (TSS) Monthly Average limit is 970 lb/day and reported value was 1300 lb/day at EFF-001. | Internal TSS loading, from algal growth in open water portions of the Wastewater Treatment Plant (oxidation ponds and portions of the treatment wetlands), has resulted in higher than normal TSS concentration in the Treatment Plant Effluent. Changes have been made to the operational strategy in response to the high TSS concentration in the treatment system but the changes had little effect on the concentration of TSS in the Treatment Plant effluent. Despite high TSS concentrations, wet weather conditions experienced in February necessitated the need for high volume discharge in order to maintain Treatment Plant capacity. A decrease in TSS concentration was realized by the end of the month. This decrease was likely influenced by the large input of freshwater into the treatment system. Operational staff continues to make operational changes as necessary to maintain capacity within the treatment system and minimize discharges of TSS over the effluent limit. Additionally, Arcata Marsh Research Institute staff is researching possible treatment options to improve Treatment Plant performance. |
| 985526 | 12/31/2014 | CAT1 | Total Suspended Solids (TSS) Percent Reduction limit is 85 % and reported value was 75 % at EFF-001. | High influent flows occur during periods of heavy rainfall due to inflow and infiltration (I&I) issues in the collection system. Flows from I&I have low TSS concentrations compared to typical treatment plant effluent. As such, influent TSS values tend to be lower during wet weather periods due to a dilution from I&I. The City has an active I&I reduction program with repairs being made to the collection system as allowable each budget year. |
| 993130 | 12/27/2014 | CAT1 | Total Suspended Solids (TSS) Weekly Average limit is 1900 lb/day and reported value was 2900 lb/day at EFF-001. | |
| 1001929 | 12/27/2014 | CAT1 | Total Suspended Solids (TSS) Weekly Average limit is 45 mg/L and reported value was 61 mg/L at EFF-001. | |
| 1001927 | 12/13/2014 | CAT1 | Total Suspended Solids (TSS) Weekly Average limit is 1490 lb/day and reported value was 1565 lb/day at EFF-001. | |
| 985525 | 12/4/2014 | DMON | This deficient monitoring violation pertains to two samples collected for compliance purposes at EFF-001 and EFF-002 which were analyzed past the required hold time. | Laboratory records indicate that a sample collected on 12/4/2014 for compliance with pH monitoring requirements at Effluent-001 and Effluent-002 was analyzed past the 15 minute hold time. Hold time requirements were reviewed with laboratory staff. Based on discussions of typical laboratory routines it is likely that the sample was analyzed within the hold time period and that a transcription error led to the hold time exceedance, though there is no definitive evidence of this. A sample collected on 12/22/2014 for compliance with TSS monitoring requirements at Effluent-001 and Effluent-002 was analyzed past the 7 day hold time. Initially, the sample was analyzed by the contract laboratory on 12/28/2014. However, the result of the initial analysis did not agree with the result obtained by in-house laboratory analysis of the same sample. Further, a review of process control samples collected on the same day from upstream treatment units showed that none of the upstream processes, with the exception of the influent, had a TSS concentration as high as the value obtained by the contract laboratory. The City requested that the contract laboratory re-analyze the sample past the hold time. The result of the re-analysis agreed with the value obtained by the City's in-house laboratory and was within the range of TSS values that would be expected given the operating and weather conditions at the time the sample was collected. The City has determined that the sample result obtained upon re-analysis of the TSS sample collected on 12/22/2014 is representative of the water quality for the representative period. As such, the City is reporting TSS data obtained from the re-analysis for compliance purposes. The original TSS data point is reported in CIWQS with the QC code "Data rejected". The original TSS value is not included in any compliance calculations. |
| 983586 | 11/30/2014 | CAT2 | Copper, Total Recoverable Monthly Average limit is 2.9 ug/L and reported value was 3.9 ug/L at EFF-001. | No corrective action taken. On 11/20/2014 the Regional Board approved Order No. R1-2014-0050 eliminating effluent limits for copper at Outfall-001. |
| 983589 | 10/31/2014 | Deficient Reporting | The City failed to self report an effluent limit exceedence. | A sample collected on 10/21/2014 for dichlorobromomethane had a result that exceeded the average monthly effluent limitation. The average monthly value was reported in the October 2014 SMR however, the City failed to enter a self-determined violation for the exceedance. Further, the City failed to recognize the effluent violation in the October 2014 SMR cover letter and noncompliance letter. |

APPENDIX B. NPDES DISCHARGE VIOLATIONS 2012-2015
WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT
CITY OF ARCATA

| | | | | |
|---|---|---|---|---|
| 981413 | 10/31/2014 | CAT1 | Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Monthly Average limit is 45 mg/L and reported value was 52 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | Seasonal increase in BOD typically occurs in the Fall due to a variety of factors in the natural treatment system. Under normal combined-basin operational mode effluent to Outfall-002 is treated with chlorine for disinfection and sulfur dioxide for dechlorination. This treatment provides a small amount of BOD removal upstream of Outfall-002 and is advantageous in keeping the effluent from exceeding the discharge specifications for BOD at Outfall-002. The City determined that it was beneficial to continue operating the treatment plant in single-pass mode, during which Effluent-002 is not chlorinated and dechlorinated, in order to collect data which will help us plan for future treatment plant upgrades where single pass mode will be the normal operation. During the reporting period the City was actively making operational decisions and testing methods of nitrogenous BOD removal to achieve compliance with the discharge specifications for BOD at Outfall-002. On 10/23/2014 the City switched back to combined-basin mode in preparation for winter weather and because a decrease in BOD at Outfall-002 was not realized. |
| 981410 | 10/31/2014 | CAT2 | Copper, Total Recoverable Monthly Average limit is 2.9 ug/L and reported value was 3.9 ug/L at EFF-001. | A Water Effect Ratio (WER) study for discharges of copper from Arcata Wastewater Treatment Plant was submitted to the Regional Water Quality Control Board in December 2012 for consideration of applying a site-specific WER for copper at Outfall-001. The WER was approved by the Board in November 2014. |
| 981405 | 10/31/2014 | CAT2 | Copper, Total Recoverable Monthly Average limit is 4.7 ug/L and reported value was 7.9 ug/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | A Water Effect Ratio (WER) study for discharges of copper from Arcata Wastewater Treatment Plant was submitted to the Regional Water Quality Control Board in December 2012 for consideration of applying a site-specific WER for copper at Outfall-002. The WER was approved by the Regional Water Quality Control Board in November 2014. |
| 983417 | 10/31/2014 | CAT2 | Dichlorobromomethane Monthly Average limit is 0.56 ug/L and reported value was 2.0 ug/L at EFF-001. | |
| 981408 | 10/25/2014 | CAT1 | Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Weekly Average limit is 65 mg/L and reported value was 70 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | Seasonal increase in BOD typically occurs in the Fall due to a variety of factors in the natural treatment system. Under normal combined-basin operational mode effluent to Outfall-002 is treated with chlorine for disinfection and sulfur dioxide for dechlorination. This treatment provides a small amount of BOD removal upstream of Outfall-002 and is advantageous in keeping the effluent from exceeding the discharge specifications for BOD at Outfall-002. The City determined that it was beneficial to continue operating the treatment plant in single-pass mode, during which Effluent-002 is not chlorinated and dechlorinated, in order to collect data which will help us plan for future treatment plant upgrades where single pass mode will be the normal operation. During the reporting period the City was actively making operational decisions and testing methods of nitrogenous BOD removal to achieve compliance with the discharge specifications for BOD at Outfall-002. On 10/23/2014 the City switched back to combined-basin mode in preparation for winter weather and because a decrease in BOD at Outfall-002 was not realized. |
| 981407 | 10/18/2014 | CAT1 | Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Weekly Average limit is 65 mg/L and reported value was 70 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | Seasonal increase in BOD typically occurs in the Fall due to a variety of factors in the natural treatment system. Under normal combined-basin operational mode effluent to Outfall-002 is treated with chlorine for disinfection and sulfur dioxide for dechlorination. This treatment provides a small amount of BOD removal upstream of Outfall-002 and is advantageous in keeping the effluent from exceeding the discharge specifications for BOD at Outfall-002. The City determined that it was beneficial to continue operating the treatment plant in single-pass mode, during which Effluent-002 is not chlorinated and dechlorinated, in order to collect data which will help us plan for future treatment plant upgrades where single pass mode will be the normal operation. During the reporting period the City was actively making operational decisions and testing methods of nitrogenous BOD removal to achieve compliance with the discharge specifications for BOD at Outfall-002. On 10/23/2014 the City switched back to combined-basin mode in preparation for winter weather and because a decrease in BOD at Outfall-002 was not realized. |
| 981406 | 10/13/2014 | DMON | QA/QC issues | The nitrate sample collected at EFF-001 on 10/13/2014 was analyzed approximately 10 minutes past the hold time. The results are reported in the October 2014 SMR with comments regarding the QA/QC issue. Effluent-001 was re-sampled for nitrate in November 2014. |
| 981409 | 10/4/2014 | CAT1 | Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Weekly Average limit is 65 mg/L and reported value was 74 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | Seasonal increase in BOD typically occurs in the Fall due to a variety of factors in the natural treatment system. Under normal combined-basin operational mode effluent to Outfall-002 is treated with chlorine for disinfection and sulfur dioxide for dechlorination. This treatment provides a small amount of BOD removal upstream of Outfall-002 and is advantageous in keeping the effluent from exceeding the discharge specifications for BOD at Outfall-002. The City determined that it was beneficial to continue operating the treatment plant in single-pass mode, during which Effluent-002 is not chlorinated and dechlorinated, in order to collect data which will help us plan for future treatment plant upgrades where single pass mode will be the normal operation. During the reporting period the City was actively making operational decisions and testing methods of nitrogenous BOD removal to achieve compliance with the discharge specifications for BOD at Outfall-002. On 10/23/2014 the City switched back to combined-basin mode in preparation for winter weather and because a decrease in BOD at Outfall-002 was not realized. |
| 978713 | 9/30/2014 | CAT1 | Biochemical Oxygen Demand (BOD) (5-day @ 20 Deg. C) Monthly Average limit is 45 mg/L and reported value was 47 mg/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | HOLD |
| 978709 | 9/30/2014 | CAT2 | Copper, Total Monthly Average limit is 4.7 ug/L and reported value was 5.7 ug/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | A Water Effect Ratio (WER) study for discharges of copper at Arcata Wastewater Treatment Facility outfalls was submitted to the Regional Water Quality Control Board in December 2012 for consideration of a site specific WER for discharges of copper at Outfall-002. |
| 980068 | 8/30/2014 | Order Conditions | A malfunction of a chlorine analyzer resulted in the discharge of approximately 208,000 gallons of incompletely disinfected effluent to Humboldt Bay. The discharge violates Prohibition III.E of Order No. R1-2012-0031. | Maintenance and calibration of the chlorine analyzer was performed and appear to correct the malfunction. |

APPENDIX B. NPDES DISCHARGE VIOLATIONS 2012-2015
WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT
CITY OF ARCATA

| | | | | |
|---|---|---|---|---|
| 980069 | 8/30/2014 | OEV | Fecal Coliform Maximum Daily (MDEL) limit is 43 MPN/100 mL and reported value was 49 MPN/100 mL at EFF-001. | The malfunctioning chlorine analyzer was repaired, calibrated, and returned to service. |
| 977210 | 8/27/2014 | DMON | This Deficient Monitoring Violation applies to TSS samples collected on 8/27/2014 at Inf-001, Eff-001 and Eff-002. | Due to a compressor failure in the refrigerator at the contract laboratory, the Total Suspended Solids samples collected on 8/27/2014 were not held at less than 6° C for the entire hold time. Results of the analyses were in the range typically expected and have been accepted by the City as representative of the influent and effluent waste streams at the time of sampling. |
| 978710 | 7/31/2014 | Deficient Reporting | A single sample was collected for compliance with quarterly monitoring requirements. | The City collected a sample for dichlorobromomethane on July 24, 2014. The results of the analysis was 5.7 ug/L, a violation of both monthly average and daily maximum effluent limits for discharges at Outfall-001. The daily maximum and average monthly values for this sample were reported in the July 2014 Self Monitoring Report (SMR). However, the City failed to enter self-determined violations for exceeding the monthly average and daily maximum effluent limits for dichlorobromomethane at Effluent-001. Further, the City failed to recognized the effluent violations in the July 2014 SMR Cover Letter and July 2014 Noncompliance Letter. The City is resolving this issue by making this Deficient Reporting Self-Determined Violation entry and by reporting Self-Determined Violations for exceeding the effluent limits for monthly average and daily maximum for dichlorobromomethane in this SMR. |
| 975642 | 7/31/2014 | CAT2 | Copper, Total Recoverable Monthly Average limit is 4.7 ug/L and reported value was 4.8 ug/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | A single sample is collected for compliance with monthly monitoring requirements. A Water Effect Ratio (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of applying of a site-specific WER for discharges of copper at Outfall-002. |
| 978711 | 7/31/2014 | CAT2 | Dichlorobromomethane Monthly Average limit is 0.56 ug/L and reported value was 5.7 ug/L at EFF-001. | Historical performance indicates that dichlorobromomethane occurs occasionally but not consistently, indicating that it is unlikely that dichlorobromomethane levels remained above the effluent limit throughout the compliance period. Dichlorobromomethane is a common disinfection byproduct and may be a result of chlorinating wastewater for disinfection. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV its primary disinfectant no later than December 1, 2016. |
| 978712 | 7/24/2014 | CAT2 | Dichlorobromomethane Maximum Daily (MDEL) limit is 1.12 ug/L and reported value was 5.7 ug/L at EFF-001. | Historical performance indicates that dichlorobromomethane occurs occasionally but not consistently, indicating that it is unlikely that dichlorobromomethane levels remained above the effluent limit throughout the compliance period. Dichlorobromomethane is a common disinfection byproduct and may be a result of chlorinating wastewater for disinfection. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV its primary disinfectant no later than December 1, 2016. |
| 975643 | 7/17/2014 | DMON | A single sample is collected for compliance with weekly monitoring requirements. | Due to a sample handling error in the laboratory the result of the weekly 3x5 sample was reported as a range; <1.8 - 7.8 MPN/100mL. The results are considered valid and are within the normal range for Effluent-001. Corrective action by the contract laboratory consisted of review of test procedure with laboratory technician responsible for the error. |
| 975641 | 7/9/2014 | OEV | pH Instantaneous Minimum limit is 6.0 SU and reported value was 5.9 SU at EFF-001. | Historical performance indicates that pH decreases in the late summer and fall as plant material begins to break-down in the natural treatment system. Diurnal fluctuations in pH occur in the natural treatment system as plants takes up carbon dioxide during photosynthesis; indicating that it is unlikely that pH remained below the minimum throughout the compliance period. |
| 971014 | 5/31/2014 | CAT2 | Copper, Total Monthly Average limit is 2.9 ug/L and reported value was 5.1 ug/L at EFF-001. | A Water Effect Ratio (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of a site-specific WER for discharges of copper at Effluent-001. |
| 971015 | 5/31/2014 | CAT2 | Copper, Total Monthly Average limit is 4.7 ug/L and reported value was 5.1 ug/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | A Water Effect Ratio (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of a site-specific WER for discharges of copper at Effluent-002. |
| 969589 | 5/23/2014 | DMON | A deficient monitoring violation is being reported for failing to use the correct analytical method for ammonia nitrogen analysis, and for failing to collect pH and settleable solids samples at Outfall-001 and Outfall-002 on 4/5/2014. | Due to an operator error, the City failed to collect and analyze samples for pH and suspended solids at Outfall-001 and Outfall-002 on 4/5/2014. Monitoring requirements were reviewed with all operators with emphasis on frequency of sample collection and established time frames (e.g. daily is defined as midnight to 11:59 p.m., weekly is defined as Sunday-Saturday, etc.), and procedures for notifying management of deficient monitoring or other violations. The City of Arcata initiated monitoring for ammonia nitrogen in August 2012 and has subsequently collected, analyzed, and reported results for seven quarterly ammonia nitrogen samples. To date, all ammonia nitrogen samples have been analyzed using Standard Methods (20th edition) 4500-NH3 D without distillation, as specified in the method. During a recent review of 40 CFR Part 136 it has come to my attention that the federal regulation requires distillation of wastewater samples prior to analysis of ammonia nitrogen samples analyzed with Standard Methods 4500-NH3 D. All future ammonia nitrogen samples will be analyzed using Standard Methods 4500-NH3 D with distillation beginning with the sample collected on May 23, 2014 (Quarter 2, 2014). A letter documenting this monitoring deficiency is included as an attachment to this SMR. |
| 969588 | 5/14/2014 | CTOX | Chronic Toxicity 3-Sample Median limit is 1 TUc and reported value was 1.3 TUc at EFF-001. | A chronic Whole Effluent Toxicity (WET) test conducted 3/17/2014 showed a significant reduction in reproduction at 100% effluent concentration, resulting in a single-test TUc of 1.3 and a three-sample median greater than 1TUc for the reproduction test, triggering accelerated monitoring for chronic WET. The City was in receipt of initial sample results which indicated an exceedance of the chronic toxicity trigger on 3/27/2014. Accelerated monitoring commenced on April 14, 2014. The results of the three accelerated monitoring chronic WET tests conducted in April 2014 showed that there was no significant reduction in survival or reproduction at 100% effluent concentration (i.e., TUc = 1). Consequently, the three-sample median for chronic WET reproduction was back in compliance with narrative conditions after the second week of accelerated monitoring. A running summary of chronic WET test results and accelerated monitoring test reports are attached. Accelerated monitoring continued into May 2014. |
| 981412 | 4/30/2014 | Deficient Reporting | Failed to log a deficient monitoring violation in the April 2014 SMR. | The City failed to log a deficient monitoring violation in the April 2014 SMR for failure to collect pH and settleable solids samples on 4/5/2014 from EFF-001 and EFF-002. The City recognized the deficient monitoring violation in the April 2014 SMR cover letter and non-compliance summary letter but failed to make an entry for the violation into CIWQS. A deficient monitoring violation for the event is reported in the October 2014 SMR. |
| 969587 | 4/30/2014 | CAT2 | Copper, Total Monthly Average limit is 2.9 ug/L and reported value was 5.6 ug/L at EFF-001. | A Water Effect Ratio (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of a site-specific WER for copper at Outfall-001. |

APPENDIX B. NPDES DISCHARGE VIOLATIONS 2012-2015
WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT
CITY OF ARCATA

| | | | | |
|---|---|---|---|---|
| 969586 | 4/30/2014 | CAT2 | Copper, Total Monthly Average limit is 4.7 ug/L and reported value was 5.6 ug/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | A Water Effect Ratio (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of a site-specific WER for copper at Outfall-002. |
| 981411 | 4/5/2014 | DMON | Violation occurred in April 2014. | Due to an operator error, the City failed to collect and analyze samples for pH and settleable solids from EFF-001 and EFF-002 on 4/5/2014. The deficient monitoring violation was recognized in the April 2014 SMR cover letter and non-compliance letter but the City failed to enter the violation into CIWQS. |
| 967699 | 3/31/2014 | CAT2 | Copper, Total Monthly Average limit is 2.9 ug/L and reported value was 7.6 ug/L at EFF-001. | A Water Effect Ratio (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of applying a site-specific WER for discharges of copper at Outfall-001. |
| 967697 | 3/31/2014 | CAT2 | Copper, Total Monthly Average limit is 4.7 ug/L and reported value was 7.6 ug/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | A Water Effect Ratio (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of applying a site-specific WER for discharges of copper at Outfall-002. |
| 967695 | 3/26/2014 | DMON | Due to a laboratory error, the hold time requirement for compliance samples representative of Influent-001, Effluent-001 and Effluent-002 TSS was not met. The data is consistent with the ongoing TSS trend and a TSS sample collected the day previous. | Samples for TSS were analyzed one day past the official hold time due to a laboratory error at the contract laboratory. |
| 983415 | 3/21/2014 | CAT2 | Dichlorobromomethane Daily Maximum limit is 1.12 ug/L and reported value was 2.0 ug/L at EFF-001. | |
| 967698 | 3/17/2014 | CTOX | Chronic Toxicity 3-Sample Median limit is 1 TUc and reported value was 1.3 TUc at EFF-001. | A chronic Whole Effluent Toxicity (WET) test conducted 3/17/2014 showed a significant reduction in reproduction at 100% effluent concentration, resulting in a single-test TUc of 1.3 and a three-sample median greater than 1TUc for the reproduction test, triggering accelerated monitoring for chronic WET. The City was in receipt of initial sample results which indicated an exceedance of the chronic toxicity trigger on 3/27/2014. Accelerated monitoring commenced on April 14, 2014. |
| 967693 | 3/15/2014 | CAT1 | Total Suspended Solids (TSS) Weekly Average (Mean) limit is 1700 lb/day and reported value was 2000 lb/day at EFF-001. | Changes have been made to the operational strategy in response to the high TSS concentration in the treatment system however; realization of decreased TSS has been slow, mainly because of the slow changes inherent in a natural treatment process. Despite high TSS concentrations, wet weather conditions experienced in March necessitated the need for high volume discharge in order to maintain Treatment Plant capacity. With the exception of the TSS sample collected on 3/12/2014, TSS concentration in the effluent was within effluent limits and is trending downwards. |
| 967700 | 3/15/2014 | CAT1 | Total Suspended Solids (TSS) Weekly Average (Mean) limit is 45 mg/L and reported value was 48 mg/L at EFF-001. | Changes have been made to the operational strategy in response to the high TSS concentration in the treatment system however; realization of decreased TSS has been slow, mainly because of the slow changes inherent in a natural treatment process. Despite high TSS concentrations, wet weather conditions experienced in March necessitated the need for high volume discharge in order to maintain Treatment Plant capacity. With the exception of the TSS sample collected on 3/12/2014, TSS concentration in the effluent was within effluent limits and is trending downwards. |
| 967694 | 3/5/2014 | CAT2 | Copper, Total Daily Maximum limit is 5.8 ug/L and reported value was 7.6 ug/L at EFF-001. | A Water Effect Ratio (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of applying a site-specific WER for discharges of copper at Outfall-001. |
| 966037 | 2/28/2014 | CAT1 | Total Suspended Solids (TSS) Monthly Average limit is 30 mg/L and reported value was 38 mg/L at EFF-001. | Internal TSS loading, from algal growth in open water portions of the Wastewater Treatment Plant (oxidation ponds and portions of the treatment wetlands), has resulted in higher than normal TSS concentration in the Treatment Plant Effluent. Changes have been made to the operational strategy in response to the high TSS concentration in the treatment system but the changes had little effect on the concentration of TSS in the Treatment Plant effluent. Despite high TSS concentrations, wet weather conditions experienced in February necessitated the need for high volume discharge in order to maintain Treatment Plant capacity. A decrease in TSS concentration was realized by the end of the month. This decrease was likely influenced by the large input of freshwater into the treatment system. Operational staff continues to make operational changes as necessary to maintain capacity within the treatment system and minimize discharges of TSS over the effluent limit. Additionally, Arcata Marsh Research Institute staff is researching possible treatment options to improve Treatment Plant performance. |
| 966043 | 2/28/2014 | CAT1 | Total Suspended Solids (TSS) Monthly Average limit is 755 lb/day and reported value was 878 lb/day at EFF-001. | Internal TSS loading, from algal growth in open water portions of the Wastewater Treatment Plant (oxidation ponds and portions of the treatment wetlands), has resulted in higher than normal TSS concentration in the Treatment Plant Effluent. Changes have been made to the operational strategy in response to the high TSS concentration in the treatment system but the changes had little effect on the concentration of TSS in the Treatment Plant effluent. Despite high TSS concentrations, wet weather conditions experienced in February necessitated the need for high volume discharge in order to maintain Treatment Plant capacity. A decrease in TSS concentration was realized by the end of the month. This decrease was likely influenced by the large input of freshwater into the treatment system. Operational staff continues to make operational changes as necessary to maintain capacity within the treatment system and minimize discharges of TSS over the effluent limit. Additionally, Arcata Marsh Research Institute staff is researching possible treatment options to improve Treatment Plant performance. |
| 966042 | 2/28/2014 | CAT1 | Total Suspended Solids (TSS), Percent Removal Monthly Average limit is 85 % and reported value was 84 % at EFF-001. | Internal TSS loading, from algal growth in open water portions of the Wastewater Treatment Plant (oxidation ponds and portions of the treatment wetlands), has resulted in higher than normal TSS concentration in the Treatment Plant Effluent. Changes have been made to the operational strategy in response to the high TSS concentration in the treatment system but the changes had little effect on the concentration of TSS in the Treatment Plant effluent. Despite high TSS concentrations, wet weather conditions experienced in February necessitated the need for high volume discharge in order to maintain Treatment Plant capacity. A decrease in TSS concentration was realized by the end of the month. This decrease was likely influenced by the large input of freshwater into the treatment system. Operational staff continues to make operational changes as necessary to maintain capacity within the treatment system and minimize discharges of TSS over the effluent limit. Additionally, Arcata Marsh Research Institute staff is researching possible treatment options to improve Treatment Plant performance. |
| 966036 | 2/28/2014 | CAT2 | Copper, Total Monthly Average limit is 2.9 ug/L and reported value was 6.8 ug/L at EFF-001. | A Water Effect Ratio (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of applying of a site-specific WER for discharges of copper at Outfall-001. |

APPENDIX B. NPDES DISCHARGE VIOLATIONS 2012-2015
WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT
CITY OF ARCATA

| | | | | |
|---|---|---|---|---|
| 966040 | 2/28/2014 | CAT2 | Copper, Total Monthly Average limit is 4.7 ug/L and reported value was 6.8 ug/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | A Water Effect Ratio (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of applying of a site-specific WER for discharges of copper at Outfall-002. |
| 966039 | 2/25/2014 | CAT2 | Copper, Total Daily Maximum limit is 5.8 ug/L and reported value was 6.8 ug/L at EFF-001. | A Water Effect Ratio (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of applying of a site-specific WER for discharges of copper at Outfall-001. |
| 966038 | 2/22/2014 | CAT1 | Total Suspended Solids (TSS) Weekly Average limit is 1500 lb/day and reported value was 2000 lb/day at EFF-001. | Internal TSS loading, from algal growth in open water portions of the Wastewater Treatment Plant (oxidation ponds and portions of the treatment wetlands), has resulted in higher than normal TSS concentration in the Treatment Plant Effluent. Changes have been made to the operational strategy in response to the high TSS concentration in the treatment system but the changes had little effect on the concentration of TSS in the Treatment Plant effluent. Despite high TSS concentrations, wet weather conditions experienced in February necessitated the need for high volume discharge in order to maintain Treatment Plant capacity. A decrease in TSS concentration was realized by the end of the month. This decrease was likely influenced by the large input of freshwater into the treatment system. Operational staff continues to make operational changes as necessary to maintain capacity within the treatment system and minimize discharges of TSS over the effluent limit. Additionally, Arcata Marsh Research Institute staff is researching possible treatment options to improve Treatment Plant performance. |
| 984614 | 2/22/2014 | CAT1 | Total Suspended Solids (TSS) Weekly Average limit is 45 mg/L and reported value was 47 mg/L at EFF-001. | Internal TSS loading, from algal growth in open water portions of the Wastewater Treatment Plant (oxidation ponds and portions of the treatment wetlands), has resulted in higher than normal TSS concentration in the Treatment Plant Effluent. Changes have been made to the operational strategy in response to the high TSS concentration in the treatment system but the changes had little effect on the concentration of TSS in the Treatment Plant effluent. Despite high TSS concentrations, wet weather conditions experienced in February necessitated the need for high volume discharge in order to maintain Treatment Plant capacity. A decrease in TSS concentration was realized by the end of the month. This decrease was likely influenced by the large input of freshwater into the treatment system. Operational staff continues to make operational changes as necessary to maintain capacity within the treatment system and minimize discharges of TSS over the effluent limit. Additionally, Arcata Marsh Research Institute staff is researching possible treatment options to improve Treatment Plant performance. |
| 966041 | 2/15/2014 | CAT1 | Total Suspended Solids (TSS) Weekly Average limit is 45 mg/L and reported value was 49 mg/L at EFF-001. | Internal TSS loading, from algal growth in open water portions of the Wastewater Treatment Plant (oxidation ponds and portions of the treatment wetlands), has resulted in higher than normal TSS concentration in the Treatment Plant Effluent. Changes have been made to the operational strategy in response to the high TSS concentration in the treatment system but the changes had little effect on the concentration of TSS in the Treatment Plant effluent. Despite high TSS concentrations, wet weather conditions experienced in February necessitated the need for high volume discharge in order to maintain Treatment Plant capacity. A decrease in TSS concentration was realized by the end of the month. This decrease was likely influenced by the large input of freshwater into the treatment system. Operational staff continues to make operational changes as necessary to maintain capacity within the treatment system and minimize discharges of TSS over the effluent limit. Additionally, Arcata Marsh Research Institute staff is researching possible treatment options to improve Treatment Plant performance. |
| 964233 | 1/31/2014 | CAT1 | Total Suspended Solids (TSS) Monthly Average limit is 30 mg/L and reported value was 31 mg/L at EFF-001. | The Arcata Wastewater Treatment Plant has been experiencing an increase in the internal loading of total suspended solids due to the growth of algae in the open water portions of the treatment plant. This is due in part to the unusually warm and sunny weather and to the lack of rainfall. Operational staff and Arcata Marsh Research Institute staff are currently evaluating options for improving Treatment Plant performance. |
| 964235 | 1/31/2014 | CAT2 | Copper, Total Monthly Average limit is 2.9 ug/L and reported value was 6.7 ug/L at EFF-001. | A Water Effect Ratio (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of a site-specific WER for copper at Effluent-001. |
| 964234 | 1/31/2014 | CAT2 | Copper, Total Monthly Average limit is 4.7 ug/L and reported value was 6.7 ug/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | A Water Effect Ratio (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of a site-specific WER for copper at Effluent-002. |
| 964232 | 1/13/2014 | CAT2 | Copper, Total Daily Maximum limit is 5.8 ug/L and reported value was 6.7 ug/L at EFF-001. | A Water Effect Ratio (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of a site-specific WER for copper at Effluent-001. |
| 962767 | 12/31/2013 | CAT2 | Copper, Total Recoverable Monthly Average limit is 2.9 ug/L and reported value was 4.2 ug/L at EFF-001. | A Water Effect Ration (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of applying a site-specific WER for discharges of copper at EFF-001. |
| 962763 | 12/18/2013 | DMON | A deficient monitoring violation, with an occurrence date of December 18, 2013 is reported in this SMR in association with BOD samples collected at Influent-001, Effluent-001 and Effluent-002. Due to laboratory error the samples were incubated for six days prior to the final dissolved oxygen determination. | The results of the BOD tests were accepted as representative because the organic standard was well within the contract laboratory?s acceptance limits and because the sample values are consistent with historical values for the monitoring locations. The laboratory error was due to staffing changes implemented during the holidays. Corrective action taken by the contract laboratory included reviewing test procedures with the analyst responsible for the error and ensuring that the regular staff person is again scheduled to handle BOD analysis. |
| 960857 | 11/30/2013 | CAT2 | Copper, Total Monthly Average limit is 2.9 ug/L and reported value was 4.9 ug/L. | A Water Effect Ratio (WER) study was submitted to the Regional Water Quality Control Board in December 2012 for consideration of a site-specific WER for discharges of copper at Effluent-001. |
| 960856 | 11/30/2013 | CAT2 | Copper, Total Monthly Average limit is 4.7 ug/L and reported value was 4.9 ug/L at EFF-002. *** MMP Exempt Reason:This outfall does not discharge to a water of the U.S., therefore is not subject to CWC 13385. | A Water Effect Ratio (WER) study was submitted to the Regional Water Quality Control Board in December 2012 for consideration of a site-specific WER for discharges of copper at Effluent-002. |
| 960855 | 11/8/2013 | DMON | The BOD sample collected on 11/6/2013 was analyzed past the hold time due to laboratory error. | A technician working for the contract laboratory used by the City of Arcata dropped all of the BOD test bottles for sample location Inf-001 at the end of the 5-day holding period, before the samples could be analyzed for dissolved oxygen concentration. The contract laboratory used the remaining sample to set-up a new BOD test. Formal corrective action was not taken by the contract laboratory due to the nature of the incident. |

APPENDIX B. NPDES DISCHARGE VIOLATIONS 2012-2015
WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT
CITY OF ARCATA

| | | | | |
|---|---|---|---|---|
| 962766 | 10/31/2013 | Deficient Reporting | A deficient reporting violation, with an occurrence date of October 31, 2013 is reported in this SMR for failure to report CTR pollutant monitoring data in the October 2013 SMR. Samples for CTR pollutants were collected at regular intervals over a 10.5-hour period for use in local limits development. Further, average monthly and maximum daily values for carbon tetrachloride, dichlorobromomethane and bis (2-ethylhexyl) phthalate, obtained as a result of the local limits development project, were not reported in the October 2013 SMR. The City also failed to report settleable solids monitoring data for Outfall-002 on 10/29/2013 in the October SMR. Monitoring data for CTR pollutants collected as grab samples; calculated compliance data (i.e. average monthly, daily maximum) for carbon tetrachloride, dichlorobromomethane, bis (2-ethylhexyl) phthalate and; settleable solids data for Outfall-002 on 10/29/2013 are submitted in this SMR in tabular format as an attachment. | Reporting errors occurred in the October 2013 SMR due to a staffing shortage and failure to properly implement quality control review of the report. Quality control/report completeness review procedures will be reviewed with the appropriate staff to ensure that reporting errors do not occur in the future. |
| 960859 | 10/31/2013 | Deficient Reporting | The City of Arcata failed to submit daily Total Residual Chlorine data for monitoring location Effluent-002, TCDD-Equivalent data for monitoring location EFF-001, and an exceedance of the discharge standard for copper at EFF-002 in the October 2013 SMR. Furthermore, it has come to my attention that the copper violation at EFF-002 that was reported in the October 2013 SMR was reported with the incorrect units; the violation should have been reported in ug/L not as %. | Daily Total Residual Chlorine data for Effluent-002 and TCDD-Equivalents data for the reporting period 0f October 1-31, 2013 is included in this SMR as an attachment. A violation for the exceedance of the monthly average discharge standard for copper at EFF-002 in October 2013 is logged as a violation in this SMR. |
| 960858 | 10/31/2013 | CAT2 | Copper, Total Monthly Average limit is 4.7 ug/L and reported value was 5.2 ug/L. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | A Water Effect Ratio (WER) study was submitted to the Regional Water Quality Control Board in December 2012 for consideration of a site-specific WER for discharges of copper at Effluent-002. |
| 958994 | 10/31/2013 | CAT2 | Copper, Total Recoverable Monthly Average (Mean) limit is 2.9 ug/L and reported value was 5.2 ug/L at EFF-001. | A Water Effect Ration (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of applying a site-specific WER for discharges of copper at discharge monitoring location Outfall-001. |
| 962765 | 10/31/2013 | CAT2 | Dichlorobromomethane Monthly Average limit is 0.56 ug/L and reported value was 1.4 ug/L at EFF-001. | Historical performance indicates that dichlorobromomethane occurs occasionally but not consistently, indicating that it is unlikely that dichlorobromomethane levels remained above the effluent limit throughout the compliance period. Dichlorobromomethane is a common disinfection byproduct and may be a result of chlorinating wastewater for disinfection. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV as its primary disinfectant no later than December 1, 2016. |
| 962764 | 10/14/2013 | CAT2 | Dichlorobromomethane Daily Maximum limit is 1.12 ug/L and reported value was 1.4 ug/L at EFF-001. | Historical performance indicates that dichlorobromomethane occurs occasionally but not consistently, indicating that it is unlikely that dichlorobromomethane levels remained above the effluent limit throughout the compliance period. Dichlorobromomethane is a common disinfection byproduct and may be a result of chlorinating wastewater for disinfection. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV as its primary disinfectant no later than December 1, 2016. |
| 957556 | 9/30/2013 | CAT2 | Copper, Total Monthly Average limit is 2.9 ug/L and reported value was 3.0 ug/L. | A Water Effect Ratio (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of applying of a site-specific WER for discharges of copper at the monitoring location Outfall-001. |
| 957557 | 9/30/2013 | CAT2 | Copper, Total Monthly Average limit is 4.7 ug/L and reported value was 7.9 ug/L. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | A Water Effect Ration (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of applying a site-specific WER for discharges of copper at discharge monitoring location Outfall-002. |
| 955721 | 8/31/2013 | DMON | Sample analyzed past hold time. | The BOD sample collected at INF-001 on 8/21/2013 had excessive oxygen depletion during the initial analysis. This occurred because the sample volume used in the analysis was too large. The sample was reanalyzed past the official hold time using a smaller sample volume. Results obtained by the contract laboratory are similar to results obtained by our in-house laboratory for the same sample. |
| 955719 | 8/31/2013 | CAT2 | Copper, Total Monthly Average limit is 2.9 ug/L and reported value was 4.3 ug/L. | A Water Effect Ratio (WER) study for copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of implementing site-specific WERs for copper at the City's discharge locations. |
| 957554 | 8/31/2013 | CAT2 | Dichlorobromomethane Monthly Average limit is 0.56 ug/L and reported value was 2.2 ug/L. | Historical performance indicates that dichlorobromomethane occurs occasionally but not consistently, indicating that it is unlikely that dichlorobromomethane levels remained above the effluent limit throughout the compliance period. Dichlorobromomethane is a common disinfection byproduct and may be a result of chlorinating wastewater for disinfection. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV its primary disinfectant no later than December 1, 2016. |

APPENDIX B. NPDES DISCHARGE VIOLATIONS 2012-2015
WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT
CITY OF ARCATA

| | | | | |
|---|---|---|---|---|
| 957553 | 8/30/2013 | Deficient Reporting | A deficient reporting violation, with a date of August 30, 2013, is reported in this SMR for failure to identify in the August 2013 SMR two instances of permit non-compliance for effluent limit exceedances for dichlorobromomethane. The results of the sample were reported in the August 2013 SMR. | Effluent violations for dichlorobromomethane monthly average and daily maximum are reported in this SMR. |
| 955722 | 8/21/2013 | DMON | Sample analyzed past hold time. | The BOD sample collected at EFF-002 on 8/14/2013 had insufficient oxygen depletion during the initial analysis. This occurred because the sample was incorrectly labeled as an influent sample. The contract laboratory used a small sample volume, as instructed, anticipating high oxygen demand from an influent sample. The sample was reanalyzed past the official hold time using a larger sample volume. Results obtained by the contract laboratory are similar to results obtained by our in-house laboratory for the same sample. Samples were properly labeled in subsequent sampling events. The BOD sample collected at EFF-002 on 8/21/2013 had insufficient oxygen depletion during the initial analysis. This occurred because insufficient sample volume was used in the analysis. The sample was reanalyzed past the official hold time using a larger sample volume. Results obtained by the contract laboratory are similar to results obtained by our in-house laboratory for the same sample. The contract laboratory was instructed to use a larger sample volume in subsequent sampling events. |
| 955720 | 8/16/2013 | OEV | pH Instantaneous Minimum limit is 6.0 SU and reported value was 5.9 SU. | Historical performance indicates that pH decreases in the late summer and fall as plant material begins to break-down in the natural treatment system. PH fluctuates diurnally, as plant material takes up carbon dioxide from the wastewater during photosynthesis; indicating that it is unlikely that pH remained below the minimum throughout the compliance period. |
| 955723 | 8/5/2013 | DMON | Failure to meet Minimum Level for Priority Pollutant. | There was one instance of failing to meet narrative requirements specified in Waste Discharge Requirements for the City of Arcata. Due to matrix interference the sample collected for Bis (2-ethylhexyl) Phthalate had a dilution factor of 10. As a result, the reporting level for the constituent was raised above the minimum level specified in Table E-1 Test Methods and Minimum Levels for Priority Pollutants of the Monitoring and Reporting Program. |
| 957555 | 8/5/2013 | CAT2 | Dichlorobromomethane Daily Maximum limit is 1.12 ug/L and reported value was 2.2 ug/L. | Historical performance indicates that dichlorobromomethane occurs occasionally but not consistently, indicating that it is unlikely that dichlorobromomethane levels remained above the effluent limit throughout the compliance period. Dichlorobromomethane is a common disinfection byproduct and may be a result of chlorinating wastewater for disinfection. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV its primary disinfectant no later than December 1, 2016. |
| 957552 | 7/31/2013 | Deficient Reporting | A deficient reporting violation, with an occurrence date of July 31, 2013, is reported in this SMR for failure to report the results of a Chronic Whole Effluent Toxicity (WET) test on Effluent-001 in the July 2013 SMR. | A summary table of WET testing results and complete laboratory reports for WET tests conducted in Quarter 3 2013 are attached. |
| 954473 | 6/30/2013 | Deficient Reporting | Failed to report daily Total Residual Chlorine data for Effluent-002 in the June 2013 Wastewater Monthly Report. | A table of daily Total Residual Chlorine data for Effluent-002 for the reporting period of June 1-31, 2013 is attached. |
| 952200 | 6/24/2013 | CTOX | Chronic Toxicity 3-Sample Median limit is 1.0 TUc and reported value was 1.3 TUc. | Results of week 3 of 4 of accelerated monitoring. |
| 952201 | 6/10/2013 | CTOX | Chronic Toxicity 3-Sample Median limit is 1.0 TUc and reported value was 1.3 TUc. | Results of week 2 of 4 of accelerated monitoring. |
| 952199 | 6/3/2013 | CTOX | Chronic Toxicity 3-Sample Median limit is 1.0 TUc and reported value was 1.3 TUc. | Results of week 1 of 4 of accelerated monitoring. |
| 950312 | 5/31/2013 | CAT2 | Copper, Total Monthly Average limit is 2.9 ug/L and reported value was 3.9 ug/L. | A Water Effect Ratio (WER) study for discharges of copper was submitted tot he Regional Water Quality Control Board in December 2012 for consideration of applying a site-specific WER for discharges of copper at discharge monitoring location Outfall-001 |
| 950310 | 5/31/2013 | CAT2 | Dichlorobromomethane Monthly Average limit is 0.56 ug/L and reported value was 0.76 ug/L. | Historical performance indicates that dichlorobromomethane occurs occasionally but not consistently, indicating that it is unlikely that dichlorobromomethane levels remained above the effluent limit throughout the compliance period. Dichlorobromomethane is a common disinfection byproduct and may be a result of chlorinating wastewater for disinfection. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV its primary disinfectant no later than December 1, 2016. |
| 950311 | 5/13/2013 | CTOX | Chronic Toxicity 3-Sample Median limit is 0 Pass/Fail (Pass = 0, Fail = 1) and reported value was 1 Pass/Fail (Pass = 0, Fail = 1). | A chronic Whole Effluent Toxicity (WET) test conducted May 5-13, 2013 showed a significant reduction in reproduction at 100% effluent concentration, resulting in a single-test TUc of 1.3 and a three-sample median greater than 1TUc for the reproduction test, triggering accelerated monitoring for chronic WET. The City was in receipt of initial sample results which indicated an exceedance of the chronic toxicity trigger on May 21, 2013. Accelerated monitoring commenced on June 3, 2013. |
| 948881 | 4/30/2013 | CAT2 | Copper, Total Monthly Average limit is 2.9 ug/L and reported value was 5.7 ug/L. | A Water Effect Ratio (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of applying a site-specific WER for discharges of copper at Outfall-001. |
| 948882 | 4/30/2013 | CAT2 | Copper, Total Monthly Average limit is 4.7 ug/L and reported value was 5.7 ug/L. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | A Water Effect Ration (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of applying a site-specific WER for discharges of copper at discharge monitoring location Outfall-002. |
| 984611 | 3/31/2013 | CAT1 | Total Suspended Solids (TSS) Monthly Average limit is 30 mg/L and reported value was 34 mg/L at EFF-001. | Flow rates throughout the treatment system were adjusted throughout the month in an effort to provide longer residence time in the treatment marshes. Actual decreases in total suspended concentration were not realized until the beginning of April. |
| 947224 | 3/31/2013 | CAT1 | Total Suspended Solids (TSS) Monthly Average limit is 575 lb/day and reported value was 606 lb/day. | Flow rates throughout the treatment system were adjusted throughout the month in an effort to provide longer residence time in the treatment marshes. Actual decreases in total suspended concentration were not realized until the beginning of April. |

APPENDIX B. NPDES DISCHARGE VIOLATIONS 2012-2015
WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT
CITY OF ARCATA

| | | | | |
|---|---|---|---|---|
| 947223 | 3/31/2013 | CAT1 | Total Suspended Solids (TSS), Percent Removal Monthly Average limit is 85 % and reported value was 82 %. | Flow rates throughout the treatment system were adjusted throughout the month in an effort to provide longer residence time in the treatment marshes. Actual decreases in total suspended concentration were not realized until the beginning of April. |
| 947222 | 3/31/2013 | CAT2 | Copper, Total Monthly Average limit is 2.9 ug/L and reported value was 5.0 ug/L. | A Water Effect Ration (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of applying a site-specific WER for discharges of copper at discharge monitoring location Outfall-001. |
| 947220 | 3/31/2013 | CAT2 | Copper, Total Recoverable Monthly Average limit is 4.7 ug/L and reported value was 5.0 ug/L at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. Should be treated as Non15 discharge. | A Water Effect Ration (WER) study for discharges of copper was submitted to the Regional Water Quality Control Board in December 2012 for consideration of applying a site-specific WER for discharges of copper at discharge monitoring location Outfall-002. |
| 946663 | 3/14/2013 | Order Conditions | 4. Standard Provision IV.A of Attachment D to Order No. R1-2012-0035 requires that records of all monitoring information be retained, including calibration and maintenance records. Primary facility representative indicated that flow meters have not been calibrated recently and flow meter calibration records could not be located for review. | |
| 946654 | 3/14/2013 | Order Conditions | Provision I.C. of the MRP requires that ?Laboratories analyzing monitoring samples shall be certified by the Department of Health Services, in accordance with the provisions of Water Code section 13176, and must include quality assurance/quality control data with their reports. c. The 15 minute hold time for pH was exceeded on numerous occasions during the period of review (November 2012 through February 2013). | |
| 946652 | 3/14/2013 | Order Conditions | Provision I.C. requires that ?Laboratories analyzing monitoring samples shall be certified by the Department of Health Services, in accordance with the provisions of Water Code section 13176, and must include quality assurance/quality control data with their reports.? a. The laboratory does not follow QA/QC procedures or written SOPs and has not recently conducted proficiency testing for in-house analyses (i.e., temperature, pH, chlorine residual, and dissolved oxygen). | |
| 946653 | 3/14/2013 | Order Conditions | Provision I.C.of the MRP requires that ?Laboratories analyzing monitoring samples shall be certified by the Department of Health Services, in accordance with the provisions of Water Code section 13176, and must include quality assurance/quality control data with their reports.? b. Analytical records for pH and chlorine residual analyses do not include the time of analysis to demonstrate that samples are analyzed within 15 minutes of sample collection. | |
| 947225 | 3/5/2013 | DMON | Due to a laboratory logging error at the contract laboratory the sample collected for compliance with quarterly monitoring requirements for carbon tetrachloride had a dilution factor of 5. As a result, the reporting level for that constituent was raised above the minimum level specified in Table E-1 Test Methods and Minimum Levels for Priority Pollutants of the Monitoring and Reporting Program. The laboratory report for quarterly compliance samples was received by the City of Arcata after the end of first quarter 2013 therefore we were unable to collect a resample during the monitoring period. | The contract laboratory has taken corrective action to ensure that the log-in error does not occur again in the future. Documentation of the laboratory error and correction action from the contract laboratory is included as an attachment to the March 2013 Monthly Report. |

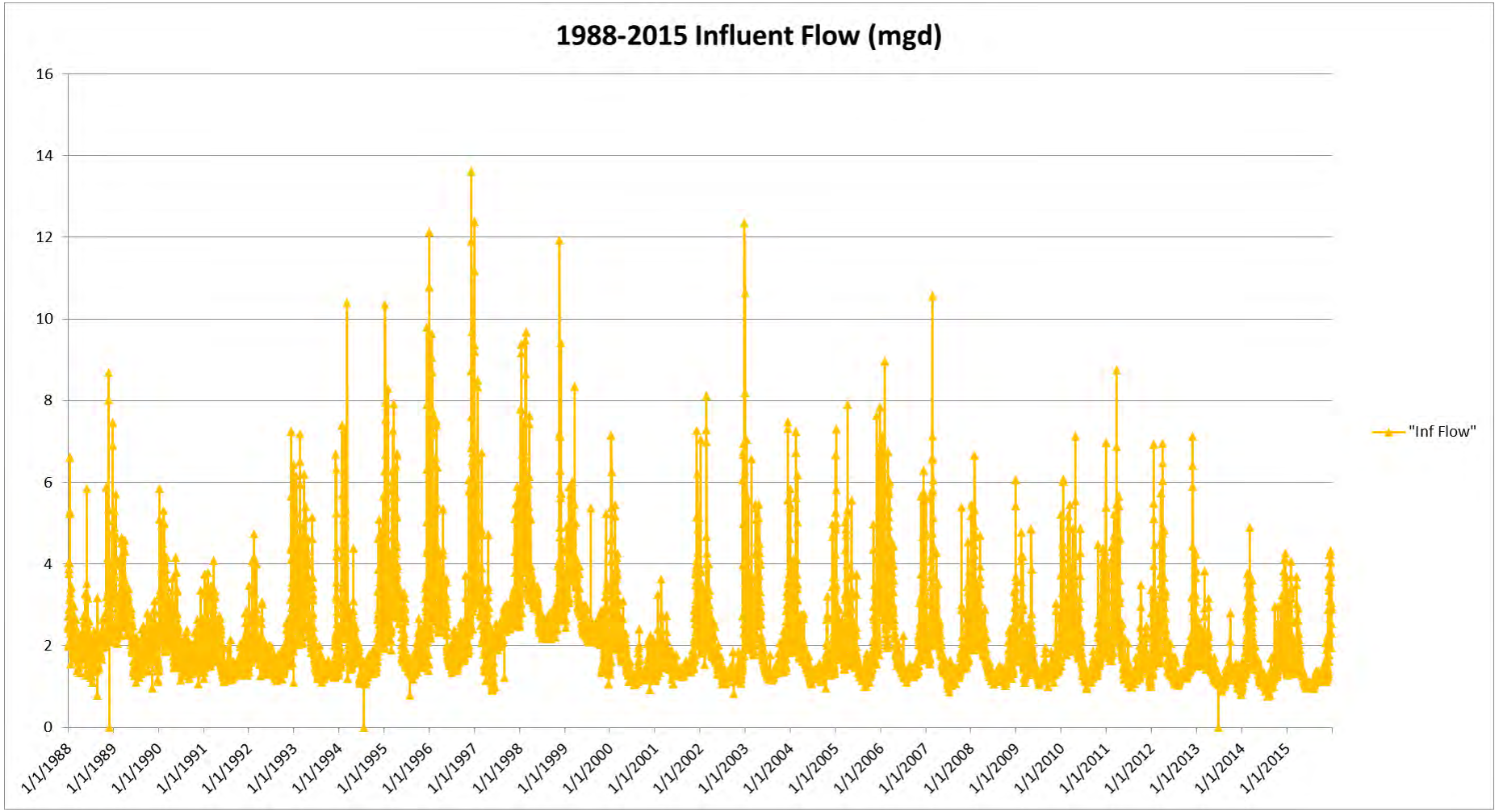
APPENDIX B. NPDES DISCHARGE VIOLATIONS 2012-2015
WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT
CITY OF ARCATA

| | | | | |
|---|---|---|---|---|
| 947221 | 3/5/2013 | DMON | Due to a laboratory logging error at the contract laboratory the sample collected for compliance with quarterly monitoring requirements for dichlorobromomethane had a dilution factor of 5. As a result, the reporting level for that constituent was raised above the minimum level specified in Table E-1 Test Methods and Minimum Levels for Priority Pollutants of the Monitoring and Reporting Program. The laboratory report for quarterly compliance samples was received by the City of Arcata after the end of first quarter 2013 therefore we were unable to collect a resample during the monitoring period. | The contract laboratory has taken corrective action to ensure that the log-in error does not occur again in the future. Documentation of the laboratory error and correction action from the contract laboratory is included as an attachment to the March 2013 Monthly Report. |
| 946661 | 2/28/2013 | DMON | Records reviewed during 3/14/13 inspection revealed that effluent flow is not being recorded continuously as required by sections IV.A.1 (Table E-4) and IV. B.1 (Table E-5) of the MRP. | |
| 944931 | 2/28/2013 | CAT2 | Copper, Total Monthly Average limit is 2.9 ug/L and reported value was 3.5 ug/L. | The City submitted a Water Effect Ratio study for discharges of copper to the Regional Water Quality Control Board in December 2012 with a request to re-open NPDES Permit No. CA0022713 for consideration of application of a site-specific WER for discharges of copper from monitorning locations at the Arcata Wastewater Treatment Plant. |
| 946659 | 1/31/2013 | DMON | Records reviewed during 3/14/13 inspection revealed that effluent flow is not being recorded continuously as required by sections IV.A.1 (Table E-4) and IV. B.1 (Table E-5) of the MRP. | |
| 944432 | 1/31/2013 | CAT2 | Copper, Total Monthly Average limit is 2.9 ug/L and reported value was 3.5 ug/L at EFF-001. | The City of Arcata submitted a Water Effect Ratio (WER) study for discharges of copper to the Regional Water Quality Control Board in December 2012 with a request that the Board re-open NPDES Permit No. CA0022713 for consideration of applying a site-specific WER for copper for discharges from the Arcata Wastewater Treatment Facility. |
| 946658 | 12/31/2012 | DMON | Records reviewed during 3/14/13 inspection revealed that effluent flow is not being recorded continuously as required by sections IV.A.1 (Table E-4) and IV. B.1 (Table E-5) of the MRP. | |
| 946657 | 12/31/2012 | Deficient Reporting | Ammonia result for December 2012 not reported | |
| 946656 | 12/31/2012 | Deficient Reporting | The December 2012 eSMR is missing nitrate result for EFF-001 | |
| 942884 | 12/31/2012 | Order Conditions | The City exceeded average monthly total residual chlorine discharge specifications at Outfall-002. Occurrence Date: 12/31/2012 Maximum Daily Effluent Limit: 0.02 mg/L Result: 0.08 mg/L | Outfall-002 is monitored continuously for the absence of total residual chlorine. However, for reporting purposes, a minimum of one grab sample is collected daily and analyzed for total residual chlorine. This reporting practice results in a high monthly average when one or more daily samples have a high total residual chlorine concentration. Continuous monitoring records indicate that with the exception of the 30-minute discharge of chlorinated effluent that occurred on December 1, 2012, total residual chlorine concentration at Outfall -002 during the month of December 2012 was 0.00 mg/L. |
| 942890 | 12/31/2012 | CAT2 | 2,3,7,8-TCDD (Dioxin) Monthly Average limit is 0.013 pg/L and reported value was 0.28 pg/L. | A single sample for 2,3,7,8-TCDD equivalents is collected for compliance with quarterly compliance requirements. Historical performance indicates that 2,3,7,8-TCDD equivalents occur occasionally but not consistently, indicating that it is unlikely that 2,3,7,8-TCDD equivalent levels remained above the effluent limit throughout the compliance period. Certain chemicals have been shown to form polychlorinated dibenzodioxin compounds during wastewater disinfection. The City is in the planning stages of treatment plant upgrade which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV as its primary disinfectant no later than December 1, 2016. |
| 942893 | 12/31/2012 | CAT2 | Copper, Total Monthly Average limit is 2.9 ug/L and reported value was 3.7 ug/L. | On December 20, 2012 the City of Arcata submitted a final report titled ?Determination of the Water-Effect Ratio for Copper using Ceriodaphnia dubia in Toxicity Testing of Discharged Effluent at Outfalls in the Arcata Wastewater Treatment Facility? with a request that the Regional Water Quality Control Board reopen Order No. R1-2012-0031 for consideration of applying a site-specific WER to copper discharges from the Arcata Wastewater Treatment Facility. |
| 942892 | 12/31/2012 | CAT2 | Dichlorobromomethane Monthly Average limit is 0.56 ug/L and reported value was 0.7 ug/L. | A single sample for dichlorobromomethane is collected each quarter for compliance with monitoring requirements. Historical performance indicates that dichlorobromomethane occurs occasionally but not consistently, indicating that it is unlikely that dichlorobromomethane levels remained above the effluent limit throughout the compliance period. Dichlorobromomethane is a common disinfection byproduct and may be a result of chlorinating wastewater for disinfection. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV its primary disinfectant no later than December 1, 2016. |
| 942891 | 12/10/2012 | CAT2 | 2,3,7,8-TCDD (Dioxin) Daily Maximum limit is 0.026 pg/L and reported value was 0.28 pg/L. | A single sample for 2,3,7,8-TCDD equivalents is collected for compliance with quarterly compliance requirements. Historical performance indicates that 2,3,7,8-TCDD equivalents occur occasionally but not consistently, indicating that it is unlikely that 2,3,7,8-TCDD equivalent levels remained above the effluent limit throughout the compliance period. Certain chemicals have been shown to form polychlorinated dibenzodioxin compounds during wastewater disinfection. The City is in the planning stages of treatment plant upgrade which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV as its primary disinfectant no later than December 1, 2016. |
| 942886 | 12/8/2012 | CAT1 | Total Suspended Solids (TSS) Weekly Average limit is 1900 lb/day and reported value was 2200 lb/day at EFF-001. | Non-compliance occurred because actual effluent flow rate exceeded the maximum allowable flow rate used in the wet weather mass-loading emissions calculation. |
| 942888 | 12/2/2012 | CAT1 | Settleable Solids Daily Maximum limit is 0.2 ml/L and reported value was 0.4 ml/L. | The City anticipates that this type of non-compliance will occur less often once Treatment Marshes 5 and 6 are fully established and in regular use since this will provide additional treatment capacity within the treatment marshes. Marshes 5 and 6 are expected to be in regular use after the next growing season. |

APPENDIX B. NPDES DISCHARGE VIOLATIONS 2012-2015
WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT
CITY OF ARCATA

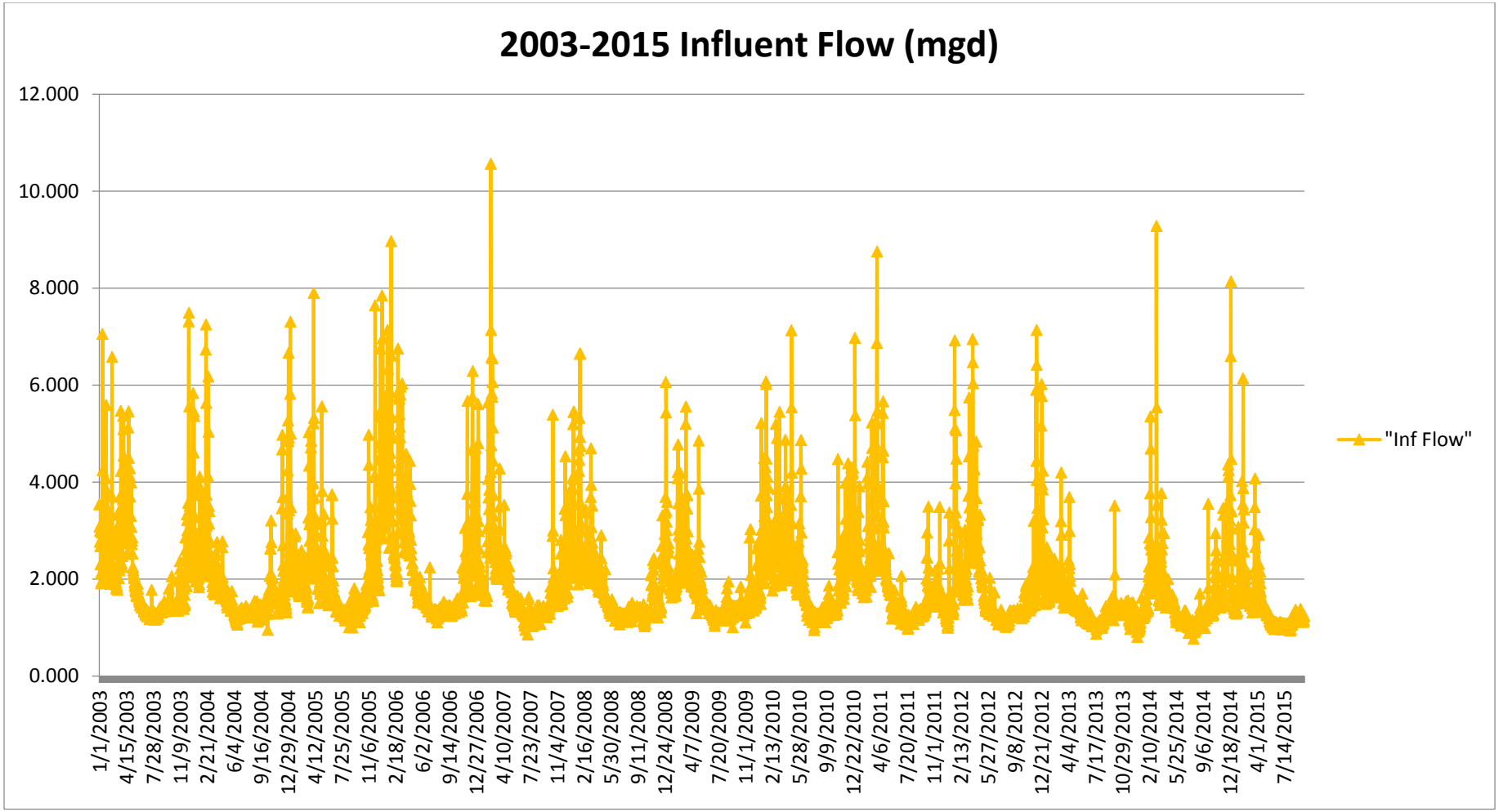
| | | | | |
|---|---|---|---|---|
| 942885 | 12/2/2012 | CAT1 | Settleable Solids Daily Maximum limit is 0.2 ml/L/hr and reported value was 0.4 ml/L/hr at EFF-002. *** MMP Exempt Reason:The receiving water for Outfall 002 is not designated as a water of the United States, so is not subject to MMPs. | Due to the high rainfall experienced during this time period the Oxidation Ponds were near capacity. The Pond 2 Storm Pumps were operated to expedite the flow of water through the treatment plant. High settleable solids are expected when Pond 2 Storm Pumps are operated since this diverts a portion of Pond 2 effluent around the treatment marshes and directly into the chlorine contact basin. The City anticipates that this type of non-compliance will occur less often once Treatment Marshes 5 and 6 are fully established and in regular use since this will provide additional treatment capacity within the treatment marshes. Marshes 5 and 6 are expected to be in regular use after the next growing season. |
| 942894 | 12/1/2012 | CAT2 | Chlorine, Total Residual Daily Maximum limit is 0.02 mg/L and reported value was 0.05 mg/L at EFF-002. *** MMP Exempt Reason:This outfall does not discharge to a water of the U.S., therefore is not subject to CWC 13385. | The Wastewater Treatment Plant experienced an upset which resulted in the discharge of chlorinated effluent tat Outfall-002. The WWTP experienced a power surge which caused the Water Champ chemical feed pump that feeds sulfur dioxide to the chlorine contact basin to trip. For unknown reasons, the chemical feed pump failed to automatically reset after the power surge. Based on operational records, this incident lasted for 30 minutes. During this period of time approximately 16,400 gallons were discharged to Arcata Marsh and Wildlife Sanctuary through discharge point Effluent-002. The total residual chlorine concentration of a sample collected immediately after turning the chemical feed pump back on was 2.36 mg/L. A complete report documenting this upset was submitted to Lisa Bernard on December 5, 2012 and is included as an attachment in this self-monitoring report. By December 1, 2016 the City will complete treatment plant upgrades including the installation of a UV disinfection system for primary disinfection. Under the new configuration, Outfall-002 will no longer be chlorinate/dechlorinated. |
| 942887 | 12/1/2012 | CAT2 | Chlorine, Total Residual Daily Maximum limit is 0.02 mg/L and reported value was 0.073 mg/L at EFF-001. | By December 1, 2016 the City will complete treatment plant upgrades including the installation of a UV disinfection system for primary disinfection. The current disinfection system will be evaluated leading up to treatment plant upgrades to determine if it will continue to be used for emergency discharges (i.e. flows greater than 5.9 MGD after Effluent-003 is established) or if an alternate disinfection system will be used. |
| 946660 | 11/30/2012 | DMON | Records reviewed during 3/14/13 inspection revealed that effluent flow is not being recorded continuously as required by sections IV.A.1 (Table E-4) and IV. B.1 (Table E-5) of the MRP. | |
| 941291 | 11/30/2012 | CAT2 | Copper, Total Recoverable Monthly Average limit is 2.9 ug/L and reported value was 3.8 ug/L. | A Water Effect Ratio study for discharges of copper was submitted to the Regional Water Quality Control Board on December 20, 2012. |
| 940074 | 10/31/2012 | CAT2 | Copper, Total Monthly Average limit is 2.9 ug/L and reported value was 3.2 ug/L. | A copper Water Effect Ratio (WER) study is underway. The WER study report is scheduled to be submitted to the Regional Water Quality Control Board on December 21, 2012. |
| 938766 | 9/30/2012 | CAT2 | Copper, Total Monthly Average limit is 2.9 ug/L and reported value was 3.3 ug/L. | A copper Water Effect Ration (WER) study is underway. The WER study report is scheduled to be submitted to the Regional Water Quality Control Board on December 21, 2012. |
| 938764 | 8/31/2012 | CAT2 | Carbon Tetrachloride Monthly Average (Mean) limit is 0.25 ug/L and reported value was 0.8 ug/L. | Carbon tetrachloride is a disinfection byproduct and may be a result of chlorinating wastewater for disinfection. Research has also shown that carbon tetrachloride is sometimes used for cleaning the inside of chlorine storage vessels and may end up as an impurity in chlorine. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV its primary disinfectant no later than December 1, 2016. |
| 938765 | 8/31/2012 | CAT2 | Copper, Total Monthly Average (Mean) limit is 2.9 ug/L and reported value was 3.3 ug/L. | At this time the City has contracted for a copper Water Effects Ratio (WER) study to be performed on treatment plant effluent. The WER is scheduled to be submitted to the Regional Water Quality Control Board on December 21, 2012. |
| 938762 | 8/31/2012 | CAT2 | Dichlorobromomethane Monthly Average limit is 0.56 ug/L and reported value was 2.2 ug/L. | Dichlorobromomethane is a common disinfection byproduct and may be a result of chlorinating wastewater for disinfection. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV its primary disinfectant no later than December 1, 2016. |
| 938763 | 8/28/2012 | CAT2 | Carbon Tetrachloride Daily Maximum limit is 0.50 ug/L and reported value was 0.8 ug/L at EFF-001. | Carbon tetrachloride is a disinfection byproduct and may be a result of chlorinating wastewater for disinfection. Research has also shown that carbon tetrachloride is sometimes used for cleaning the inside of chlorine storage vessels and may end up as an impurity in chlorine. The City is in the planning stages of treatment plant upgrades which will replace chlorination with UV as the primary disinfectant. The City is required to begin using UV its primary disinfectant no later than December 1, 2016. |
| 984608 | 8/28/2012 | CAT2 | Dichlorobromomethane Daily Maximum limit is 1.12 ug/L and reported value was 2.2 ug/L at EFF-001. | |
| 935634 | 7/31/2012 | CAT2 | Copper, Total Recoverable Monthly Average (Mean) limit is 2.8 ug/L and reported value was 3.6 ug/L. | The City has initiated a Water-Effect Ratio (WER) study for copper. We anticipate that the study will conclude later this year. |
| 931859 | 6/30/2012 | CAT2 | Copper, Total Recoverable Monthly Average limit is 2.8 ug/L and reported value was 4.2 ug/L. | WER for copper in project development stage. |

# APPENDIX C – FLOW AND LOAD DATA ANALYSIS




1988-2015 Flow at Percentiles:

| | | |
|---|---|---|
| 50 | 1.796 | mgd |
| 75 | 2.505 | mgd |
| 90 | 3.4364 | mgd |
| 95 | 4.277 | mgd |
| 98 | 5.67536 | mgd |
| 99 | 6.65164 | mgd |




2003-2015 Flow at Percentiles:

| | | |
|---|---|---|
| 50 | 1.574 | mgd |
| 75 | 2.1855 | mgd |
| 90 | 3.1506 | mgd |
| 95 | 3.9903 | mgd |
| 99 | 5.93182 | mgd |

Example Peak Wet Weather Flows For Long Duration Dec 1996-Jan 1997

| | |
|---|---|
| 12/1/1996 | 3.785 |
| 12/2/1996 | 3.1 |
| 12/3/1996 | 3.183 |
| 12/4/1996 | 8.734 |
| 12/5/1996 | 7.603 |
| 12/6/1996 | 5.96 |
| 12/7/1996 | 6.849 |
| 12/8/1996 | 13.604 |
| 12/9/1996 | 11.912 |
| 12/10/1996 | 9.703 |
| 12/11/1996 | 6.527 |
| 12/12/1996 | 4.725 |
| 12/13/1996 | 3.97 |
| 12/14/1996 | 3.49 |
| 12/15/1996 | 3.332 |
| 12/16/1996 | 2.935 |
| 12/17/1996 | 2.947 |
| 12/18/1996 | 2.831 |
| 12/19/1996 | 2.404 |
| 12/20/1996 | 6.736 |
| 12/21/1996 | 7.054 |
| 12/22/1996 | 6.433 |
| 12/23/1996 | 5.991 |
| 12/24/1996 | 3.551 |
| 12/25/1996 | 3.505 |
| 12/26/1996 | 5.869 |
| 12/27/1996 | 6.515 |
| 12/28/1996 | 5.825 |
| 12/29/1996 | 6.923 |
| 12/30/1996 | 9.209 |
| 12/31/1996 | 11.178 |
| 1/1/1997 | 12.381 |

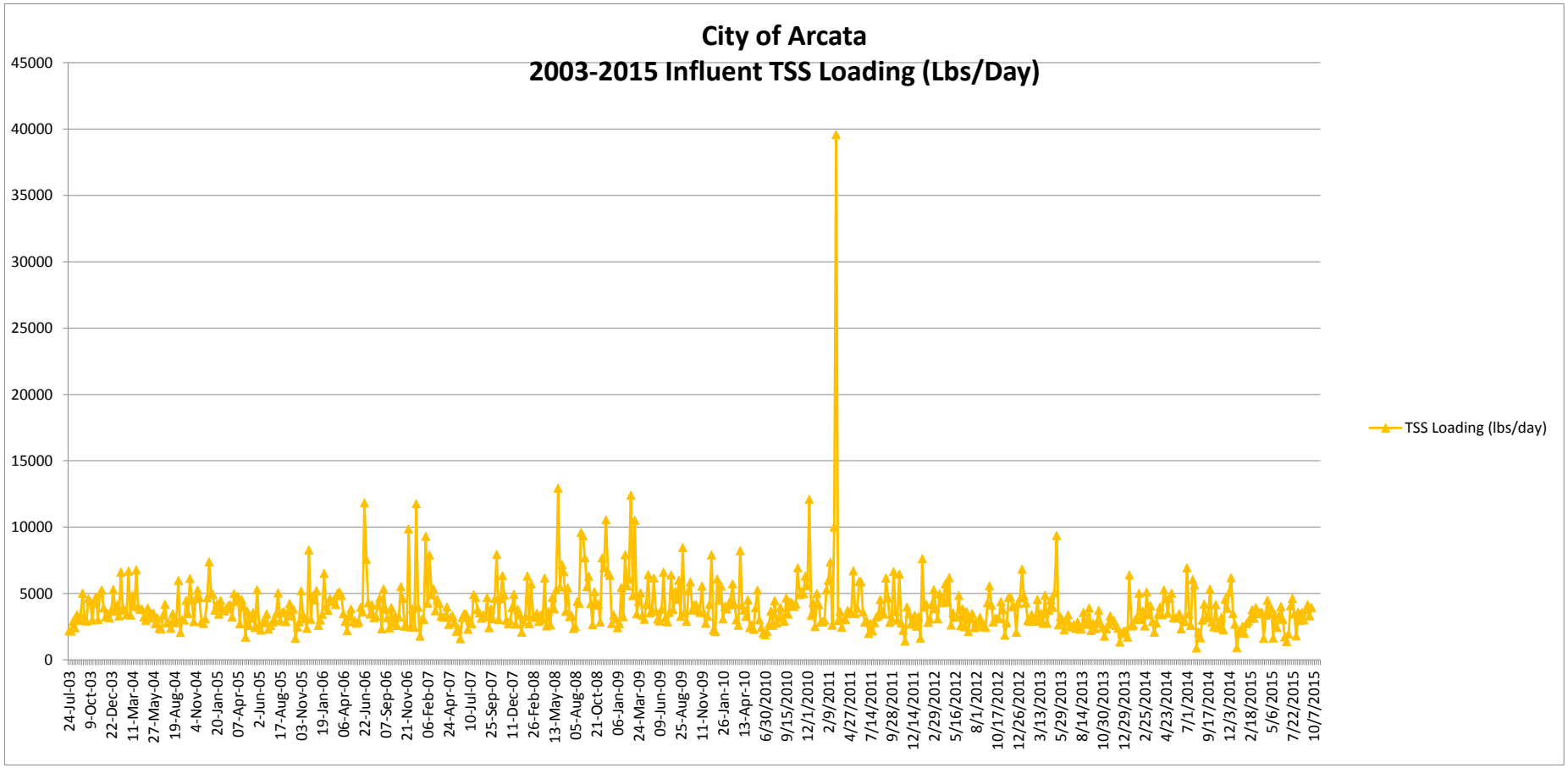
| | |
|---|---|
| 1/2/1997 | 9.368 |
| 1/3/1997 | 8.418 |
| 1/4/1997 | 5.969 |
| 1/5/1997 | 4.201 |
| 1/6/1997 | 4.182 |
| 1/7/1997 | 4.053 |
| 1/8/1997 | 3.567 |
| 1/9/1997 | 3.504 |
| 1/10/1997 | 3.388 |
| 1/11/1997 | 5.4 |
| 1/12/1997 | 3.191 |
| 1/13/1997 | 3.391 |
| 1/14/1997 | 3.169 |
| 1/15/1997 | 3.026 |
| 1/16/1997 | 3.321 |
| 1/17/1997 | 3.152 |
| 1/18/1997 | 3.325 |
| 1/19/1997 | 3.808 |
| 1/20/1997 | 4.403 |
| 1/21/1997 | 5.361 |
| 1/22/1997 | 4.557 |
| 1/23/1997 | 4.336 |
| 1/24/1997 | 5.726 |
| 1/25/1997 | 8.341 |
| 1/26/1997 | 8.488 |
| 1/27/1997 | 6.577 |
| 1/28/1997 | 5.744 |
| 1/29/1997 | 5.354 |
| 1/30/1997 | 4.979 |
| 1/31/1997 | 6.528 |

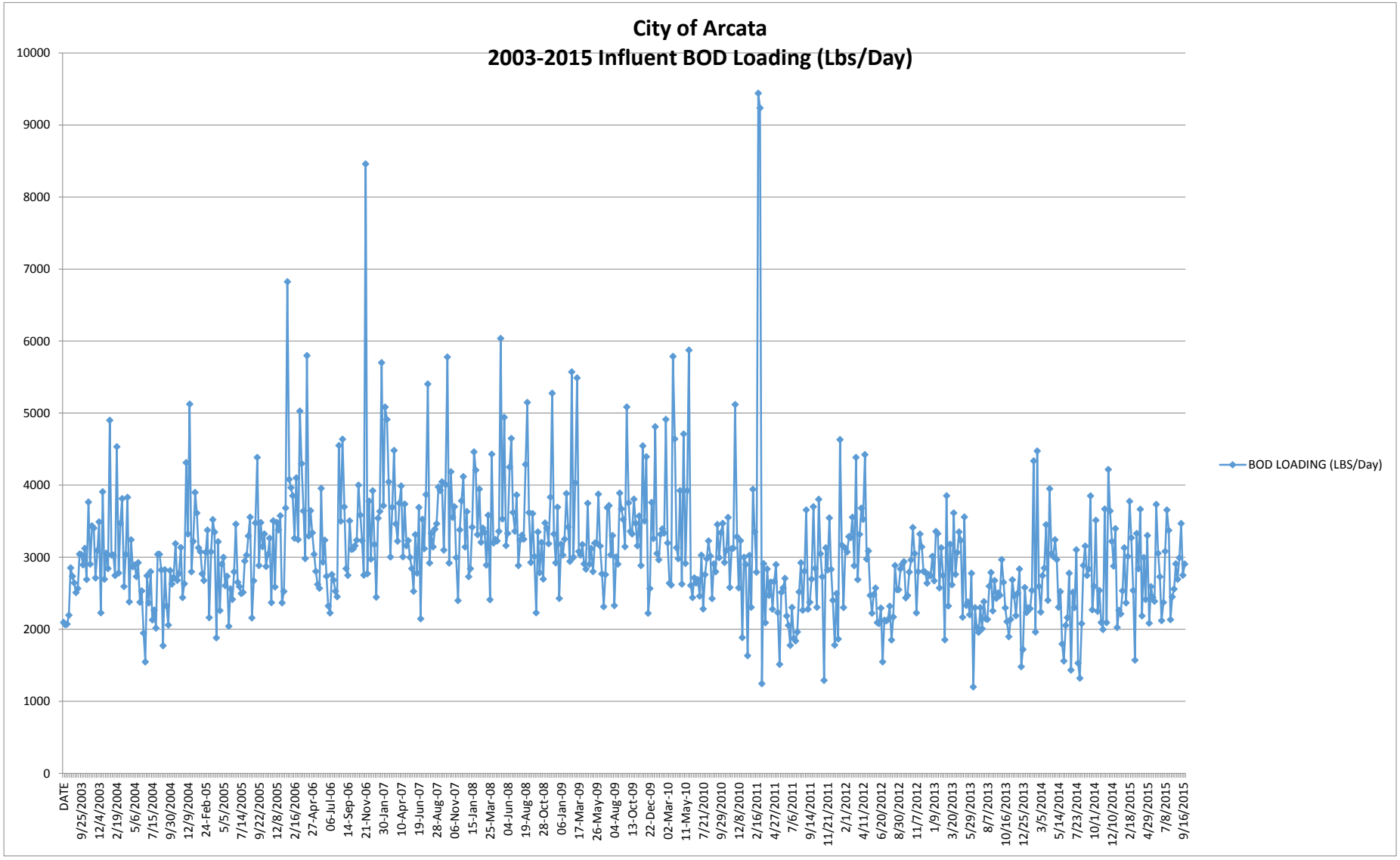
**90th Percentile Influent (Pt 1) Concentration and Load**

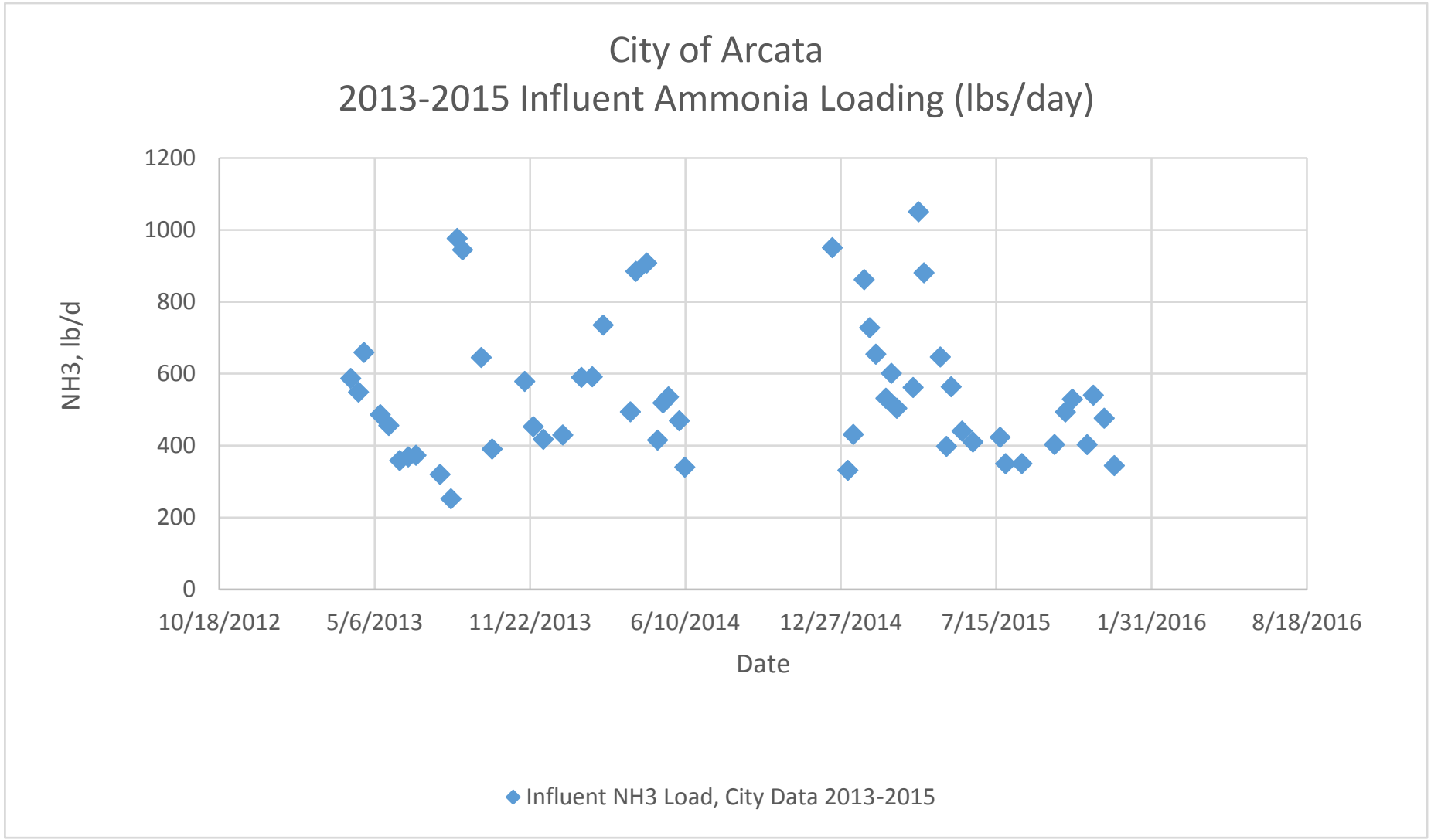
| City Data Set 1988-2015 (Data by City and AMRI) | | City Data Set 1988-2015 (Data by City and AMRI) | | | City Data Set 2003-2015[3] (Data by City) | | |
|---|---|---|---|---|---|---|---|
| 90th Percentile 1988-2015[1]: | | 90th Percentile Jul 2003-Sep/Oct2015: | | | 90th Percentile Jul 2003-Sep/Oct 2015: | | |
| BOD (mg/L) | 268 | BOD (mg/L) | 276.1 | Sep | BOD (mg/L) | 280 | Sep |
| TSS (mg/L) | 329.6 | TSS (mg/L) | 337.2 | Oct | TSS (mg/L) | 390 | Oct |
| NH3 (mg/L) | 70.4 | | | | NH3 (mg/L)[5] | 53.6 | |
| Equiv Load at 2.3 MGD[2] | | | | | Equiv Load at 2.3 MGD[2] | | |
| BOD (lb/d) | 5140.8 | | | | BOD (lb/d) | 5371.0 | |
| TSS (lb/d) | 6322.4 | | | | TSS (lb/d) | 7481.0 | |
| NH3 (lb/d) | 1350.0 | | | | NH3 (lb/d) | 1028.2 | |
| 90th Percentile 1988-2015[1]: | | 90th Percentile Jul 2003-Sep/Oct2015: | | | 90th Percentile Jul 2003-Sep 2015[4]: | | |
| BOD (lb/d) | 4556.9 | BOD (lb/d) | 3893.8 | Sep | BOD (lb/d) | 3940 | |
| TSS (lb/d) | 5703.5 | TSS (lb/d) | 5023.2 | Oct | TSS (lb/d) | 5760 | |
| NH3 (lb/d) | 898.6 | | | | NH3 (lb/d)[5] | 880 | |

Notes:

1. BOD and TSS data (by City) provided from Jan 1988 to Dec 2015. NH3 data (by City+AMRI) provided from Feb 2011 to Dec 2015.
2. Based on the 90th percentile concentration and a peak dry weather flow of 2.3 MGD.
3. City data set from 2003 to 2015 is compliance data sent to the Regional Board. Use for flow and load projections per City on 1/27/16.
4. Flow data provided in this data set only through Sep 2015.
5. City ammonia data provided from Apr 2013 to Dec 2015. AMRI data was deleted from this data set.


City of Arcata
2003-2015 Influent TSS Loading (Lbs/Day)
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
24-Jul-03
9-Oct-03
22-Dec-03
11-Mar-04
27-May-04
19-Aug-04
4-Nov-04
20-Jan-05
07-Apr-05
2-Jun-05
17-Aug-05
03-Nov-05
19-Jan-06
06-Apr-06
22-Jun-06
07-Sep-06
21-Nov-06
06-Feb-07
24-Apr-07
10-Jul-07
25-Sep-07
11-Dec-07
26-Feb-08
13-May-08
05-Aug-08
21-Oct-08
06-Jan-09
24-Mar-09
09-Jun-09
25-Aug-09
11-Nov-09
26-Jan-10
13-Apr-10
6/30/2010
9/15/2010
12/1/2010
2/9/2011
4/27/2011
7/14/2011
9/28/2011
12/14/2011
2/29/2012
5/16/2012
8/1/2012
10/17/2012
12/26/2012
3/13/2013
5/29/2013
8/14/2013
10/30/2013
12/29/2013
2/25/2014
4/23/2014
7/1/2014
9/17/2014
12/3/2014
2/18/2015
5/6/2015
7/22/2015
10/7/2015
TSS Loading (lbs/day)


City of Arcata
2003-2015 Influent BOD Loading (Lbs/Day)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
DATE
9/25/2003
12/4/2003
2/19/2004
5/6/2004
7/15/2004
9/30/2004
12/9/2004
24-Feb-05
5/5/2005
7/14/2005
9/22/2005
12/8/2005
2/16/2006
27-Apr-06
06-Jul-06
14-Sep-06
21-Nov-06
30-Jan-07
10-Apr-07
19-Jun-07
28-Aug-07
06-Nov-07
15-Jan-08
25-Mar-08
04-Jun-08
19-Aug-08
28-Oct-08
06-Jan-09
17-Mar-09
26-May-09
04-Aug-09
13-Oct-09
22-Dec-09
02-Mar-10
11-May-10
7/21/2010
9/29/2010
12/8/2010
2/16/2011
4/27/2011
7/6/2011
9/14/2011
11/21/2011
2/1/2012
4/11/2012
6/20/2012
8/30/2012
11/7/2012
1/9/2013
3/20/2013
5/29/2013
8/7/2013
10/16/2013
12/25/2013
3/5/2014
5/14/2014
7/23/2014
10/1/2014
12/10/2014
2/18/2015
4/29/2015
7/8/2015
9/16/2015
BOD LOADING (LBS/Day)


City of Arcata
2013-2015 Influent Ammonia Loading (lbs/day)
NH3, lb/d
1200
1000
800
600
400
200
0
10/18/2012
5/6/2013
11/22/2013
6/10/2014
12/27/2014
7/15/2015
1/31/2016
8/18/2016
Date
Influent NH3 Load, City Data 2013-2015

# APPENDIX D – UNIT PROCESS FLOW DIAGRAMS

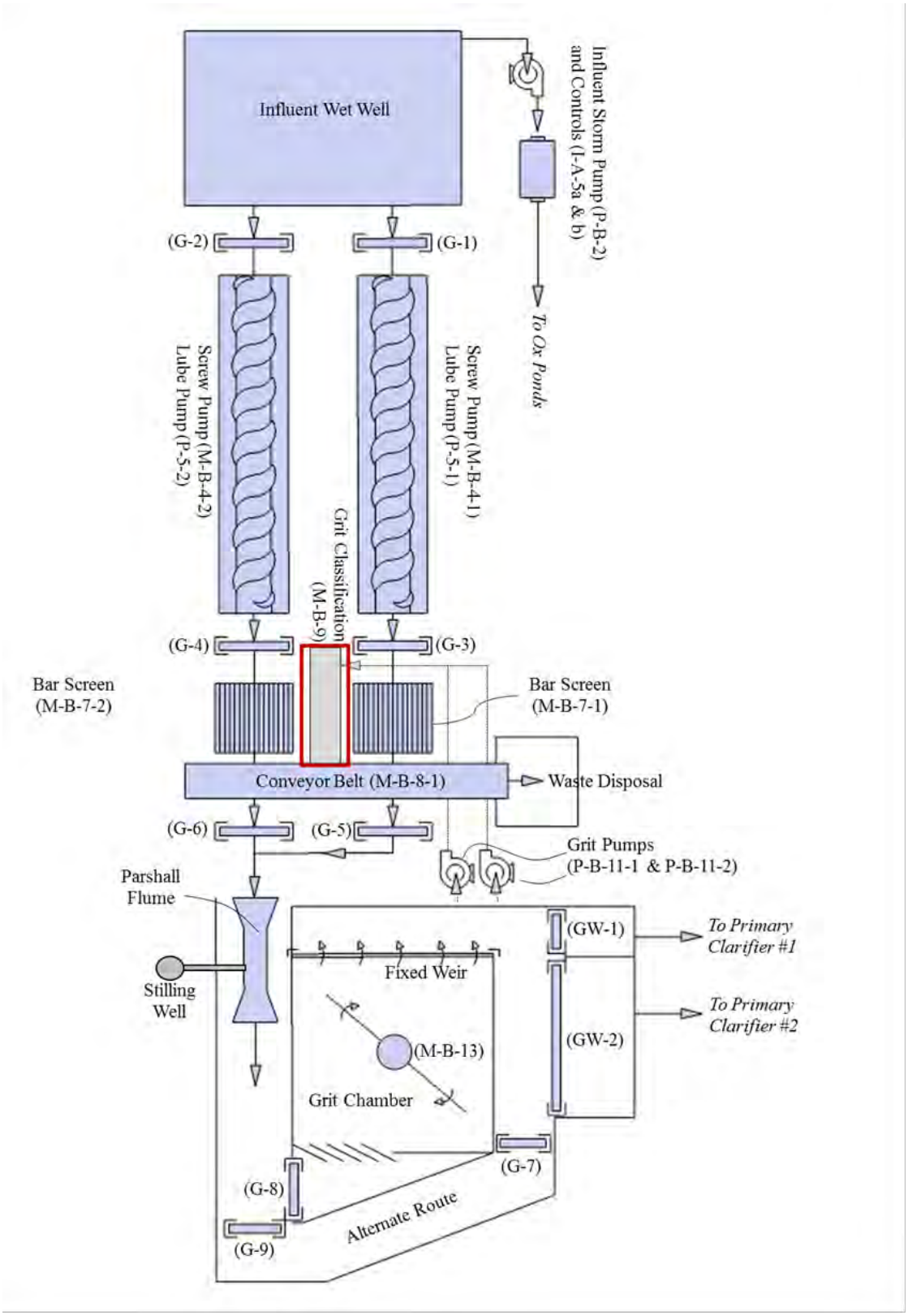



**Figure D-1: Headworks Process Flow Schematic**

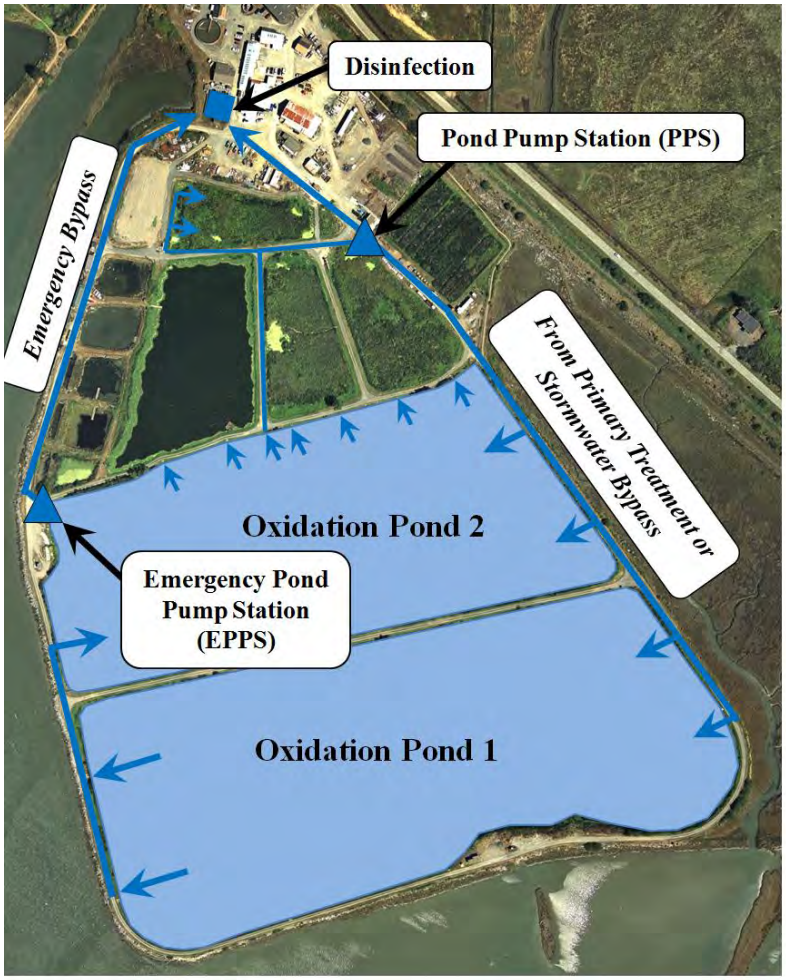



**Figure D-2: Oxidation Ponds Site Aerial**

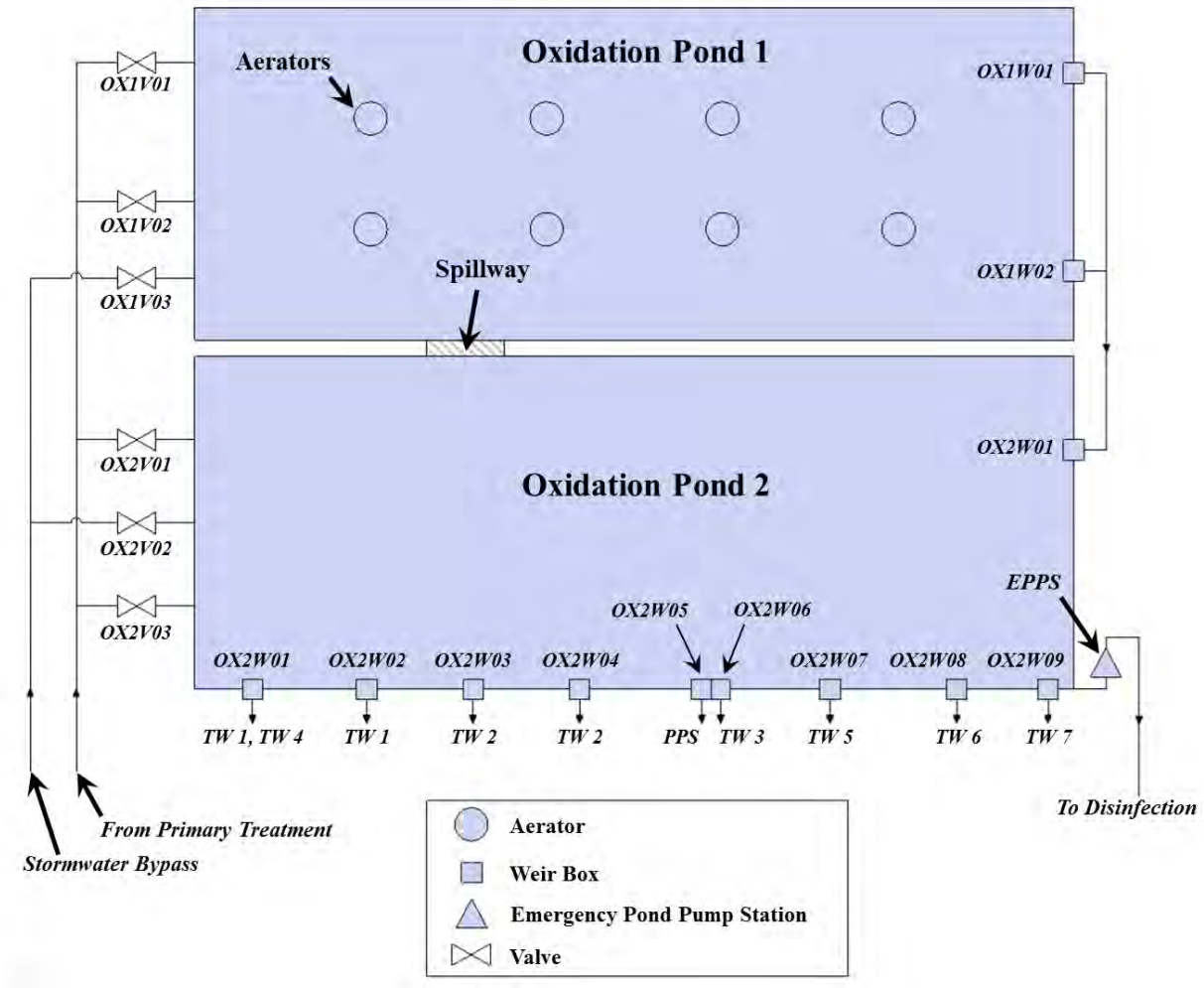



**Figure D-3: Oxidation Ponds Process Flow Schematic**




**Figure D-4: Treatment Wetlands Site Aerial Showing Influent Weir Configurations**

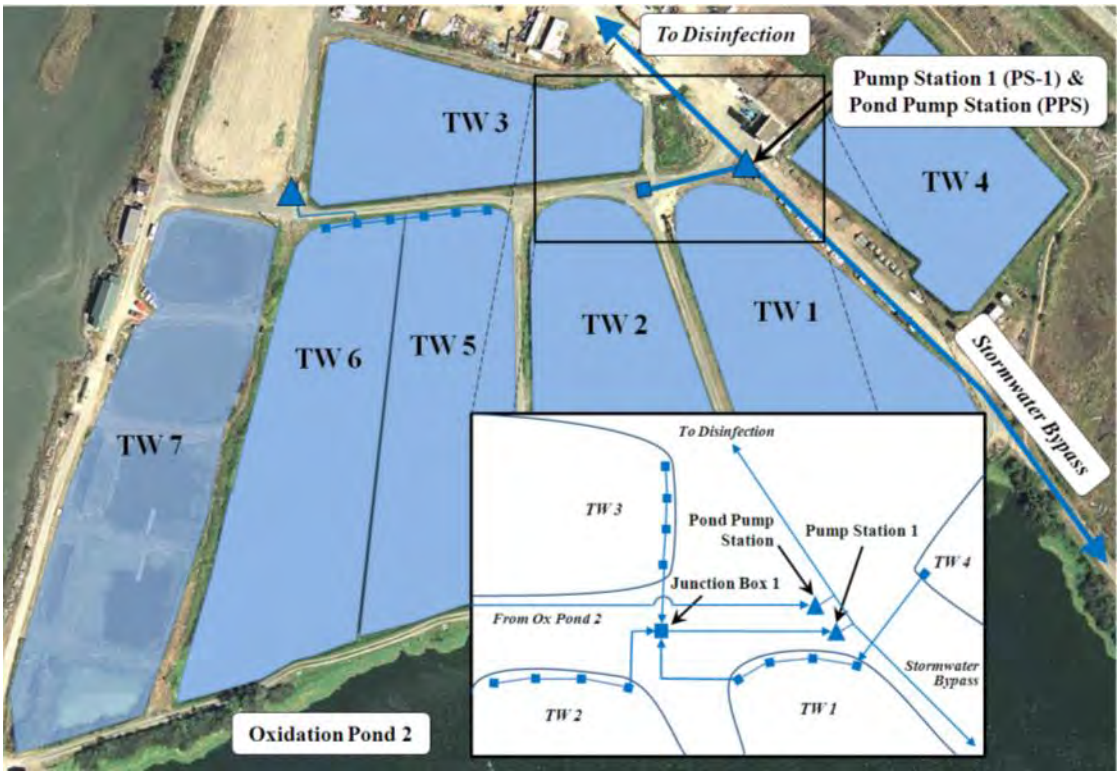



**Figure D-5: Treatment Wetlands Site Aerial Showing Effluent Weir Configurations**

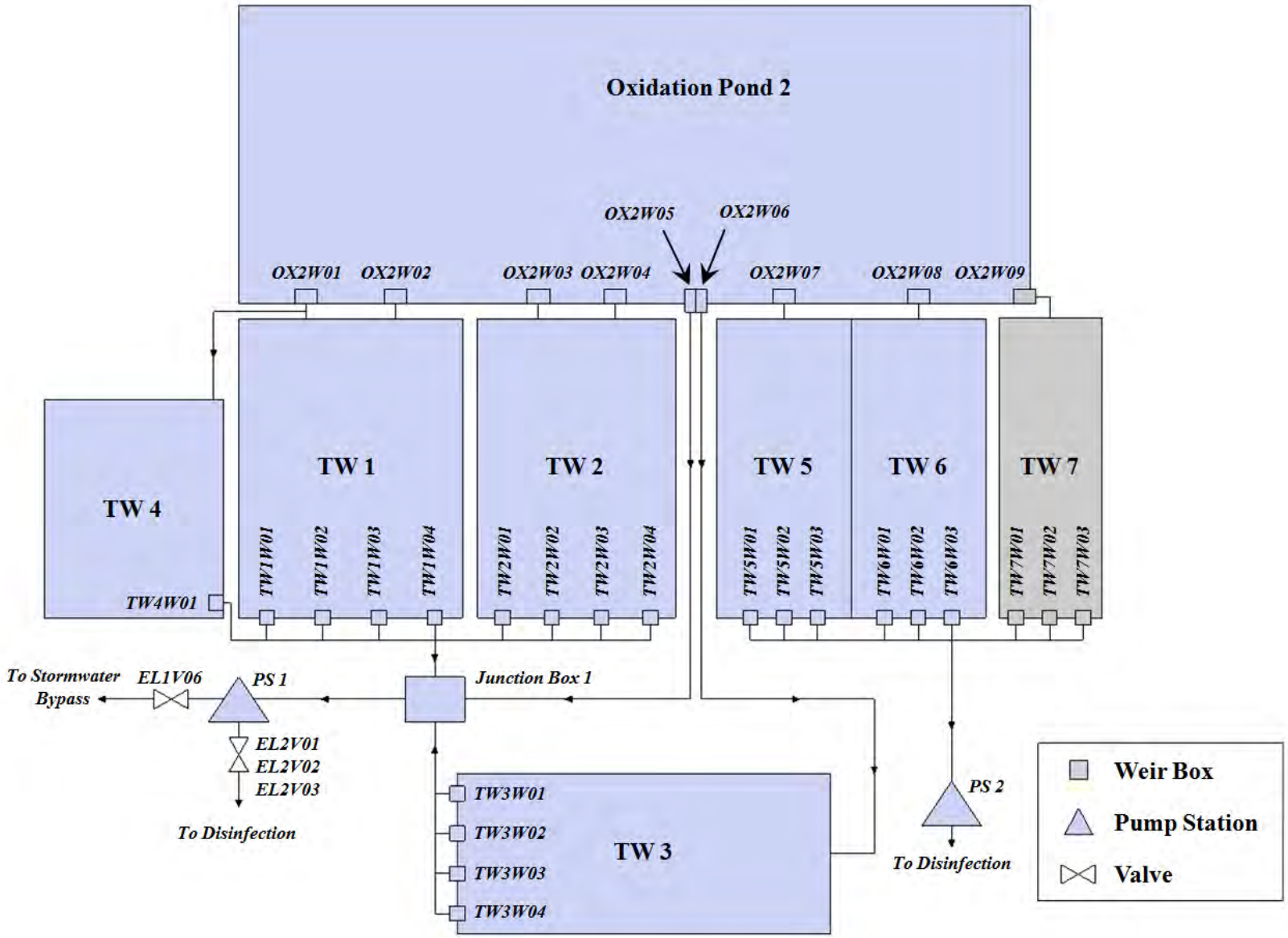



**Figure D-6: Treatment Wetlands Process Flow Schematic**

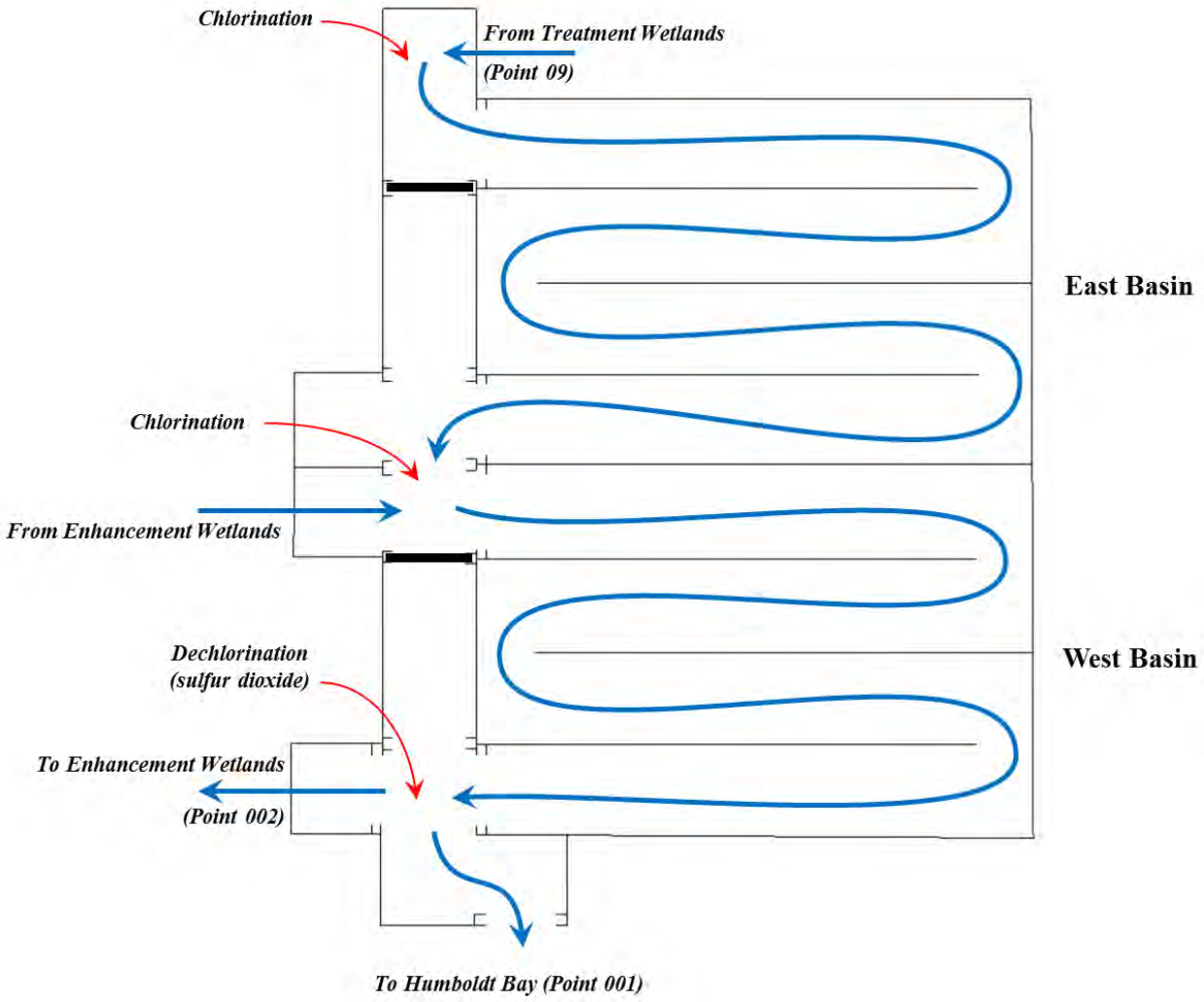



**Figure D-7: Chlorine Contact Basin Process Flow Schematic - Combined Basin Mode**

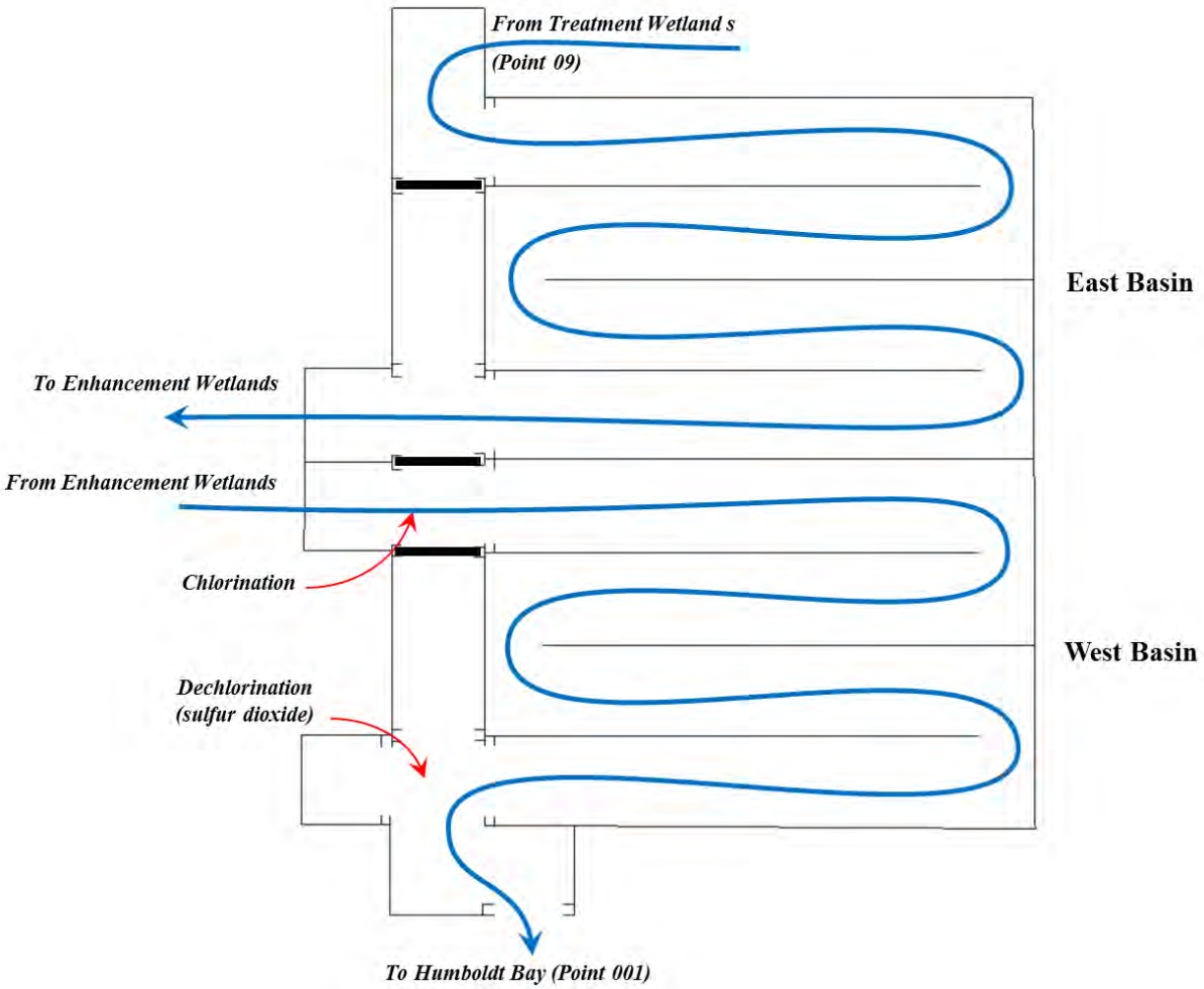



**Figure D-8: Chlorine Contact Basin Process Flow Schematic - Split Basin Mode**

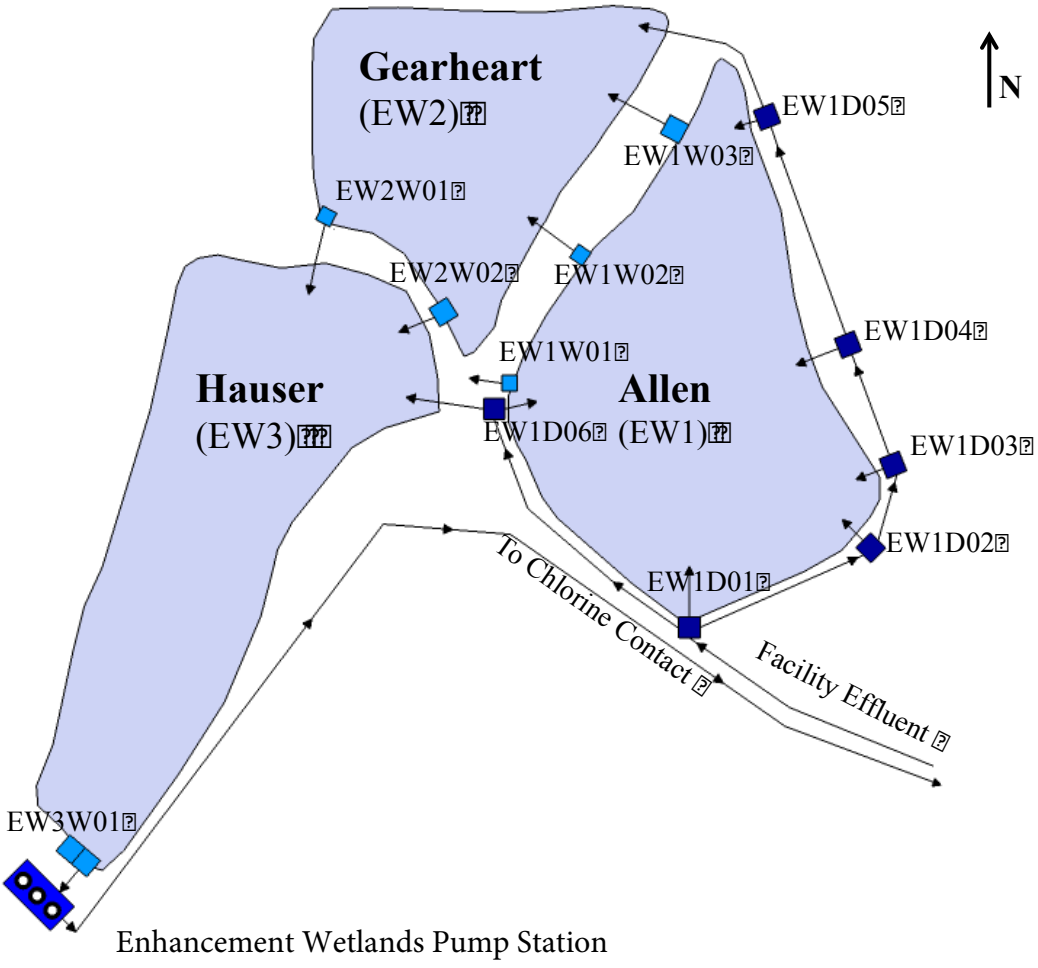
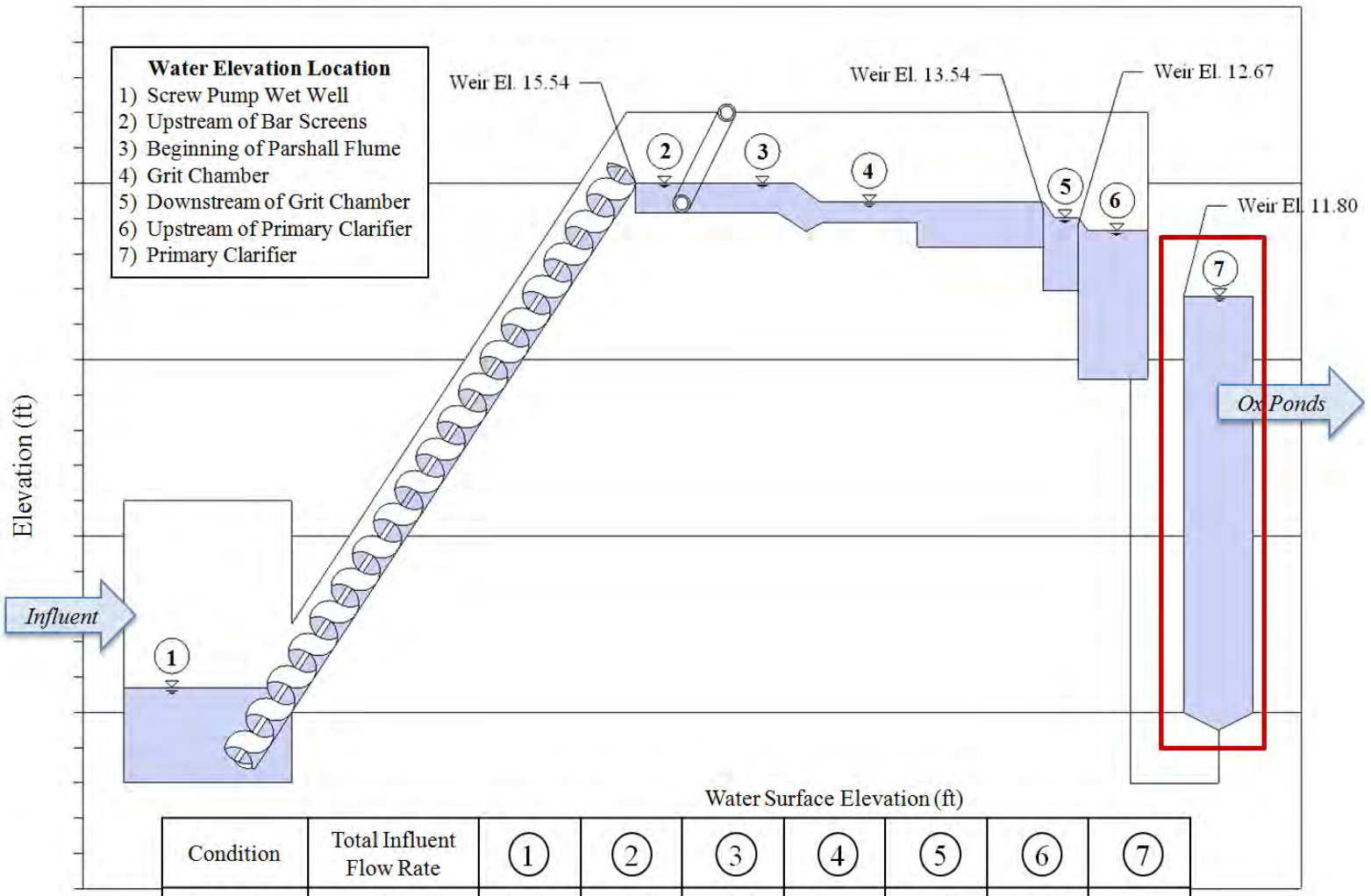



Figure D-9: Enhancement Wetlands Process Flow Schematic

# APPENDIX E – EXISTING HYDRAULIC PROFILES




| Condition | Total Influent Flow Rate | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Min Month | 1.0 MGD | 0.10 | 14.02 | 13.99 | 13.65 | 12.88 | 11.89 | 11.87 |
| Avg Annual | 2.3 MGD | 0.70 | 14.45 | 14.40 | 13.75 | 13.05 | 12.02 | 11.90 |
| Peak Flow | 16.5 MGD | 1.75 | 15.07 | 14.99 | 13.87 | 13.29 | 12.42 | 11.94 |

**Figure E-1: Hydraulic grade line of the headworks with the primary clarifiers highlighted by the red box.**

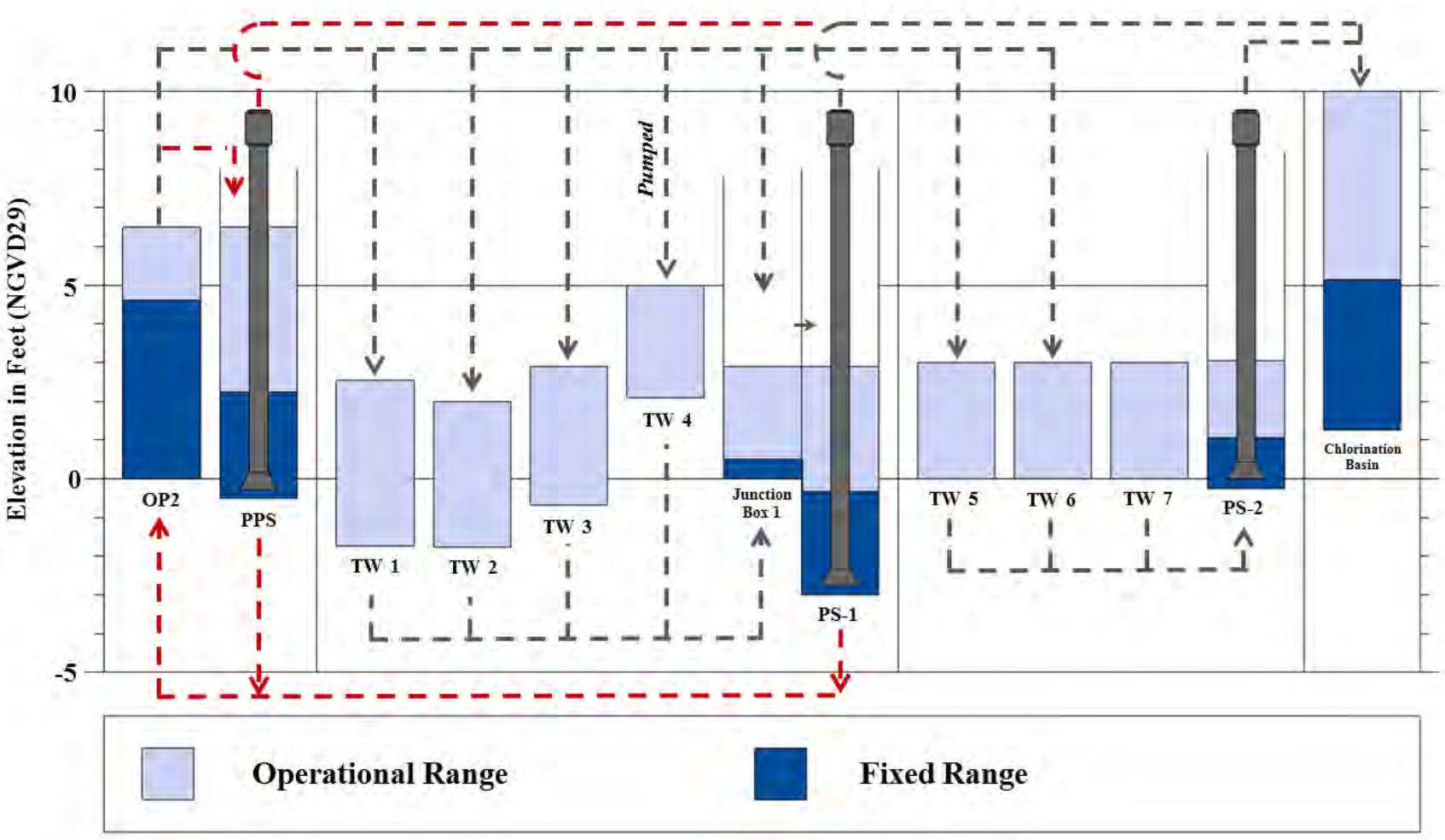



**Figure E-2: Hydraulic gradeline for the TWs; red lines indicate abnormal flow routing alternatives**

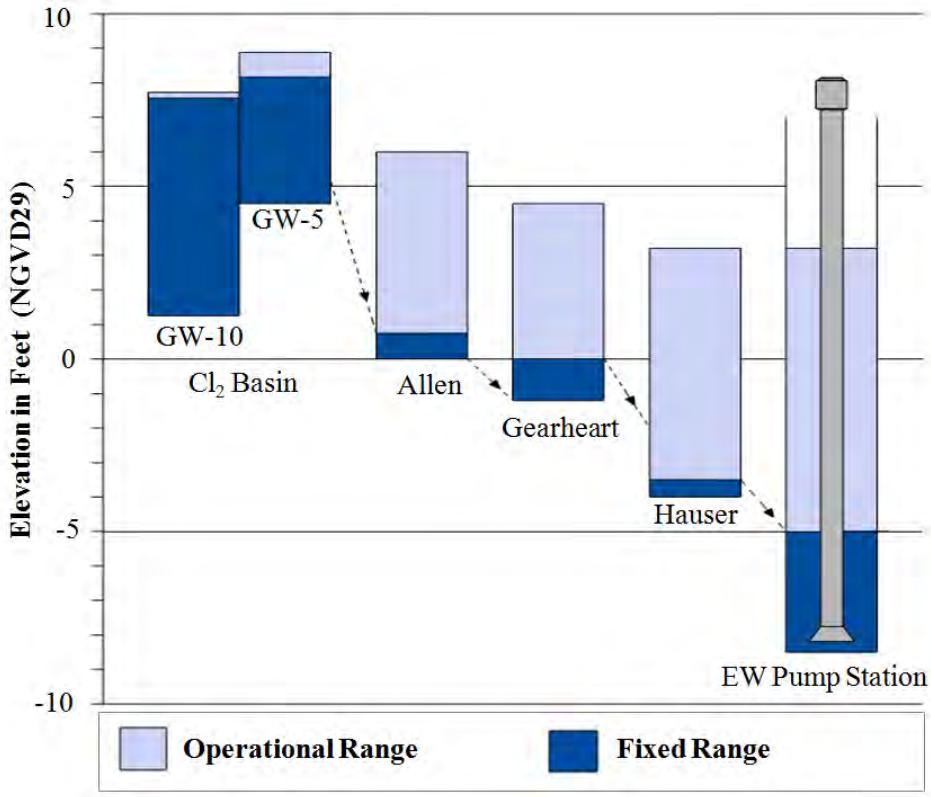



**Figure E-3: Hydraulic grade lines for flow through EWs; see *Chapter XVII- Disinfection* for locations of GW-10 and GW-5 in the chlorine contact basin.**

# APPENDIX F – SUMMARY OF EXISTING SECONDARY EFFLUENT PUMPING CAPACITIES

**Table F- 1. Operational flow measurements of different effluent pumping combinations in parallel.**

| Pump Combination | Flow (MGD) |
|---|---|
| 1 PS-1 | 1.20 |
| 2 PS-1 | 2.30 |
| 3 PS-1 | 2.99 |
| 1 PS-2 | 1.5 |
| 2 PS-2 | 2.4 |
| 1 PPS | 1.8 |
| 2 PPS | 2.9 |
| 3 PPS | 4.5 |
| 1 EPPS | 4.2 |
| 2 EPPS | 5.8 |
| 2 PS-1 + 1 PPS | 4.5 |
| 3 PS-1 + 1 PPS | 4.9 |
| 3 PS-1 + 3 PPS | 6.0 |
| 2 PS-2 + 1 EPPS | 5.9 |
| 2 PS-2 + 2 EPPS | 7.6 |
| 3 PPS + 2 EPPS + 3 PS-1 | 13.6 |

# APPENDIX G – PRESENTATION MATERIALS FROM THE OCTOBER AND NOVEMBER 2015 WORKSHOPS

# City of Arcata
## Wastewater Treatment Facility Improvements Project

Update on Facility Plan Capacity Review

October 29, 2015

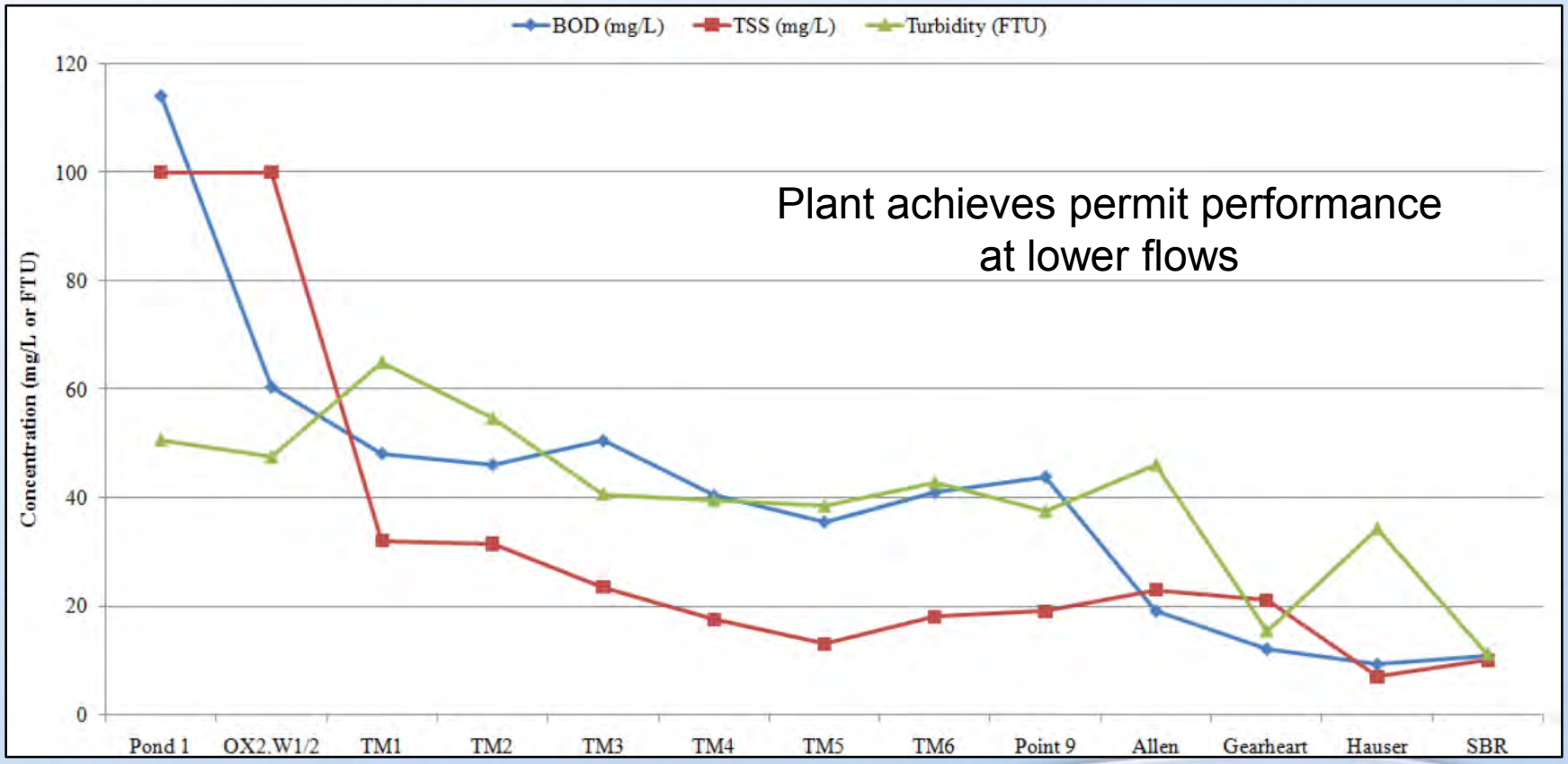
CarolloBlueTemplateWithLogo.pptx

# Agenda

- Treatment capacity – review of AMRI information
- Meeting Required Capacity – review concepts for workshop
- Disinfection – review of recent UVT data and impact of rainfall on wet weather flows
- Discuss agenda for workshop

CarolloBlueTemplateWithLogo.pptx

# Plant performance in September 2015 @ 1.4 MGD

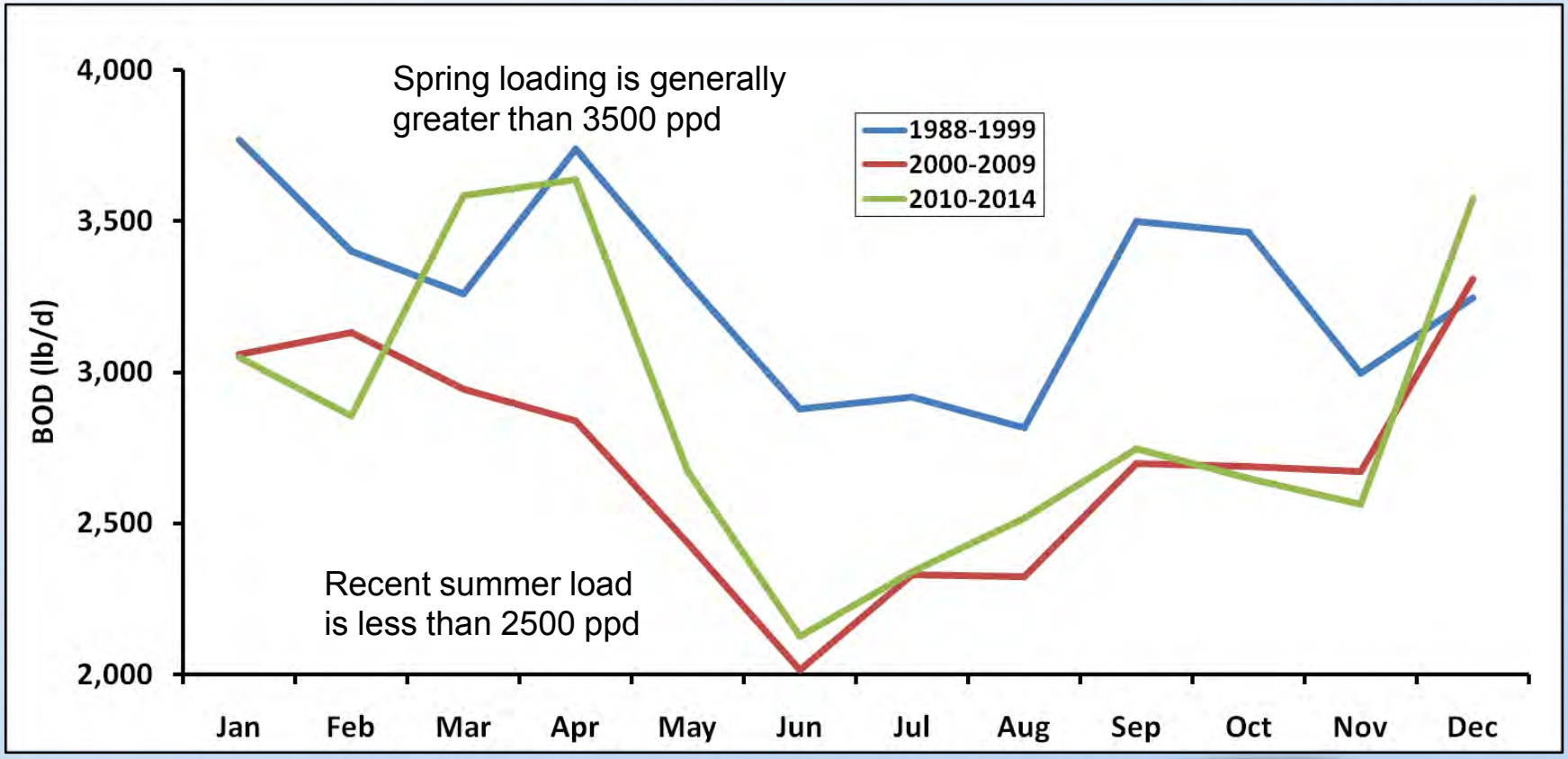



From 9/21/15 email from Bob Gearheart

# Plant Loading

CarolloBlueTemplateWithLogo.pptx

# Monthly median treatment facility influent BOD loading (1)

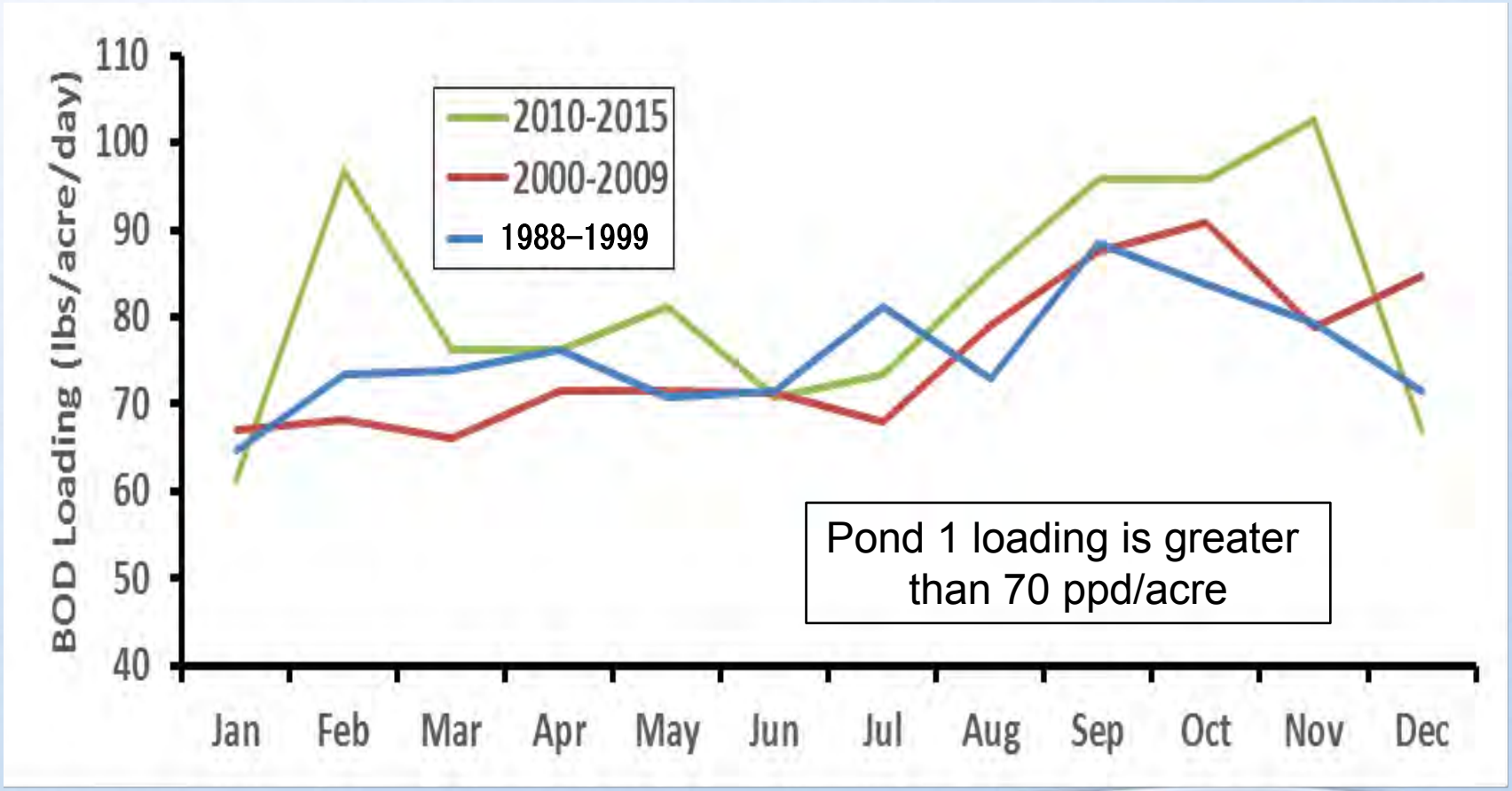



**Note: 1. From "AWTF Treatment Capacity Evaluation and Additional Treatment Recommendations Swanson, Gearheart and Adabie Sept 2015**

# Pond Capacity

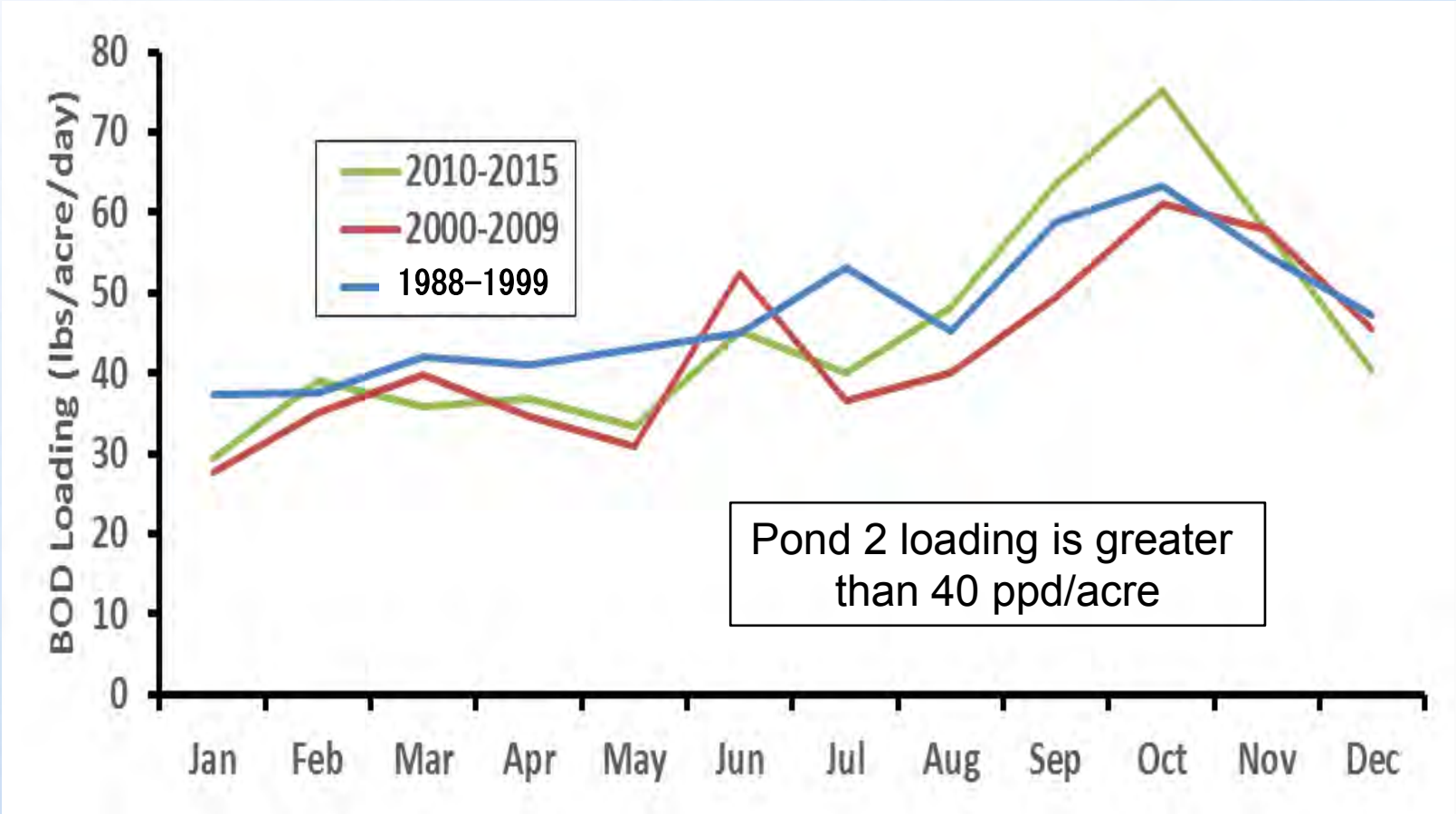
CarolloBlueTemplateWithLogo.pptx

# Monthly median pond 1 influent BOD loading



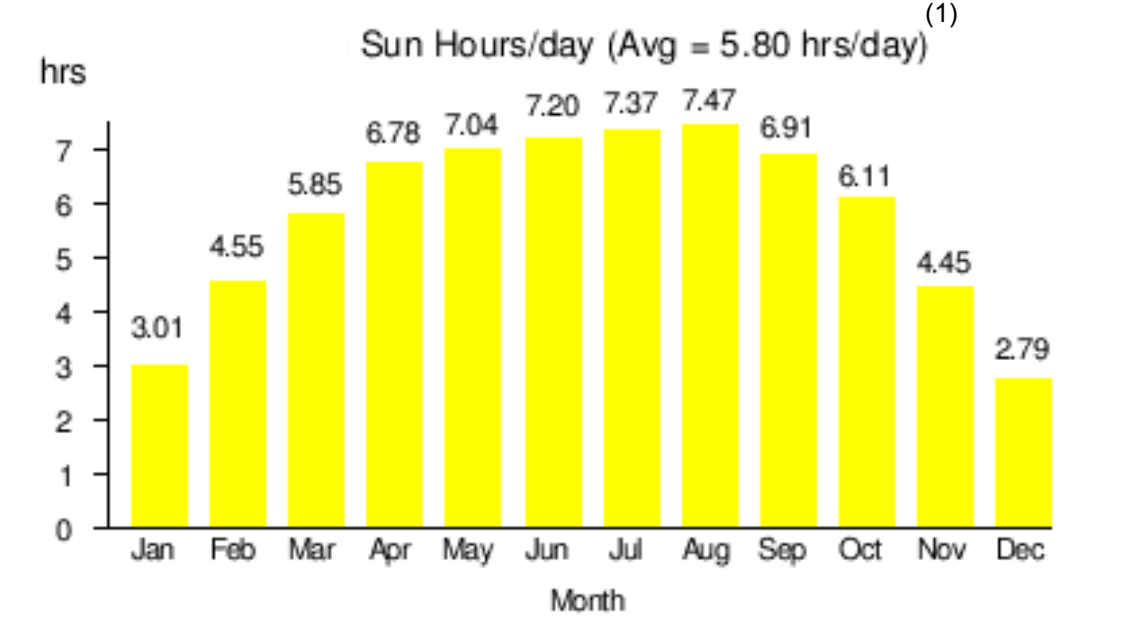

CarolloBlueTemplateWithLogo.pptx

# Monthly median pond 2 influent BOD loading



# Pond wastewater treatment process

- Temperature dependent
- Amount of solar radiation or sunlight




Note: 1. Need to verify for Arcata using HSU data

# Typical Wastewater Treatment Pond BOD Loading Criteria

| Type | Depth, ft | Detention Time, Days | Loading , PPD per acre | Effleunt- BOD mg/L | Effluent - TSS mg/L |
|---|---|---|---|---|---|
| Arcata Oxidation Pond | 4.5 | TBD | 70 to 100 | 25 to 90 | TBD |
| Oxidation Pond (1) | 3 to 4.5 | 10 to 40 | 35 to 125 | 20 to 40 | 80 to 140 |
| Facultative Ponds (1) | 4.5 to 7.5 | 25 to 180 | 20 to 60 | 30 to 40 | 40 to 100 |
| Partial Mix Aerated Lagoon (1) | 6 to 18 | 7 to 20 | 45 to 180 | 30 to 40 | 30 to 60 |
| From 1. Natural System For Waste Management and Treatment, Reed et al | | | | | |

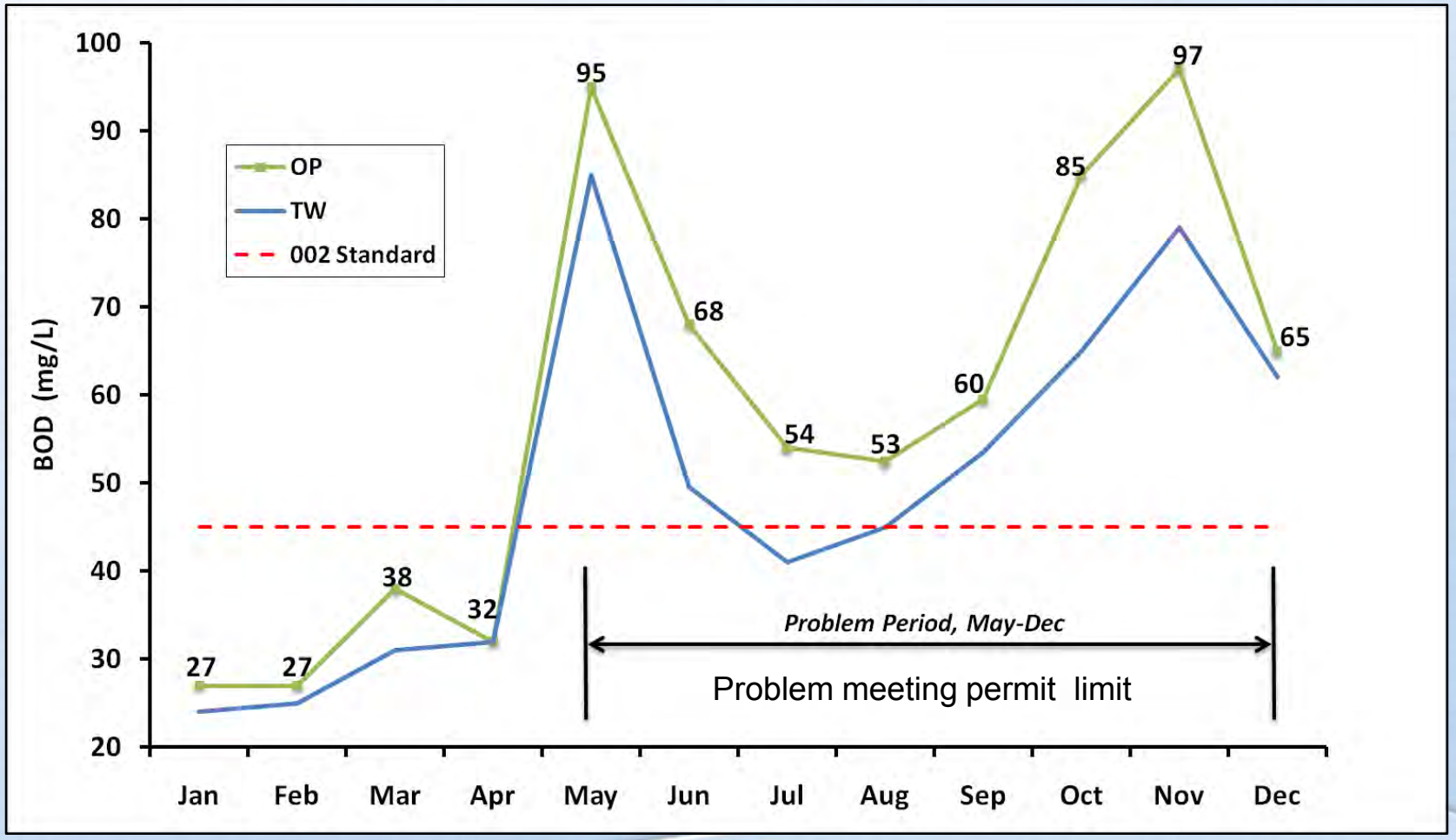
Carollo recommends 25 ppd/acre for Northern California

CarolloBlueTemplateWithLogo.pptx

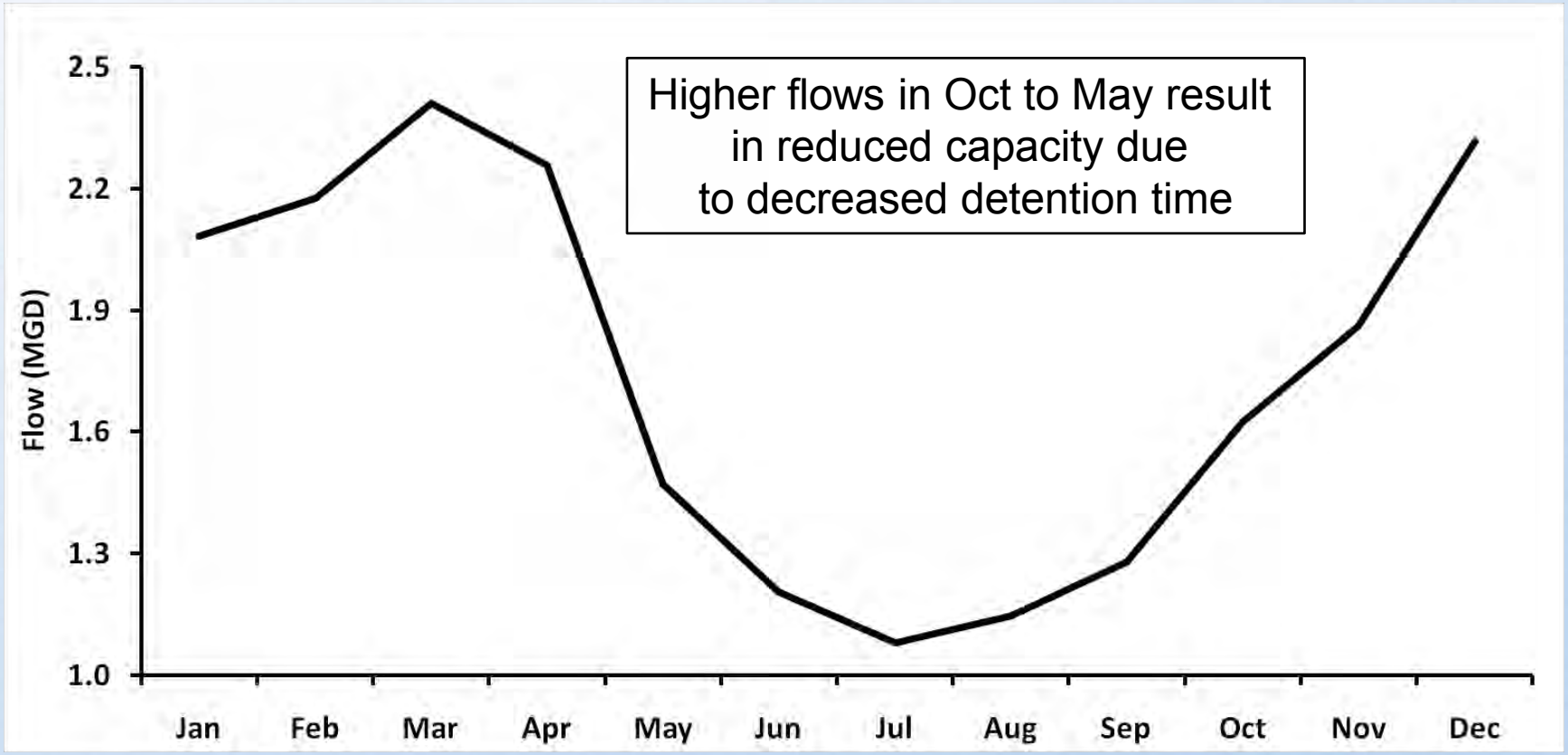
# Treatment Wetland Capacity

CarolloBlueTemplateWithLogo.pptx

# Pond and TW Monthly Median Effluent BOD



# Monthly median TW flows



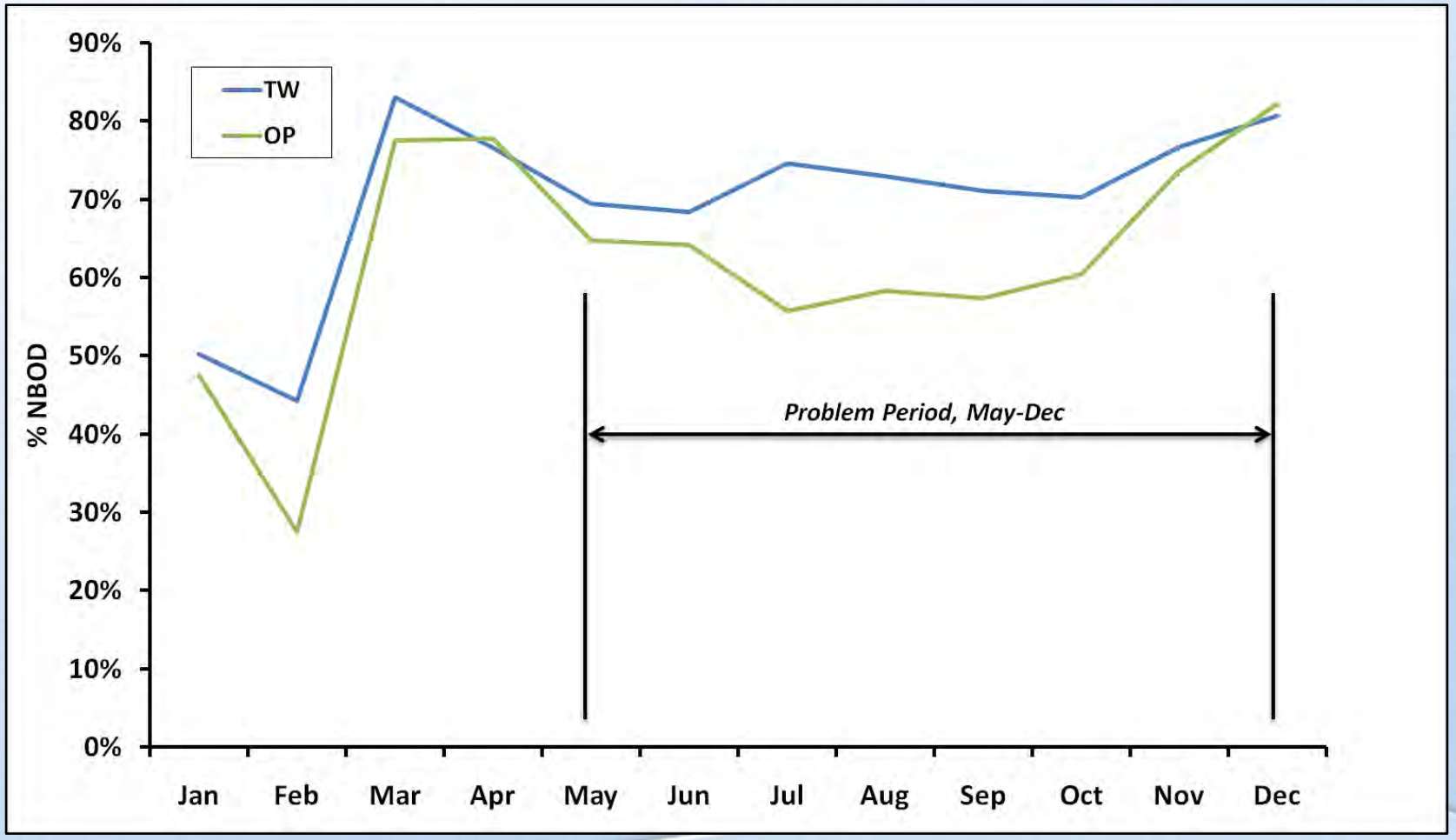
# Treatment wetland capacity

| | Detention Time, days | Depth, ft | Loading ppd/acre | Effluent BOD, mg/L | Effluent TSS, mg/L |
|---|---|---|---|---|---|
| Textbook(1) | 7 to 15 | 1 to 3 | 100 -200 | 5 to 10 | 5 to 15 |
| Arcata | 3 to 8 for low to high flows | Varies - min depth 1 foot | TBD | 25 to 85 | 10 to 40 for TM 5 and 6 |
| 1. Natural Systems for Waste Management and Treatment | | | | | |

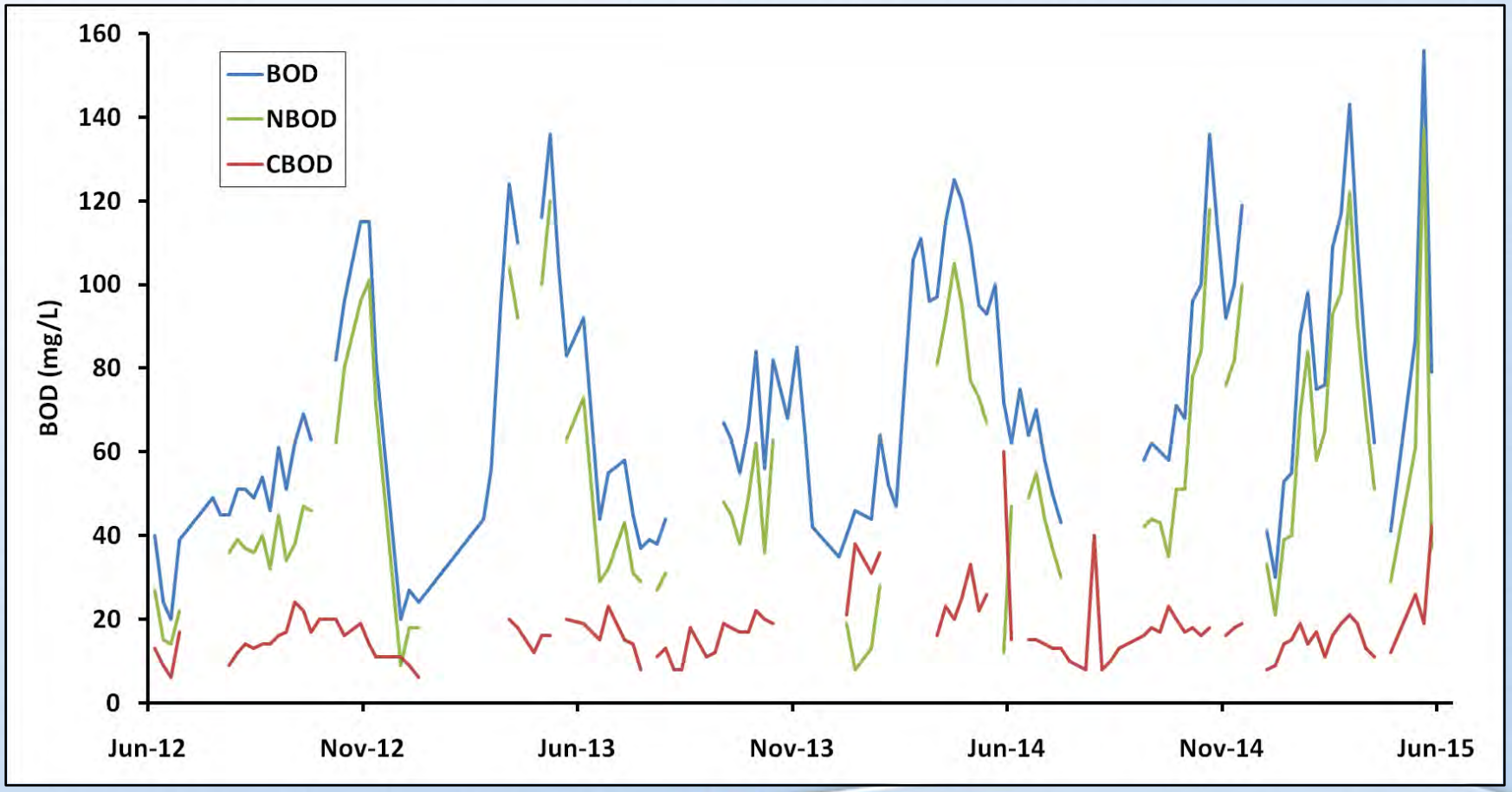
# Nutrient (Nitrogen loads)

- Historic focus of RWQCB has been on permit and meeting BOD and TSS.
- Recent discussion on nutrients has indicated that ammonia and nutrients may be a future concern.
- Current data suggests that nitrogen loads impact plant capacity

# Nitrogen BOD makes up a large portion of the BOD load



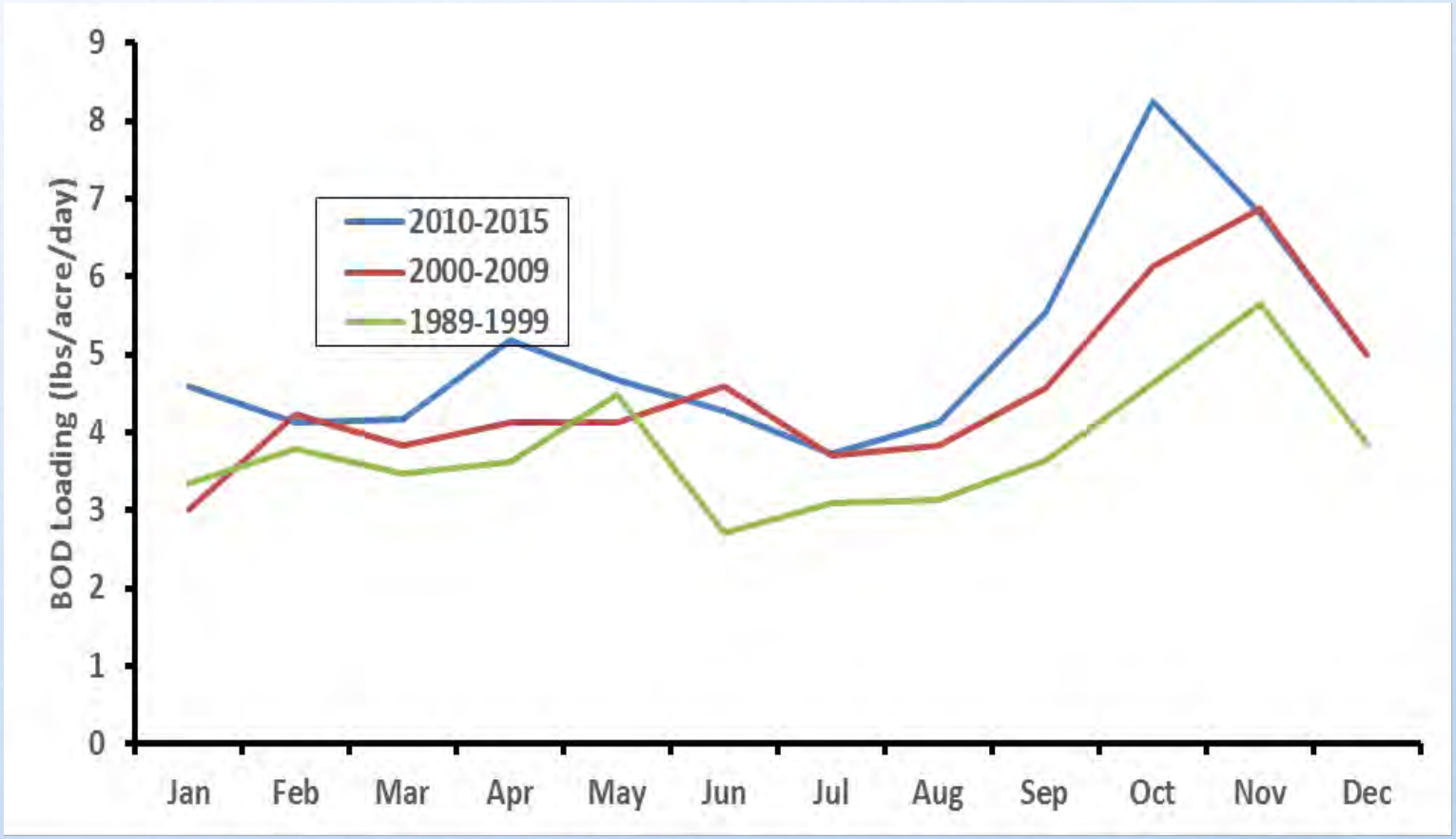
# TW effluent BOD and relation to NBOD



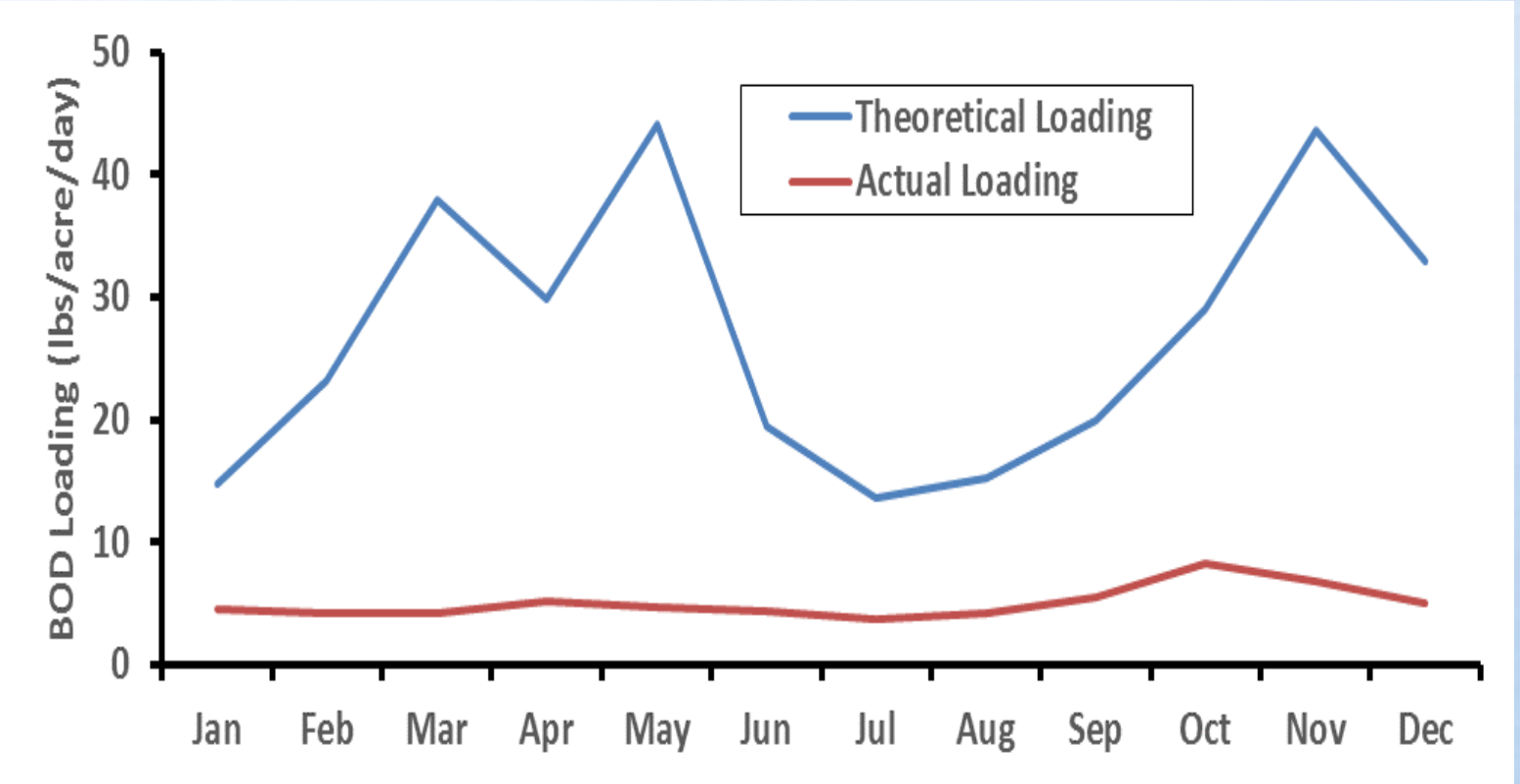
# Enhancement Wetland Capacity

CarolloBlueTemplateWithLogo.pptx

# Historic EW loadings



# Potential EW loadings may increase 4 to 5 times above the actual historic loadings



# Enhancement wetland model – 30 mg/l limit

Inputs:

Date (mm/dd/yy): 1/1/13

| Jan, Feb | | Enhancement Wetland Effluent BOD Concentration (mg/L) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Flow Rate | HRT | Influent BOD | | | | | | | | | | | | | | |
| | | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 |
| 1.0 | 11.9 | 1.7 | 2.5 | 3.4 | 4.2 | 5.1 | 5.9 | 6.7 | 7.6 | 8.4 | 9.3 | 10.1 | 10.9 | 11.8 | 12.6 | 13.5 |
| 1.1 | 10.8 | 1.8 | 2.8 | 3.7 | 4.6 | 5.5 | 6.5 | 7.4 | 8.3 | 9.2 | 10.2 | 11.1 | 12.0 | 12.9 | 13.8 | 14.8 |
| 1.2 | 9.9 | 2.0 | 3.0 | 4.0 | 5.0 | 6.0 | 7.0 | 8.0 | 9.0 | 10.0 | 11.0 | 12.0 | 13.0 | 14.0 | 15.1 | 16.1 |
| 1.3 | 9.1 | 2.2 | 3.2 | 4.3 | 5.4 | 6.5 | 7.6 | 8.7 | 9.7 | 10.8 | 11.9 | 13.0 | 14.1 | 15.1 | 16.2 | 17.3 |
| 1.4 | 8.5 | 2.3 | 3.5 | 4.6 | 5.8 | 7.0 | 8.1 | 9.3 | 10.4 | 11.6 | 12.7 | 13.9 | 15.1 | 16.2 | 17.4 | 18.5 |
| 1.5 | 7.9 | 2.5 | 3.7 | 4.9 | 6.2 | 7.4 | 8.6 | 9.9 | 11.1 | 12.3 | 13.6 | 14.8 | 16.0 | 17.3 | 18.5 | 19.7 |
| 1.6 | 7.4 | 2.6 | 3.9 | 5.2 | 6.5 | 7.8 | 9.1 | 10.5 | 11.8 | 13.1 | 14.4 | 15.7 | 17.0 | 18.3 | 19.6 | 20.9 |
| 1.7 | 7.0 | 2.8 | 4.1 | 5.5 | 6.9 | 8.3 | 9.6 | 11.0 | 12.4 | 13.8 | 15.2 | 16.5 | 17.9 | 19.3 | 20.7 | 22.0 |
| 1.8 | 6.6 | 2.9 | 4.3 | 5.8 | 7.2 | 8.7 | 10.1 | 11.6 | 13.0 | 14.5 | 15.9 | 17.4 | 18.8 | 20.3 | 21.7 | 23.2 |
| 1.9 | 6.2 | 3.0 | 4.5 | 6.1 | 7.6 | 9.1 | 10.6 | 12.1 | 13.6 | 15.1 | 16.7 | 18.2 | 19.7 | 21.2 | 22.7 | 24.2 |
| 2.0 | 5.9 | 3.2 | 4.7 | 6.3 | 7.9 | 9.5 | 11.1 | 12.6 | 14.2 | 15.8 | 17.4 | 19.0 | 20.5 | 22.1 | 23.7 | 25.3 |
| 2.2 | 5.4 | 3.4 | 5.1 | 6.8 | 8.5 | 10.2 | 11.9 | 13.6 | 15.3 | 17.0 | 18.8 | 20.5 | 22.2 | 23.9 | 25.6 | 27.3 |
| 2.4 | 4.9 | 3.6 | 5.5 | 7.3 | 9.1 | 10.9 | 12.8 | 14.6 | 16.4 | 18.2 | 20.0 | 21.9 | 23.7 | 25.5 | 27.3 | 29.2 |
| 2.6 | 4.6 | 3.9 | 5.8 | 7.7 | 9.7 | 11.6 | 13.5 | 15.5 | 17.4 | 19.3 | 21.3 | 23.2 | 25.1 | 27.1 | 29.0 | 30.9 |
| 2.8 | 4.2 | 4.1 | 6.1 | 8.1 | 10.2 | 12.2 | 14.3 | 16.3 | 18.3 | 20.4 | 22.4 | 24.4 | 26.5 | 28.5 | 30.5 | 32.6 |
| 3.0 | 4.0 | 4.3 | 6.4 | 8.5 | 10.7 | 12.8 | 14.9 | 17.1 | 19.2 | 21.3 | 23.5 | 25.6 | 27.7 | 29.9 | 32.0 | 34.1 |
| 3.2 | 3.7 | 4.5 | 6.7 | 8.9 | 11.1 | 13.4 | 15.6 | 17.8 | 20.0 | 22.3 | 24.5 | 26.7 | 28.9 | 31.2 | 33.4 | 35.6 |
| 3.4 | 3.5 | 4.6 | 6.9 | 9.3 | 11.6 | 13.9 | 16.2 | 18.5 | 20.8 | 23.1 | 25.4 | 27.8 | 30.1 | 32.4 | 34.7 | 37.0 |
| 3.6 | 3.3 | 4.8 | 7.2 | 9.6 | 12.0 | 14.4 | 16.8 | 19.2 | 21.6 | 24.0 | 26.3 | 28.7 | 31.1 | 33.5 | 35.9 | 38.3 |
| 3.8 | 3.1 | 4.9 | 7.4 | 9.9 | 12.4 | 14.8 | 17.3 | 19.8 | 22.3 | 24.7 | 27.2 | 29.7 | 32.1 | 34.6 | 37.1 | 39.6 |
| 4.0 | 3.0 | 5.1 | 7.6 | 10.2 | 12.7 | 15.3 | 17.8 | 20.4 | 22.9 | 25.5 | 28.0 | 30.5 | 33.1 | 35.6 | 38.2 | 40.7 |
| 4.2 | 2.8 | 5.2 | 7.8 | 10.5 | 13.1 | 15.7 | 18.3 | 20.9 | 23.5 | 26.1 | 28.8 | 31.4 | 34.0 | 36.6 | 39.2 | 41.8 |
| 4.4 | 2.7 | 5.4 | 8.0 | 10.7 | 13.4 | 16.1 | 18.8 | 21.4 | 24.1 | 26.8 | 29.5 | 32.2 | 34.8 | 37.5 | 40.2 | 42.9 |
| 4.6 | 2.6 | 5.5 | 8.2 | 11.0 | 13.7 | 16.5 | 19.2 | 21.9 | 24.7 | 27.4 | 30.2 | 32.9 | 35.7 | 38.4 | 41.1 | 43.9 |
| 4.8 | 2.5 | 5.6 | 8.4 | 11.2 | 14.0 | 16.8 | 19.6 | 22.4 | 25.2 | 28.0 | 30.8 | 33.6 | 36.4 | 39.2 | 42.0 | 44.8 |
| 5.0 | 2.4 | 5.7 | 8.6 | 11.4 | 14.3 | 17.1 | 20.0 | 22.9 | 25.7 | 28.6 | 31.4 | 34.3 | 37.2 | 40.0 | 42.9 | 45.7 |
| 5.5 | 2.2 | 6.0 | 9.0 | 11.9 | 14.9 | 17.9 | 20.9 | 23.9 | 26.9 | 29.9 | 32.9 | 35.8 | 38.8 | 41.8 | 44.8 | 47.8 |
| 6.0 | 2.0 | 6.2 | 9.3 | 12.4 | 15.5 | 18.6 | 21.7 | 24.8 | 27.9 | 31.0 | 34.1 | 37.2 | 40.3 | 43.4 | 46.5 | 49.6 |
| 6.5 | 1.8 | 6.4 | 9.6 | 12.8 | 16.0 | 19.2 | 22.4 | 25.6 | 28.8 | 32.0 | 35.3 | 38.5 | 41.7 | 44.9 | 48.1 | 51.3 |
| 7.0 | 1.7 | 6.6 | 9.9 | 13.2 | 16.5 | 19.8 | 23.1 | 26.4 | 29.7 | 33.0 | 36.3 | 39.6 | 42.9 | 46.2 | 49.5 | 52.8 |
| 7.5 | 1.6 | 6.8 | 10.1 | 13.5 | 16.9 | 20.3 | 23.7 | 27.0 | 30.4 | 33.8 | 37.2 | 40.6 | 43.9 | 47.3 | 50.7 | 54.1 |

CarolloBlueTemplateWithLogo.pptx

CarrolloBlueTemplateWithLogo.pptx

# Additional Treatment Capacity

CarolloBlueTemplateWithLogo.pptx

# Additional TW BOD removal with optimal TW performance

| Pt 002 BOD Permit Limit (mg/L) | 45 | | |
|---|---|---|---|
| Flow Exceedance Probability | 50% | 10% | 0.5% |
| Flow (MGD) | 1.8 | 4 | 6 |
| Pt 002 BOD Load (lb/d) | 676 | 1,501 | 2,252 |
| Problem Period | Jun-Sep | May, Oct-Nov | May, Oct-Nov |
| Median Monthly Pond 2 BOD (mg/L) | 53 | 97 | 97 |
| Pond 2 BOD Load (lb/d) | 796 | 3,236 | 4,854 |
| Total Required BOD Removal (lb/d) | 120 | 1,735 | 2,602 |
| Optimal TW BOD Removal (lb/d) | 388 | 585 | 585 |
| Remaining BOD Treatment (lb/d) | 0 | 1,150 | 2,017 |
| Remaining Treatment as NBOD (lb/d) | 0 | 747 | 1,311 |
| Remaining Treatment as N (lb/d) | 0 | 218 | 382 |

# Capacity Issues

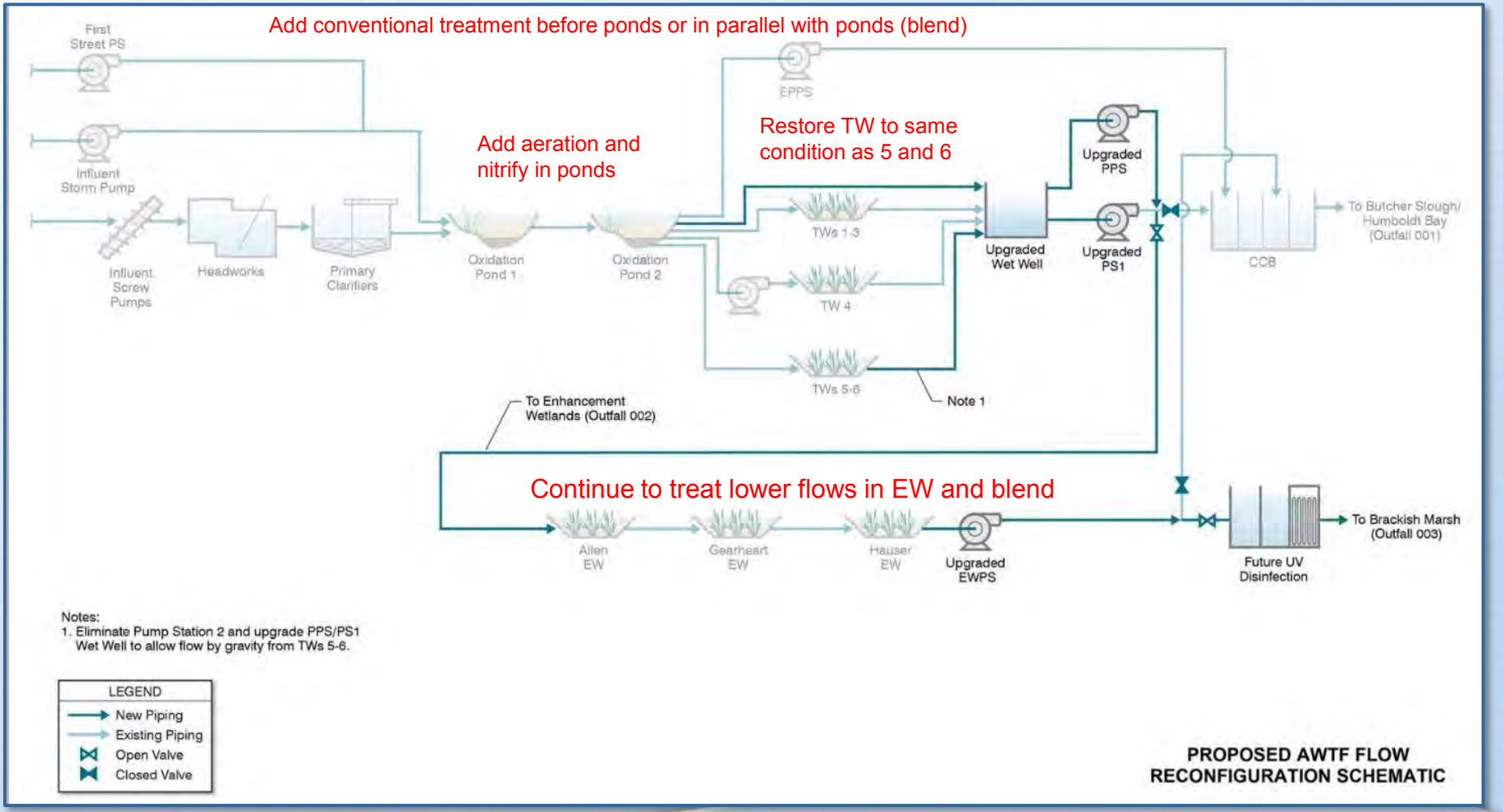
- Ponds
  - High Pond 1 BOD loading
  - Pond 2 short circuiting
  - Sludge accumulation and impact on capacity
  - Minimum volume to store wet weather flows
  - Do not nitrify in fall, winter and spring
- Treatment wetlands
  - Need to revegetate/regrade wetlands No. 1- 4.
  - Need more acreage beyond proposed No. 7
  - Require on-going vegetation management

# Capacity issues, cont.

- Enhancement wetlands
  - Proposed flows are higher than ever designed
  - Short circuiting reduces detention time
  - Peak flows reduce detention time and predicted effluent BOD exceeds permit
  - Requires on-going vegetation management

CarolloBlueTemplateWithLogo.pptx

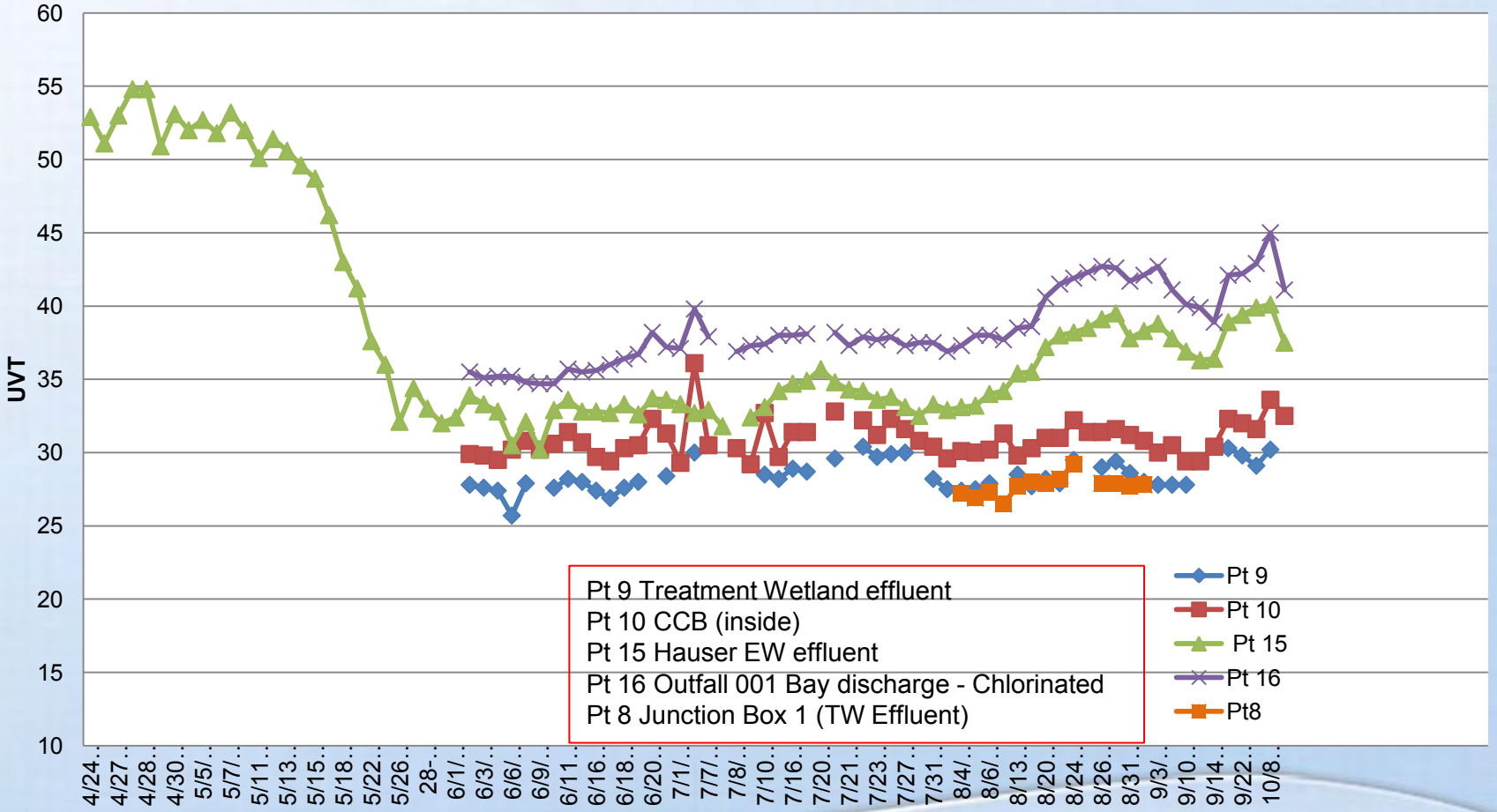
# Potential Capacity Improvements



# Outfall 003 Disinfection

CarolloBlueTemplateWithLogo.pptx

# UVT Analysis – Design for lower than 35%. Lower 10th percentile – 32.5 for Pt 15



# UV System Installation Cost Estimate – based on 35% UVT

| Dose ($mJ/cm^2$) | 35 | 35 with Redundancy | 50 | 50 with Redundancy |
|---|---|---|---|---|
| UV Disinfection Equipment Cost | $800,000 | $1,090,000 | $1,050,000 | $1,310,000 |
| **Total Construction Costs:** | | | | |
| Low range (3 times equipment) | $2,400,000 | $3,270,000 | $3,150,000 | $3,930,000 |
| High range (5 times equipment) | $4,000,000 | $5,450,000 | $5,250,000 | $6,550,000 |
| Notes:<br>(1) Equipment sizing is based on an End of Lamp Life Factor of 0.90 and a Fouling Factor of 0.95. | | | | |

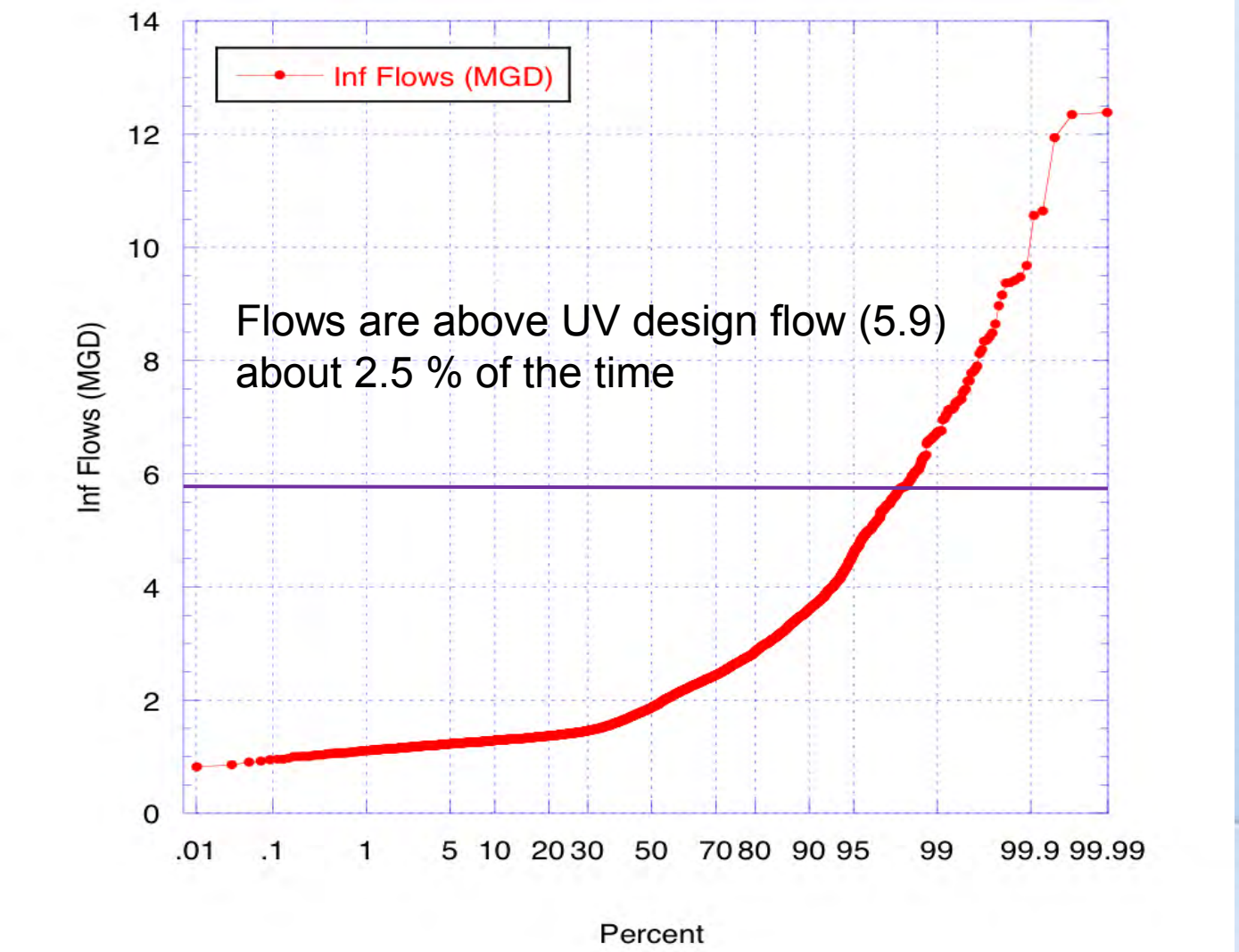
Based on Trojan UV 3000Plus



# Outfall 001 Disinfection

CarolloBlueTemplateWithLogo.pptx

# Influent Flows for Point 1 from 1997 – 2010



# Impact of Rainfall on Plant Flows
# Dry Weather (1)

| | Dry Weather | | | | | |
|---|---|---|---|---|---|---|
| Rainfall | 1.3 MGD | | | | | |
| (in/day) | TW Flow | Pond Pump | Pt 001 Chlorine Disinfection. | Pt 002 | UV Flow | Total |
| 0.2 | 1.6 | 0.0 | 0.0 | 1.6 | 1.8 | 1.8 |
| 0.4 | 1.9 | 0.0 | 0.0 | 1.9 | 2.4 | 2.4 |
| 0.6 | 2.3 | 0.0 | 0.0 | 2.3 | 2.9 | 2.9 |
| 0.8 | 2.6 | 0.0 | 0.0 | 2.6 | 3.5 | 3.5 |
| 1.0 | 2.9 | 0.0 | 0.0 | 2.9 | 4.0 | 4.0 |
| 1.2 | 3.2 | 0.0 | 0.0 | 3.2 | 4.5 | 4.5 |
| 1.4 | 3.6 | 0.0 | 0.0 | 3.6 | 5.1 | 5.1 |
| 1.6 | 3.9 | 0.0 | 0.0 | 3.9 | 5.6 | 5.6 |
| 1.8 | 4.2 | 0.0 | 0.3 | 3.9 | 5.9 | 6.2 |
| 2.0 | 4.5 | 0.0 | 0.8 | 3.7 | 5.9 | 6.7 |
| 2.2 | 4.9 | 0.0 | 1.4 | 3.5 | 5.9 | 7.3 |
| 2.4 | 5.2 | 0.0 | 1.9 | 3.3 | 5.9 | 7.8 |
| 2.6 | 5.5 | 0.0 | 2.4 | 3.1 | 5.9 | 8.3 |
| 2.8 | 5.8 | 0.0 | 3.0 | 2.9 | 5.9 | 8.9 |
| 3.0 | 6.2 | 0.0 | 3.5 | 2.6 | 5.9 | 9.4 |

**1. Expected and feasible flow rates through various parts of the Arcata WWTF based on influent flow rates of 1.3 and 2.3 MGD**
**Halverson 11/2012**

# Impact of Rainfall on Plant Flows
# Design Flow

| | Design Flow | | | | | |
|---|---|---|---|---|---|---|
| **Rainfall** | 2.3 MGD | | | | | |
| **(in/day)** | TW Flow | Pond Pump | Pt 001 Chlorine Disinfection. | Pt 002 | UV Flow | Total |
| **0.2** | 2.6 | 0.0 | 0.0 | 2.6 | 2.8 | 2.8 |
| **0.4** | 2.9 | 0.0 | 0.0 | 2.9 | 3.4 | 3.4 |
| **0.6** | 3.3 | 0.0 | 0.0 | 3.3 | 3.9 | 3.9 |
| **0.8** | 3.6 | 0.0 | 0.0 | 3.6 | 4.5 | 4.5 |
| **1.0** | 3.9 | 0.0 | 0.0 | 3.9 | 5.0 | 5.0 |
| **1.2** | 4.2 | 0.0 | 0.0 | 4.2 | 5.5 | 5.5 |
| **1.4** | 4.6 | 0.0 | 0.2 | 4.4 | 5.9 | 6.1 |
| **1.6** | 4.9 | 0.0 | 0.7 | 4.2 | 5.9 | 6.6 |
| **1.8** | 5.2 | 0.0 | 1.3 | 3.9 | 5.9 | 7.2 |
| **2.0** | 5.5 | 0.0 | 1.8 | 3.7 | 5.9 | 7.7 |
| **2.2** | 5.9 | 0.0 | 2.4 | 3.5 | 5.9 | 8.3 |
| **2.4** | 6.2 | 0.0 | 2.9 | 3.3 | 5.9 | 8.8 |
| **2.6** | 6.2 | 0.3 | 3.4 | 3.1 | 5.9 | 9.3 |
| **2.8** | 6.2 | 0.6 | 4.0 | 2.9 | 5.9 | 9.9 |
| **3.0** | 6.2 | 1.0 | 4.5 | 2.6 | 5.9 | 10.4 |

# Impact of Rainfall on Plant Flows
# Wet Weather flow

| | Wet Weather Flow | | | | | |
|---|---|---|---|---|---|---|
| **Rainfall** | 6.4 MGD | | | | | |
| **(in/day)** | TW Flow | Pond Pump | Pt 001 Chlorine Disinfection. | Pt 002 | UV Flow | Total |
| **0.2** | 6.2 | 0.5 | 1.0 | 5.7 | 5.9 | 6.9 |
| **0.4** | 6.2 | 0.8 | 1.6 | 5.5 | 5.9 | 7.5 |
| **0.6** | 6.2 | 1.2 | 2.1 | 5.2 | 5.9 | 8.0 |
| **0.8** | 6.2 | 1.5 | 2.7 | 5.0 | 5.9 | 8.6 |
| **1.0** | 6.2 | 1.8 | 3.2 | 4.8 | 5.9 | 9.1 |
| **1.2** | 6.2 | 2.1 | 3.7 | 4.6 | 5.9 | 9.6 |
| **1.4** | 6.2 | 2.5 | 4.3 | 4.4 | 5.9 | 10.2 |
| **1.6** | 6.2 | 2.8 | 4.8 | 4.2 | 5.9 | 10.7 |
| **1.8** | 6.2 | 3.1 | 5.4 | 3.9 | 5.9 | 11.3 |
| **2.0** | 6.2 | 3.4 | 5.9 | 3.7 | 5.9 | 11.8 |
| **2.2** | 6.2 | 3.8 | 6.5 | 3.5 | 5.9 | 12.4 |
| **2.4** | 6.2 | 4.1 | 7.0 | 3.3 | 5.9 | 12.9 |
| **2.6** | 6.2 | 4.4 | 7.5 | 3.1 | 5.9 | 13.4 |
| **2.8** | 6.2 | 4.7 | 8.1 | 2.9 | 5.9 | 14.0 |
| **3.0** | 6.2 | 5.1 | 8.6 | 2.6 | 5.9 | 14.5 |

**1. Expected and feasible flow rates through various parts of the Arcata WWTF based on influent flow rates of 6.4 MGD**
**Halverson 11/2012**

# Disinfection Issues

- Wetland effluent UVT and impact on UV system cost and size.
- Disinfection of peak flows
  - Need to turn on / off
  - Sits idle most of the time
  - Disinfection byproducts
  - Dechlorination required

# Existing Pond Storage – City needs to confirm storage is available



# Wrap up and review

- Capacity – limited by existing natural system footprint and environment
- Additional treatment options – needed to make up for shortfall, and to reliably meet permit
- Disinfection – need to address wet weather and increasing costs
- Workshop agenda – collaborate on items for discussion

# Wrap up and Action Item

- Agenda for Workshop in November
- Logistics for Workshop in November
- Address treatment capacity shortfall
- Address UV and alternative disinfection
- Review comments and finalize Facility Plan
- Follow up with update for RWQCB

# City of Arcata
# Wastewater Treatment Facility Improvements Project

Update on Facility Plan Capacity Review

Questions / Comments Doug Wing
dwing@Carollo.com

CarolloBlueTemplateWithLogo.pptx

# City of Arcata
# Wastewater Treatment Facility Improvements Project

Facility Plan Capacity Workshop

November 5-6, 2015

CarolloBlueTemplateWithLogo.pptx

# Agenda

## Thursday PM

- Revisit project goals
- Review current flows, loads and capacity
- Treatment capacity options – conceptual size
- Meeting required capacity – flow charts
- Ranking and feedback on options
- Conceptual Costs
- Feedback

# Agenda

## Friday AM

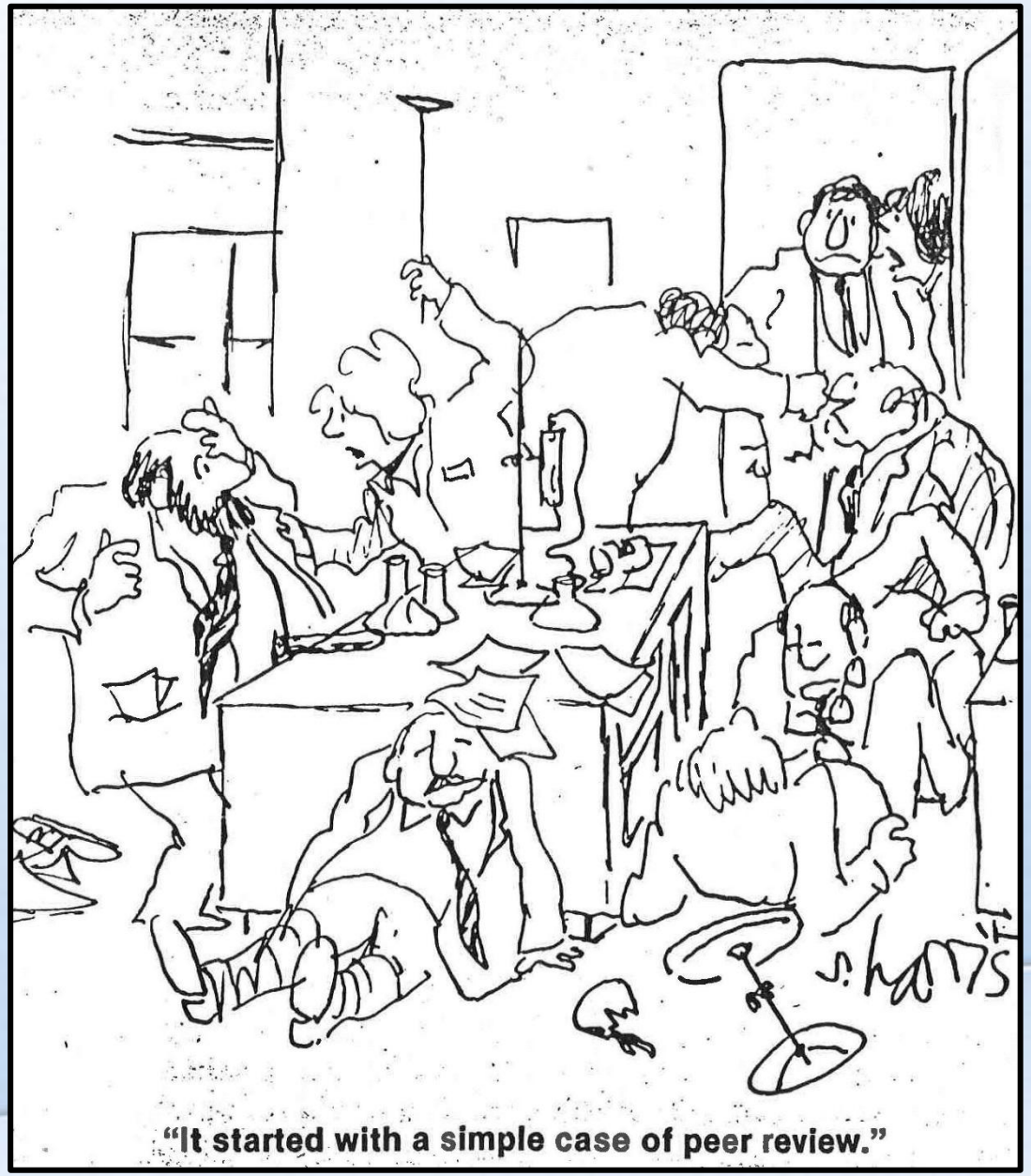
- Disinfection criteria
- Disinfection options ranking
- Comparison of disinfection options
- Revisit treatment capacity flow options
- Discuss Facility Plan next steps

## Friday PM

- Visit Petaluma Ellis Creek WRF

CarolloBlueTemplateWithLogo.pptx

# It started as a simple review

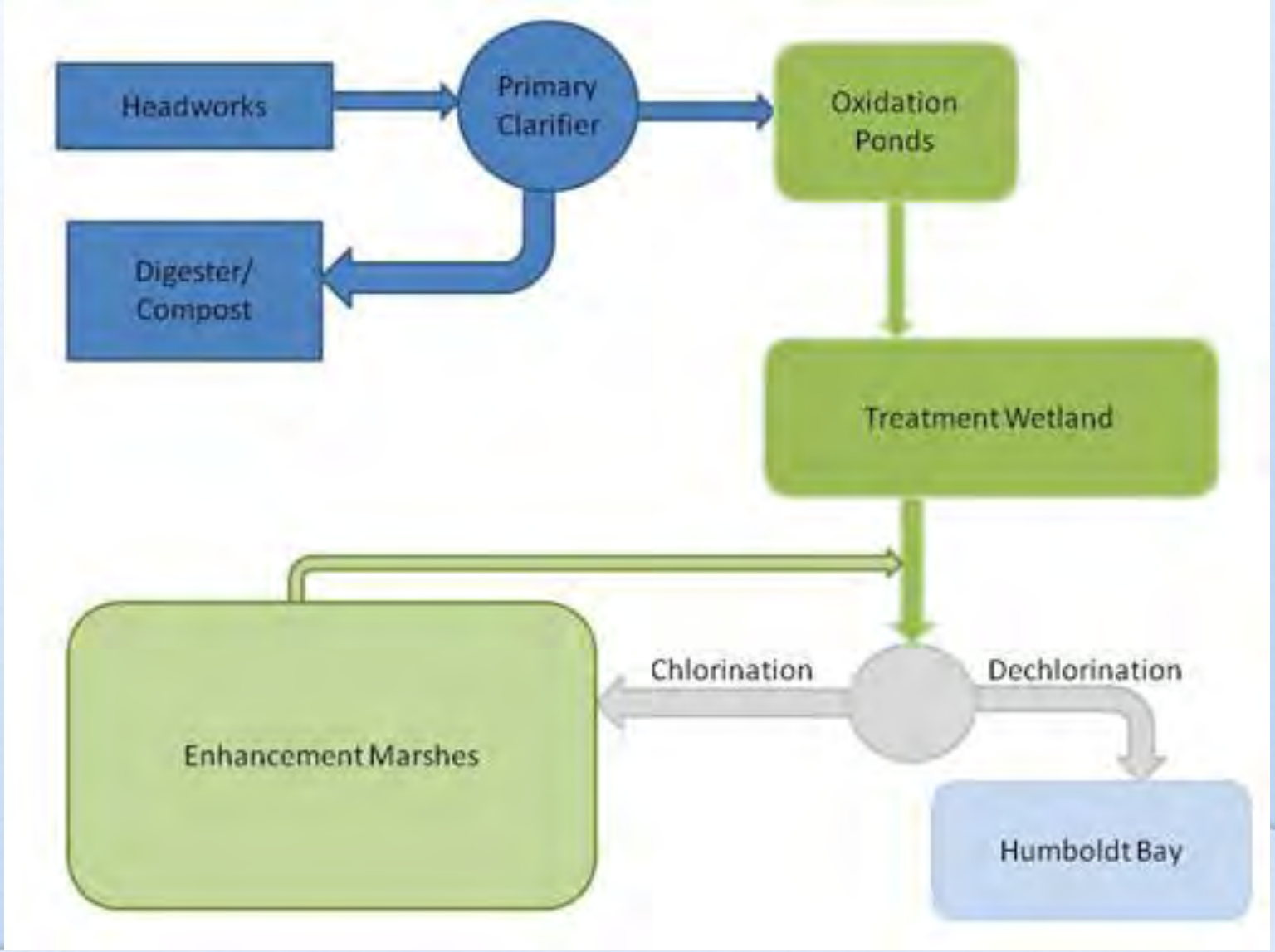


# Facility Plan Task Objectives

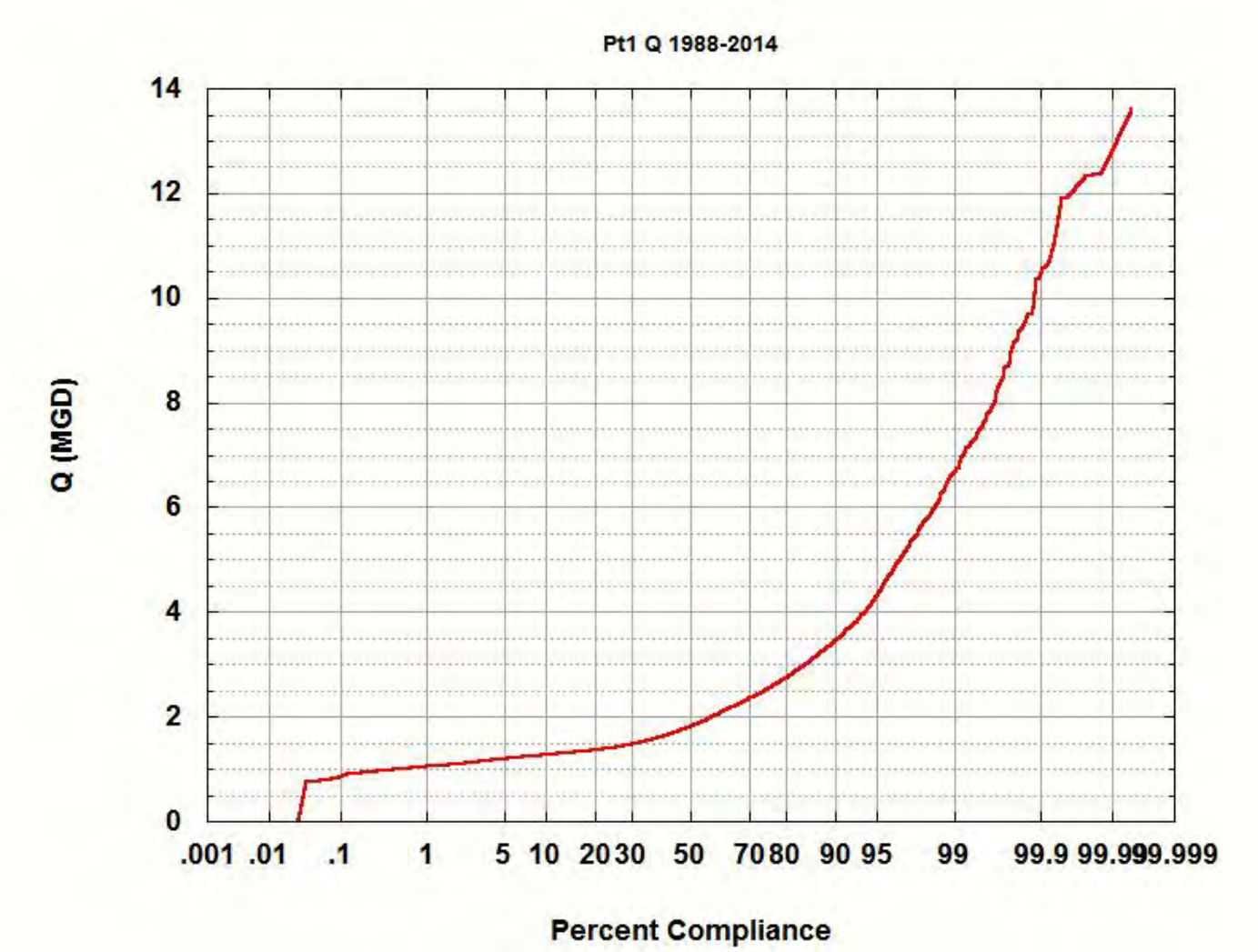
1. Focus on permit required improvements
2. Capital improvements for AWTF
3. Approach to address:
   a. Aging infrastructure
   b. Energy efficiency
   c. Community needs
   d. CAPACITY NEEDS



# Existing plant operation



# Point 1 Flow from 1988 – 2014

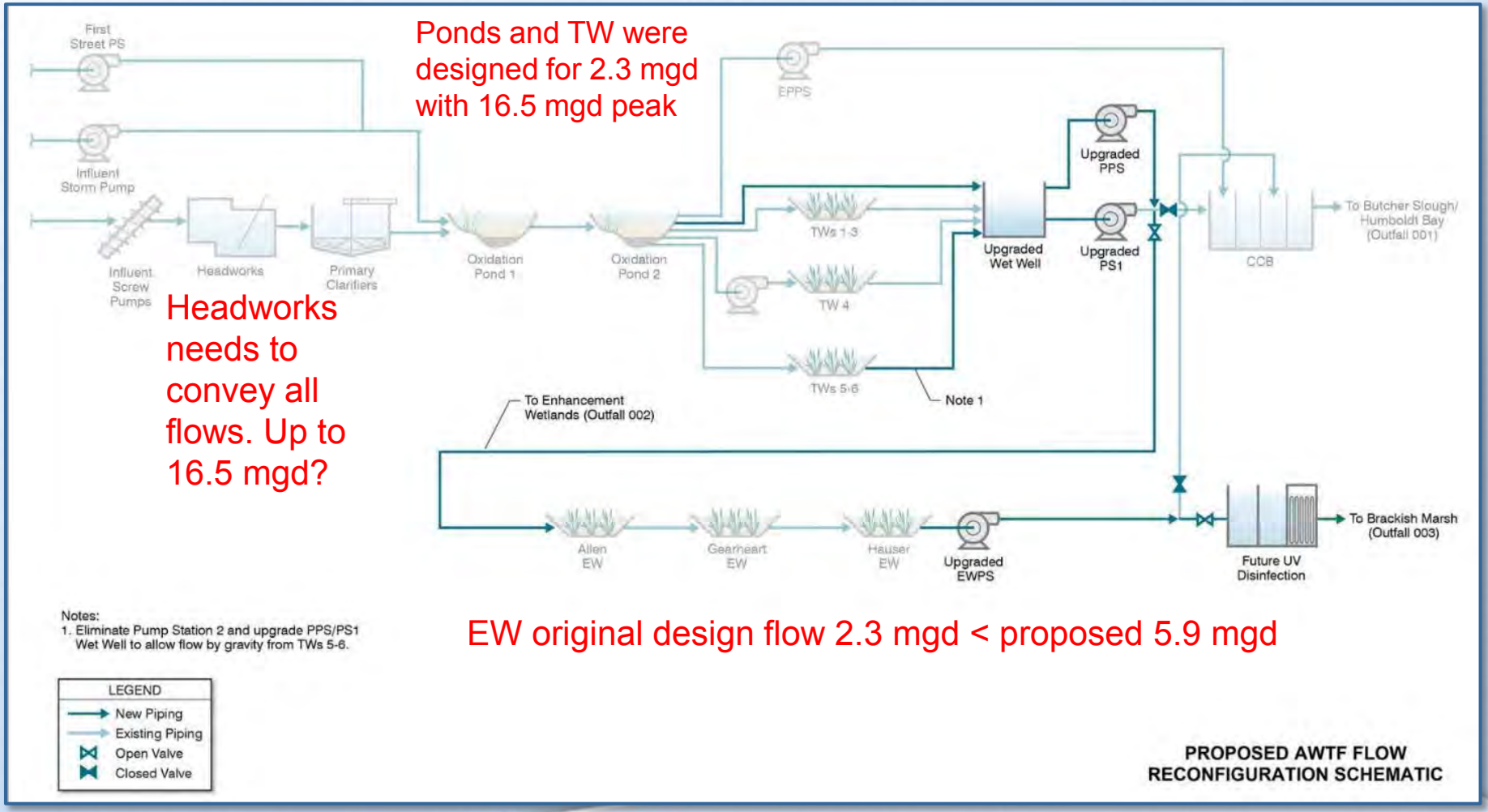


# Current Permit Design Flows

- Current dry weather 1.4 mgd
- Permit design – 2.3 mgd
- Permit wet weather - 5.9 mgd
- Permit peak wet weather – 16.5 mgd

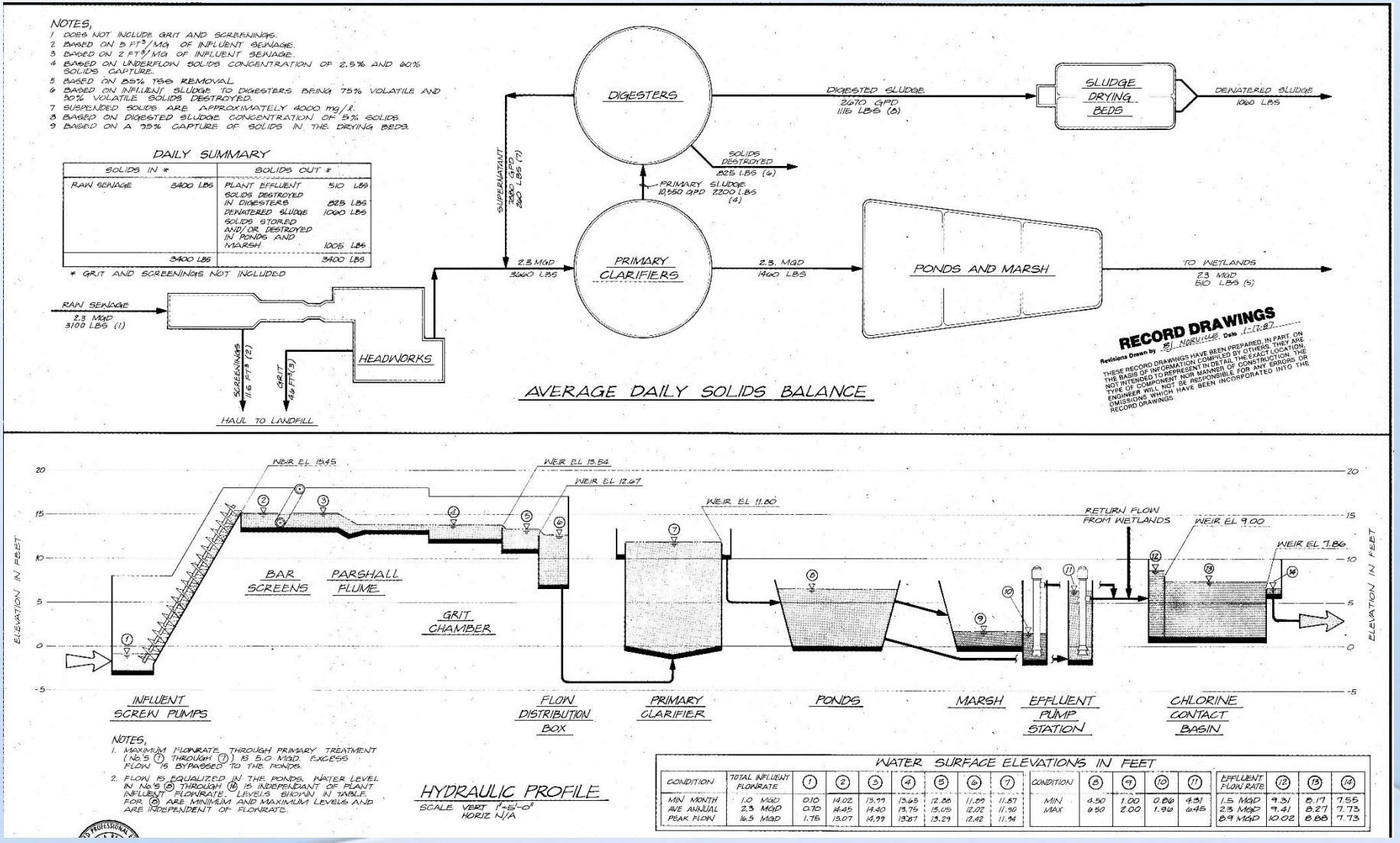
CarolloBlueTemplateWithLogo.pptx

# Existing design flow rates




CarolloBlueTemplateWithLogo.pptx

# Original Hydraulic Design



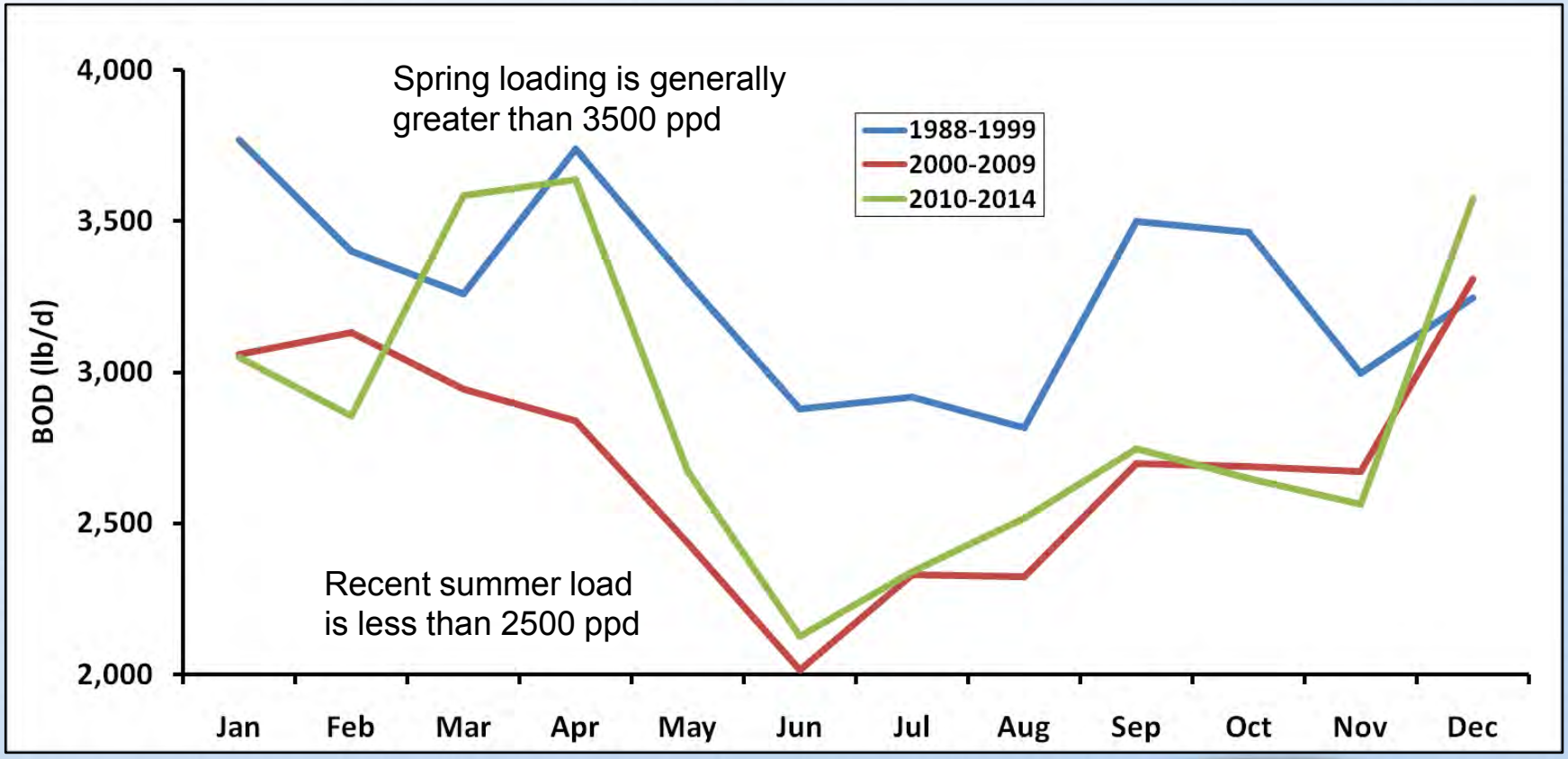



CarolloBlueTemplateWithLogo.pptx

# Impact of flow on HRT

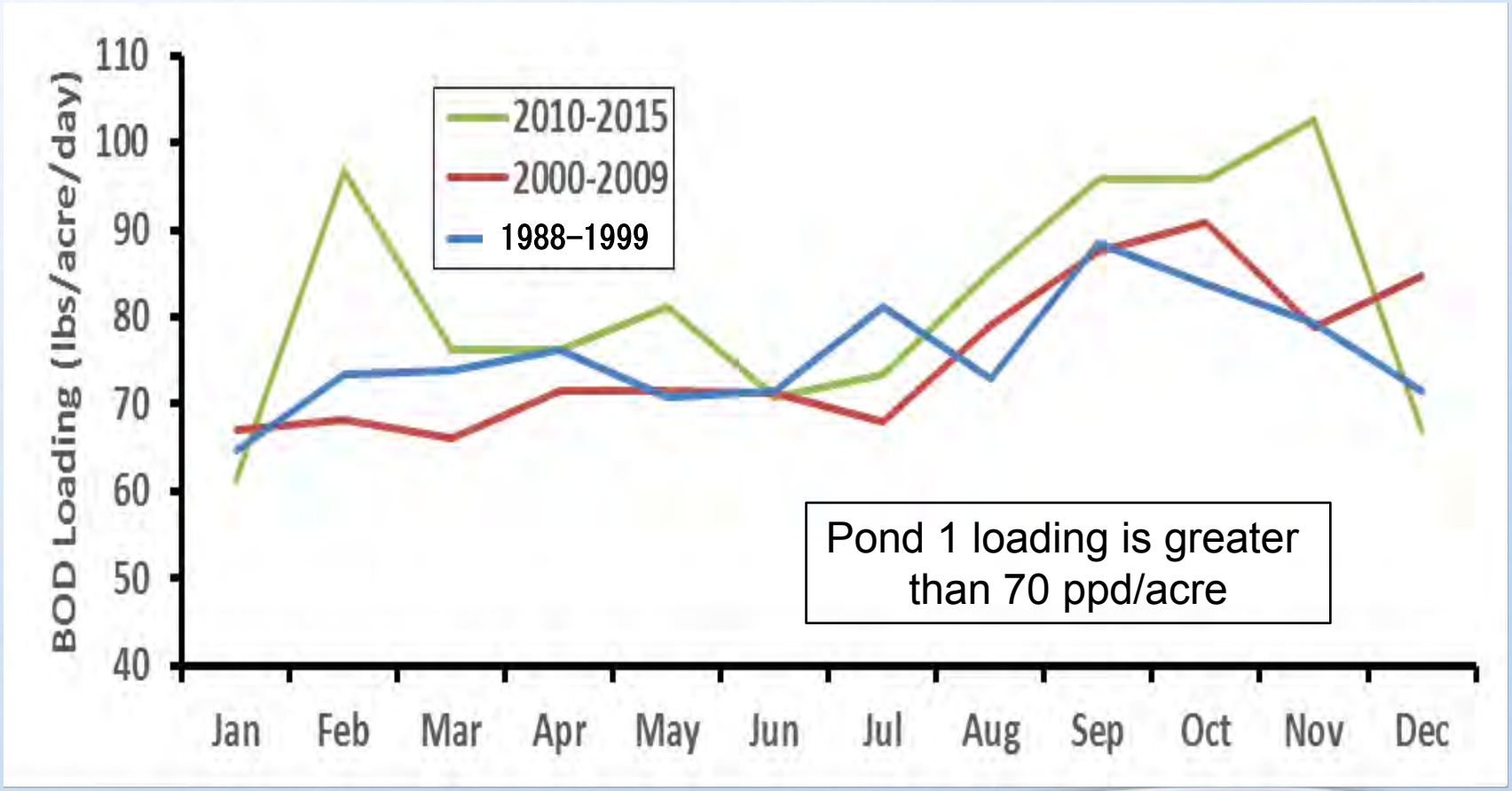
| | Area | Typical Operating Depth | Min. Depth | Max. Depth | Typical Operating Volume | Min. Volume | Max. Volume | Storage | HRT for Low Flow (1.3 MGD) | HRT for Design Flow (2.3 MGD) | HRT for High Flow (4 MGD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Ma | | Min | Ma | | 1.3 | 2.3 | 4 |
| | (ac | (ft) | (ft) | (ft) | (m | (m | (m | (m | (d) | (d) | (d) |
| ***Ponds*** | | | | | | | | | | | |
| Oxidation Pond 1 | 24 | 5.9 | 4.5 | 6.5 | 46 | 35 | 51 | 16 | 35. | 20. | 11. |
| Oxidation Pond 2 | 22 | 6 | 4.5 | 6.5 | 43 | 32 | 47 | 14 | 33. | 18. | 10. |
| **Pond Total** | 46 | | | | 89 | 67 | 97 | 30 | **69** | **39** | **22** |
| ***Treatment*** | | | | | | | | | | | |
| TM 1 | 1.8 | 4.3 | 1 | 4.3 | 2.6 | 0.6 | 2.6 | 2.0 | 9.6 | 5.0 | 2.8 |
| TM 2 | 1.9 | 4.6 | 1 | 4.6 | 2.9 | 0.6 | 2.9 | 2.3 | 9.6 | 5.0 | 2.8 |
| TM 3 | 1.2 | 3.6 | 1 | 3.6 | 1.5 | 0.4 | 1.5 | 1.1 | 9.6 | 5.0 | 2.8 |
| TM 4 | 0.9 | 2.9 | 1 | 2.9 | 0.9 | 0.3 | 0.9 | 0.6 | 4.3 | 4.3 | 4.3 |
| TM 5 | 1.7 | 3 | 1 | 5.5 | 1.7 | 0.6 | 3.0 | 2.5 | 9.6 | 5.0 | 2.8 |
| TM 6 | 1.9 | 3 | 1 | 5.5 | 1.9 | 0.6 | 3.4 | 2.8 | 9.6 | 5.0 | 2.8 |
| TM 7 | | | | | | | | | | | |
| **TM Total (avg)** | 9.6 | | | | 11 | 3 | 14 | 11 | **8.3** | **4.8** | **3.2** |
| ***Enhancement Wetlands*** | | | | | | | | | | | |
| Allen | 10 | 2.3 | 0.7 | 6 | 7 | 2 | 20 | | 5.8 | 3.3 | 1.9 |
| Gearheart | 10 | 2.1 | 0.7 | 4.5 | 7 | 2 | 15 | | 5.3 | 3.0 | 1.7 |
| Hauser | 10 | 3.7 | 0.7 | 5.5 | 12 | 2 | 18 | | 9.3 | 5.2 | 3.0 |
| **EM Total** | 30 | 2.7 | | | 26 | 0 | 52 | 26 | **20** | **11** | **7** |
| **System Total** | | | | | | | | 68 | **97** | **55** | **32** |

# Monthly median treatment facility influent BOD loading (1)



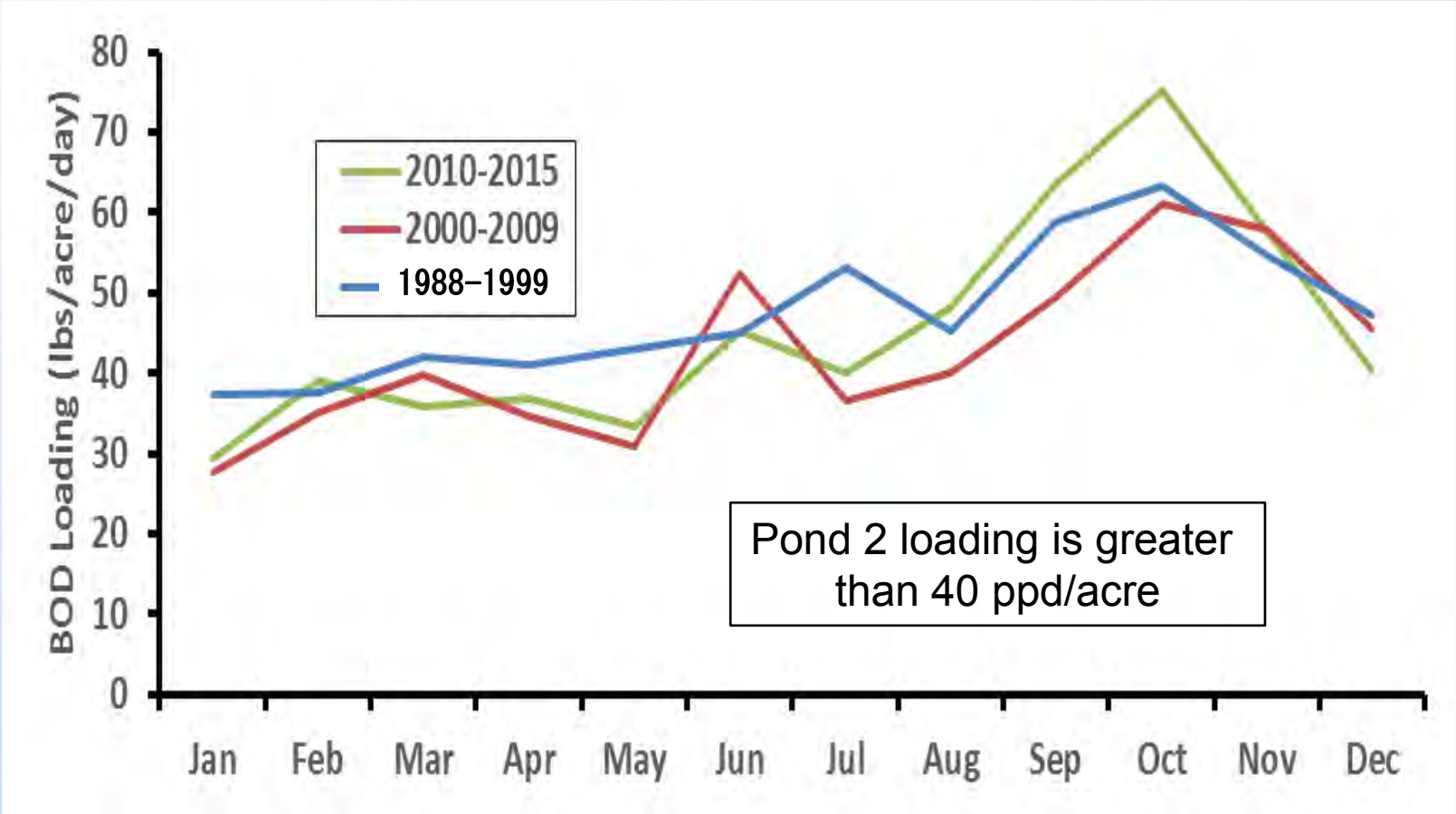

**Note: 1. From "AWTF Treatment Capacity Evaluation and Additional Treatment Recommendations Swanson, Gearheart and Adabie Sept 2015**

# Monthly median pond 1 influent BOD loading

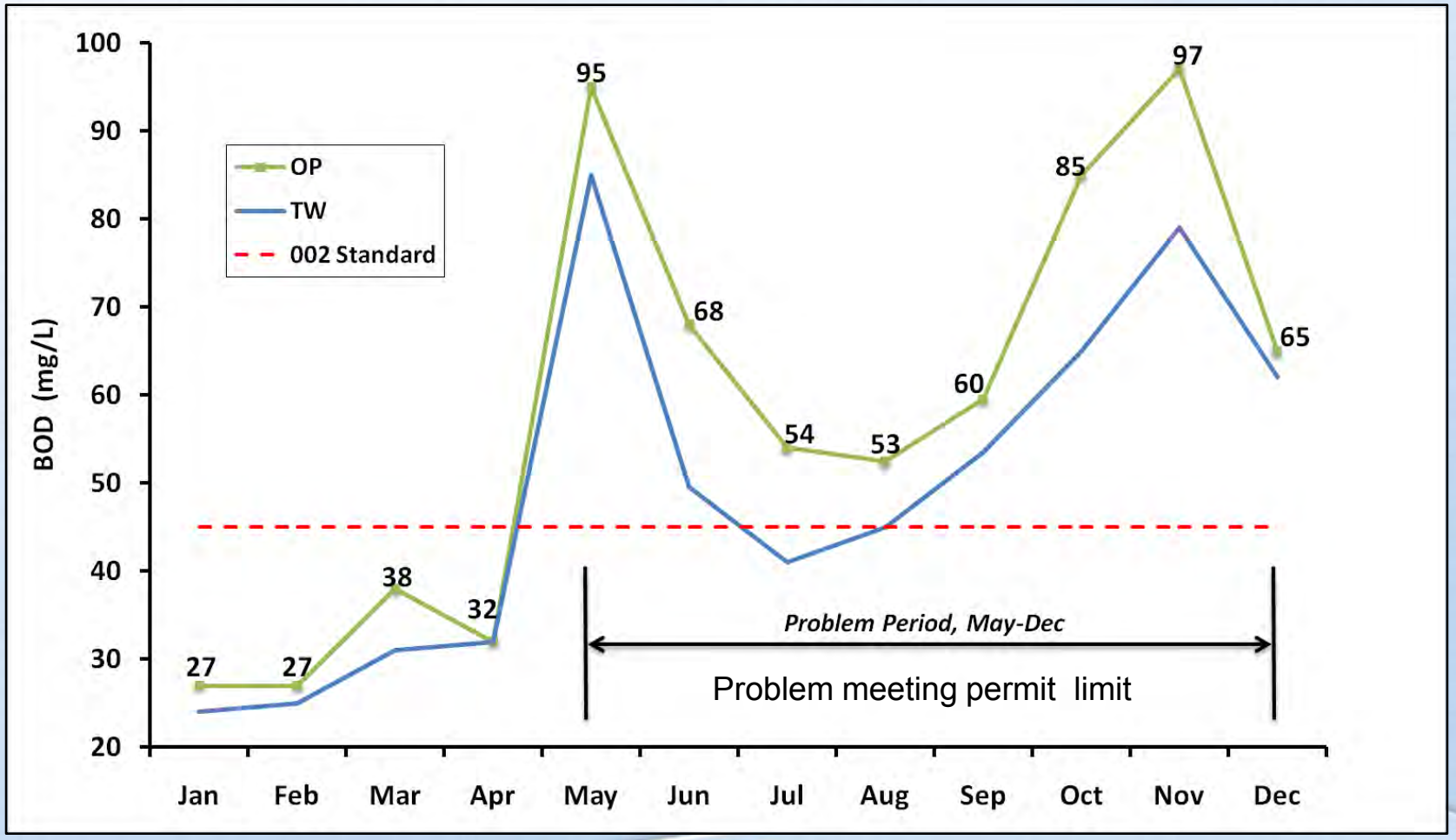



CarolloBlueTemplateWithLogo.pptx

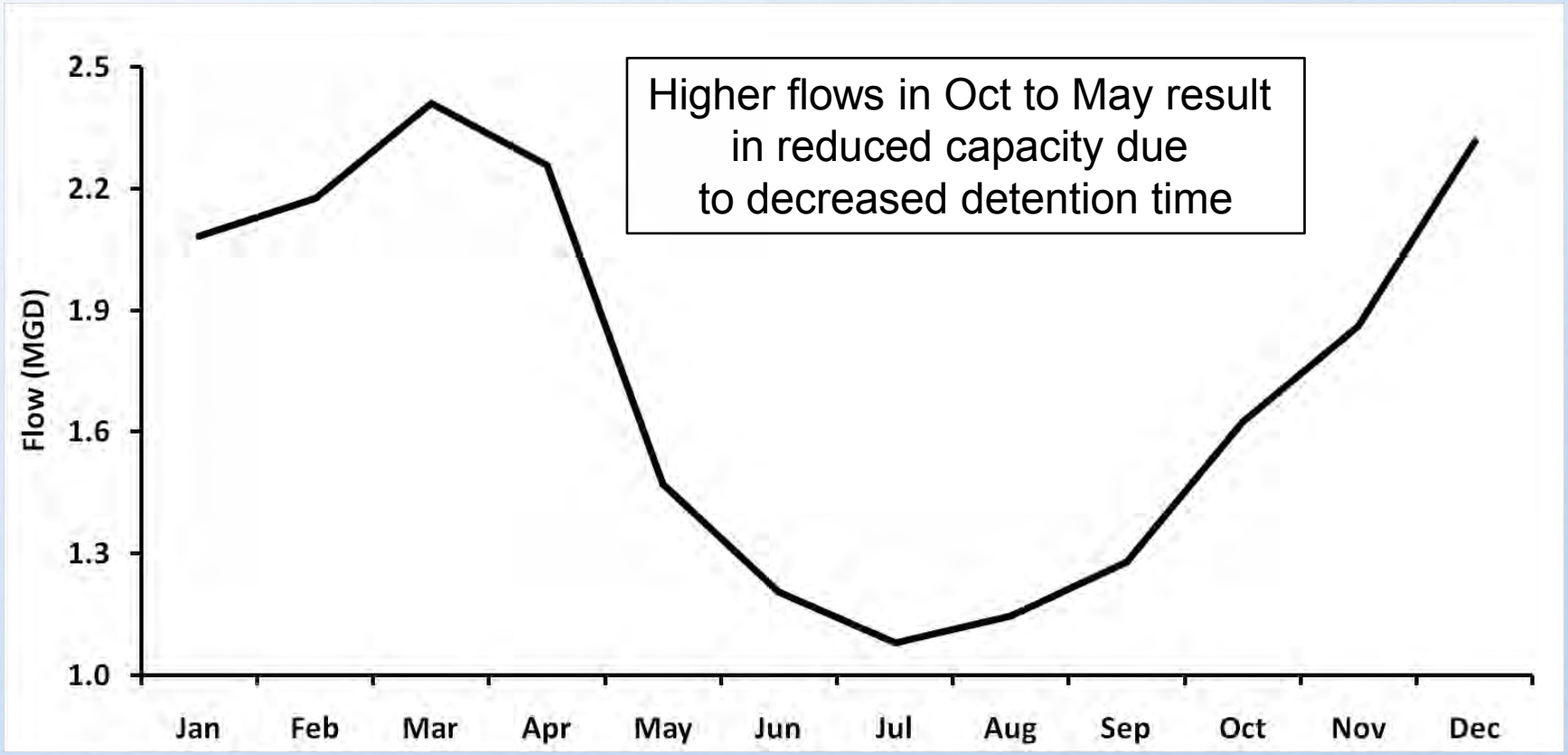
# Monthly median pond 2 influent BOD loading



# Pond and TW Monthly Median Effluent BOD



# Monthly median TW flows



# Secondary Treatment

CarolloBlueTemplateWithLogo.pptx

# Secondary Treatment Considerations

- Dry/wet weather flows
- Loads
- Permit & Compliance Points
- Options:
  - Flow Routing
    - Parallel, Series
    - Enhancement Wetlands
    - Blending
    - Discharges
  - Treatment Alternatives for BOD & TSS Removal
- Future Considerations e.g. nutrient removal

# Proposed Design Flows

Secondary Treatment and Outfall 001 disinfection

- Dry weather design – 2.3 mgd < 74%
- Permit wet weather - 5.9 mgd < 92.5%
- Permit peak wet weather – 16.5 mgd

EW and Outfall 003 disinfection

- EW peak design – 2.3 mgd < 74%

CarolloBlueTemplateWithLogo.pptx

# Design Loads

- BOD

< 90% is less than 260 mg/L

<75% is less than 200 mg/L

< 50% is less than 190 mg/L

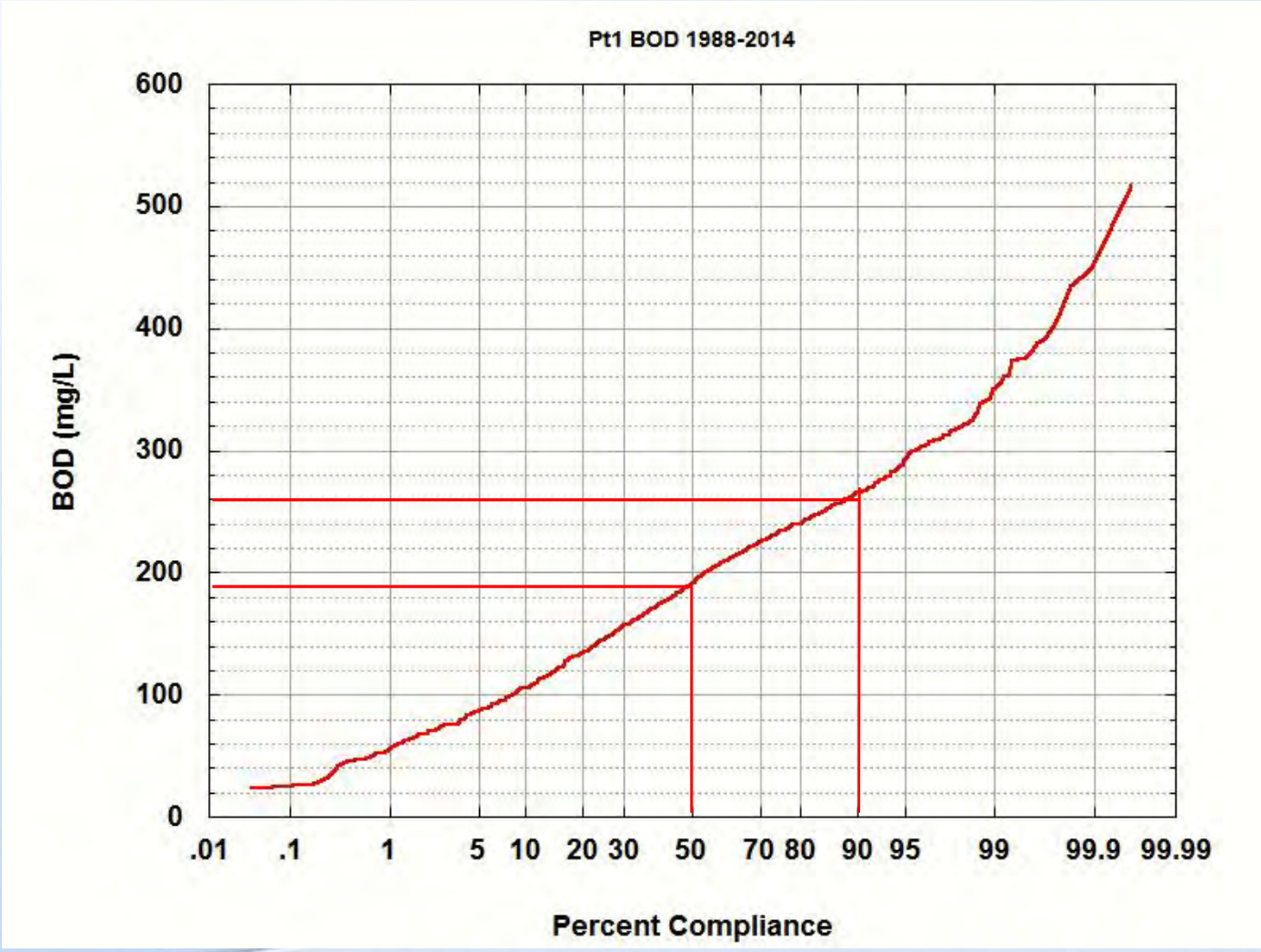
- TSS

< 90% is less than 325 mg/L

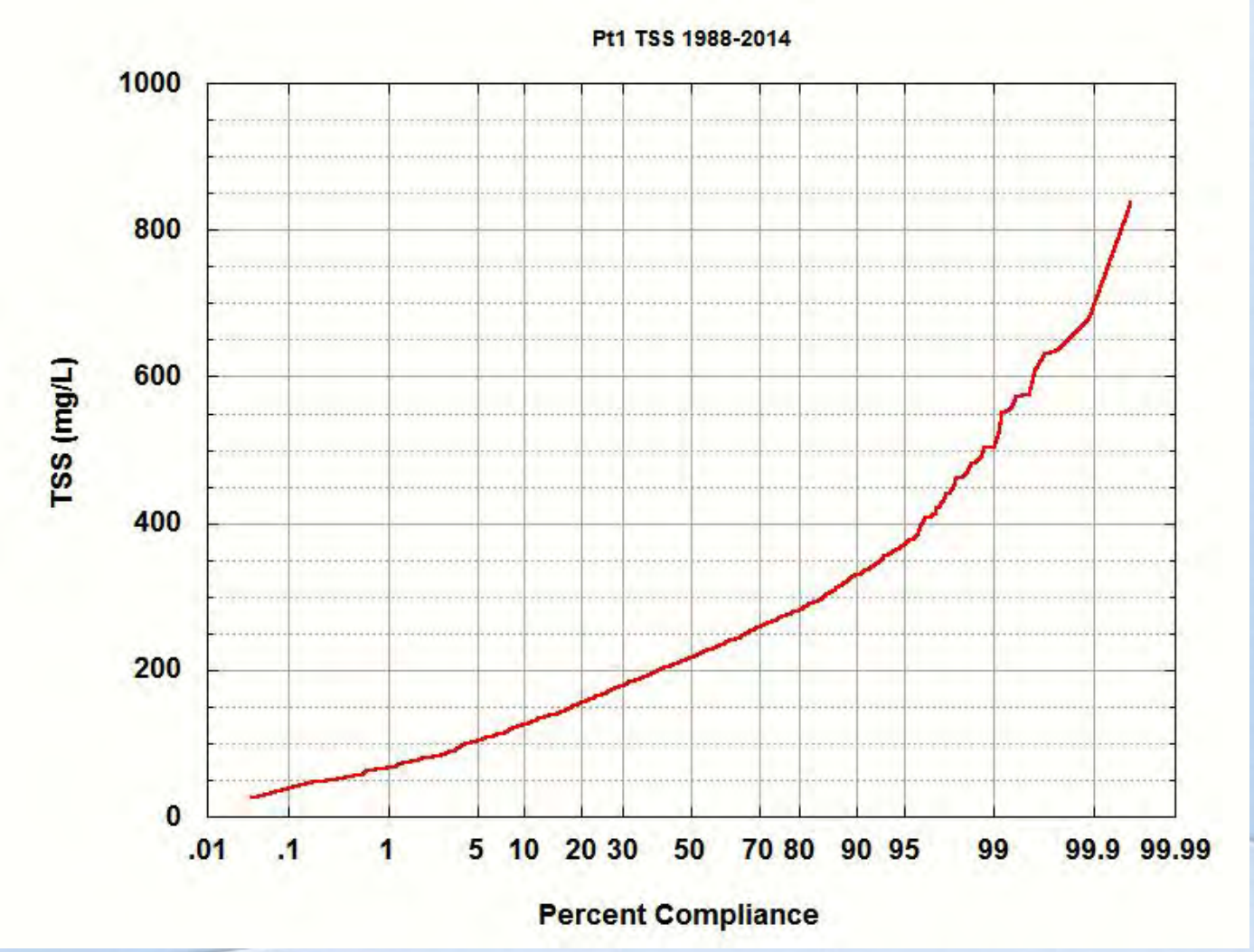
<75% is less than 225 mg

< 50% is less than 180

# Point 1 BOD from 1988 – 2014

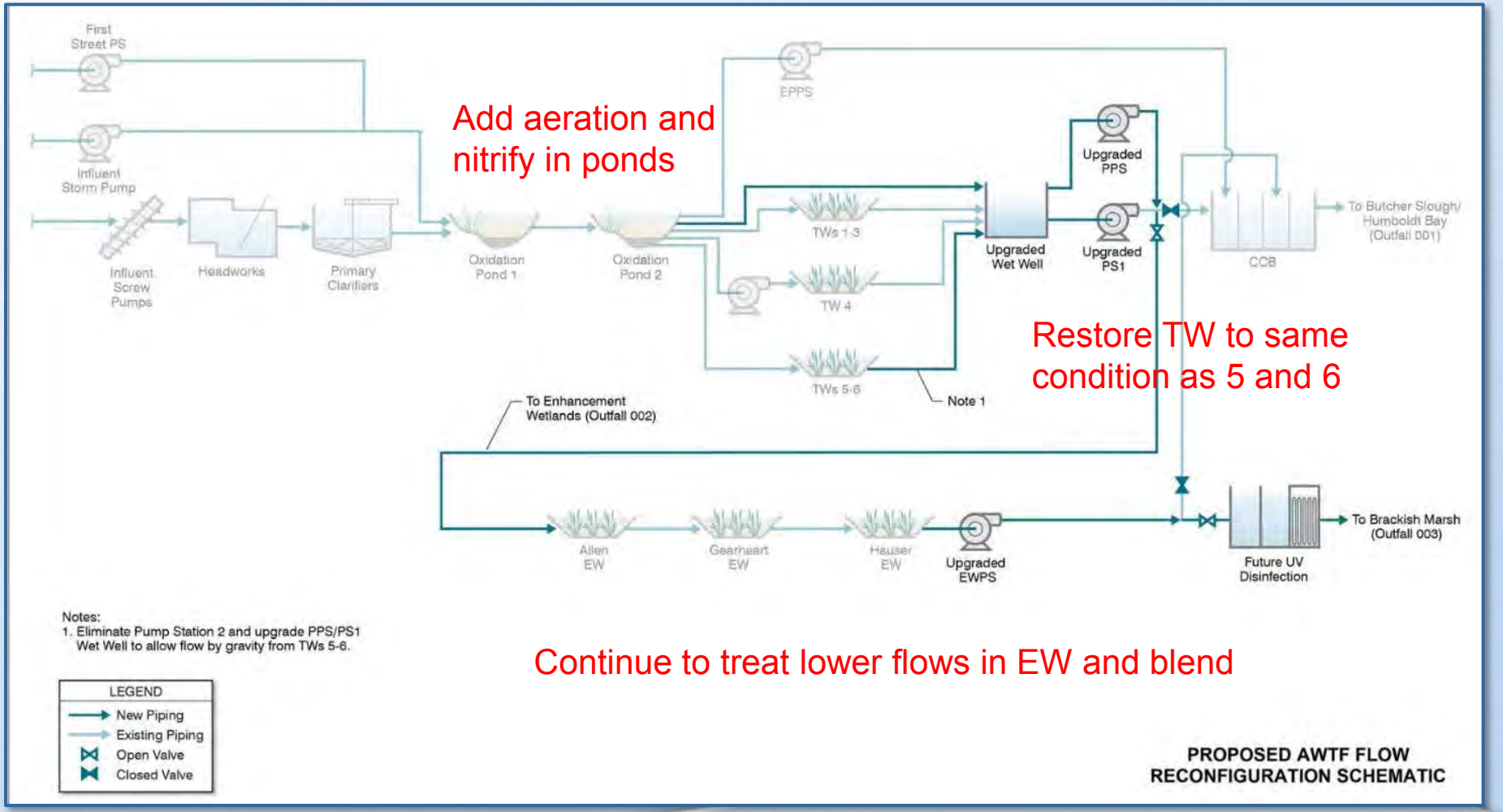


# Point 1 TSS from 1988 – 2014



# Potential capacity improvements

Add conventional treatment before ponds or in parallel with ponds (blend)



# Secondary treatment processes

- BOD Removal
- Biological Processes - Dissolved Oxygen, MLSS, Sludge generation or Sloughing
  - Aeration Equipment - Blowers and Diffusers or Aerators, and Process Control
  - TF Equipment - Pumps, Ventilation & Odor Control
- Secondary Clarifiers
  - Return Activated Sludge - Pumps
  - Waste Activated Sludge - Pumps

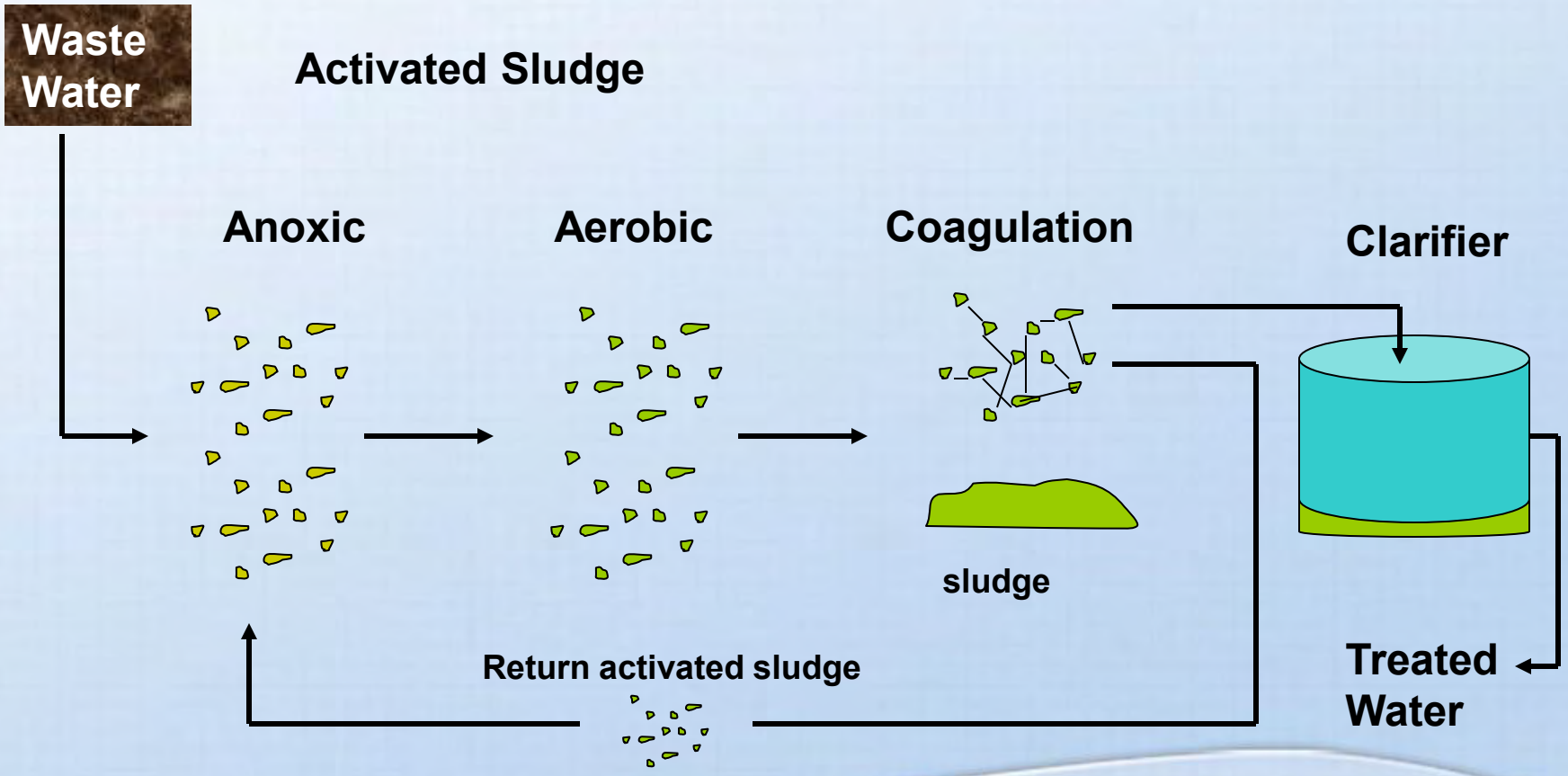
CarolloBlueTemplateWithLogo.pptx

# Secondary treatment alternatives

- Conventional Activated Sludge (Aeration Basins, Blowers, Diffusers)
- Extended Aeration (Oxidation Ditch)
- Trickling Filters (Older rock media newer with Plastic Media)
- Oxidation Pond Modifications (Aerated lagoon, Biolac)

CarolloBlueTemplateWithLogo.pptx

# Suspended growth biological processes




Anoxic – no dissolved oxygen

CarolloBlueTemplateWithLogo.pptx

# Conventional activated sludge







Membrane diffusers by Sanitaire

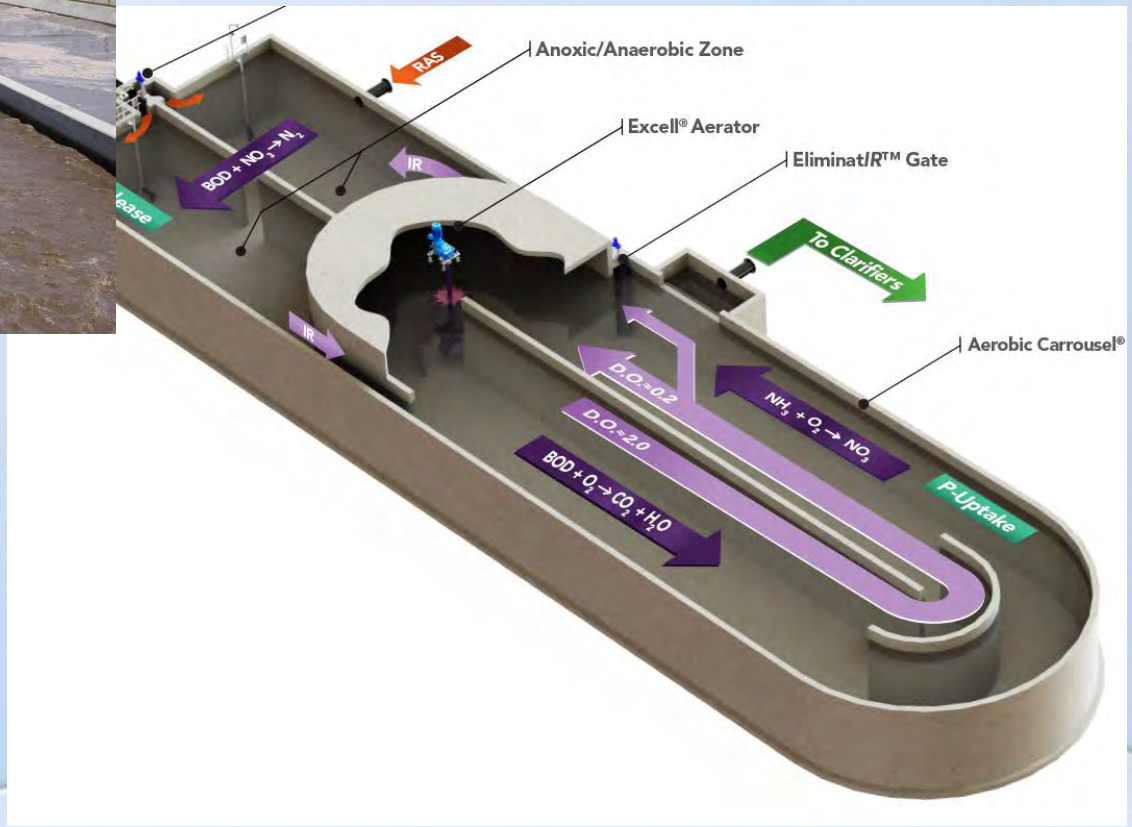


# Extended aeration – Oxidation ditch



# Extended Aeration - Oxidation Ditch





# Extended Aeration - Oxidation Ditch



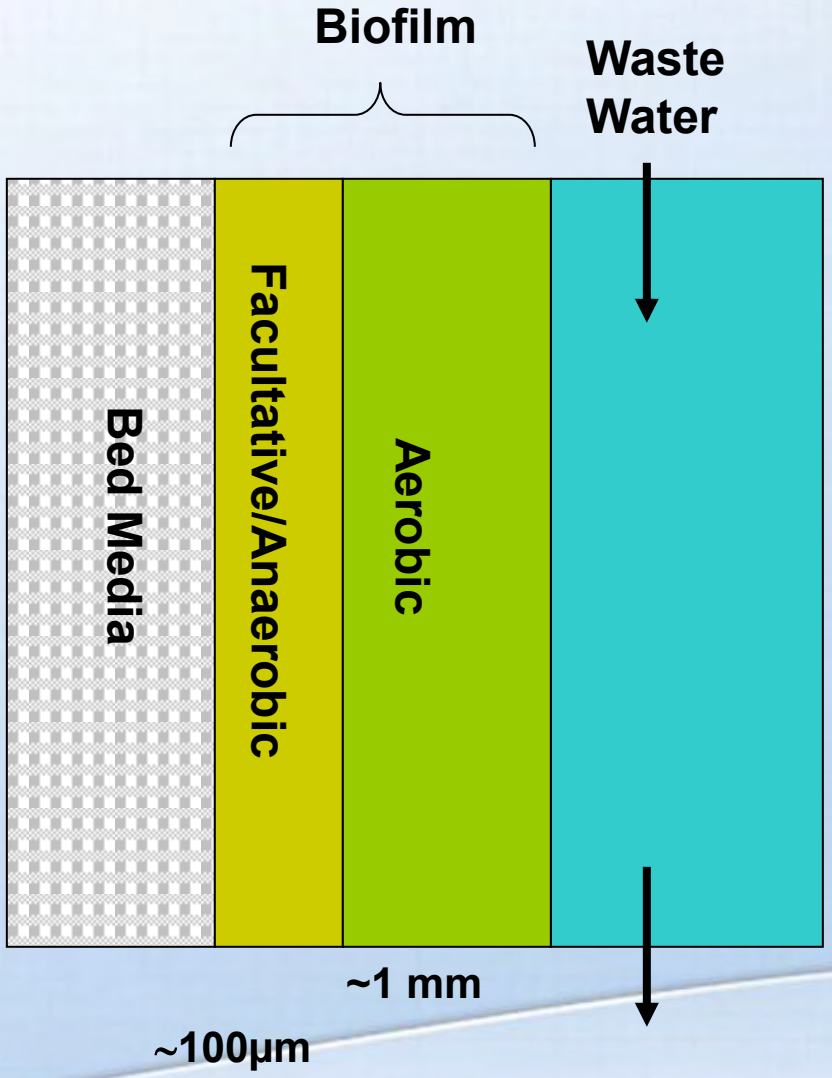


# Extended aeration - Oxidation ditch





# Fixed film biological processes




CarolloBlueTemplateWithLogo.pptx

# Fixed film biological processes



Trickling filter



Rotating biological contactor
(40% submerged rotates at 1-1.5 rpm)

**Uses biofilm to treat water to remove BOD**

CarolloBlueTemplateWithLogo.pptx

# Trickling Filters





Plastic “Mixed Media” by Brentwood Industries



CarolloBlueTemplateWithLogo.pptx

# Pond – extended aeration





# Pond – extended aeration







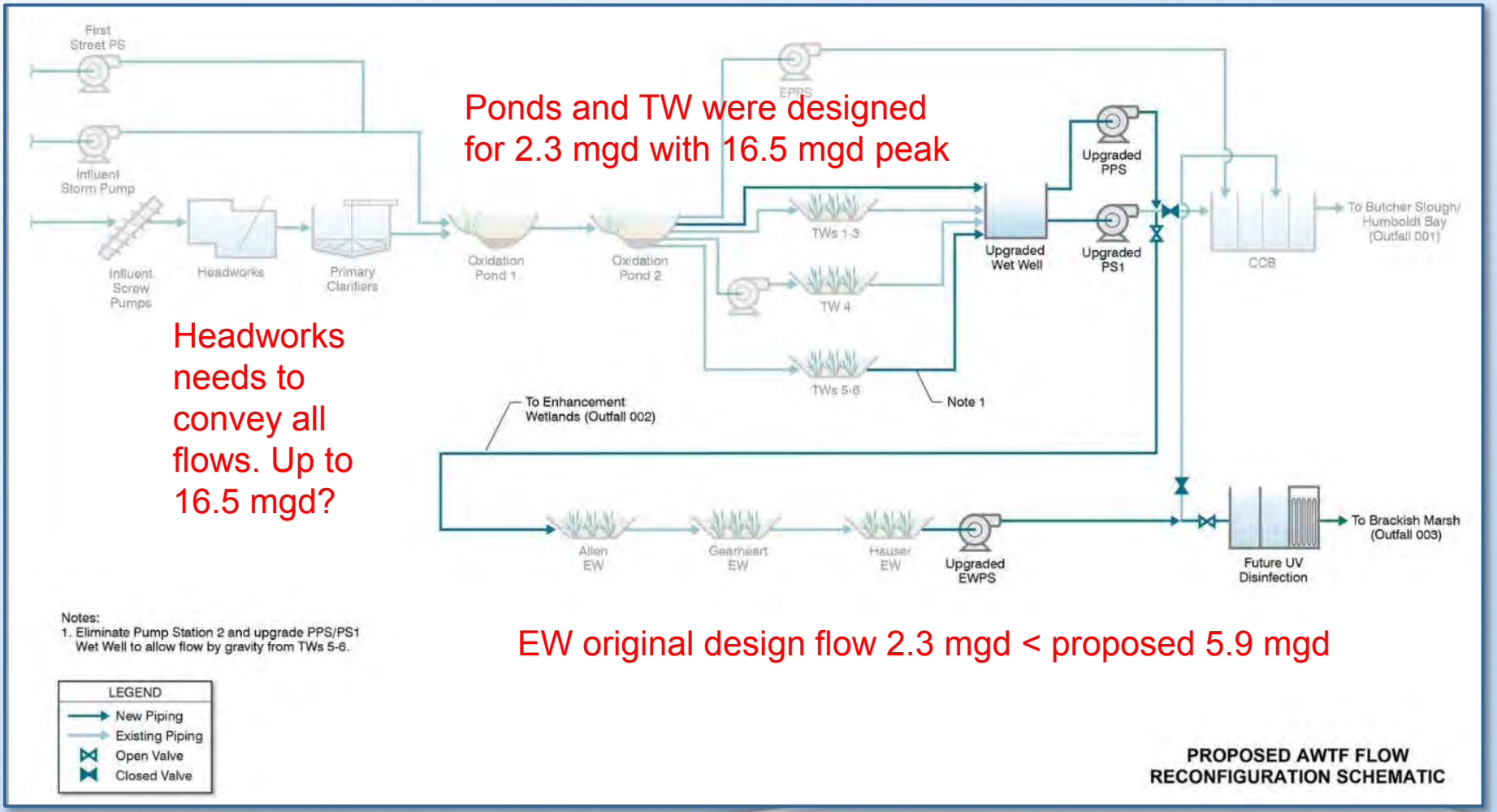
# Vertical surface aerators







# Existing design flow rates




Ponds and TW were designed for 2.3 mgd with 16.5 mgd peak

Headworks needs to convey all flows. Up to 16.5 mgd?

EW original design flow 2.3 mgd < proposed 5.9 mgd

CarolloBlueTemplateWithLogo.pptx

# Design criteria for secondary treatment alternatives

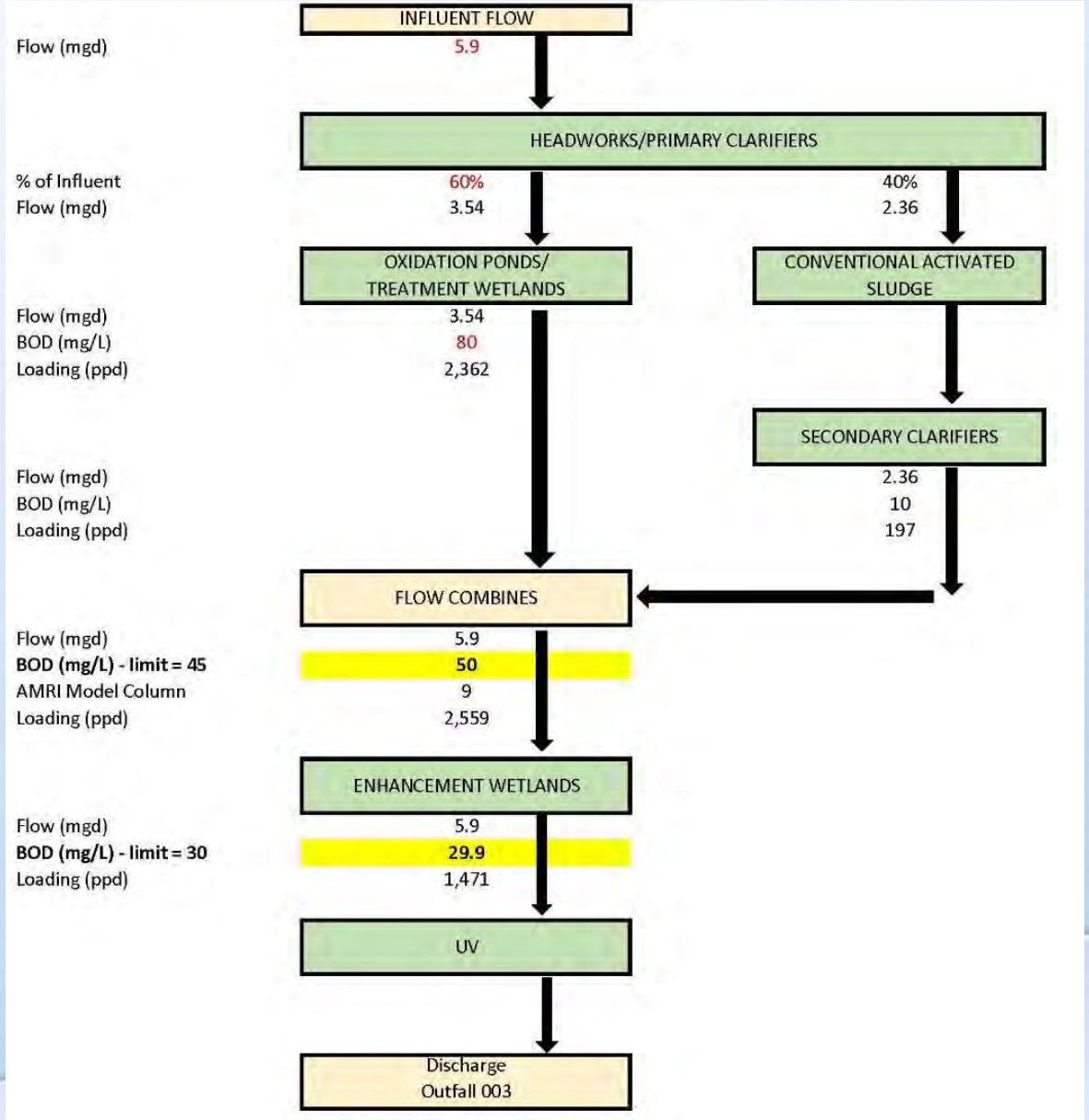
| Design Parameter | Average Value | 90th Percentile |
|---|---|---|
| ADW Flow (mgd) | 2.3 | |
| PWW Flow (mgd) | 5.9 | 5.0 |
| Influent BOD Concentration (mg/L) | 180 | 260 |
| Influent TSS Concentration (mg/L) | 200 | 325 |
| Influent BOD Load (lb/d) | 3500 | |
| Influent TSS Load (lb/d) | 3850 | |

CarolloBlueTemplateWithLogo.pptx

# Conceptual sizing of secondary treatment alternatives

| | Alternative | | | |
|---|---|---|---|---|
| **Item** | Conventional Activated Sludge | Extended Aeration | Trickling Filters | Oxidation Pond Modifications |
| **Primary Clarifiers - Quantity & Diameter** | 2 @ 40 ft ea | N/A | 2 @ 40 ft ea | N/A |
| **Aeration Basins - Quantity & Volume** | 2 @ 0.23 MG ea | 2 @ 1.44 MG ea | N/A | 2 @ 1.44 MG ea |
| **Trickling Filters - Quantity, Height & Diameter** | N/A | N/A | 2 @ 20 ft H, 61 ft ea | N/A |
| **Secondary Clarifiers - Quantity & Diameter** | 2 @ 70 ft ea | 2 @ 70 ft ea | 2 @ 70 ft ea | 2 @ 70 ft ea |
| **Effluent BOD (mg/L)** | 10 | 20 | 30 | 20 |
| **Effluent TSS (mg/L)** | 10 | 20 | 30 | 20 |
| **Effluent Ammonia (mg/L)** | Same | <1 | Same | <1 |

# Alternative Flow Diagrams




CarolloBlueTemplateWithLogo.pptx

# Secondary treatment ranking criteria

- Economic
  - Construction cost
  - Footprint
  - Operator attention
  - Power cost
  - Sludge production
  - Maintenance requirements
- Non economic
  - Safety
  - Meets permit
  - Constructability
  - Reliability
  - Impact on GHG emissions

CarolloBlueTemplateWithLogo.pptx

# Secondary Treatment Alternatives Ranking of Economic Criteria

| | Criteria | | | | | |
|---|---|---|---|---|---|---|
| **Alternative** | Construction Cost | Footprint[A] | Operator Attention | Power Cost | Sludge Production | Maintenance Requirement |
| **Conventional Activated Sludge** | 3/4 | 3 | 1 | | 1 | 1 |
| **Extended Aeration – Oxidation Ditch** | 2 | 1 | 2/3 | | 2/3 | 2/3 |
| **Trickling Filters** | 1 | 2 | 4 | 4 | 4 | 4 |
| **Oxidation Pond Modifications** | 3/4 | 4 | 2/3 | | 2/3 | 2/3 |

1 = Least Favorable Rank/Score; 4 = Most Favorable Rank/Score

Note:
A. Footprint consideration includes primary clarifiers, if needed. Assumes modification of existing oxidation ponds.

# Secondary Treatment Alternatives Ranking of Non-Economic Criteria

| | Criteria | | | | | |
|---|---|---|---|---|---|---|
| **Alternative** | Safety | Meets Permit | Ease of O&M | Constructability | Reliability & Redundancy | Impact on GHG Emissions |
| **Conventional Activated Sludge** | 2 | 4 | 1 | 4 | 3/4 | |
| **Extended Aeration – Oxidation Ditch** | 3/4 | 2/3 | 2/3 | 2 | 3/4 | |
| **Trickling Filters** | 1 | 1 | 4 | 3 | 1 | |
| **Oxidation Pond Modifications** | 3/4 | 2/3 | 2/3 | 1 | 2 | |

1 = Least Favorable Rank/Score; 4 = Most Favorable Rank/Score

CarolloBlueTemplateWithLogo.pptx

# Typical Costs for Secondary Treatment Alternatives at Preliminary Design Criteria

| Alternative | Typical Construction Cost [1] |
|---|---|
| Conventional Activated Sludge | $ 7 to 10 M |
| Extended Aeration – Oxidation Ditch | $ 8 to 11 M |
| Trickling Filters | $ 12 to 15 M |
| Oxidation Pond Modifications | $ 8 to 11 M |

Note:
1. In 2015 dollars. Typical construction cost for secondary treatment alternative, secondary clarifiers, and primary clarifiers (if applicable). Sized for design criteria.

# Other topics

- Plant rehabilitation
- Treatment wetland rehabilitation
- Pond solids- dredging and removal

# Feedback and wrap up

- Flows
- Loads
- Capacity needs
- Treatment options
- Flow diagrams and blending options
- Other ideas

CarolloBlueTemplateWithLogo.pptx

# City of Arcata
# Wastewater Treatment Facility Improvements Project

Facility Plan Capacity Workshop

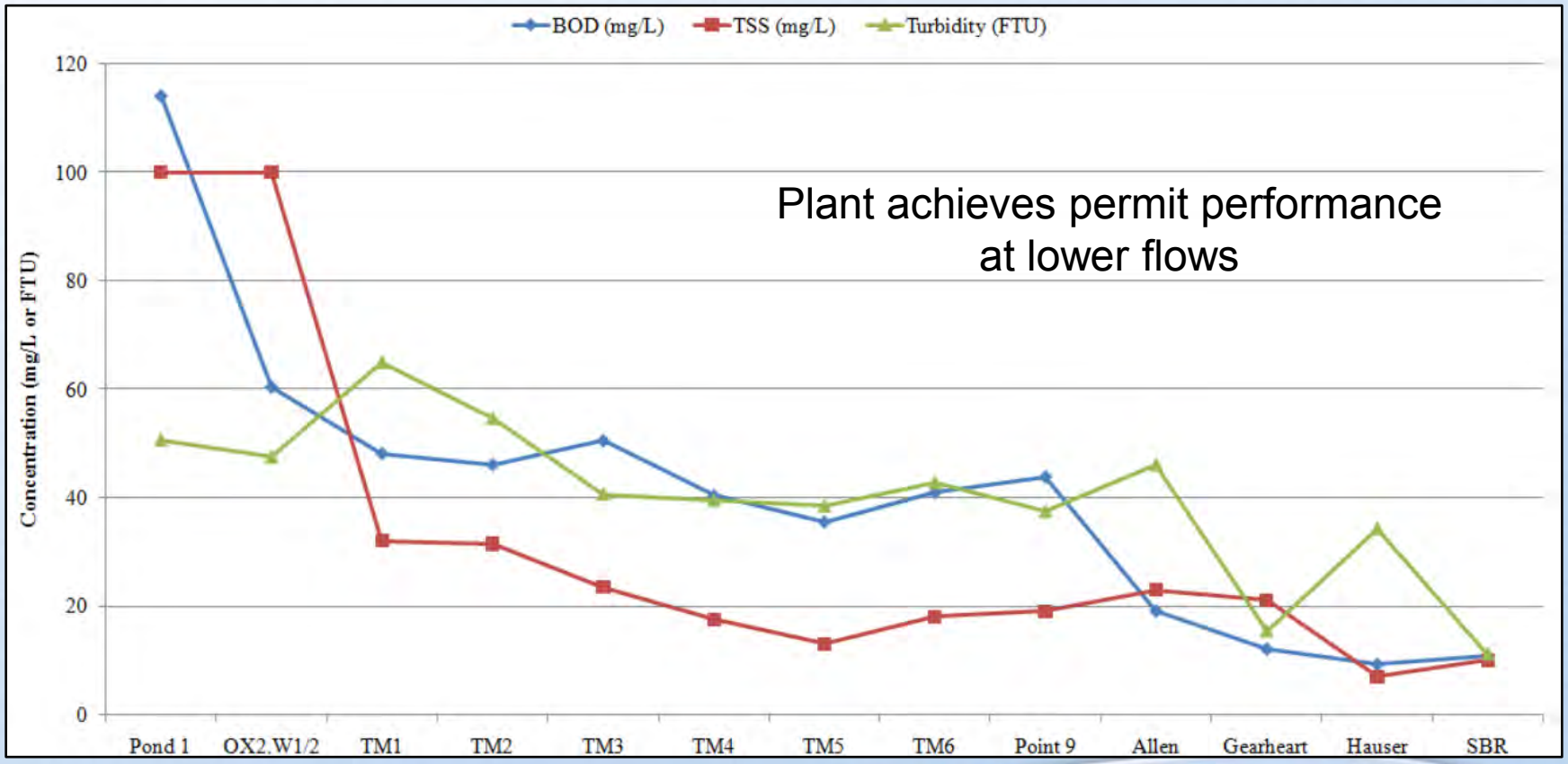
November 5-6, 2015

CarolloBlueTemplateWithLogo.pptx

# Plant Loading

CarolloBlueTemplateWithLogo.pptx

# Plant performance in September 2015 @ 1.4 MGD



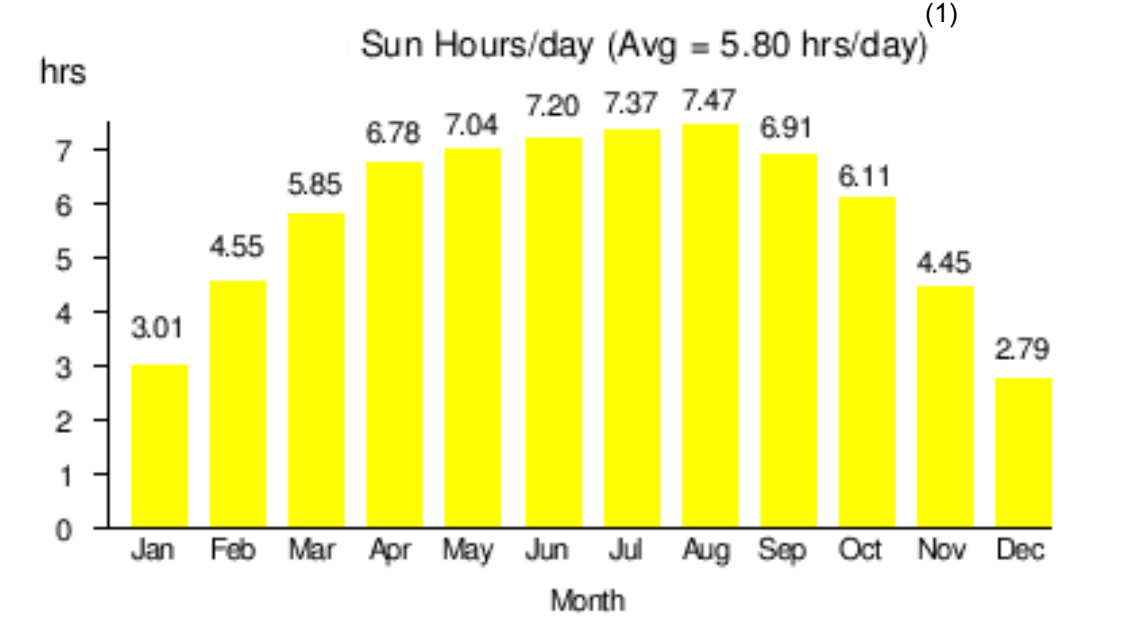

From 9/21/15 email from Bob Gearheart

# Pond Capacity

CarolloBlueTemplateWithLogo.pptx

# Pond wastewater treatment process

- Temperature dependent
- Amount of solar radiation or sunlight




Note: 1. Need to verify for Arcata using HSU data

# Typical Wastewater Treatment Pond BOD Loading Criteria

| Type | Depth, ft | Detention Time, Days | Loading , PPD per acre | Effleunt- BOD mg/L | Effluent - TSS mg/L |
|---|---|---|---|---|---|
| Arcata Oxidation Pond | 4.5 | TBD | 70 to 100 | 25 to 90 | TBD |
| Oxidation Pond (1) | 3 to 4.5 | 10 to 40 | 35 to 125 | 20 to 40 | 80 to 140 |
| Facultative Ponds (1) | 4.5 to 7.5 | 25 to 180 | 20 to 60 | 30 to 40 | 40 to 100 |
| Partial Mix Aerated Lagoon (1) | 6 to 18 | 7 to 20 | 45 to 180 | 30 to 40 | 30 to 60 |
| From 1. Natural System For Waste Management and Treatment, Reed et al | | | | | |

Carollo recommends 25 ppd/acre for Northern California

CarolloBlueTemplateWithLogo.pptx

# Treatment Wetland Capacity

CarolloBlueTemplateWithLogo.pptx

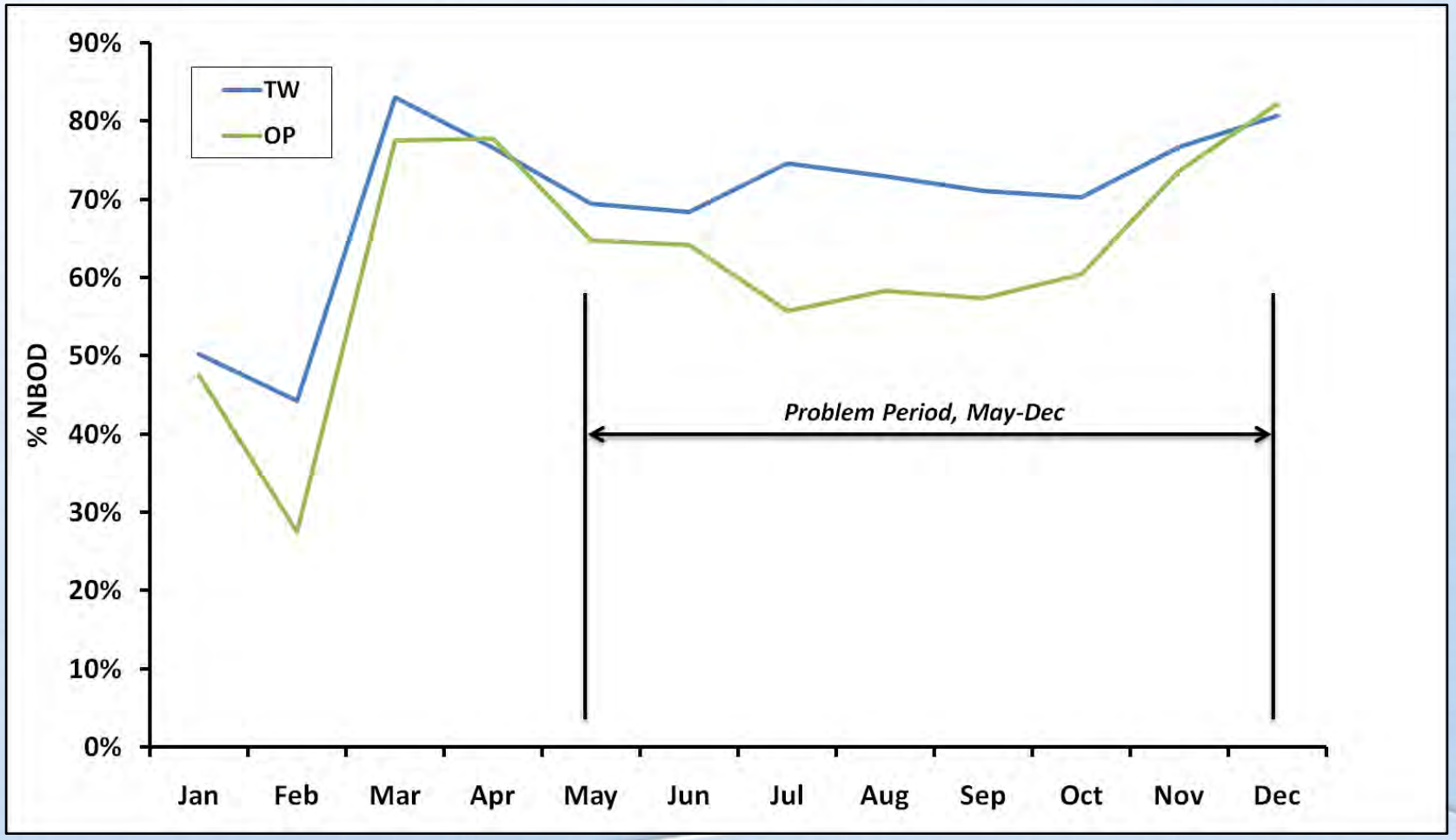
# Treatment wetland capacity

| | Detention Time, days | Depth, ft | Loading ppd/acre | Effluent BOD, mg/L | Effluent TSS, mg/L |
|---|---|---|---|---|---|
| Textbook(1) | 7 to 15 | 1 to 3 | 100 -200 | 5 to 10 | 5 to 15 |
| Arcata | 3 to 8 for low to high flows | Varies - min depth 1 foot | TBD | 25 to 85 | 10 to 40 for TM 5 and 6 |
| 1. Natural Systems for Waste Management and Treatment | | | | | |

# Nutrient (Nitrogen loads)

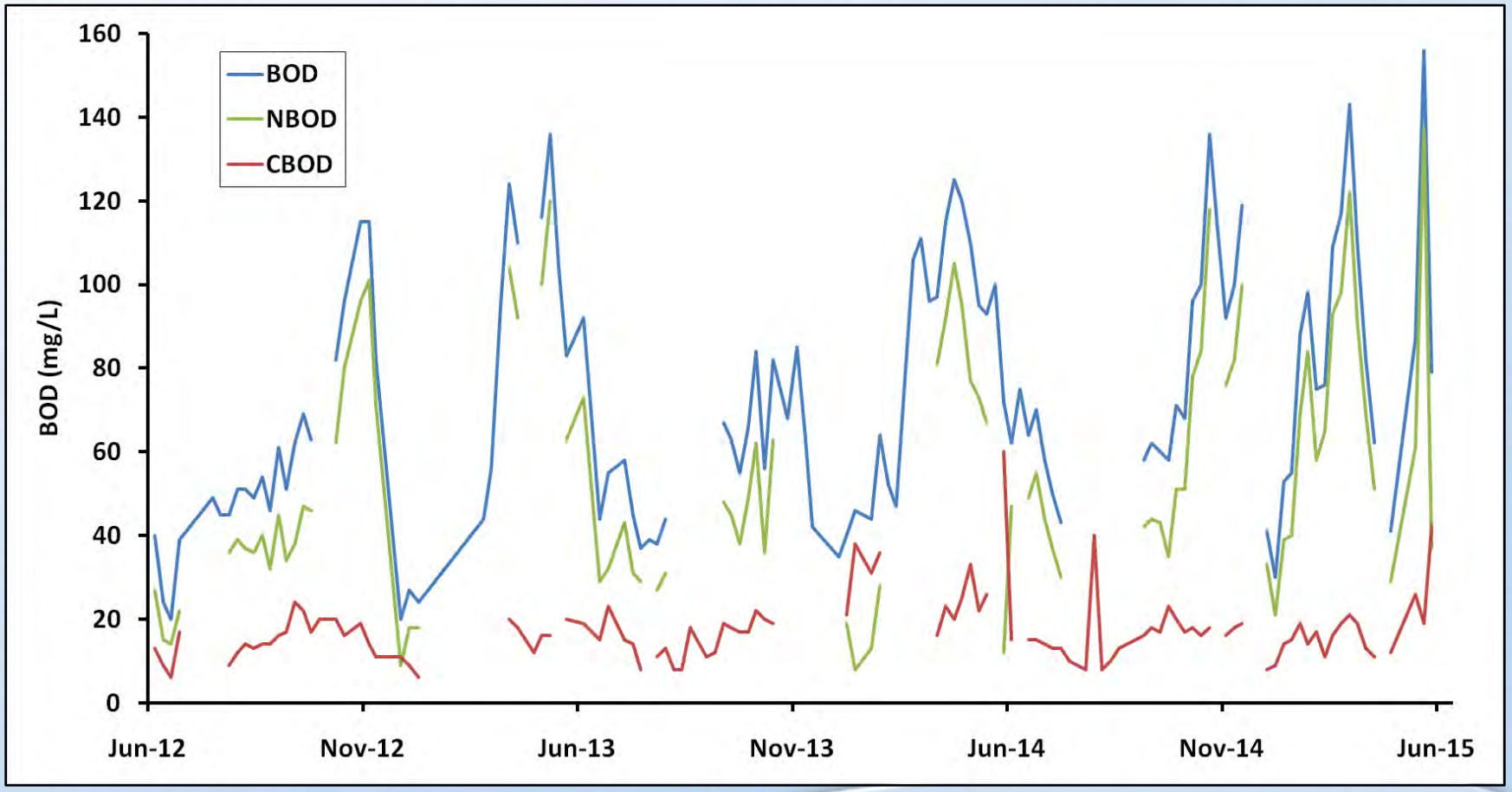
- Historic focus of RWQCB has been on permit and meeting BOD and TSS.
- Recent discussion on nutrients has indicated that ammonia and nutrients may be a future concern.
- Current data suggests that nitrogen loads impact plant capacity

# Nitrogen BOD makes up a large portion of the BOD load




CarolloBlueTemplateWithLogo.pptx

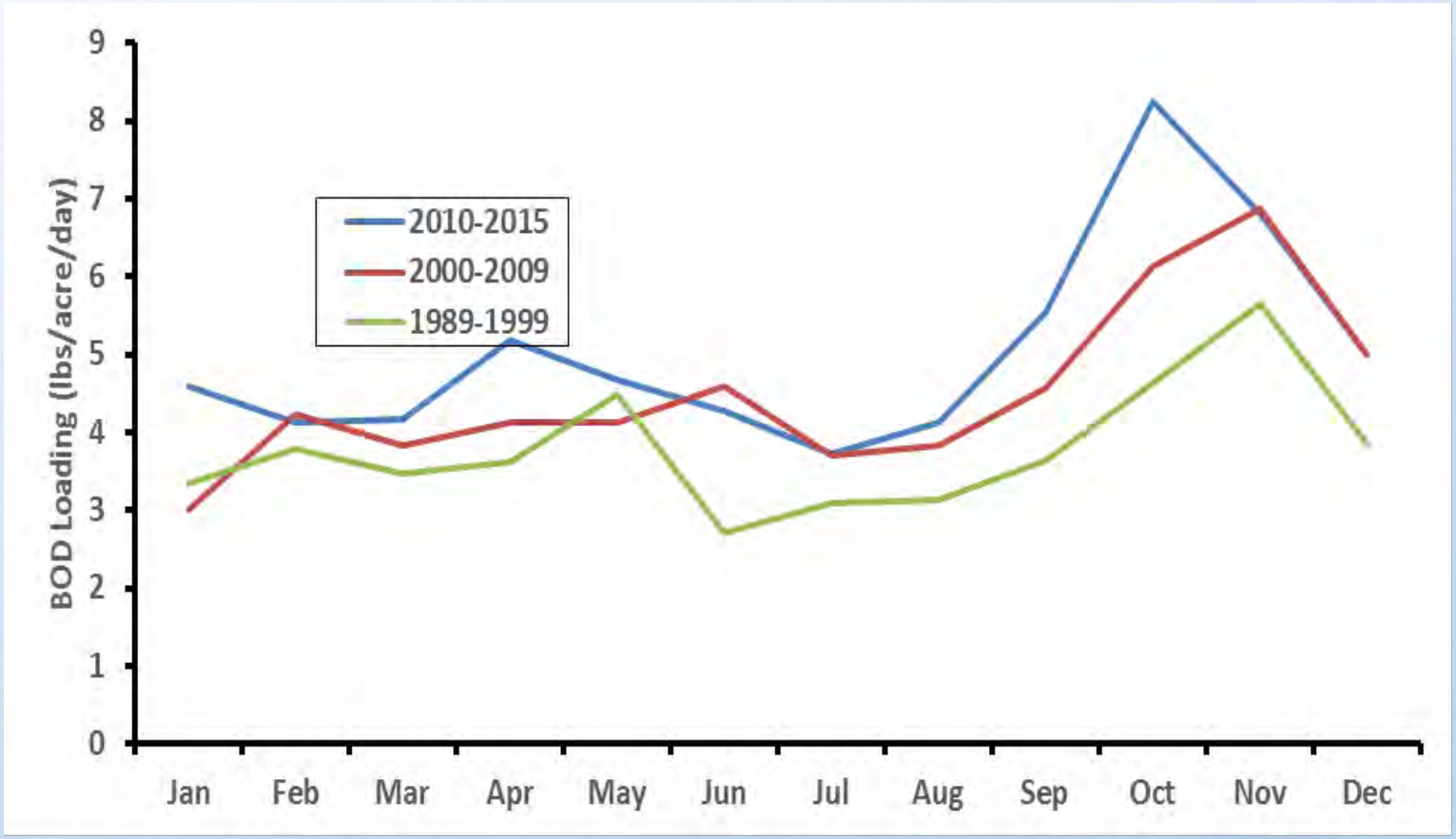
# TW effluent BOD and relation to NBOD



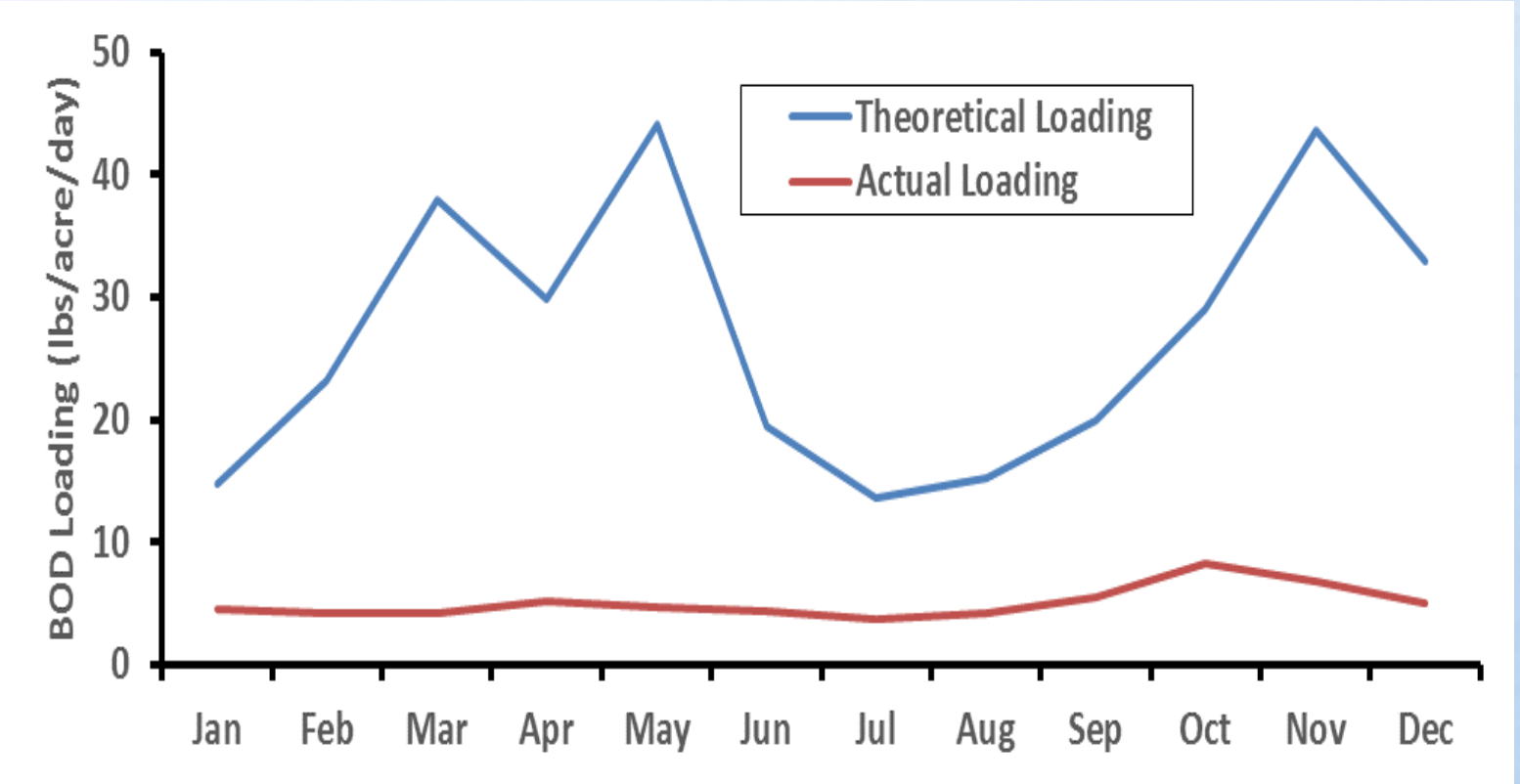
# Enhancement Wetland Capacity

CarolloBlueTemplateWithLogo.pptx

# Historic EW loadings



# Potential EW loadings may increase 4 to 5 times above the actual historic loadings



# Enhancement wetland model – 30 mg/l limit

Inputs:

Date (mm/dd/yy): 1/1/13

| Jan, Feb | | Enhancement Wetland Effluent BOD Concentration (mg/L) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Flow Rate | HRT | Influent BOD | | | | | | | | | | | | | | |
| | | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 |
| 1.0 | 11.9 | 1.7 | 2.5 | 3.4 | 4.2 | 5.1 | 5.9 | 6.7 | 7.6 | 8.4 | 9.3 | 10.1 | 10.9 | 11.8 | 12.6 | 13.5 |
| 1.1 | 10.8 | 1.8 | 2.8 | 3.7 | 4.6 | 5.5 | 6.5 | 7.4 | 8.3 | 9.2 | 10.2 | 11.1 | 12.0 | 12.9 | 13.8 | 14.8 |
| 1.2 | 9.9 | 2.0 | 3.0 | 4.0 | 5.0 | 6.0 | 7.0 | 8.0 | 9.0 | 10.0 | 11.0 | 12.0 | 13.0 | 14.0 | 15.1 | 16.1 |
| 1.3 | 9.1 | 2.2 | 3.2 | 4.3 | 5.4 | 6.5 | 7.6 | 8.7 | 9.7 | 10.8 | 11.9 | 13.0 | 14.1 | 15.1 | 16.2 | 17.3 |
| 1.4 | 8.5 | 2.3 | 3.5 | 4.6 | 5.8 | 7.0 | 8.1 | 9.3 | 10.4 | 11.6 | 12.7 | 13.9 | 15.1 | 16.2 | 17.4 | 18.5 |
| 1.5 | 7.9 | 2.5 | 3.7 | 4.9 | 6.2 | 7.4 | 8.6 | 9.9 | 11.1 | 12.3 | 13.6 | 14.8 | 16.0 | 17.3 | 18.5 | 19.7 |
| 1.6 | 7.4 | 2.6 | 3.9 | 5.2 | 6.5 | 7.8 | 9.1 | 10.5 | 11.8 | 13.1 | 14.4 | 15.7 | 17.0 | 18.3 | 19.6 | 20.9 |
| 1.7 | 7.0 | 2.8 | 4.1 | 5.5 | 6.9 | 8.3 | 9.6 | 11.0 | 12.4 | 13.8 | 15.2 | 16.5 | 17.9 | 19.3 | 20.7 | 22.0 |
| 1.8 | 6.6 | 2.9 | 4.3 | 5.8 | 7.2 | 8.7 | 10.1 | 11.6 | 13.0 | 14.5 | 15.9 | 17.4 | 18.8 | 20.3 | 21.7 | 23.2 |
| 1.9 | 6.2 | 3.0 | 4.5 | 6.1 | 7.6 | 9.1 | 10.6 | 12.1 | 13.6 | 15.1 | 16.7 | 18.2 | 19.7 | 21.2 | 22.7 | 24.2 |
| 2.0 | 5.9 | 3.2 | 4.7 | 6.3 | 7.9 | 9.5 | 11.1 | 12.6 | 14.2 | 15.8 | 17.4 | 19.0 | 20.5 | 22.1 | 23.7 | 25.3 |
| 2.2 | 5.4 | 3.4 | 5.1 | 6.8 | 8.5 | 10.2 | 11.9 | 13.6 | 15.3 | 17.0 | 18.8 | 20.5 | 22.2 | 23.9 | 25.6 | 27.3 |
| 2.4 | 4.9 | 3.6 | 5.5 | 7.3 | 9.1 | 10.9 | 12.8 | 14.6 | 16.4 | 18.2 | 20.0 | 21.9 | 23.7 | 25.5 | 27.3 | 29.2 |
| 2.6 | 4.6 | 3.9 | 5.8 | 7.7 | 9.7 | 11.6 | 13.5 | 15.5 | 17.4 | 19.3 | 21.3 | 23.2 | 25.1 | 27.1 | 29.0 | 30.9 |
| 2.8 | 4.2 | 4.1 | 6.1 | 8.1 | 10.2 | 12.2 | 14.3 | 16.3 | 18.3 | 20.4 | 22.4 | 24.4 | 26.5 | 28.5 | 30.5 | 32.6 |
| 3.0 | 4.0 | 4.3 | 6.4 | 8.5 | 10.7 | 12.8 | 14.9 | 17.1 | 19.2 | 21.3 | 23.5 | 25.6 | 27.7 | 29.9 | 32.0 | 34.1 |
| 3.2 | 3.7 | 4.5 | 6.7 | 8.9 | 11.1 | 13.4 | 15.6 | 17.8 | 20.0 | 22.3 | 24.5 | 26.7 | 28.9 | 31.2 | 33.4 | 35.6 |
| 3.4 | 3.5 | 4.6 | 6.9 | 9.3 | 11.6 | 13.9 | 16.2 | 18.5 | 20.8 | 23.1 | 25.4 | 27.8 | 30.1 | 32.4 | 34.7 | 37.0 |
| 3.6 | 3.3 | 4.8 | 7.2 | 9.6 | 12.0 | 14.4 | 16.8 | 19.2 | 21.6 | 24.0 | 26.3 | 28.7 | 31.1 | 33.5 | 35.9 | 38.3 |
| 3.8 | 3.1 | 4.9 | 7.4 | 9.9 | 12.4 | 14.8 | 17.3 | 19.8 | 22.3 | 24.7 | 27.2 | 29.7 | 32.1 | 34.6 | 37.1 | 39.6 |
| 4.0 | 3.0 | 5.1 | 7.6 | 10.2 | 12.7 | 15.3 | 17.8 | 20.4 | 22.9 | 25.5 | 28.0 | 30.5 | 33.1 | 35.6 | 38.2 | 40.7 |
| 4.2 | 2.8 | 5.2 | 7.8 | 10.5 | 13.1 | 15.7 | 18.3 | 20.9 | 23.5 | 26.1 | 28.8 | 31.4 | 34.0 | 36.6 | 39.2 | 41.8 |
| 4.4 | 2.7 | 5.4 | 8.0 | 10.7 | 13.4 | 16.1 | 18.8 | 21.4 | 24.1 | 26.8 | 29.5 | 32.2 | 34.8 | 37.5 | 40.2 | 42.9 |
| 4.6 | 2.6 | 5.5 | 8.2 | 11.0 | 13.7 | 16.5 | 19.2 | 21.9 | 24.7 | 27.4 | 30.2 | 32.9 | 35.7 | 38.4 | 41.1 | 43.9 |
| 4.8 | 2.5 | 5.6 | 8.4 | 11.2 | 14.0 | 16.8 | 19.6 | 22.4 | 25.2 | 28.0 | 30.8 | 33.6 | 36.4 | 39.2 | 42.0 | 44.8 |
| 5.0 | 2.4 | 5.7 | 8.6 | 11.4 | 14.3 | 17.1 | 20.0 | 22.9 | 25.7 | 28.6 | 31.4 | 34.3 | 37.2 | 40.0 | 42.9 | 45.7 |
| 5.5 | 2.2 | 6.0 | 9.0 | 11.9 | 14.9 | 17.9 | 20.9 | 23.9 | 26.9 | 29.9 | 32.9 | 35.8 | 38.8 | 41.8 | 44.8 | 47.8 |
| 6.0 | 2.0 | 6.2 | 9.3 | 12.4 | 15.5 | 18.6 | 21.7 | 24.8 | 27.9 | 31.0 | 34.1 | 37.2 | 40.3 | 43.4 | 46.5 | 49.6 |
| 6.5 | 1.8 | 6.4 | 9.6 | 12.8 | 16.0 | 19.2 | 22.4 | 25.6 | 28.8 | 32.0 | 35.3 | 38.5 | 41.7 | 44.9 | 48.1 | 51.3 |
| 7.0 | 1.7 | 6.6 | 9.9 | 13.2 | 16.5 | 19.8 | 23.1 | 26.4 | 29.7 | 33.0 | 36.3 | 39.6 | 42.9 | 46.2 | 49.5 | 52.8 |
| 7.5 | 1.6 | 6.8 | 10.1 | 13.5 | 16.9 | 20.3 | 23.7 | 27.0 | 30.4 | 33.8 | 37.2 | 40.6 | 43.9 | 47.3 | 50.7 | 54.1 |

CarolloBlueTemplateWithLogo.pptx

CarrolloBlueTemplateWithLogo.pptx

# Additional Treatment Capacity

CarolloBlueTemplateWithLogo.pptx

# Additional TW BOD removal with optimal TW performance

| Pt 002 BOD Permit Limit (mg/L) | 45 | | |
|---|---|---|---|
| Flow Exceedance Probability | 50% | 10% | 0.5% |
| Flow (MGD) | 1.8 | 4 | 6 |
| Pt 002 BOD Load (lb/d) | 676 | 1,501 | 2,252 |
| Problem Period | Jun-Sep | May, Oct-Nov | May, Oct-Nov |
| Median Monthly Pond 2 BOD (mg/L) | 53 | 97 | 97 |
| Pond 2 BOD Load (lb/d) | 796 | 3,236 | 4,854 |
| Total Required BOD Removal (lb/d) | 120 | 1,735 | 2,602 |
| Optimal TW BOD Removal (lb/d) | 388 | 585 | 585 |
| Remaining BOD Treatment (lb/d) | 0 | 1,150 | 2,017 |
| Remaining Treatment as NBOD (lb/d) | 0 | 747 | 1,311 |
| Remaining Treatment as N (lb/d) | 0 | 218 | 382 |

# Capacity Issues

- Ponds
  - High Pond 1 BOD loading
  - Pond 2 short circuiting
  - Sludge accumulation and impact on capacity
  - Minimum volume to store wet weather flows
  - Do not nitrify in fall, winter and spring
- Treatment wetlands
  - Need to revegetate/regrade wetlands No. 1- 4.
  - Need more acreage beyond proposed No. 7
  - Require on-going vegetation management

# Capacity issues, cont.

- Enhancement wetlands
  - Proposed flows are higher than ever designed
  - Short circuiting reduces detention time
  - Peak flows reduce detention time and predicted effluent BOD exceeds permit
  - Requires on-going vegetation management

CarolloBlueTemplateWithLogo.pptx

# City of Arcata
# Wastewater Treatment Facility Improvements Project

Facility Plan Capacity Workshop

FRIDAY November 6, 2015

CarolloBlueTemplateWithLogo.pptx

# Agenda

## Thursday PM

- Revisit project goals
- Review current flows, loads and capacity
- Treatment capacity options – conceptual size
- Meeting required capacity – flow charts
- Ranking and feedback on options
- Conceptual Costs
- Feedback

# Agenda

## Friday AM

- Disinfection criteria
- Disinfection options ranking
- Comparison of disinfection options
- Revisit treatment capacity flow options
- Discuss Facility Plan next steps

## Friday PM

- Visit Petaluma Ellis Creek WRF

CarolloBlueTemplateWithLogo.pptx

# Facility Plan Task Objectives

1. Focus on permit required improvements
2. Capital improvements for AWTF
3. Approach to address:
   a. Aging infrastructure
   b. Energy efficiency
   c. Community needs
   d. CAPACITY NEEDS



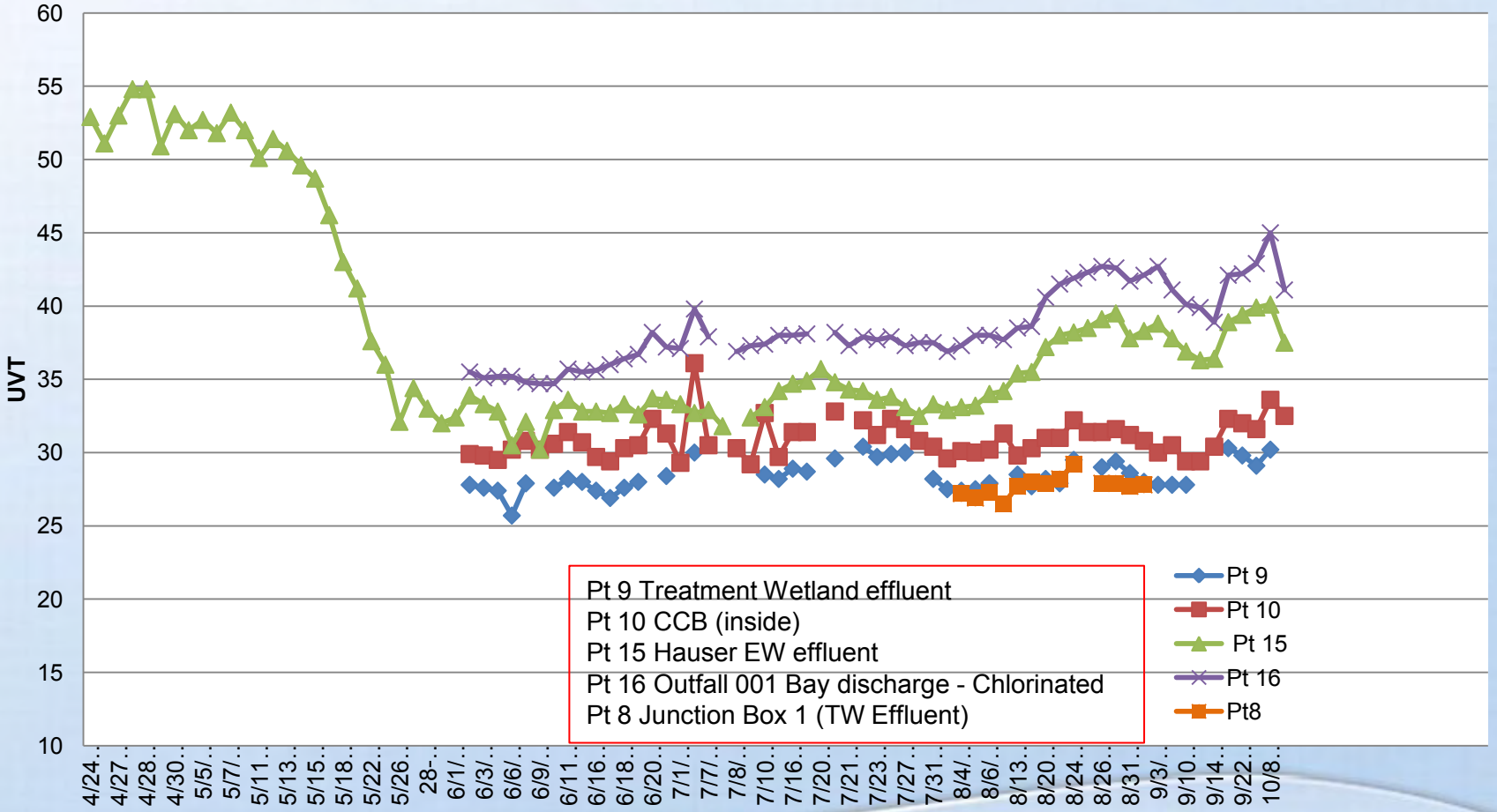
# Disinfection

CarolloBlueTemplateWithLogo.pptx

# Outfall 003 Disinfection

CarolloBlueTemplateWithLogo.pptx

# UVT Analysis – Design for lower than 35%. Lower 10th percentile – 32.5 for Pt 15

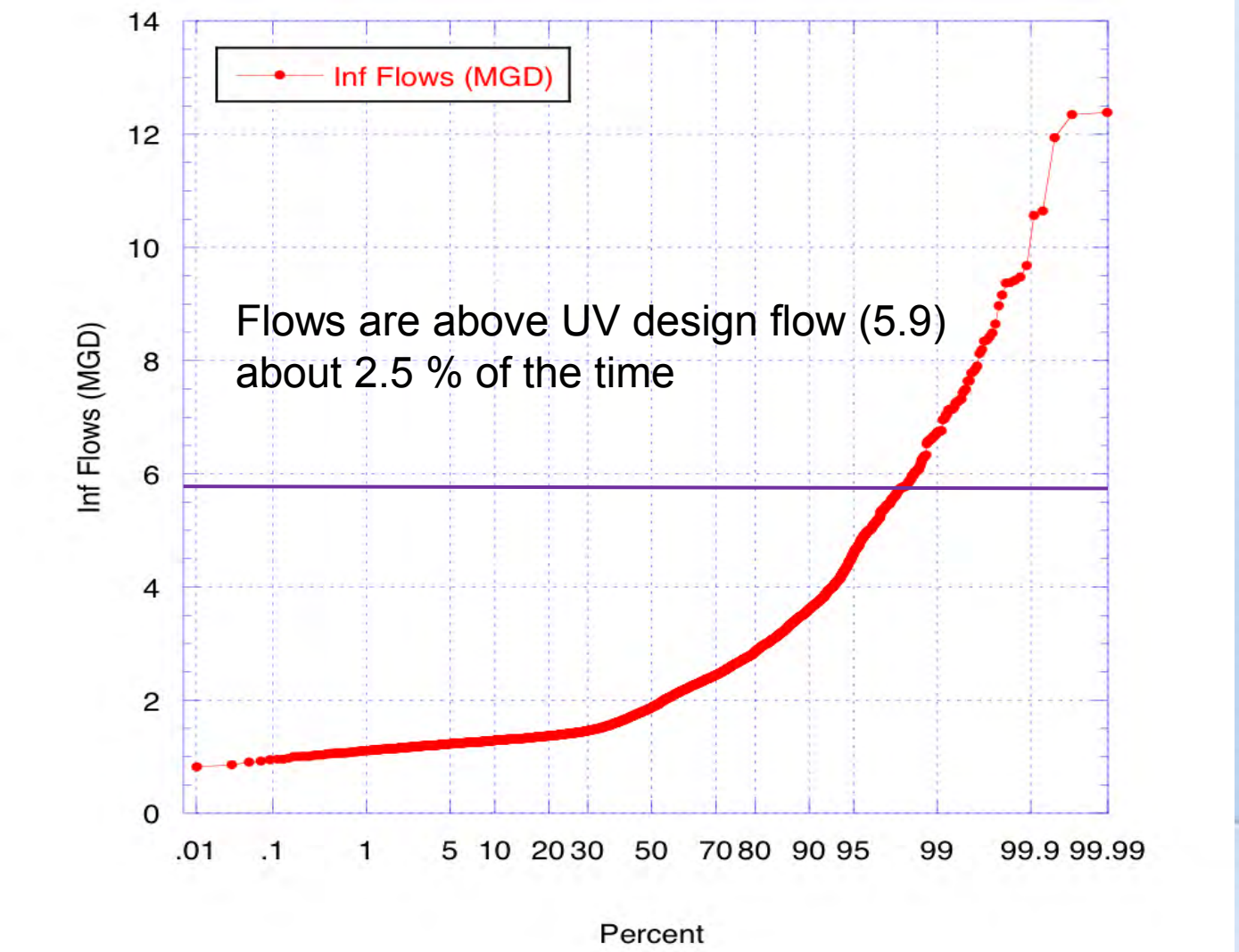



CarolloBlueTemplateWithLogo.pptx

# Outfall 001 Disinfection

CarolloBlueTemplateWithLogo.pptx

# Influent Flows for Point 1 from 1997 – 2010



# Impact of Rainfall on Plant Flows
# Dry Weather (1)

| | Dry Weather | | | | | |
|---|---|---|---|---|---|---|
| Rainfall | 1.3 MGD | | | | | |
| (in/day) | TW Flow | Pond Pump | Pt 001 Chlorine Disinfection. | Pt 002 | UV Flow | Total |
| 0.2 | 1.6 | 0.0 | 0.0 | 1.6 | 1.8 | 1.8 |
| 0.4 | 1.9 | 0.0 | 0.0 | 1.9 | 2.4 | 2.4 |
| 0.6 | 2.3 | 0.0 | 0.0 | 2.3 | 2.9 | 2.9 |
| 0.8 | 2.6 | 0.0 | 0.0 | 2.6 | 3.5 | 3.5 |
| 1.0 | 2.9 | 0.0 | 0.0 | 2.9 | 4.0 | 4.0 |
| 1.2 | 3.2 | 0.0 | 0.0 | 3.2 | 4.5 | 4.5 |
| 1.4 | 3.6 | 0.0 | 0.0 | 3.6 | 5.1 | 5.1 |
| 1.6 | 3.9 | 0.0 | 0.0 | 3.9 | 5.6 | 5.6 |
| 1.8 | 4.2 | 0.0 | 0.3 | 3.9 | 5.9 | 6.2 |
| 2.0 | 4.5 | 0.0 | 0.8 | 3.7 | 5.9 | 6.7 |
| 2.2 | 4.9 | 0.0 | 1.4 | 3.5 | 5.9 | 7.3 |
| 2.4 | 5.2 | 0.0 | 1.9 | 3.3 | 5.9 | 7.8 |
| 2.6 | 5.5 | 0.0 | 2.4 | 3.1 | 5.9 | 8.3 |
| 2.8 | 5.8 | 0.0 | 3.0 | 2.9 | 5.9 | 8.9 |
| 3.0 | 6.2 | 0.0 | 3.5 | 2.6 | 5.9 | 9.4 |

**1. Expected and feasible flow rates through various parts of the Arcata WWTF based on influent flow rates of 1.3 and 2.3 MGD**
**Halverson 11/2012**

# Impact of Rainfall on Plant Flows
# Design Flow

| | Design Flow | | | | | |
|---|---|---|---|---|---|---|
| **Rainfall** | 2.3 MGD | | | | | |
| **(in/day)** | TW Flow | Pond Pump | Pt 001 Chlorine Disinfection. | Pt 002 | UV Flow | Total |
| **0.2** | 2.6 | 0.0 | 0.0 | 2.6 | 2.8 | 2.8 |
| **0.4** | 2.9 | 0.0 | 0.0 | 2.9 | 3.4 | 3.4 |
| **0.6** | 3.3 | 0.0 | 0.0 | 3.3 | 3.9 | 3.9 |
| **0.8** | 3.6 | 0.0 | 0.0 | 3.6 | 4.5 | 4.5 |
| **1.0** | 3.9 | 0.0 | 0.0 | 3.9 | 5.0 | 5.0 |
| **1.2** | 4.2 | 0.0 | 0.0 | 4.2 | 5.5 | 5.5 |
| **1.4** | 4.6 | 0.0 | 0.2 | 4.4 | 5.9 | 6.1 |
| **1.6** | 4.9 | 0.0 | 0.7 | 4.2 | 5.9 | 6.6 |
| **1.8** | 5.2 | 0.0 | 1.3 | 3.9 | 5.9 | 7.2 |
| **2.0** | 5.5 | 0.0 | 1.8 | 3.7 | 5.9 | 7.7 |
| **2.2** | 5.9 | 0.0 | 2.4 | 3.5 | 5.9 | 8.3 |
| **2.4** | 6.2 | 0.0 | 2.9 | 3.3 | 5.9 | 8.8 |
| **2.6** | 6.2 | 0.3 | 3.4 | 3.1 | 5.9 | 9.3 |
| **2.8** | 6.2 | 0.6 | 4.0 | 2.9 | 5.9 | 9.9 |
| **3.0** | 6.2 | 1.0 | 4.5 | 2.6 | 5.9 | 10.4 |

# Impact of Rainfall on Plant Flows
# Wet Weather flow

| | Wet Weather Flow | | | | | |
|---|---|---|---|---|---|---|
| **Rainfall** | 6.4 MGD | | | | | |
| **(in/day)** | TW Flow | Pond Pump | Pt 001 Chlorine Disinfection. | Pt 002 | UV Flow | Total |
| **0.2** | 6.2 | 0.5 | 1.0 | 5.7 | 5.9 | 6.9 |
| **0.4** | 6.2 | 0.8 | 1.6 | 5.5 | 5.9 | 7.5 |
| **0.6** | 6.2 | 1.2 | 2.1 | 5.2 | 5.9 | 8.0 |
| **0.8** | 6.2 | 1.5 | 2.7 | 5.0 | 5.9 | 8.6 |
| **1.0** | 6.2 | 1.8 | 3.2 | 4.8 | 5.9 | 9.1 |
| **1.2** | 6.2 | 2.1 | 3.7 | 4.6 | 5.9 | 9.6 |
| **1.4** | 6.2 | 2.5 | 4.3 | 4.4 | 5.9 | 10.2 |
| **1.6** | 6.2 | 2.8 | 4.8 | 4.2 | 5.9 | 10.7 |
| **1.8** | 6.2 | 3.1 | 5.4 | 3.9 | 5.9 | 11.3 |
| **2.0** | 6.2 | 3.4 | 5.9 | 3.7 | 5.9 | 11.8 |
| **2.2** | 6.2 | 3.8 | 6.5 | 3.5 | 5.9 | 12.4 |
| **2.4** | 6.2 | 4.1 | 7.0 | 3.3 | 5.9 | 12.9 |
| **2.6** | 6.2 | 4.4 | 7.5 | 3.1 | 5.9 | 13.4 |
| **2.8** | 6.2 | 4.7 | 8.1 | 2.9 | 5.9 | 14.0 |
| **3.0** | 6.2 | 5.1 | 8.6 | 2.6 | 5.9 | 14.5 |

**1. Expected and feasible flow rates through various parts of the Arcata WWTF based on influent flow rates of 6.4 MGD**
**Halverson 11/2012**

# Disinfection Issues

- Wetland effluent UVT and impact on UV system cost and size.
- Disinfection of peak flows
  - Need to turn on / off
  - Sits idle most of the time
  - Disinfection byproducts
  - Dechlorination required

# Disinfection Considerations

- Flow Routing
- Disinfection Alternatives:
  - UV
  - Chlorine (Gas, Sodium Hypochlorite, Chloramination)
  - Ozone
- Evaluation of Alternatives:
  - Ranking of Criteria by Importance:
    - Safety
    - Chemicals
    - Lifecycle Cost
    - DBPs
    - Future Permit
  - Pair-Wise Evaluation

# Alternative Flow Routing

# UV Petaluma



# Chlorine Gas





# VSFCD Hypochlorite



# On-Site Hypochlorite






# Chloramine disinfection – Anhydrous Ammonia addition with chlorine






# Ozone



# Ozone



# Disinfection alternatives ranking criteria

- Safety
- Chemicals
- Cost
- Disinfection  byproducts
- Future permit

CarolloBlueTemplateWithLogo.pptx

# Disinfection Considerations

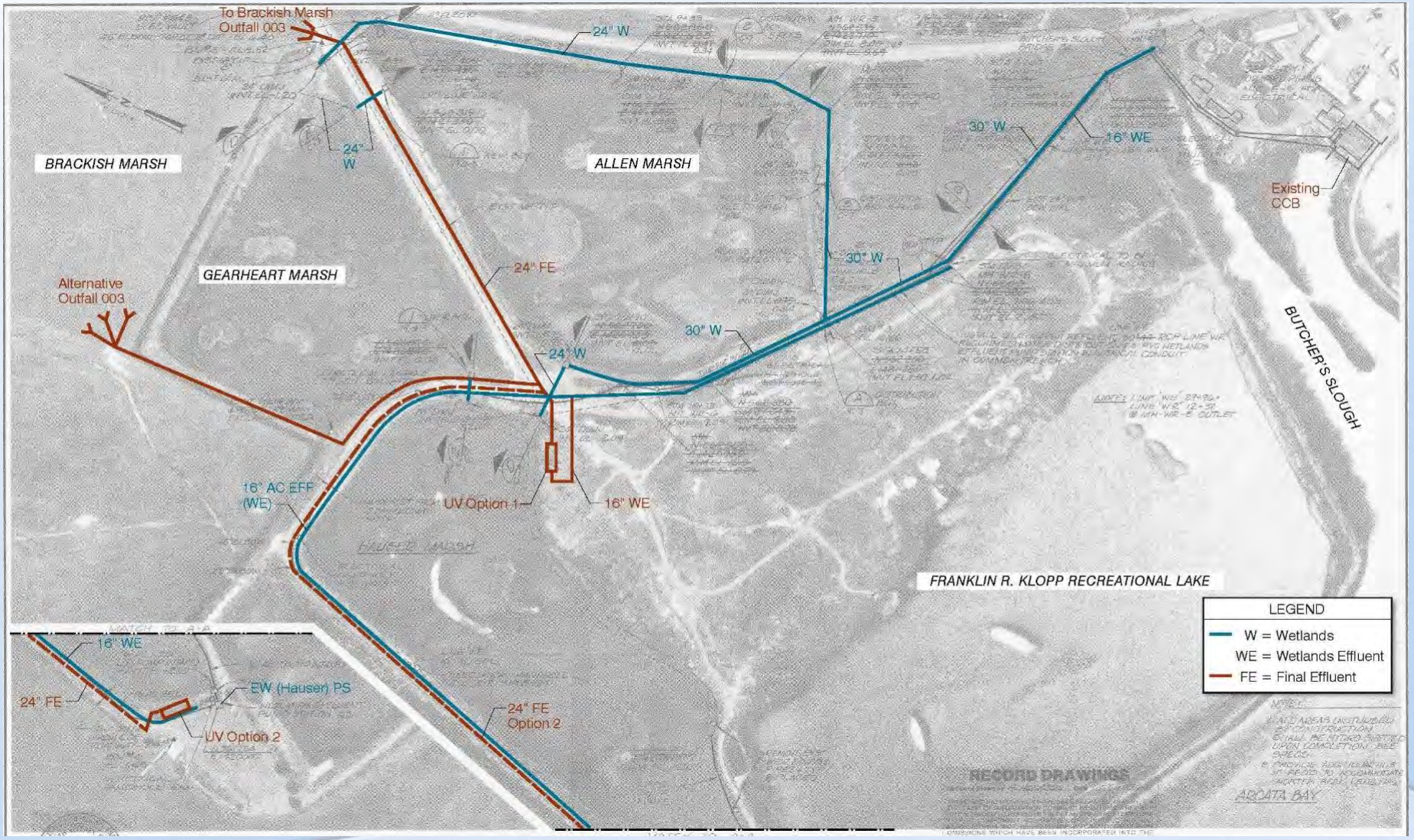
- Flow Routing
- Disinfection Alternatives:
  - UV
  - Chlorine (Gas, Sodium Hypochlorite, Chloramination)
  - Ozone
- Evaluation of Alternatives:
  - Ranking of Criteria by Importance:
    - Safety
    - Chemicals
    - Lifecycle Cost
    - DBPs
    - Future Permit
  - Pair-Wise Evaluation

# Disinfection Alternatives Ranking

| | Criteria | | | | |
|---|---|---|---|---|---|
| **Alternative** | Safety | Chemicals | Lifecycle Cost | DBPs | Future Permit |
| **UV** | 4 | 5 | 2 | 5 | 2 |
| **Chlorine – Gas (Existing)** | 1 | 2 | 5 | 1 | 4 |
| **Chlorine – Sodium Hypochlorite (Delivered)** | 3 | 2 | 3 | 1 | 4 |
| **Chlorine – Sodium Hypochlorite (Generated Onsite)** | 2-3 | 2 | 3 | 1 | 4 |
| **Chlorine - Chloramination** | 2-3 | 1 | 2-3 | 2-3 | 1 |
| **Ozone** | 3 | 4 | 1 | 4 | 5 |
| **Peracetic Acid** | 4 | 3 | 3 | 4 | 1 |

1 = Least Favorable Rank/Score; 5 = Most Favorable Rank/Score

# UV Location


To Brackish Marsh Outfall 003
24" W
24" W
BRACKISH MARSH
ALLEN MARSH
30" W
16" WE
Existing CCB
Alternative Outfall 003
GEARHEART MARSH
24" FE
30" W
24" W
BUTCHER'S SLOUGH
16" AC EFF (WE)
UV Option 1
16" WE
FRANKLIN R. KLOPP RECREATIONAL LAKE
LEGEND
W = Wetlands
WE = Wetlands Effluent
FE = Final Effluent
16" WE
24" FE
EW (Hauser) PS
UV Option 2
24" FE Option 2
RECORD DRAWINGS
ARCATA BAY

# Wrap up and review

- Capacity – limited by existing natural system footprint and environment
- Additional treatment options – needed to make up for shortfall, and to reliably meet permit
- Disinfection – need to address wet weather and increasing costs
- Workshop agenda – collaborate on items for discussion

# Wrap up and Action Item

- Address treatment capacity shortfall
- Address UV and alternative disinfection
- Provide draft chapter to Facility plan
- Review comments and finalize Facility Plan
- Follow up with update for RWQCB

# City of Arcata
# Wastewater Treatment Facility Improvements Project

Facility Plan Capacity Workshop

FRIDAY November 6, 2015

CarolloBlueTemplateWithLogo.pptx

# Petaluma Ellis Creek WRF



# City of Arcata
# Wastewater Treatment Facility Improvements Project

Update on Facility Plan Capacity Review

Questions / Comments Doug Wing
dwing@Carollo.com

CarolloBlueTemplateWithLogo.pptx

# Disinfection

CarolloBlueTemplateWithLogo.pptx

# UV System Installation Cost Estimate – based on 35% UVT

| Dose ($mJ/cm^2$) | 35 | 35 with Redundancy | 50 | 50 with Redundancy |
|---|---|---|---|---|
| UV Disinfection Equipment Cost | $800,000 | $1,090,000 | $1,050,000 | $1,310,000 |
| **Total Construction Costs:** | | | | |
| Low range (3 times equipment) | $2,400,000 | $3,270,000 | $3,150,000 | $3,930,000 |
| High range (5 times equipment) | $4,000,000 | $5,450,000 | $5,250,000 | $6,550,000 |
| Notes:<br>(1) Equipment sizing is based on an End of Lamp Life Factor of 0.90 and a Fouling Factor of 0.95. | | | | |

Based on Trojan UV 3000Plus



# Existing Pond Storage – City needs to confirm storage is available



# APPENDIX H – PROCESS AREA PHOTOS

# Appendix H - Condition Assessment Photos

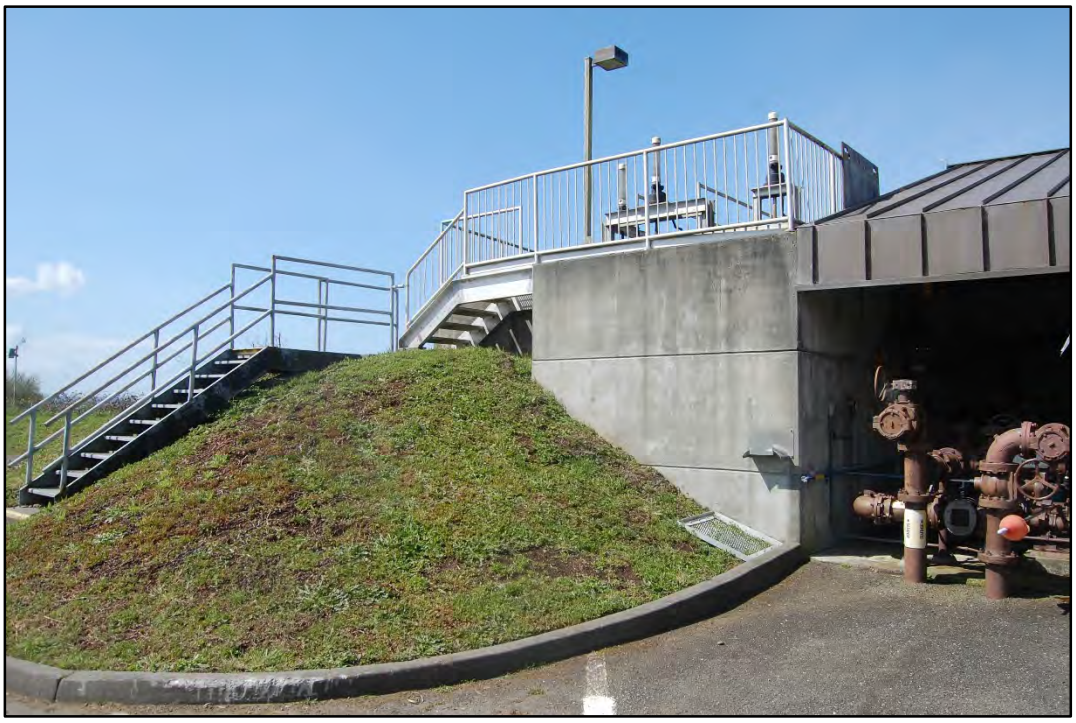


Photo 1 - Headworks - Grit Tank and Effluent Distribution Box



Photo 2 - Headworks - Grit Pumps, Screenings, and Grit Bin



Photo 03 - Headworks - Facing the Archimedes Screw Pumps



Photo 04 - Headworks - Screw Pump Close up.



Photo 05 - Headworks Grit Pump Room



Photo 06 - Headworks Grit Pump


Photo 07 - Headworks Grit Pump

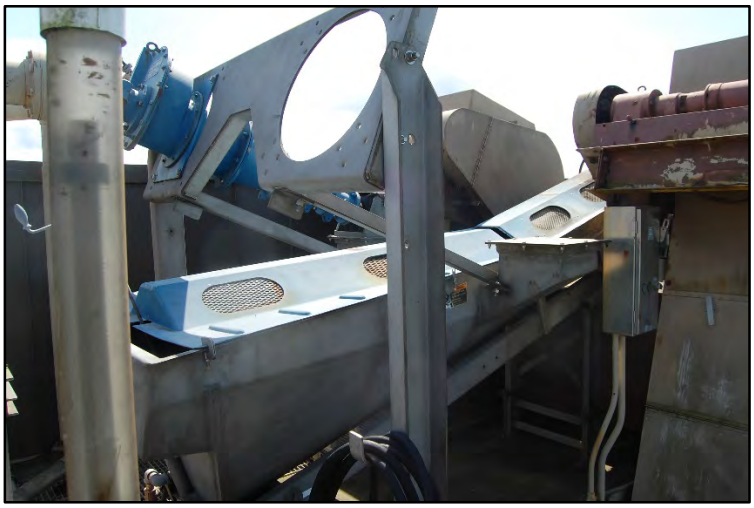


Photo 08 - Headworks Grit Classifier



Photo 09 - Headworks Grit Classifier



Photo 10 - Headworks - Flume Channel



Photo 11 - Primary Clarifier No. 2 (larger unit)



Photo 12 - Primary Clarifier No. 2 - Effluent Weir and Scum Box



Photo 13 - Primary Clarifier No. 2 Drive Mechanism and Motor




Photo 14 - Primary Clarifier No. 2 - Hycor Grease and Scum Concentrator Unit



Photo 15 - Primary Clarifier No. 1



Photo 16 - Primary Clarifier No. 1 - Drive Mechanism



Photo 17 - Primary Clarifier No. 1 - Scum Beach and Effluent Weir



Photo 18 - Primary Clarifier No. 1 - Mechanism



Photo 19 - Primary Clarifier No. 1 - Exposed aggregate concrete

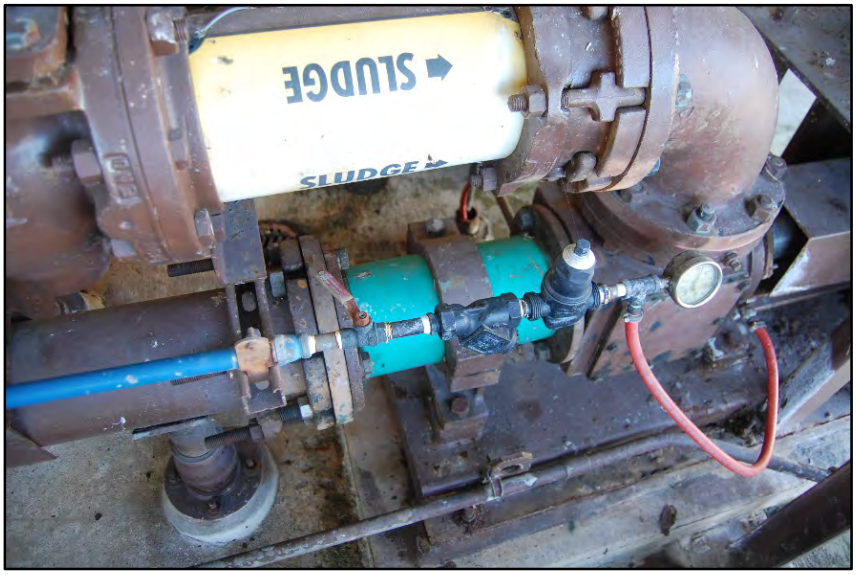



Photo 20 - Primary Clarifier Sludge Pumps



Photo 21 - Primary Clarifier Sludge Pumps

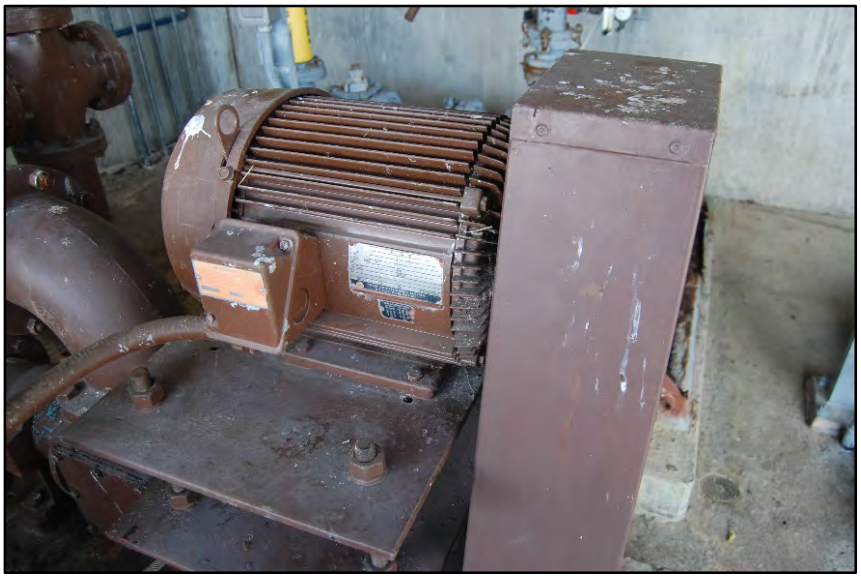


Photo 22- Primary Clarifier Sludge Pump Motor



Photo 23 - Pond 1 Shoreline



Photo 24 - Pond 1 aerators



Photo 25 - Pond 2 - Outlet side and weir structure



Photo 26 - Treatment wetland No. 1 - outlet structure.



Photo 27 - Treatment Wetlands 1 -



Photo 28 - Treatment Wetland 2- Inlet structure



Photo 29 - Treatment Wetland 2 - Effluent end looking toward ponds



Photo 30 - Treatment Wetland 3- Effluent box



Photo 31 - Treatment Wetlands Influent Box - Wetlands 4 feed pump



Photo 32 - Treatment Wetlands Influent Box - Automated weir



Photo 33 - Berm between Oxidation Pond No. 2 and Treatment Wetlands



Photo 34: Pond Pump Station and Pump Station 1



Photo 35 - Pond Pump Station and Pump Station 1



Photo 36 - Pond Pump Station and Pump Station 1




Photo 37 - Pond Pump Station and Pump Station 1



Photo 38 - Emergency Pond Pump Station



Photo 39 - Emergency Pond Pumps



Photo 40 - Treatment Wetlands Pump Station 2 - Treatment wetlands 5 and 6



Photo 41- Treatment Wetland 4 and 5 - FRP Interlocking sheets



Photo 42 - Hauser Wetland Pump Station - Inlet Structure



Photo 43- Enhancement Wetlands Pump Station - Inlet Manual Screen



Photo 44 - Hauser Effluent PS - Pump Station Vault



Photo 44- Enhancement Wetlands Pump Station



Photo 45- Enhancement Wetlands Pump Station



Photo 46 - Chlorine Contact Basin 1



Photo 47 - Chlorine Contact Basin 2



Photo 48 - Chlorinator Room


Photo 49 - Chlorine Contact Basin 3



Photo 50 - Chlorine Storage Building



Photo 51 - Chlorine Storage Building



Photo 52 - Chlorine Storage Building




Photo 53 - Chlorine Contact Basin LCP



Photo 54 - Chlorine residual analyzers


Photo 55 - Chlorine Contact Basin - Treatment wetland Influent piping and flowmeters



Photo 56 - Chlorine Contact Basin Drain Pump Station



Photo 57: Bypass Flowmeter



Photo 58 - Primary Digester




Photo 59 - Primary Digester Gas Piping



Photo 60 - Sludge Drying Beds



Photo 61 - Generator Building

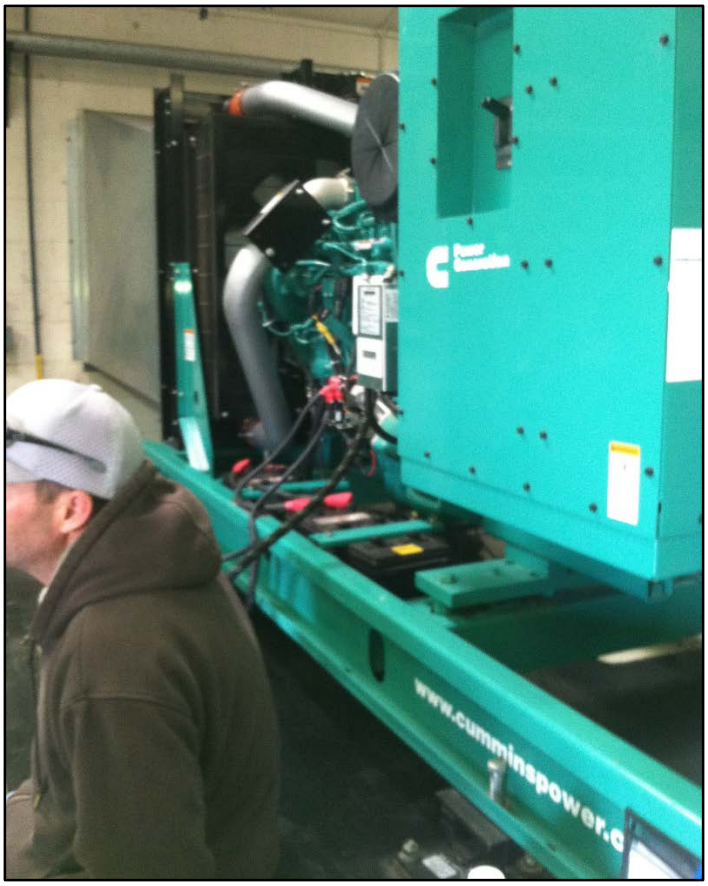



Photo 62 - Standby Generator




Photo 63 - Transfer Switch



Photo 64 - Main MCC

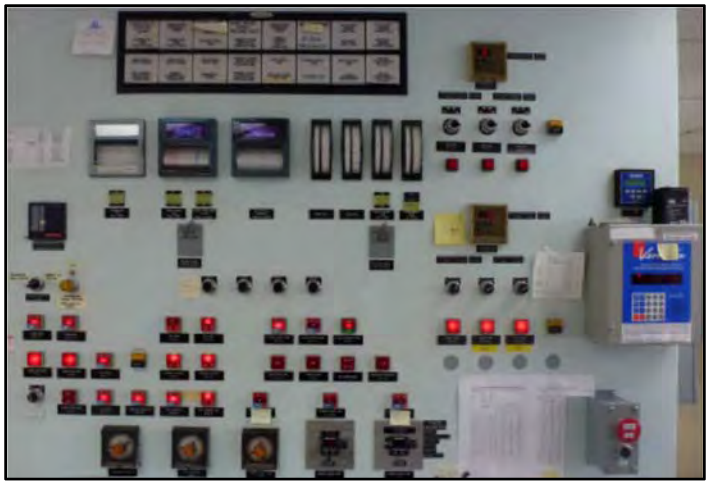


Photo 65 - Operator Control Panel

# APPENDIX I – DETAILED ASSET INVENTORY AND RANKINGS

# APPENDIX I AWTF Condition Assessment

**WWTP Improvement Project**
**City of Arcada**
**Initial Installation Year 1984**

| Process | Asset Description | Equipment ID | Existing Design Criteria | Revised Design Criteria | Install Year | Condition | Comments |
|---|---|---|---|---|---|---|---|
| Collection System Pumping | First Street Pump 1 | P-A-1 | 5.5 MGD each | | 1984 | NR | Pump wastewater directly to OPs during high flow conditions. Engine driven propeller. |
| Collection System Pumping | First Street Pump 2 | P-A-2 | 5.5 MGD each | | 1984 | NR | Pump wastewater directly to OPs during high flow conditions. Engine driven propeller. |
| Collection System Pumping | Influent Storm Pump | P-B-2 | 5MGD | | 1984 | 3 | Pump wastewater directly to OPs during high flow conditions. Variabale speed, Engine driven. |
| | | | | | | | |
| Headworks | Cast-in-place Concrete Structure | NA | | | 1984 | 3 | |
| Headworks | Influent Screw Pump #1 (East Side) | M-B-4-1 | Screw Pump, 2.5MGD | Upsize to handle at least 3 mgd | 1984 | 5 | |
| Headworks | Influent Screw Pump #2 (West Side) | M-B-4-2 | Screw Pump, 2.5MGD | Upsize to handle at least 3 mgd | 1984 | 5 | |
| Headworks | Mechanical Bar Screen (East Side) | M-B-7-1 | 5.9 MGD | | 1984 | 4 | |
| Headworks | Mechanical Bar Screen (West Side) | M-B-7-2 | 5.9 MGD | | 1984 | 4 | |
| Headworks | Screened Material Conveyor Belt | M-B-8-1 | | | 1984 | 4 | |
| Headworks | Screening washer / compactor | | | | TBD | 5 | Failed and removed by plant staff |
| Headworks | Barscreen Gates - 6 units 2 @ 50x57 and 4 @ 36x27 | | | | 1984 | 3 | |
| Headworks | Influent flume / flow transmitter | | | | TBD | 3 | Accuracy TBD |
| Headworks | Grit Chamber | | 144 ft2 Horizontal Flow Chamber | | 1984 | 5 | Assume replacement with vortex grit |
| Headworks | Grit Classfication Equipment | M-B-9 | | | 1984 | 4 | Includes a Cyclone Separator and Grit Washer |
| Headworks | Grit Chamber Rake Equipment | M-B-13 | | Assume replace with vortex | 1984 | 4 | Assume replacement with vortex grit equipment |
| Headworks | Grit Removal Gates - 6 units 2 @ 12x18 and 3 @ misc | | | | 1984 | 3 | |
| Headworks | 5 Hp Grit Pump | P-B-11-1 | 200 GPM; In Operation | | 1984 | 4 | Grit Chamber to Grit Classfication System |
| Headworks | 5 Hp Grip Pump | P-B-11-2 | 200 GPM; Standby | | 1984 | 4 | Grit Chamber to Grit Classfication System |
| | | | | | | | |
| Primary Clarifiers | Clarifier #1 Structure | M-C-2 | 0.04 MG Circular; 26' Diameter | | 1957 | 5 | Bring on-line when flow exceeds 4 MGD or Clarifier #1 in maintenance |
| | Mechanism | | | | TBD | 5 | Age TBD |
| Primary Clarifiers | Clarifier #2 Structure | M-C-1 | 0.25 MG Circular; 60' Diameter | | 1957 | 5 | Operate when flow under 4 MGD |
| | Mechanism | | | | TBD | 4 | Age TBD |
| Primary Clarifiers | Scum Concentrator / Pump | | | | TBD | 4 | Added ??? |
| Primary Clarifiers | Primary Sludge Pump #1 | P-C-3-1 | 90 GPM; Manually Controlled | | 1984 | 4 | Pump Sludge from Clarifier #1 to P-F-2 Primary Anaerobic Digester Transfer Pump |
| Primary Clarifiers | Primary Sludge Pump #2 | P-C-3-2 | 90 GPM; Timer Controlled | | 1984 | 4 | Pump Sludge from Clarifier #2 to P-F-2 Primary Anaerobic Digester Transfer Pump |
| Primary Clarifiers | Primary Sludge Pump #3 | P-C-3-3 | 90 GPM; Timer Controlled | | 1984 | 4 | Pump Sludge from Clarifier #2 to P-F-2 Primary Anaerobic Digester Transfer Pump |
| | | | | | | | |

# APPENDIX I AWTF Condition Assessment

**WWTP Improvement Project**
**City of Arcada**
**Initial Installation Year 1984**

| Process | Asset Description | Equipment ID | Existing Design Criteria | Revised Design Criteria | Install Year | Condition | Comments |
|---|---|---|---|---|---|---|---|
| Anaerobic Digestion | Primary Anaerobic Digester Structure | AD1 | 0.3 MG, 45' * 28' Circular | | 1957 | 4 | Gas holder cover replaced in 1984, 4000 gallons from Clarifier/day |
| Anaerobic Digestion | Secondary Settling Digester Structure | AD2 | 0.1 MG, 26' * 28' Circular | | 1957 | 4 | Gas holder cover replaced in 1984 |
| Anaerobic Digestion | Sludge Mixing/Transfer Pump | P-F-2 | 1160 GPM @ 40 ft | | 2002 | 2 | Chopper type pump |
| Anaerobic Digestion | Heated Sludge Recirculation Pump | P-F-1-1 | 200 GPM @ 20 feet | | 2002 | 2 | Chopper type pump |
| Anaerobic Digestion | Boiler/Heat Exchanger Combination | | TBD | | TBD | 3 | Age TBD |
| Anaerobic Digestion | Heated water recirc pump | | 80 gpm | | TBD | 3 | Age TBD |
| Anaerobic Digestion | Digester waste gas burner | | 3-inch unit | | TBD | 3 | Age TBD |
| Anaerobic Digestion | Sludge Recirculation Pump (Not In Operation) | P-F-1-2 | | | 1984 | 5 | Pump sludge through boiler and back to Primary Digester. |
| Anaerobic Digestion | Sludge drying bed structure | | XX SF | | 1984 | 3 | Visual asseesment |
| Anaerobic Digestion | Compost facilities | | TBD | | TBD | 3 | Biosolids mixer and 2 blowers - condition TBD |
| | | | | | | | |
| Oxidation Ponds | Pond 1 | | 24 Acres | | | 3 | 24 acre - Depth 4.5 to 6.5 ft 46 MG volume |
| Oxidation Ponds | Pond 2 | | 22 acres | | | 3 | 22 acre - Depth 4.5 to 6.5 ft 43 MG volume |
| Oxidation Ponds | Pond 2 Aerators | | TBD | | | 4 | Eight existing aerators |
| | | | | | | | |
| Oxidation Ponds | Pond Pump Station | PPS | Firm Capacity - 2.9 mgd<br>Total Capacity - 4.5 mgd | | 1984 | 3 | In use when effluent from OP2 exceeds maximum TW design flow of 2.3 MGD |
| Oxidation Ponds | Pond Pump Station Pump 1 | P-E-9-1 | 1.8 mgd | | 1984 | 4 | Vertical Turbine |
| Oxidation Ponds | Pond Pump Station Pump 2 | P-E-9-2 | 1.8 mgd | | 1984 | 4 | Vertical Turbine |
| Oxidation Ponds | Pond Pump Station Pump 3 | P-E-9-3 | 1.8 mgd | | 1984 | 4 | Vertical Turbine |
| Oxidation Ponds | PPS Influent Gate | ELIS01 | | | 1984 | 3 | |
| Oxidation Ponds | PS-1 And PPS Wet Wells Mixing Gate | EL2S02 | | | 1984 | 3 | |
| Oxidation Ponds | Emergency Pond Pump Station | EPPS | Firm Capacity - 3.6 mgd<br>Total Capacity - 5.8 mgd | | 1984 | 3 | Routing effluent from OP2 to disinfection when OP2 effluent exceeds the maximum combined pumping capacity of PPS, PS-1, PS-2 (8.4 MGD) |
| Oxidation Ponds | Emergency Oxidation Pond 2 Effluent Pump 1 | P-E-9-4 | 3.6 mgd | | 1984 | 3 | Combined Q - 5.9 MGD, Self prime Gorman Rupp |
| Oxidation Ponds | Emergency Oxidation Pond 2 Effluent Pump 2 | P-E-9-5 | 3.6 mgd | | 1984 | 3 | Self prime Gorman Rupp |
| | | | | | | | |
| Treatment Wetlands | Treatment Wetlands 1 | | 1.8 acre | | 1985 | 4 | 1.8 acre Depth 4.3 feet |
| | Treatment Wetlands 2 | | 1.9 acre | | 1985 | 4 | 1.9 acre Depth 4.6 feet |
| | Treatment Wetlands 3 | | 1.2 acre | | 1985 | 4 | 1.2 acre Depth 3.6 feet |
| | Treatment Wetlands 4 | | 0.9 acre | | 1985 | ND | 0.9 acre 0.9 feet |
| | Treatment Wetlands 5 | | 1.7 acre | | TBD | 3 | 1.7 acre Depth 3 feet |
| | Treatment Wetlands 6 | | 1.9 acre | | TBD | 3 | 1.9 acre Depth 3 feet |
| Treatment Wetlands | Treatment Wetland 7 | | TBD | | Future | Future | Future Project |
| Treatment Wetlands | Pump Station 1 | PS-1 | Firm Capacity - 2.3 mgd<br>Total Capacity - 3.0 mgd | | 1984 | 3 | Pump TW 1-4 effluent from Junction Box 1 to disinfection |
| Treatment Wetlands | Pump Station 1 Pump 1 | P-E-8-1 | 1.2 mgd | | 1984 | 4 | 1.2 MGD for 1 pump. Fixed Speed. |
| Treatment Wetlands | Pump Station 1 Pump 2 | P-E-8-2 | 1.2 mgd; VFD | | 1984 | 4 | 2.3 MGD for 2 pumps. Variable Speed |
| Treatment Wetlands | Pump Station 1 Pump 3 | P-E-8-3 | 1.2 mgd; VFD | | 1984 | 4 | 2.99 MGD for 3 pumps. Variable Speed. |
| Treatment Wetlands | Pump Station 1 Influent Gate | EL2S01 | | | 1984 | 3 | |
| Treatment Wetlands | Treatment Wetlands 4 Pump 1 | | | | | 4 | |
| Treatment Wetlands | Treatment Wetlands 4 Pump 2 | | | | | 4 | |
| Treatment Wetlands | Pump Station 2 | PS-2 | Firm Capacity - 1.67 mgd<br>Total Capacity - 2.4 mgd | | 1984 | 3 | Pump effluent from TW 5-7 to Junction Box1 or to disinfection or TW3 influent |
| Treatment Wetlands | Pump Station 2 Pump 1 | P-E-8-4 | 1.67 mgd; VFD | | 1984 | 4 | Pump effluent from TW 5-7 to Junction Box1 or to disinfection or TW3 influent |
| Treatment Wetlands | Pump Station 2 Pump 2 | P-E-8-5 | 1.67 mgd; VFD | | 1984 | 4 | Pump effluent from TW 5-7 to Junction Box1 or to disinfection or TW3 influent |

# APPENDIX I AWTF Condition Assessment

**WWTP Improvement Project**
**City of Arcada**
**Initial Installation Year 1984**

| Process | Asset Description | Equipment ID | Existing Design Criteria | Revised Design Criteria | Install Year | Condition | Comments |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Enhancement Wetlands | Allen Enhancement Wetlands | | 10 acre | | | 4 | 10 acre @ 2+ ft depth, Need to install baffles for short circuit |
| | Gearheart Enhancement Wetlands | | 10 acre | | | 4 | 10 acre @ 2+ ft depth, Need to install baffles for short circuit |
| | Hauser Enhancement Wetlands | | 10acre | | | 4 | 10 acre @ 3.5 ft depth, Need to install baffles for short circuit, need to revise outlet for effleunt PS |
| Enhancement Wetlands | Hauser Effluent Weir And Distribution Box - New Screen | EW3W01 | | | 1984 | 4 | |
| Enhancement Wetlands | Enhancement Wetland Pump Station | EWPS | Firm Capacity - 1.8 mgd<br>Total Capacity - 2.3 mgd | Firm Capacity - 6.0 mgd<br>Total Capacity - 9.0 mgd | 1984 | 3 | Pump effluent from EW to disinfection.<br>Future Firm Capacity needs to be 5.9 mgd. |
| Enhancement Wetlands | Influent Screen | | N/A | | N/A | 5 | Future project |
| Enhancement Wetlands | Effleunt Stariner | | | | N/A | NA | Future project |
| Enhancement Wetlands | EW Effluent Pump 1 | P-E-40-1 | 1.5 mgd | 3.0 mgd | 1984 | 4 | Current capacity is less than original design capacity |
| Enhancement Wetlands | EW Effluent Pump 2 | P-E-40-2 | 1.5 mgd | 3.0 mgd | 1984 | 4 | Current capacity is less than original design capacity |
| Enhancement Wetlands | EW Effluent Pump 3 | P-E-40-3 | 1.5 mgd | 3.0 mgd | 1984 | 4 | Current capacity is less than original design capacity |
| Enhancement Wetlands | Outfall 003 | | | | | NA | Future project |
| | | | | | | | |
| Chlorination | Chlorine Contact Basin (East) | | 2.3 MGD split-basin mode | | 1984 | 3 | |
| Chlorination | Chlorine Contact Basin (West | | 5.9 MGD combined-basin mode | | 1984 | 3 | |
| Chlorination | Chlorinators | | | | 1984 | 3 | |
| Chlorination | Sulfonators | | | | 1984 | 3 | |
| Chlorination | Chlorine Piping | | | | 1984 | 3 | |
| Chlorination | Sulfur Dioxide Piping | | | | 1984 | 3 | In Operation |
| Chlorination | Chlorine mixer 1 (Water Champ) | | 3 HP | | 1984 | 2 | Standby |
| Chlorination | Chlorine mixer 1 (Water Champ) | | 3 HP | | 1984 | 2 | |
| Chlorination | Sulfur Dioxide mixer 1 (Water Champ) | | 3 HP | | 1984 | 2 | |
| Chlorination | CCB Gates | | | | 1984 | 3 | |
| Chlorination | Sample Pumps | | | | 1984 | 4 | |
| Chlorination | Residual analyzers | | | | 1984 | 2 | |
| Chlorination | Chemical building structure | | | | 1984 | 2 | |
| | | | | | | | |

# APPENDIX J – DR. GEARHEART NOTES ON TREATMENT WETLANDS

## Doug Wing

**From:** Bob Gearheart <bobgearheart@gmail.com>
**Sent:** Thursday, July 30, 2015 8:34 AM
**To:** Doug Wing; Erik Lust; Rachel Hernandez; Paul A. Gregson, P. E.
**Subject:** Responses to Doug's questions
**Attachments:** Arcata Upgrade-comments to Doug.pdf

Doug
I have attached a document that is our initial responses to your questions, there are elaborations on any of these if necessary. I have attached as my photos as possible to give you an idea of changes over the 35 yr period. There are several documents on the restoration of the treatment wetlands in terms of vegetation and biosolids removal.

Generally-three things which are not necessarily mutually exclusive

Excavate sections of vegetative mat-dry/compost-size filter press

Pump liquid/biosolid to pond 2-dry mat-transpire bound water-remove -till and cut removed by low pressure equipment-solid handling like above

Excavate with long reach-used sludge dredge from Eureka options above for mat.

Aerate in place with mobil generator/aerator to reduce BOD , h2S and ammonia levels
combinations of the above for biosolides.

More???

Bob
.

To: Doug Wing July 27, 2015
From: Bob Gearheart
Subject: Response to questions

The treatment wetland design concept was to serve as the treatment step prior to process through the enhancement marsh. This was based on the pilot project study (1979-1984) where one of the studies was to place weirs every 25 ft in a 200 ft cell and monitor for a year to obtain kinetic data on BOD, TSS, and ammonia removal. What we found was that majority (60 tom75%) of the TSS is removed in the first 2 days of HRT . This removed solid material which has been removed from by discrete and flocculent settling breaks down the VSS anaerobically releasing degradable organic byproducts. This addition of soluble BOD which has been contributed from this solubilized particulate BOD. The result is that the soluble BOD actually increases until the anaerobic bacteria in the water column and attached to plant stems and roots start to reduce soluble BOD. The treatment wetlands were designed to have a theoretical retention time of about 3 to 4 days and operated in parallel (due to space limitations). Table 1 shows these relationships as monitoring in Cell 8 of the pilot project, which had a constant input over the year.

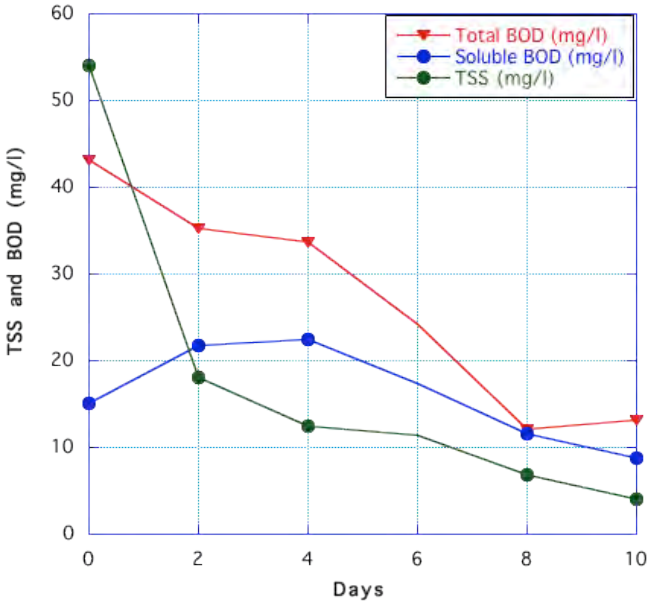



Table 1-Total BOD, soluble BOD and TSS sampled at internal points through Pilot Project. Internal points were related to the theoretical hydraulic retention time (d). (Pilot Project data 1984).

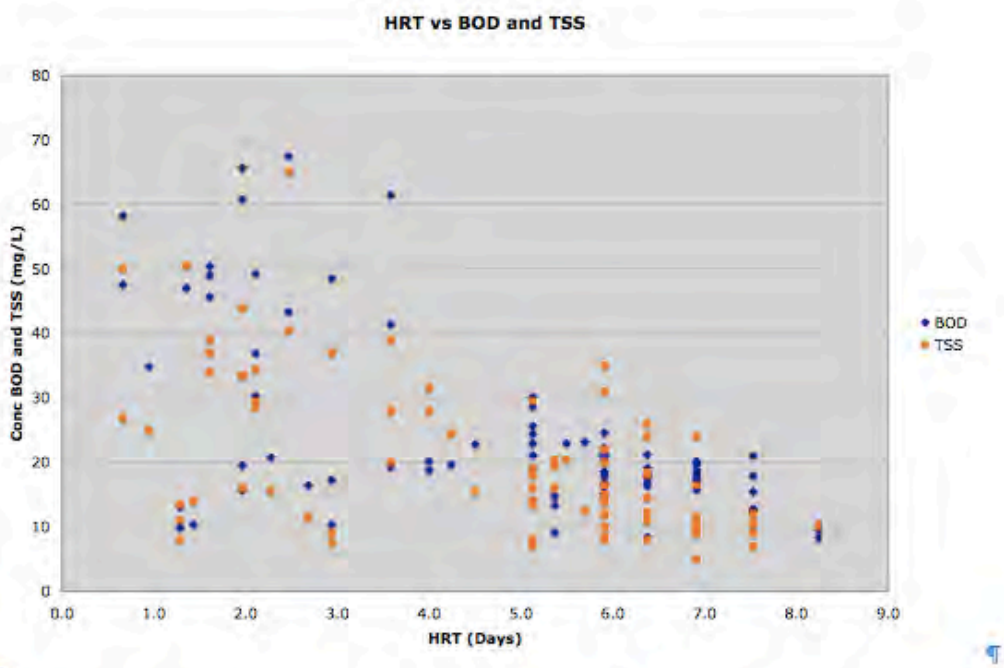
## IMPORTANT RECOMMENDATIONS FROM AMRI

**Studies performed on Treatment Marsh 3 (TM-3) in the summer and fall of 2008 demonstrated the effect of increasing the existing design theoretical HRT of 2 days to HRT's up to 8 days. The TM-3 influent BOD and TSS in the summer and early fall period ranged from 30 to 90 mg/l at hydraulic loading rates of 0.4 to 1.4 mad. The effect of increased hydraulic loading is to reduce the HRT through the treatment wetlands. The lower the HRT the less time there is in the treatment marsh for the TSS to settle and for the soluble BOD to degrade. The greater the HRT, lower hydraulic loading rate, the more time there is for solids to auto flocculate, settle, and decompose. This effect can be seen in Figure 1 where the HRT's of less than 4.0 days produce a highly variable effluent BOD and TSS, which in general is above the NPDES requirement of 30 mg/l BOD, and TSS. See following table**

**The proposed upgrade is to construct three new treatment marshes, which will double the amount of treatment marsh capacity to 11.5 acres from the existing 5.7 acres. The new treatment marshes will be constructed on the footprint of the existing Oxidation Pond 3 and the area of fishponds. The new treatment marshes will have upgraded influent manifold works and multiple outlet weirs. The wetlands will have several submerged beams normal to the flow pattern along with small open water waters. The combinations of these design elements will significantly improved the internal hydraulics, which along with increasing the HRT to above 4 days will increase treatment capacity. With the addition of three new wetlands the summer and fall average flow rate to each of the seven wetlands will be approximately 0.20 mgd or 1.4 mgd total flow. There will also be restoration and enhancement on both TM-1 and TM-2 as the new upgrade plan is implemented. New effluent weirs in TM-2 were installed in 2007 and similar influent weirs will be installed in TM-1 in the summer of 2009.**

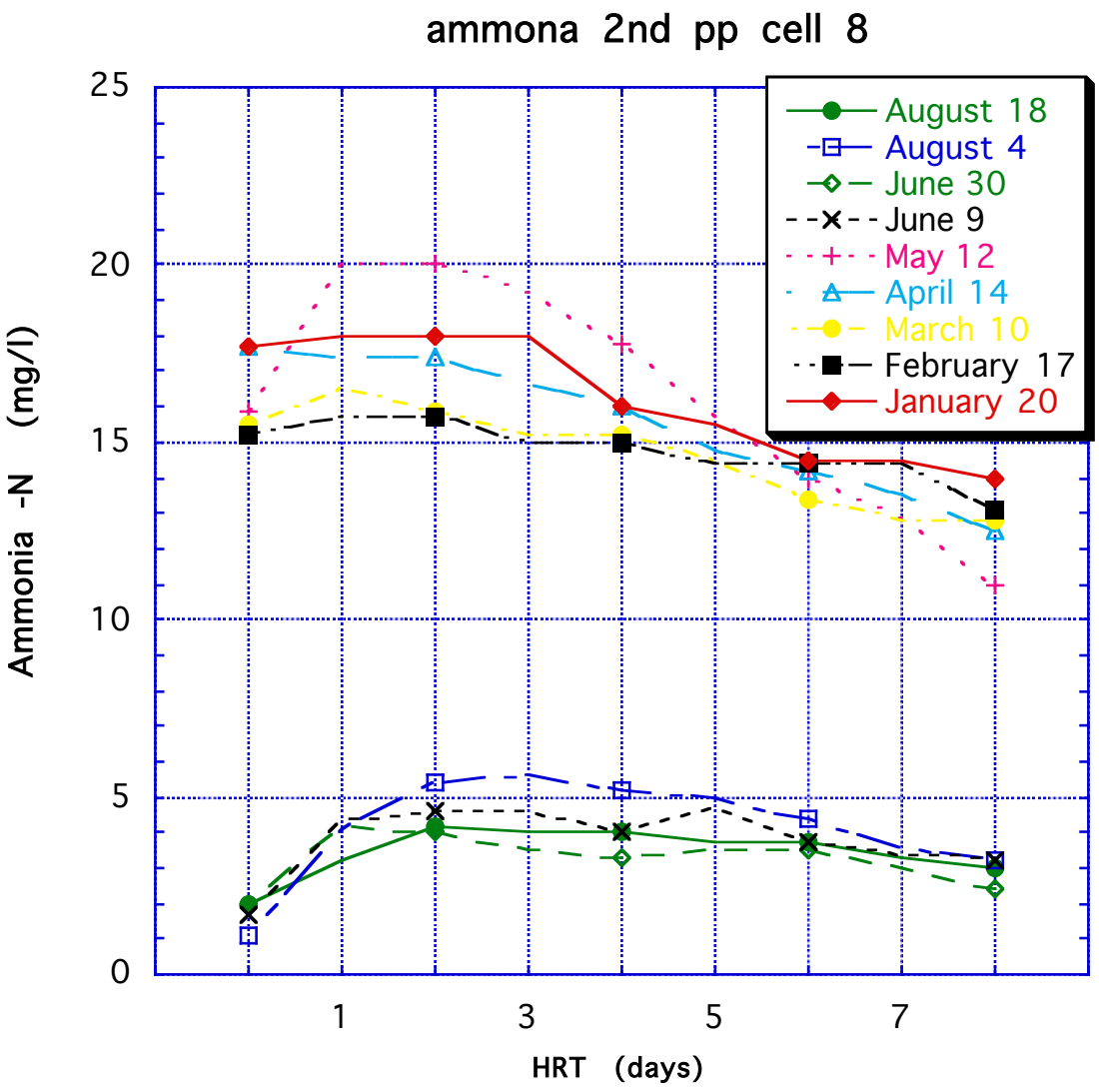
**As of 2015 the storage capacity for settled suspended solids and detrital wetland accumulation is a maximum resulting in a significant decrease in HRT which does not allow for sufficient BOD removal. TSS is still removed since it is depended solely on flocculent and discrete settling velocities. There as been a reduction in TSS removal close to 40 to 50% removal is still being achieved.**

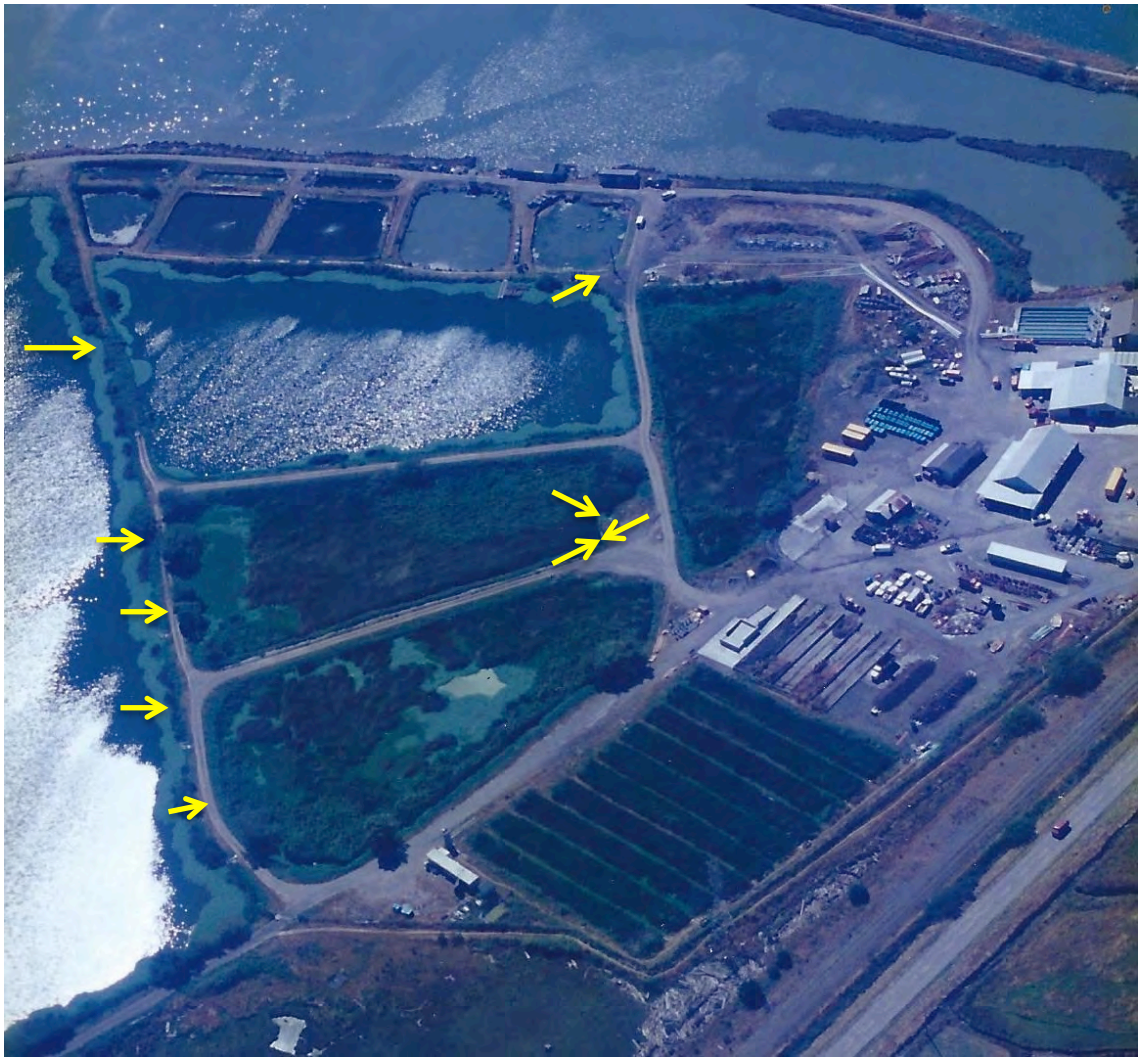
**Two have been build TM5 and TM6-waiting for approval for TM7**




We performed an experiment with Treatment marsh 3 where we changed the flow rate to produce different HRTs. The graph above shows the response of changing the HRT over a range of 8 days.

Assumed volume 0.9504 millons of gallons, includes 30% plant material


ammona 2nd pp cell 8
Ammonia -N (mg/l)
HRT (days)
0
5
10
15
20
25
1
3
5
7
August 18
August 4
June 30
June 9
May 12
April 14
March 10
February 17
January 20



System Operation with box type effluent weirs from TM1 and 2, TM 3 directly to Pt8 Aroun 1988-89. Yellow arrows show influent and effluent pTreatmenet Wetland systems 1987 TM1 deeper channel/hole east side planting patterns showing rows of hardstem bulbush. Show Pilot project with different portions harvested to determine WQ effect.
Important to note is that TM! Was never leveled as a result there is deeper are along the east side, which has significantly affect the flow pattern and resultant removals. The upgrade option if proposed to levels the marsh where needed, place berms normal to the flow and excavate deeper regions for solids accumulations, TM5 and 6 model.

Above is what Hauser looked like during the construction period of Hauser Pump station. Graded flat except for the drainage channel on left side of pictures and deep channel next to the road out of picture on the left.

)
System Dimensions with 6 Treatment Marshes: Area, Volume, and Storage (HRT

| | Area | Typical Operating Depth | Min. Depth | Max. Depth | Typical Operating Volume | Min. Volume | Max. Volume | Storage | HRT for Low Flow (1.3 MGD) | HRT for Design Flow (2.3 MGD) | HRT for High Flow (4 MGD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Ma | | Min | Ma | | 1.3 | 2.3 | 4 |
| | (ac | (ft) | (ft) | (ft) | (m | (m | (m | (m | (d) | (d) | (d) |
| ***Ponds*** | | | | | | | | | | | |
| Oxidation Pond 1 | 24 | 5.9 | 4.5 | 6.5 | 46 | 35 | 51 | 16 | 35. | 20. | 11. |
| Oxidation Pond 2 | 22 | 6 | 4.5 | 6.5 | 43 | 32 | 47 | 14 | 33. | 18. | 10. |
| **Pond Total** | 46 | | | | 89 | 67 | 97 | 30 | **69** | **39** | **22** |
| ***Treatment*** | | | | | | | | | | | |
| TM 1 | 1.8 | 4.3 | 1 | 4.3 | 2.6 | 0.6 | 2.6 | 2.0 | 9.6 | 5.0 | 2.8 |
| TM 2 | 1.9 | 4.6 | 1 | 4.6 | 2.9 | 0.6 | 2.9 | 2.3 | 9.6 | 5.0 | 2.8 |
| TM 3 | 1.2 | 3.6 | 1 | 3.6 | 1.5 | 0.4 | 1.5 | 1.1 | 9.6 | 5.0 | 2.8 |
| TM 4 | 0.9 | 2.9 | 1 | 2.9 | 0.9 | 0.3 | 0.9 | 0.6 | 4.3 | 4.3 | 4.3 |
| TM 5 | 1.7 | 3 | 1 | 5.5 | 1.7 | 0.6 | 3.0 | 2.5 | 9.6 | 5.0 | 2.8 |
| TM 6 | 1.9 | 3 | 1 | 5.5 | 1.9 | 0.6 | 3.4 | 2.8 | 9.6 | 5.0 | 2.8 |
| TM 7 | | | | | | | | | | | |
| **TM Total (avg)** | 9.6 | | | | 11 | 3 | 14 | 11 | **8.3** | **4.8** | **3.2** |
| ***Enhancement Wetlands*** | | | | | | | | | | | |
| Allen | 10 | 2.3 | 0.7 | 6 | 7 | 2 | 20 | | 5.8 | 3.3 | 1.9 |
| Gearheart | 10 | 2.1 | 0.7 | 4.5 | 7 | 2 | 15 | | 5.3 | 3.0 | 1.7 |
| Hauser | 10 | 3.7 | 0.7 | 5.5 | 12 | 2 | 18 | | 9.3 | 5.2 | 3.0 |
| **EM Total** | 30 | 2.7 | | | 26 | 0 | 52 | 26 | **20** | **11** | **7** |
| **System Total** | | | | | | | | 68 | **97** | **55** | **32** |

*Figure 1: Area, depth and calculated Hydraulic Retention Time for the treatment system with 6 treatment marshes. Assumptions: the flow remains in the range for the period. High Flow (4 MGD) occurs between 80-95% of the time (City of Arcata data from 2005-08).*

*Dimensions were obtained from the following sources and are documented in the MEMO on Operating Dimensions. Pond area and min max values for treatment marshes are from the Wastewater Treatment Plant Modifications CH2M Hill March 1984. Pond, treatment marsh, and enhancement wetland depths were physically measured during different studies conducted by AMRI.*

The conceptual design form TM 5 and 6 is shown on the next page. We took information we learned from the Pilot Project (cell 8 and other cells) where we had baffles. Requiring the flow to gather in deeper regions and then flow over a shallow berm increases the nominal retention time (reducing short circuiting), enhances autoflocculation, and stratifies the flow vertically. The concept was to have three berms operating at 8 to 12 inches with deeper sections preceding shallow marsh prior to the berm. The deep section allow accumulation of solids that cen be anaerobically reduced. The open water become covered with floating aquatic plants,. With these sizes of wetland cells it is impossible to keep open water areas. It is not a problem though because we don't want sunlight to reignite algal populations.

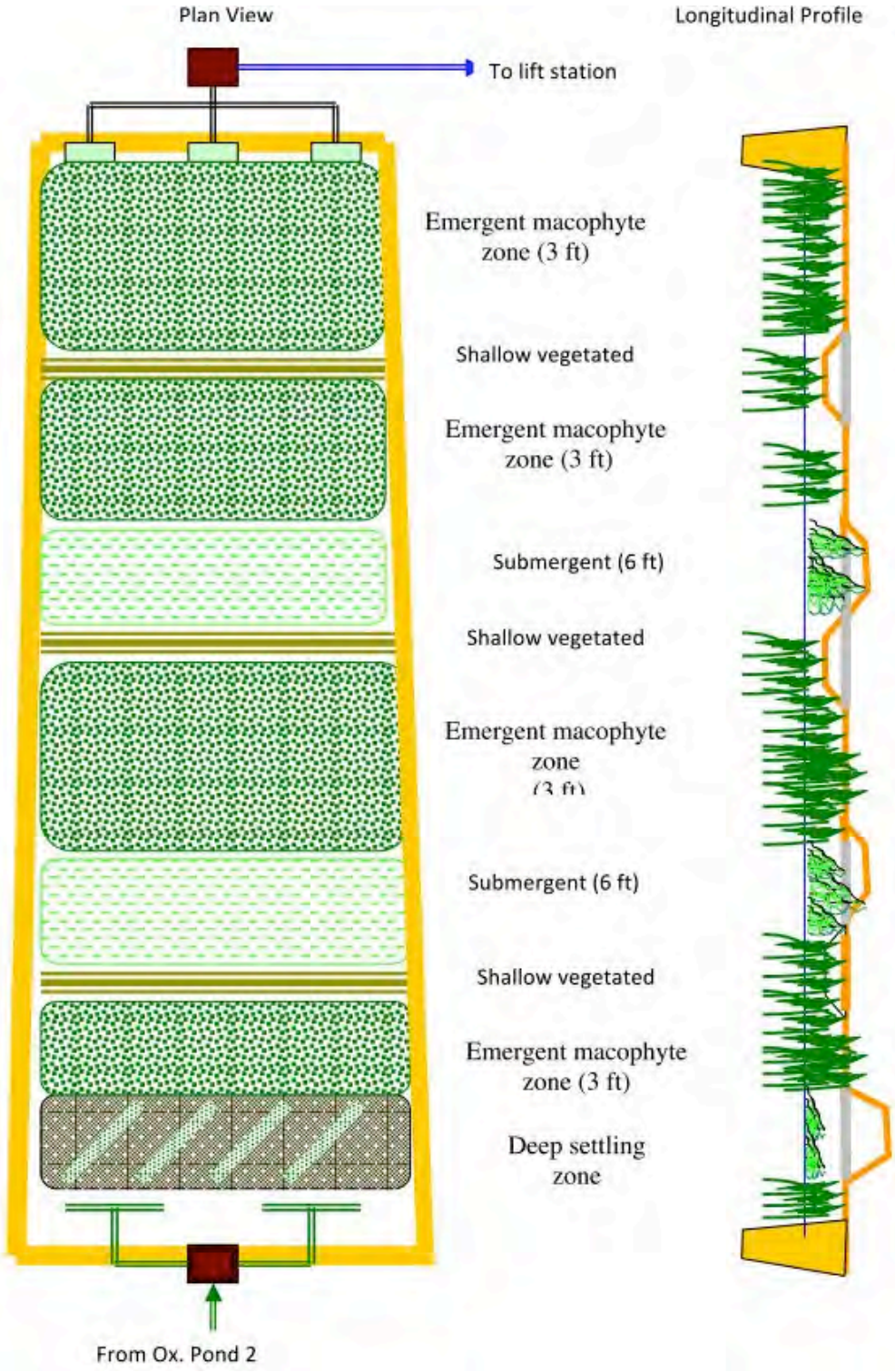

Plan View
Longitudinal Profile
To lift station
Emergent macophyte zone (3 ft)
Shallow vegetated
Emergent macophyte zone (3 ft)
Submergent (6 ft)
Shallow vegetated
Emergent macophyte zone
Submergent (6 ft)
Shallow vegetated
Emergent macophyte zone (3 ft)
Deep settling zone
From Ox. Pond 2

Table 12 Experimental Water Quality Conditions-Oxidation Pond Effluent-Marsh Cell Influent (I) Characteristics and Marsh Cell 8 Effluent Characteristics

| | DO | BOD Effluent | BOD %Removal | NFR Effluent | NFR %Removal | Ammonia Effluent | Ammonia %Removal | Nitrate Effluent | Nitrate %Remov |
|---|---|---|---|---|---|---|---|---|---|
| Influent | 4.7 | 50.0 | | 49.2 | | 9.4 | | 4.5 | |
| Cell 1-50% Harvested Effluent | 0.7 | 19.4 | 61 | 11.5 | 76 | 11.3 | +20 | 2.2 | 51 |
| Cell 2-100% Harvested | 1.5 | 18.2 | 63 | 15.3 | 69 | 6.7 | 28 | 2.6 | 42 |
| Cell 3-Not Harvested | 1.5 | 11.1 | 78 | 9.7 | 80 | 4.3 | 54 | 5.9 | +31 |
| Cell 4-Alternating 10% Harvested | 0.8- | 12.5 | 75 | 7.7 | 84 | 8.0 | 15 | 3.8 | 15 |
| Cell 5-Not Harvested | 0.72 | 12.6 | 75 | 8.7 | 82 | 10.7 | +14 | 3.1 | 31 |
| Cell 6-2 Baffled Compartments | 0.7 | 14.6 | 71 | 10.0 | 79 | 9.6 | + 2 | 2.7 | 40 |
| Cell 7-4 Baffled Compartments | 1.1 | 11.1 | 78 | 10.2 | 79 | 7.6 | 19 | 3.4 | 24 |
| Cell 8-8 Baffled Compartments | 1.1 | 10.0 | 86 | 8.6 | 82 | 8.3 | 11 | 3.2 | 29 |
| Cell 9-50% Harvested Alternating 1/4 | 1.5 | 18.4 | 63 | 13.8 | 72 | 8.1 | 14 | 3.2 | 29 |
| Cell 10-50% Harvested-Influent | 1.4 | 10.3 | 79 | 13.6 | 72 | 6.6 | 29 | 2.8 | 37 |

Table 12 shows the effect of different vegetation removal options in terms of how much and where in the flow sequence the vegetation is remove. The key cells to look at are cell 8-8 which had baffles every 25 ft for 8 cells with no vegetation removed. This cell had the highest BOD and TSS removal, basis for the TM 5 and 6 design.

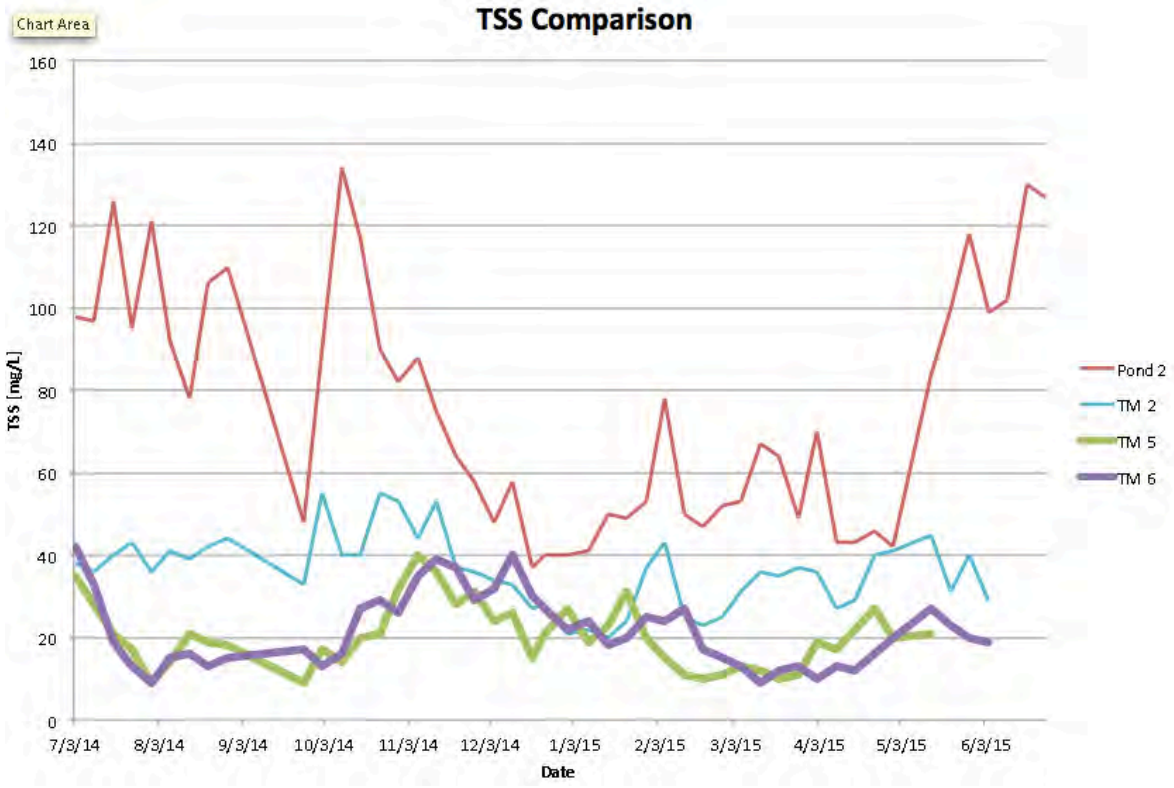
It also shows that harvesting strips such as every 25% and every 10 % has minimum impact on effluent WQ The effect of plants on ammonia removal is seen in the non-harvested cells Cell3 and 5. The 100% harvested Cell 1 had the worst WQ but still acceptable for an interim period.

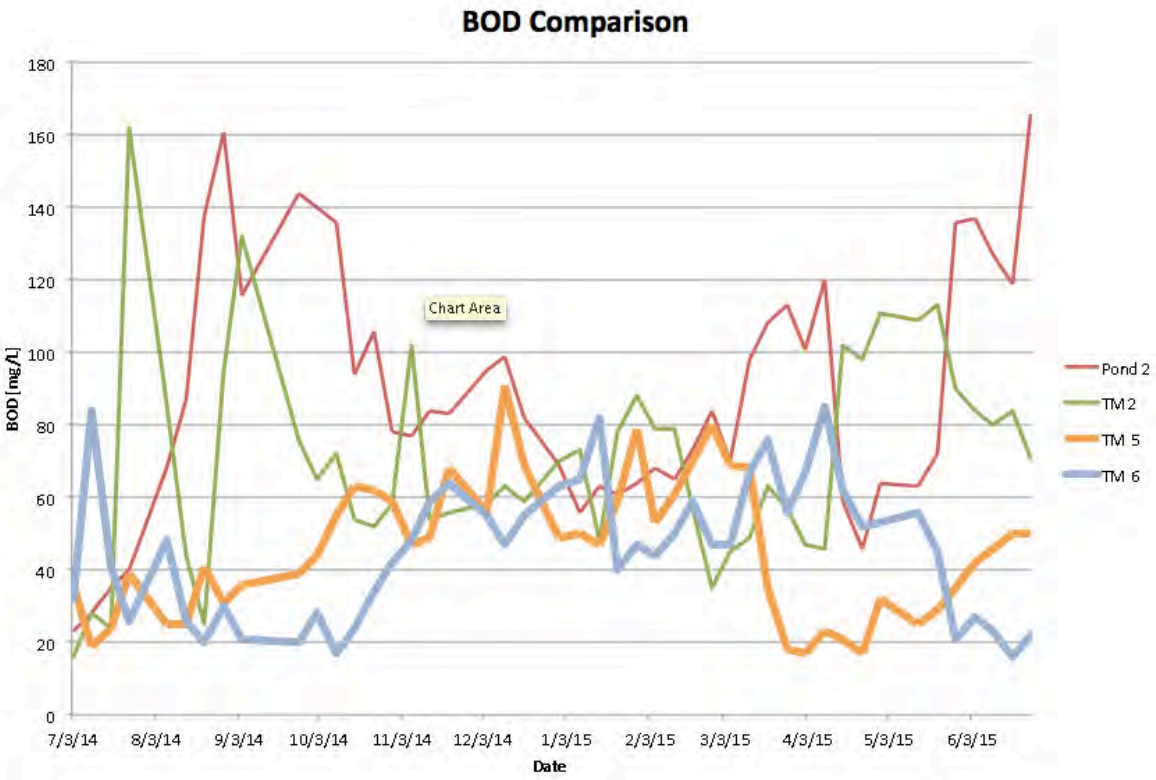
Treatment Marsh 4 was constructed out of the original pilot project, which originally had twelve 200 by 20 ft cells with a 2 ft berm between each cell. In about 1990 or so the two mostly northerly pilot cells were vacated and use for the building across from the pump station, compost operations, et; leaving ten cells. In 2009 the ten remaining cells were configured into 7 serpentine cells with 3 cell (Influent –southerly area

made into an inlet zone feeding the seven serpentine cells. The influent flows by gravity directly to the Pump station across the road.

The graphs on the next pages shows the Oxidation pond and treatment wetland BOD and TSS levels for the last two years. TM5 and 6 went through a difficult period getting the plants in place and growing. We were total inundated with coots who consume our plantings. We went through several cycles of replanting along with trying different hazing techniques. By spring of 2014 we to control of the coots and focused on planting the openwater which one of the coot attractants. By Spring of 2015 the system was in place and you see the resultant effects. Late spring and summer TM 5 and 6 are receiving over 80% of the flow, close to 500,000 gal/day. It was our expectations that it would take at least one year to become functional.

These graphs show how the pond BOD and TSS vary over the year somewhat out of sequence with influent flow to the treatment wetlands. This load variations works in favor of the way these systems work as progressive clarifiers.




BOD Comparison
180
160
140
120
100
80
60
40
20
0
BOD [mg/L]
Chart Area
7/3/14
8/3/14
9/3/14
10/3/14
11/3/14
12/3/14
1/3/15
2/3/15
3/3/15
4/3/15
5/3/15
6/3/15
Date
Pond 2
TM 2
TM 5
TM 6





## Recommendations for Enhancement Marsh Upgrades

The sketch below shows a concept for insuring Hauser effluent meeting NPDES 30/30 permit requirement during higher flow and higher TSS periods. The concept is to minimize short circuiting in these two wetlands. (understanding that they were never design to treat natural system effluent-poor island siting and configuration, poor siting of inlets and outlets,etc). We have a calibrated model that has been used to assist in the development of this alternative. The table below estimates the increase in the flow period with this baffled serpentine configuration. Allen marsh's flow period with increase by about 100 % (1200 ft to 2400 Ft) and Gearheart marsh will increase about 300%. The discharge from Gearheart marsh will be at the gate on the southeast corner (the gate install at original upgrade and will discharge into the Northeast corner of Hauser. The release of Gearheart into Hauser will utilize a larger section of Hauser that has been a dead zone for the most part. The table also gives the approximate amount of baffle curtain required.



| Baffle or Flow Path | Distance from Google Earth [Ft.] |
|---|---|
| 1 | 142 |
| 2 | 213 |
| 3 | 97 |
| 4 | 342 |
| 5 | 60 |
| 6 | 238 |
| 7 | 107 |
| 8 | 124 |
| 9 | 206 |
| 10 | 110 |
| 11 | 108 |
| Allen short circuit path | 1200 |
| Gearheart short circuit | 702 |
| Allen flow path | 2341 |
| Gearheart flow path | 1990 |

## Doug Wing

**From:** Bob Gearheart <bobgearheart@gmail.com>
**Sent:** Thursday, July 30, 2015 11:05 AM
**To:** Doug Wing; Erik Lust; Rachel Hernandez; Charles Swanson; Brad Finney; Eileen Cashman
**Subject:** BOD model sensitivity analysis Enhancement wetland
**Attachments:** EWPredictedBOD_VariousConditions (2).docx

All

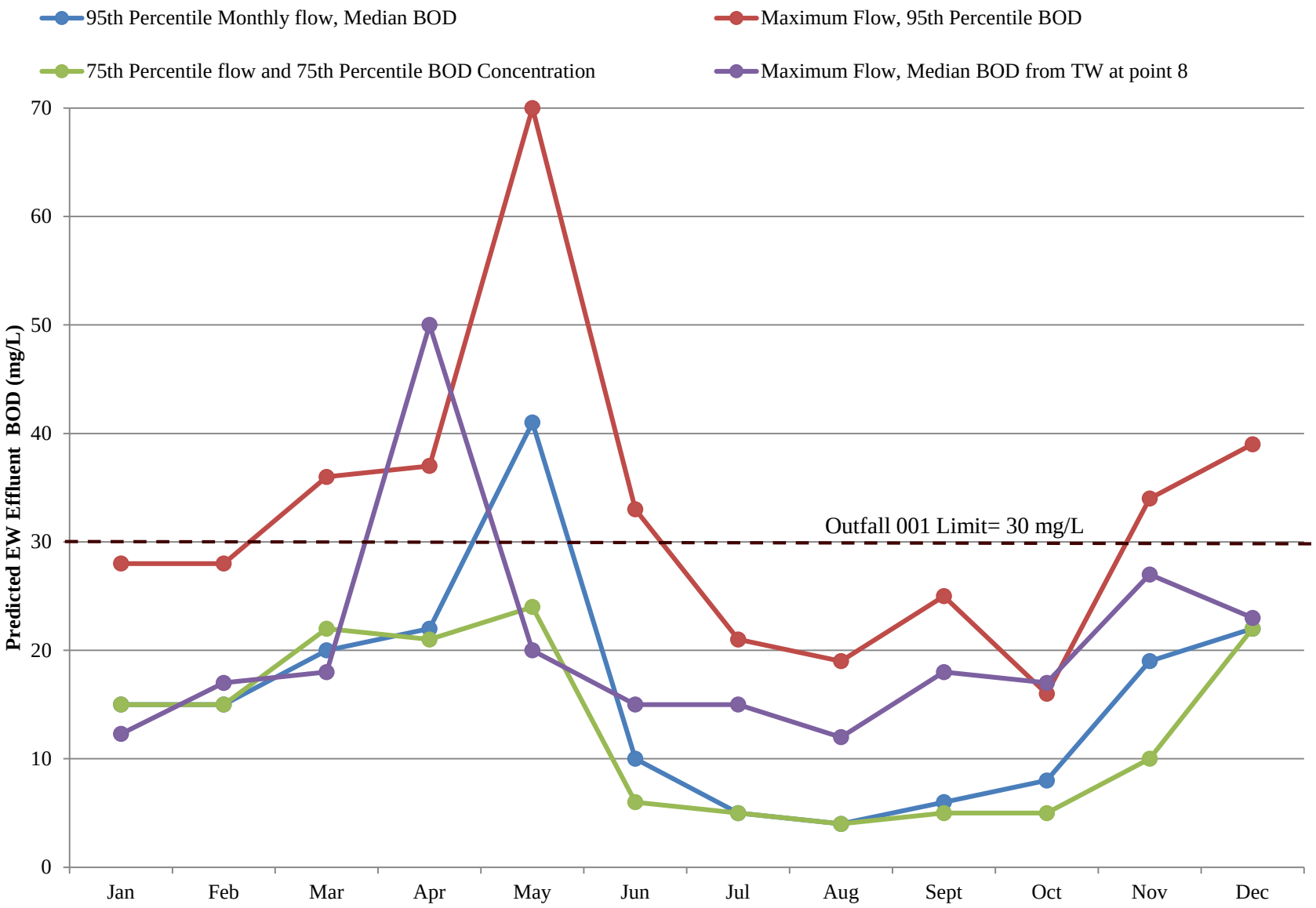
Lauren has been working with and upgrading Heidi's EW BOD model the last couple of weeks ( see attachment). I have asked her to develop a range of monthly flow and BOD levels to test the capacity of the EW under the existing conditions of flow (dye studies). The objective of this analysis is to determine the time and extent of Hauser effluent not meeting a 20 mg/l level (a target for a 30 mg/l permit requirement). There are months in the winter and early spring where the monthly predictions are above 20 mg/l. The upgrade suggestions of siting baffle curtains strategically in Allen and Gearheart will increase HRT's and hopefully will decrease the effluent levels for these months below 20 mg/l (this analysis is in process).

i would appreciate any comments you might have on our approach.

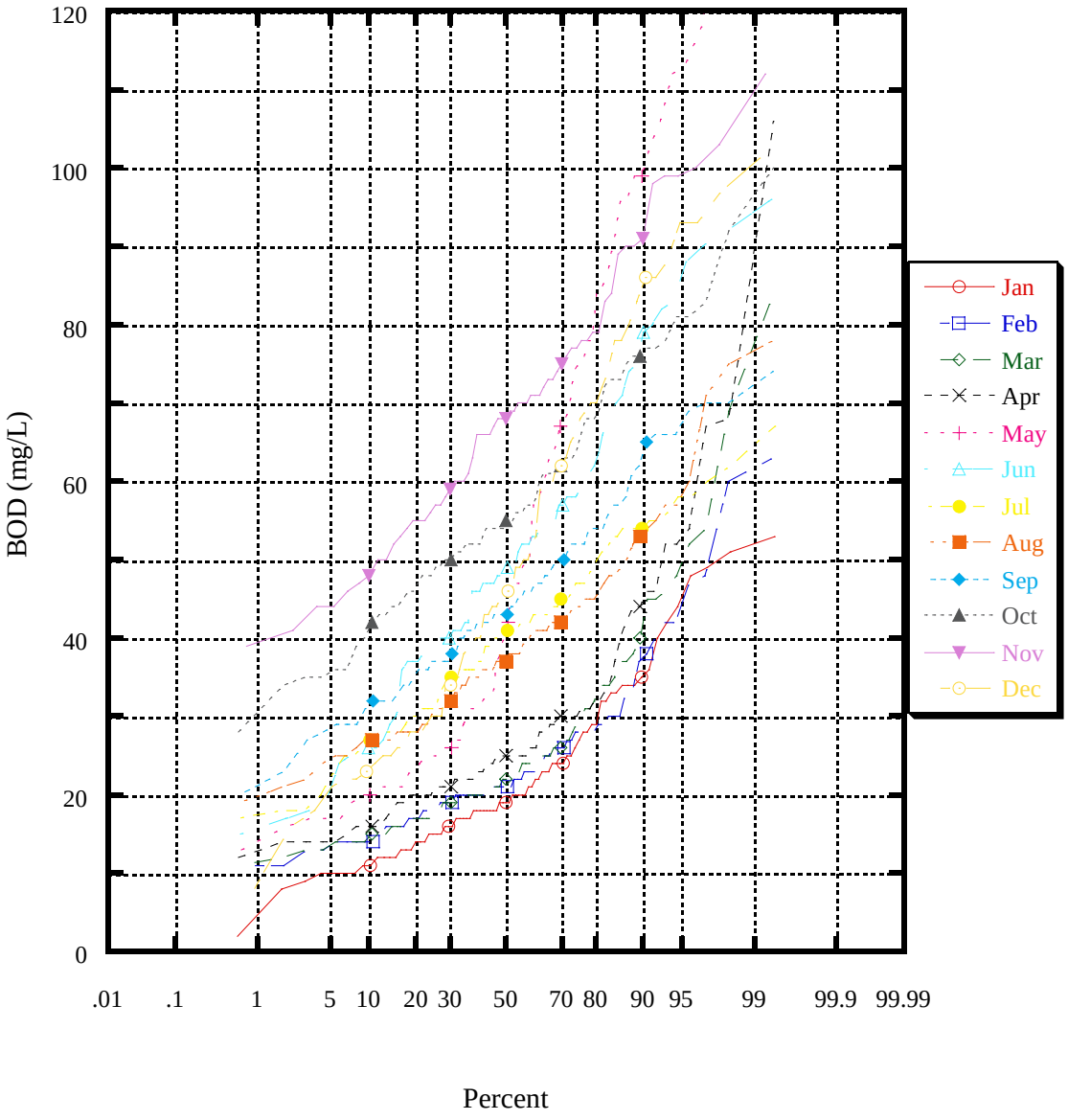
Bob

| Predicted Enhancement Wetland BOD by Various Months and Conditions (Calculated using EW BOD Model (Halverson,2013)). | | | | | |
|---|---|---|---|---|---|
| Month | Flow Rate (MGD) | Influent BOD (mg/L) | Total HRT | Predicted Effluent (mg/L) | Conditions |
| | 5.9 | 45 | 2.19 | 28 | BOD=95th Percentile of Month |
| | 5.9 | 18 | 2.19 | 12.3 | Median BOD from TW at point 8 |
| | 5.2 | 18 | 2.41 | 15 | 95th Percentile Monthly flow, Median BOD |
| Jan/Feb | 3.2 | 28 | 3.78 | 15 | 75th Percentile flow and 75th Percentile BOD Concentration |
| | 5.9 | 50 | 2.19 | 36 | BOD=95th Percentile of Month |
| | 5.9 | 22 | 2.19 | 17 | Median BOD from TW at point 8 |
| | 5.8 | 22 | 2.19 | 20 | 95th Percentile Monthly flow, Median BOD |
| Mar | 4.3 | 28 | 2.89 | 22 | 75th Percentile flow and 75th Percentile BOD Concentration |
| | 5.9 | 53 | 2.19 | 37 | BOD=95th Percentile of Month |
| | 5.9 | 25 | 2.19 | 18 | Median BOD |
| | 5.5 | 25 | 2.19 | 22 | 95th Percentile Monthly flow, Median BOD |
| Apr | 3.7 | 30 | 3.36 | 21 | 75th Percentile flow and 75th Percentile BOD Concentration |
| | 5.9 | 112 | 2.19 | 70 | BOD=95th Percentile of Month |
| | 5.9 | 80 | 2.19 | 50 | Median BOD |
| | 3.8 | 80 | 3.19 | 41 | 95th Percentile Monthly flow, Median BOD |
| May | 2.3 | 75 | 5.49 | 24 | 75th Percentile flow and 75th Percentile BOD Concentration |
| | 5.9 | 87 | 2.19 | 33 | BOD=95th Percentile of Month |
| | 5.9 | 50 | 2.19 | 20 | Median BOD |
| | 2.6 | 50 | 4.66 | 10 | 95th Percentile Monthly flow, Median BOD |
| Jun | 1.55 | 55 | 8.06 | 6 | 75th Percentile flow and 75th Percentile BOD Concentration |
| | 5.9 | 58 | 2.19 | 21 | BOD=95th Percentile of Month |
| | 5.9 | 40 | 2.19 | 15 | Median BOD |
| | 1.6 | 40 | 7.56 | 5 | 95th Percentile Monthly flow, Median BOD |
| Jul | 1.3 | 48 | 7.94 | 5 | 75th Percentile flow and 75th Percentile BOD Concentration |
| | 5.9 | 58 | 2.19 | 19 | BOD=95th Percentile of Month |
| | 5.9 | 35 | 2.19 | 12 | Median BOD |
| | 1.5 | 35 | 8.06 | 4 | 95th Percentile Monthly flow, Median BOD |
| Aug | 1.3 | 45 | 9.3 | 4 | 75th Percentile flow and 75th Percentile BOD Concentration |
| | 5.9 | 65 | 2.19 | 25 | BOD=95th Percentile of Month |
| | 5.9 | 45 | 2.19 | 18 | Median BOD |
| | 1.5 | 45 | 8.06 | 6 | 95th Percentile Monthly flow, Median BOD |
| Sep | 1.35 | 52 | 9.3 | 5 | 75th Percentile flow and 75th Percentile BOD Concentration |

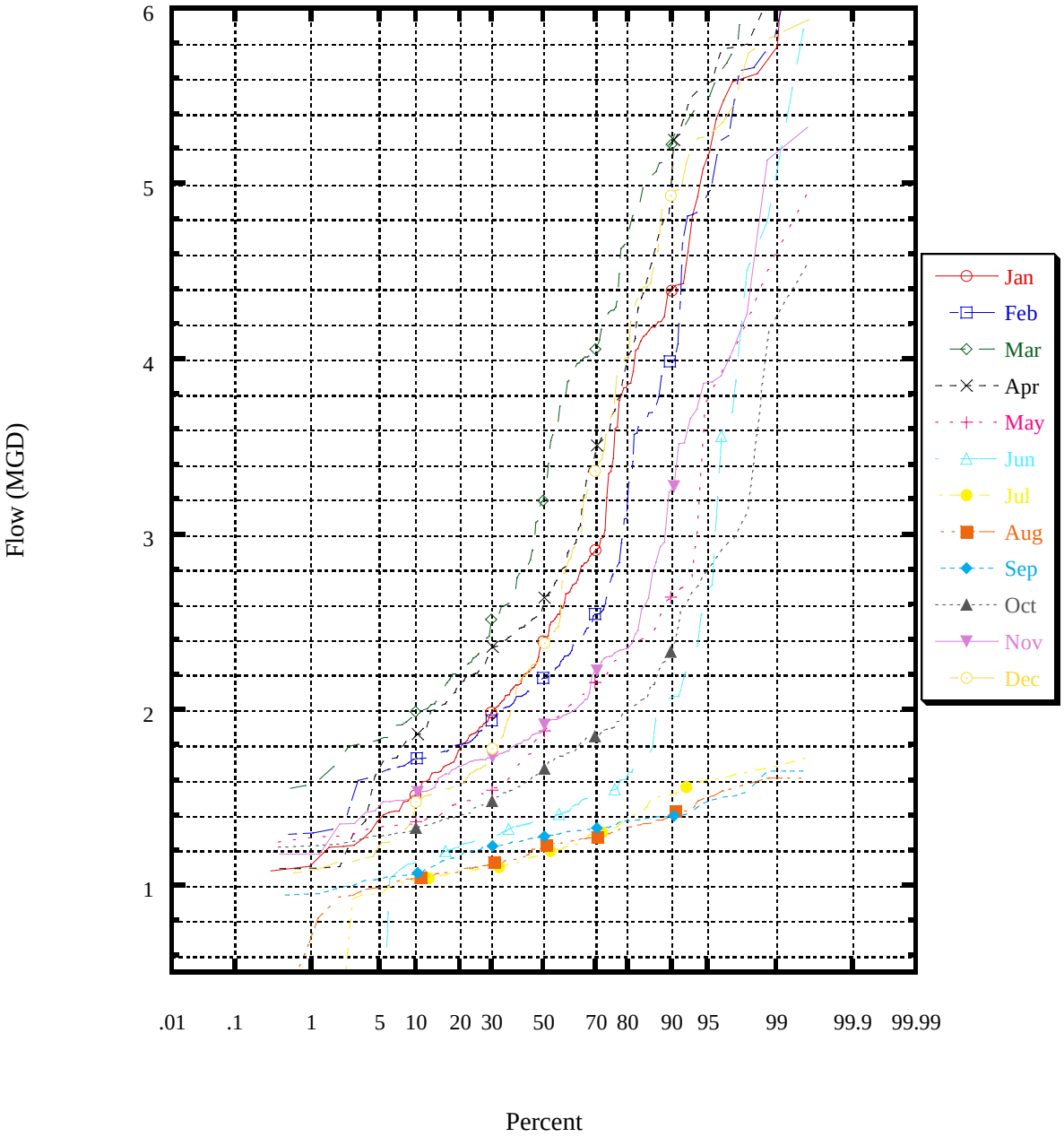
| | | | | | |
|---|---|---|---|---|---|
| | 5.9 | 80 | 2.19 | 16 | BOD=95th Percentile of Month |
| | 5.9 | 55 | 2.19 | 17 | Median BOD |
| | 2.8 | 55 | 4.33 | 8 | 95th Percentile Monthly flow, Median BOD |
| Oct | 1.9 | 65 | 6.37 | 5 | 75th Percentile flow and 75th Percentile BOD Concentration |
| | 5.9 | 99 | 2.19 | 34 | BOD=95th Percentile of Month |
| | 5.9 | 70 | 2.19 | 27 | Median BOD |
| | 3.9 | 70 | 3.19 | 19 | 95th Percentile Monthly flow, Median BOD |
| Nov | 2.3 | 75 | 5.49 | 10 | 75th Percentile flow and 75th Percentile BOD Concentration |
| | 5.9 | 93 | 2.19 | 39 | BOD=95th Percentile of Month |
| | 5.9 | 50 | 2.19 | 23 | Median BOD |
| | 5.25 | 50 | 2.41 | 22 | 95th Percentile Monthly flow, Median BOD |
| Dec | 3.6 | 68 | 3.36 | 22 | 75th Percentile flow and 75th Percentile BOD Concentration |

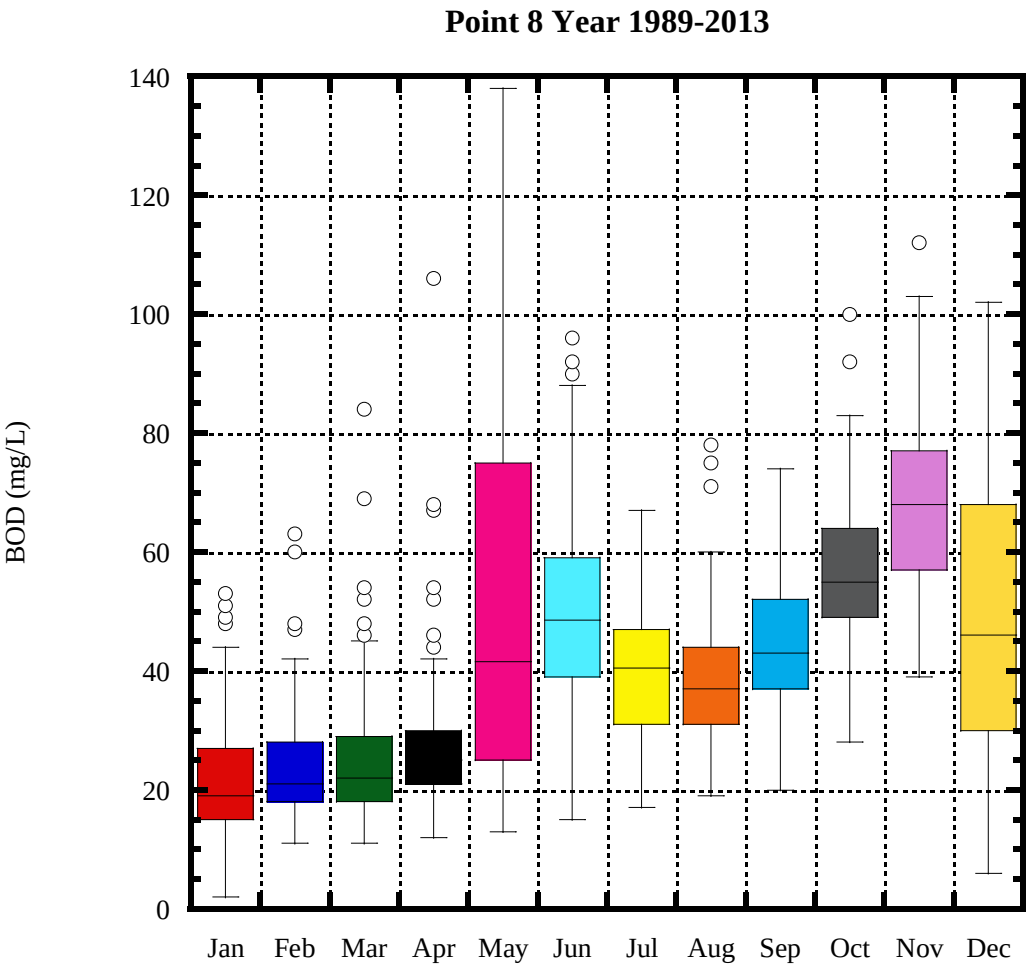

95th Percentile Monthly flow, Median BOD
Maximum Flow, 95th Percentile BOD
75th Percentile flow and 75th Percentile BOD Concentration
Maximum Flow, Median BOD from TW at point 8
Predicted EW Effluent BOD (mg/L)
70
60
50
40
30
20
10
0
Outfall 001 Limit= 30 mg/L
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec

**Point 8 Years 1989-2013**



**Point 9**


6
5
4
3
2
1
Flow (MGD)
.01
.1
1
5
10
20
30
50
70
80
90
95
99
99.9
99.99
Percent
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Point 8 Year 1989-2013
BOD (mg/L)
140
120
100
80
60
40
20
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

# APPENDIX K – CIP ALTERNATIVE PROJECT DESIGN CRITERIA

| | | Alternative 1 Existing System rehabilitation | Alternative 2 Existing System with Side-stream Treatment | Alternative 3 Existing System with Parallel Treatment |
|---|---|---|---|---|
| **Primary Treatment** | | | | |
| **Primary Clarifiers** | | | | |
| Number | | 2 | 2 | 1 |
| Capacity, each | MGD | 3.0 | 3.0 | 2.0 |
| Size, Diameter | FT | 50 | 50 | 50 |
| **Secondary Treatment** | | | | |
| **Oxidation Ponds** | | | | |
| Number | | 2 | 2 | 2 |
| Acres | | 46 | 46 | 46 |
| Pond 2 Aerators | | | | |
| Number | | 8 | 8 | NA |
| **Treatment Wetlands** | | | | |
| Number | | 7 | 7 | 6 |
| Size | acres | 12 | 12 | |
| **Oxidation Ditch** | | | | |
| Number | | 0 | 1 | 2 |
| Total Volume | MG | NA | 2 | 4 |
| Volume per Basin | MG | NA | 2 | 2 |
| **Secondary Clarifiers** | | | | |
| Number | | 0 | 1 | 2 |
| Capacity | | 0 | 2.0 | 4.0 |
| Diameter, ea | ft | NA | 55 | 55 |
| **Enhancement Wetlands** | | | | |
| Number | | 3 | 3 | 3 |
| Overall area | acres | 33 | 33 | 33 |
| Vegitated area | acres | 8 | 8 | 8 |
| **Disinfection** | | | | |
| **UV Disinfection** | | | | |
| New Firm Capacity | MGD | 5.9 | 5.9 | 5.9 |
| Design UVT | % | **35** | **35** | **55** |
| Design Dose | mJ/cm2 | 35 | 35 | 35 |
| Proposed lamps | Number | 528 | 528 | 336 |
| Wet Weather | | Storage | Storage | Storage |
| Volume | MG | 24 | 24 | 24 |
| Rainfall | MG | 2 to 6 MG | 2 to 6 MG | 2 to 6 MG |

# APPENDIX L – SUMMARY OF CHLORINE AND SULFUR DIOXIDE CHEMICAL USE

| Month/Year | Monthly Ave Flow (MGD) | Average $SO_2$ Use (lbs/day) | Average $SO_2$ Dose (mg/L) | $SO_2$ Peak Daily Use (lbs) | Average $CL_2$ Use (lbs/day) | Average $CL_2$ Dose (mg/L) | $CL_2$ Peak Daily Use (lbs) |
|---|---|---|---|---|---|---|---|
| Jun-10 | 2.17 | 186 | 10.28 | 370 | 220 | 12.16 | 520 |
| Jul-10 | 1.32 | 143 | 12.99 | 210 | 176 | 15.99 | 270 |
| Aug-10 | 1.28 | 160 | 14.99 | 220 | 230 | 21.55 | 360 |
| Sep-10 | 1.37 | 145 | 12.69 | 200 | 341 | 29.84 | 530 |
| Oct-10 | 1.48 | 221 | 17.90 | 400 | 347 | 28.11 | 470 |
| Nov-10 | 2.47 | 233 | 11.31 | 390 | 263 | 12.77 | 470 |
| Dec-10 | 3.52 | 270 | 9.20 | 420 | 275 | 9.37 | 500 |
| AVERAGE | | 194 | | 316 | 265 | | 446 |
| Jan-11 | 2.75 | 205 | 8.94 | 350 | 197 | 8.59 | 340 |
| Feb-11 | 2.51 | 203 | 9.70 | 320 | 189 | 9.03 | 300 |
| Mar-11 | 3.26 | 307 | 11.29 | 510 | 373 | 13.72 | 560 |
| Apr-11 | 2.54 | 220 | 10.39 | 420 | 227 | 10.72 | 420 |
| May-11 | 1.70 | 139 | 9.80 | 170 | 202 | 14.25 | 340 |
| Jun-11 | 1.48 | 118 | 9.56 | 180 | 178 | 14.42 | 250 |
| Jul-11 | 1.18 | 92 | 9.35 | 140 | 190 | 19.31 | 380 |
| Aug-11 | 1.25 | 132 | 12.66 | 180 | 412 | 39.52 | 286 |
| Sep-11 | 1.33 | 143 | 12.89 | 180 | 347 | 31.28 | 540 |
| Oct-11 | 2.00 | 217 | 13.01 | 300 | 362 | 21.70 | 560 |
| Nov-11 | 1.59 | 201 | 15.16 | 290 | 234 | 17.65 | 320 |
| Dec-11 | 1.42 | 145 | 12.24 | 200 | 218 | 18.41 | 380 |
| AVERAGE | . | 177 | | 270 | 261 | | 390 |
| Jan-12 | 2.79 | 213 | 9.15 | 315 | 271 | 11.65 | 360 |
| Feb-12 | 2.03 | 187 | 11.05 | 290 | 252 | 14.88 | 380 |
| Mar-12 | 2.74 | 241 | 10.55 | 340 | 256 | 11.20 | 420 |
| Apr-12 | 3.16 | 231 | 8.77 | 400 | 317 | 12.03 | 580 |
| May-12 | 1.67 | 151 | 10.84 | 220 | 237 | 17.02 | 320 |
| Jun-12 | 1.38 | 132 | 11.47 | 180 | 163 | 14.16 | 380 |
| Jul-12 | 1.19 | 145 | 14.61 | 200 | 137 | 13.80 | 200 |
| Aug-12 | 1.21 | 134 | 13.28 | 190 | 225 | 22.30 | 310 |
| Sep-12 | 1.31 | 145 | 13.27 | 190 | 232 | 21.23 | 320 |
| Oct-12 | 1.37 | 154 | 13.48 | 200 | 199 | 17.42 | 270 |
| Nov-12 | 1.72 | 198 | 13.80 | 310 | 198 | 13.80 | 420 |
| Dec-12 | 3.28 | 238 | 8.70 | 510 | 282 | 10.31 | 830 |
| AVERAGE | | 181 | | 279 | 231 | | 399 |

| Month/Year | Monthly Ave Flow (MGD) | Average $SO_2$ Use (lbs/day) | Average $SO_2$ Dose (mg/L) | $SO_2$ Peak Daily Use (lbs) | Average $CL_2$ Use (lbs/day) | Average $CL_2$ Dose (mg/L) | $CL_2$ Peak Daily Use (lbs) |
|---|---|---|---|---|---|---|---|
| Jan-13 | 2.00 | 179 | 10.73 | 230 | 166 | 9.95 | 240 |
| Feb-13 | 1.86 | 212 | 13.67 | 270 | 217 | 13.99 | 290 |
| Mar-13 | 2.40 | 175 | 8.74 | 230 | 181 | 9.04 | 290 |
| Apr-13 | 1.72 | 150 | 10.46 | 210 | 195 | 13.59 | 290 |
| May-13 | 1.40 | 139 | 11.90 | 210 | 153 | 13.10 | 240 |
| Jun-13 | 1.24 | 166 | 16.05 | 210 | 235 | 22.72 | 390 |
| Jul-13 | 1.10 | 149 | 16.24 | 200 | 287 | 31.28 | 440 |
| Aug-13 | 1.19 | 105 | 10.58 | 280 | 236 | 23.78 | 380 |
| Sep-13 | 1.32 | 96 | 8.72 | 260 | 198 | 17.99 | 670 |
| Oct-13 | 1.37 | 156 | 13.65 | 250 | 237 | 20.74 | 440 |
| Nov-13 | 1.30 | 142 | 13.10 | 210 | 347 | 32.01 | 530 |
| Dec-13 | 1.19 | 120 | 12.09 | 160 | 174 | 17.53 | 320 |
| AVERAGE | | 149 | | 227 | 219 | | 377 |
| Jan-14 | 1.32 | 129 | 11.72 | 180 | 170 | 15.44 | 240 |
| Feb-14 | 2.16 | 213 | 11.82 | 360 | 266 | 14.77 | 490 |
| Mar-14 | 2.28 | 213 | 11.20 | 380 | 266 | 13.99 | 520 |
| Apr-14 | 1.73 | 194 | 13.45 | 260 | 167 | 11.57 | 240 |
| May-14 | 1.41 | 156 | 13.27 | 200 | 170 | 14.46 | 220 |
| Jun-14 | 1.16 | 136 | 14.06 | 190 | 227 | 23.46 | 500 |
| Jul-14 | 1.07 | 75 | 8.40 | 180 | 187 | 20.96 | 470 |
| Aug-14 | 1.18 | 59 | 6.00 | 90 | 158 | 16.05 | 200 |
| Sep-14 | 1.85 | 94 | 6.09 | 160 | 190 | 12.31 | 480 |
| Oct-14 | 1.57 | 142 | 10.84 | 300 | 263 | 20.09 | 770 |
| Nov-14 | 1.67 | 211.3 | 15.17 | 240 | 318.3 | 22.85 | 460 |
| Dec-14 | 3.19 | 284 | 10.67 | 420 | 302 | 11.35 | 460 |
| AVERAGE | | 159 | | 247 | 224 | | 421 |
| Jan-15 | 1.55 | 180 | 13.92 | 320 | 193 | 14.93 | 360 |
| Feb-15 | 1.93 | 203 | 12.61 | 320 | 233 | 14.48 | 410 |
| Mar-15 | 1.77 | 194 | 13.14 | 260 | 191 | 12.94 | 320 |
| Apr-15 | 1.84 | 211 | 13.75 | 280 | 202 | 13.16 | 260 |
| May-15 | 1.29 | 90 | 8.37 | 180 | 87 | 8.09 | 240 |
| AVERAGE | | 176 | | 272 | 181 | | 318 |

# APPENDIX M – UVT DATA AND EVALUATION

# PROJECT MEMORANDUM

| | | | |
|---|---|---|---|
| **Project Name:** | WWTP Improvements Project | **Date:** | June 4, 2015 |
| **Client:** | City of Arcata (LACO) | **Project Number:** | 9913A10 |
| **Prepared By:** | Andrew Salveson | | |
| **Reviewed By:** | Doug Wing | | |
| **Subject:** | Technical Brief - UVT Data Summary and Implications | | |
| **Distribution:** | LACO, City, File | | |

This technical brief reviews several UV transmittance (UVT) data sets, provides a graphical comparison of those data sets, and evaluates the potential implications. Recommendations for additional sampling are also provided.

## 1.0 UVT DATA

The Carollo team was provided with several UVT data sets:

- Sample Dates: 2008, 2011, and 2015 (current).
- Sample Locations: 8, 8-3, 9, and 15.

The sample locations are shown in Figure 1. Point 15 is the Hauser effluent, whereas Points 8, 8-3, and 9, as we interpret the locations, all represent essentially the same location in the treatment process, which is after the treatment wetlands but before the enhancement marshes. The UVT data is presented in Figures 2 to 5.

## 2.0 DATA ANALYSIS

Our review of this data set results in both questions and answers, and more data is needed. We propose the following items for discussion with the City:

- Points 8, 8-3, and 9 have consistently had a low UVT in the ~20% range (Figure 2 and Figure 3). The higher UVT using one UVT meter in 2011 may be the result of a calibration issue.
- Point 15 has had a UVT of ~40% to ~55%, with consistent data in 2011, but a concerning downward trend in 2015. Something has changed within the process treatment train which is driving the UVT down as part of the latest testing. It may be that flows to the enhancement marshes were chlorinated, which may have reduced increased UVT by oxidizing soluble organic matter. We are in need of feedback from the City.
- The UV system is currently considered for implementation after Point 15, and thus the UVT data from Point 15 is most relevant. If the current downward UVT trend at Point 15 continues, then the new UV system will be quite expensive to implement. Further, the UVT at Point 15 is currently well below the UVT value in the new permit.

- The increase in UVT from Points 8, 8-3, and 9 to Point 15 is substantial and must be better understood. Is the UVT increase purely a function of biological activity and filtration through the Hauser Marsh? Was there (or is there) any other type of treatment that occurs after Points 8, 8-3, and 9 but before the end of the enhancement marshes?

## 3.0 RECOMMENDATIONS

It is recommended that the UVT sampling at location 15 be expanded to include testing after the treatment wetlands, at either points 8 or 9, prior to the chlorine contact basin. Further, we suggest testing of UVT as it enters the Hauser Marsh.




| LOCATION | SAMPLE ID # |
|---|---|
| Influent Wet Well | 1 |
| Clarifier | 2 |
| Oxidation Pond 1 Effluent (South) | 3 |
| Treatment Wetland 1 Influent (2 weirs) | 4-1 |
| Treatment Wetland 2 Influent (2 weirs) | 4-2 |
| Treatment Wetland 3 Influent | 4-3 |
| Treatment Wetland 4 Influent | (4-1) |
| Treatment Wetland 5 Influent | 4-5 |
| Treatment Wetland 6 Influent | 4-6 |
| Junction Box 1 (TW 1-4 combo box) | 8 |
| Treatment Wetland 1 Effluent (4 weirs) | 8-1 |
| Treatment Wetland 2 Effluent (4 weirs) | 8-2 |
| Treatment Wetland 3 Effluent (4 weirs) | 8-3 |
| Treatment Wetland 4 Effluent | 6-B |
| Treatment Wetland 5 Effluent (3 weirs) | 8-5 |
| Treatment Wetland 6 Effluent (3 weirs) | 8-6 |
| Chlorine Contact Basin Influent (TW 1-6) | 9 |
| Chlorine Contact Basin Influent (TW 5-6) | 9-B |
| Inside Chlorine Contact Basin | 10 |
| Allen Wetland Influent (v-notch weir) | 11 |
| Allen Wetland Effluent | 12 |
| Gearheart Wetland Influent | 13 |
| Gearheart Wetland Effluent | 14 |
| Hauser Wetland Influent | 14 |
| Hauser Wetland Effluent | 15 |
| Bay Discharge | 16 |

**Figure III- 2. Locations and labels for sampling points through the AWTF.**

**Figure 1 – Sample Locations**

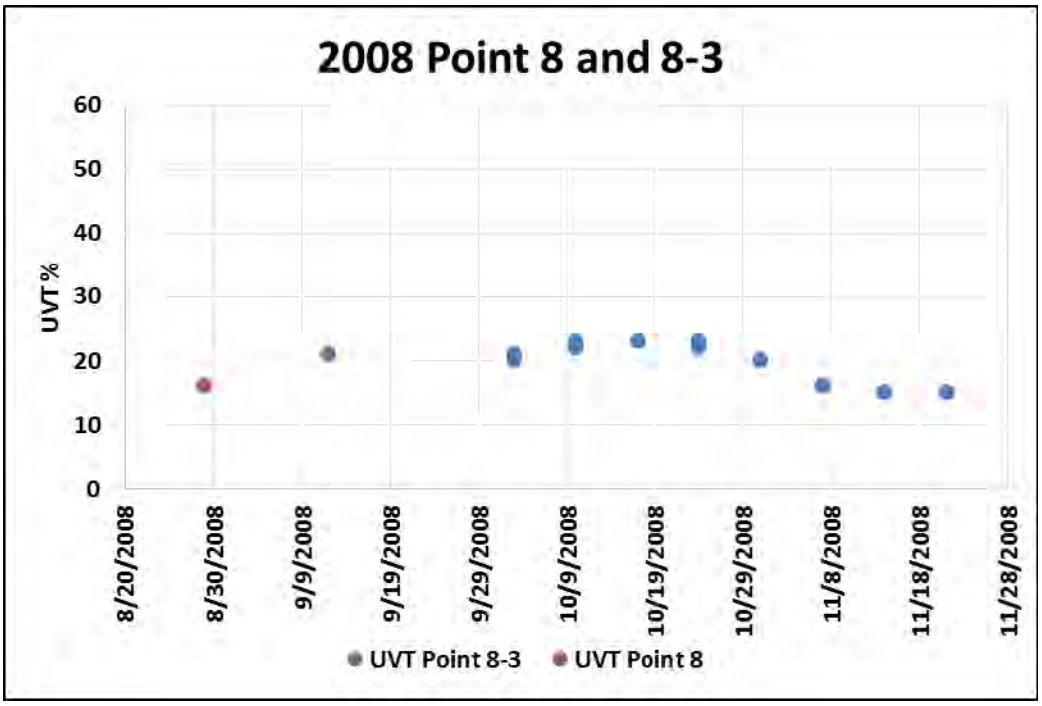



**Figure 2 – 2008 Data, Points 8 and 8-3**

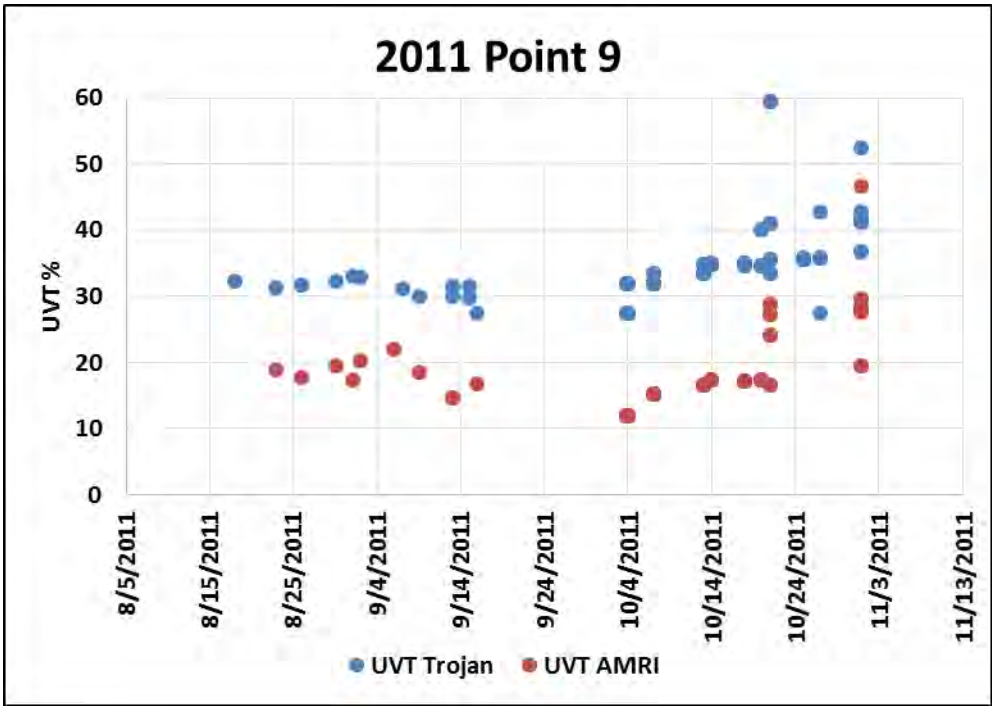



**Figure 3 – 2011 Data, Point 9**

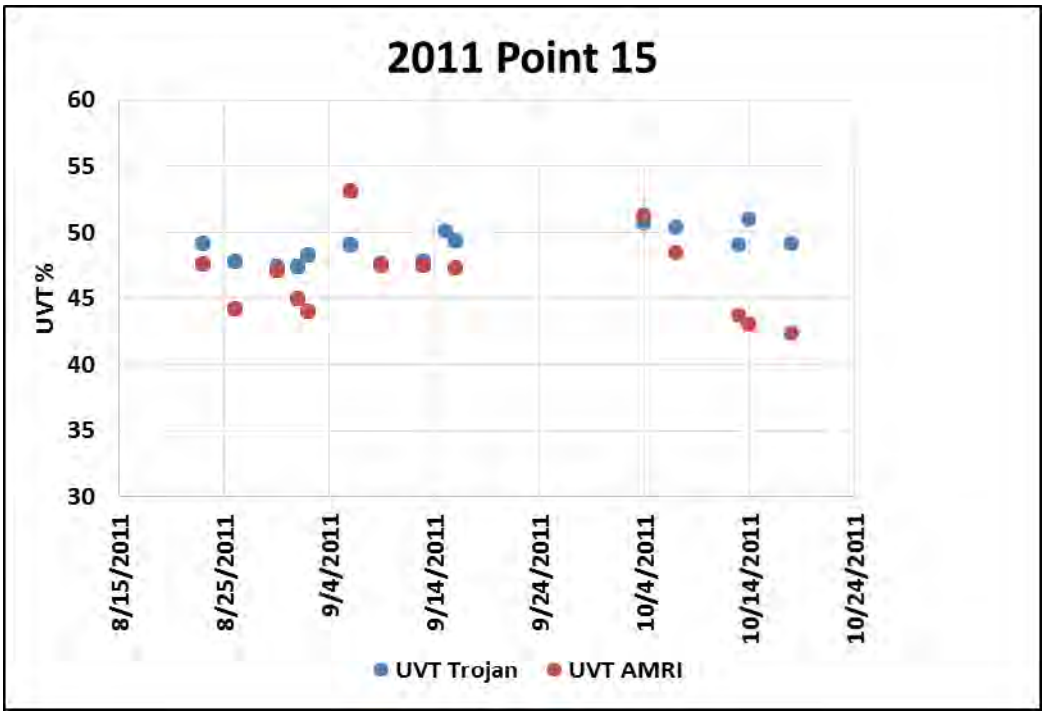



**Figure 4 – 2011, Point 15**

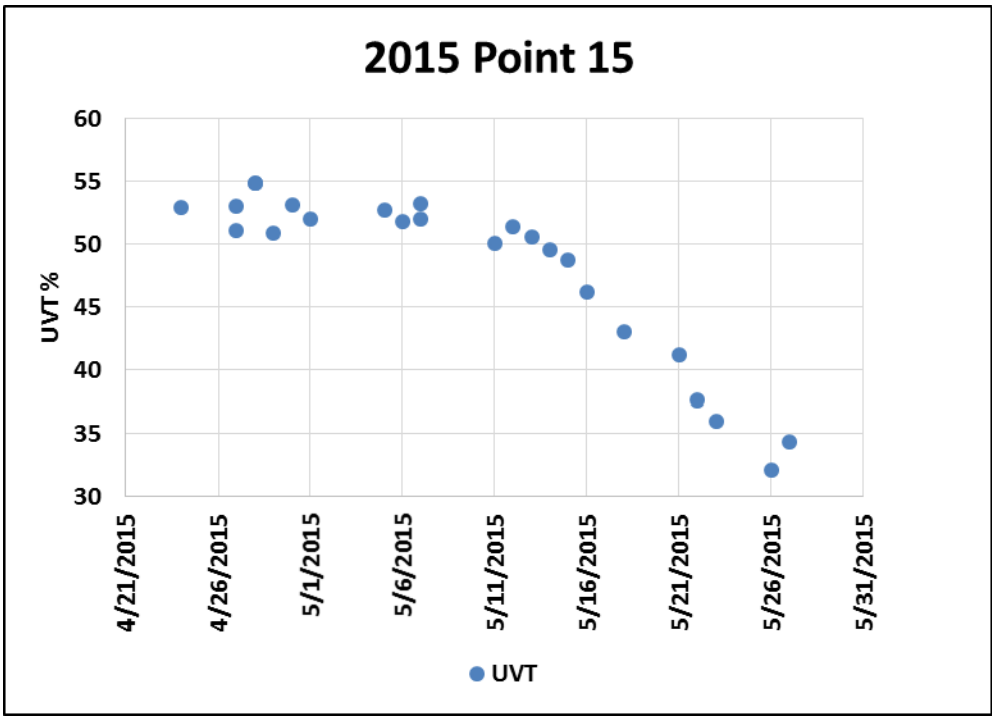


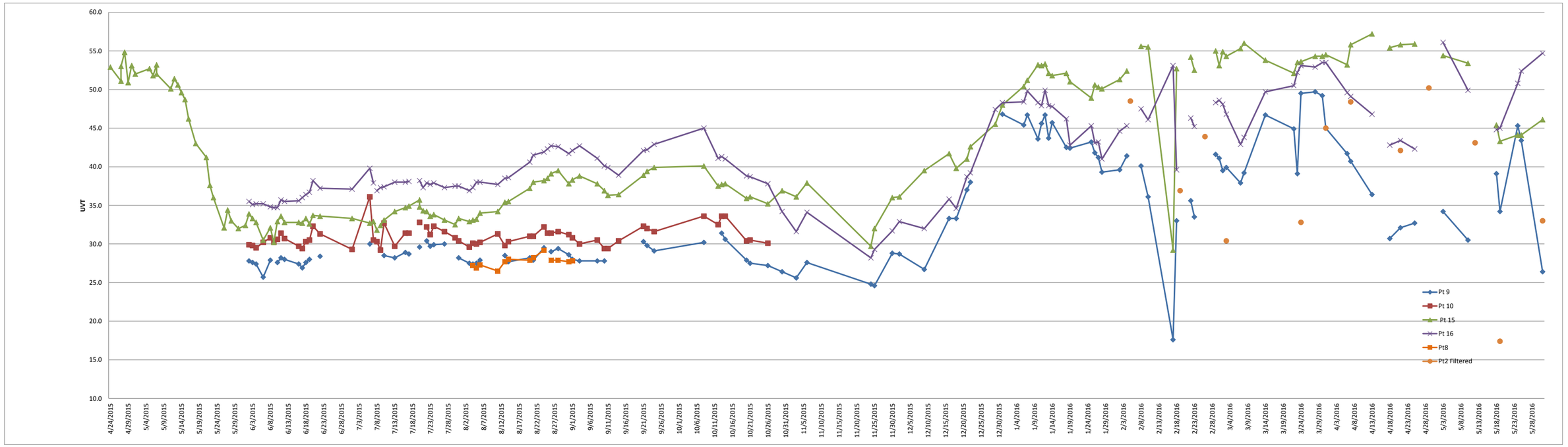

**Figure 5 – 2015, Point 15**

**Prepared By:**

Andrew Salveson

This is where the engineer digital seal will be placed.

Appendix M, UVT Data
City of Arcata
Wastewater Treatment Facility Improvements Project



# APPENDIX N – 2011 PILOT UV DISINFECTION TEST REPORT

# MEMO

From: Arcata Marsh Research Institute

Date: November 2, 2011

---

# UV Disinfection of the City of Arcata's treated wastewater

## *Purpose*

Presently, UV disinfection is being considered to replace chlorine disinfection. Alternative sites for UV disinfection are being considered depending upon permitting requirements. The purpose of studying UV disinfection at multiple locations is to provide information that can be used to prove effectiveness and to design a full-system UV disinfection process. Continuing to disinfect with a chlorine-based system will produce disinfection byproducts that are not removed in the dechlorination process and are known human and ecological toxins. These disinfection byproducts have been identified in Arcata's effluent. The following list states the multipurpose goals of this UV pilot system.

- City of Arcata treats their wastewater with the lowest impact possible to meet all existing permit requirements (for disinfection permit limits see Table 1).
- Eliminating the chlorination disinfection system eliminates toxic byproducts and human hazards associated with chlorine usage.
- Options for disinfection are Point 9, a mixture of Point 9 and Point 15, and Point 15.
- Installation of UV disinfection at Point 001 is redundant when disinfection has been achieved at Point 002. Therefore, disinfection should be focused at Point 002. Additional water quality limits (BOD, TSS, Ammonia, metals etc) should be argued for and implemented at a final discharge point (Pt 001, or Pt 003 – to McDaniels Slough).
- Installation of UV disinfection at Point 001 while chlorinating at Point 002 does not eliminate the delivery of toxic byproducts to the Tertiary Constructed Wetlands (TCW). If the TCW are decided to be Waters of the State then fresh water toxicity limits from chlorination will be a difficult permit limit to meet.

**Table 1: City of Arcata coliform permit limits at Outfall 001 and 002.**

| Permit location | Permit limit | Units | Monthly Average | Daily Maximum |
|---|---|---|---|---|
| Outfall 001 | Fecal Coliform | MPN/100mL | 14 | 43 |
| Outfall 002 | Total Coliform | MPN/100mL | 23 | 230 |

**Water Quality Objectives**

The North Coast Water Quality Control Board defines water quality objectives for (1) shellfish growing areas and (2) watersheds in the ***North Coast Basin Plan*** (Plan)**.** Objectives for shellfish growing waters (applied within the Bay waters) state "*the geometric mean for fecal coliform shall not exceed 14 MPN per 100 ml and that the 90th percentile value for fecal coliform shall not exceed 43 MPN per 100 ml*." This Study applied the 90th percentile value of 43 MPN in the interpretation analyses of bay water samples.

## *Ultraviolet Disinfection – Background Information*

The use of ultraviolet disinfection is an environmentally responsible, convenient, safe, and cost-effective way to disinfect municipal wastewater discharge. UV disinfection performance is equal to chlorine. The effluent easily meets NPDES permit requirements and is a more effective viralcide than chlorine. As a result, adequate disinfection is provided, permit requirements are met, and local aquatic life is protected. By reducing reliance on chlorine, the potential for accidental worker and/or citizen exposure is reduced.

## Advantages

**Safety:** UV disinfection is safer than wastewater treatment systems that rely on chlorine gas. By eliminating transport and handling of large quantities of a hazardous chemical, the UV system reduces potential liability for worker/community exposure. Studies also suggest that UV disinfection controls viruses and many disease-causing bacteria better than chlorination/dechlorination.

**Simplified Compliance:** UV disinfection can help ease compliance with NPDES permit requirements and Fire Code regulations. Continued use of chlorine would require Arcata to build a new disinfection area incorporating secondary containment and a scrubbing/neutralization system.

**Reduced Effluent Toxicity:** Even at low concentrations, chlorine is toxic to aquatic organisms. Dechlorination only removes chlorine in the free residual form leaving combined forms. Aqueous chlorination practices also generate halogenated organic compounds, which may also be toxic. UV disinfection protects the aquatic habitat of the receiving waters. (Literature citation)

**Operation, Maintenance and Cleaning:** The operation and maintenance of UV disinfection systems is simpler than chlorination/dechlorination systems. UV process monitoring and controls relies on instrumentation that maintains optimum irradiation levels for disinfection. Automatic shutoff values exist to stop flow when conditions for target disinfections are compromised. (Literature citation)

**Chemical of concern:** UV has been demonstrated to reduce and remove a wide range of personal products and pharmaceutical found in domestic wastewater. There is a large body of literature showing the effectiveness of UV light on complex organic compounds in wastewater including endocrine disrupters. UV disinfection system can serve as an effective process to deal with the next group of potential NPDES parameters. (Literature citation)

**Energy Consumption:** The total energy requirement for UV is less than chlorination mostly due to the transportation and handling energy cost. UV has the potential to use the electricity generated from anaerobic digesters on-site. Presently Arcata does not use biogas for electrical power production.

# UV Disinfection Studies

Currently, an open channel Trojan UV3000 system is being used to test disinfection of the City of Arcata's reclaimed wastewater. Previous studies (Wilson 1996, Ly 2008, Finney et al. 2009, and Garrison 2010) indicate UV disinfection is successful at both current chlorine disinfection locations (Pt 9 and Pt 15). The UV3000 model open-channel configuration believed to be the best model yet tested to handle the typical water quality seen at Pt 9 and Pt 15. Typical design range for industry norms is 20-140 $mJ/cm^2$.

## Past UV Studies

The City of Arcata has invested in 2 previous pilot scale studies (Finney et al. 2009, and Garrison 2010), and 2 bench scale studies (Wilson 1996, and Ly 2008) to determine the efficacy of UV disinfection as a replacement for the use of chlorine.

**Table 2: Summary of previous UV studies at the Arcata Marsh.**

| **Study** | **UV system (Q)** | **Study period;**<br><br>**[# of runs]** | **Point of disinfection; Water quality** |
|---|---|---|---|
| Wilson (1996) | Lifeguard Aquatics, QL-40 (40 Watt bulb); closed vessel, (.96-5 GPM) | Oct. 1994 – Apr. 1995 | Hauser effluent: Turbidity (0.9-6.1 NTU), TSS (0.3-8.2 mg/L), Transmittance (43-58%) |
| UV effectively disinfected all samples at all ranges below permit requirements. Dose ranged 48.4-283.63 $mJ/cm^2$. Note 19% of untreated samples complied with permit requirements. | | | |
| Ly (2007) | Bench-scale Double Helix UV sterilizer, closed vessel; (10 gallon samples) | Aug. – Dec. 2007<br><br>[n=15] | TM 4: TSS (17-35 mg/l), Transmittance (44.8 – 54.7%) |
| Influent FC ranged from 600-11,200 CFU/100ml all UV radiated samples achieved total FC kill and resulted in clean plates. UV dose is estimated to have ranged from 96-153 $mW/cm^2$. | | | |

| | | | |
|---|---|---|---|
| Finney et al. (2009) | Aquionics Inline 40+, closed vessel<br><br>(5-75 gal/min) | Aug. 2010<br><br>[n=5] | Pt 8: Turbidity (38-41 NTU), TSS (27-31 mg/l), Transmittance (16%). Water quality considered too low to achieve disinfection. |
| | | Sept. – Nov. 2010<br><br>[n=45] | TM 3: Turbidity (20-40 NTU), TSS (9-35 mg/l), Transmittance (25%). |
| | | Dec. 2010<br>[n=9] | Hauser: Turbidity (6 NTU), TSS (3 mg/l), Transmittance (49%). |
| Increased TSS correlated with higher turbidity and lower transmittance. FC fairly easy to inactivate, TC harder, TM 3 effluent needed a dose over 200 mJ/cm$^2$. Hauser effluent achieved disinfection at a dose of 100 mJ/cm$^2$. | | | |
| Garrison (2010) | Trojan Fit, model 18AL40 closed vessel<br><br>(0.11 – 1 MGD) | Sept. 2010 – Jan. 2011<br><br>[n = 107] | Pt 8: TSS (15-76 mg/L), Turbidity (10-75NTU), Transmittance @254 nm (22.5-56.3%) |
| The study shows disinfection is achieved at all tested levels of TSS and UVT with varying dosages. Consistent and sufficient disinfection was achieved at 100 mJ/cm$^2$. There was no clear relationship between TSS and effectiveness nor between UVT and effectiveness although both TSS and UVT are considered the main parameters that affect effectiveness. Trojan was unable to provide the dosage equation that may better describe these relationships. | | | |

## Findings:

Garrison (2010) found effective disinfection even though the closed-chamber Trojan Fit met unpredicted issues with solids build-up and flow regulation.

- Accumulated algal solids, unexpected cattail fragments, frogs, snails, and sticks.
- The UV lamps accumulated an opaque film that was described as excessive by the Trojan representative.
- The flow rate used to achieve UV disinfection was often below the designed operating parameters for the unit resulting in laminar flow rather than turbulent flow.

## Recommendations

- Routine maintenance and screening at the influent pump station would reduce the amount of detrital solids entering the disinfection systems.
- Find appropriate cleaning solution for opaque film if it occurs again.
- Closed chamber UV disinfection is not appropriate

# The 2011 UV Project – Testing Point 15 (Hauser) and Point 9 effluent

## *Pilot Study Design*

A Trojan UV3000 pilot-scale UV unit for ultra-violet disinfection is being tested for effectiveness on Arcata Marsh secondary treated effluent. UV disinfection effectiveness is being determined by both the ease of operations and the ability to disinfect total and fecal coliform (TC & FC). The disinfection efficacy at different doses and ease of operations are used as design criteria and in developing operational strategies. The UV unit is located on the berm next to the chlorine contact basin to allow for multiple influent sources (Figure 1).

In order to test the disinfection effectiveness, the UV dose can be altered by changing the flow rate and therefore the residence time. The second way to change the UV dose is to alter the level of power delivered to the water.

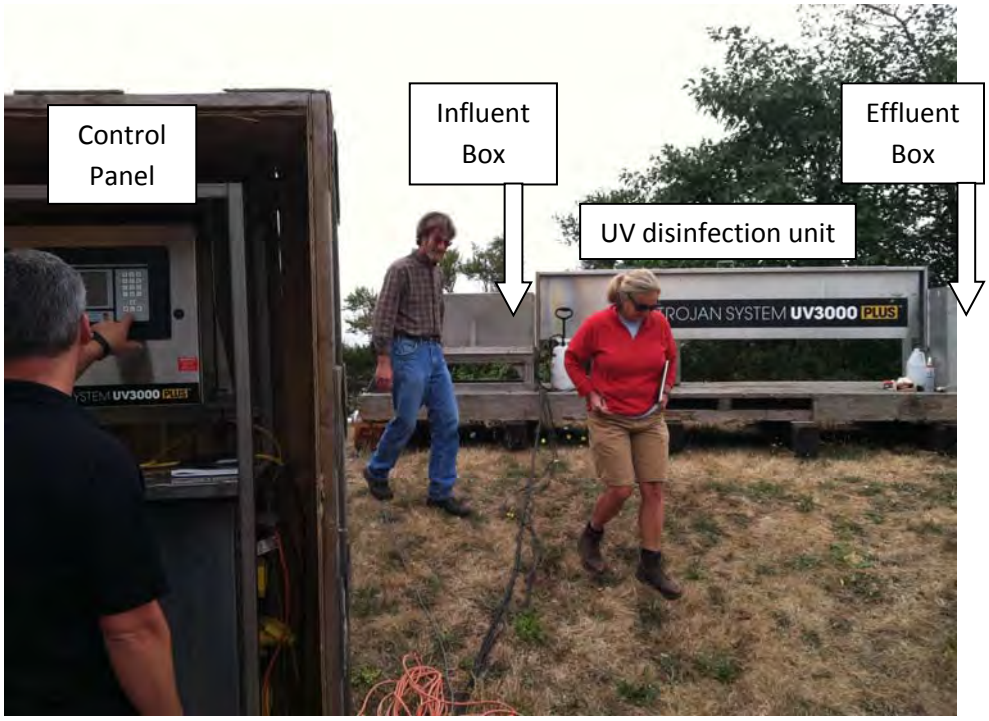



**Figure 1: Trojan UV3000 control panel and disinfection unit.**

The first source of water to be tested is from Hauser Wetland (Point 15). Additional sources of water to be tested are from Point 9 and a mixture from Point 9 and Hauser Wetland. The City of Arcata discharge permit has fecal coliform (FC) and total coliform (TC) limits for Outfall 001/Point 15 and Outfall 002/Point 9 (Table 3).

**Table 3: City of Arcata discharge permit limits for total and fecal coliform.**

| Permit location | Permit limit | Units | Monthly Average | Daily Maximum |
|---|---|---|---|---|
| Outfall 001 | Fecal Coliform | MPN/100mL | 14 | 43 |
| Outfall 002 | Total Coliform | MPN/100mL | 23 | 230 |

The different sources of water have different constituents that affect the ultra-violet transmittance (UVT). UVT is a measure of how well UV wavelengths can penetrate the source water and is effected by the turbidity, suspended and dissolved solids of the sample water. The assessment of each sampling location includes measuring UVT, turbidity, and TSS (Table 4). The Hauser Wetland effluent is typically described with a high UVT, low turbidity and TSS. Point 9 effluent is described with a lower UVT, and greater turbidity and TSS. The testing season, late summer, represents "worst-case" conditions for UVT due to high algal TSS, high turbidity, and increased humic acids (dissolved solids) from plant decomposition. Effective UV disinfection at this time of year provides design parameters that would cover poor water quality conditions.

**Table 4: Water quality parameters for the influent sources to the UV system.**

| Source of UV influent | Dates of operation | UVT range | TSS (mg/L) | Turbidity (NTU) |
|---|---|---|---|---|
| Point 9 | Aug 23 – Sept 16 | 27.5 – 34.9 | 54 – 77* | 40 - 59 |
| Mixture of Pt 9 and Hauser Wetland | | | | |
| Hauser Wetland | Oct 4 - 13 & Oct 25 - 28 | 47.4 – 49.4 | 3 - 6 | 4 - 18 |

On October 7$^{th}$ – 10$^{th}$ or something – there were three days in a row of heavy rainfall. The high value for TSS reflects a spike in solids during this rainfall event.

## *Methods*

Ease of operations is a function of how much time and effort is required by the treatment plant operators to maintain the UV unit as well as how much pre-treatment is necessary to deliver a quality of water that can be effectively disinfected.

Disinfection of coliform is being determined by the effect of UV dose on colony formation (reported in CFU/100mL) in accordance with Standard Methods for the Examination of Water and Wastewater. An alternative method for measuring coliform is the Most Probable Number (MPN) test that yields results in brackets of probable coliform abundance. The MPN test is the reporting standard for the discharge requirement.

The dose of UV light delivered to the water is described by a proprietary equation using flow rate and ultra-violet transmittance (UVT) (Figure 2). At this time of year, the effluent from Hauser Wetland is consistently about 50% UVT and Point 9 is about 30% UVT.

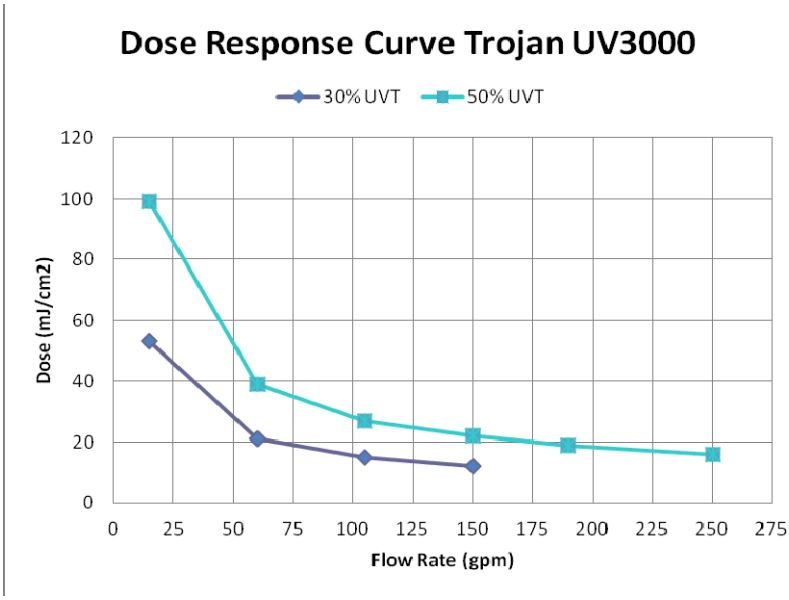



**Figure 2: Dose response curve for Trojan UV3000.**

## *Results and Discussion*

### Maintenance

Weekly visual inspections conducted by AMRI staff and City of Arcata wastewater treatment operators have demonstrated clean bulbs and some accumulation of solids. The clean bulbs were contrasted with the areas of grayish build-up on the bulbs that do not function as a part of the disinfection process and are not reached by the automatic cleaning mechanism (Figure 3). The accumulated solids were comprised of stringy material that may originate in the pipe between Hauser and the UV unit or may

originate in Hauser Wetland itself (Figure 4). Once the influent source changed to Point 9, the influent settling basin showed pebbles and debris collecting. A simple screen was placed in front of the UV chamber to reduce the amount of large particles moving through the disinfection process. Throughout the study, the bulbs remained clean and clear of any noticeable film or build-up.

Operators have indicated that the maintenance time requirements of the UV unit are acceptable. Daily tasks are checking the UV control panel for alarms, checking the flow rate and the level of water in the unit. Additionally, when the unit is being run with Hauser influent, the operators turn off the unit and travel to the Hauser pump station to clean the effluent screen. If the screen is not cleaned daily, or if it accumulates a lot of solids there is a corresponding drop in the flow rate to the UV unit. The weekly visual inspections are demonstrating success and providing confidence in the ability of the UV unit to continue operations without a lot of maintenance.

The accumulation of stringy solids and large solids is potentially problematic, as solids can provide shielding for coliform as they move through the system. The result would be viable coliform on the effluent end of the UV unit. The solution would be a mechanical self-cleaning screen on the influent to the UV disinfection system.



**Figure 3: Visual inspection demonstrating build-up of greyish coating on area of bulbs where the wiper does not reach.**

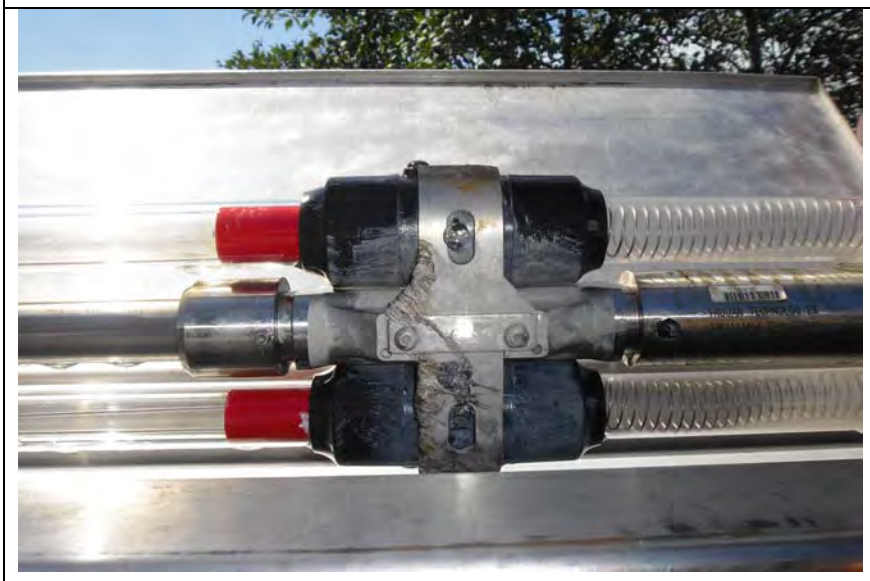


**Figure 4: Visual inspection demonstrating the accumulation of stringy solids on bulb apparatus and very clean bulbs.**

## UV Disinfection Effectiveness receiving Hauser Effluent

Doses were tested ranging from 11-44 mJ/cm$^2$, at flows from 48.8 to 192 gpm, and with UVT of 47-50%. Doses were reported from Trojan after supplying the conditions for flow rate and UVT. Ten sampling events were run from August 23 – September 16, 2011 to assess the disinfection of Hauser Wetland effluent. Samples were not taken at flows lower than about 50 gpm due to difficulties in setting the effluent weir in the UV unit. Each dose was analyzed for Total and Fecal Coliform (TC and FC respectively), TSS, turbidity, temperature, and UVT.

The results for TC were determined to be unreliable because of competition with muccoid colonies causing interference with the growth of TC colonies and a lack of agreement with North Coast Laboratory samples run using the MPN test. The results for FC have been verified by North Coast Laboratory samples run using the MPN test (Figure 5).

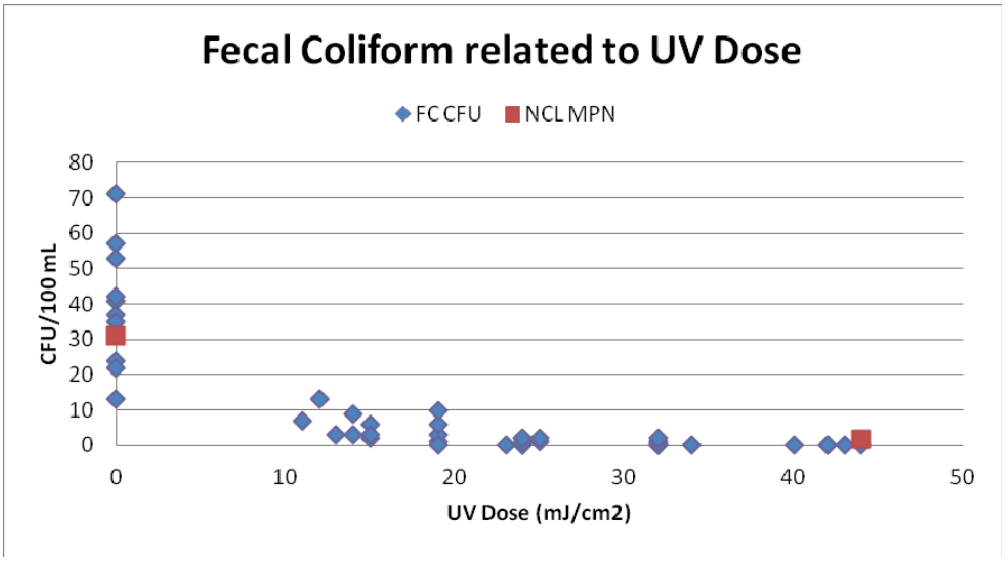



**Figure 5: Fecal coliform colonies in CFU/100mL as related to applying different doses.**

The lowest dose necessary to achieve permit levels for a daily maximum of 43 MPN/100mL was often achieved before disinfection, and was demonstrated by the coliform results at a dose of 0 mJ/cm$^2$ (Figure 5). All FC results were below 20 CFU/100mL. Results below 10 CFU/100mL were seen at doses greater than 20 mJ/cm$^2$.

The Trojan proprietary equation describing UV dose uses UVT and flow rate data. UVT is likely influenced by turbidity, TSS, and dissolved organics. The relationship between UVT, Turbidity, and TSS during the pilot study on Point 9 water is seen in **Error! Reference source not found.**. The distribution of turbidity data across the spectrum of UVT in Figure 6 shows a stronger correlation than that of TSS. As the turbidity of the water decreases the UVT increases.

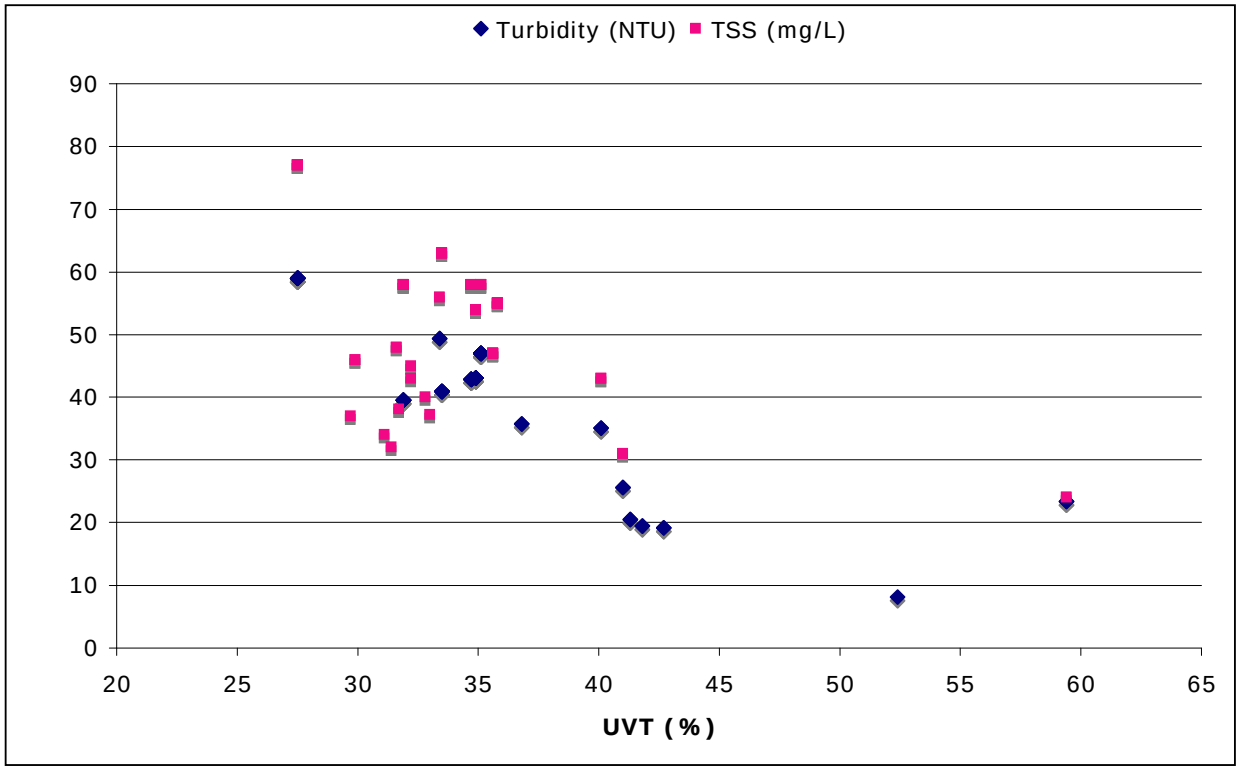



**Figure 6: Ultra-violet transmittance as it relates to TSS and turbidity using Point 9 influent.**

## UV Disinfection Effectiveness receiving Point 9 Effluent

Doses were tested ranging from 20-42.6 mJ/cm$^2$, at flows from 21-132 gpm, and with UVT 27.5-59%. Doses were reported from Trojan after supplying the conditions for flow rate and UVT. Ten sampling events were run from October 4 – November 1, 2011 to assess the disinfection of Point 9 effluent. Samples were not taken at flows lower than 20.8 gpm as this is the low flow rate limit for the machine. Each dose was analyzed for Total and Fecal Coliform (TC and FC respectively), TSS, turbidity, and UVT.

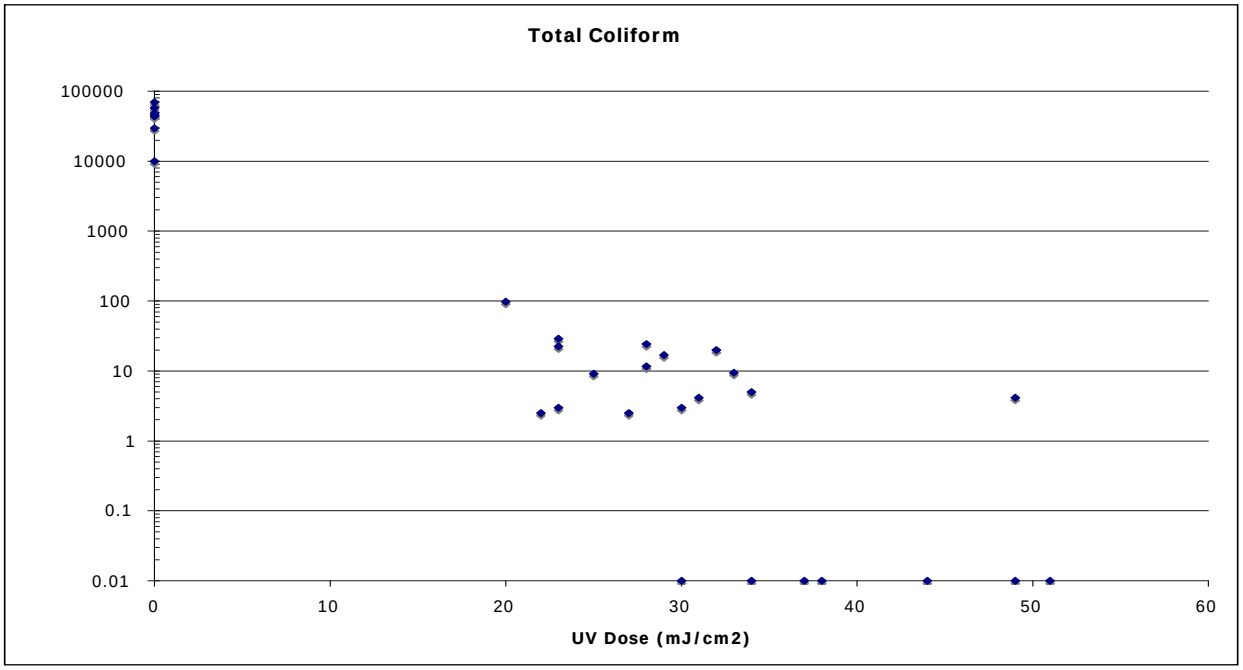



**Figure 7: Total coliform in response to increasing UV dose applied to Point 9 influent. Value of 0.01 coliform is substituted for 0 coliform to use a logarithmic scale.**

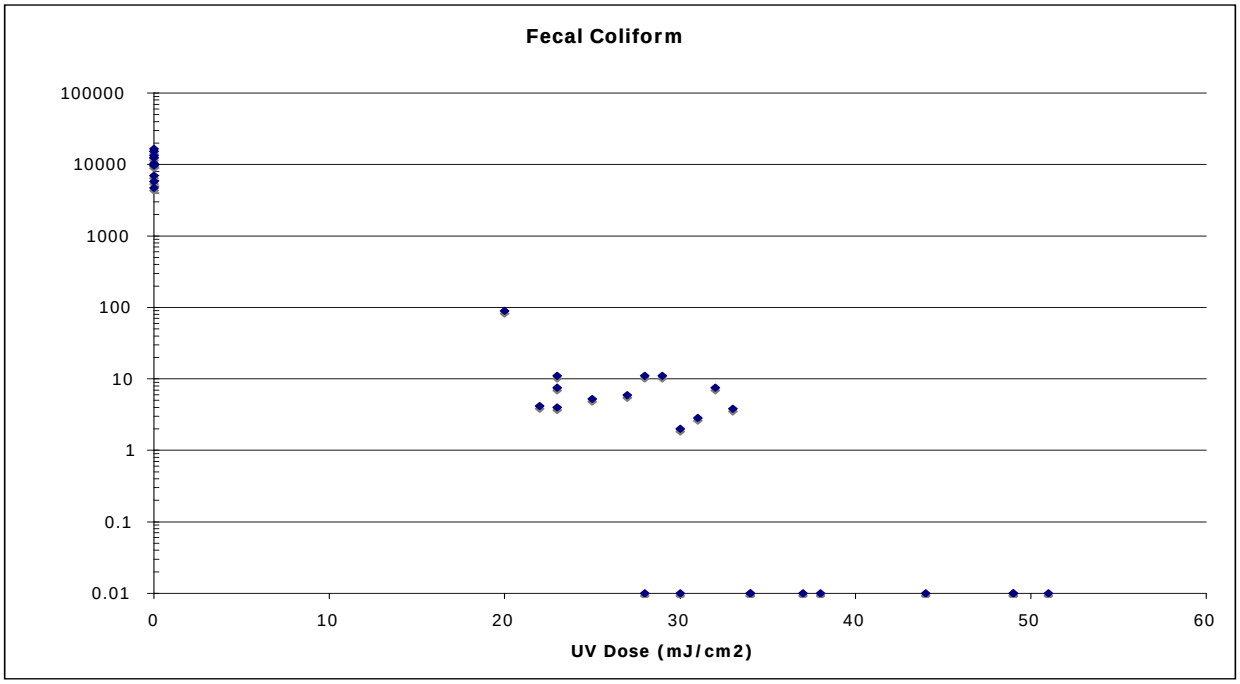



**Figure 8: Fecal coliform in response to increasing UV dose applied to Point 9 influent. Value of 0.01 coliform is substituted for 0 coliform to use a logarithmic scale.**

Total and fecal coliform colonies are reduced to less than 10 CFU/100mL at doses above 35 mJ/cm$^2$. All but one value for CFUs above 35 mJ/cm$^2$ are zero and are reported on the logarithmic scale as 0.01 CFU/100mL.

## *Conclusions*

The open-channel Trojan UV3000 unit was shown to function well given the water quality and conditions of Hauser Wetland effluent (Point 15) and Treatment Marsh effluent (Point 9). Weekly visual inspections demonstrated the functionality of the wiper mechanism in keeping the bulbs clean of any build-up that could obscure the UV bulb.

The observation of stringy solids from Hauser Wetland on the UV bulb apparatus, large suspended solids from Point 9, and noticeable attached growth on the influent box for the UV unit indicates a potential problem for UV disinfection. If such large solids are allowed to pass through the unit, they may shield coliform from UV radiation and therefore not achieve disinfection. The recommendation for solving this issue is to install a mechanical self-cleaning screen to reduce influent solids and adopt a strict cleaning routine to eliminate attached growth.

Fecal coliform levels in Hauser Wetland effluent often meet permit limits without disinfection. UV disinfection of Hauser Wetland effluent at current conditions described by UVT at ~50%, TSS at 3-6 mg/L, and turbidity at 3-4 NTUs, achieves levels below 10 CFU/100mL at doses above 20 mJ/cm$^2$. This low dose is considered the low end of the industry standard for UV disinfection and indicates the effectiveness of UV disinfection of Hauser Wetland effluent.

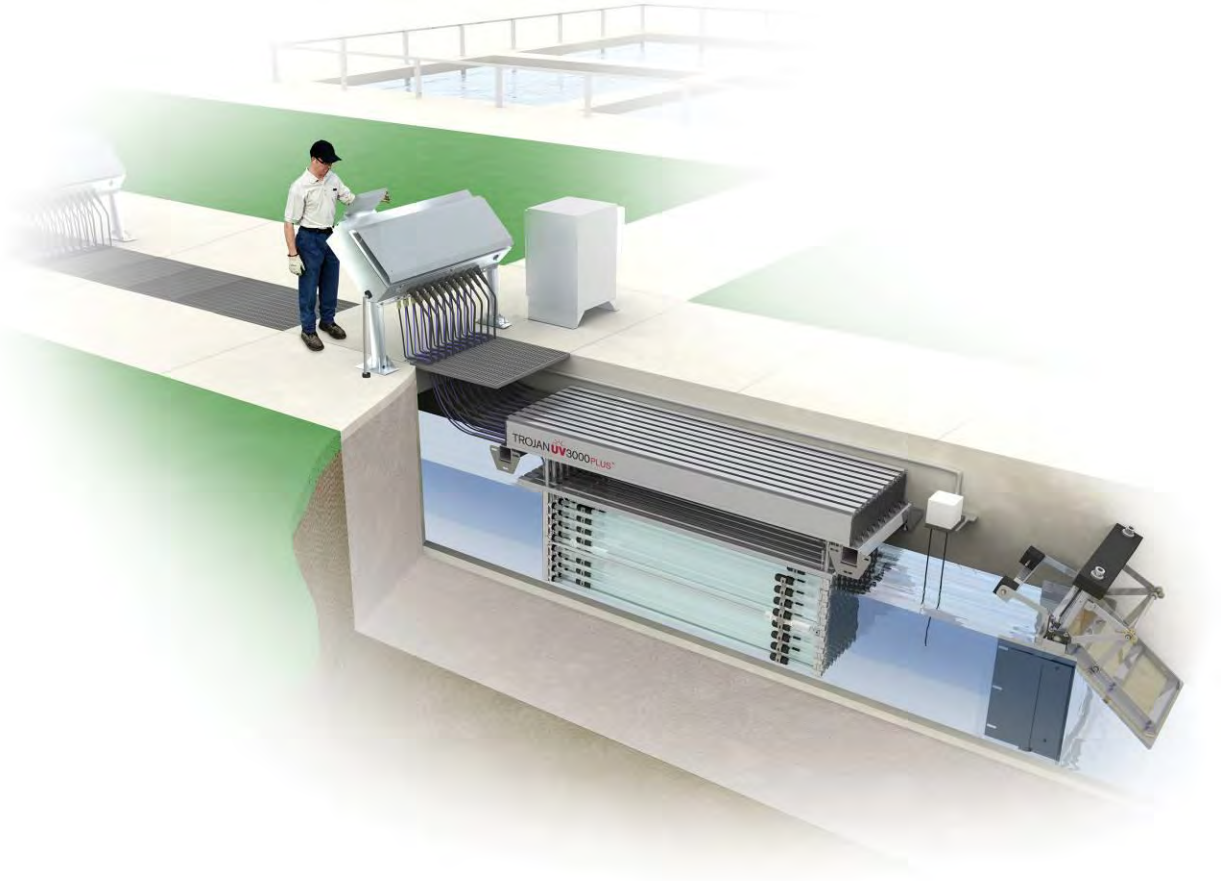
Total and fecal coliform levels in Point 9 effluent are numerous, around $10^4$. UV disinfection of Point 9 effluent at current conditions described by UVT at ~34%, TSS at ~57 mg/L, and turbidity at 44 NTUs, achieves levels below 10 CFU/100mL at doses above 35 mJ/cm$^2$. This dose is at the low end of the industry standard for UV disinfection and indicates the effectiveness of UV disinfection of Point 9 effluent.

# APPENDIX O – UV DISINFECTION EQUIPMENT PROPOSALS

TROJAN UV3000 PLUS™

# PROPOSAL FOR THE CITY OF ARCATA, CA

QUOTE: LJKR1061E
6/16/2015




The TrojanUV3000Plus™ is operating in **over 1300** municipal wastewater plants around the world. Disinfecting **over 17 billion** gallons a day, the TrojanUV3000Plus™ has become the reference standard in the industry.

June 16, 2015

In response to your request, we are pleased to provide the following TrojanUV3000Plus™ proposal for the **Arcata** project.

The TrojanUV3000Plus™ has been shown in over 1300 installations to provide dependable performance, simplified maintenance, and superior electrical efficiency. As explained in this proposal, the system incorporates innovative features to reduce O&M costs, including variable output electronic ballasts to provide dimming capability and Trojan's revolutionary ActiClean-WW™ system – the industry's only online chemical and mechanical quartz sleeve cleaning system. All Trojan installations are supported by a global network of certified Service Representatives providing local service and support.

Please do not hesitate to call us if you have any questions regarding this proposal. Thank you for the opportunity to quote the TrojanUV3000Plus™ and we look forward to working with you on this project.

With best regards,

Jordan Fournier
3020 Gore Road
London, Ontario N5V 4T7
Canada
(519) 457 – 3400 ext. 2193
jfournier@trojanuv.com

**Local Representative:**
David Frost
The Coombs-Hopkins Company
2855 Mitchell Drive
Suite 215, Walnut Creek, CA 94598-1609
USA
(925) 947-6733

# DESIGN CRITERIA

**ARCATA**

| | |
|---|---|
| Peak Design Flow: | **5.9 MGD** |
| UV Transmittance: | **35%** (minimum) |
| Total Suspended Solids: | **50 mg/l** (30 Day Average, grab sample) |
| Disinfection Limit: | **43 fecal coliform per 100 ml**, based on a 1 day Maximum (90%ile) of consecutive daily grab samples |
| Design Dose: | **35,000 µWs/cm$^2$**, bioassay validated |
| Validation Factors: | **0.90** end of lamp life factor (Low-Pressure Amalgam Lamps)<br>**0.95** fouling factor (ActiClean-WW™ Chemical / Mechanical Cleaning System) |

# DESIGN SUMMARY

**QUOTE: LJKR1061E**

Based on the above design criteria, the TrojanUV3000Plus™ proposed consists of:

| | |
|---|---|
| **CHANNEL** (Please reference Trojan layout drawings for details.) | |
| Number of Channels: | **1** |
| Approximate Channel Length Required: | **30 ft** |
| Channel Width Based on Number of UV Modules: | **66 in** |
| Channel Depth Recommended for UV Module Access: | **54 in** |
| **UV MODULES** | |
| Total Number of Banks: | **2** |
| Number of Modules per Bank: | **22** |
| Number of Lamps per Module: | **8** |
| Total Number of UV Lamps: | **352** |
| Maximum Power Draw: | **88 kW** |
| **UV PANELS** | |
| Power Distribution Center Quantity: | **2** |
| System Control Center Quantity: | **1** |
| **MISCELLANEOUS EQUIPMENT** | |
| Level Controller Quantity: | **1** |
| Type of Level Controller: | **Weighted Gate (ALC)** |
| Automatic Chemical / Mechanical Cleaning: | **Trojan ActiClean-WW™** |
| UV Module Lifting Device: | **Davit Crane** |
| On-line UVT Monitor: | **Hach UVAS sc Sensor** |
| Standard Spare Parts / Safety Equipment: | **Included** |
| Other Equipment: | |
| **ELECTRICAL REQUIREMENTS** | |

1. Each Power Distribution Center requires an electrical supply of one (1) 480 Volts, 3 phase, 4 wire (plus ground), 44.9 kVA.
2. The Hydraulic System Center requires an electrical supply of one (1) 480 Volts, 3 phase, 3 wire (plus ground), 2 kVA.
3. The System Control Center requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 15 Amps.
4. The Online UVT Monitor requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 1 Amp.
5. Electrical disconnects required per local code are not included in this proposal.

# COMMERCIAL INFORMATION

**Total Capital Cost: $750,000 (US$)**

This price excludes any taxes that may be applicable and is valid for 90 days from the date of this letter.

# OPERATING COST ESTIMATE

## Operating Conditions

Average Flow: **2.0 MGD**
Yearly Usage: **8760 hours**
UV Transmittance: **35%**

| Power Requirements | | Lamp Replacement | |
|---|---|---|---|
| Average Power Draw: | **44 kW** | Number lamps per year: | **129** |
| Cost per kW hour: | **$0.10** | Price per lamp: | **$250** |
| **Annual Power Cost:** | **$38,544** | **Annual Lamp Replacement Cost:** | **$32,250** |
| **Total Annual O&M Cost: $70,794** | | | |

This cost estimate is based on the average flow and UV transmittance listed above. Actual operating costs may be lower due to the TrojanUV3000Plus™ automatic dose pacing control system. As UV demand decreases, by a change in operating conditions, the power level of the lamps decreases accordingly. The dose pacing system minimizes equipment power levels while the target UV dose is maintained to ensure disinfection at all times.

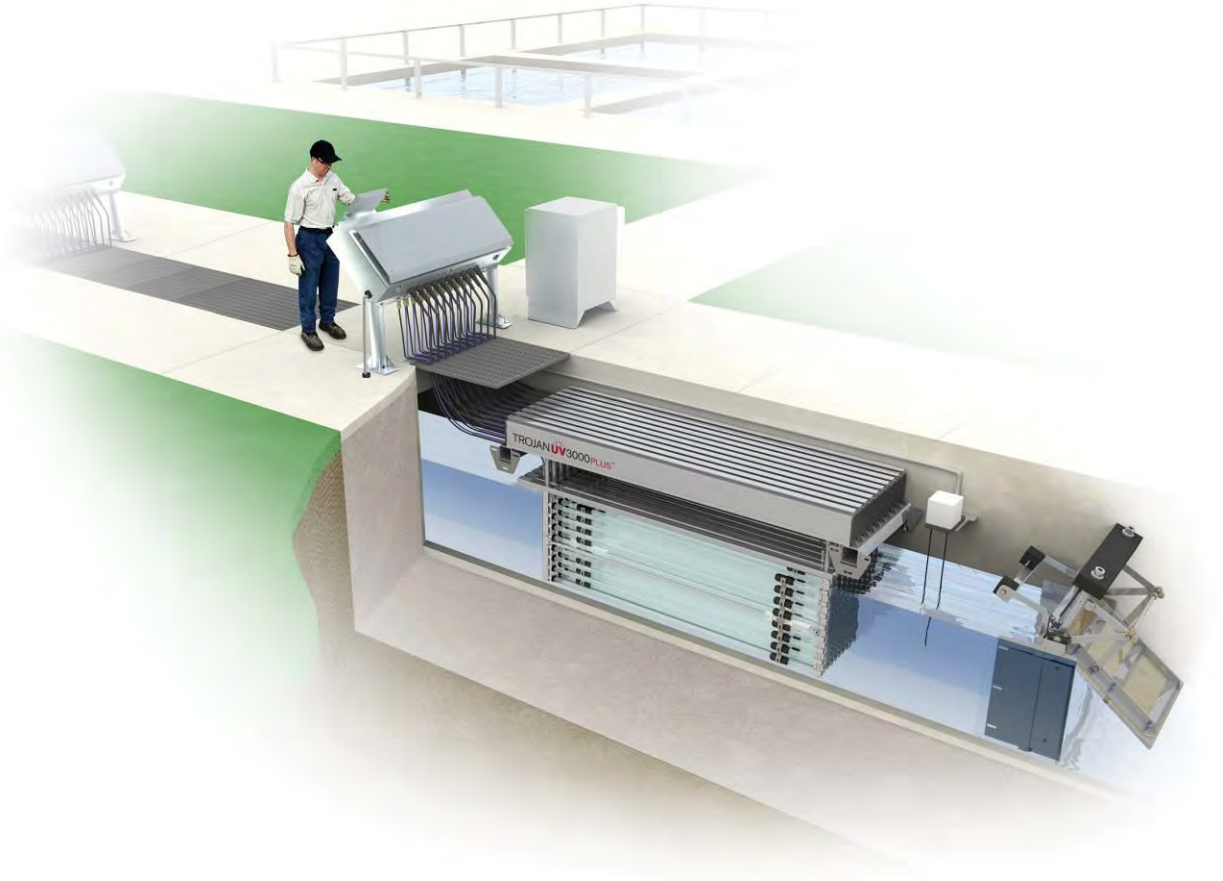
# EQUIPMENT WARRANTEES

1. Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, which ever comes first.
2. UV lamps purchased are warranted for 12,000 hours of operation or 3 years from shipment, whichever comes first. The warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge.
3. Electronic ballasts are warranted for 5 years, pro-rated after 1 year.

TROJAN UV3000 PLUS™

# PROPOSAL FOR THE CITY OF ARCATA, CA

QUOTE: LJKR1061G
6/16/2015




The TrojanUV3000Plus™ is operating in **over 1300** municipal wastewater plants around the world. Disinfecting **over 17 billion** gallons a day, the TrojanUV3000Plus™ has become the reference standard in the industry.

June 16, 2015

In response to your request, we are pleased to provide the following TrojanUV3000Plus™ proposal for the **Arcata** project.

The TrojanUV3000Plus™ has been shown in over 1300 installations to provide dependable performance, simplified maintenance, and superior electrical efficiency. As explained in this proposal, the system incorporates innovative features to reduce O&M costs, including variable output electronic ballasts to provide dimming capability and Trojan's revolutionary ActiClean-WW™ system – the industry's only online chemical and mechanical quartz sleeve cleaning system. All Trojan installations are supported by a global network of certified Service Representatives providing local service and support.

Please do not hesitate to call us if you have any questions regarding this proposal. Thank you for the opportunity to quote the TrojanUV3000Plus™ and we look forward to working with you on this project.

With best regards,

Jordan Fournier
3020 Gore Road
London, Ontario N5V 4T7
Canada
(519) 457 – 3400 ext. 2193
jfournier@trojanuv.com

**Local Representative:**
David Frost
The Coombs-Hopkins Company
2855 Mitchell Drive
Suite 215, Walnut Creek, CA 94598-1609
USA
(925) 947-6733

# DESIGN CRITERIA

**ARCATA**

| | |
|---|---|
| Peak Design Flow: | **5.9 MGD** |
| UV Transmittance: | **35%** (minimum) |
| Total Suspended Solids: | **50 mg/l** (30 Day Average, grab sample) |
| Disinfection Limit: | **43 fecal coliform per 100 ml**, based on a 1 day Maximum (90%ile) of consecutive daily grab samples |
| Design Dose: | **35,000 µWs/cm$^2$**, bioassay validated |
| Validation Factors: | **0.90** end of lamp life factor (Low-Pressure Amalgam Lamps)<br>**0.95** fouling factor (ActiClean-WW™ Chemical / Mechanical Cleaning System) |
| Redundancy: | **50%** |

# DESIGN SUMMARY

**QUOTE: LJKR1061G**

Based on the above design criteria, the TrojanUV3000Plus™ proposed consists of:

| | |
|---|---|
| **CHANNEL** (Please reference Trojan layout drawings for details.) | |
| Number of Channels: | **1** |
| Approximate Channel Length Required: | **42 ft** |
| Channel Width Based on Number of UV Modules: | **66 in** |
| Channel Depth Recommended for UV Module Access: | **54 in** |
| **UV MODULES** | |
| Total Number of Banks: | **3 (2 duty, 1 redundant)** |
| Number of Modules per Bank: | **22** |
| Number of Lamps per Module: | **8** |
| Total Number of UV Lamps: | **528** |
| Maximum Power Draw: | **132 kW** |
| **UV PANELS** | |
| Power Distribution Center Quantity: | **3** |
| System Control Center Quantity: | **1** |
| **MISCELLANEOUS EQUIPMENT** | |
| Level Controller Quantity: | **1** |
| Type of Level Controller: | **Weighted Gate (ALC)** |
| Automatic Chemical / Mechanical Cleaning: | **Trojan ActiClean-WW™** |
| UV Module Lifting Device: | **Davit Crane** |
| On-line UVT Monitor: | **Hach UVAS sc Sensor** |
| Standard Spare Parts / Safety Equipment: | **Included** |
| Other Equipment: | |

**ELECTRICAL REQUIREMENTS**

1. Each Power Distribution Center requires an electrical supply of one (1) 480 Volts, 3 phase, 4 wire (plus ground), 44.9 kVA.
2. The Hydraulic System Center requires an electrical supply of one (1) 480 Volts, 3 phase, 3 wire (plus ground), 2 kVA.
3. The System Control Center requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 15 Amps.
4. The Online UVT Monitor requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 1 Amp.
5. Electrical disconnects required per local code are not included in this proposal.

# COMMERCIAL INFORMATION

**Total Capital Cost: $1,090,000 (US$)**

This price excludes any taxes that may be applicable and is valid for 90 days from the date of this letter.

# OPERATING COST ESTIMATE

## Operating Conditions

Average Flow: **2 MGD**
Yearly Usage: **8760 hours**
UV Transmittance: **35%**

| Power Requirements | | Lamp Replacement | |
|---|---|---|---|
| Average Power Draw: | **44 kW** | Number lamps per year: | **129** |
| Cost per kW hour: | **$0.10** | Price per lamp: | **$250** |
| **Annual Power Cost:** | **$38,544** | **Annual Lamp Replacement Cost:** | **$32,250** |
| **Total Annual O&M Cost: $70,794** | | | |

This cost estimate is based on the average flow and UV transmittance listed above. Actual operating costs may be lower due to the TrojanUV3000Plus™ automatic dose pacing control system. As UV demand decreases, by a change in operating conditions, the power level of the lamps decreases accordingly. The dose pacing system minimizes equipment power levels while the target UV dose is maintained to ensure disinfection at all times.

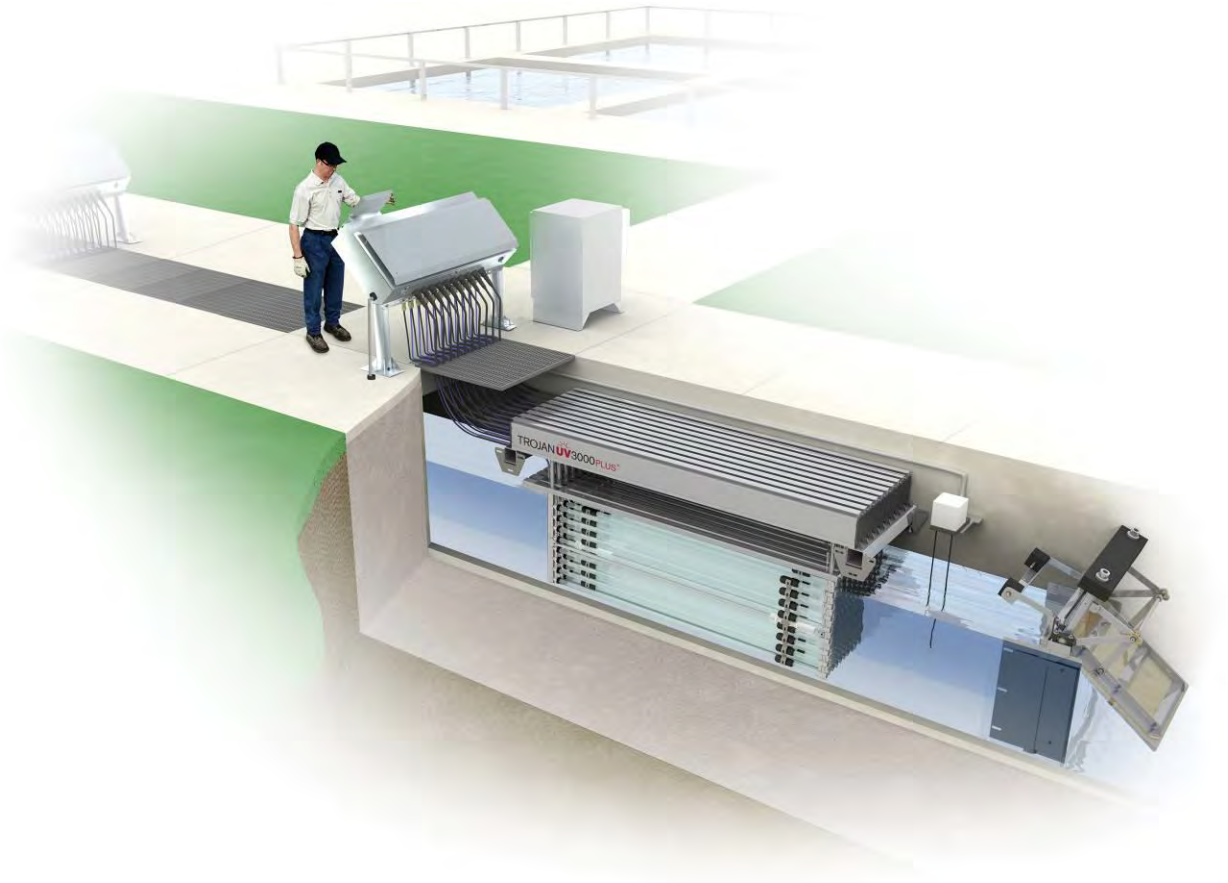
# EQUIPMENT WARRANTEES

1. Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, which ever comes first.
2. UV lamps purchased are warranted for 12,000 hours of operation or 3 years from shipment, whichever comes first. The warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge.
3. Electronic ballasts are warranted for 5 years, pro-rated after 1 year.

TROJAN UV3000 PLUS™

# PROPOSAL FOR THE CITY OF ARCATA, CA

QUOTE: LJKR1061D
6/16/2015




The TrojanUV3000Plus™ is operating in **over 1300** municipal wastewater plants around the world. Disinfecting **over 17 billion** gallons a day, the TrojanUV3000Plus™ has become the reference standard in the industry.

June 16, 2015

In response to your request, we are pleased to provide the following TrojanUV3000Plus™ proposal for the **Arcata** project.

The TrojanUV3000Plus™ has been shown in over 1300 installations to provide dependable performance, simplified maintenance, and superior electrical efficiency. As explained in this proposal, the system incorporates innovative features to reduce O&M costs, including variable output electronic ballasts to provide dimming capability and Trojan's revolutionary ActiClean-WW™ system – the industry's only online chemical and mechanical quartz sleeve cleaning system. All Trojan installations are supported by a global network of certified Service Representatives providing local service and support.

Please do not hesitate to call us if you have any questions regarding this proposal. Thank you for the opportunity to quote the TrojanUV3000Plus™ and we look forward to working with you on this project.

With best regards,

Jordan Fournier
3020 Gore Road
London, Ontario N5V 4T7
Canada
(519) 457 – 3400 ext. 2193
jfournier@trojanuv.com

**Local Representative:**
David Frost
The Coombs-Hopkins Company
2855 Mitchell Drive
Suite 215, Walnut Creek, CA 94598-1609
USA
(925) 947-6733

# DESIGN CRITERIA

**ARCATA**

| | |
|---|---|
| Peak Design Flow: | **5.9 MGD** |
| UV Transmittance: | **35%** (minimum) |
| Total Suspended Solids: | **50 mg/l** (30 Day Average, grab sample) |
| Disinfection Limit: | **43 fecal coliform per 100 ml**, based on a 1 day Maximum (90%ile) of consecutive daily grab samples |
| Design Dose: | **50,000 µWs/cm$^2$**, bioassay validated |
| Validation Factors: | **0.90** end of lamp life factor (Low-Pressure Amalgam Lamps)<br>**0.95** fouling factor (ActiClean-WW™ Chemical / Mechanical Cleaning System) |

# DESIGN SUMMARY

**QUOTE: LJKR1061D**

Based on the above design criteria, the TrojanUV3000Plus™ proposed consists of:

| **CHANNEL** (Please reference Trojan layout drawings for details.) | |
|---|---|
| Number of Channels: | **1** |
| Approximate Channel Length Required: | **42 ft** |
| Channel Width Based on Number of UV Modules: | **60 in** |
| Channel Depth Recommended for UV Module Access: | **54 in** |
| **UV MODULES** | |
| Total Number of Banks: | **3** |
| Number of Modules per Bank: | **20** |
| Number of Lamps per Module: | **8** |
| Total Number of UV Lamps: | **480** |
| Maximum Power Draw: | **120 kW** |
| **UV PANELS** | |
| Power Distribution Center Quantity: | **3** |
| System Control Center Quantity: | **1** |
| **MISCELLANEOUS EQUIPMENT** | |
| Level Controller Quantity: | **1** |
| Type of Level Controller: | **Weighted Gate (ALC)** |
| Automatic Chemical / Mechanical Cleaning: | **Trojan ActiClean-WW™** |
| UV Module Lifting Device: | **Davit Crane** |
| On-line UVT Monitor: | **Hach UVAS sc Sensor** |
| Standard Spare Parts / Safety Equipment: | **Included** |
| Other Equipment: | |

**ELECTRICAL REQUIREMENTS**

1. Each Power Distribution Center requires an electrical supply of one (1) 480 Volts, 3 phase, 4 wire (plus ground), 40.8 kVA.
2. The Hydraulic System Center requires an electrical power supply that is powered from the Power Distribution Center.
3. The System Control Center requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 15 Amps.
4. The Online UVT Monitor requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 1 Amp.
5. Electrical disconnects required per local code are not included in this proposal.

# COMMERCIAL INFORMATION

**Total Capital Cost: $999,000 (US$)**

This price excludes any taxes that may be applicable and is valid for 90 days from the date of this letter.

# OPERATING COST ESTIMATE

## Operating Conditions

Average Flow: **2 MGD**
Yearly Usage: **8760 hours**
UV Transmittance: **35%**

| Power Requirements | | Lamp Replacement | |
|---|---|---|---|
| Average Power Draw: | **60.8 kW** | Number lamps per year: | **234** |
| Cost per kW hour: | **$0.10** | Price per lamp: | **$250** |
| **Annual Power Cost:** | **$53,261** | **Annual Lamp Replacement Cost:** | **$58,500** |
| **Total Annual O&M Cost: $111,761** | | | |

This cost estimate is based on the average flow and UV transmittance listed above. Actual operating costs may be lower due to the TrojanUV3000Plus™ automatic dose pacing control system. As UV demand decreases, by a change in operating conditions, the power level of the lamps decreases accordingly. The dose pacing system minimizes equipment power levels while the target UV dose is maintained to ensure disinfection at all times.

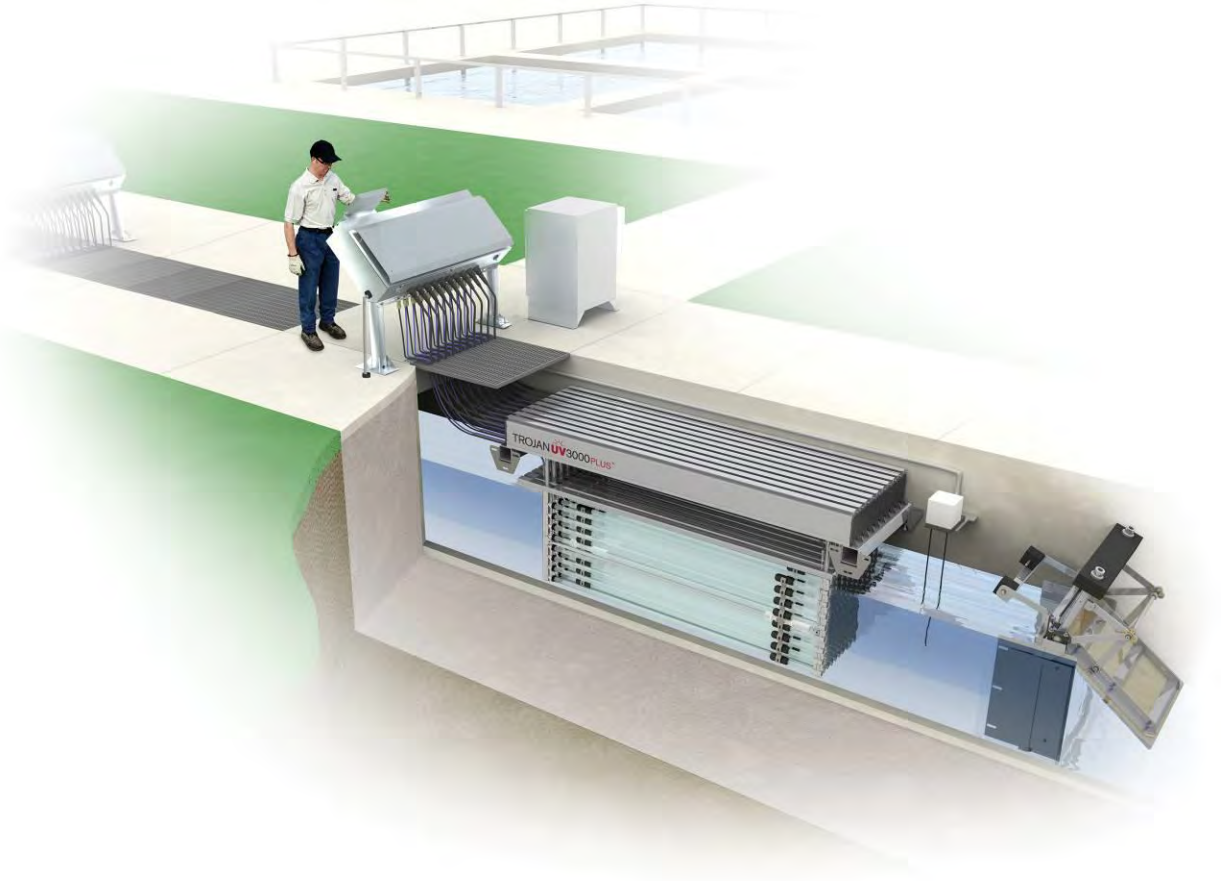
# EQUIPMENT WARRANTEES

1. Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, which ever comes first.
2. UV lamps purchased are warranted for 12,000 hours of operation or 3 years from shipment, whichever comes first. The warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge.
3. Electronic ballasts are warranted for 5 years, pro-rated after 1 year.

TROJAN UV3000 PLUS™

# PROPOSAL FOR THE CITY OF ARCATA, CA

QUOTE: LJKR1061F
6/16/2015




The TrojanUV3000Plus™ is operating in **over 1300** municipal wastewater plants around the world. Disinfecting **over 17 billion** gallons a day, the TrojanUV3000Plus™ has become the reference standard in the industry.

June 16, 2015

In response to your request, we are pleased to provide the following TrojanUV3000Plus™ proposal for the **Arcata** project.

The TrojanUV3000Plus™ has been shown in over 1300 installations to provide dependable performance, simplified maintenance, and superior electrical efficiency. As explained in this proposal, the system incorporates innovative features to reduce O&M costs, including variable output electronic ballasts to provide dimming capability and Trojan's revolutionary ActiClean-WW™ system – the industry's only online chemical and mechanical quartz sleeve cleaning system. All Trojan installations are supported by a global network of certified Service Representatives providing local service and support.

Please do not hesitate to call us if you have any questions regarding this proposal. Thank you for the opportunity to quote the TrojanUV3000Plus™ and we look forward to working with you on this project.

With best regards,

Jordan Fournier
3020 Gore Road
London, Ontario N5V 4T7
Canada
(519) 457 – 3400 ext. 2193
jfournier@trojanuv.com

**Local Representative:**
David Frost
The Coombs-Hopkins Company
2855 Mitchell Drive
Suite 215, Walnut Creek, CA 94598-1609
USA
(925) 947-6733

# DESIGN CRITERIA

**ARCATA**

| | |
|---|---|
| Peak Design Flow: | **5.9 MGD** |
| UV Transmittance: | **35%** (minimum) |
| Total Suspended Solids: | **50 mg/l** (30 Day Average, grab sample) |
| Disinfection Limit: | **43 fecal coliform per 100 ml**, based on a 1 day Maximum (90%ile) of consecutive daily grab samples |
| Design Dose: | **50,000 µWs/cm$^2$**, bioassay validated |
| Validation Factors: | **0.90** end of lamp life factor (Low-Pressure Amalgam Lamps)<br>**0.95** fouling factor (ActiClean-WW™ Chemical / Mechanical Cleaning System) |
| Redundancy: | **33%** |

# DESIGN SUMMARY

**QUOTE: LJKR1061F**

Based on the above design criteria, the TrojanUV3000Plus™ proposed consists of:

| **CHANNEL** (Please reference Trojan layout drawings for details.) | |
|---|---|
| Number of Channels: | **1** |
| Approximate Channel Length Required: | **54 ft** |
| Channel Width Based on Number of UV Modules: | **60 in** |
| Channel Depth Recommended for UV Module Access: | **54 in** |
| **UV MODULES** | |
| Total Number of Banks: | **4 (3 duty, 1 redundant)** |
| Number of Modules per Bank: | **20** |
| Number of Lamps per Module: | **8** |
| Total Number of UV Lamps: | **640** |
| Maximum Power Draw: | **160 kW** |
| **UV PANELS** | |
| Power Distribution Center Quantity: | **4** |
| System Control Center Quantity: | **1** |
| **MISCELLANEOUS EQUIPMENT** | |
| Level Controller Quantity: | **1** |
| Type of Level Controller: | **Weighted Gate (ALC)** |
| Automatic Chemical / Mechanical Cleaning: | **Trojan ActiClean-WW™** |
| UV Module Lifting Device: | **Davit Crane** |
| On-line UVT Monitor: | **Hach UVAS sc Sensor** |
| Standard Spare Parts / Safety Equipment: | **Included** |
| Other Equipment: | |

**ELECTRICAL REQUIREMENTS**

1. Each Power Distribution Center requires an electrical supply of one (1) 480 Volts, 3 phase, 4 wire (plus ground), 40.8 kVA.
2. The Hydraulic System Center requires an electrical supply of one (1) 480 Volts, 3 phase, 3 wire (plus ground), 2 kVA.
3. The System Control Center requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 15 Amps.
4. The Online UVT Monitor requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 1 Amp.
5. Electrical disconnects required per local code are not included in this proposal.

# COMMERCIAL INFORMATION

**Total Capital Cost: $1,310,000 (US$)**

This price excludes any taxes that may be applicable and is valid for 90 days from the date of this letter.

# OPERATING COST ESTIMATE

## Operating Conditions

Average Flow: **2.0 MGD**
Yearly Usage: **8760 hours**
UV Transmittance: **35%**

| Power Requirements | | Lamp Replacement | |
|---|---|---|---|
| Average Power Draw: | **60.8 kW** | Number lamps per year: | **234** |
| Cost per kW hour: | **$0.10** | Price per lamp: | **$250** |
| **Annual Power Cost:** | **$53,261** | **Annual Lamp Replacement Cost:** | **$58,500** |
| **Total Annual O&M Cost: $111,761** | | | |

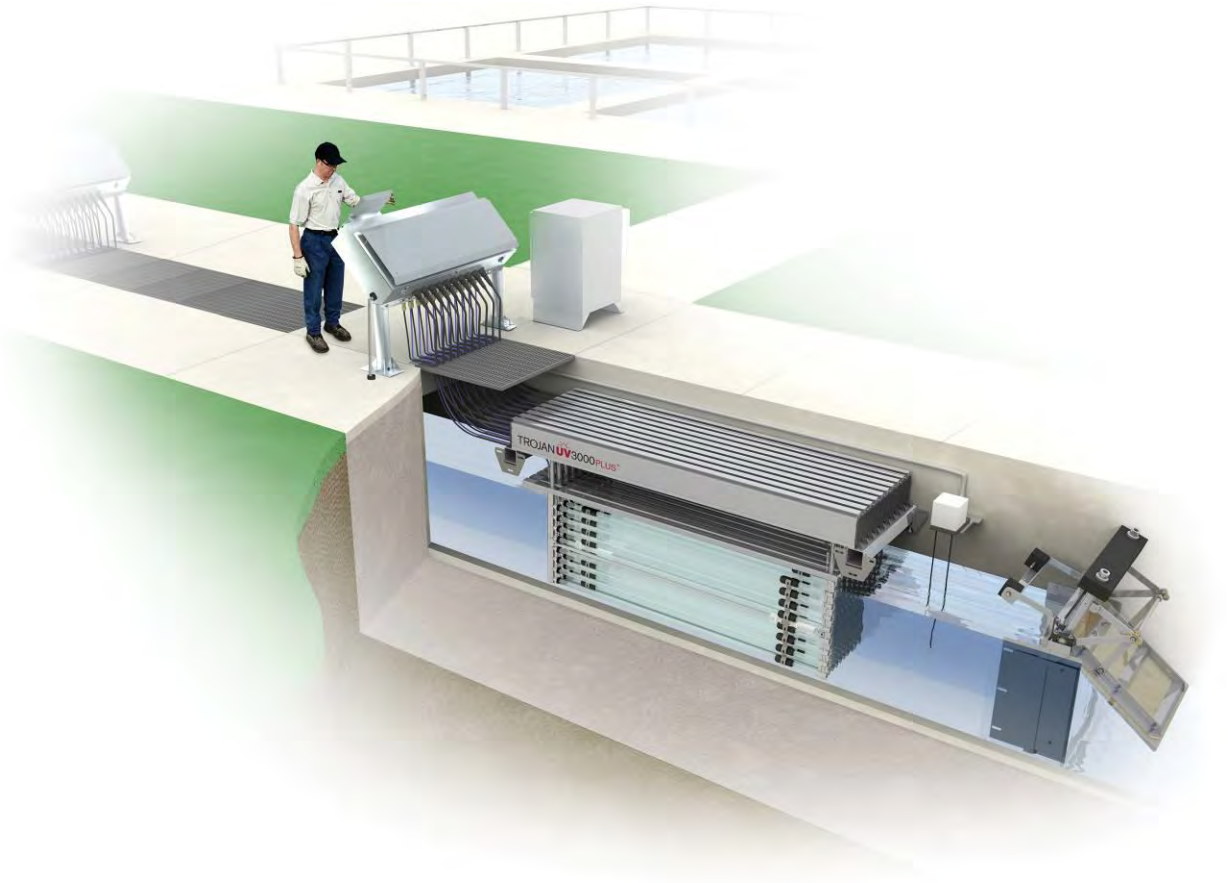
This cost estimate is based on the average flow and UV transmittance listed above. Actual operating costs may be lower due to the TrojanUV3000Plus™ automatic dose pacing control system. As UV demand decreases, by a change in operating conditions, the power level of the lamps decreases accordingly. The dose pacing system minimizes equipment power levels while the target UV dose is maintained to ensure disinfection at all times.

# EQUIPMENT WARRANTEES

1. Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, which ever comes first.
2. UV lamps purchased are warranted for 12,000 hours of operation or 3 years from shipment, whichever comes first. The warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge.
3. Electronic ballasts are warranted for 5 years, pro-rated after 1 year.

TROJAN UV3000 PLUS™

PROPOSAL FOR THE CITY OF ARCATA, CA
QUOTE: LJKR1061H
6/19/2015




The TrojanUV3000Plus™ is operating in **over 1300** municipal wastewater plants around the world. Disinfecting **over 17 billion** gallons a day, the TrojanUV3000Plus™ has become the reference standard in the industry.

June 19, 2015

In response to your request, we are pleased to provide the following TrojanUV3000Plus™ proposal for the **Arcata** project.

The TrojanUV3000Plus™ has been shown in over 1300 installations to provide dependable performance, simplified maintenance, and superior electrical efficiency. As explained in this proposal, the system incorporates innovative features to reduce O&M costs, including variable output electronic ballasts to provide dimming capability and Trojan's revolutionary ActiClean-WW™ system – the industry's only online chemical and mechanical quartz sleeve cleaning system. All Trojan installations are supported by a global network of certified Service Representatives providing local service and support.

Please do not hesitate to call us if you have any questions regarding this proposal. Thank you for the opportunity to quote the TrojanUV3000Plus™ and we look forward to working with you on this project.

With best regards,

Jordan Fournier
3020 Gore Road
London, Ontario N5V 4T7
Canada
(519) 457 – 3400 ext. 2193
jfournier@trojanuv.com

**Local Representative:**
David Frost
The Coombs-Hopkins Company
2855 Mitchell Drive
Suite 215, Walnut Creek, CA 94598-1609
USA
(925) 947-6733

# DESIGN CRITERIA

**ARCATA**

| | |
|---|---|
| Peak Design Flow: | **5.9 MGD** |
| UV Transmittance: | **35%** (minimum) |
| Total Suspended Solids: | **50 mg/l** (30 Day Average, grab sample) |
| Disinfection Limit: | **43 fecal coliform per 100 ml**, based on a 1 day Maximum (90%ile) of consecutive daily grab samples |
| Design Dose: | **100,000 µWs/cm$^2$**, bioassay validated |
| Validation Factors: | **0.90** end of lamp life factor (Low-Pressure Amalgam Lamps)<br>**0.95** fouling factor (ActiClean-WW™ Chemical / Mechanical Cleaning System) |

# DESIGN SUMMARY

**QUOTE: LJKR1061H**

Based on the above design criteria, the TrojanUV3000Plus™ proposed consists of:

| **CHANNEL** (Please reference Trojan layout drawings for details.) | |
|---|---|
| Number of Channels: | **2** |
| Approximate Channel Length Required: | **54 ft** |
| Channel Width Based on Number of UV Modules: | **78 in** |
| Channel Depth Recommended for UV Module Access: | **54 in** |
| **UV MODULES** | |
| Total Number of Banks: | **8** |
| Number of Modules per Bank: | **26** |
| Number of Lamps per Module: | **8** |
| Total Number of UV Lamps: | **1664** |
| Maximum Power Draw: | **416 kW** |
| **UV PANELS** | |
| Power Distribution Center Quantity: | **8** |
| System Control Center Quantity: | **1** |
| **MISCELLANEOUS EQUIPMENT** | |
| Level Controller Quantity: | **2** |
| Type of Level Controller: | **Weighted Gate (ALC)** |
| Automatic Chemical / Mechanical Cleaning: | **Trojan ActiClean-WW™** |
| UV Module Lifting Device: | **Davit Crane** |
| On-line UVT Monitor: | **Hach UVAS sc Sensor** |
| Standard Spare Parts / Safety Equipment: | **Included** |
| Other Equipment: | |

**ELECTRICAL REQUIREMENTS**

1. Each Power Distribution Center requires an electrical supply of one (1) 480 Volts, 3 phase, 4 wire (plus ground), 53.1 kVA.
2. The Hydraulic System Center requires an electrical power supply that is powered from the Power Distribution Center.
3. The System Control Center requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 15 Amps.
4. The Online UVT Monitor requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 1 Amp.
5. Electrical disconnects required per local code are not included in this proposal.

# COMMERCIAL INFORMATION

**Total Capital Cost: $3,240,000 (US$)**

This price excludes any taxes that may be applicable and is valid for 90 days from the date of this letter.

# OPERATING COST ESTIMATE

## Operating Conditions

Average Flow: **2 MGD**
Yearly Usage: **8760 hours**
UV Transmittance: **35%**

| Power Requirements | | Lamp Replacement | |
|---|---|---|---|
| Average Power Draw: | **125 kW** | Number lamps per year: | **456** |
| Cost per kW hour: | **$0.10** | Price per lamp: | **$250** |
| **Annual Power Cost:** | **$109,500** | **Annual Lamp Replacement Cost:** | **$114,000** |
| **Total Annual O&M Cost: $223,500** | | | |

This cost estimate is based on the average flow and UV transmittance listed above. Actual operating costs may be lower due to the TrojanUV3000Plus™ automatic dose pacing control system. As UV demand decreases, by a change in operating conditions, the power level of the lamps decreases accordingly. The dose pacing system minimizes equipment power levels while the target UV dose is maintained to ensure disinfection at all times.

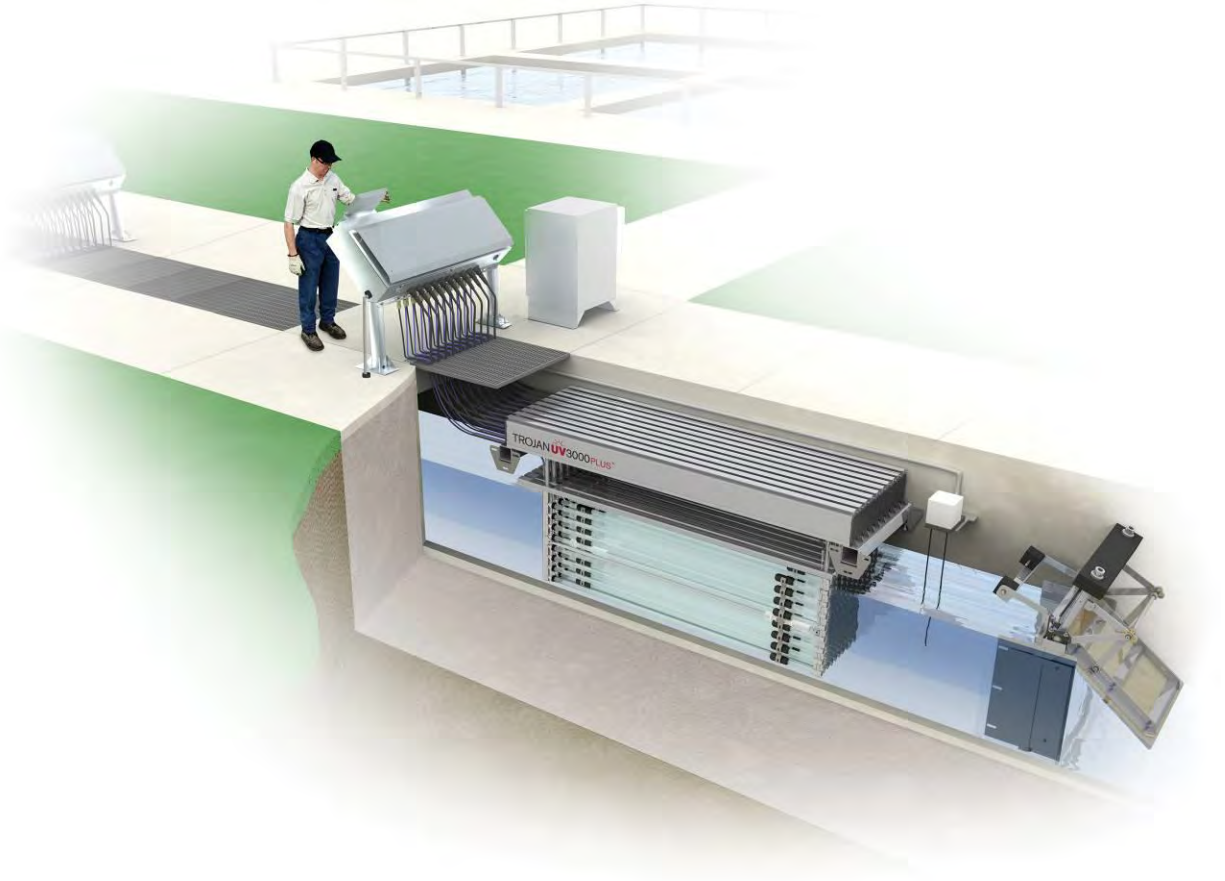
# EQUIPMENT WARRANTEES

1. Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, which ever comes first.
2. UV lamps purchased are warranted for 12,000 hours of operation or 3 years from shipment, whichever comes first. The warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge.
3. Electronic ballasts are warranted for 5 years, pro-rated after 1 year.

TROJAN UV3000 PLUS™

# PROPOSAL FOR THE CITY OF ARCATA, CA

QUOTE: LJKR1061I
2/23/2016




The TrojanUV3000Plus™ is operating in **over 1300** municipal wastewater plants around the world. Disinfecting **over 17 billion** gallons a day, the TrojanUV3000Plus™ has become the reference standard in the industry.

February 24, 2016

Attention:

In response to your request, we are pleased to provide the following TrojanUV3000Plus™ proposal for the **Arcata** project.

The TrojanUV3000Plus™ has been shown in over 1300 installations to provide dependable performance, simplified maintenance, and superior electrical efficiency. As explained in this proposal, the system incorporates innovative features to reduce O&M costs, including variable output electronic ballasts to provide dimming capability and Trojan's revolutionary ActiClean-WW™ system – the industry's only online chemical and mechanical quartz sleeve cleaning system. All Trojan installations are supported by a global network of certified Service Representatives providing local service and support.

Please do not hesitate to call us if you have any questions regarding this proposal. Thank you for the opportunity to quote the TrojanUV3000Plus™ and we look forward to working with you on this project.

**Best Regards,**

**John Houghton**
Municipal Applications
**TROJANUV / SALSNES FILTER**

3020 Gore Road, London, Canada N5V 4T7
(519) 457-3400 *office*
(519) 902-1892 *mobile*
trojanuv.com

**Local Representative:**
David Frost
The Coombs-Hopkins Company
2855 Mitchell Drive
Suite 215, Walnut Creek, CA 94598-1609
(925) 947-6733

# DESIGN CRITERIA

**ARCATA**

| | |
|---|---|
| Peak Design Flow: | **5.9 MGD** |
| UV Transmittance: | **55%** (minimum) |
| Total Suspended Solids: | **50 mg/l** (30 Day Average, grab sample) |
| Design Dose: | **35 mJ/cm$^2$**, bioassay validated per NWRI 2012 protocol, CR 1.0 |
| Validation Factors: | **0.9** end of lamp life factor CA DHS approved (LP Amalgam Lamps)<br>**0.95** fouling factor CA DHS approved (ActiClean-WW™ Chemical / Mechanical Cleaning System) |
| Redundancy: | **50%** |

# DESIGN SUMMARY

**QUOTE: LJKR1061I**

Based on the above design criteria, the TrojanUV3000Plus™ proposed consists of:

| | |
|---|---|
| **CHANNEL** (Please reference Trojan layout drawings for details.) | |
| Number of Channels: | **2** |
| Approximate Channel Length Required: | **42 ft** |
| Channel Width Based on Number of UV Modules: | **28 in** |
| Channel Depth Recommended for UV Module Access: | **62 in** |
| **UV MODULES** | |
| Total Number of Banks: | **6 (4 Duty, 2 Redundant)** |
| Number of Modules per Bank: | **7** |
| Number of Lamps per Module: | **8** |
| Total Number of UV Lamps: | **336 (Including Redundancy)** |
| Maximum Power Draw: | **84 kW (Including Redundancy)** |
| **UV PANELS** | |
| Power Distribution Center Quantity: | **6** |
| System Control Center Quantity: | **1** |
| **MISCELLANEOUS EQUIPMENT** | |
| Level Controller Quantity: | **2** |
| Type of Level Controller: | **Fixed Weir** |
| Automatic Chemical / Mechanical Cleaning: | **Trojan ActiClean-WW™** |
| UV Module Lifting Device: | **Davit Crane** |
| On-line UVT Monitor: | **Hach UVAS sc Sensor** |
| Standard Spare Parts / Safety Equipment: | **Included** |
| **ELECTRICAL REQUIREMENTS** | |

1. Each Power Distribution Center requires an electrical supply of one (1) 480 Volts, 3 phase, 4 wire (plus ground), 14.3 kVA.
2. The Hydraulic System Center requires an electrical supply of one (1) 480 Volts, 3 phase, 3 wire (plus ground), 2 kVA.
3. The System Control Center requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 15 Amps.
4. The Online UVT Monitor requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 1 Amp.
5. Electrical disconnects required per local code are not included in this proposal.

# COMMERCIAL INFORMATION

| |
|---|
| **Total Capital Cost: $785,500** |
| **Deduct for NO redundancy (remove 2 banks): $234,198** |

This price excludes any taxes that may be applicable and is valid for 90 days from the date of this letter.

# OPERATING COST ESTIMATE

## Operating Conditions

Average Flow: **2.0 MGD**
Yearly Usage: **8760 hours**
UV Transmittance: **55%**
Number of Banks Operating at Average Flow: **2 in 1 Channel**

| **Power Requirements** | | **Lamp Replacement** | |
|---|---|---|---|
| Average Power Draw: | **21.3 kW** | Number lamps per year: | **82** |
| Cost per kW hour: | **$0.1** | Price per lamp: | **$250** |
| **Annual Power Cost:** | **$18,658** | **Annual Lamp Replacement Cost:** | **$20,500** |
| **Total Annual O&M Cost: $39,158** | | | |

This cost estimate is based on the average flow and UV transmittance listed above. Actual operating costs may be lower due to the TrojanUV3000Plus™ automatic dose pacing control system. As UV demand decreases, by a change in operating conditions, the power level of the lamps decreases accordingly. The dose pacing system minimizes equipment power levels while the target UV dose is maintained to ensure disinfection at all times.

# EQUIPMENT WARRANTEES

1. Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, which ever comes first.
2. UV lamps purchased are warranted for 12,000 hours of operation or 3 years from shipment, whichever comes first. The warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge. .
3. Electronic ballasts are warranted for 5 years, pro-rated after 1 year.

# APPENDIX P – BASIS OF COSTS

# Appendix P
# Basis of Cost

## 1.0 PURPOSE

As part of the Arcata Wastewater Treatment Facility Improvements Project, several types of cost estimates were developed. This appendix provides procedures and guidelines for estimating capital and repair and replacement (R&R) costs.

## 2.0 INTRODUCTION

Cost estimates are often prepared at various stages during project planning and design. The cost estimate is one of the most sensitive products prepared for a project. The level of accuracy that can be expected is directly proportional to the level of engineering effort completed. Each cost estimate must be carefully prepared from the conceptual level to the facilities plan level, through the preliminary design and the final engineer's estimate.

### 2.1 SCOPE AND LEVEL OF ACCURACY

The Association for the Advancement of Cost Engineering International (AACE International, formerly known as the American Association of Cost Engineers) has suggested levels of accuracy for five estimate classes. These five estimate classes are presented in the AACE International Recommended Practice No. 18R-97 (Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries). Table P1 presents a summary of these five estimate classes and their characteristics, including expected accuracy ranges.

The quantity and quality of the information required to prepare an estimate depends on the end use for that estimate. Typically, as a project progresses from the conceptual phase to the study phase, preliminary design and final design, the quantity and quality of information increases, thereby providing data for development of a progressively more accurate cost estimate. A contingency is often used to compensate for lack of detailed engineering data, oversights, anticipated changes, and imperfection in the estimating methods used. As the quantity and quality of data becomes better, smaller contingency allowances are typically utilized. For the projects developed as a part of the Facility Plan, cost estimates are developed following the AACE International Recommended Practice No. 18R-97 estimate class 5.

| **Table P1** | **Classes of Cost Estimates[1]**<br>**ATWF Improvements Project**<br>**City of Arcata** | | | | |
|---|---|---|---|---|---|
| **Estimate Class** | **Primary Characteristic** | **Secondary Characteristic** | | | |
| | **Level of Project Definition** Expressed as % of complete definition | **End Usage** Typical purpose of estimate | **Methodology** Typical estimating method | **Expected Accuracy Range** Typical variation in low and high ranges[1a] | **Preparation Effort** Typical degree of effort relative to least cost index of 1[1b] |
| **Class 5** | 0% to 2% | Concept Screening | Capacity Factored, Parametric Models, Judgment, or Analogy | L: -20% to -50%<br>H: +30% to +100% | 1 |
| **Class 4** | 1% to 15% | Study or Feasibility | Equipment Factored or Parametric Models | L: - 15% to -30%<br>H: +20% to +50% | 2 to 4 |
| **Class 3** | 10% to 40% | Budget, Authorization, or Control | Semi-Detailed Unit Costs with Assembly Level Line Items | L: - 10% to -20%<br>H: +10% to +30% | 3 to 10 |
| **Class 2** | 30% to 70% | Control or Bid/Tender | Detailed Unit Cost with Forced Detailed Take-Off | L: - 5% to -15%<br>H: +5% to +20% | 4 to 20 |
| **Class 1** | 50% to 100% | Check Estimate or Bid/Tender | Detailed Unit Cost with Detailed Take-Off | L: - 3% to -10%<br>H: +3% to +15% | 5 to 100 |

Note:

(1) Table 1 comes from the AACE International Recommended Practices, No. 18R-97:

(a) The state of process technology and availability of applicable reference cost data affect the range markedly. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for a given scope.

(b) If the range index value of "1" represents 0.005% of project costs, then an index value of 100 represents 0.5%. Estimate preparation effort is highly dependent upon the size of the project and the quality of estimating data and tools.

Class 4 and 5 estimates are prepared for any number of strategic business planning purposes, including, but not limited to: project screening, evaluation of resource needs and budgeting, and long-range capital planning. Very limited information is available at the time when a Class 5 estimate is developed. Therefore, Class 5 estimates virtually always use stochastic estimating methods such as cost to capacity curves and various scaling factors. Subsequently, estimated costs have wide accuracy ranges. Typical accuracy ranges for Class 5 estimates are -20 percent to –50 percent on the low side, and +30 percent to

+100 percent on the high side, depending on the technological complexity of the project, availability and accuracy of appropriate reference information, and the inclusion of an appropriate contingency determination. Capital costs for the Facility Plan improvements are prepared based on Class 4 and 5 estimates, depending on the available information.

## 3.0 BASIS OF COST EVALUATIONS

The costs presented in the Facility Plan are based on equipment useful life and existing conditions, increased capacity, preliminary layouts, preliminary unit process sizes, and conceptual alternative configurations. Construction costs are estimated for new capital, replacement and repair and rehabilitation projects. Construction costs for new capital and replacement projects are estimated from unit costs developed from past Bay Area construction contracts, estimating guides, unit prices, and construction costs of similar facilities and configurations at other locations. Construction costs for repair and rehabilitation are based on structural and equipment estimates. Equipment costs were developed from reference projects and RS means data.

A summary of the economic criteria to be used for estimating costs is presented in Table P2.

**Table P2 Economic Criteria**
**ATWF Improvements Project**
**City of Arcata**

| Item | Assumption |
|---|---|
| Costs in Time and Place(1) | Costs are based on June 2015 costs in Arcata, California |
| Inflation Rate | Annual inflation rate is assumed to be 4 percent |
| Interest Rate | 6 percent for amortization purpose |
| Amortization Period | 20 years |

Note:
(1) San Francisco ENR CCI of 11,155 was used to update costs to June 2015. The 2014 R.S. Means location factor for the City of Eureka of 108.5 was used.

## 4.0 CAPITAL COSTS

While the estimated construction costs represent the average bidding conditions for many projects, variations in bidding climate at the time the facilities are constructed can affect actual construction costs. Further, the size of the facilities may be refined during preliminary design based on the most current operational information available. For these reasons, the actual construction costs may be lower or higher than originally estimated.

Construction costs have historically escalated with time. This trend is expected to continue in the future. To record these trends in rising costs, several indices have been established for various fields of construction. The standard indicator of changes in heavy construction

prices is the ENR CCI. Construction costs in June 2015 are based on the San Francisco ENR CCI of 11,155. To account for the project location, the corresponding R.S. Means Location Factor of 108.5 was used, which is the location factor for Eureka, California.

The construction costs presented typically include contractor's overhead and profit, and construction contingencies. Costs to the owner, such as engineering, legal, administrative, project contingencies, and construction management costs are added to the construction costs. The basis for estimating capital costs for new capital and replacement projects is presented in Table P3.

The replacement cost estimates for individual assets are estimates of the total project cost to purchase and install similar assets in today's dollars. Replacement values comprise both direct and indirect costs. Direct costs are the actual cost of the replacement equipment and structures. The indirect construction costs include the other factors that are included in rehabilitation such as demolition, installation labor, contractor overhead, and profit, and other factors. Descriptions of each project cost factor are presented in Table P3. Unless otherwise noted, direct costs were estimated for in-kind replacement of each asset based on a variety of sources and are the costs directly attributed to the physical make-up of the assets (e.g., site development, materials, site dewatering, facilities, equipment, piping, electrical/ instrumentation/controls, installation and labor, etc.). A factor is then applied for installation, which ranges from 15 to 50 percent. Because the asset inventory is comprised only of the important and/or high cost assets, remaining components are accounted for in a factor termed "ancillary support." This factor encompasses items such as sump pumps, seal water pumps, small valves, service-air piping, hoses, etc. The lumped value of these assets is adjusted according to best professional judgment and usually ranges from 25 to 45 percent of the sum of the itemized asset costs; therefore, an 80 to 140 percent construction cost factor is applied to each asset. Indirect construction costs are then applied, including general conditions, contractor overhead and profit and sales tax. The resulting total construction cost factor ranges from 2.75 to 4.3 for simple and complex rehabilitation items. In addition, cost factors to complete the overall project, including engineering / legal / administration, and construction management are added to estimate the overall project cost.

As noted, these factors are adjusted to two levels of project complexity: 1) conducted by external contractors at a simple level, or 2) conducted by external contractors with complexity requiring design services and/or contractor staging. The overall cost factor applied to direct costs then ranges from 2.75 to 4.5 (rounded from 4.3) depending on the level of complexity.

**Table P3 Project Cost Factors**
**ATWF Improvements Project**
**City of Arcata**

| Factor | Description | External Project | |
|---|---|---|---|
| | | Simple | Complex |
| Demolition | Destruction and removal of existing asset. | 5% | 10% |
| Installation | | 15% | 50% |
| Ancillary Support | Lumped cost of mechanical piping, electrical cable, conduit and other costs. | 25% | 45% |
| Construction and Estimating Contingency | Unforeseen or unanticipated project costs involved in the design details and installation of the new asset. | 35% | 35% |
| | **Subtotal** | **80%** | **140%** |
| General Conditions | All items contained within Division 01 of most project specifications including: mobilization and demobilization, contractor temporary facilities, contractor's field supervision, and bonds and insurance. | 10% | 10% |
| Contractor Overhead and Profit Margin | This value includes general contractor home office overheads and profit. | **10%** | **25%** |
| Sales Tax Factor | Sales tax factor applied to approximately half of direct cost. | 5% | 5% |
| | **Subtotal** | **25%** | **40%** |
| **Total Construction Cost Factor** | | **2.2 (1)** | **3.2(1)** |
| Engineering, Legal, Administrative, and Project Contingencies | Engineering (design and services during construction), legal, and administrative costs reflect assistance with permitting and financing. | 25% | 35% |
| **Total Project Cost Factor** | | **1.25** | **1.35** |
| **Total Construction and Project Multipliers (Compounded)** | | **2.75(1)** | **4.3(1)** |

Note:
(1) Factor is compounded from both subtotal values.

## 4.1 Treatment Plant Cost Estimating Approach

The treatment plant unit process construction cost estimates are developed using past City and other Carollo Engineers project costs and the cost curve approach for estimating. The “cost curve approach” is the use of historical project cost data to estimate planning level costs for capital improvement projects. In this approach, historical project cost data are used to develop plots of total cost versus process capacity, or “cost curves,” for a given unit process. In the development of the cost curves, the project locations and dates of costs are accounted for with the application of “location factors” (R.S. Means Location Factors), and ENR CCI values. The location factors are based upon the R.S. Means national average construction costs.

City-to-City location adjustment factors may be accurately derived by dividing the published factor for one location by the factor for another. By accounting for location factors and ENR CCI values, the cost curves are plots of “location-less” costs and in today’s dollars. Given a known required capacity for a capital improvement project, the estimated cost is extrapolated from the cost curve.

# APPENDIX Q - CIP ALTERNATIVE CAPITAL COST INFORMATION

**ALTERNATIVE 1: EXISTING SYSTEM REHABILITATION**
**AWTF CIP CASH FLOW 2016-2026**
**CITY OF ARCATA**

| PROJECT DESCRIPTION | | | | | COST ESTIMATES | | |
|---|---|---|---|---|---|---|---|
| CITY PROJECT ID [1] | PROJECT TYPE | PROJECT TITLE | ORIGINAL PROJECT DESCRIPTION (BY CITY) | RECOMMENDED PROJECT DESCRIPTION (BY CAROLLO) | SOFT COSTS (CEQA, DESIGN, LEGAL, ADMIN, CM) | ESTIMATED CONSTRUCTION COST | ESTIMATED PROJECT COST |
| 1 | Regulatory - Permit | UV Disinfection System | Replace current chlorine disinfection system with a new UV disinfection system | New UV disinfection system for Outfall 003 sized for 5.9 mgd (UVT 35%). Existing chlorine disinfection system remains for wet weather discharge to Outfall 001. | $ 1,308,000 | $ 4,360,000 | $ 5,670,000 |
| 3 | Capacity | Treatment Marsh #7 | Reconfigure current aquaculture ponds into another treatment wetland | Reconfigure current aquaculture ponds into another treatment wetland (2.3 acres). Includes additional environmental permitting costs. | $ 269,000 | $ 230,000 | $ 500,000 |
| 4 | Regulatory - Permit | AWTF Reconfiguration/ New Outfall 003 | a. Re-route the wastewater treatment flow from a two-pass configuration to a single-pass configuration (permit)<br>b. Construct Outfall 003 (permit)<br>c. Replace the pumps at the Enhancement Wetlands (Hauser) PS (Moved to Project #22) | a. Reroute flow (piping) from the two pass configuration to single pass configuration.<br>b. Construct Outfall 003 and effluent piping (from UV to Outfall 003). | $ 543,000 | $ 1,810,000 | $ 2,350,000 |
| 8 | Modernization | 30 kW PV System | New Photovoltaic system to offset power for UV disinfection. | Determine whether or not the project economics are still viable without current grants (during pre-design). If yes, package with UV Disinfection System. | $ 81,000 | $ 270,000 | $ 350,000 |
| 10, 11, 12 | Rehabilitation & Repair (R&R) | Headworks: Influent Screw Pump, Bar Screen, Flume and Grit Chamber Replacement | Replacement of headworks equipment | Replace structural and mechanical headworks assets due to age and condition. Upsize headworks to handle PWWF of 5.9 mgd. | $ 1,980,000 | $ 6,600,000 | $ 8,580,000 |
| 13 | R&R | Primary Clarifier Replacement | Replacement and upsizing of existing primary clarifiers with 2 identical 5.9-mgd clarifiers for complete redundancy | Replacement of existing primary clarifiers with two new 3.0 mgd clarifier (1 standby). Package with sludge pump replacement project | $ 1,386,000 | $ 4,620,000 | $ 6,010,000 |

**ALTERNATIVE 1: EXISTING SYSTEM REHABILITATION**
**AWTF CIP CASH FLOW 2016-2026**
**CITY OF ARCATA**

| PROJECT DESCRIPTION | | | | | COST ESTIMATES | | |
|---|---|---|---|---|---|---|---|
| CITY PROJECT ID [1] | PROJECT TYPE | PROJECT TITLE | ORIGINAL PROJECT DESCRIPTION (BY CITY) | RECOMMENDED PROJECT DESCRIPTION (BY CAROLLO) | SOFT COSTS (CEQA, DESIGN, LEGAL, ADMIN, CM) | ESTIMATED CONSTRUCTION COST | ESTIMATED PROJECT COST |
| 14 | R&R | Primary Clarifier: Sludge and Scum Pump Replacement | Replacement of primary sludge and scum pumps (with redundancy) for new 5.9 mgd primary clarifiers. | Package with primary clarifier project. | $ 69,000 | $ 230,000 | $ 300,000 |
| 15A | Regulatory - Capacity | Digester R&R Project - Phase 1 | Replace and reconfigure sludge digestion system to improve performance. | Upgrade and reconfigure sludge digestion system to accommodate additional primary sludge. Elements to be determined during preliminary design but may include digester cover rehabilitation and digester tank modifications. | $ 225,000 | $ 750,000 | $ 980,000 |
| 16 | R&R | Treatment Wetlands 4 Influent Pump Replacement | Replacement of Treatment Wetlands 4 Influent Pumps | Evaluate whether project still required during preliminary design. Package with treatment wetlands or oxidation ponds project. | $ 36,000 | $ 120,000 | $ 160,000 |
| 17 | R&R | Treatment Wetlands: Pump Station 1 R&R Project | Replacement of Pump Station 1 pumps | Replace pumps with 2.3 mgd firm capacity (3 mgd with standby running) and rehabilitate wet well.<br>Package with PPS project. | $ 54,000 | $ 180,000 | $ 230,000 |
| 18 | R&R | Treatment Wetlands: Pump Station 2 R&R Project | Replacement of Pump Station 2 pumps | Evaluate whether project still required during preliminary design or if pump station can be demolished with rehabilitation of PPS/PS1 wet well. Package with PPS/PS1 project. | $ 18,000 | $ 60,000 | $ 80,000 |
| 19 | R&R | Oxidation Ponds: Pond Pump Station R&R Project | Plan and implement performance improvements for Oxidation Pond 2 Reconfigure inlet/outlet structures | Replace pumps with 3.6 mgd capacity (with standby running) and rehabilitate wet well.<br>Package with PS1 project. | $ 54,000 | $ 180,000 | $ 230,000 |
| 20 | R&R | Oxidation Ponds: Transfer Structure Reconfiguration | Reconfigure Pond 1 to 2 effluent structures | Allows for better flow distribution and potential storage.<br>Package with oxidation pond work. | $ 82,500 | $ 275,000 | $ 360,000 |
| 21 | R&R | Disinfection: Chlorine/SO2 Project | Project is undefined | Upgrade existing chlorine gas disinfection system or conversion to hypochlorite liquid chlorine system for plant water chlorination. | $ 45,000 | $ 150,000 | $ 200,000 |

**ALTERNATIVE 1: EXISTING SYSTEM REHABILITATION**
**AWTF CIP CASH FLOW 2016-2026**
**CITY OF ARCATA**

| PROJECT DESCRIPTION | | | | | COST ESTIMATES | | |
|---|---|---|---|---|---|---|---|
| CITY PROJECT ID [1] | PROJECT TYPE | PROJECT TITLE | ORIGINAL PROJECT DESCRIPTION (BY CITY) | RECOMMENDED PROJECT DESCRIPTION (BY CAROLLO) | SOFT COSTS (CEQA, DESIGN, LEGAL, ADMIN, CM) | ESTIMATED CONSTRUCTION COST | ESTIMATED PROJECT COST |
| 22 | R&R | Enhancement Wetlands: Pump Station Project | Replacement of enhancement wetland effluent pump station (Hauser PS) | Replace pumps at the EWPS with 2.3 mgd firm capacity. Add a mechanical bar screen on PS inlet and a strainer on the discharge line. | $ 258,000 | $ 860,000 | $ 1,120,000 |
| 24 | R&R | Oxidation Ponds: Aerator Replacement | Aerator replacement / upgrades | Addition of aerators in Pond 2 for aeration capacity and flow diversion. Includes electrical improvements. | $ 255,000 | $ 850,000 | $ 1,110,000 |
| 26 | R&R | Treatment Wetlands Re-Vegetation Project | Dikes and vegetation maintenance | Regrading (deep and shallow zones) and replanting in TW 1-4 only. | $ 174,000 | $ 580,000 | $ 750,000 |
| 27 | R&R | Enhancement Wetlands Re-Vegetation Project | Dikes and vegetation maintenance | Vegetation maintenance, new inlet/outlet structures with piping, new baffles for short circuiting. Includes additional environmental permitting costs and EW influent pipe sliplining. | $ 822,000 | $ 1,740,000 | $ 2,560,000 |
| 29 | R&R | Oxidation Ponds: Emergency Pond Pump Replacement Project | Develop and implement a disinfection system for Pond 2 storm pumps under the new flow configuration | Provide bypass piping to allow Oxidation Pond 1 effluent to be pumped to Oxidation Pond 2. Package with PPS/PS1 or oxidation pond work. | $ 60,000 | $ 200,000 | $ 260,000 |
| 35N | R&R | Oxidation Ponds: Sludge Removal R&R Project | New Project | Allows for improved treatment and hydraulic capacity in Oxidation Ponds 1 & 2. Assumes 1' sludge dredging, dewatering and disposal. | $ 765,000 | $ 2,550,000 | $ 3,320,000 |
| 37N | Regulatory - Capacity | Additional Secondary Treatment Capacity: New Treatment Wetlands | New Project | N/A in Alternative #1 | $ - | | $ - |
| 38N | Regulatory - Capacity | New Secondary Sludge Thickening Project | New Project | N/A in Alternative #1 | $ - | | $ - |
| 39N | R&R | Corporation Yard Modifications & Building Replacement | New Project | Allows for corporation yard and building modification costs associated with new and improved facilities. | $ 6,000 | $ 20,000 | $ 30,000 |
| **TOTAL 10 YR CIP** | | | | | | **$ 26,640,000** | **$ 35,150,000** |

Notes: 1. Project ID number as identifed in City of Arcata Capital Improvements Program (CIP)
2. Project priority generally defined as follows: 1 = Permit and Capacity; 2 = R&R; 3 = Modernization; 4 = Sea Level Rise.

**ALTERNATIVE 2: EXISTING SYSTEM WITH SIDESTREAM TREATMENT**
**AWTF CIP CASH FLOW 2016-2026**
**CITY OF ARCATA**

| PROJECT DESCRIPTION | | | | | COST ESTIMATES | | |
|---|---|---|---|---|---|---|---|
| CITY PROJECT ID [1] | PROJECT TYPE | PROJECT TITLE | ORIGINAL PROJECT DESCRIPTION (BY CITY) | RECOMMENDED PROJECT DESCRIPTION (BY CAROLLO) | SOFT COSTS (CEQA, DESIGN, LEGAL, ADMIN, CM) | ESTIMATED CONSTRUCTION COST | ESTIMATED PROJECT COST |
| 1 | Regulatory - Permit | UV Disinfection System | Replace current chlorine disinfection system with a new UV disinfection system | New UV disinfection system for Outfall 003 sized for 5.9 mgd (UVT 35%). Existing chlorine disinfection system remains for wet weather discharge to Outfall 001. | $ 1,308,000 | $ 4,360,000 | $ 5,670,000 |
| 3 | Capacity | Treatment Marsh #7 | Reconfigure current aquaculture ponds into another treatment wetland | Reconfigure current aquaculture ponds into another treatment wetland (2.3 acres). Includes additional environmental permitting costs. | $ 269,000 | $ 230,000 | $ 500,000 |
| 4 | Regulatory - Permit | AWTF Reconfiguration/ New Outfall 003 | a. Re-route the wastewater treatment flow from a two-pass configuration to a single-pass configuration (permit)<br>b. Construct Outfall 003 (permit)<br>c. Replace the pumps at the Enhancement Wetlands (Hauser) PS (capacity) | a. Reroute flow (piping) from the two pass configuration to single pass configuration.<br>b. Construct Outfall 003 and effluent piping (from UV to Outfall 003). | $ 543,000 | $ 1,810,000 | $ 2,350,000 |
| 8 | Modernization | 30 kW PV System | New Photovoltaic system to offset power for UV disinfection. | Determine whether or not the project economics are still viable without current grants (during pre-design). If yes, package with UV Disinfection System. | $ 81,000 | $ 270,000 | $ 350,000 |
| 10, 11, 12 | Rehabilitation & Repair (R&R) | Headworks: Influent Screw Pump, Bar Screen, Flume and Grit Chamber Replacement | Replacement of headworks equipment | Replace structural and mechanical headworks assets due to age and condition. Upsize headworks to handle PWWF of 5.9 mgd. | $ 1,980,000 | $ 6,600,000 | $ 8,580,000 |
| 13 | R&R | Primary Clarifier Replacement | Replacement and upsizing of existing primary clarifiers with 2 identical 5.9-mgd clarifiers for complete redundancy | Replacement of existing primary clarifiers with two new 3.0 mgd clarifier (1 standby). Package with sludge pump replacement project | $ 1,386,000 | $ 4,620,000 | $ 6,010,000 |

**ALTERNATIVE 2: EXISTING SYSTEM WITH SIDESTREAM TREATMENT**
**AWTF CIP CASH FLOW 2016-2026**
**CITY OF ARCATA**

| PROJECT DESCRIPTION | | | | | COST ESTIMATES | | |
|---|---|---|---|---|---|---|---|
| CITY PROJECT ID [1] | PROJECT TYPE | PROJECT TITLE | ORIGINAL PROJECT DESCRIPTION (BY CITY) | RECOMMENDED PROJECT DESCRIPTION (BY CAROLLO) | SOFT COSTS (CEQA, DESIGN, LEGAL, ADMIN, CM) | ESTIMATED CONSTRUCTION COST | ESTIMATED PROJECT COST |
| 14 | R&R | Primary Clarifier: Sludge Pump Replacement | 'Replacement of primary sludge and scum pumps (With redundancy) | Package with primary clarifier project. | $ 69,000 | $ 230,000 | $ 300,000 |
| 15A | Regulatory - Capacity | Digester R&R Project - Phase 1 | Replace and reconfigure sludge digestion system to improve performance. | Upgrade and reconfigure sludge digestion system to accommodate additional sludge from new secondary treatment project. Elements to be determined during preliminary design but may include digester cover rehabilitation, digester tank modifications, and heater/boiler upgrade. | $ 300,000 | $ 1,000,000 | $ 1,300,000 |
| 16 | R&R | Treatment Wetlands 4 Influent Pump Replacement | Replacement of Treatment Wetlands 4 Influent Pumps | Evaluate whether project still required during preliminary design. Package with treatment wetlands or oxidation ponds project. | $ 36,000 | $ 120,000 | $ 160,000 |
| 17 | R&R | Treatment Wetlands: Pump Station 1 R&R Project | Replacement of Pump Station 1 pumps | Replace pumps with 2.3 mgd firm capacity (3 mgd with standby running) and rehabilitate wet well.<br>Package with PPS project. | $ 54,000 | $ 180,000 | $ 230,000 |
| 18 | R&R | Treatment Wetlands: Pump Station 2 R&R Project | Replacement of Pump Station 2 pumps | Evaluate whether project still required during preliminary design or if pump station can be demolished with rehabilitation of PPS/PS1 wet well. Package with PPS/PS1 project. | $ 18,000 | $ 60,000 | $ 80,000 |
| 19 | R&R | Oxidation Ponds: Pond Pump Station R&R Project | Plan and implement performance improvements for Oxidation Pond 2 Reconfigure inlet/outlet structures | Replace pumps with 3.6 mgd capacity (with standby running) and rehabilitate wet well.<br>Package with PS1 project. | $ 54,000 | $ 180,000 | $ 230,000 |
| 20 | R&R | Oxidation Ponds: Transfer Structure Reconfiguration | Reconfigure Pond 1 to 2 effluent structures | Allows for better flow distribution and potential storage.<br>Package with oxidation pond work. | $ 82,500 | $ 275,000 | $ 360,000 |

**ALTERNATIVE 2: EXISTING SYSTEM WITH SIDESTREAM TREATMENT**
**AWTF CIP CASH FLOW 2016-2026**
**CITY OF ARCATA**

| PROJECT DESCRIPTION | | | | | COST ESTIMATES | | |
|---|---|---|---|---|---|---|---|
| CITY PROJECT ID [1] | PROJECT TYPE | PROJECT TITLE | ORIGINAL PROJECT DESCRIPTION (BY CITY) | RECOMMENDED PROJECT DESCRIPTION (BY CAROLLO) | SOFT COSTS (CEQA, DESIGN, LEGAL, ADMIN, CM) | ESTIMATED CONSTRUCTION COST | ESTIMATED PROJECT COST |
| 21 | R&R | Disinfection: Chlorine/SO2 Project | Project is undefined | Upgrade existing chlorine gas disinfection system or conversion to hypochlorite liquid chlorine system for plant water chlorination. | $ 45,000 | $ 150,000 | $ 200,000 |
| 22 | R&R | Enhancement Wetlands: Pump Station Project | Replacement of enhancement wetland effluent pump station (Hauser PS) | Replace pumps at the EWPS with 2.3 mgd firm capacity. Add a mechanical bar screen on PS inlet and a strainer on the discharge line. | $ 258,000 | $ 860,000 | $ 1,120,000 |
| 24 | R&R | Oxidation Ponds: Aerator Replacement | Aerator replacement / upgrades | Addition of aerators in Pond 2 for aeration capacity and flow diversion. Includes electrical improvements. | $ 255,000 | $ 850,000 | $ 1,110,000 |
| 26 | R&R | Treatment Wetlands Re-Vegetation Project | Dikes and vegetation maintenance | Regrading (deep and shallow zones) and replanting in TW 1-4 only. | $ 174,000 | $ 580,000 | $ 750,000 |
| 27 | R&R | Enhancement Wetlands Re-Vegetation Project | Dikes and vegetation maintenance | Vegetation maintenance, new inlet/outlet structures with piping, new baffles for short circuiting. Includes additional environmental permitting costs and EW influent pipe sliplining. | $ 822,000 | $ 1,740,000 | $ 2,560,000 |
| 29 | R&R | Oxidation Ponds: Emergency Pond Pump Replacement Project | Develop and implement a disinfection system for Pond 2 storm pumps under the new flow configuration | Provide bypass piping to allow Oxidation Pond 1 effluent to be pumped to Oxidation Pond 2. Package with PPS/PS1 or oxidation pond work. | $ 60,000 | $ 200,000 | $ 260,000 |
| 35N | R&R | Oxidation Ponds: Sludge Removal R&R Project | New Project | Allows for improved treatment and hydraulic capacity in Oxidation Ponds 1 & 2. Assumes 1' sludge dredging, dewatering and disposal. | $ 765,000 | $ 2,550,000 | $ 3,320,000 |
| 37N | Regulatory - Capacity | New Secondary Treatment Project: Oxidation Ditch and Secondary Clarifier Project | New Project | One new oxidation ditch and secondary clarifier sized for 2 mgd capacity. | $ 1,510,500 | $ 5,035,000 | $ 6,550,000 |
| 38N | Regulatory - Capacity | New Secondary Sludge Thickening Project | New Project | New secondary sludge thickening equipment sized for secondary sludge from one oxidation ditch and secondary clarifier. | $ 588,000 | $ 1,960,000 | $ 2,550,000 |

**ALTERNATIVE 2: EXISTING SYSTEM WITH SIDESTREAM TREATMENT**
**AWTF CIP CASH FLOW 2016-2026**
**CITY OF ARCATA**

| PROJECT DESCRIPTION | | | | | COST ESTIMATES | | |
|---|---|---|---|---|---|---|---|
| **CITY PROJECT ID [1]** | **PROJECT TYPE** | **PROJECT TITLE** | **ORIGINAL PROJECT DESCRIPTION (BY CITY)** | **RECOMMENDED PROJECT DESCRIPTION (BY CAROLLO)** | **SOFT COSTS (CEQA, DESIGN, LEGAL, ADMIN, CM)** | **ESTIMATED CONSTRUCTION COST** | **ESTIMATED PROJECT COST** |
| 39N | R&R | Corporation Yard Modifications & Building Replacement | New Project | Allows for corporation yard and building modification costs associated with new and improved facilities. | $ 30,000 | $ 100,000 | $ 130,000 |
| **TOTAL 10 YR CIP** | | | | | | **$ 33,960,000** | **$ 44,670,000** |

Notes: 1. Project ID number as identifed in City of Arcata Capital Improvements Program (CIP)
2. Project priority generally defined as follows: 1 = Permit and Capacity; 2 = R&R; 3 = Modernization; 4 = Sea Level Rise.

**ALTERNATIVE 3: EXISTING SYSTEM WITH PARALLEL TREATMENT**
**AWTF CASH FLOW 2016-2026**
**CITY OF ARCATA**

| PROJECT DESCRIPTION | | | | | COST ESTIMATES | | |
|---|---|---|---|---|---|---|---|
| **CITY PROJECT ID [(1)]** | **PROJECT TYPE** | **PROJECT TITLE** | **ORIGINAL PROJECT DESCRIPTION (BY CITY)** | **RECOMMENDED PROJECT DESCRIPTION (BY CAROLLO)** | **SOFT COSTS (CEQA, DESIGN, LEGAL, ADMIN, CM)** | **ESTIMATED CONSTRUCTION COST** | **ESTIMATED PROJECT COST** |
| 1 | Regulatory - Permit | UV Disinfection System | Replace current chlorine disinfection system with a new UV disinfection system | New UV disinfection system for Outfall 003 sized for 5.9 mgd (UVT 55%). Existing chlorine disinfection system remains for Outfall 001. | $ 942,600 | $ 3,142,000 | $ 4,080,000 |
| 3 | Capacity | Treatment Marsh #7 | Reconfigure current aquaculture ponds into another treatment wetland | N/A in Alternative #3 within 10-yr CIP (deferred to later phase). | $ - | | $ - |
| 4 | Regulatory - Permit | AWTF Reconfiguration/ New Outfall 003 | a. Re-route the wastewater treatment flow from a two-pass configuration to a single-pass configuration (permit)<br>b. Construct Outfall 003 (permit)<br>c. Replace the pumps at the Enhancement Wetlands (Hauser) PS (capacity) | a. Reroute flow (piping) from the two pass configuration to single pass configuration.<br>b. Construct Outfall 003 and effluent piping (from UV to Outfall 003).<br>c. Package with new secondary treatment project. | $ 543,000 | $ 1,810,000 | $ 2,350,000 |
| 8 | Modernization | 30 kW PV System | New Photovoltaic system to offset power for UV disinfection. | Determine whether or not the project economics are still viable without current grants (during pre-design). If yes, package with UV Disinfection System. | $ 81,000 | $ 270,000 | $ 350,000 |
| 10, 11, 12 | Rehabilitation & Repair (R&R) | Headworks: Influent Screw Pump, Bar Screen, Flume and Grit Chamber Replacement | Replacement of headworks equipment | Replace structural and mechanical headworks assets due to age and condition. Upsize headworks to handle PWWF of 5.9 mgd. | $ 1,980,000 | $ 6,600,000 | $ 8,580,000 |
| 13 | R&R | Primary Clarifier Replacement | Replacement and upsizing of existing primary clarifiers with 2 identical 5.9-mgd clarifiers for complete redundancy | Replacement of existing primary clarifiers with one new 1.8 mgd clarifier. Package with sludge pump replacement project | $ 468,000 | $ 1,560,000 | $ 2,030,000 |

**ALTERNATIVE 3: EXISTING SYSTEM WITH PARALLEL TREATMENT**
**AWTF CASH FLOW 2016-2026**
**CITY OF ARCATA**

| PROJECT DESCRIPTION | | | | | COST ESTIMATES | | |
|---|---|---|---|---|---|---|---|
| CITY PROJECT ID [1] | PROJECT TYPE | PROJECT TITLE | ORIGINAL PROJECT DESCRIPTION (BY CITY) | RECOMMENDED PROJECT DESCRIPTION (BY CAROLLO) | SOFT COSTS (CEQA, DESIGN, LEGAL, ADMIN, CM) | ESTIMATED CONSTRUCTION COST | ESTIMATED PROJECT COST |
| 14 | R&R | Primary Clarifier: Sludge Pump Replacement | Replacement of primary sludge and scum pumps for one 1.8 mgd clarifier. | Package with primary clarifier project. | $ 42,000 | $ 140,000 | $ 180,000 |
| 15A | Regulatory - Capacity | Digester R&R Project - Phase 1 | Replace and reconfigure sludge digestion system to improve performance. | Upgrade and reconfigure sludge digestion system to accommodate additional sludge from new secondary treatment project. Elements to be determined during preliminary design but may include digester cover rehabilitation, digester tank modifications, and heater/boiler upgrade. | $ 300,000 | $ 1,000,000 | $ 1,300,000 |
| 16 | R&R | Treatment Wetlands 4 Influent Pump Replacement | Replacement of Treatment Wetlands 4 Influent Pumps | Evaluate whether project still required during preliminary design. Package with treatment wetlands or oxidation ponds project. | $ 36,000 | $ 120,000 | $ 160,000 |
| 17 | R&R | Treatment Wetlands: Pump Station 1 R&R Project | Replacement of Pump Station 1 pumps | Replace pumps with 1.3 mgd firm capacity (1.8 mgd with standby running) and rehabilitate wet well.<br>Package with PPS project. | $ 36,000 | $ 120,000 | $ 160,000 |
| 18 | R&R | Treatment Wetlands: Pump Station 2 R&R Project | Replacement of Pump Station 2 pumps | Evaluate whether project still required during preliminary design or if pump station can be demolished with rehabilitation of PPS/PS1 wet well. Package with PPS/PS1 project. | $ 18,000 | $ 60,000 | $ 80,000 |
| 19 | R&R | Oxidation Ponds: Pond Pump Station R&R Project | Plan and implement performance improvements for Oxidation Pond 2 Reconfigure inlet/outlet structures | Replace pumps with 2.3 mgd firm capacity and rehabilitate wet well.<br>Package with PS1 project. | $ 45,000 | $ 150,000 | $ 200,000 |
| 20 | R&R | Oxidation Ponds: Transfer Structure Reconfiguration | Reconfigure Pond 1 to 2 effluent structures | Allows for better flow distribution and potential storage.<br>Package with oxidation pond work. | $ 82,500 | $ 275,000 | $ 360,000 |

**ALTERNATIVE 3: EXISTING SYSTEM WITH PARALLEL TREATMENT**
**AWTF CASH FLOW 2016-2026**
**CITY OF ARCATA**

| PROJECT DESCRIPTION | | | | | COST ESTIMATES | | |
|---|---|---|---|---|---|---|---|
| CITY PROJECT ID [1] | PROJECT TYPE | PROJECT TITLE | ORIGINAL PROJECT DESCRIPTION (BY CITY) | RECOMMENDED PROJECT DESCRIPTION (BY CAROLLO) | SOFT COSTS (CEQA, DESIGN, LEGAL, ADMIN, CM) | ESTIMATED CONSTRUCTION COST | ESTIMATED PROJECT COST |
| 21 | R&R | Disinfection: Chlorine/SO2 Project | Project is undefined | Upgrade existing chlorine gas disinfection system or conversion to hypochlorite liquid chlorine system for plant water chlorination. | $ 45,000 | $ 150,000 | $ 200,000 |
| 22 | R&R | Enhancement Wetlands: Pump Station Project | Replacement of enhancement wetland effluent pump station (Hauser PS) | Replace pumps at the EWPS with 1.8 mgd firm capacity. Add a mechanical bar screen on PS inlet and a strainer on the discharge line. | $ 249,000 | $ 830,000 | $ 1,080,000 |
| 24 | R&R | Oxidation Ponds: Aerator Replacement | Aerator replacement / upgrades | N/A in Alternative #3. | $ - | | $ - |
| 26 | R&R | Treatment Wetlands Re-Vegetation Project | Dikes and vegetation maintenance | Regrading (deep and shallow zones) and replanting in TW 1-4 only. | $ 174,000 | $ 580,000 | $ 750,000 |
| 27 | R&R | Enhancement Wetlands Re-Vegetation Project | Dikes and vegetation maintenance | Vegetation maintenance, new inlet/outlet structures with piping, new baffles for short circuiting. Includes additional environmental permitting costs and EW influent pipe sliplining. | $ 822,000 | $ 1,740,000 | $ 2,560,000 |
| 29 | R&R | Oxidation Ponds: Emergency Pond Pump Replacement Project | Develop and implement a disinfection system for Pond 2 storm pumps under the new flow configuration | Provide bypass piping to allow Oxidation Pond 1 effluent to be pumped to Oxidation Pond 2. Package with PPS/PS1 or oxidation pond work. | $ 60,000 | $ 200,000 | $ 260,000 |
| 35N | R&R | Oxidation Ponds: Sludge Removal R&R Project | New Project | Allows for improved treatment and hydraulic capacity in Oxidation Ponds 1 & 2. Assumes 1' sludge dredging, dewatering and disposal. | $ 765,000 | $ 2,550,000 | $ 3,320,000 |
| 37N | Regulatory - Capacity | New Secondary Treatment Project: Oxidation Ditches and Secondary Clarifiers Project | New Project | New oxidation ditches and secondary clarifiers sized for 4.1 mgd capacity. | $ 3,021,000 | $ 10,070,000 | $ 13,090,000 |
| 38N | Regulatory - Capacity | New Secondary Sludge Thickening Project | New Project | New secondary sludge thickening equipment sized for secondary sludge from oxidation ditches and secondary clarifiers. | $ 588,000 | $ 1,960,000 | $ 2,550,000 |

**ALTERNATIVE 3: EXISTING SYSTEM WITH PARALLEL TREATMENT**
**AWTF CASH FLOW 2016-2026**
**CITY OF ARCATA**

| PROJECT DESCRIPTION | | | | | COST ESTIMATES | | |
|---|---|---|---|---|---|---|---|
| **CITY PROJECT ID [1]** | **PROJECT TYPE** | **PROJECT TITLE** | **ORIGINAL PROJECT DESCRIPTION (BY CITY)** | **RECOMMENDED PROJECT DESCRIPTION (BY CAROLLO)** | **SOFT COSTS (CEQA, DESIGN, LEGAL, ADMIN, CM)** | **ESTIMATED CONSTRUCTION COST** | **ESTIMATED PROJECT COST** |
| 39N | R&R | Corporation Yard Modifications & Building Replacement | New Project | Allows for corporation yard and building modification costs associated with new and improved facilities. | $ 30,000 | $ 100,000 | $ 130,000 |
| **TOTAL CIP** | | | | | | **$ 33,430,000** | **$ 43,770,000** |

Notes: 1. Project ID number as identifed in City of Arcata Capital Improvements Program (CIP)
2. Project priority for early phase (A) and late phase (B) generally defined as follows: 1 = Permit and Capacity; 2 = R&R; 3 = Modernization; 4 = Sea Level Rise.

# APPENDIX R – CIP ALTERNATIVE OPERATION AND MAINTENANCE COST INFORMATION

Appendix R-1 CIP Alternative O Cost Information
City of Arcata
Wastewater Treatment Facility Improvements Project

**Alternative 1: Existing System Rehabilitation**

| | PROCESS | | | | | POWER | | | | | PARTS REPLACEMENT | | | CHEMICAL | Vegetation Management | Added Labor | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Process Area | Average Flow (mgd) | No. of Operating Units | TDH (ft) | Power Required (hp) | Connected Motor Power (hp) | Total Operating Motor Power (hp) | Annual Use (%) | Total (hp) | Power input (KW) | Power Cost ($/year) | Material ($/year) | Labor ($/year) | Total ($/year) | Chemical Cost ($/year) | $/year | **Added Labor $/year** | **O&M Cost ($/year)** |
| Primary Clarifiers (2 @3.0 mgd) | 2.3 | | | | | | | | | | | | | | | | |
| Clarifier Mechanism | | 1 | | | 2 | 2 | 100% | 2 | 1 | $1,830 | $1,000 | | $1,000 | | | | |
| Primary Sludge Pumps | 0.3 | 1 | 50 | 3 | 3.4 | 3 | 100% | 3 | 3 | $3,085 | $1,000 | | $1,000 | | | | |
| Primary Scum Pumps | 0.1 | 1 | 50 | 1 | 1.7 | 2 | 100% | 2 | 1 | $1,542 | | | | | | | |
| | | | | | | | | | | **$6,500** | | | **$2,000** | **$0** | | | **$8,500** |
| Oxidation Ponds | 2.3 | | | | | | | | | | | | | | | | |
| Aerators | | 8 | | | 15.0 | 120 | 100% | 120 | 90 | $109,827 | $1,000 | | $1,000 | | | | |
| Pumping | | | | | | | | | | | | | | | | | |
| PS1 | 2.3 | 1 | 20 | 8 | 10.8 | 11 | 100% | 11 | 8 | $9,854 | $1,000 | | $1,000 | | | | |
| EPPS | 0 | 1 | 10 | 0 | 0.0 | 0 | 10% | 0 | 0 | $0 | | | | | | | |
| PPS | 0 | 1 | 20 | 0 | 0.0 | 0 | 25% | 0 | 0 | $0 | | | | | | | |
| EWPS | 2.3 | 1 | 30 | 12 | 15.0 | 15 | 100% | 15 | 11 | $13,728 | $1,000 | | $1,000 | | | | |
| | | | | | | | | | | **$133,400** | | | **$3,000** | **$0** | | | **$136,400** |
| Ultraviolet Disinfection (UVT @ 35%) | 2.3 | | | | | | | | | | | | | | | | |
| Lamps | | | | | | | | | 55 | **$67,771** | $112,000 | | $112,000 | | | **$30,000** | **$209,771** |
| Chlorine Disinfection | | | | | | | | | | | | | | | | | |
| Hypochlorite (3W) | | | | | | | | | | | | | | | | | |
| Metering Pumps | 0.1 | 1 | 30 | 1 | 1.0 | 1 | 100% | 1 | 1 | $915 | $5,000 | | $5,000 | | | $2,500 | **$13,415** |
| Wetland Vegetation Management | | | | | | | | | | | | | | | | | |
| Treatment wetlands 12 acres @ $5,000 per acre | | | | | | | | | | | | | | | $60,000 | $10,000 | **$70,000** |
| Enhancement wetlands 33 acres @ $2,500 per acre | | | | | | | | | | | | | | | $82,500 | $10,000 | **$92,500** |
| Pond Sludge Removal (Cost per year, for removal every 5 years) | | | | | | | | | | | | | | | | | **$10,000** |
| **Permit Violations (Does not include any Nutrient Criteria violations)** | | | | | | | | | | | | | | | | | **$125,000** |
| | | | | | | | | | | **$208,586** | **$122,000** | | **$5,000** | | **$142,500** | **$52,500** | **$666,000** |

Unit Prices

| | | |
|---|---|---|
| Elec: | $0.14 | $/kwh |
| Pond Dredging Cost | $50,000 | $/ac-ft |
| Treatment Wetlands Rehab: | $100,000 | $/ac |
| Violations: | $3,000 | $/violation |

**Alternative 2: Existing System Rehabilitation with Side stream Treatment**

| | PROCESS | | | | | POWER | | | | | | PARTS REPLACEMENT | | | CHEMICAL | Vegetation Manageme | Added Labor | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Process Area | Flow (mgd) | No. of Operating Units | TDH (ft) | Power Required (hp) | Connected Motor Power (hp) | Req'd Pump (bhp) | Total Operating Motor Power (hp) | Annual Use (%) | Total (hp) | Power input (KW) | Power Cost ($/year) | Material ($/year) | Labor ($/year) | Total ($/year) | Chemical Cost ($/year) | $/year | **Added Labor $/year** | **O&M Cost ($/year)** |
| Primary Clarifiers (2 @ 3.0 mgd) | 2.3 | | | | | | | | | | | | | | | | | |
| Clarifier Mechanism | | 1 | | | 2 | -- | 2 | 100% | 2 | 1 | $1,830 | $1,000 | | $1,000 | | | | |
| Primary Sludge Pumps | 0.3 | 1 | 50 | 3 | 3.4 | -- | 3 | 100% | 3 | 3 | $3,085 | $1,000 | | $1,000 | | | | |
| Primary Scum Pumps | 0.1 | 1 | 50 | 1 | 1.7 | | 2 | 100% | 2 | 1 | $1,542 | | | | | | | |
| | | | | | | | | | | | **$6,500** | | | **$2,000** | **$0** | | | **$8,500** |
| Oxidation Ponds | 1.5 | | | | | | | | | | | | | | | | | |
| Aerators | | 8 | | | 15.0 | -- | 120 | 100% | 120 | 90 | $109,827 | $1,000 | | $1,000 | | | | |
| Pumping | | | | | | | | | | | | | | | | | | |
| PS1 | 2.3 | 1 | 20 | 8 | 10.8 | | 11 | 100% | 11 | 8 | $9,854 | $1,000 | | $1,000 | | | | |
| EPPS | 0 | 1 | 10 | 0 | 0.0 | | 0 | 10% | 0 | 0 | $0 | | | | | | | |
| PPS | 0 | 1 | 20 | 0 | 0.0 | | 0 | 25% | 0 | 0 | $0 | | | | | | | |
| EWPS | 2.3 | 1 | 30 | 12 | 15.0 | | 15 | 100% | 15 | 11 | $13,728 | $1,000 | | $1,000 | | | | |
| | | | | | | | | | | | **$133,400** | | | **$3,000** | **$0** | | | **$136,400** |
| Oxidation Ditches | 0.8 | | | | | | | | | | | | | | | | | |
| Aerators | | 1 | | | 100.0 | -- | 100 | 100% | 100 | 75 | $91,522 | $5,000 | | $5,000 | | | $12,500 | |
| Secondary Clarifiers | | | | | | | | | | | | | | | | | | |
| Clarifier Mechanism | | 1 | | | 2 | | 2 | 100% | 2 | 1 | $1,830 | $1,000 | | $1,000 | | | | |
| RAS Pumping | 0.8 | 1 | 25 | 4 | 4.7 | | 5 | 100% | 5 | 3 | $4,284 | $1,000 | | $1,000 | | | | |
| WAS Pumping | 0.1 | 1 | 25 | 0 | 0.4 | | 0 | 100% | 0 | 0 | $386 | $500 | | $500 | | | | |
| Scum Pumping | 0.1 | 1 | 40 | 1 | 0.7 | | 1 | 100% | 1 | 1 | $617 | $250 | | $250 | | | | |
| | | | | | | | | | | | **$98,600** | | | **$7,800** | **$0** | | **$12,500** | **$118,900** |
| Ultraviolet Disinfection (UVT @ 35%) | 5.9 | | | | | | | | | | | | | | | | | |
| Lamps | | | | | | | | | | 55 | $67,771 | $111,749 | | $111,749 | | | **$30,000** | **$209,520** |
| Chlorine Disinfection | | | | | | | | | | | | | | | | | | |
| Hypochlorite (3W) | | | | | | | | | | | | | | | | | | |
| Metering Pumps | 0.1 | 1 | 30 | 1 | 1.0 | | 1 | 100% | 1 | 1 | $915 | | | $5,000 | $5,000 | | $2,500 | **$13,415** |
| Thickening | | | | | | | | | | | | | | | | | | |
| Gravity Belt Thickener | | 1 | | | 5 | | 5 | 50% | 3 | 2 | $2,288 | $ 2,000 | | $ 2,000 | | | $12,500 | |
| TWAS Pumping | | 1 | | | 7.5 | | 8 | 50% | 4 | 3 | $3,432 | $ 500 | | $ 500 | | | | |
| Polymer System | | 1 | | | 1 | | 1 | 50% | 1 | 0 | $458 | $ 500 | | $ 500 | $5,000 | | | |
| | | | | | | | | | | | $6,178 | | | $ 3,000 | $5,000 | | $12,500 | **$26,678** |
| Wetland Vegetation Management | | | | | | | | | | | | | | | | | | |
| Treatment wetlands 12 acres | | | | | | | | | | | | | | | | $60,000 | $10,000 | $70,000 |
| Enhancement wetlands 33 acres | | | | | | | | | | | | | | | | $165,000 | $10,000 | $175,000 |
| | | | | | | | | | | | **$313,364** | | | **$132,549** | **$10,000** | **$225,000** | **$77,500** | **$758,000** |
| | | | | | | | | | | | | | | | | | | $758,413 |

Unit Prices

| | | |
|---|---|---|
| Elec: | $0.14 | $/kwh |
| Pond Dredging Cost | $50,000 | $/ac-ft |
| Treatment Wetlands Rehab: | $100,000 | $/ac |
| Violations: | $3,000 | $/violation |

**Alternative 3: Existing System Rehabilitation with Parallel Treatment**

| | PROCESS | | | | | POWER | | | | | | PARTS REPLACEMENT | | | CHEMICAL | Mangement | Labor | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Process Area | Flow (mgd) | No. of Operating Units | TDH (ft) | Power Required (hp) | Connected Motor Power (hp) | Req'd Pump (bhp) | Total Operating Motor Power (hp) | Annual Use (%) | Total (hp) | Power input (KW) | Power Cost ($/year) | Material ($/year) | Labor ($/year) | Total ($/year) | Chemical Cost ($/year) | $/year | **Added Labor $/year** | **O&M Cost ($/year)** |
| Primary Clarifiers (1 @ 3.0 mgd) | 2.3 | | | | | | | | | | | | | | | | | |
| Clarifier Mechanism | | 1 | | | 2 | -- | 2 | 100% | 2 | 1 | $1,830 | $1,000 | | $1,000 | | | | |
| Primary Sludge Pumps | 0.3 | 1 | 50 | 3 | 3.4 | -- | 3 | 100% | 3 | 3 | $3,085 | $1,000 | | $1,000 | | | | |
| Primary Scum Pumps | 0.1 | 1 | 50 | 1 | 1.7 | | 2 | 100% | 2 | 1 | $1,542 | | | | | | | |
| | | | | | | | | | | | **$6,500** | | | **$2,000** | **$0** | | | **$8,500** |
| Oxidation Ponds | 1 | | | | | | | | | | | | | | | | | |
| Aerators | | 0 | | | 15.0 | -- | 0 | 25% | 0 | 0 | $0 | | | | | | | |
| Pumping | | | | | | | | | | | | | | | | | | |
| EPPS | 0 | 1 | 10 | 0 | 0.0 | | 0 | 10% | 0 | 0 | $0 | | | | | | | |
| PPS/PS1 | 1 | 1 | 20 | 4 | 4.7 | | 5 | 100% | 5 | 3 | $4,284 | $1,000 | | $1,000 | | | | |
| EWPS | 1 | 1 | 30 | 5 | 15.0 | | 15 | 100% | 15 | 11 | $13,728 | | | | | | | |
| | | | | | | | | | | | | $1,000 | | $1,000 | | | | |
| | | | | | | | | | | | **$18,000** | | | **$2,000** | **$0** | | | **$20,000** |
| Oxidation Ditches | 1.3 | | | | | | | | | | | | | | | | | |
| Aerators | | 1 | | | 100.0 | -- | 100 | 100% | 100 | 75 | $91,522 | $5,000 | | $5,000 | | | $12,500 | |
| Secondary Clarifiers | | | | | | | | | | | | | | | | | | |
| Clarifier Mechanism | | 1 | | | 2 | | 2 | 100% | 2 | 1 | $1,830 | $1,000 | | $1,000 | | | | |
| RAS Pumping | 1.3 | 1 | 25 | 6 | 7.6 | | 8 | 100% | 8 | 6 | $6,962 | $1,000 | | $1,000 | | | | |
| WAS Pumping | 0.1 | 1 | 25 | 0 | 0.4 | | 0 | 100% | 0 | 0 | $386 | $500 | | $500 | | | | |
| Scum Pumping | 0.1 | 1 | 40 | 1 | 0.7 | | 1 | 100% | 1 | 1 | $617 | $250 | | $250 | | | | |
| | | | | | | | | | | | **$101,300** | | | **$7,800** | **$0** | | **$12,500** | **$121,600** |
| Ultraviolet Disinfection (UVT @ 35%) | 5.9 | | | | | | | | | | | | | | | | | |
| Lamps | | | | | | | | | | 55 | $43,127 | $40,000 | | $40,000 | | | **$25,000** | **$108,127** |
| Chlorine Disinfection | | | | | | | | | | | | | | | | | | |
| Hypochlorite (3W) | | | | | | | | | | | | | | | | | | |
| Metering Pumps | 0.1 | 1 | 30 | 1 | 1.0 | 1 | | 100% | 1 | 1 | $915 | | | $5,000 | $5,000 | | $2,500 | **$13,415** |
| Thickening | | | | | | | | | | | | | | | | | | |
| Gravity Belt Thickener | | 1 | | | 5 | 5 | | 50% | 3 | 2 | $2,288 | $ 2,000 | | $ 2,000 | | | $12,500 | |
| TWAS Pumping | | 1 | | | 7.5 | 8 | | 50% | 4 | 3 | $3,432 | $ 500 | | $ 500 | | | | |
| Polymer System | | 1 | | | 1 | 1 | | 50% | 1 | 0 | $458 | $ 500 | | $ 500 | $5,000 | | | |
| | | | | | | | | | | | $6,178 | | | $ 3,000 | $5,000 | | $12,500 | **$26,678** |
| Wetland Vegitation Management | | | | | | | | | | | | | | | | | | |
| Treatment wetlands 12 acres | | | | | | | | | | | | | | | | $30,000 | $10,000 | $40,000 |
| Enhancement wetlands 33 acres | | | | | | | | | | | | | | | | $82,500 | $10,000 | $92,500 |
| | | | | | | | | | | | **$176,020** | | | **$59,800** | **$10,000** | **$112,500** | **$72,500** | **$431,000** |
| | | | | | | | | | | | | | | | | | | $430,820 |

Unit Prices

| | | |
|---|---|---|
| Elec: | $0.14 | $/kwh |
| Pond Dredging Cost | $50,000 | $/ac-ft |
| Treatment Wetlands Rehab: | $100,000 | $/ac |
| Violations: | $3,000 | $/violation |

# APPENDIX S - PRESENTATIONS TO CITY COUNCIL




## What we heard at April Council Meeting

- Need to closely revisit capacity shortfall
- Look at opportunities to rehabilitate existing facilities
  - Pond solids removal
  - Wetlands revegetation
- Expand Alternatives discussion
- Confirmed plan to move away from chlorine disinfection and use UV disinfection instead

## Agenda

- Background
- Treatment/Permit Overview
- Existing Facilities Review
  - Capacity Shortfall
- Expanded Alternatives
- Alternatives Comparison
- Next Steps



## Wastewater Treatment Facility Improvement Project Goals



- Provide reliable service to the community now and in the future



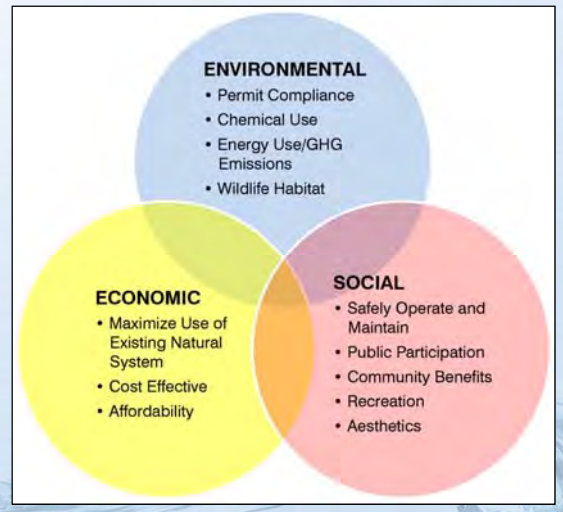
- Meet permit/regulatory requirements that protect public health and the environment



- Meet City's goals for sustainability, as much as possible

## Philosophy of Sustainability – What does that mean for this project?

*Triple bottom line framework*






## Arcata's system is recognized around the world - sustainable treatment with community and environmental benefits



## Drivers to do anything different

- Permit violations
- Aging infrastructure
- Capacity limitations
- Deferred maintenance







## Process for this Improvement Project

| Task Description | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|
| Facility Plan | | | | | | |
| RWQCB Meetings | | | | | | |
| Predesign | | | | | | |
| Final design | | | | | | |
| Construction | | | | | | |
| Start up | | | | | | |

## Break for Questions/ Comments



## Wastewater Treatment/ Permit Overview

## Discharge permit requirements are governed by California and EPA

- Effluent standards for treatment wetlands prior to AMWS
- Effluent standards for discharge to Humboldt Bay:
  - Current location
  - New discharge point at brackish marsh
- Water Quality Criteria established to be protective of human health and aquatic organisms


Water Boards

North Coast Regional Water Quality Control Board

ORDER NO. R1-2012-0031
NPDES NO. CA0022713
WDID NO. 1B82114OHUM

WASTE DISCHARGE REQUIREMENTS
FOR THE
CITY OF ARCATA
MUNICIPAL WASTEWATER TREATMENT FACILITY



## Only allowed to discharge to Humboldt Bay because of enhancement wetlands

*Discharges to enclosed bays and estuaries are prohibited by state law*

- Resolution No. 83-9 by RWQCB acknowledged that discharge of treated waste water through the AMWS met definition of “enhancement” as established by State.
- Permit ensures that water quality is enhanced by treatment through AMWS to the fullest extent possible prior to discharge to Humboldt Bay



## "How It Works"

Arcata's sustainable system combines conventional and land based treatment elements:

- Headworks and primary clarifier
- Oxidation ponds, treatment wetlands, and enhancement wetlands: Allen, Gearheart, and Hauser.
- Chemical treatment/disinfection
- Digesters, and sludge drying beds
- Discharge to bay




*from FOAM website*



## History of treatment in Arcata



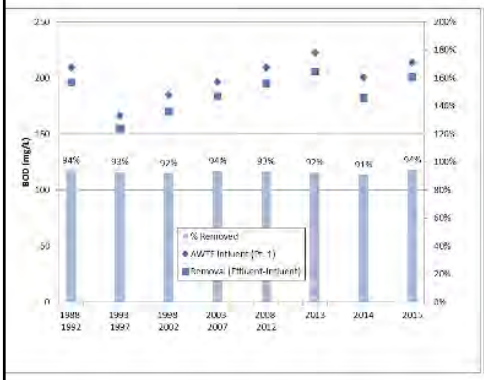
*Early primary treatment, circa 1954*

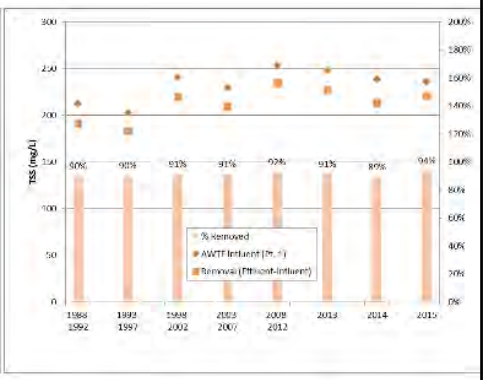


*Ponds and wetlands, around 1989*

- Mandatory minimum penalties implemented by State Board in 1999, enforced in 2006
- Regulatory climate is increasingly stringent

## Looking at annual averages…. existing system has performed well over the years




## However…. Permit compliance is not measured on annual averages



## Compliance review found ongoing treatment issues (violations)

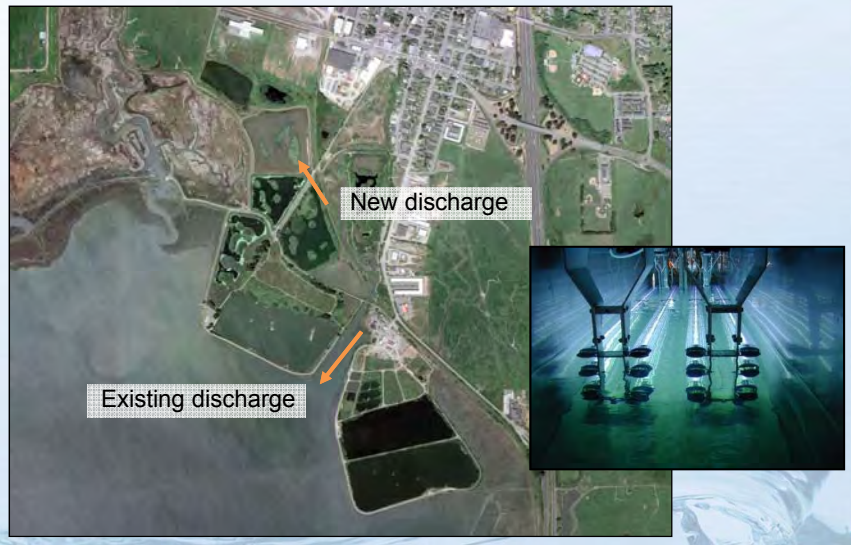
- NPDES permit notes violations/penalties (2008-2012)
- 2013: 12 noncompliance treatment incidents
- 2014: 23 noncompliance treatment incidents
- 2015: 27 noncompliance treatment incidents

May be subject to mandatory penalties (34 of 62 incidents)

**Issues related to:**
- Secondary Treatment
- Disinfection (by products)
- Ammonia Toxicity



## 2012 Permit requires UV disinfection and Flow reconfiguration - new discharge

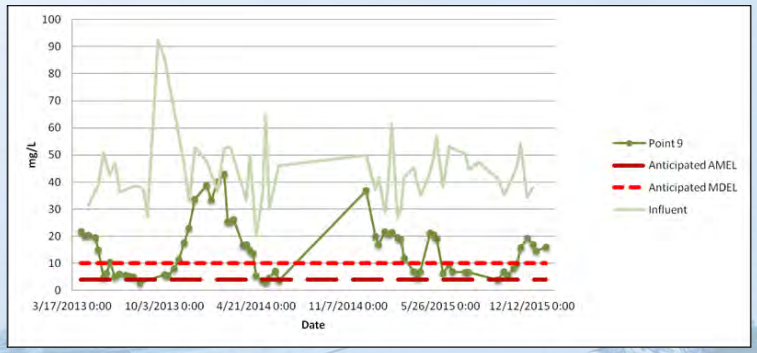







## Potential future regulatory issues

- Virus disinfection to provide shellfish protection
- Ammonia/Nutrient limits expected in the next permit in 2018 (to protect aquatic health/toxicity)
- Pharmaceuticals and other contaminants in future permits

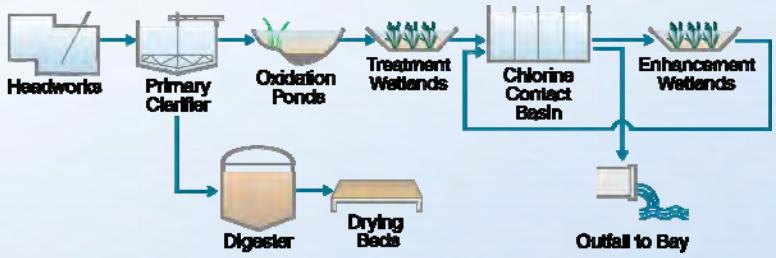


## Break for Questions/ Comments



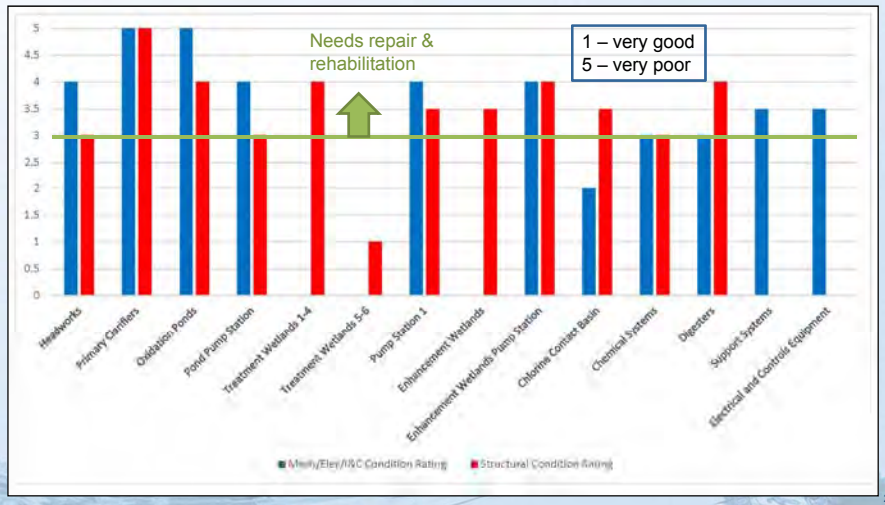
## Existing Facility Review

# Existing Facility Schematic

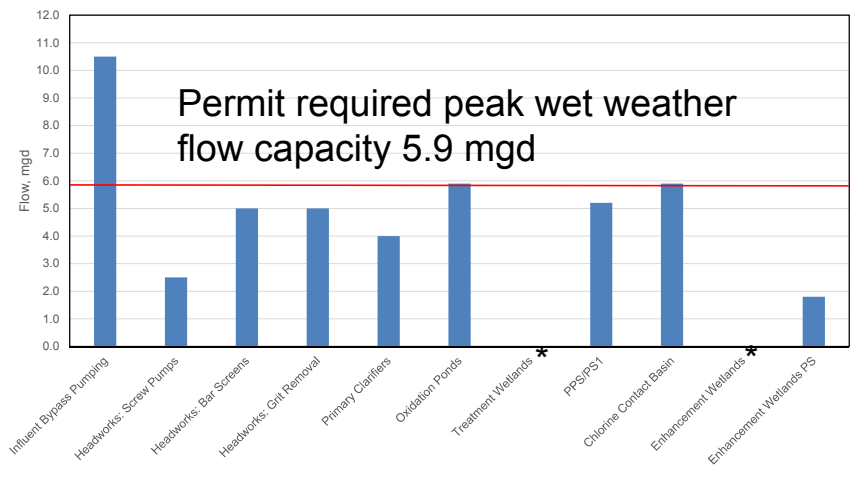





# Condition Rankings: 30 year old facilities are well maintained but in need of rehabilitation and repairs



# Hydraulic Capacity - Shortfalls

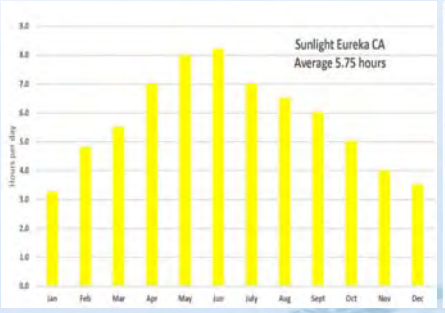


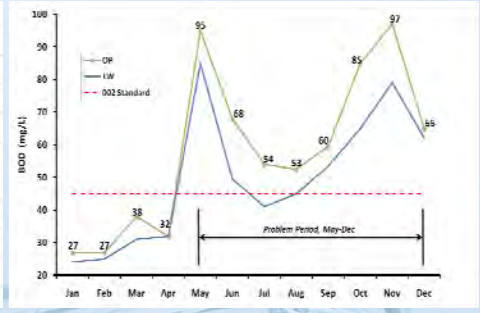

* Wetland hydraulic capacity based on pump stations



# Pond and wetland treatment capacity

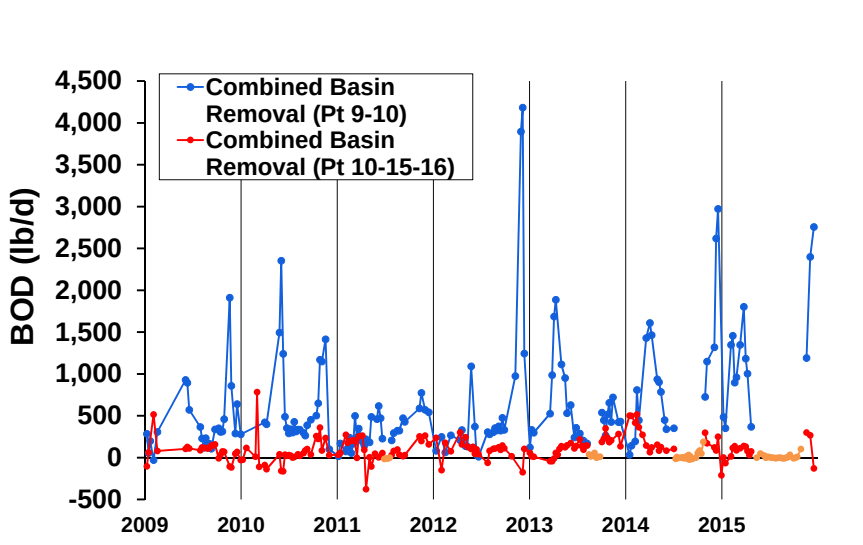
- Land based system has performed well over past 30 years, with help of chlorination system (oxidizing)
- Treatment capacity has deteriorated due to deferred vegetation maintenance and solids accumulation
- System has variable performance due to climate which make it difficult to comply with increasingly restrictive limits




*From Arcata Marsh Research Institute (AMRI)*

## Chlorination impact on BOD removal capacity






## Process Capacity shortfall identified

| Process | BOD load removed, ppd | BOD load remaining, ppd |
|---|---|---|
| Influent | | 4,400 |
| Primary Clarifiers | 1,320 | 3,080 |
| Ponds | 1,150 | 1,930 |
| Treatment Wetlands | 340 | 1,590 |
| Enhancement Wetlands | 120 | 1,470 |
| Disinfection | none if UV | |
| Discharge Goal at 10 mg/l | 190 | 1,280 |
| BOD Capacity Shortfall | | 1,280 |

- Influent load to meet General Plan = 4400 ppd BOD
- Existing facilities capacity (without Cl) < 3200 ppd
- BOD removal capacity shortfall = 1280 ppd

## Summary of Future Needs

**Capacity**

- Projected 10% increase in load
  - 4000 ppd BOD Design going to 4400 ppd
- Consistent with General Plan projections
- Dry weather flow is not an issue

**Future regulatory requirements**

- Ammonia
- Nutrients (Total Nitrogen and Phosphorus)
- Toxicity
- Contaminants of Emerging Concern



## Break for Questions/ Comments

# Expanded Alternatives



## Review of philosophy in developing alternatives and CIP

- 100% permit compliance
- Reliable capacity to meet all flows/loads and general plan growth
- Maximize existing natural system
- Address deferred maintenance
- Address aging infrastructure through repair and rehabilitation





## Common CIP project elements identified for near term

| Process | Action | Driver |
|---|---|---|
| Flow configuration | New outfall in brackish marsh | • ***Permit*** condition |
| Disinfection | New UV disinfection | • Prevent ***permit*** violations<br>• Eliminates chlorine use |
| Headworks | Replace and provide new equipment | • Increase reliable ***capacity***<br>• ***Replacement*** of aging infrastructure |
| Primary Treatment | Replace | • Increase reliable ***capacity***<br>• ***Replacement*** of aging inf. |
| Plant Pumping Systems | Replace | • Increase reliable ***capacity***<br>• ***Replacement*** of aging inf. |
| Digesters | Rehabilitate | • Maintain reliable ***capacity***<br>• ***Replacement*** of aging inf. |



## Common Elements – Address Deferred Maintenance

- Oxidation Ponds
  - Solids removal
  - Flow routing
  - Attenuation of wet weather flows
- Treatment Wetlands
  - Removal of vegetative mats and solids
  - Regrading
  - Revegetation
- Enhancement Wetlands
  - Vegetation Management
  - Flow short circuiting





# Initial screening evaluated treatment type compared to constituents removed

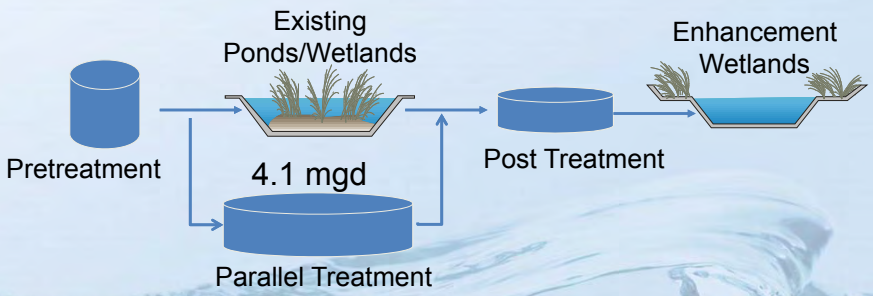
| Process | Ability to Remove | | |
|---|---|---|---|
| | Organics (BOD)(1) | Ammonia(2) | Total Nitrogen(2) |
| **Suspended Growth** | | | |
| Activated Sludge (conventional or oxidation ditch) | X | X | X |
| **Attached Growth** | | | |
| Trickling Filters | X | | |
| Nitrifying Trickling Filters | | X | |
| Denitrification Filters | | | X |
| **Land Based Systems** | | | |
| Ponds (Aerated or not) | X | Summer only | |
| Vegetated Wetlands | X | minor | If nitrified before |
| Open Water Wetlands | X | moderate | If nitrified before |

*Notes:*
*(1) Current permit discharge requirement.*
*(2) Anticipated future permit discharge requirement.*



# Second screening considered sequence of treatment relative to existing system

- Considered:
  - Pretreatment - reduce BOD load before/in ponds
  - Parallel - provide BOD treatment for part of flow
  - Post treatment – provide BOD removal after TWs



## Pretreatment options considered:

| | Treatment Option | Adds BOD capacity ? | Removes ammonia ? | Improves final UVT? | Reliable? | Move forward ? |
|---|---|---|---|---|---|---|
| Pretreatment | Chemically Enhanced Primary | < 400 ppd | No | No | Yes | No |
| | Aeration in Ponds | yes | limited | No | Yes | Yes |
| | Trickling Filter | Yes | only if 2-stage | No | Yes | No |
| | Activated Sludge/Ox Ditch | Yes | Yes | No | Yes | No |



## Parallel Treatment options considered:

| | Treatment Option | Adds BOD capacity ? | Removes ammonia ? | Improves final UVT? | Reliable? | Move forward ? |
|---|---|---|---|---|---|---|
| Parallel | Additional Ponds/Wetlands | Yes | Summer only | No | Maybe | TW#7 |
| | Rehabilitate Ponds/Wetlands | Yes - not enough | Summer only | No | Maybe | Yes |
| | Trickling Filter | Yes | only if 2-stage | No | Yes | Yes |
| | Activated Sludge/Ox Ditch | Yes | Yes | Yes | Yes | Yes |

## Post treatment options considered

| | Treatment Option | Adds BOD capacity ? | Removes ammonia ? | Improves final UVT? | Reliable? | Move forward? |
|---|---|---|---|---|---|---|
| Post Treatment | Trickling Filter/Nitrifying TF | Yes | 2-stage | No | No | No |
| | Submerged Biofilter | Yes | Yes | ? Likely No | Unknown | No - Need to pilot |
| | Ozone/Biological Active Filtration | Yes | Maybe - must pilot | Not needed | Maybe - must pilot | No - Need to pilot |
| | Filtration | < 400 ppd | No | Maybe | Yes | No - Need to pilot |



## Summary of screening (carried forward)

In addition to rehabilitation of the land based system is included in all alternatives

- Pretreatment Options
  - Aeration in ponds
- Parallel treatment Options
  - Rehab existing system (ponds/wetlands)/add TW#7
  - Conventional Activated Sludge (Aeration Basins, Blowers, Diffusers)
  - Extended Aeration Activated Sludge (Oxidation Ditch)
  - Trickling Filters (Plastic Media)

## Evaluation of Parallel treatment options — Noneconomic factors

| Alternative | Meets Permit | Ease of O&M | Constructability | Reliability | Ammonia Removal |
|---|---|---|---|---|---|
| Conventional Activated Sludge | 3 | 1 | 3 | 3 | 2 |
| Extended Aeration – Oxidation Ditch | 3 | 3 | 2 | 3 | 3 |
| Trickling Filters | 1 | 2 | 2 | 1 | 1 |

*Criteria: 1 = least favorable to 3 = most favorable*



## Evaluation of Parallel treatment options — Economic factors

| Alternative | Construction Cost | Footprint | Operator Attention | Power Cost | Sludge Production | Maintenance Requirement |
|---|---|---|---|---|---|---|
| Conventional Activated Sludge | 3 | 3 | 1 | 1 | 1 | 1 |
| Extended Aeration – Oxidation Ditch | 2 | 1 | 2 | 2 | 2 | 3 |
| Trickling Filters | 1 | 2 | 3 | 3 | 3 | 2 |

*Criteria: 1 = least favorable to 3 = most favorable*

## Alternatives developed to provide adequate capacity

- Alternative 1 – Existing System Rehabilitation with Aerators
- Alternative 2 – Existing System Rehabilitation with Sidestream Treatment
- Alternative 3 – Existing System Rehabilitation with Parallel Treatment
- New Process assumptions:



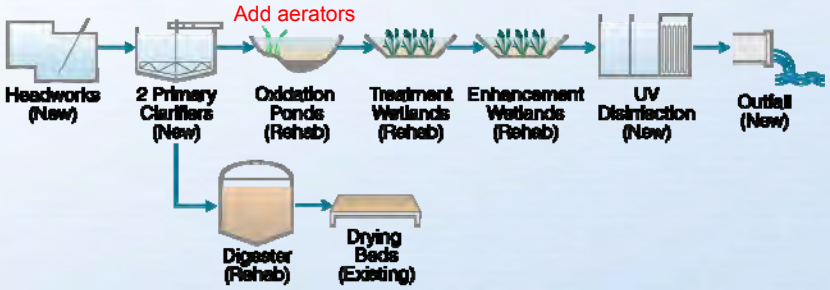
*UV Disinfection*



*Ox Ditch Supplemental Capacity*



## Alternative 1 – Existing System Rehab with Aerators

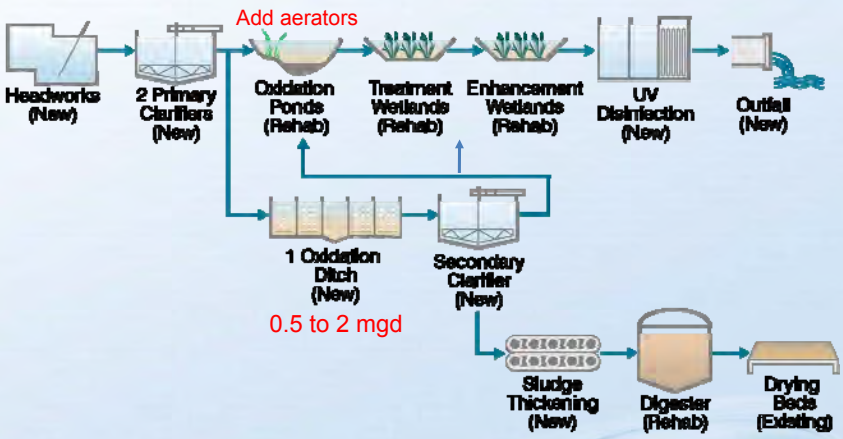


## Alternative 1 – Process Elements

- New headworks with 5.9 mgd firm capacity
- Two new primary clarifiers for a total of 5.9 mgd
- Remove pond solids, rehab pond structures and put in new aerators in Pond 2
- Rehab treatment wetlands and add TW #7 (limit flow to 2.3 mgd)
- PS upgrades to (PS1) and from (Hauser PS) enhancement wetlands for a firm capacity of 2.3 mgd
- New UV disinfection (35% transmittance)
- Flow reconfiguration and new outfall
- Digester rehab (mechanical)



## Alternative 2 – Existing System Rehab with Side-Stream Treatment

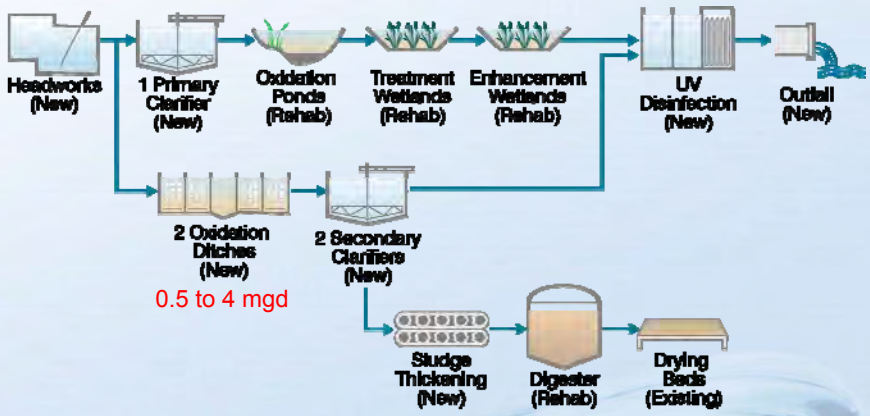


## Alternative 2 – Process Elements

- New headworks with 5.9 mgd firm capacity
- Two new primary clarifiers for a total of 5.9 mgd
- Remove pond solids, rehab pond structures and put new aerators in Pond 2
- Rehab treatment wetlands and add TW #7 (limit flow to 2.3 mgd)
- New ox ditch (1) and new secondary clarifier (1)
- PS upgrades to (PS1) and from (Hauser PS) enhancement wetlands for a firm capacity of 2.3 mgd
- New UV disinfection (35% transmittance)
- Flow reconfiguration and new outfall
- Digester rehab and new sludge thickening



## Alternative 3 – Existing System Rehab with Parallel Treatment

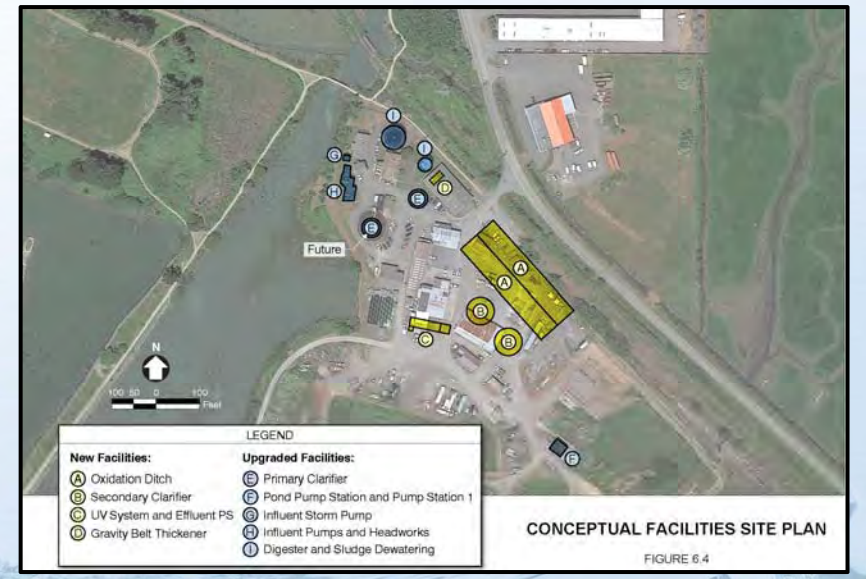


## Alternative 3 – Process Elements

- New headworks with 5.9 mgd firm capacity
- One new primary clarifier (1.8 mgd) for ponds
- Remove pond solids and rehab ponds structures
- Rehab treatment wetlands and add TW #7 (limit flow to 1.8 mgd)
- New ox ditch (2) and new secondary clarifier (2)
- PS upgrades to (PS1) and from (Hauser PS) enhancement wetlands for a firm capacity of 2.3 mgd
- New UV at 55% transmittance
- Flow reconfiguration and new outfall
- Digester rehab and new sludge thickening



## Proposed facilities site plan



## Break for Questions/ Comments



## Alternatives Comparison

## Summary of Alternative Comparison for Non-Economic Factors

| Alternative | Meets Permit | Ease of O&M | Construct-ability | Reli-ability | Ammonia Removal |
|---|---|---|---|---|---|
| 1. Existing System Rehabilitation with Aerators | 1 | 3 | 1 | 1 | 1 |
| 2. Existing System Rehab with Side-stream Treatment | 2 | 1 | 2 | 2 | 2 |
| 3. Existing System Rehab with Parallel Treatment | 3 | 2 | 3 | 3 | 3 |

*Criteria: 1 = least favorable to 3 = most favorable*



## Summary of Alternative Comparison for Economic Factors

| Alternative | Construction Cost (1) | Annual O&M Cost (2) |
|---|---|---|
| 1. Existing System Rehabilitation with aerators | 26.6 | 0.67 |
| 2. Existing System Rehab with Side-stream Treatment | 33.9 | 0.75 |
| 3. Existing System Rehab with Parallel Treatment | 33.4 | 0.43 |

*Notes:*

*1) Costs are in today's dollars (May 2016), in millions.*

*2) Annual O&M costs, in millions, include only differential costs and do not include costs of common elements.*

## Summary of Alternative Life Cycle Comparison

| Alternative | Project Cost (1) | Annual O&M Cost (2) | Present Worth O&M (3) | Life-cycle Cost (3) |
|---|---|---|---|---|
| 1. Existing System Rehabilitation | 35.1 | 0.67 | 5.7 | 40.9 |
| 2. Existing System with Side-stream Treatment | 44.7 | 0.75 | 6.5 | 51.1 |
| 3. Existing System with Parallel Treatment | 43.8 | 0.43 | 3.7 | 47.5 |

*Notes:*

*1) Costs are in today's dollars (May 2016), in millions. Project Cost = Construction Cost *1.3*

*2) Annual O&M costs include only differential costs and do not include costs of common elements.*

*3) Lifecycle cost is project cost plus present worth O&M cost. Annual O&M costs were converted to present worth value based on 3 percent inflation rate, 6 percent discount rate, and 10-year analysis period.*



## Consultant Recommendation

- Retain and rehab existing land based system
- Consultant team recommends Alternative 3 based on the following factors:
  - Ability to reliably meet permit year-round
  - Flexibility to provide ammonia removal
  - Ability to keep plant operating during construction and wetland rehabilitation

## Break for Questions/ Comments



## Next steps

## Immediate next steps for implementation

- Finalize Facility Plan and Capital Improvements Program
- Meet with Regional Board – June 27th
- Financial Plan/Rate Study
- Update application for state grants and revolving loan fund (interest rate currently 1.7%) and meet with SRF
- Start CEQA and natural resource agency review
- Predesign and final design of proposed improvements

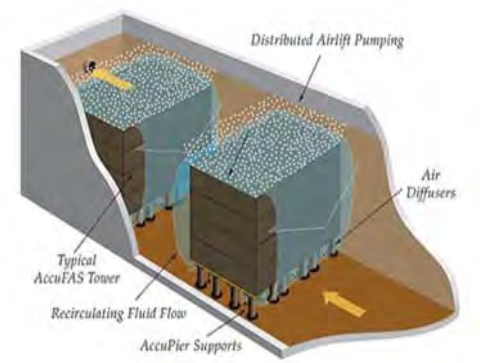


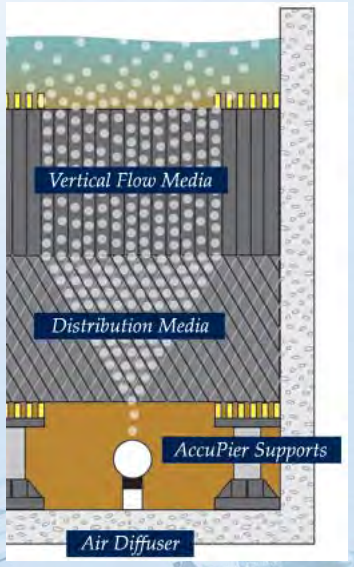
## Implementation Schedule

| Task Description | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|
| Facility Plan | | | | | | |
| RWQCB Meetings | | | | | | |
| Predesign | | | | | | |
| Final design | | | | | | |
| Construction | | | | | | |
| Start up | | | | | | |

# Questions

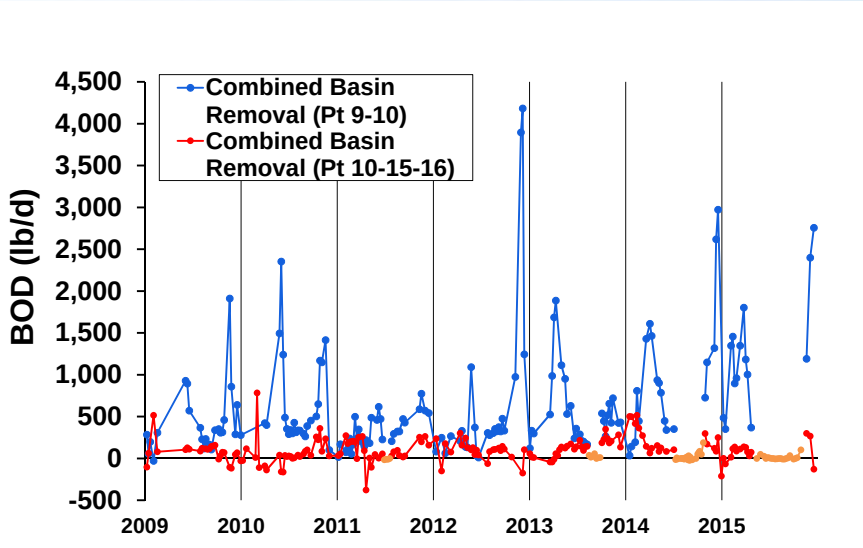
## Submerged Fixed Film Technology (AccuFAS)



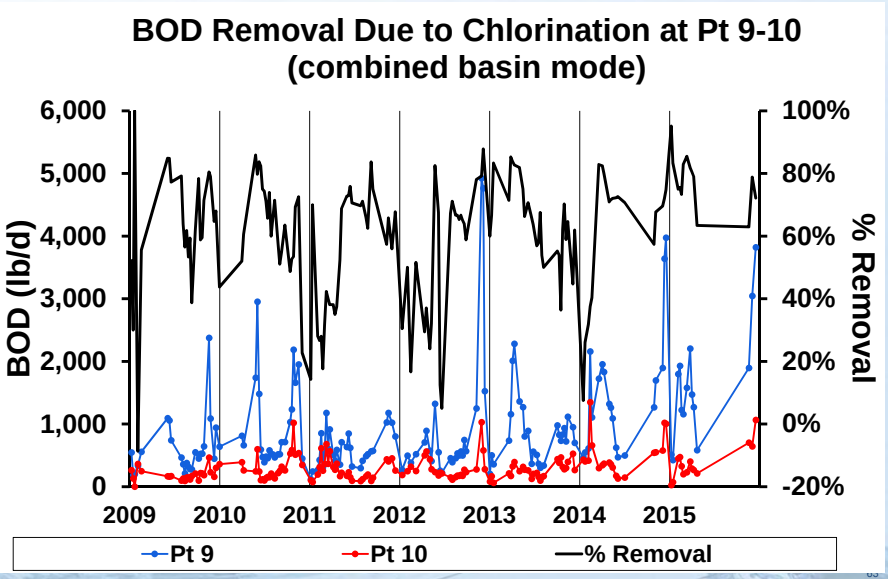





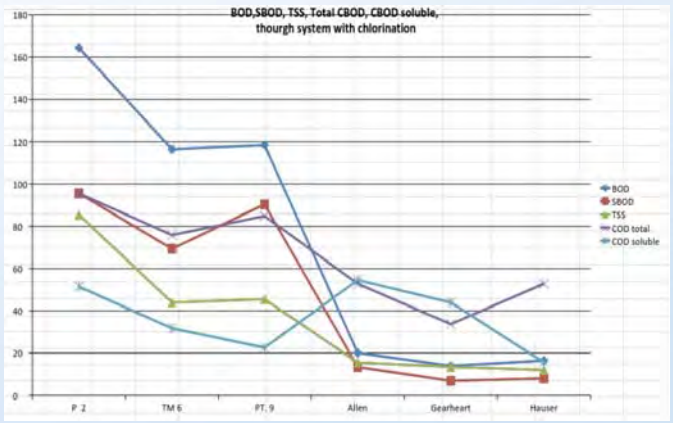

## BOD Removal Due to Chlorination



## Chlorination impact on capacity




## Chlorination has provided treatment capacity




- Average BOD Removal = 730 ppd
- 80th percentile BOD removal = 1080 ppd
- Max BOD removal = 4000 ppd

# APPENDIX T – REPORT OF WASTE DISCHARGE (BY CITY) JANUARY 2017

CITY OF ARCATA

# Supplemental Information for Report of Waste Discharge

## NPDES Permit No. CA0022713 Renewal Application

**January 2017**



# Table of Contents

Introduction ..... 1
CA0022713/Order No. R1-2012-0031 Compliance Requirements ..... 1
Permit Compliance and Violations ..... 4
Capacity and Treatment Issues ..... 5
Hydraulic capacity ..... 5
Treatment Capacity ..... 6
UV Disinfection Design Criteria ..... 6
Compliance and Construction Schedules ..... 8
2017 NPDES Permit ..... 10
Enhanced Treatment through AMWS ..... 10
Disinfection Process Requirements for UV Disinfection System ..... 11
Outfall-003 Receiving Waters Location ..... 11
Municipal Designation of Humboldt Bay ..... 11
Chronic Toxicity ..... 12
Option for Split Compliance ..... 12
Wet Weather Calculation of Mass Limits ..... 12
Percent Removal Limits ..... 13

# Introduction

Operating in its current configuration since 1985, Arcata's natural land-based treatment system achieves many beneficial uses including improved water quality, wildlife habitat, and recreation. The dynamic and sustainable system promotes the community pride and involvement, educational opportunities, including local and international research, and sustainability. Driving factors for the future of the Arcata Wastewater Treatment Plant (AWTP) include environmental, economic and social responsibilities.

In 2012, the AWTP began operating under a new NPDES permit (Order No. R1-2012-0031) that specifically addresses several long-term issues regarding disinfection, treatment units and discharge locations. Due to past compliance issues, the permit required changes to be made to improve wastewater treatment, protect beneficial uses, increase energy efficiency and reduce chemical usage. Permit required changes included installation and start-up of a new ultraviolet light (UV) disinfection treatment unit, elimination of chlorine disinfection except for discharges greater than 5.9 MGD, and construction and start-up of new discharge location Outfall-003. In response to the permit required changes, the City initiated a Facility Plan and wastewater treatment plant improvement project to address several issues including ongoing NPDES permit violations and regulatory compliance, repair and rehabilitation of aging infrastructure, deferred maintenance of the natural treatment units, and capacity and treatment for dry and wet weather flows now and in the future.

Due to the growing complexity of the wastewater treatment plant improvement project, the City did not achieve compliance with the required start-up date of December 1, 2016 for the UV disinfection system or discharge from Outfall-003. This Report of Waste Discharge (ROWD) proposes compliance schedules for implementation of UV disinfection and discharge at Outfall-003 within the next five-year permit period. The Facility Plan and wastewater treatment plant improvement project identified several other issues which need to be addressed for the AWTP to consistently achieve compliance with its NPDES permit and meet community expectations and goals. The City is proposing changes and additional treatment to the current wastewater treatment system that will occur within the next permit cycle in an effort to improve system efficiency and overall water quality.

In addition to proposed compliance schedules and changes and additions to the treatment system, the City is proposing several changes to the NPDES permit including requests to modify specific permit limits and requirements.

A more thorough discussion of many of the topics in this document is found in the City of Arcata Facility Plan (June 2016).

# CA0022713/Order No. R1-2012-0031 Compliance Requirements

The NPDES permit issued to the City in 2012 includes several regulatory requirements that affect the design and operation of the AWTP. The permit requires a new flow configuration, discharge point and a new disinfection treatment system. The permit requires all flows less than 5.9 MGD to be directed from the treatment wetlands directly to the enhancement marshes, eliminating chlorine disinfection prior to discharge to the enhancement marshes via Outfall-002 and increasing the percentage of flow receiving enhanced treatment in the enhancement marshes (Arcata Marsh and Wildlife Sanctuary (AMWS)). Outfall-003 is slated to be constructed in the brackish marsh at the north end of the Arcata Bay section of Humboldt Bay. The permit compliance date for flow reconfiguration, UV disinfection, and discharge to Outfall-003 was originally required by December 1, 2016.

The Facility Plan, which originated, in part, to address these compliance projects was initiated in early 2015 and an Administrative Draft Facility Plan was presented to City staff and the Arcata Marsh Research Institute in September 2015. During the course of evaluating the current treatment plant, compliance history and requirements, city council goals and community expectations, the City and consultant team identified several treatment and capacity concerns in direct relation to the required compliance projects, future capacity, on-going treatment and compliance issues, and aging infrastructure and deferred maintenance. A summary of the issues that arose from this initial workshop/presentation are provided below:

- Flow Reconfiguration and Wet Weather Flows

  The permit requires a new flow configuration and discharge point. With the new configuration, effluent flows will no longer discharge directly from the chlorine contact basin to Humboldt Bay through Outfall-001. Instead, disinfected enhancement marsh effluent will discharge through the future Outfall-003, which will serve as the new point of compliance. The permit requires all flows less than 5.9 MGD to flow through the enhancement marshes and disinfection system. Analysis of available modeling indicates that at flows as high as 5.9 MGD treatment capacity and resultant water quality may significantly decrease through the enhancement marshes. Further evaluation is necessary to determine the maximum continuous flow that can be treated through the enhancement marshes while still maintaining enhanced treatment.

  The permit Fact Sheet cites that the required treatment plant upgrades "will result in overall improvements to effluent quality discharged to Humboldt Bay because effluent will no longer be commingled; therefore all effluent of at least up to 5.9 MGD will receive enhanced treatment through the AMWS." Further, in Prohibition III.I "the discharge of treated effluent at Outfall 001 is prohibited, other than that portion of the flow exceeding peak flows of 5.9 MGD." This prohibition is effective upon activation of the UV disinfection system and discharge at Outfall-003. Flows greater than 5.9 MGD will either need to be attenuated in the oxidations ponds or discharged on an emergency basis through Outfall-001. Further, Regional Water Quality Control Board (RWQCB) staff has indicated that bypasses of wet weather flow around the treatment wetlands are an on-going issue that should be addressed in the wastewater treatment plant improvement project.

- UV Disinfection and Elimination of Chlorine Disinfection

  Since 2013 there have been approximately 21 permit violations for disinfection related incidents including disinfection by-products, chlorine residual, or adequate bacteria removal. The permit includes approval for construction of a new UV disinfection system, in place of the existing chlorine disinfection system. Implementation of UV disinfection will eliminate the compliance violations arising from disinfection byproducts; however, the existing natural treatment system has a very low UV transmittance (UVT), which impacts the sizing of the UV system needed to meet disinfection requirements.

  Additionally, during the course of investigating existing treatment performance and capacity, it was determined that the existing use of chlorine provides chemical treatment of $BOD_5$ and seasonal hydrogen sulfide. Eliminating the use of chlorine will result in a shortfall of $BOD_5$ removal capacity by between 600 to 1000 pounds per day.

- Secondary Treatment

  Ongoing permit violations of plant effluent limits for $BOD_5$ and TSS indicate the need for additional secondary treatment capacity. This compliance history, paired with the anticipated treatment capacity shortfall after removing chlorine disinfection and the potential need for

additional treatment for flows which cannot be routed through the treatment wetlands and enhancement marshes supports the need for treatment beyond the capacity of the existing land-based natural system.

The Facility Plan proposes three options to address secondary treatment concerns. The recommended option is a parallel oxidation ditch treatment system to address treatment shortfalls and improve UVT. A second option includes rehabilitation of treatment wetlands and oxidation ponds to deal with legacy sludge loading, and improvements to these units to maximize secondary treatment in the existing land-based system. A third option is a hybrid of a smaller parallel oxidation ditch and existing land-based system improvements and rehabilitation. These first three options included limiting flow through the enhancement marshes to 2.3 MGD to prevent a degradation of water quality. During follow-up discussions with the RWQCB in June 2016 regarding flow routing, Board staff indicated that the permit required all flows less than 5.9 MGD to receive enhanced treatment through the enhancement marshes, or AMWS. In September 2016, the consultant team proposed a fourth treatment option which includes parallel treatment via an oxidation ditch, natural treatment system rehabilitation and UV disinfection upstream of the treatment marshes, with flow up to 5.9 MGD flowing through the treatment wetlands and enhancement marshes. A draft schematic of Option 4 is included in this application package for reference. Options 1-3 have been previously submitted to the Regional Board in the Facility Plan.

- Nutrients and Pollutants of Emerging Concern

  Ammonia, phosphorus and nitrate have been identified as constituents that the Regional Board will evaluate for inclusion in the next permit cycle. The natural treatment system provides good ammonia treatment during certain times of the year and adds ammonia to the system during other times of the year. The City recognizes that it needs to implement a consistent treatment solution for future limits for nitrogen compounds which are likely to be issued in the next permit.

  Constituents of emerging concern, including pharmaceuticals and personal care products are widely recognized in the wastewater industry as pollutants which will likely be evaluated for permit inclusion in the future, as technology for treatment and standardized test methods for these constituents in wastewater are developed. While monitoring requirements and limits for pollutants of emerging concern are not currently required, the City recognizes that maintaining treatment units and selecting new treatment units which may provide treatment of pollutants of emerging concern will benefit the community well into the future.

These concerns significantly widened the scope of the Facility Plan and wastewater treatment plant improvement project since it became apparent that significant permit non-compliance would occur if the permit-required changes were implemented absent corresponding secondary treatment and hydraulic capacity improvements. In April 2016, a public workshop was held to present the findings and recommendations of the Draft Facility Plan, followed by a public city council meeting on April 20th. The Draft Facility Plan was also presented on June 6th and 13th at public city council workshops. At these meetings, significant discussion took place regarding the use of the existing land-based natural treatment system and investing to improve it. The Facility Plan incorporates additional alternative evaluations and developments to address many of the comments received during these public meetings.

In fall 2016, an oxidation pond expert was retained to evaluate the feasibility of improving and rehabilitating the oxidation ponds to achieve consistent permit compliance with current and future effluent limits and discharge standards. Initial findings indicate that the existing pond system does not have sufficient capacity

to meet permits limits. Additional baffling and aeration is suggested to improve treatment of dry season flows. However, the pond performance is anticipated to deteriorate significantly during wet season flows even with these recommended improvements. Final completion of the oxidation pond evaluation is pending.

On October 11, 2016 the City submitted a request for extension of the compliance date for activation of the UV disinfection system and implementation of discharges at Outfall-003. Upon discussion with the Regional Board it was indicated that an extension would not be issued. On January 1, 2016 the City submitted to the Regional Board N*otification of Violating or Threatening to Violate Permit Conditions Required by December 1, 2016* for failing to activate the new UV disinfection system, reconfigure flow to eliminate circular chlorination blending, and relocate primary discharge to Outfall-003 by the compliance date. The City anticipates that the Regional Board will issue a Time Schedule Order, either prior to or concurrent with issuance of the next NPDES permit.

## Permit Compliance and Violations

The AWTP provides preliminary, primary and secondary treatment followed by disinfection. Preliminary and primary treatment facilities include influent pumping, mechanical bar screens, grit removal and primary clarifiers. Primary solids are sent to anaerobic digesters, sludge drying beds and sludge composting. Secondary treatment is accomplished through two oxidation ponds in series, followed by six treatment wetlands operating in parallel. Currently, secondary effluent is disinfected with chlorine gas and dechlorinated with sulfur dioxide gas prior to discharge. Under the existing flow configuration, for about 9 months every year, a portion of the treated effluent is sent to the enhancement marshes for enhanced treatment while the remainder is discharged to Humboldt Bay via Outfall-001. Effluent out of the enhancement marshes is returned to the chlorine contact basin for a second step of disinfection and dechlorination. The result is disinfected secondary effluent that does not receive all the enhancement benefits of the enhancement marshes and is chlorinated multiple times, increasing the opportunity for formation of disinfection byproducts above water quality objectives.

The NPDES Permit (No.CA0022713) and Waste Discharge Requirements Order (No. R1-2012-0031) were issued by the North Coast Regional Water Quality Control Board (RWQCB), and became effective on August 1, 2012. The permit was subsequently modified in 2015. The new permit enabled changes to be made to improve wastewater treatment, protect beneficial uses, increase energy efficiency, reduce chemical usage, and reduce the potential for permit violations.

The permit approves a new flow configuration and discharge point. Effluent flows will no longer discharge directly to Humboldt Bay (Outfall-001), but will be discharged after enhanced treatment in the AMWS. The new point of compliance and outfall (Outfall-003) will be to the brackish marsh adjacent to the AMWS, which discharges into a slough at the north end of the Arcata Bay portion of Humboldt Bay. The permit also includes approval of a new disinfection process using UV disinfection facilities prior to Outfall-003. Until the improvements are complete, the AWTP is operating under interim effluent limits for discharge to Outfall-001, which are essentially the same as the final compliance requirements for Outfall-003. Discharge requirements for the intermediate discharge point to the AMWS (Outfall-002) are also noted in the permit.

A review of available data for the current NPDES permit period (August 1, 2012 through November 30, 2016) was conducted to provide a summary of permit violations which have occurred under the current NPDES permit. The trend of permit compliance and violations are in line with those evaluated in the Facility Plan for the period of 2004 and 2011 indicating that long-term issues regarding disinfection and treatment units continue to be an issue for the aging AWTP.

Effluent limit violations at Outfall-001 are predominantly the result of exceedances of the effluent limit for dichlorobromomethane, a disinfection byproduct. Twenty-two permit violations for the disinfection byproduct were self-reported for the current NPDES permit period. Total Suspended Solids (TSS) are also an issue at Outfall-001. Twenty permit violations were self-reported for TSS during the permit period for violations of concentration-based, mass-loading based and percent reduction effluent limits. $BOD_5$ violations and chronic toxicity violations also occur at Outfall-001. During the current NPDES permit period seven effluent violations have been reported for both constituents. Additionally, permit violations have been reported for suspended solids, total residual chlorine, cyanide, fecal coliform, bis (2-ethylhexyl) phthalate, pH and 2,3,7,8-TCDD equivalents.

Violations of discharge standards at Outfall-002 also occur with some regularity. Seventeen permit violations were self-reported during the current NPDES permit period for exceedances of the discharge specifications for $BOD_5$ at Outfall-002. Additionally, one violation for suspended solids and four violations for total residual chlorine were self-reported for exceedances of the discharge specifications at Outfall-002.

Since August 2012 there have been at least 29 violations of effluent limits or discharge standards for disinfection byproducts, fecal coliform and total residual chlorine. Implementation of UV disinfection would eliminate the disinfection byproduct violations. Ongoing violations for $BOD_5$ and total suspended solids indicate the need for additional secondary treatment capacity beyond that of the existing natural system. A secondary treatment system that is capable of ammonia removal/nitrogen treatment may also be beneficial for meeting future permit limits for ammonia or nitrogen. Some violations may be reduced or eliminated with treatment plant improvement projects which will allow for flow attenuation, including total residual chlorine violations which may otherwise occur with the use of emergency discharges via Outfall-001 and settleable solids violations which occur when oxidation pond pumps and emergency storm pumps are used to maintain hydraulic capacity.

# Capacity and Treatment Issues

## Hydraulic capacity

Hydraulic capacity at the AWTP during wet weather periods is an on-going issue. Increased flows from inflow and infiltration (I&I) during wet weather periods contribute, on average, more than 1.47 MGD of extra flow to the treatment plant. Funding is currently being sought for $7 million of I&I work in targeted areas of the collection system, scheduled to begin in September 2017. Even with the scheduled I&I work hydraulic capacity in the oxidation ponds will continue to be an issue. In addition to I&I issues, rainfall on the natural treatment system can add significant flow to the system depending on the storm event. In calendar year 2016, for example, 44 inches of rain added an additional 95.8 MG of flow to the treatment plant in the form of rainfall catchment. During wet weather periods it is normal operation to use one to three oxidation pond pumps to move effluent directly from Oxidation Pond 2 to the chlorine contact basin (skipping the treatment wetlands). Occasionally, the AWTP utilizes the Oxidation Pond 2 Emergency Storm Pumps to direct an even greater volume from Oxidation Pond 2 directly to the contact basin. Regional Board staff have indicated the need to eliminate the use of oxidation pond pumps and emergency storm pumps for bypass of treatment wetlands except in the case of emergency when hydraulic capacity threatens to be insufficient to keep oxidation ponds from overflowing.

During a June 27, 2016 meeting, RWQCB staff indicated that the Basin Plan requires the entire treatment plant flow, up to 5.9 MGD, to receive treatment through the enhancement marshes as a condition of discharge to Humboldt Bay. However, as indicated at that meeting by City staff and consultants, the flow

model available indicates that those treatment units do not have the capacity to treat flows as high as 5.9 MGD. Historically, a maximum of approximately 2.0 MGD flows through the enhancement marshes.

After start-up of the UV disinfection system and discharge to Outfall-003, flows exceeding 5.9 MGD will need to be attenuated or discharged, on an emergency basis, to Outfall-001. Using Outfall-001 for emergency discharge adds additional complications to the treatment process because although there is currently a chlorine and sulfur dioxide chemical dosing system in place for disinfection and dechlorination, it is a system that will be difficult to "mothball" until it is needed, and a new system will need to be engineered in order to provide a safe and reliable means of disinfection if flows cannot be attenuated.

During development of the Draft Facility Plan, anticipated community growth was a discussion item that needed additional evaluation. The City originally anticipated a 10 percent growth in the community based on the General Plan's redevelopment plans and planned growth at Humboldt State University. For the purposes of the Draft Facility Plan evaluation, a 10 percent growth was originally assumed. After further discussion with the City at the Council meeting on June 13, 2016, followed by input from the City's Community Development Director, the community growth is anticipated to be 20 percent from now through build out. Updates in the Facility Plan address this additional growth factor. Due to water conservation efforts seen in recent years, the growth is primarily anticipated to impact influent loading to the AWTP, and will not change the design flows.

## Treatment Capacity

As noted earlier, the existing use of chlorine provides chemical treatment of $BOD_5$ and seasonal hydrogen sulfide. Eliminating the use of chlorine will result in a shortfall of $BOD_5$ removal capacity by between 600 to 1000 pounds per day. Meeting TSS effluent limits at Outfall-001 and $BOD_5$ discharge specifications at Outfall-002 has been increasingly difficult. Some evidence indicates that the legacy load, solids which have been accumulating in the natural treatment system over time, may be contributing to the $BOD_5$ effluent violations. Other evidence suggests that the drought and unusual weather patterns experienced in Arcata during the current NPDES permit cycle have been contributing to permit violations because the natural treatment system is sensitive to changes in weather. Regardless of the cause of permit violations, the on-going violations, in addition to the predicted $BOD_5$ treatment shortfall indicate the need for additional secondary treatment capacity.

Nutrients such as nitrogen and phosphorus have been identified as potential issues. The North Coast RWQCB has recently implemented limits for these constituents for the City of Eureka and will probably be adding similar limits to other dischargers' permits. Arcata's current NPDES permit requires monitoring for ammonia and nitrate to determine the assimilative capacity of the receiving water for these nutrients and to generate background data for these constituents for a future Reasonable Potential Analysis. Board staff indicated that Arcata could expect an ammonia limit in their next permit (in 2017) similar to Eureka, based on the similar Humboldt Bay discharge. A Reasonable Potential Analysis will be conducted to develop the limit based on salinity, pH and other factors at the point of discharge. The current natural land-based treatment system does an excellent job of treating ammonia on a seasonal basis. Data shows that in the summer months virtually no ammonia is discharged from the treatment system. However, during the rest of the year ammonia levels are either stagnant or increasing from the internal load (plant die-off in the fall/winter). Inconsistent ammonia removal in the current system indicates that there is a need for reliable ammonia removal that is less dependent on weather and the natural land-based treatment process.

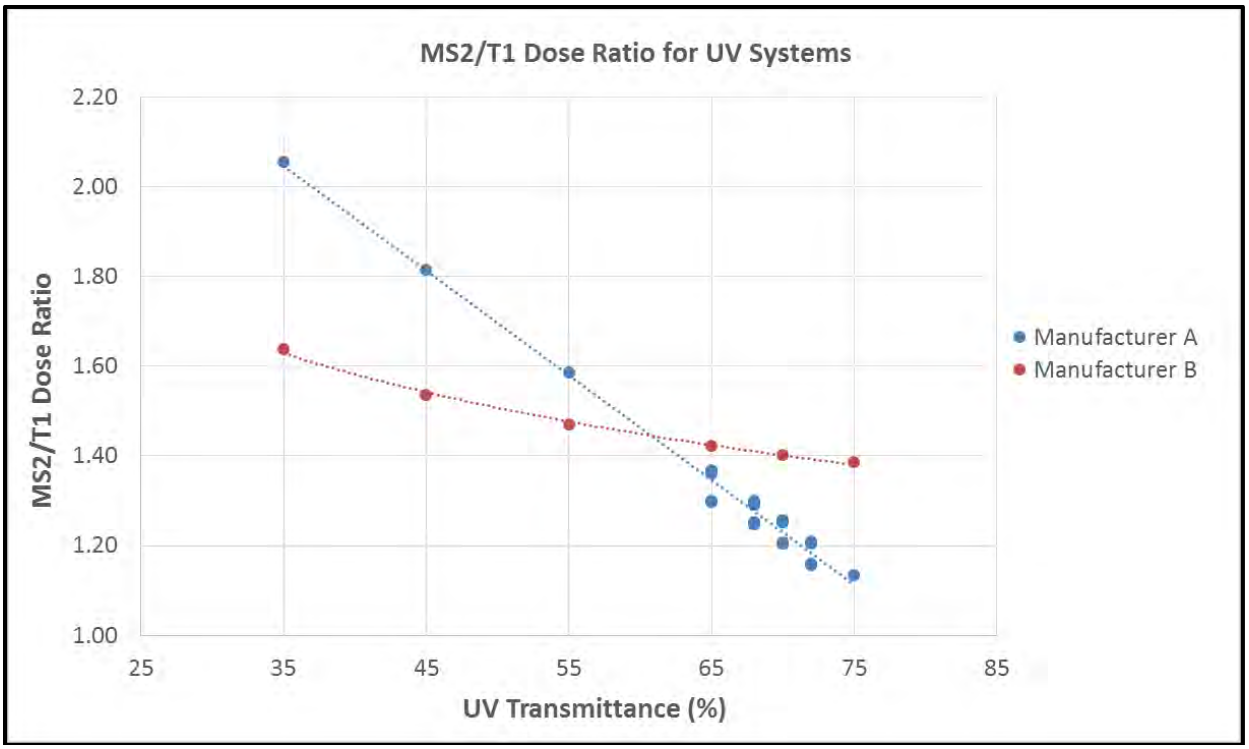
## UV Disinfection Design Criteria

The first criterion for a design dose is that the discharge must provide bacteria reduction, specifically to meet the fecal coliform level required in the discharge permit. In an initial meeting with the RWQCB, City staff, and consultant staff on June 23, 2015, RWQCB staff indicated a specific concern about virus kill. The

discussion focused on the disinfection of coliphage, but without any specific effluent target. In the second meeting with the RWQCB on June 27, 2016, there was discussion about a future virus reduction requirement. Virus reduction would require a higher design UV dose than for bacteria reduction alone. The City will need additional input from the State (RWQCB and Division of Drinking Water) on the design dose and disinfection objectives during preliminary design. The design dose discussion that follows is based on the current permit requirement for bacteria (fecal coliform) reduction.

To properly size a UV system, the dose must be determined for each target organism (bacteria and/or virus, in this case). Different organisms (e.g., bacteria, virus, and protozoa) have measurably different sensitivities to UV disinfection. For example, viruses tend to be more resistant to UV disinfection than bacteria. Much of the UV system validation work that has been completed to date has been for water reuse applications in California, where virus inactivation is the primary goal. For these applications, the ideal and recommended test organism is MS2 coliphage (MS2); however, using MS2 validation data for disinfection of bacteria results in potential under dosing since bacteria (coliforms) react differently to UV disinfection than MS2. Some manufacturers (Calgon Carbon, Ozonia, and Wedeco) have performed validation work using proven bacteria surrogates such as T1 coliphage (T1). For cases where manufacturers have not validated their system based on T1, MS2 validations can be allowed with some degree of conservatism. To account for the difference between the dose-response curves of the organisms, higher dose levels will be specified for systems validated with MS2. Based on systems that have been validated by Carollo using both MS2 and T1, the ratio between the two varies depending on the UVT and the reactor efficiency.

The figure below shows the MS2/T1 dose ratio for two different UV reactors that range between 1.63 and 2.06 at this project's design UVT of 35 percent. For the higher MS2/T1 ratio of 2.06, a T1 dose of 1.0 $mJ/cm^2$ is equivalent to an MS2 dose of 2.06 $mJ/cm^2$.




The first step is to address the permit limits. The permit requirement for the AWTP is a median fecal coliform concentration that should not exceed 14 MPN per 100 ml on a monthly basis and a daily limit that

should not exceed more than 10 percent of samples exceeding 43 MPN per 100 mL. Previous UV studies of the enhancement marsh effluent have indicated the maximum marsh effluent fecal coliform concentration is in the 10,000 MPN per 100 mL range. Therefore, the UV system is required to provide a minimum 2.85 log reduction of fecal coliform to meet the permit limit of 14 to treat effluent from the natural system (Option 1 and 2). Typically, Carollo's recommended sizing approach is to design a UV system to disinfect fecal coliform to approximately one log below the permit limit; however, due to this project's already low permit limit, a half log will be added as a safety factor.

Using T1 as a surrogate for fecal coliform, and knowing that T1 has a similar UV sensitivity as fecal coliform, the proper dose for 2.85 log reduction of coliform can be determined. T1 has a UV sensitivity of 5 $mJ/cm^2$/log inactivation; a fecal coliform log inactivation of 3.35 (2.85 + 0.50 safety factor) thus represents a T1 dose of 16.75 $mJ/cm^2$. Converting this T1 dose to a MS2 dose using the MS2/T1 ratio of 2.06 from above, the validated MS2 dose will be 34.5 $mJ/cm^2$. Therefore, the specified MS2 dose for an equivalent log inactivation of fecal coliform is 35 $mJ/cm^2$.

For Option 3, a similar dose analysis is required for blended effluents from the natural system and the oxidation ditch/secondary clarifier treatment train. The fecal coliform concentration from the oxidation ditch/secondary clarifier effluent may be as high as 2,000,000 MPN per 100 mL range. Depending on the blending ratio, a typical fecal concentration from the blended effluents might be 1,000,000 MPN per 100 mL with a UVT of 50 to 55%. The dose analysis for this scenario results in a fecal coliform log inactivation of 5.35 (4.85 plus 0.50 safety factor) for a T1 design dose of 27.11 $mJ/cm^2$. However, T1 validation is generally limited to 5 log inactivation as anything above this is not reliable. Hence, for Alternative 3 an equivalent MS2 design dose of 50 $mJ/cm^2$ is specified.

The second step of the dose analysis is to address the RWQCB concerns regarding virus kill. As part of preliminary design, the dose necessary to reduce indigenous virus (measured as coliphage) in the UV effluent should be determined. This would be done with a collimated beam test on the enhancement marsh effluent, at dose values dependent on the desired test organism. There are two types of native coliphage in effluent, F-specific and somatic). F-specific (F+) coliphage has a similar UV sensitivity to MS2; therefore, recommended dose levels are 0, 5, 10, 15, 20, 30 and 40 $mJ/cm^2$. Somatic coliphage has a similar UV sensitivity to T1; therefore, recommended dose levels are 0, 2.5, 5, 7.5, 10, 15 and 20 $mJ/cm^2$. The current permit lists the required UV system dose as 50 $mJ/cm^2$, which may be based on protection of shellfish growing operations in Humboldt Bay. The Facility Plan proposes a dose of 35 or 50 $mJ/cm^2$, depending on which option is selected, based on site specific conditions.

The proposed location of the new UV facility is at the main WWTP site, near the existing chlorination facilities. This location allows for better safety and public access control but does add extensive piping requirements for the new Outfall-003 if disinfection is required for flows immediately preceding discharge. Alternatively, split compliance would allow complying with disinfection standards at the WWTP before conveying flows to the enhancement marshes and then discharge to Outfall-003. Once an alternative is selected, the City would appreciate discussions with the RWQCB regarding the feasibility of obtaining split compliance points in their NPDES permit for the new facilities.

## Compliance and Construction Schedules

On August 1, 2012 the City began operating under a new NPDES permit which requires the City to complete several required modifications to the treatment plant no later than December 1, 2016. In general terms these conditions are activation of a new UV disinfection system, flow reconfiguration and relocation of primary wastewater treatment plant discharge to a new location, Outfall-003. Due to secondary treatment performance shortfalls and hydraulic capacity issues discussed previously, completion of the permit

required projects must be completed in conjunction with a major secondary process wastewater treatment plant upgrade and reconfiguration for flow attenuation in order to achieve compliance with permit conditions and effluent limits.

On January 1, 2017 the City submitted to the Regional Board *Notification of Violation or Threatening to Violate the Permit Conditions Required by December 1, 2016.* The notification included updated project schedules for completion of a UV disinfection system and relocation of primary wastewater treatment plant discharge to Outfall-003. Upon further review and consultation with the Carollo engineering team the City is proposing changes to the project schedules for relocation of primary wastewater treatment plant discharge to Outfall-003 and construction of the UV disinfection system in this Report of Waste Discharge. Of the four treatment plant improvement project options identified in the Facility Plan at least one option has significantly different piping for Outfall-003 than the other options. Until a final decision has been made by the City, preliminary design and concurrent environmental review cannot begin. It has been determined that it is unrealistic to complete the Outfall-003 project in the fourth quarter of 2018, as proposed in the aforementioned notification, until a wastewater treatment plant improvement project option has been selected. The City is proposing that relocation of primary wastewater treatment plant discharge to Outfall-003 occur concurrently with activation of the new UV disinfection system. The proposed schedule is:

| | |
|---|---|
| Predesign, and CEQA | 6/30/2018 |
| Design and Funding | 6/30/2019 |
| Begin Construction: | 10/1/2019 |
| End Construction: | 10/1/2021 |
| Begin Discharge: | 1/15/2022 |
| Attain Operational Level: | 1/15/2022 |

A secondary treatment process capacity augmentation project is required to address the capacity shortfall of the existing processes, especially without the chemical treatment removal that occurs with chlorine disinfection, and ammonia treatment. As discussed previously, one alternative to secondary capacity augmentation is to upgrade the oxidation ponds with aeration or another technology to improve treatment capacity and realize ammonia treatment in the existing system. Alternatives to this include addition of an oxidation ditch for parallel treatment or a hybrid-system of a smaller oxidation ditch and improvements to oxidation pond treatment. To ensure compliance with effluent limits and discharge specification this project must be completed in conjunction with the UV disinfection system and relocation of the primary discharge point to Outfall-003. The proposed schedule for the secondary treatment capacity augmentation project is:

| | |
|---|---|
| Predesign, and CEQA | 6/30/2018 |
| Design and Funding | 6/30/2019 |
| Begin Construction: | 10/1/2019 |
| End Construction: | 10/1/2021 |
| Begin Discharge: | 1/15/2022 |
| Attain Operational Level: | 1/15//2022 |

Construction of Treatment Wetland 7 is also recommended in the Facility Plan. This project would convert an existing unused aquaculture pond into a new 2.3 acre treatment wetland, increasing the hydraulic capacity of the treatment wetlands from 1.8 MGD to 2.3 MGD. Roadblocks to the Treatment Wetland 7 project have included obtaining clarification from the U.S. Army Corp of Engineers on the status of the former aquaculture ponds as Waters of the U.S. or aquaculture ponds belonging to the wastewater treatment facility, and previous surveys which have found tide water goby in at least one of the aquaculture ponds.

Construction of Treatment Wetland 7 is anticipated in the near future. The City is in the process of obtaining a final decision by the Army Corp of Engineers. Additionally, an environmental DNA (eDNA) study conducted in 2016 found evidence tidewater goby is utilizing only spillway portions of the existing aquaculture ponds. The City is developing a plan to relocate tide water goby utilizing the former aquaculture ponds to the brackish water marsh, where identical eDNA was identified. Pending the final decision of the Army Corp of Engineers and permitting, the following schedule is proposed for this improvement project:

| | |
|---|---|
| Begin Construction: | 3/1/2018 |
| End Construction: | 10/31/2018 |
| Begin Discharge: | 11/1/2018 |
| Attain Operational Level: | 12/1/2020 |

Note a two year start up schedule will be required in order to allow adequate time for the wetland vegetation to become established and functional in providing treatment.

Solids accumulation in the oxidation ponds is affecting treatment and hydraulic capacity. Between one and two feet of solids in each pond is anticipated to need dredging or in-situ treatment. One wastewater treatment plant improvement option involves optimizing oxidation pond and treatment wetland performance to achieve better $BOD_5$ and TSS treatment and provide for ammonia removal in these treatment units. If this is deemed a feasible option and selected for construction, the oxidation ponds and treatment wetlands will be improved on a schedule similar to the schedule proposed for a secondary treatment process capacity augmentation project. If this option is not selected the City still plans on rehabilitating these treatment units to mitigate years of deferred maintenance and optimize performance. Rehabilitation will include reconfiguration of oxidation pond transfer structures, dredging or in-situ treatment of accumulated sludge in the oxidation ponds and treatment wetlands and vegetation removal in the treatment wetlands to improve flow distribution and storage capacity.

Solids accumulation and heavy vegetation growth in the enhancement marshes is also affecting treatment and hydraulic capacity in these treatment units. Vegetation maintenance, new baffles, and new inlet/outlet structures are anticipated in all three enhancement marshes in order to improve treatment and hydraulic efficiency and capacity. Improvement projects will be limited to those which do not significantly reduce water quality or habitat since the enhancement marshes are Waters of the State.

Rehabilitation of the natural land-based system will occur over the span of several years due in part to the number of treatment units that need rehabilitation and because only one unit can be taken offline for work at a time. Pilot projects and evaluation of rehabilitation options are currently underway. A rehabilitation and on-going maintenance plan will be continuously developed as this project proceeds. This improvement project is scheduled to begin in 2017 and continue through 2025.

# 2017 NPDES Permit

## Enhanced Treatment through AMWS

Resolution No. 74-43, SWRCB Water Quality Control Policy for the Enclosed Bays and Estuaries of California, known as the Bays and Estuaries Policy, prohibits the discharge of municipal wastewater to enclosed bays and estuaries "unless the discharge enhances the quality of the receiving water above that which would occur in the absence of the discharge." In 1979, the State Water Board issued Order 79-20, in which it concluded that there was reasonable probability that the discharge of secondary, disinfected and dechlorinated effluent into Humboldt Bay, together with a treatment process which either created new

beneficial uses or resulted in a fuller realization of existing beneficial uses, such as the marsh treatment process proposed by Arcata, could enhance the receiving water quality. The Order further concluded that enhancement required full secondary treatment, with disinfection and dechlorination of sewage discharge, compliance with any additional NPDES permit requirements issued by the Regional Board to protect beneficial uses, and the fuller realization of existing beneficial uses or the creation of new beneficial uses either by or in conjunction with a wastewater treatment project.

The current NPDES permit requires ongoing evaluation the enhancement marshes with the purpose of using the findings of the evaluations for "adaptive management to ensure the AMWS retains maximum treatment function while protecting beneficial uses". As previously discussed, currently available data indicates that the ability to provide enhanced treatment may significantly decrease at flows greater than what has historically been treated by these treatment units. Historically, the AWTP has provided enhanced treatment by treating less than 2.0 MGD through the enhancement marshes. This practice not only preserves treatment capacity but may also preserve habitat related beneficial uses of the water bodies.

It is the opinion of the City that a treatment plant improvement project which will produce effluent which meets full secondary treatment standards and provides for ammonia removal, along with the creation of additional beneficial uses through construction of the brackish water marsh may meet the definition of enhancement, as concluded by the State Water Board in Order 79-20. Based on this opinion, the City is requesting that the enhancement marshes be allowed to be operated at historical flow rates if further evaluation indicates that treatment capacity or beneficial uses of those water bodies would be negatively impacted by increasing flows through the treatment units.

## Disinfection Process Requirements for UV Disinfection System

UV disinfection design criteria and operations and maintenance requirements cited in the current NPDES permit are based upon the National Water Research Institute validation testing from California Division of Drinking Water (formerly the Department of Public Health). As previously discussed, the Regional Board has expressed concern about virus inactivation because Humboldt Bay is an important oyster growing area for the state. However, design dose cited in the current permit is based on fecal coliform reduction. The City will need additional input from the State (RWQCB and Division of Drinking Water) on the design dose and disinfection objectives during preliminary design.

The City would like the Regional Board to consider a design dose of 35 $mJ/cm^2$ to 50 $mJ/cm^2$, depending on which treatment option is selected, as proposed in the Facility Plan and summarized above. The proposed design dose addresses conditions specific to the AWTP and concerns of both virus and bacteria inactivation.

## Outfall-003 Receiving Waters Location

The City requests clarification to the receiving water at Outfall-003, the brackish marsh as defined in the current NPDES permit. For the purposes of Reasonable Potential Analyses which require salinity and other water quality inputs, clarification is sought on whether the receiving water is considered the point at which Outfall-003 discharges into the brackish marsh, the point at which the constructed brackish marsh drains into Humboldt Bay or another location.

## Municipal Designation of Humboldt Bay

The Water Quality Control Plan for the North Coast Region (Basin Plan) designates a beneficial use of municipal and domestic supply (MUN) to Humboldt Bay. The Basin Plan implements State Water Resources Control Board Resolution No. 88-63, which establishes state policy that all waters, with certain exceptions, should be considered suitable or potentially suitable for MUN. It is noted that for the permit

issued to the City of Eureka in 2016 (R1-2016-0001) an evaluation of the salinity of Humboldt Bay in the vicinity of the discharge point was found to exceed the threshold salinity of 5,000 µS/cm and therefore the MUN designation was not applied. The City requests evaluation of the exceptions to Resolution No. 88-63 as they pertain to Humboldt Bay in the vicinity of Outfall-001 and Outfall-003 and seeks to have the MUN designation removed from the listed beneficial uses for the receiving water in the next NPDES permit.

The City additionally requests that all language referencing the MUN designation be removed, or modified, should the Regional Board find that Humboldt Bay meets and exception in Resolution No. 88-63, including removal of monitoring requirements for pollutants for which the Division of Drinking Water has established Maximum Contaminant Levels at Title 22, Division 4, Chapter 15, sections 644431 and 64444 of California Code of Regulations.

## Chronic Toxicity

On August 25, 2016 the City submitted to the RWQCB a letter requesting modification of the Monitoring and Reporting Program allowing for ammonia removal. In that request the City asked that specific language be added to Monitoring and Reporting Program Section V. Whole Effluent Toxicity Testing Requirements which provide provisions for allowing the City to demonstrate that effluent toxicity is caused by ammonia because of increasing test pH when conducting the toxicity test. The City is requesting that the Regional Board review the modification request and consider implementation of the request in the next permit cycle.

The City would like to retain the ability to choose between a variety of fresh water and salt water test species for Whole Effluent Toxicity monitoring.

## Option for Split Compliance

The LACO/Carollo consultant engineering team presented the City with four treatment plant improvement project options. Draft option four proposes parallel secondary treatment utilizing the existing natural land-based treatment system and an oxidation ditch. Effluent for both processes would be blended prior to UV disinfection at Outfall-002. The entire disinfected flow would receive treatment through the enhancement marshes prior to discharge to the brackish marsh at Outfall-003.

Although further investigation is necessary before this option can presented alongside the other three options for final selection, the City would like the RWQCB to consider the option of "split" compliance if this treatment option proves feasible and is accepted by the city council for construction. Under "split" compliance some effluent limits which are scheduled to be monitored at Outfall-003 would be monitored at Outfall-002. At a minimum, the City would request permit limits for fecal coliform to be applied at Outfall-002.

## Wet Weather Calculation of Mass Limits

Mass-based effluent limits are based on the dry weather design flow of 2.3 MGD and technology-based effluent limits for $BOD_5$ and TSS. The current permit allows for the actual daily average effluent flow rate to be used in lieu of the dry weather design flow rate during wet weather periods when influent flow exceeds dry weather design flow. However, when the actual daily average effluent flow rate exceeds the average wet weather design flow (5.0 MGD) the average wet weather design flow is the maximum flow rate that may be substituted for the dry average design flow for wet weather mass-based effluent limit calculations.

Due to the nature of the mass-based effluent limit formula when flow exceeds 5.0 MGD, the concentration of $BOD_5$ or TSS in the effluent must be lower than the technology-based effluent limit for the constituent. Mass-based effluent limits become increasingly harder to meet as effluent flow increases. The City is requesting that the permit language be modified to allow for actual daily effluent flow to be used in the wet

weather calculation of mass limits. If this is not an acceptable request, the City would like the Regional Board to consider allowing flows up to the peak wet weather design flow of 5.9 MGD to be used in the formula during wet weather conditions.

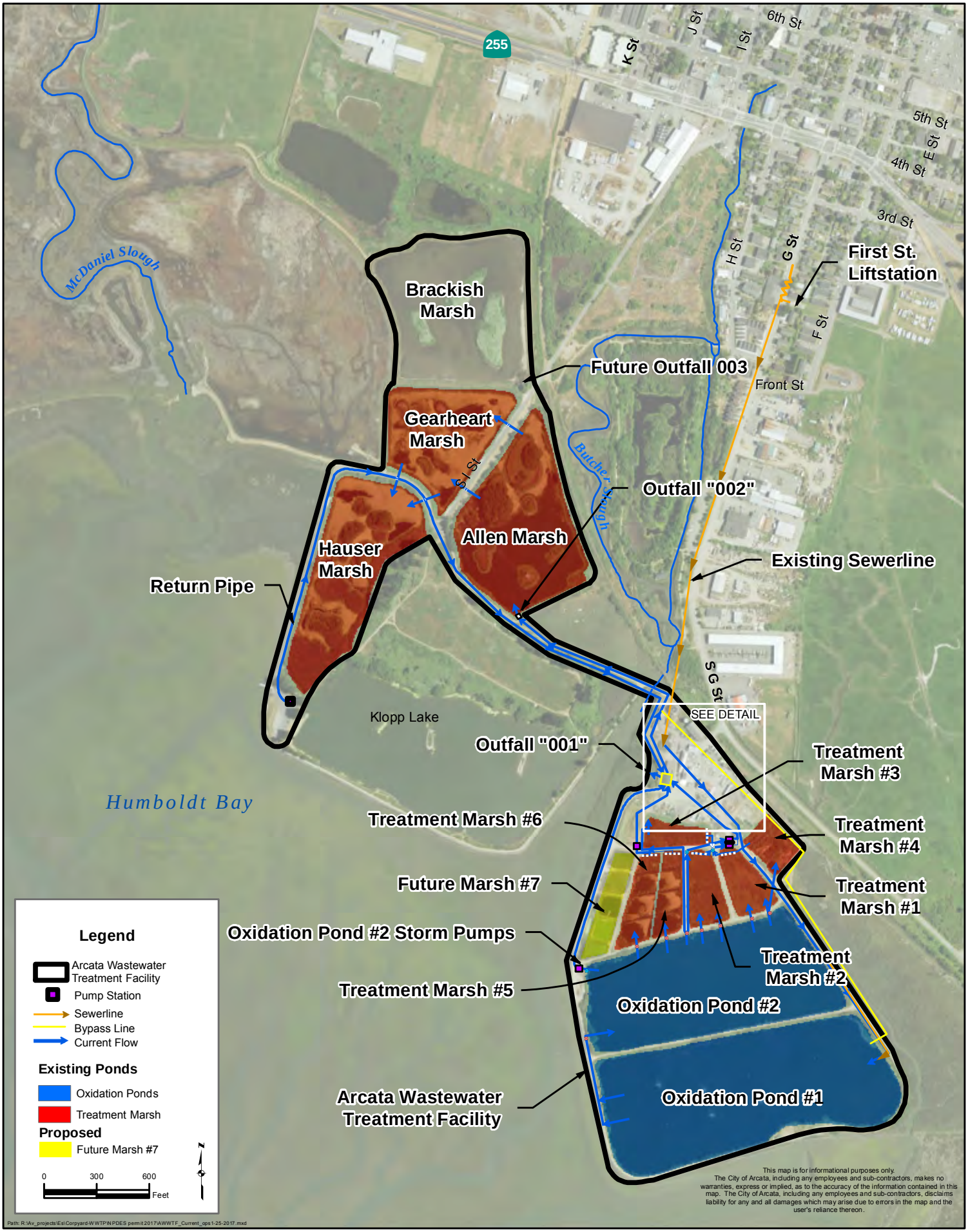
## Percent Removal Limits

Secondary treatment standards set minimum standards of 85 percent removal for $BOD_5$ and TSS. Percent removal is based on the difference between weekly influent and effluent concentrations, averaged over each calendar month. The minimum percent removal for interim Outfall-001 and Outfall-003 is 85 percent for $BOD_5$ and TSS.

During wet weather periods influent flow at the AWTP can increase dramatically depending on ground saturation conditions and rainfall. Influent $BOD_5$ and TSS concentrations during these periods are often diluted to a concentration much lower than average, making it difficult to meet the 85 percent removal requirements for $BOD_5$ and TSS despite having effluent concentrations which are well below the technology-based effluent limits. This situation is aggravated by significant rainfall on the 80 acres of ponds and wetlands which can add several million gallons per day to the plant flow during high rainfall events. The Fact Sheet for the current permit cites that secondary standards can be achieved at interim Outfall-001 in association with enhanced treatment in the enhancement marshes, however, as previously discussed, flow to the enhancement marshes is currently limited by pump capacity and there is data that shows that wet weather volumes may actually reduce treatment capacity in the enhancement marshes.

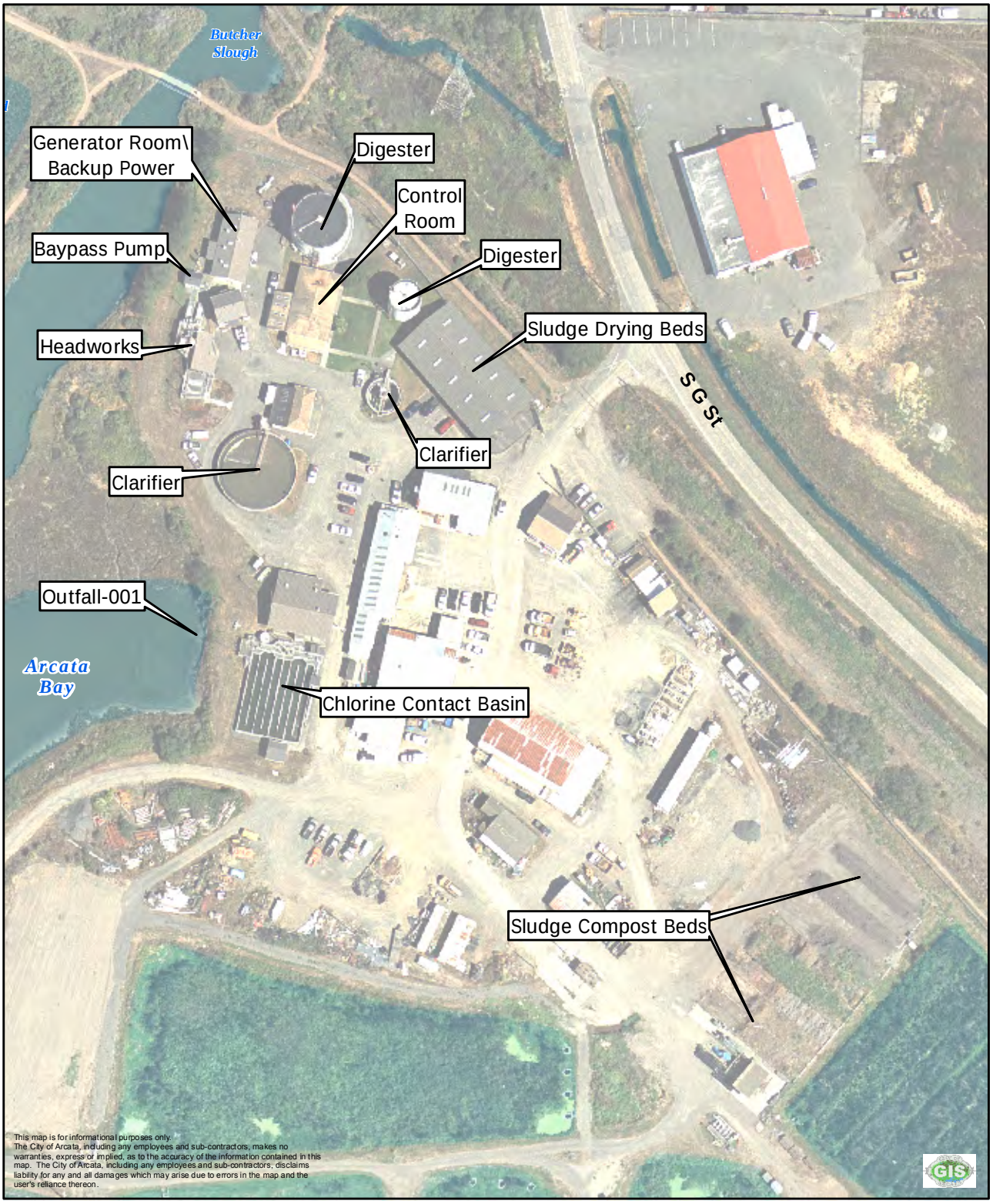
The City is requesting that wet weather allowances be made for percent removal requirements during periods when the influent flow exceeds the dry weather design flow of 2.3 MGD. During periods when the influent flow exceeds 2.3 MGD the City proposes that a 65 percent removal apply at interim Outfall-001 and Outfall-003 based on equivalent to secondary treatment standards.

# Current Operations
# Arcata Wastewater Treatment Facility




This map is for informational purposes only.
The City of Arcata, including any employees and sub-contractors, makes no warranties, express or implied, as to the accuracy of the information contained in this map. The City of Arcata, including any employees and sub-contractors, disclaims liability for any and all damages which may arise due to errors in the map and the user's reliance thereon.

Path: R:\Av_projects\Es\Corpyard-WWTP\NPDES permit 2017\AWWTF_Current_ops1-25-2017.mxd




Date Saved: 1/25/2017 3:53:05 PM Path: R:\Av_projects\Es\Corpyard-WWTP\NPDES permit 2017\AM\WWTF-Detail_1-19-2017.mxd

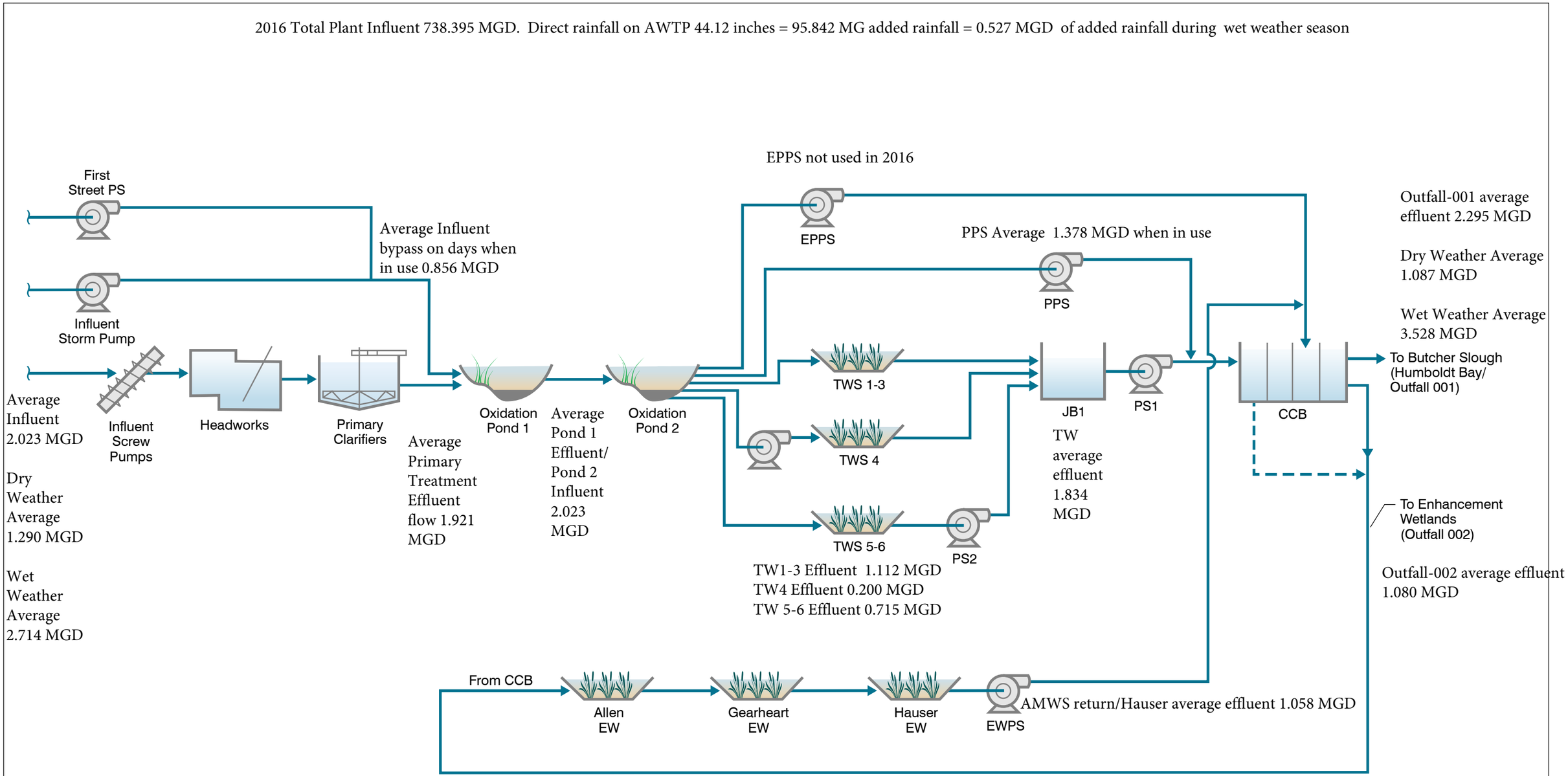
City of Arcata
*Environmental Services*

# Arcata Wastewater Treatment Facility Detail

NORTH

0 40 Feet

Flow estimates based on 2016 calendar year data




## EXISTING AWTF FLOW SCHEMATIC

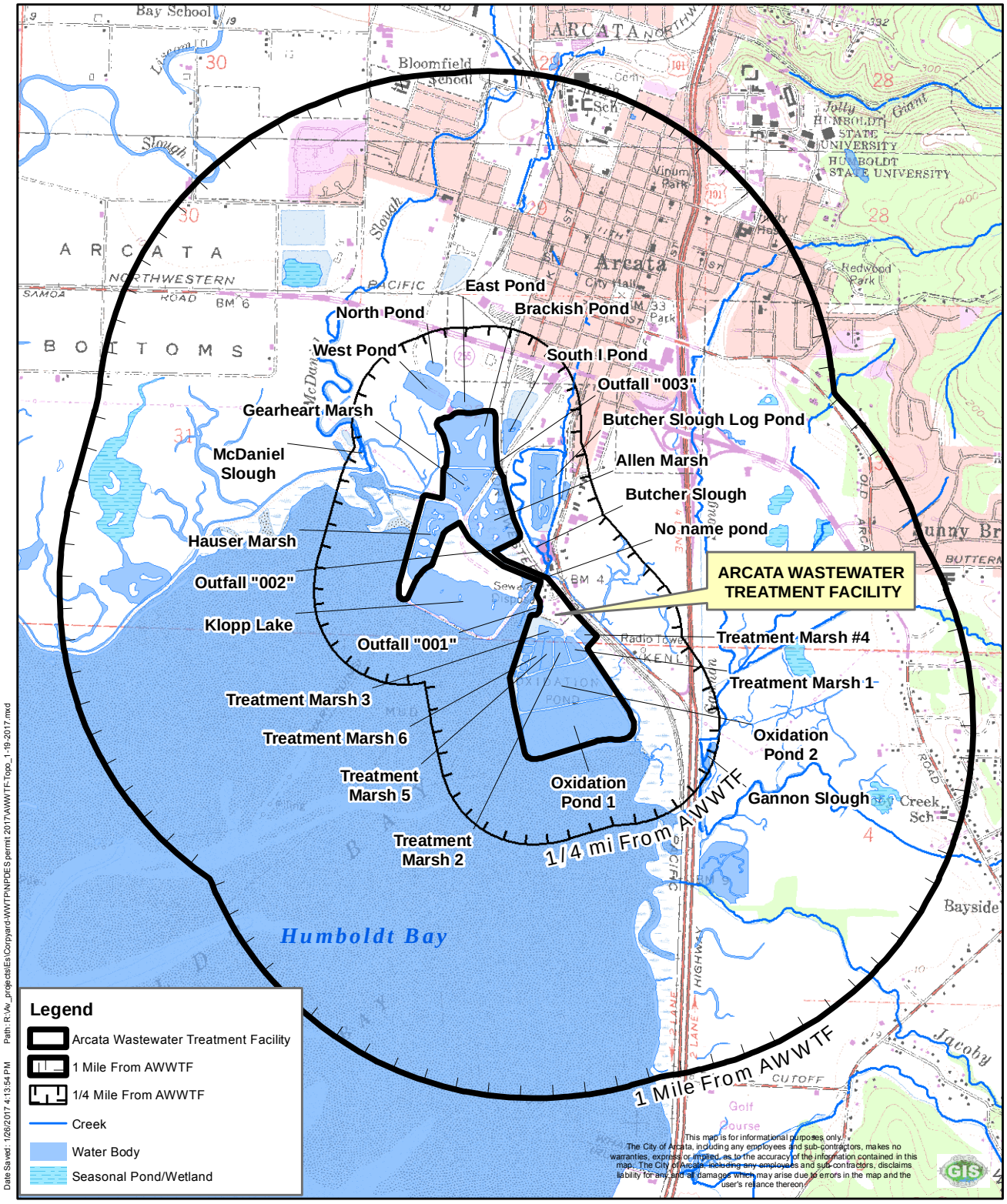
FIGURE 4.2

CITY OF ARCATA

*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

arc0915f3-9913.ai

carollo

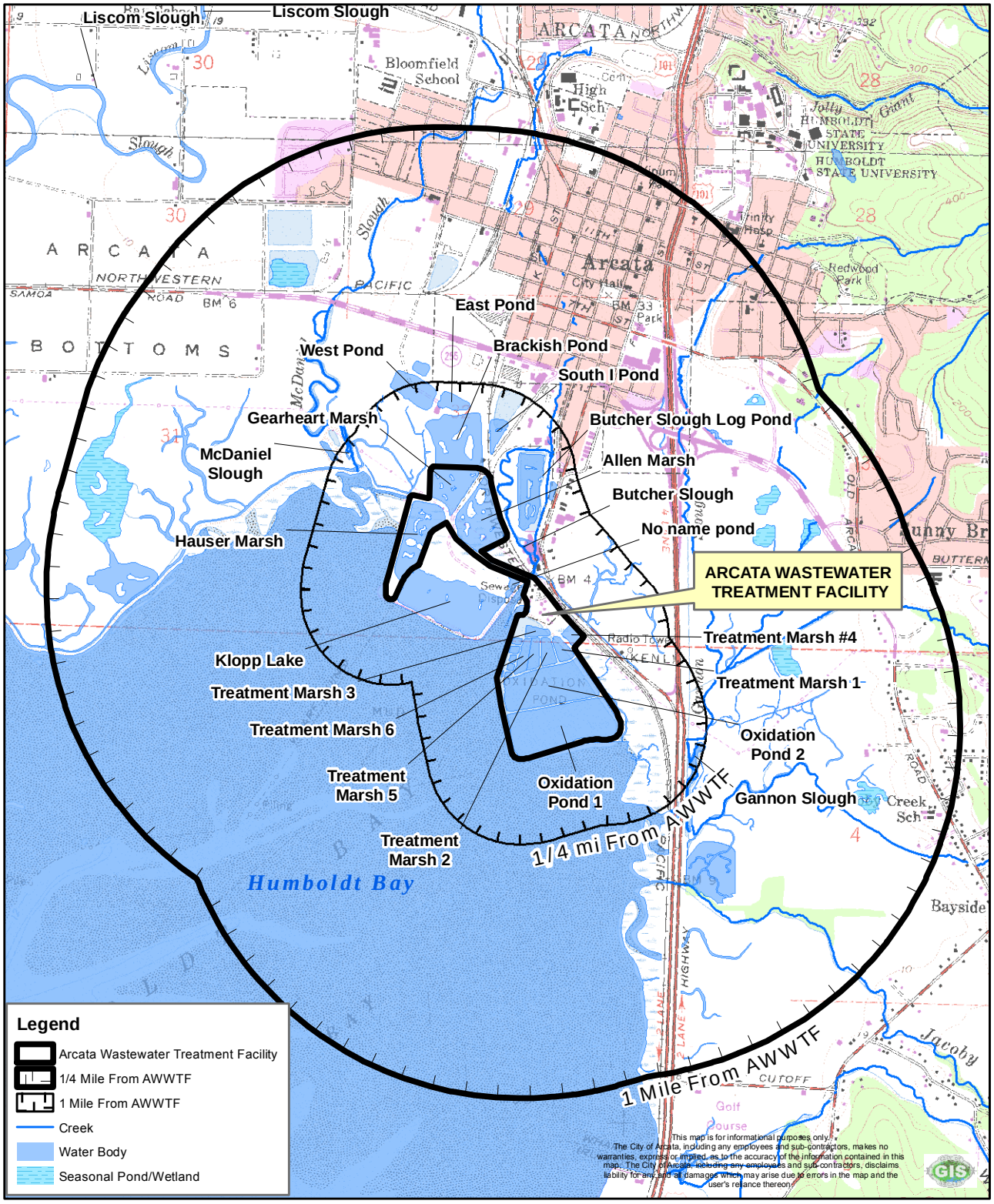



City of Arcata
*Environmental Services*

# Arcata Wastewater Treatment Facility Topographical Map

U.S.G.S. 7.5 Minute Topographic Map: Arcata South Quadrangle
Section 32 of T.6.N., R.1.E. of H.B. & M.

NORTH
0 1,000 Feet




City of Arcata

*Environmental Services*

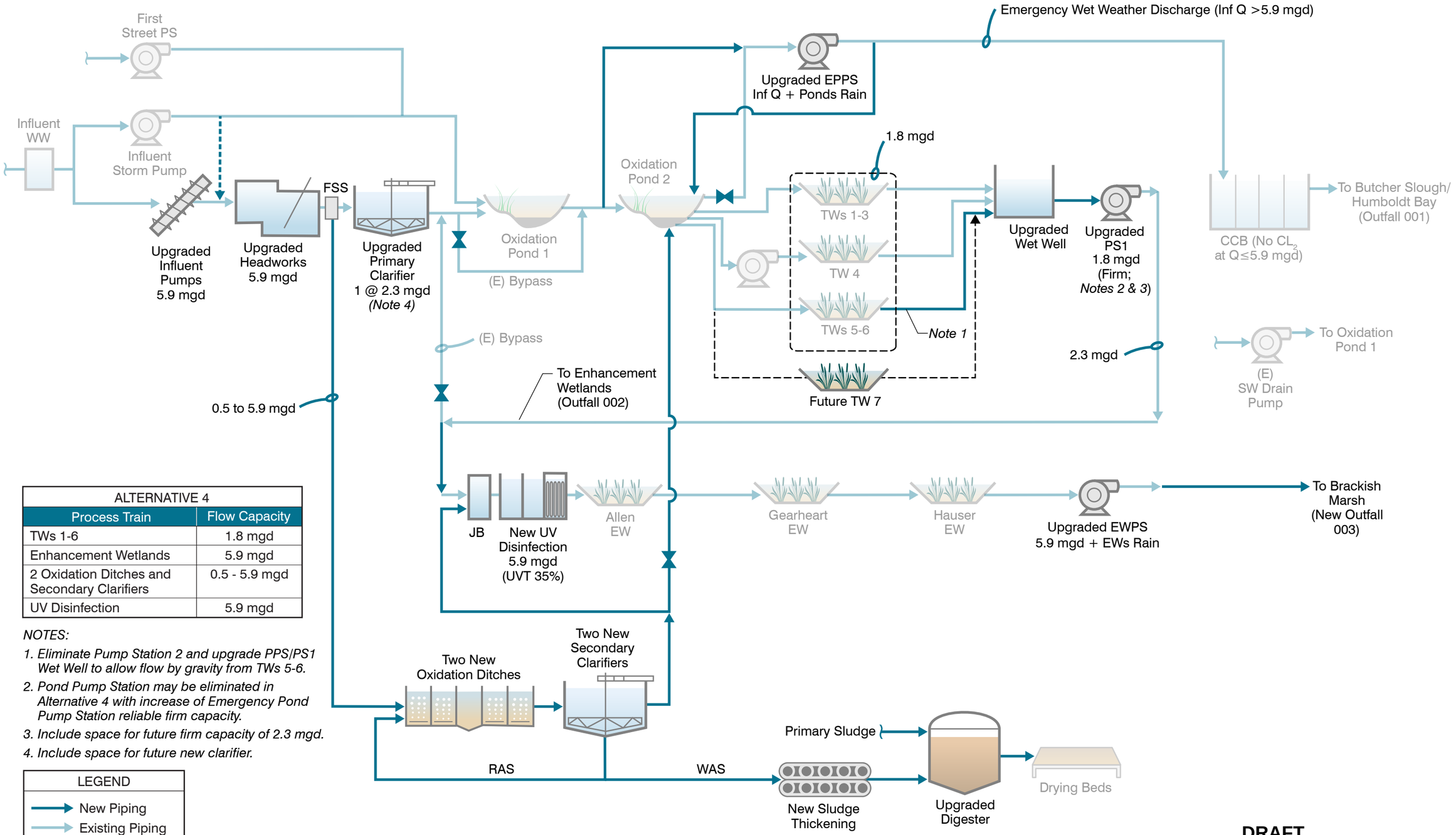
# Arcata Wastewater Treatment Facility Topographical Map

U.S.G.S. 7.5 Minute Topographic Map: Arcata South Quadrangle

Section 32 of T.6.N., R.1.E. of H.B. & M.

NORTH

0 1,000 Feet




| ALTERNATIVE 4 | |
|---|---|
| **Process Train** | **Flow Capacity** |
| TWs 1-6 | 1.8 mgd |
| Enhancement Wetlands | 5.9 mgd |
| 2 Oxidation Ditches and Secondary Clarifiers | 0.5 - 5.9 mgd |
| UV Disinfection | 5.9 mgd |

*NOTES:*

1. *Eliminate Pump Station 2 and upgrade PPS/PS1 Wet Well to allow flow by gravity from TWs 5-6.*
2. *Pond Pump Station may be eliminated in Alternative 4 with increase of Emergency Pond Pump Station reliable firm capacity.*
3. *Include space for future firm capacity of 2.3 mgd.*
4. *Include space for future new clarifier.*

LEGEND

- New Piping
- Existing Piping
- Normally Closed Valve

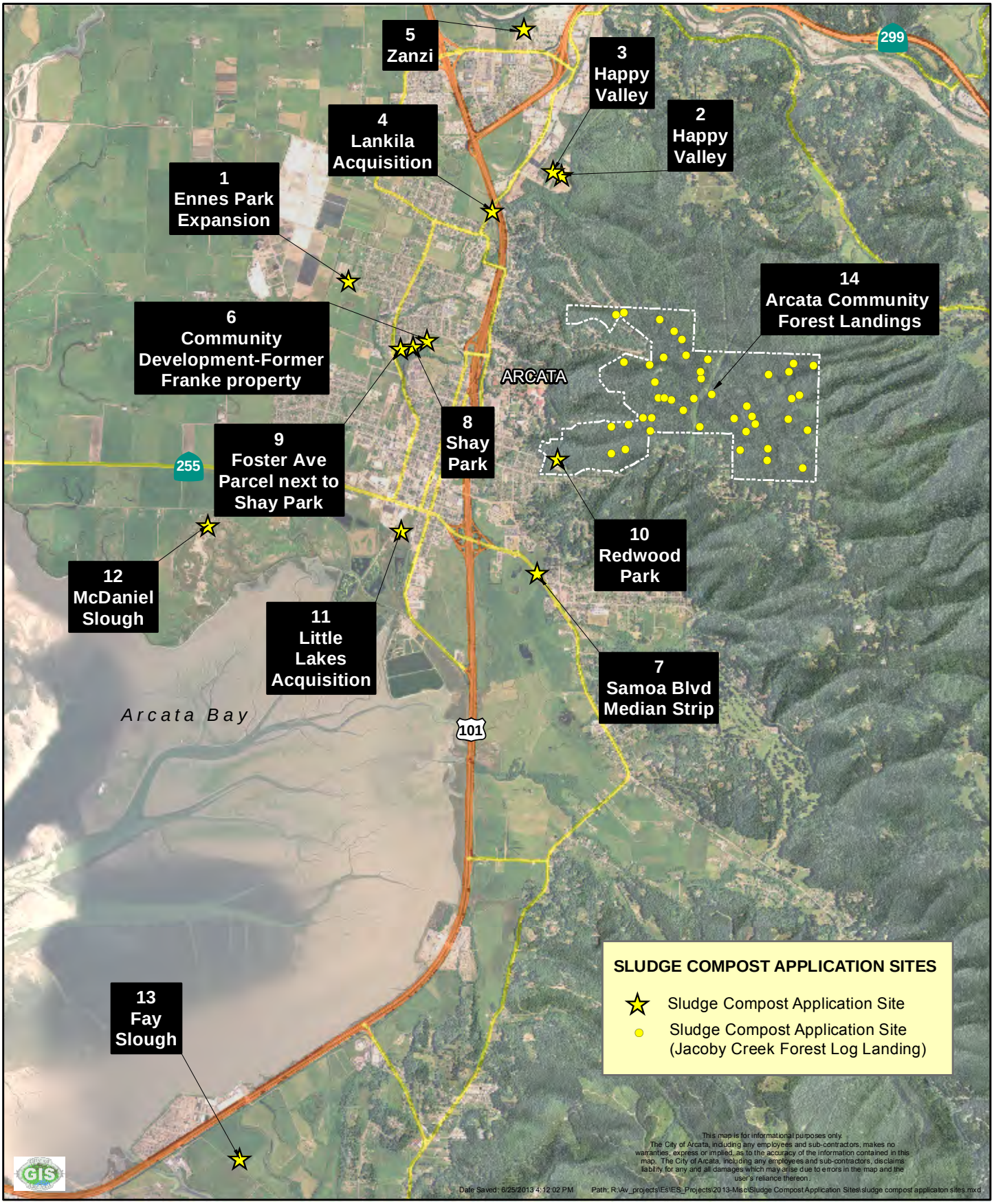
# DRAFT
# PROPOSED ALTERNATIVE 4 FLOW SCHEMATIC

CITY OF ARCATA

*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

carollo

arc0916rf1-9913.ai



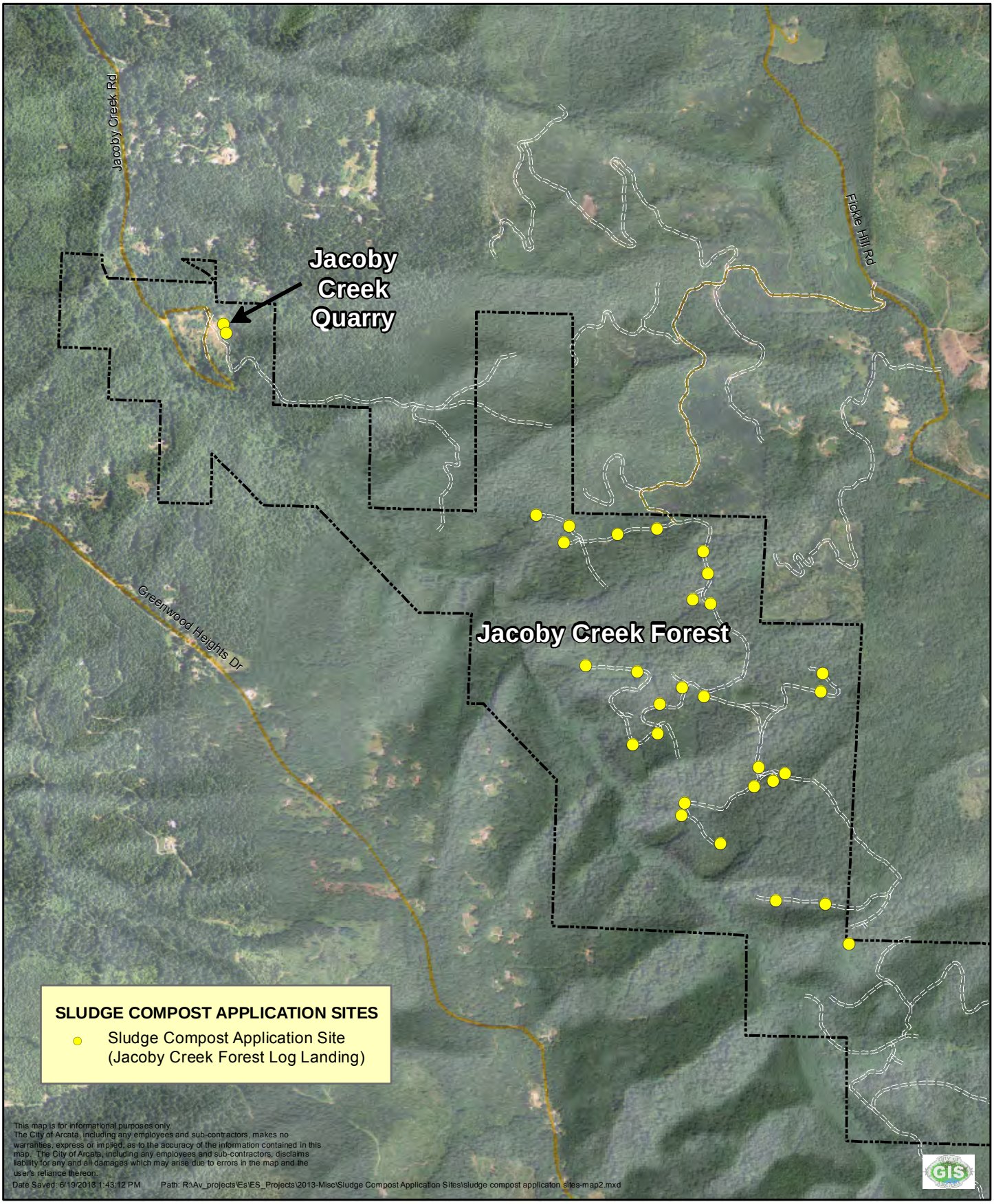

City of Arcata
*Environmental Services*

# Sludge Compost Application Sites

*Map 1 of 3*

NORTH

0 0.25 0.5 1 Miles



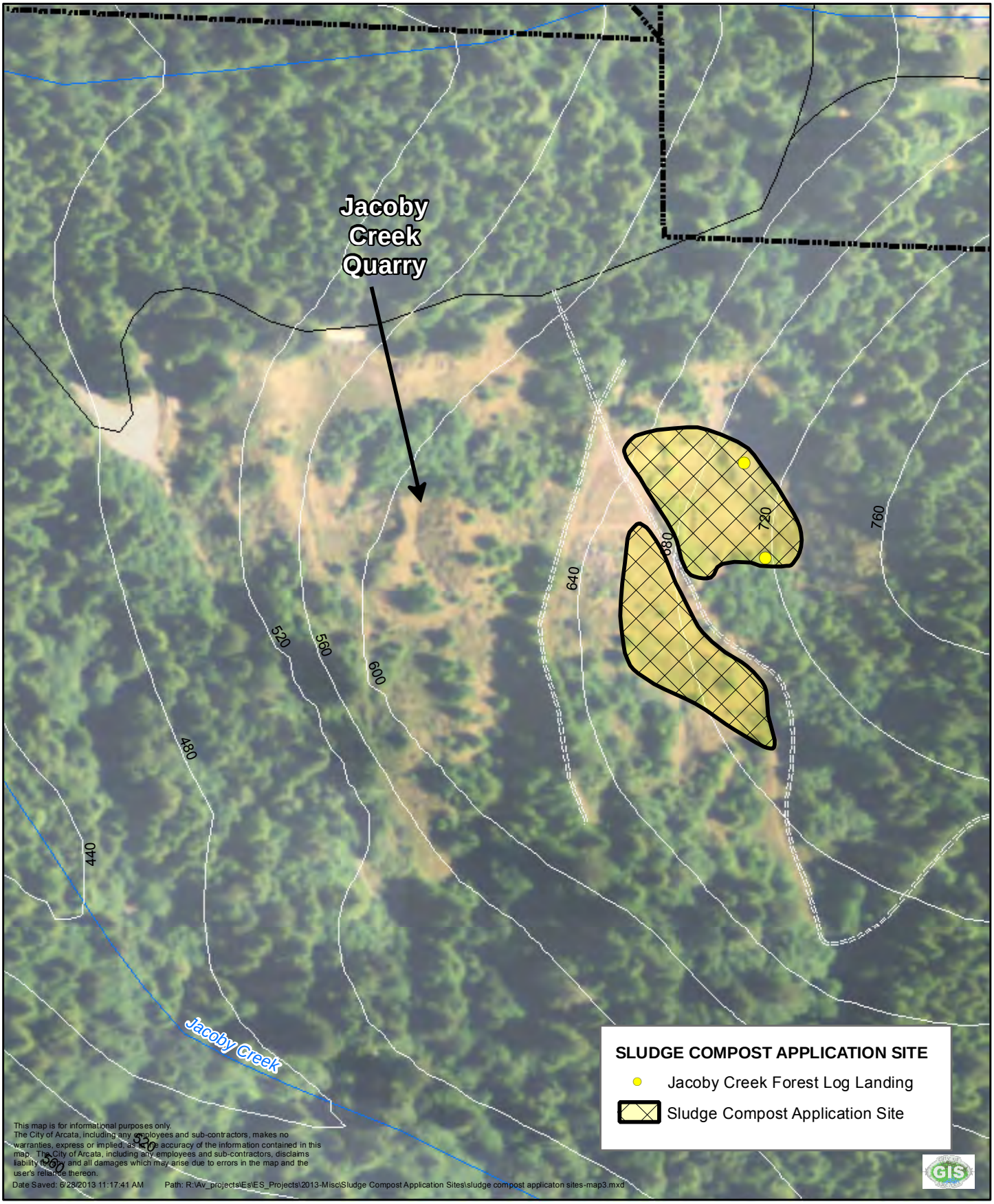

City of Arcata
*Environmental Services*

# Jacoby Creek Forest
# Sludge Compost Application Sites

*Map 2 of 2*

NORTH

0 1,000 2,000 Feet




City of Arcata
*Environmental Services*

# Jacoby Creek Forest Quarry
# Sludge Compost Application Site

NORTH
0 100 200
Feet

# APPENDIX U – PERFORMANCE REVIEW – JOE MIDDLEBROOKS FEBRUARY 2017

# Performance Expected and Operational Requirements for the Arcata, CA, Wastewater Treatment Facility

By

E. Joe Middlebrooks, PE, PhD, BCEE

After reviewing several possible modifications to the Pond system at Arcata, CA, it was decided that the most feasible and dynamic approach is to use Pond 1 as an equalization basin and divide Pond 2 into two cells designed as partial mix aerated ponds (Ponds 2A and 2B). With control of the I/I in Pond 1, coupling the ponds with the upgraded wetlands should provide an effluent quality that will meet the proposed regulatory requirements. The system could perform well for many years at the proposed average flow rate of 2.3 mgd after the I/I problems are controlled or solved.

Following are presentations discussing the proposed design and operational requirements to make the system successful. All results are based on information and data provided by the City of Arcata and information found in the report by Carollo Engineering.

Discussions of several performance situations are presented in the following sections. A summary of the most severe controlling situation at the average design flow of 2.3 mgd will be presented first.

## Worst Case Scenario

It seemed best to start with the likely severe design load that will enter Pond 2A during average design flow. The expected performance for the worst case scenario for the design of Ponds 2A and 2B receiving a flow rate of 2.3 mgd is shown in Table 1. It is assumed that Pond 1 will serve as an equalization pond, and that the equalization pond will not remove any BOD or ammonia-N, transferring the entire load from the clarifier to Pond 2A.

The greatest stress on Ponds 2A and 2B will occur when the water temperature is 6 degrees Celsius and microorganism growth rate is at its lowest. BOD removal in Pond 2A and Pond 2B should average approximately 70 and 27 mg/l, respectively. Ammonia-N conversion to $NO_3$-N likely will be minimal in Pond 2A, but it is expected that the effluent from Pond 2B will contain between 4 and 6 mg/L at the 2.3 mgd flow rate and an influent ammonia-N concentration of 55.2 mg/L. Theoretical calculations and experience with aerated ponds indicate that this level of ammonia conversion is feasible at 6 degrees Celsius (Gearheart, 2016).

Maximum power requirements as shown in Table 1 will be controlling in both cells during the warm months because of the lower solubility of oxygen at higher temperatures. The power requirements shown in Table 1 are produced by a design program that determines the controlling oxygen demand (Middlebrooks, 2005). The requirements during the cold months will be less because of the increase in solubility of oxygen and the reduced BOD and ammonia-N removed. Automated equipment should be installed to reduce the operating time for aerators used during the cold months and when power requirements might be lower after dilution of the influent during the rainy season.

During the summer and fall seasons when the flow rate is approximately 1.6 mgd, the aeration power requirements will be much less; therefore, it is essential that the aeration system be designed for control of each aerator. This will not only reduce the power consumption, but also provide better control of system performance. As pointed out above for Pond 1, the operators must be fully committed to good operation, be well informed and receive good training. There is no substitute for good operators.

As pointed out in Table 1, the power requirements are estimates that require refinement by equipment manufacturers; however the kg $O_2$/hr requirements must be provided by the equipment suppliers. The kg $O_2$/hr requirement is based on the environmental and microorganism requirements.

Based upon experience, it is best to install larger numbers of smaller aerators rather than fewer larger aerators. This approach provides better mixing, and when one or more are out of service, the power level is less affected.

## Alkalinity Requirement

Because of the low concentration of alkalinity (approximately 60 mg/L) in the wastewater, to ensure good conversion of the ammonia-N to nitrate-N it will be necessary to add alkalinity to Ponds 2A or 2B. The calculation of the alkalinity needed is shown in Table 2. The adjustment to pH normally observed in facultative or lightly aerated ponds due to growth of algae will be much less prevalent than in facultative ponds and in partial-mix aerated ponds; therefore, there will be a need to supplement the limited supply of alkalinity in the wastewater. There will be a reduced concentration of algae in the aerated ponds that might help buffer the wastewater, but it is necessary to maintain the pH at 7 to maximize ammonia-N conversion.

During the summer and fall when the flow rate averages approximately 1.6 mgd, the needed alkalinity will be less, and the dosage will vary with the influent ammonia-N concentration and the influent flow rate. The influent alkalinity will vary significantly with the seasons; therefore, careful monitoring of the influent alkalinity will be needed to control costs for chemicals.

With an influent alkalinity of 60 to 100 mg/L there would be enough to convert approximately 8 to 14 mg $NH_4$/L to $NO_3$-N, respectively. Using all of the alkalinity would reduce the pH value below 7, the optimum for conversion.

Alkalinity also will be required with a carousel activated sludge process. If this was mentioned in the Corolla report I overlooked it.

## Influence of I/I

As the flow increases during the rainy season, the performance in Ponds 2A and 2B will be significantly influenced by the control of the water transferred from Pond 1. Assuming good control of discharges from Pond 1, the pond system could produce a good quality effluent; however, the impact of solids washout into Pond 2A could be problematic with the first large surge of influent. Without diligent control of transfer of wastewater from Pond 1, the most dramatic effect on Ponds 2A and 2B will occur when a large rainfall occurs and washes the solids from Pond

1 into Pond 2A. Solids in Pond 1 are not similar or biologically active as those in Pond 2A and would dilute the active mass of organisms in Pond 2A. By controlling discharge from Pond 1 as diligently as possible, the system should function reasonably well throughout the year. It is imperative that washout of the active mass of solids be controlled constantly. It is essential that the operating staff be trained and educated about the urgency of flow control, and then monitor the system constantly.

With dilution of large inflow, the effects should not overwhelm the system provided the suspended solids in the pond ae not reduced to the point of biological inactivity. Also, the dramatic effect on the hydraulic retention time would significantly affect the efficiency of the system. Control of the depth of water in Pond 1 is critical if Ponds 2A and 2B are to function adequately during the rainy season. An automated depth control device is essential.

### Storage Available

Normal operation of equalization ponds recommends that the depth of the pond not be drawn down below two feet to prevent odors. Following this advice, at a pond depth of 5.5 feet the volume in Pond 1 is approximately 45 MG, and at a depth of 2 feet the volume is approximately 16 MG. This leaves 29 MG for storage, which provides adequate room to control the discharge from Pond 1 if careful monitoring is exercised. Because the high rainfall occurs during the cool months, it is likely that odor control should not be a problem. Although redundant, it cannot be over emphasized that careful control of Pond 1 will determine how well Ponds 1, 2A and 2B perform; therefore, as stated above, automatic level control is highly recommended.

## Impact of High Flow Rates

### Flow Rate = 4.3 mgd

Assuming that the influent flow rate to Pond 2A is increased to 4.6 mgd and the BOD reduced by 50 percent, the effluent BOD would be less than that observed for the worst case scenario as shown in Table3. If the ammonia-N entering Pond

2B were also reduced to half of the influent to Pond 2A, the performance should also be equal to the worst case or less. These assumptions require a serious caveat: The accuracy of these projected effluent concentrations is dependent on to what degree the suspended solids in Ponds 2A and 2B are washed out. Doubling the flow to 4.6 with the diluted wastewater by very careful introduction of wastewater from Pond 1 that did not reduce the suspended solids concentration in the aerated pond, by more than 5 to 10 %, the performance predicted in Table 3 would likely produce an effluent quality similar to that shown. However, with aerated pond suspended solids reductions beyond the 5 to 10 %, the reduction in efficiency likely will be directly proportional to the percentage that the solids are diluted in Ponds 2A and 2B. As mentioned below, the success of the proposed system is directly related to the degree of success with controlling the discharge from Pond 1.

**Flow Rate = 5.9 mgd**

Assuming an influent flow rate of 5.9 mgd and dilution of the pond influent BOD and ammonia-N by a ratio of 2.565 (5.9 MGD/2.3 MGD), the design concentrations for BOD and ammonia are 71 and 21.5 mg/L, respectively. The results of this analysis are shown in Table 4. All of the concerns apply here that were expressed in the caveat in the 4.3 mgd section. Also, there are concerns about the significant increase in flow rate that would wash out an excess quantity of suspended solids in Pond 2A unless there is careful control of discharge from Pond 1.

## Projected Performance

Diligently implementing the above suggestions, the total system could produce effluent concentrations as follows: BOD < 30 mg/L, TSS 30 to 40 mg/L, ammonia-N 4 to 6 mg/L, and a pH value 7.0. The system could provide an effluent that will meet the regulatory requirements for the 20% growth projected for Arcata.

## Recommendations and Comments

1. **Use Pond 1 as an equalization basin and divide Pond 2 into two cells of equal volume and designed as partial mix aerated ponds as described in this report (Ponds 2A and 2B).**
2. **Practice diligent control and use the recommendations for the pond system, and the system coupled with the upgraded wetlands could satisfy the anticipated effluent standards for many years.**
3. **Correct the I/I problem and the entire treatment system will function well without the careful control of Pond 1, and will provide treatment for the projected 20% growth to an average flow rate of 2.3 mgd for many years.**
4. **Install control equipment that will provide flexibility in control of depth in Pond 1. This is essential to ensure good performance in Ponds 2A and 2B.**
5. **Install aeration equipment with controls that will provide flexibility in operation during all seasons of the year.**
6. **Install chemical feed equipment to add alkalinity to Pond 2A with controls that will provide flexibility in operation during all seasons.**
7. **Maintain a minimum pH value of 7.0 in Ponds 2A and 2B.**
8. **Provide excellent training for the operators. Careful operation is required for peak performance from the pond system and other components of the system.**

## References

Gearheart, Robert and Swanson, Chuck. 2016. Facultative Oxidation Pond Aeration, Project Description, EIT, AMRI, January 15, 2016.

Middlebrooks, E. Joe. 2005. Program for Partial-Mix Aerated Wastewater Stabilization Pond Design, With Known Temperature and Hydraulic Detention Time.

## Table 1. Expected treatment in Pond 2A and 2B at design flow rate of 2.3 mgd at various water temperatures when Pond 2 is divided into two equal cells.

**Assuming Pond 1 Does Not Remove any BOD or NH3-N. (Worst Case Scenario). Design based on average design flow rate of 2.3 mgd , and assuming 30% BOD removal in primary tank influent of 260 mg/L.**

| Water Temperature Degrees Celsius | Pond 2A Effluent BOD Flow Rate = 2.3 mgd Inf. BOD = 182 mg/L mg/L | Pond 2A Dissolved Oxygen Requirement for BOD Without Correction for Equipment Efficiency[a] kg $O_2$/hr[b] | kW Required In Pond 2A for BOD at 2.3 mgd kW[b] |
|---|---|---|---|
| 6 | 69.38 | 153.56 | 80.82 |
| 10 | 63.41 | 156.95 | 82.61 |
| 15 | 56.32 | 160.06 | 84.24 |
| 20 | 49.68 | 161.98 | 85.25 |
| 25 | 43.56 | 162.92 | 85.75 |
| 30 | 37.97 | 163.12 | 85.85 |
| 35 | 32.93 | 162.74 | 85.65 |

[a]Excludes correction for equipment efficiencies , but Includes environmental corrections and multiplying factor of 1.5 for BOD removal.

[b]Controlled by Summer Temperature.

[c]These power req. are approximate values and are used for the preliminary selection of equipment. These values are used in conjunction with equipment manufacturers catalogs to select the proper equipment.

## Table 1 Cont. Expected treatment in Pond 2A and 2B at design flow rate of 2.3 mgd at various water temperatures when Pond 2 is divided into two equal cells.

**Assuming Pond 1 Does Not Remove any BOD or NH3-N. (Worst Case Scenario). Design based on average design flow rate of 2.3 mgd , and assuming 30% BOD removal in primary tank influent of 260 mg/L.**

| Pond 2B Effluent BOD Flow Rate = 2.3 mgd Inf. BOD = Col. B mg/L | Pond 2B Dissolved Oxygen Requirement for BOD Without Correction for Equipment Efficiency[a] kg $O_2$/hr[b] | kW Required In Pond 2B for BOD at 2.3 mgd kW[b] | Pond 2B Dissolved Oxygen Requirement for $NH_3$-N Without Correction for Equipment Efficiency[a] kg $O_2$/hr[b] |
|---|---|---|---|
| 26.45 | 51.55 | 27.13 | 132.39 |
| 22.10 | 48.03 | 25.28 | 135.32 |
| 17.45 | 43.34 | 22.81 | 138.00 |
| 13.56 | 38.54 | 20.28 | 139.66 |
| 10.42 | 33.84 | 17.81 | 140.46 |
| 7.92 | 29.39 | 15.47 | 140.64 |
| 5.96 | 25.30 | 13.32 | 140.31 |

[a]Excludes correction for equipment efficiencies , but Includes environmental corrections and multiplying factor of 1.5 for BOD removal.

[b]Controlled by Summer Temperature.

[c]These power req. are approximate values and are used for the preliminary selection of equipment. These values are used in conjunction with equipment manufacturers catalogs to select the proper equipment.

## Table 1 Cont. Expected treatment in Pond 2A and 2B at design flow rate of 2.3 mgd at various water temperatures when Pond 2 is divided into two equal cells.

**Assuming Pond 1 Does Not Remove any BOD or NH3-N. (Worst Case Scenario). Design based on average design flow rate of 2.3 mgd , and assuming 30% BOD removal in primary tank influent of 260 mg/L.**

| kW Required In Pond 2B for NH3-N at 2.3 mgd<br>kWb | Total Oxygen Demand for Pond 2B Flow rate = 2.3 mgd<br>kg O2/hrb | Total kW Required for Pond 2 Flow Rate = 2.3 mgd<br>kWb | Total hp Required for Pond 2 Flow Rate = 2.3 mgd<br>hpb |
|---|---|---|---|
| 69.68 | 337.5 | 177.63 | 238.20 |
| 71.22 | 340.3 | 179.11 | 240.19 |
| 72.63 | 341.4 | 179.68 | 240.95 |
| 73.50 | 340.18 | 179.03 | 240.08 |
| 73.93 | 337.22 | 177.49 | 238.01 |
| 74.02 | 333.15 | 175.34 | 235.13 |
| 73.65 | 328.35 | 172.62 | 231.48 |

aExcludes correction for equipment efficiencies , but Includes environmental corrections and multiplying factor of 1.5 for BOD removal.

bControlled by Summer Temperature.

cThese power req. are approximate values and are used for the preliminary selection of equipment. These values are used in conjunction with equipment manufacturers catalogs to select the proper equipment.

## Table 2. Alkalinity in the wastewater is consumed during the process; therefore, must calculate needed alkalinity for 2.3 mgd.

| | | |
|---|---|---|
| Flow rate = | 8706.5 | $m^3/d$ |
| Influent Alkalinity | 60 | mg/L |
| Influent Total Nitrogen = | 55.2 | mg/L |
| Assumed conversion = | 0.96 | |
| $NO_3$ = TN - Ne | 53.0 | mg/L |
| Influent Alkalinity | 60 | mg/L |
| Alk. used for nitrif. = (7.14 g $CaCO_3/gNH_4$-N)($NO_x$) = | 378 | mg/L used as $CaCO_3$ |
| Alkalinity Residual needed to maintain pH at 7 = | 80 | mg/L as $CaCO_3$ |
| Alk to maintain pH at approx. 7 = Alk Used + Residual Alk. to maintain pH 7 - Inf. Alk | 398.4 | mg/L as $CaCO_3$ |
| | | |
| Alkalinity Needed = | 3468 | kg/d as $CaCO_3$ |

## Table 3. Expected treatment in Ponds 2A and 2B at Various Temperatures and 4.6 mgd.

| Water Temperature | Pond 2A Effluent BOD | Pond 2A | Pond 2B Effluent BOD | Pond 2B | Pond 2B Dissolved Oxygen |
|---|---|---|---|---|---|
| Degrees Celsius | Flow Rate =4.6 mgd<br>Inf. BOD = 91 mg/L | kg O2/hr Required at | Flow Rate = 4.6 mgd<br>Inf. BOD = 2A Effluent | kg O2/hr Required at | Requirement for $NH_3$-N<br>Influent = 27.6 mg/L |
| | mg/L | 4.6 mgd | mg/L | 4.6 mgd | kg $O_2$/hr |
| 6 | 50.23 | 153.55 | 27.73 | 74.65 | 122.04 |
| 8 | 48.63 | 155.35 | 25.99 | 73.03 | 123.47 |
| 10 | 47.03 | 156.95 | 24.30 | 71.24 | 124.74 |
| 15 | 43.01 | 160.06 | 20.33 | 66.20 | 127.21 |
| 20 | 39.03 | 161.98 | 16.74 | 60.55 | 128.74 |
| 25 | 35.14 | 162.92 | 13.57 | 54.61 | 129.49 |
| 30 | 31.41 | 163.12 | 10.84 | 48.64 | 129.65 |
| 35 | 27.88 | 162.74 | 8.54 | 42.85 | 129.35 |

# Table 4. Expected treatment in Ponds 2A and 2B at Various Temperatures and 5.9 mgd.

| Water Temperature | Pond 2A Effluent BOD | Pond 2A | Pond 2B Effluent BOD | Pond 2B | Pond 2B Dissolved Oxygen |
|---|---|---|---|---|---|
| Degrees Celsius | Flow Rate = 5.9 mgd | kg O2/hr Required at | Flow Rate = 5.9 mgd Inf. BOD = 2A Effluent | kg O2/hr Required at | Requirement for $NH_3$-N |
| | Inf. BOD = 91 mg/L | | | | Influent = 27.6 mg/L |
| | mg/L | 5.9 mgd | mg/L | 5.9 mgd | kg $O_2$/hr |
| 6 | 34.69 | 196.95 | 13.22 | 66.12 | 156.4 |
| 8 | 33.18 | 199.26 | 12.1 | 63.91 | 156.4 |
| 10 | 31.71 | 201.31 | 11.05 | 61.61 | 156.4 |
| 15 | 28.16 | 205.29 | 8.71 | 55.59 | 156.4 |
| 20 | 24.84 | 207.76 | 6.78 | 49.43 | 156.4 |
| 25 | 21.78 | 208.17 | 5.21 | 47.89 | 156.4 |
| 30 | 18.98 | 209.22 | 3.96 | 37.70 | 156.4 |
| 35 | 16.46 | 208.74 | 2.98 | 32.45 | 156.4 |

# APPENDIX V – PUBLIC MEETING AND COUNCIL PRESENTATIONS = MARCH AND APRIL 2017

**6. ADJOURNMENT**

**REGULAR MEETING**
6:00 p.m.

**I. FLAG SALUTE**

**II. ROLL CALL**

**III. CEREMONIAL MATTERS**

**A. Proclamation Celebrating *Water Week*, May 7–13, 2017.**

**B. Proclamation in Recognition of the *22nd Annual Godwit Days Spring Migration Bird Festival*, April 19–25, 2017.**

**C. Proclamation in Recognition of *Wetlands Month*, May 2017.**

**D. Proclamation Designating May 2017 as *National Historic Preservation Month in Arcata*.**

**E. Proclamation in Recognition of *Bike Month*, May 2017.**

**F. Swear-in Appointed City Council Member Brett Watson.**

**IV. REPORT BY COMMISSION/COMMITTEE**

**A. Annual Report of the Wetlands and Creeks Committee 2016.**

**V. EARLY ORAL COMMUNICATIONS**

This 15-minute time period is provided for people to address the Council on matters not on the agenda. At the conclusion of all oral communications the Council may respond to statements. Any request that requires Council action will be set by the Council for a future agenda or referred to staff. Speakers addressing the Council at this time may be limited to two minutes. All other Oral and Written Communications will be heard at this meeting under Agenda Item XI.

**VI. N/A**

**VII. CONSENT CALENDAR**

All matters on the Consent Calendar are considered to be routine by the City Council and are enacted in one motion. There is no separate discussion of any of these items. If discussion is required, that item is removed from the Consent Calendar and considered separately. At the end of the reading of the Consent Calendar, Council members or members of the public can request that an item be removed for separate discussion.

**A. Approve Minutes of the City Council Meeting of April 5, 2017.**

**B. Bi-Weekly Report on General Warrants.**

**C. Reappoint Brad Freeman to the Open Space and Agriculture Committee for a New Three-Year Term Ending April 30, 2020; and Reappoint Zane Brotherton and Jayne McGuire to the Parks and Recreation Committee for New Three-Year Terms Ending April 30, 2020.**

**D. Accept an $800 Donation from Arcata Main Street's "Plaza Watershed Program" for Riparian Tree Planting in the Jolly Giant Creek Watershed.**

**E. Adopt Resolution No. 167-46 Authorizing a Grant Application to the California Natural Resources Agency (CNRA) Urban Greening Program for the Forsyth Property Acquisition (49 acres); and Authorize the City Manager to Execute Pertinent Grant Agreements.**

**F. Authorize Mayor to Sign On to the Climate Mayors' Letter to President Trump Opposing the Rollback of U.S. Climate Actions.**

**G. Authorize the Mayor to Sign a Letter in Support of Assembly Bill 1326, Theft: Aggregate Valuation.**

## VIII. ITEMS REMOVED FROM CONSENT CALENDAR

Items removed from the Consent Calendar will be heard under this section.

## IX. OLD BUSINESS

**A. Receive an Update on the Wastewater Treatment Plant Facility Plan and Upgrade Project; Authorize an Upgrade Alternative to Pursue for Development of Additional Detail; Authorize Staff to Seek State Revolving Loan/Grant Funding for Preliminary Design and Engineering; and Initiate CEQA Environmental Review.**

The Arcata Wastewater Treatment Plant (WWTP) Facility Plan/upgrades are designed to:

- provide reliable service to the community now and in the future;
- meet permit/regulatory requirements that protect public health and the environment; and
- meet the City's goals for sustainability, as much as possible.

The required capital improvements fall into three general categories:

1) Facilities beyond their useful life including the WWTP headworks, clarifier and internal and external pumping stations.
2) Facilities necessary to accomplish the permit requirements to be chlorine free and move our discharge point to be in compliance with our NPDES permit including pipes, pumps, and valves to re-route wastewater. This will allow the plant to utilize ultra-violet (UV) disinfection process and eliminate chlorine contact basin blending that is not compliant with current standards.

3) Identified performance issues to reduce WWTP discharge violations and resolve the narrow compliance safety margins, including the removal of chlorine from the WWTP treatment process which currently contributes significantly to the WWTP's biochemical oxygen demand (BOD) reduction; as well as other pollutants of concern including total and suspended solids removal and anticipated new effluent limits requirements for ammonia discharges to the bay.

Performance enhancements to assure WWTP performance include increased reliability, ease of operation, redundancy and flexibility to accommodate moderate growth and high volume wet weather flows.

Following City Council presentations and focused workshops on this topic, the City Council directed staff and the consultant team to further explore a few items including:

1) Meeting with Regional Water Quality Control Board staff to obtain clarity on the future permit requirements.
2) Provide detail on the WWTP flow rating and/rainfall inflow for sizing.
3) Consideration of oxidation pond improvements.
4) Determine if the underlying bay muds would allow for long term use of unlined ponds for treatment and also if the existing bay front levee was stable enough to raise elevation over time for sea level rise adaptation.
5) Provide detail on estimated population growth projections.
6) Return with revised alternatives for consideration.
7) Provide additional detail on costs.

RECOMMENDATION:

It is recommended that the Council:

1) Receive an update on the Wastewater Treatment Plant Facility Plan and upgrade project;
2) Authorize an alternative to pursue for development of additional detail;
3) Authorize staff to seek State Revolving Loan/Grant funds for preliminary design and engineering; and
4) Initiate CEQA Environmental Review.

**B. Introduce Ordinance No. 1486, an Ordinance of the City Council of the City of Arcata Amending Arcata Municipal Code Title IX—Land Use Code, Section 9.12.020, Zoning Map and Zoning Districts, Affecting 21 Parcels, Waive Reading of the Text and Consent to Read by Title Only; and Adopt Resolutions Amending the Zoning and General Plan Designations for 21 Publicly Owned Properties and a Minor Adjustment to the Urban Services Boundary Affecting the Forsyth Property (Assessor's Parcel No. 020-201-005).**

On March 1 and 15, 2017, the City Council received staff reports and public testimony, and deliberated on this item. The Council directed staff to separate the two aspects of the project by bringing the zoning map and land

use amendments affecting 21 parcels back for adoption independent from the larger Urban Service Boundary and Sphere of Influence boundary adjustments, which will be considered at a later date.

The Forsyth Urban Services Boundary adjustment, however, is a minor adjustment to accommodate existing conditions on the site and will facilitate the acquisition of a 49-acre property by the City for inclusion into the Arcata Community Forest. This was included originally in the larger project and was reviewed by the Planning Commission which recommended approval of all the proposed amendments in its adoption of Resolution PC-17-02 on January 24, 2017.

This action will approve general plan and zoning amendments for the subject publicly owned parcels and a minor Urban Services Boundary adjustment to better align a segment of the boundary to existing conditions. Previous staff reports can be viewed on the City's Meeting Portal website.

RECOMMENDATION:
Staff recommends the Council:

1) Introduce Ordinance No. 1486, an Ordinance of the City Council of the City of Arcata Amending Arcata Municipal Code Title IX—Land Use Code, Section 9.12.020, Zoning Map and Zoning Districts, affecting 21 parcels, waive reading of the text and consent to read by title only;
2) Adopt Resolution No. 167-33, A Resolution of the City Council of the City of Arcata Adopting a General Plan Amendment Modifying the Land Use Designations of 21 Parcels Throughout the City;
3) Adopt Resolution No. 167-43, Accepting a General Plan Amendment Modifying the Urban Services Boundary Affecting the Forsyth property (Assessor's Parcel No. 020-201-005); and
4) Find that the project is covered by the General Rule, §15061(b)(3) of the California Environmental Quality Act Guidelines, for projects that will not have a significant effect on the environment.

**C. Review Investment Policy and Adopt Resolution No. 167-44, Adopting the City of Arcata Investment Policy.**

Section 53646(a) of the California Government Code states that the treasurer may annually provide the City Council with a statement of investment policy for consideration at a public meeting. The City's Investment Policy was last reviewed and adopted by the City Council on June 13, 2012.

RECOMMENDATION:
Adopt Resolution No. 167-44, Adopting the City of Arcata Investment Policy.

**D. Adopt Resolution No. 167-47, A Resolution of the City Council of the City of Arcata Approving an Agreement Declaring Restrictive Covenants for the Transfer of Caltrans Property, Assessor's Parcel No. 507-141-050, to the City of Arcata and the Cooperative Agreement for Same Property.**

The purpose of the Agreement Declaring Restrictive Covenants for the transfer of property and Cooperative Agreement for shared use of the property is to allow the City of Arcata to utilize the property as a park to provide the infrastructure to promote public access to the Mad River, promote conservation and stewardship, develop public appreciation for nature, and support outdoor recreation on the property.

RECOMMENDATION:
It is recommended that the Council adopt Resolution No. 167-47, A Resolution of the City Council of the City of Arcata Approving an Agreement Declaring Restrictive Covenants for the Transfer of Caltrans Property, Assessor's Parcel No. 507-141-050 to the City of Arcata and the Cooperative Agreement for Same Property.

## X. NEW BUSINESS

**A. Appoint Members for Three Vacancies on the Open Space and Agriculture Committee for Two Terms Expiring on April 30, 2020, and One Term Expiring on April 30, 2018.**

## XI. ORAL AND WRITTEN COMMUNICATIONS

This time is provided for people to address the Council or submit written communications on matters not on the agenda. At the conclusion of all oral and written communications, the Council may respond to statements. Any request that requires Council action will be set by the Council for a future agenda or referred to staff. Speakers addressing the Council may be limited to three minutes, with a maximum of five minutes, and a time limit on the overall length of oral communications may be imposed.

## XII. COUNCIL AND STAFF REPORTS

All reports shall be specifically limited to City business and shall not request or lead to action by the Council at this meeting.

## XIII. DATES OF FUTURE MEETINGS—None

## XIV. CLOSED SESSION

## XV. CLOSED SESSION REPORTS

## XVI. ADJOURNMENT

Other than items continued or tabled to a date certain, the Council may, by majority vote, continue all matters not completed by 10:30 p.m. to the following Thursday at 6:00 p.m. in the Council Chamber. Should the Council vote to continue the meeting past 10:30 p.m., discussion on an item on the agenda that either requires or allows for public input may not begin without a unanimous vote of the City Council members present. (Closed Session items may begin later.) (Reference: Resolution No. 101-69)

# STAFF REPORT – CITY COUNCIL MEETING

April 19, 2017

**TO:** Honorable Mayor and City Council Members

**FROM:** Mark Andre, Director of Environmental Services

**PREPARER:** Mark Andre, Director of Environmental Services

**DATE:** April 13, 2017

**TITLE:** **Receive an Update on the Wastewater Treatment Plant Facility Plan and Upgrade Project; Authorize an Upgrade Alternative to Pursue for Development of Additional Detail; Authorize Staff to Seek State Revolving Loan/Grant Funding for Preliminary Design and Engineering; and Initiate CEQA Environmental Review.**

---

**RECOMMENDATION:**

It is recommended that the Council:

1) Receive an update on the Wastewater Treatment Plant Facility Plan and upgrade project;
2) Authorize an alternative to pursue for development of additional detail;
3) Authorize staff to seek State Revolving Loan/Grant funds for preliminary design and engineering; and
4) Initiate CEQA Environmental Review.

**INTRODUCTION:**

The Arcata Wastewater Treatment Plant (WWTP) Facility Plan/upgrades are designed to:

- provide reliable service to the community now and in the future;
- meet permit/regulatory requirements that protect public health and the environment; and
- meet the City's goals for sustainability, as much as possible.

The required capital improvements fall into three general categories:

1) Facilities beyond their useful life including the WWTP headworks, clarifier and internal and external pumping stations.
2) Facilities necessary to accomplish the permit requirements to be chlorine free and move our discharge point to be in compliance with our NPDES permit including pipes, pumps, and valves to re-route wastewater. This will allow the plant to utilize ultra-violet (UV) disinfection process and eliminate chlorine contact basin blending that is not compliant with current standards.
3) Identified performance issues to reduce WWTP discharge violations and resolve the narrow compliance safety margins, including the removal of chlorine from the WWTP treatment process which currently contributes significantly to the WWTP's biochemical oxygen demand (BOD) reduction; as well as other pollutants of concern including total and suspended solids removal and anticipated new effluent limits requirements for ammonia discharges to the bay.

Performance enhancements to assure WWTP performance include increased reliability, ease of operation, redundancy and flexibility to accommodate moderate growth and high volume wet weather flows.
Following City Council presentations and focused workshops on this topic, the City Council directed staff and the consultant team to further explore a few items including:

1) Meeting with Regional Water Quality Control Board staff to obtain clarity on the future permit requirements.
2) Provide detail on the WWTP flow rating and/rainfall inflow for sizing.
3) Consideration of oxidation pond improvements.
4) Determine if the underlying bay muds would allow for long term use of unlined ponds for treatment and also if the existing bay front levee was stable enough to raise elevation over time for sea level rise adaptation.
5) Provide detail on estimated population growth projections.
6) Return with revised alternatives for consideration.
7) Provide additional detail on costs.

**DISCUSSION:**

1.) Permit discussions with Regional Water Quality Control Board (RWQCB):
Staff and the consultant team met with the RWQCB in Santa Rosa on June 27, 2016.
That meeting provided important feedback to inform the direction of the plant upgrades including:
All flow under 5.9 MGD are to pass through the AMWS enhancement wetlands, which affects hydraulic capacity needs of the total system.
Expect ammonia limits as low as 4 mg/l in permit renewal July 2017. On this matter City staff is requesting a seasonal limit and we are also collecting onsite data so that we can make a case for an appropriate limit rather than an arbitrary one for ammonia.
The RWQCB expects that the City will continually monitor inflow and infiltration (I/I) and work aggressively to reduce it as well as Sanitary Sewer Overflows or SSO's.

2.) Rainfall Influence and flow rating findings
The land based system receives significant additional flow due to rainfall that totals 2 MGD for every one inch of rain that falls directly on the oxidation ponds/wetland system. We decided to use a 3 inch per 24-hour storm event as our design condition. Continued improvements to the wastewater collection system to reduce I/I are ongoing and the City is estimating a reduction of up to 1.2MGD with the currently proposed project which we are currently seeking State Revolving Funds (SRF) to begin construction late this summer. Continued efforts to reduce I/I citywide and specifically working to reduce the I/I emanating from the private side of the system will require continued vigilance and collaborative efforts to successfully reduce it as much as possible. With improved I/I control in the future it may be possible to reduce the size of future long term WWTP capital improvements, improve treatment efficiency as well as significantly reducing sanitary sewer overflows and violations. This is one of the merits of using a phased approach to the facility plan implementation. Currently, storage of I&I in oxidation ponds helps reduce WWTP peak flows while we continue to make I/I reductions in the entire collection system.

3.) Oxidation Pond Improvements Findings
Considerable time and effort was spent on looking at potential upgrades and enhancements to both the treatment marshes and the oxidation ponds in order to determine what appropriate investments to those components would yield cost effective treatment gains. A focused study was prepared by an expert in field, Dr. Joe Middlebrooks, and he provided findings and recommendations including:

Use of oxidation pond 1 for wet weather equalization allowing planned wet weather storage and wastewater metering.
Adding baffles and inlet/outlet controls to prevent short circuiting and approximately 20 (15 HP) aerators to oxidation pond 2 for enhanced treatment of pollutants of concern and specifically ammonia conversion.
Improve removal efficiencies and our ability to meet permit limits likely in low flow months, compromised during wet weather, cold months
Predicted improved ammonia removal, but may not meet permit limit year round requiring other measures.
Remove existing legacy sludge from the 50 year-old ponds to increase depth, volume and reduce internal loading.

4.) Geotechnical Findings
The findings from the LACO Associates geotechnical report and Arcata Marsh Research Institute (AMRI) infiltrometer testing show that the underlying bay muds under the existing ponds and dikes constructed from and within the bay muds are extremely low permeability. The proposed new wetland treatment Marsh 7 to be constructed at the former aquaculture facility and adjacent to the AMRI lab will likely not require lining. The existing bay mud levee that protects and surrounds the oxidation ponds and WWTP were also found to be sound enough to raise the elevation by 2-3 feet over time up to approximately 15' which would be high enough to protect the oxidation ponds from the maximum credible storm surge waves of 14' estimated by FEMA in 2015. This is an important adaptive strategy as well which will allow the City to protect this critical facility as well as adjust to predicted credible storm events and sea level rise. Raising the levees higher will likely require moving material into the oxidation pond in order to allow elevation augmentation. These findings also are supportive of the Citys goal to protect the shoreline with living shorelines where possible.

5.) Population Growth Projection Findings
Based upon analysis of past growth rates, future growth rates and the General Plan build out estimates, Arcata's population can be expected to grow at approximately 1% over the next 20 year planning horizon. It is important to stress that the planned WWTP improvements are designed for the Arcata General Plan build-out and growth rate projections and it is not a project that will lead to growth inducing effect.

6.) Expanded Alternatives and staff recommended alternative.
Project alternatives and estimated costs are listed on Attachment (A.) A total of five alternatives were expanded and analyzed since June 2016. All project alternatives include common upgrades to the aging components of the WWTP and the UV disinfection system and re-route of discharge to McDaniel Slough. All alternatives except for Alternative #5 direct significant investments to the land based oxidation pond/treatment/ enhancement wetland systems. All alternatives listed are expected to meet compliance and flow requirements except for Alternative (4.) which is the pond/wetland improvements only alternative without additional secondary components.

Of the expanded alternatives, staff and our consultant team are recommending #4.1. This alternative is a hybrid of the land based wetlands plus the addition of one oxidation ditch and secondary with a design for the addition of another oxidation ditch that would be phased in at some point in the future if needed. This "hybrid" alternative strikes a balance with costs and allows for phasing in improvements. It allows for pond improvements to be made while still maintaining treatment; meets expected compliance objectives; allows an opportunity to obtain information from pond near-term improvements to inform potential additional treatment plant components and sizing needs; allows an

opportunity to ascertain how much reduction the City can obtain from I&I work; provides a level of confidence for future planned growth in the City.

The hybrid system and phased approach as outlined in Alternative #4.1 utilizes an adaptive management strategy. Adaptive management (learning by doing) is a structured, iterative process of decision making in the face of uncertainty, with a goal for reducing uncertainty over time using system monitoring. Because adaptive management is based on information feedback, it improves outcomes in the long-run. For the City's WWTP, the challenge of the adaptive approach is in finding a solid balance between acquiring knowledge to improve operations in the future and achieving the best short-term outcomes based on current knowledge and information.

Other considerations:
Sea level rise will impact the levees at the WWTP and any anticipated new structures. All recommended plant upgrades will be viable for the next 30-40-year design life cycle. Future plant upgrades on a smaller footprint (corporation yard) will extend the viability of the core WWTP at least another 30-40 years. All project alternatives will incorporate sea level rise adaptive measures including:
Phased raising of the levee around the oxidation ponds, treatment marshes and WWTP/Corporation Yard.
Establishment of "living shorelines" on the outboard side of the levee to minimize wave energy; reduce armoring costs and to provide habitats.
Design of replacement facilities on a higher base elevation within the corporation yard and design of outfall pipes and pumps to be able to work under higher future sea levels.
Provide flexibility for flow paths.

*Note: the facility plan and alternatives do not detail costs for sea level rise adaptation measures at this time. These additional costs are not listed a near term but must be planned and programmed in the CIP. Staff will be looking at possible special funding opportunities for both sea level rise adaptation measures and energy upgrades. For long-term planning (beyond 30-40 years), protection of the core corporation yard (approx. nine acres) and WWTP involves approximately 3,700 linear feet of levee. An additional mile of levee protection would be required to if we were to try to protect the oxidation ponds and treatment marshes beyond the current planning horizon of 30-40 years.

All project alternatives have a substantial increase in energy consumption. Components such as UV, aerators, oxidation ditch aerators and pumps have an impact on energy consumption and costs. While the project includes a modest 60kW photovoltaic system to provide some energy offset, it is less than 10% of the total net energy increase. The 60 kW systems are near term placeholder for now for systems that can be accommodated on anticipated building roofs within the corp. yard. A much larger system may be able to site at the WWTP after a more detailed design is completed. Additionally, staff will recommend that in the near future a separate project to analyze the sludge digester and provide information on the potential to generate energy from biogas (methane). Additionally, staff is interesting in exploring the total lifecycle costs in terms of carbon footprint. From a literature review, it is apparent that the lifecycle aspects of UV compared to chlorine may be favorable. This will be further explored as well as the current carbon footprint of the City's current chemical disinfection system in order to provide net energy and carbon impact comparison.

Next Steps:
Move forward with improvements
(not all decisions on process need to be made yet)
Start CEQA and environmental review

Apply for Disadvantaged Community status state revolving loan/grant
Confirm design criteria based on tentative NPDES permit (June 2017)
Predesign to finalize proposed improvements

The City's existing National Pollution Discharge Elimination System (NPDES) Permit required work such as reconfiguring the plant and switching to UV disinfection be completed by December 2016. Preliminary design must begin as soon as possible due to an impending Time Schedule Order applied to resolve the missed December 2016 permit requirements. The missed permit conditions are to relocate the wastewater treatment plant outfall, switch to UV disinfection, and eliminate the circular blending pattern known as Combined Basin Mode.
Other critical work such as replacing old equipment should begin as soon as possible to reduce the danger of costly and dangerous equipment failure and to fulfill the permit requirement that equipment be maintained adequately. Due to widespread replacement needs covering most of the primary equipment preliminary design and engineering should begin as soon as possible. The project elements already identified as CIP priorities such as: influent pumps, bar screens, grit removal system, primary clarifiers, and pump stations within the plant will collectively require a substantial amount of planning/engineering dollars in the immediate future and are required regardless of approach used to resolve the performance deficiency.
There is a clear need to secure a substantial amount of funding for planning/engineering as soon as possible. Securing planning/engineering funding will allow portions of the total project to move forward.

**BUDGET/FISCAL IMPACT**:
The complete project costs for replacement and/or refurbishing WWTP components plus adding the permit required UV disinfection and piping to new outfall total $21.9 million (M), this is the minimum level of work required immediately to maintain the aged system and comply with the goal to be chlorine free.
The staff recommended project is Alternative 4.1 (see Attachment A.) which additionally includes the improvements to the existing oxidation ponds as described above, rehabilitation of existing wetlands and construction of an additional Marsh 7, ($8.0 M), construction of a 1.8 MGD oxidation ditch, digester improvements and sludge handling ($12.4M). This would result in an estimated total project cost of $42.3 million dollars.
Life cycle costs for the alternatives analyzed are included in Attachment B.
Staff will be developing additional detail on the necessary rate structure to support capital costs and debt services for the project once those costs are better determined. It is unknown at this time how much loan or grant funding may be available for this project.

**ATTACHMENTS:**
A. Alternatives and Cost Estimates (PDF)
B. Alternatives Lifecycle Costs and and Energy Usage (PDF)
C. Estimated Power Usage by process (PDF)

DRAFT

# City of Arcata Wastewater Treatment Facility Improvements Project - Estimated Alternatives Project and Construction Costs

Prepared by LACO/Carollo. LACO Project No. 8226.00

Updated April 5, 2017

| CIP ELEMENTS | DESCRIPTION / BASIS | Common Elements | | ALTERNATIVE 4 PHASED SECONDARY TREATMENT | | | | | | | | ALTERNATIVE 5 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Plant Rehabilitation and Modernization plus UV Disinfection plus 60 kW Photovoltaic System | | Alt 4 Common Elements plus Pond Improvements (Oxidation Ponds,Treatment Wetlands, and Enhancemnet Wetlands) | | Alt 4-1 Common Elements plus Pond Improvements plus One Oxidation Ditch and Secondary Clarifier | | Alt 4-2 Common Elements plus Pond Improvements plus Two Oxidation Ditches and Two Secondary Clarifiers | | Alt 4-3 Common Elements plus Pond Improvements plus Three Oxidation Ditches and Three Secondary Clarifiers | | Treatment Three Oxidation Ditches and Clarifiers Modified Common Elements No Pond Improvements No Phasing | |
| **Headworks Capacity** [1] | | 5.9 MGD | | 5.9 MGD | | 5.9 MGD | | 5.9 MGD | | 5.9 MGD | | 5.9 MGD | |
| **Total Secondary Process Capacity** [1] | | None added | | 2.3 MGD | | 4.1 MGD | | 5.9 MGD | | > 5.9 MGD | | 5.9 MGD | |
| **UV/Outfall Capacity** [1] | | 5.9 MGD | | 5.9 MGD | | 5.9 MGD | | 5.9 MGD | | 5.9 MGD | | 5.9 MGD | |
| | | Construction Cost | Project Cost | Construction Cost | Project Cost | Construction Cost | Project Cost | Construction Cost | Project Cost | Construction Cost | Project Cost | Construction Cost | Project Cost |
| **Flow Reconfiguration** | | **$ 3,200,000** | **$ 4,240,000** | **$ 3,200,000** | **$ 4,240,000** | **$ 3,200,000** | **$ 4,240,000** | **$ 3,200,000** | **$ 4,240,000** | **$ 3,200,000** | **$ 4,240,000** | **$ 2,910,000** | **$ 3,780,000** |
| AWTF Reconfiguration/New Outfall 003 | 4200 ft of 24-inch pipe and new outfall, takeoff | $ 1,810,000 | $ 2,350,000 | $ 1,810,000 | $ 2,350,000 | $ 1,810,000 | $ 2,350,000 | $ 1,810,000 | $ 2,350,000 | $ 1,810,000 | $ 2,350,000 | $ 1,810,000 | $ 2,350,000 |
| Treatment Wetlands 4 Influent Pump Replacement | Pump and structure | $ 60,000 | $ 160,000 | $ 60,000 | $ 160,000 | $ 60,000 | $ 160,000 | $ 60,000 | $ 160,000 | $ 60,000 | $ 160,000 | $ - | $ - |
| Treatment Wetlands: Pump Station 1 R&R Project | Three new pumps & VFDs | $ 170,000 | $ 220,000 | $ 170,000 | $ 220,000 | $ 170,000 | $ 220,000 | $ 170,000 | $ 220,000 | $ 170,000 | $ 220,000 | $ - | $ - |
| Treatment Wetlands: Pump Station 2 R&R Project | Two new pumps & VFDs (if needed) | $ 60,000 | $ 80,000 | $ 60,000 | $ 80,000 | $ 60,000 | $ 80,000 | $ 60,000 | $ 80,000 | $ 60,000 | $ 80,000 | $ - | $ - |
| Enhancement Wetlands: Pump Station Project | New 5.9 mgd pump station based on cost curve | $ 1,100,000 | $ 1,430,000 | $ 1,100,000 | $ 1,430,000 | $ 1,100,000 | $ 1,430,000 | $ 1,100,000 | $ 1,430,000 | $ 1,100,000 | $ 1,430,000 | $ 1,100,000 | $ 1,430,000 |
| **Headworks/Primary** | | **$ 8,650,000** | **$ 11,240,000** | **$ 8,650,000** | **$ 11,240,000** | **$ 8,650,000** | **$ 11,240,000** | **$ 8,650,000** | **$ 11,240,000** | **$ 8,650,000** | **$ 11,240,000** | **$ 6,600,000** | **$ 8,580,000** |
| Headworks: Influent Screw Pump, Bar Screen, Flume and Grit Chamber Replacement | New 5.9 MGD headworks based on cost curve | $ 6,600,000 | $ 8,580,000 | $ 6,600,000 | $ 8,580,000 | $ 6,600,000 | $ 8,580,000 | $ 6,600,000 | $ 8,580,000 | $ 6,600,000 | $ 8,580,000 | $ 6,600,000 | $ 8,580,000 |
| Primary Clarifier Replacement | New 2.3 mgd Primary Clarifier based on cost curve | $ 1,910,000 | $ 2,480,000 | $ 1,910,000 | $ 2,480,000 | $ 1,910,000 | $ 2,480,000 | $ 1,910,000 | $ 2,480,000 | $ 1,910,000 | $ 2,480,000 | $ - | $ - |
| Primary Clarifier: Sludge Pump Replacement | Four sludge/scum pumps | $ 140,000 | $ 180,000 | $ 140,000 | $ 180,000 | $ 140,000 | $ 180,000 | $ 140,000 | $ 180,000 | $ 140,000 | $ 180,000 | $ - | $ - |
| **Ponds/Wetlands** | | | | **$ 5,860,000** | **$ 7,980,000** | **$ 5,860,000** | **$ 7,980,000** | **$ 5,860,000** | **$ 7,980,000** | **$ 5,860,000** | **$ 7,980,000** | **$ 200,000** | **$ 260,000** |
| Treatment Marsh #7 | 2.3 acres @ $100,000 per acre | | | $ 230,000 | $ 500,000 | $ 230,000 | $ 500,000 | $ 230,000 | $ 500,000 | $ 230,000 | $ 500,000 | $ - | $ - |
| Oxidation Ponds: Pond Pump Station R&R Project | Three new pumps | | | $ 150,000 | $ 200,000 | $ 150,000 | $ 200,000 | $ 150,000 | $ 200,000 | $ 150,000 | $ 200,000 | $ - | $ - |
| Oxidation Ponds: Transfer Structure Reconfiguration | Placeholder from Erik Lust | | | $ 275,000 | $ 360,000 | $ 275,000 | $ 360,000 | $ 275,000 | $ 360,000 | $ 275,000 | $ 360,000 | $ - | $ - |
| Oxidation Ponds: Aerator Replacement | Aerator additions based on a ratio from Petaluma aerator addition 2005 bid (escalated) | | | $ 1,470,000 | $ 1,910,000 | $ 1,470,000 | $ 1,910,000 | $ 1,470,000 | $ 1,910,000 | $ 1,470,000 | $ 1,910,000 | $ - | $ - |
| Oxidation Ponds: Baffle Wall | Takeoff based on diagonal and SF cost for sheet pile, maybe a high unit cost | | | $ 810,000 | $ 1,060,000 | $ 810,000 | $ 1,060,000 | $ 810,000 | $ 1,060,000 | $ 810,000 | $ 1,060,000 | $ - | $ - |
| Treatment Wetlands Re-Vegetation Project | TW 1 to 4: total acres x $100,000 | | | $ 580,000 | $ 750,000 | $ 580,000 | $ 750,000 | $ 580,000 | $ 750,000 | $ 580,000 | $ 750,000 | $ - | $ - |
| Enhancement Wetlands Re-Vegetation Project | EW (3) total acres x $50,000 | | | $ 870,000 | $ 1,280,000 | $ 870,000 | $ 1,280,000 | $ 870,000 | $ 1,280,000 | $ 870,000 | $ 1,280,000 | $ - | $ - |
| Oxidation Ponds: Emergency Pond Pump Replacement Project | Added pump and piping | | | $ 200,000 | $ 260,000 | $ 200,000 | $ 260,000 | $ 200,000 | $ 260,000 | $ 200,000 | $ 260,000 | $ 200,000 | $ 260,000 |
| Oxidation Ponds: Sludge Removal R&R Project | Takeoff based on $600/ dry ton (Synagro) and compared to McKinleyville - Pond 2 Prioritized | | | $ 1,275,000 | $ 1,660,000 | $ 1,275,000 | $ 1,660,000 | $ 1,275,000 | $ 1,660,000 | $ 1,275,000 | $ 1,660,000 | $ - | $ - |
| **New Parallel/Sidestream Treatment** [2] | | | | | | **$ 7,380,000** | **$ 9,600,000** | **$ 14,760,000** | **$ 19,200,000** | **$ 23,410,000** | **$ 30,460,000** | **$ 23,350,000** | **$ 30,370,000** |
| New Secondary Treatment Project: Oxidation Ditches and Secondary Clarifiers Project | Scaled from Modesto 2.3 MGD OD bid (2008?) and added secondary clarifier from cost curve | | | | | $ 7,380,000 | $ 9,600,000 | $ 14,760,000 | $ 19,200,000 | $ 23,410,000 | $ 30,460,000 | $ 23,350,000 | $ 30,370,000 |
| **UV Disinfection/Other** | | **$ 4,510,000** | **$ 5,870,000** | **$ 4,510,000** | **$ 5,870,000** | **$ 4,510,000** | **$ 5,870,000** | **$ 4,510,000** | **$ 5,870,000** | **$ 4,510,000** | **$ 5,870,000** | **$ 3,292,000** | **$ 4,280,000** |
| UV Disinfection System | Based on facility plan const cost (based on Trojan budget proposal) | $ 4,360,000 | $ 5,670,000 | $ 4,360,000 | $ 5,670,000 | $ 4,360,000 | $ 5,670,000 | $ 4,360,000 | $ 5,670,000 | $ 4,360,000 | $ 5,670,000 | $ 3,142,000 | $ 4,080,000 |
| Disinfection: Chlorine/SO2 Project | Placeholder from Erik Lust | $ 150,000 | $ 200,000 | $ 150,000 | $ 200,000 | $ 150,000 | $ 200,000 | $ 150,000 | $ 200,000 | $ 150,000 | $ 200,000 | $ 150,000 | $ 200,000 |
| **Digester** [2] | | | | | | **$ 1,200,000** | **$ 1,560,000** | **$ 1,200,000** | **$ 1,560,000** | **$ 1,200,000** | **$ 1,560,000** | **$ 1,200,000** | **$ 1,560,000** |
| Digester R&R Project - Phase 1 | Based on placeholder for cover rehab from Erik Lust and replacement boiler (larger capacity) | | | | | $ 1,200,000 | $ 1,560,000 | $ 1,200,000 | $ 1,560,000 | $ 1,200,000 | $ 1,560,000 | $ 1,200,000 | $ 1,560,000 |
| **Thickening** [2] | | | | | | **$ 940,000** | **$ 1,220,000** | **$ 1,410,000** | **$ 1,830,000** | **$ 1,970,000** | **$ 2,560,000** | **$ 1,910,000** | **$ 2,480,000** |
| New Secondary Sludge Thickening Project | Based on Rotary drum thickener, Marin SD#5 2012 bid | | | | | $ 940,000 | $ 1,220,000 | $ 1,410,000 | $ 1,830,000 | $ 1,970,000 | $ 2,560,000 | $ 1,910,000 | $ 2,480,000 |
| **Relocation/Modernization** | | **$ 400,000** | **$ 520,000** | **$ 400,000** | **$ 520,000** | **$ 400,000** | **$ 520,000** | **$ 400,000** | **$ 520,000** | **$ 400,000** | **$ 520,000** | **$ 400,000** | **$ 520,000** |
| 60 kW PV System | Based on budget quote | $ 300,000 | $ 390,000 | $ 300,000 | $ 390,000 | $ 300,000 | $ 390,000 | $ 300,000 | $ 390,000 | $ 300,000 | $ 390,000 | $ 300,000 | $ 390,000 |
| Corporation Yard Modifications & Building Replacement | Placeholder | $ 100,000 | $ 130,000 | $ 100,000 | $ 130,000 | $ 100,000 | $ 130,000 | $ 100,000 | $ 130,000 | $ 100,000 | $ 130,000 | $ 100,000 | $ 130,000 |
| **TOTAL COSTS** | | **$ 16,760,000** | **$ 21,870,000** | **$ 22,620,000** | **$ 29,850,000** | **$ 32,140,000** | **$ 42,230,000** | **$ 39,990,000** | **$ 52,440,000** | **$ 49,200,000** | **$ 64,430,000** | **$ 39,862,000** | **$ 51,830,000** |

Notes:
1. Based on influent flow.
2. Includes 20 % growth factor applied to secondary treatment and solids handling facilities.
3. Costs are in today's dollars.

**Table X** **Estimated Lifecycle Cost and Energy Usage Comparison of Treatment Alternatives**
Wastewater Treatment Plant Improvement Project
City of Arcata, California
Updated April 5, 2017

| Alternative | Description | Secondary Treatment Capacity (MGD) | Estimated Total Project Cost[1] | O&M | | | Lifecycle Cost[3] |
|---|---|---|---|---|---|---|---|
| | | | | Annual Power Usage (kWh) | Annual Cost[2] | Present Worth[3] | |
| 4 | Common Elements + Pond Improvements Only | 2.3 | $29,850,000 | 1,860,000 | $474,000 | $8,330,000 | $38,180,000 |
| 4-1 | Common Elements + Pond Improvements + 1 Ox Ditch | 4.1 | $42,230,000 | 2,650,000 | $625,000 | $10,990,000 | $53,220,000 |
| 4-2 | Common Elements + Pond Improvements + 2 Ox Ditches | 5.9 | $52,440,000 | 3,430,000 | $776,000 | $13,650,000 | $66,090,000 |
| 4-3 | Common Elements + Pond Improvements + 3 Ox Ditches (Ponds Offline) | 5.9 | $64,430,000 | 3,160,000 | $747,000 | $13,140,000 | $77,570,000 |
| 5 | Modified Common Elements + 3 Ox Ditches No Pond Improvements and No Phasing | 5.9 | $51,830,000 | 3,160,000 | $747,000 | $13,140,000 | $64,970,000 |

Notes:

(1) Costs are in today's dollars.

(2) Annual O&M power usage and costs include only differential O&M costs, and does not include the cost of common O&M costs such as influent pumping which are common to all alternatives..

(3) Lifecycle cost is total project cost plus present worth value of annual O&M costs. Annual O&M costs were converted to present worth value based on 3 percent inflation rate, 6 percent discount rate, and 25-year analysis period.

**Table Y** **Estimated Power Usage by Process**
Wastewater Treatment Improvement Project
City of Arcata, California
Updated April 5, 2017

| Alternative | Description | Estimated Annual Power Usage | |
|---|---|---|---|
| | | kWh | Percent |
| 4 | **Pond Improvements** | **1,859,000** | |
| | Primary Clarifier | 46,000 | 2.5% |
| | Oxidation Ponds | 1,051,000 | 56.5% |
| | UV Disinfection | 484,000 | 26.0% |
| | Chlorine Disinfection | 7,000 | 0.4% |
| | Effluent Pumping | 271,000 | 14.6% |
| **4-1** | **Pond Improvements + 1 Ox Ditch** | **2,645,000** | |
| | Primary Clarifier | 46,000 | 1.7% |
| | Oxidation Ponds | 1,051,000 | 39.7% |
| | Oxidation Ditch | 654,000 | 24.7% |
| | Secondary Clarifier | 89,000 | 3.4% |
| | Thickening | 44,000 | 1.7% |
| | UV Disinfection | 484,000 | 18.3% |
| | Chlorine Disinfection | 7,000 | 0.3% |
| | Effluent Pumping | 271,000 | 10.2% |
| **4-2** | **Pond Improvements + 2 Ox Ditches** | **3,432,000** | |
| | Primary Clarifier | 46,000 | 1.3% |
| | Oxidation Ponds | 1,051,000 | 30.6% |
| | Oxidation Ditch | 1,307,000 | 38.1% |
| | Secondary Clarifier | 178,000 | 5.2% |
| | Thickening | 88,000 | 2.6% |
| | UV Disinfection | 484,000 | 14.1% |
| | Chlorine Disinfection | 7,000 | 0.2% |
| | Effluent Pumping | 271,000 | 7.9% |
| **4-3** | **Pond Improvements + 3 Ox Ditches (Ponds Offline)** | **3,165,000** | |
| | Primary Clarifier | - | |
| | Oxidation Ponds | - | |
| | Oxidation Ditch | 2,143,000 | 67.7% |
| | Secondary Clarifier | 292,000 | 9.2% |
| | Thickening | 145,000 | 4.6% |
| | UV Disinfection | 308,000 | 9.7% |
| | Chlorine Disinfection | 7,000 | 0.2% |
| | Effluent Pumping | 271,000 | 8.6% |
| **5** | **Conventional Treatment 3 Ox Ditches** | **3,165,000** | |
| | Oxidation Ditch | 2,143,000 | 67.7% |
| | Secondary Clarifier | 292,000 | 9.2% |
| | Thickening | 145,000 | 4.6% |
| | UV Disinfection | 308,000 | 9.7% |
| | Chlorine Disinfection | 7,000 | 0.2% |
| | Effluent Pumping | 271,000 | 8.6% |

Attachment: C. Estimated Power Usage by process (1452 : WWTP Reconfiguration Progress Report and Recommendation)




## Agenda:

- Review of Facility Plan and where we left off
- Findings of Additional Study
- Expanded Alternatives
- Next Steps

## Decisions needed to proceed:

- Agree that improvements are needed
  - Don't have to agree exactly on all elements, will clarify during predesign
- Apply for grants (Disadvantaged Community)
- Begin Environmental Assessment (CEQA)

## Where we last left Council



## Where we left off last April and June… at last Council meetings

- Facility Plan was complete and found that improvements were needed to address:
  1. Hydraulic limitations
  2. Aging Infrastructure
  3. Treatment capacity shortfalls
  4. Future permit compliance





## Where we left off last April and June… at last Council meetings

- Directed to further explore a few items:
  1. Future permit renewal with RWQCB
  2. Flow/rainfall for sizing
  3. Pond improvement considerations
  4. Revisit growth projections
  5. Come back with revised alternatives

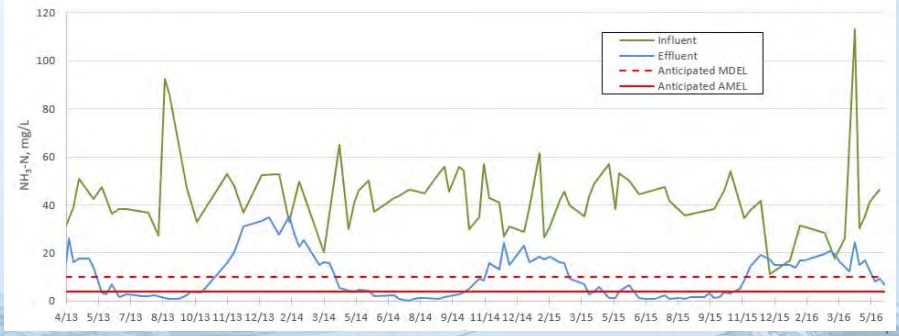




## Additional Studies

## Results of additional study - Permit

- Permit discussions with Regional Water Board:
  - Want all flow under 5.9 MGD to go through enhancement wetlands, which affects hydraulic capacity needs
  - Expect ammonia limits as low as 4 mg/l in permit renewal July 2017.






## Plant flow and rainfall



- Land based system receives significant additional flow due to rainfall
- Decided to use 3 inches over 24 hours as design condition
- Considered improvements to collection system to reduce inflow and infiltration
- Result:
  - Could downsize some facilities by 0.5 to 1mgd (City)
  - Keep hydraulic capacity at 5.9 mgd (permitted flow)
  - Storage in ponds helps reduce peak flows

## Results of additional study - Ponds

- Geotechnical review to evaluate ponds
  - Recommendations: minimum levee (approx. 3 feet) raising (for sea level rise protection only); underlying bay muds are very impervious, TM including proposed Marsh 7 will not require lining;
  - Hired pond expert to consider improvements needed:
  - Use Pond 1 for wet weather equalization
  - Add baffles and aerators to Pond 2 for better treatment
  - Ability to meet permit limits likely in low flow months, compromised during wet weather, cold months
  - Predicted ammonia removal may not meet permit limit year round





## Expanded Alternatives

## Original direction for developing alternatives and CIP

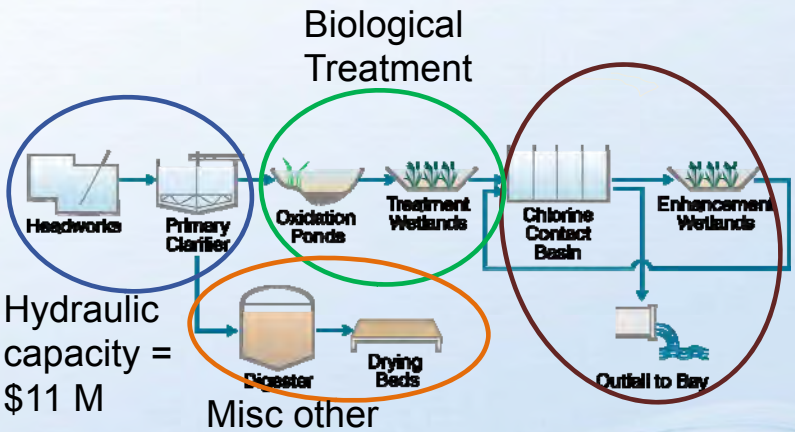
- 100% permit compliance
- Reliable capacity to meet all flows/loads and general plan growth
- Maximize existing natural system
- Address deferred maintenance
- Address aging infrastructure through repair and rehabilitation







## Existing Facility Areas of Improvement ($ 25 M without biological treatment)



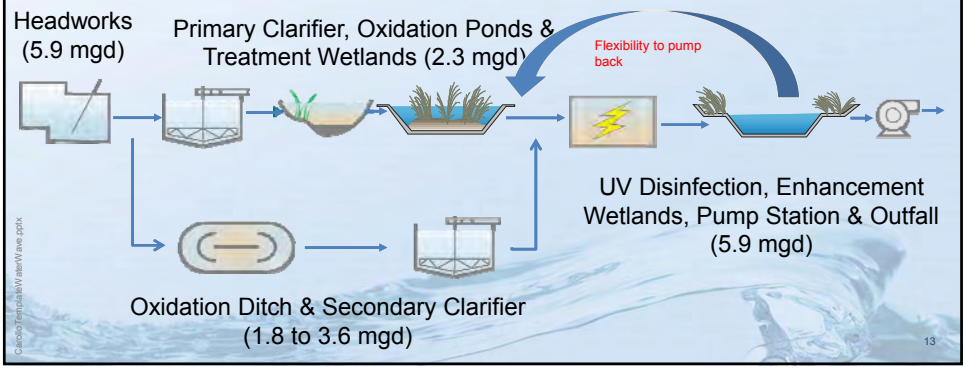

Hydraulic capacity = $11 M

Misc other improvements = $4 M

UV Disinfection /Discharge = $10 M

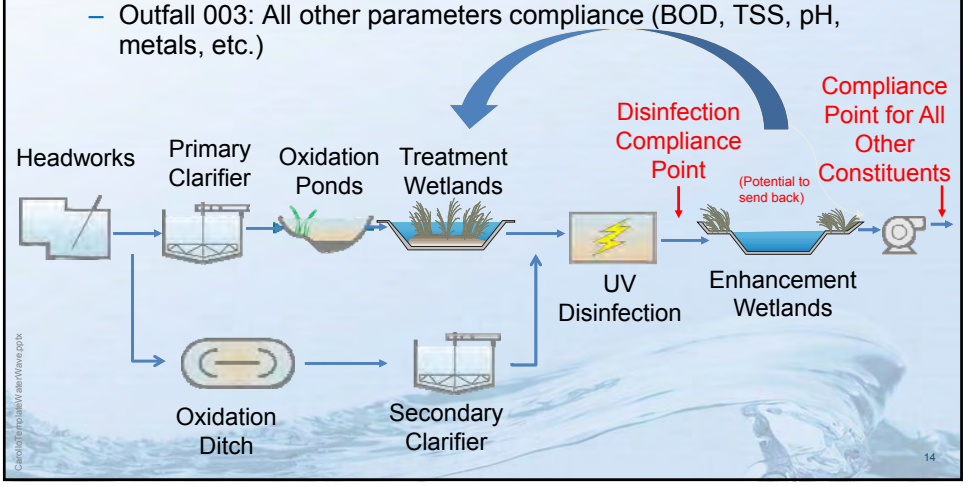
## Alternatives focus around biological treatment relative to existing system

- New components:
  - Recommended pond & wetlands improvements = $8 M
  - Parallel treatment for high flows and ammonia reduction = $10 M (one Ox Ditch) or $20 M (two Ox Ditches)




## Discharge Compliance Points

- Dual compliance point locations
  - UV Discharge to Enhancement Wetlands: Disinfection compliance (Fecal coliform)
  - Outfall 003: All other parameters compliance (BOD, TSS, pH, metals, etc.)



# Comparison of Biological Treatment Options

| | Project Costs | Pros/Cons |
|---|---|---|
| Make improvements to ponds and wetlands only (include aerators and baffle wall) | $8 million | Will not consistently meet permit requirements, provides 2.3 mgd of secondary treatment |
| Improve ponds<br>+<br>Build one Ox Ditch | $8 million<br>+<br>$10 million | Still risk of permit violation due to ammonia, and does not provide 5.9 mgd of secondary treatment |
| Improve ponds<br>+<br>Build two Ox Ditches | $8 million<br>+<br>$20 million | Provides 5.9 mgd of secondary treatment and will comply with permit 90% to 95% of time |
| | | |

DRAFT

15






## Schedule

- NPDES Permit October 2017
- Preliminary Design July 2017 –June 2018
- Final Design June 2018 – May 2019
- Bid/Award May 2019 – September 2019
- Construction October 2019 – December 2021
- Begin Discharge January 2022







CarolloTemplateWaterWave.pptx



# Next steps

CarolloTemplateWaterWave.pptx

## Immediate next steps for implementation

- Decide to move forward with improvements (not all decisions on process need to be made yet)
- Apply for Disadvantaged Community SRF loan/grant
- Confirm design criteria based on tentative NPDES permit (June 2017)
- Start CEQA and environmental review
- Predesign to finalize proposed improvements





# ATTACHMENT 20

City of Arcata. 2000. *Noise Element of the Arcata General Plan.*

# *NOISE ELEMENT*

## 6.4 INTRODUCTION

The Noise Element is one of the seven required General Plan Elements that must be prepared by California cities and counties (Government Code Section 65302). The California General Plan Guidelines state that the Noise Element of the General Plan provides a basis for comprehensive local programs to control and abate environmental noise and to protect citizens from excessive exposure. The Noise Element is required to identify and appraise noise in the community and follow the guidelines adopted by the Office of Noise Control in the State Department of Health Services. Local governments must analyze and quantify noise levels, and the extent of noise exposure, through actual measurements or the use of noise modeling.



The air into which noise is emitted, and on which it travels, is a common resource of the community. It is a public good and as such its use, as well the responsibility of maintaining it, belongs to everyone.

THE STATE OF CALIFORNIA GENERAL PLAN GUIDELINES* FOR THE FUNDAMENTAL GOALS OF THE NOISE ELEMENT ARE:

- To provide sufficient information concerning the community noise environment so that noise may be effectively considered in the land use planning process. In so doing, the necessary groundwork will have been developed so that a community noise ordinance may be utilized to resolve noise complaints.
- To develop strategies for abating excessive noise exposure through cost-effective mitigating measures in combination with zoning, as appropriate, to avoid incompatible land uses.
- To protect those existing regions of the planning area whose noise environments are deemed acceptable and also those locations throughout the community deemed "noise sensitive."
- To utilize the definition of the community noise environment, in the form of CNEL or Ldn noise contours as provided in the Noise Element for local compliance with the State Noise Insulation Standards. These standards require specified levels of outdoor to indoor noise reduction for new multi-family residential constructions in areas where the outdoor noise exposure exceeds CNEL (or Ldn) 60 dB.

(*Appendix A of the Guidelines)

Loud noise is a health issue. The human ear is not designed to accommodate loud noise for long durations. Exposure to sounds louder than 90 decibels (e.g., a power lawnmower) for more than one or two hours begins to damage the inner ear. Therefore, all people, businesses, industry, and organizations have an obligation to respect the health and

comfort of others, and to acknowledge that the effects of broadcasted noise are not limited to their own private property. In sharing the community's common resources, everyone has an obligation to respect the health of others in ways that are compatible with, and do not detract from, other uses. Noise levels from sources commonly found in the community are shown in Figure N-a.

**Definitions of noise, potential effects on people, and existing ordinances.** Noise, commonly defined as unwanted sound, is an environmental phenomenon to which people are exposed throughout life. Noise is among the most pervasive pollutants, a waste product generated primarily by human activities.

As urbanization and development have intensified globally, regionally, and locally in Arcata, noise levels have also increased. Studies have shown that increased noise levels have a direct adverse impact on the quality of home, work, and recreational environments.

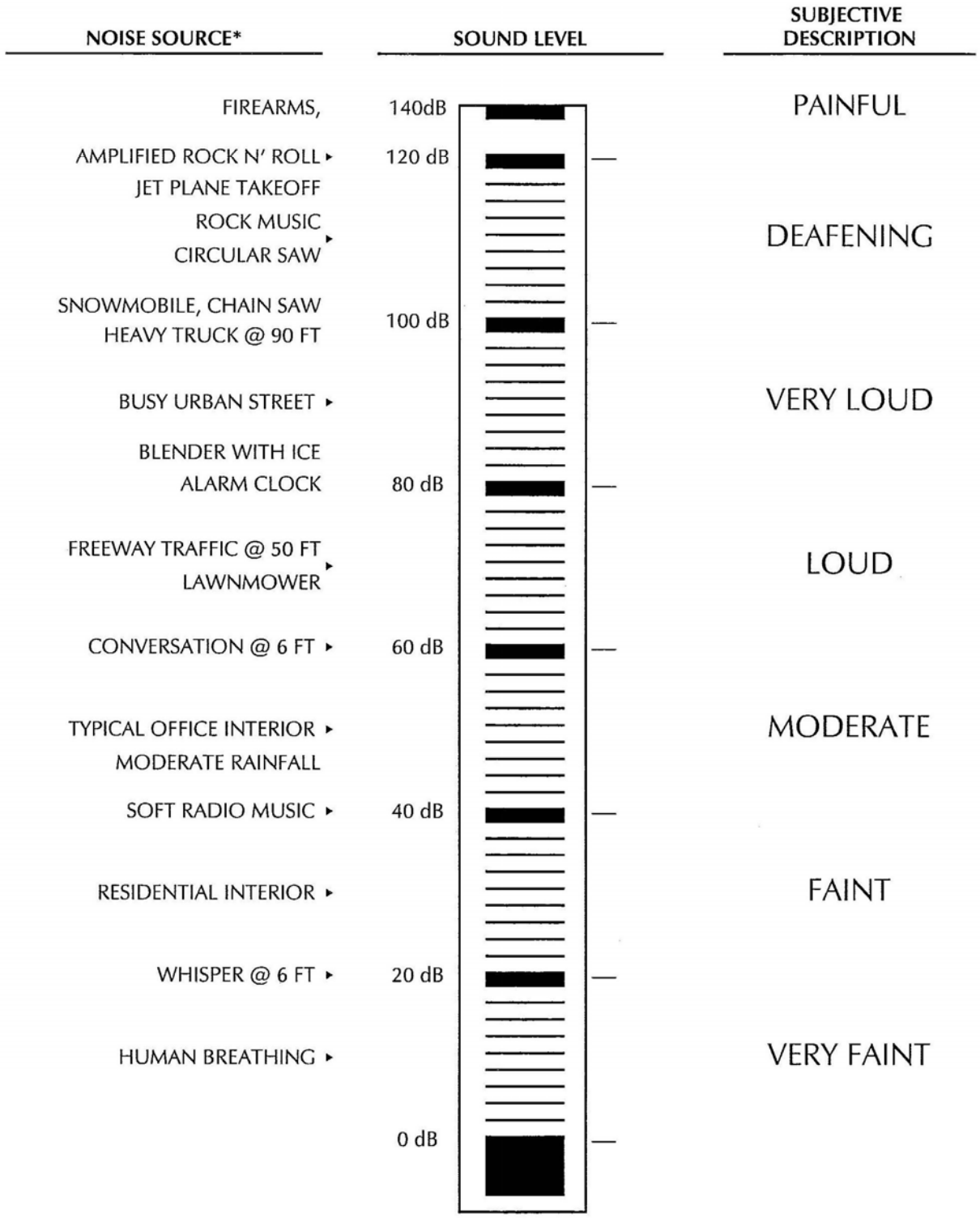
In recognition of these adverse impacts, the Arcata City Council passed a Plaza Area Noise Ordinance (City Ordinance #1249) prohibiting unnecessary, excessive, and annoying noise from all sources. The Noise Ordinance states that excessive noise levels, offensive noise, and unreasonably disturbing noise are detrimental to the public health, welfare and safety and are contrary to the public interest. Detrimental noises interfere with: sleep, communication, relaxation, and the full use of private property; use and enjoyment of the Arcata Plaza by the general public; noise-sensitive land uses, particularly residential apartments and lodging; and productive commerce. Detrimental noises contribute to hearing impairment and a range of adverse physiological stress conditions and adversely affect the value of real property.



It is the intent of the Noise Ordinance to protect the public health, comfort, convenience, safety, welfare, prosperity, peace, and quiet by reducing excessive noise levels and by prohibiting the generation of offensive, or unreasonably disturbing, noise.

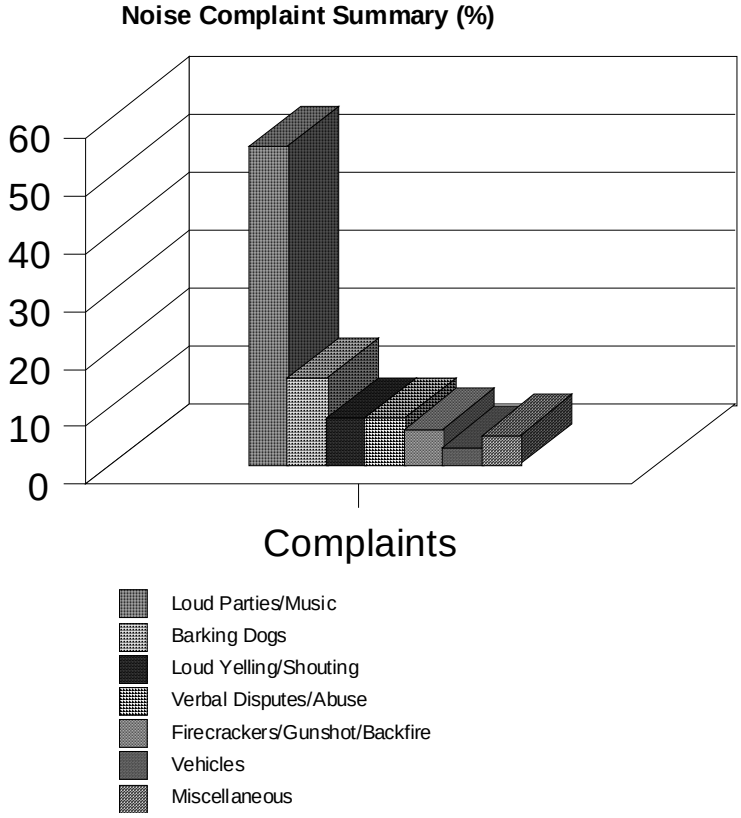
**Noise environment overview.** Arcata has experienced change from its small, rural town beginnings to a growing, urban community with more intensive and diverse uses. Preservation of surrounding open spaces, and General Plan policies for more efficient land uses, have promoted in-fill urban development which intersperses residential uses (noise receptors) with commercial and industrial land uses (noise generators). The proximity of noise generators to noise receptors such as higher volume vehicle travel on local roadways has resulted in increased noise levels at receptor sites. Future development of commercial and industrial uses will increase the potential for future noise conflicts.

## FIGURE N-a A WORLD OF NOISE




* Unless otherwise noted, noise levels are measured at the source

A September 1997 community noise survey conducted as part of General Plan background studies showed that typical noise levels in noise-sensitive areas of the City range from 46 dB to 63 dB $L_{dn}$. Traffic, local roadways, major roadways (including State Routes 101, 299 and 255), railroad operations, industrial activities, and neighborhood activities are the primary sources of background noise levels. Some residences have outdoor activity areas directly exposed to major noise sources (such as the railroad tracks, major roadways, and industrial areas) that exceed generally acceptable noise exposure criteria.




Note: The percentages expressed in this figures are projected based on the existing noise element (1986).

Noise complaints received by the City also measure noise levels. The Arcata Police Department has received increasing numbers of noise complaints over the last several years. Police activity reports show 866 noise complaints in 1995; 951 in 1996; and 1,043 in 1997, which is a twenty percent increase. Some of the most frequent noise complaints within the City of Arcata are associated with barking dogs, loud parties, boom boxes, car stereos, existing industrial activities, and existing on-site commercial noise sources such as outdoor speaker systems, street sweeping, and early morning garbage pickup. Some of these noises are considered infractions, and are covered in the penal code. Others are referred to other agencies, or determined to be unenforceable, and are not included in the complaint records.



**Future noise environment overview.**

Community noise levels can increase with development. This is especially true for noise along major roadways, such as State Routes 101 and 299. The projected future noise controls are shown in Figure N-b. As development continues, there is a growing potential for noise increases due to commercial or industrial operations. It is now recognized that noise pollution can often be reduced through attenuation measures such as barriers, mufflers, and insulation, with little or no penalty to progress.

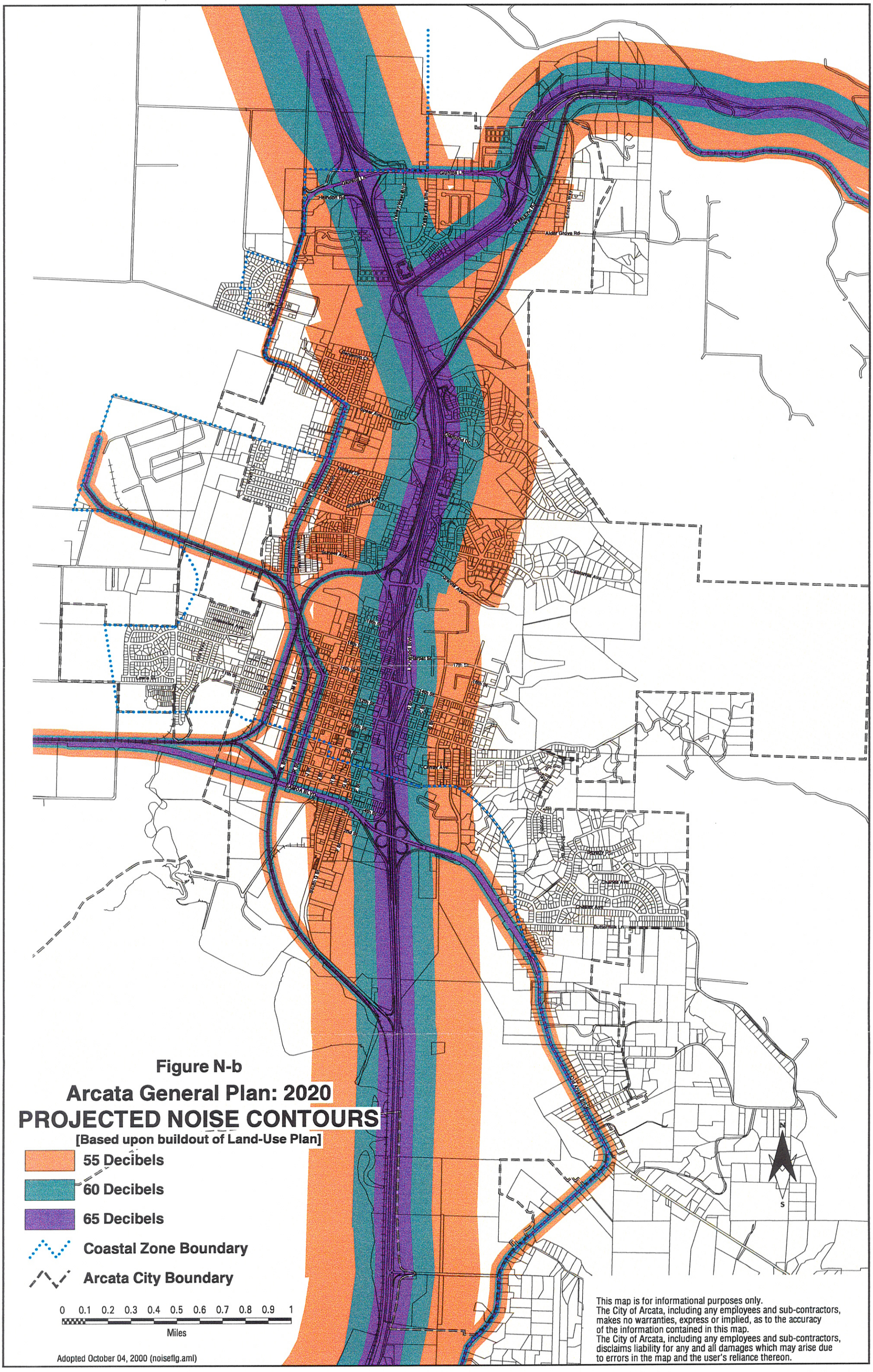


Figure N-b
Arcata General Plan: 2020
PROJECTED NOISE CONTOURS
[Based upon buildout of Land-Use Plan]
55 Decibels
60 Decibels
65 Decibels
Coastal Zone Boundary
Arcata City Boundary
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1
Miles
Adopted October 04, 2000 (noiseflg.aml)
This map is for informational purposes only.
The City of Arcata, including any employees and sub-contractors, makes no warranties, express or implied, as to the accuracy of the information contained in this map.
The City of Arcata, including any employees and sub-contractors, disclaims liability for any and all damages which may arise due to errors in the map and the user's reliance thereon.
Heindon Rd
Alder Grove Rd
Samoa Blvd
Harpst St
Central Ave
Janes Rd
Old Arcata Rd
N
S

**Responsibilities of a Noise Element.** The Noise Element advances the ethic that a low-noise-level environment is a common resource that can be enjoyed by all, and that noise generated by some has the potential to negatively affect others. The Noise Element provides a mechanism for evaluating and mitigating the potential effects of noise on the community. It identifies potential noise sources that exceed acceptable standards and noise sources that may be considered annoying. It also provides criteria for determining acceptable noise exposure. The California General Plan Guidelines state that the Noise Element will be as detailed as necessary to describe the local situation and mitigate local noise problems. This means that the City is not limited to applying noise controls and noise reduction techniques to projects and other activities requiring City review and permits, but can address other noise generating activities in the community.

The Noise Element sets policy direction for evaluating the potential effects of noise due to new industrial processes or commercial noise sources. (Projected future noise contours are shown on Figure N-b.) Many times, however, noise sources are overlooked during the review process, or are added on-site at a later date. Once the project is approved, the administrative actions for responding to complaints of these noise sources generally fall outside of the City's review process. In these cases a noise ordinance is required in order to determine compliance with local standards or the potential for annoyance.

In the event of an individual being annoyed due to a neighbor's barking dog or an existing commercial activity, a noise ordinance would provide a complaint and enforcement mechanism. These types of noises, however, are most effectively addressed through educating community members about "good neighbor policies," since dog ownership, or existing commercial activities, are not subject to City review, and enforcement is usually considered as a last resort. Complaint and enforcement mechanisms include:

- Ordinance 1249, for the Plaza Area only.
- Penal code 415 – Disturbing the Peace.
- Land Use and Development Guide regulations.



**City responsibilities.** The City of Arcata can set an example for business and industry by considering the acoustic concerns and future noise impacts of City operations and business. The City can lead the way by demonstrating that ongoing operations and new noise-producing uses and products can meet specified noise criteria by making effective noise attenuation information available, and by providing a procedure for mediating noise disputes. The City can accomplish this by preferential purchasing of quieter equipment; reducing use of noisy equipment (as demonstrated by City Council action to eliminate the use of leaf blowers in certain public areas); limiting hours of operation for public works projects (except for emergencies) in residential areas; and incorporating acoustic materials and barriers in all

new City facilities.

Public surveys on noise show that many people do not know how to effectively address noise issues. Community members in general appear to lack knowledge of how to reduce noise conflicts. There also seems to be a pattern of governmental agencies responding to noise complaints with little or no enforcement or action against noise violations. This pattern may be as typical of Arcata as other urban settings. To address this issue, procedures and educational materials are being developed, including a noise control manual.

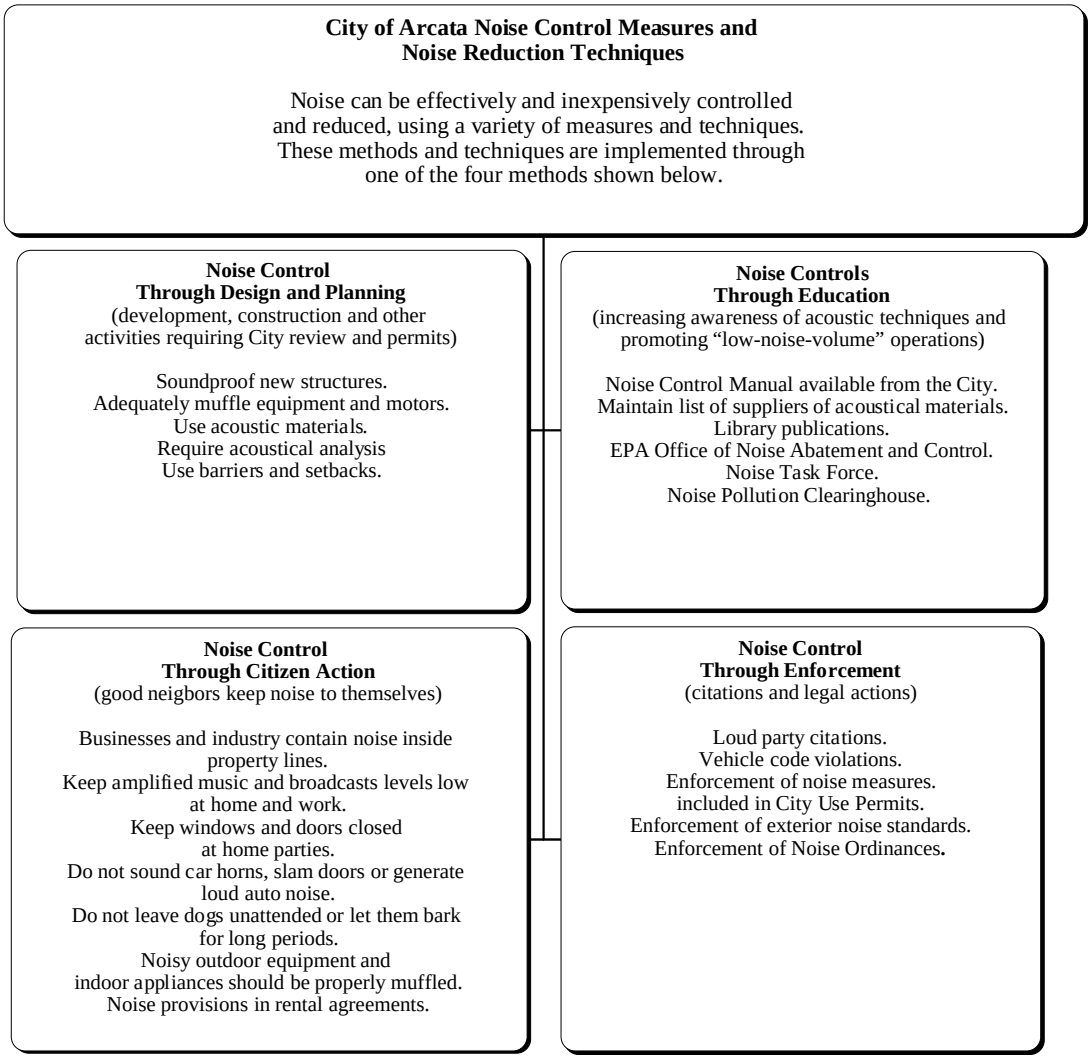
**Community responsibilities.** The quality of the soundscape is a growing environmental concern and is an important aspect of the City's livability. To increase pubic awareness of achieving and maintaining a high quality soundscape, the community can draw on noise attenuation techniques, such as those in the Noise Control Manual.

One of the most effective ways to contribute to the solution is to be a good neighbor. Most importantly, this means taking responsibility for reducing noise at the source. Businesses and industry can contain noise generating uses and activities within buildings, or construct barriers so that noise does not reach adjacent areas. Residents should also consider how the noise they generate could affect others and reduce the level accordingly. Motorists and other vehicle operators should be conscientious of the potential for vehicle noise to disturb others. Figure N-c shows noise control measures for all neighbors and neighborhoods.

**Guiding Principles and Goals.**

A. Reduce noise at the source.
B. Protect City residents from the harmful and disturbing effects of noise through controls on noise-producing activities.
C. Promote noise mitigation techniques in the design of both noise receptors and noise generators.
D. Encourage state-of-the-art land use planning methodologies and acoustic control techniques (refer to City Noise Control Manual) to reduce existing and potential noise conflicts.
E. Encourage cooperative and voluntary action by businesses and industry, to reduce noise emissions from annoying noise sources.
F. Promote mediation as a means of reducing noise complaints which result from existing noise sources.
G. Educate community residents about good neighbor policies, the benefits of reduced noise levels, and living in a community with a high quality soundscape.
H. Bring all noise sources into compliance with noise guidelines by strongly encouraging voluntary compliance, pursuing funding for noise attenuation measures to mitigate any financial hardships, and through enforcement of a Noise Ordinance.

## FIGURE N-c NOISE CONTROL MEASURES




## 6.5 NOISE POLICIES

The Noise Element contains the following policies:

N-1 Noise Attenuation
N-2 Stationary Noise Sources and Levels
N-3 Transportation Noise Sources and Levels
N-4 Requirements for Acoustical Analysis
N-5 Intrusive and Intermittent Noise Sources

## POLICY N-1 NOISE ATTENUATION

**Objective.** Reduce, or eliminate, noise impacts at their source by providing enclosures, barriers, and other on-site noise attenuation measures for noise generating activities. Monitor noise levels to ensure that acceptable noise levels are maintained on adjacent sites.

N-1a **Noise attenuation measures.** Noise attenuation measures, and stationary noise source controls shall include the use of barriers, setbacks, site design, baffles, enclosures, silencers, and improved facade construction techniques.

N-1b **Noise attenuation guidelines.** Noise attenuation measures and stationary noise source controls shall follow the guidelines provided in the technical document entitled: Noise Control Manual (which is considered an implementation measure).

N-1c **Noise mitigation.** Where noise mitigation measures are required, the emphasis of such measures shall be placed upon site planning and project design. The use of noise barriers shall be considered a means of achieving the noise standards only after all other practical design-related noise mitigation measures have been integrated into the project.

N-1d **Noise level reduction.** To reduce existing, objectionable, industrial, and stationary noise levels at the source, the City shall work with local industries to incorporate noise control technology through building and site design and engineering solutions. The City shall make available current acoustical attenuation techniques (Noise Control Manual) for new and retrofitted industrial development.

N-1e **Noise standards enforcement.** Enforcement of noise standards shall be accomplished through development and implementation of a noise control ordinance, post-project compliance testing, and through the use of mediation.

N-1f **Mediation of noise conflicts.** Where noise conflicts may occur, all affected parties shall strive to use innovative and positive solutions to solve those disputes, including the use of trained mediators. The City recognizes that many noise issues can be resolved before they get to the complaint stage if there is a procedure for airing the issue with an impartial third party.

N-1g **Resolution of noise disputes.** The City shall establish positive ways to discuss and resolve noise issues and disputes, including the use of trained mediators.

## POLICY N-2 STATIONARY NOISE SOURCES AND LEVELS

**Objective.** Establish acceptable noise levels for land uses and activities that will protect community residents from the harmful effects of excessive noise exposure from stationary

noise generators. Maintain interior and exterior noise standards that will achieve land use compatibility with respect to community noise.

N-2a **Noise contour maps.** The noise contour map (Figure N-b) and other estimates of noise source levels shall be used in conjunction with the noise source criteria to evaluate the feasibility of a proposed project.

N-2b **New development of noise-sensitive uses.** New noise receptors shall not be allowed where the noise level from non-transportation noise generators will exceed noise level standards (Table N-1), unless effective noise mitigation measures that meet City standards are incorporated.

N-2c **Noise created by new or proposed stationary noise sources.** Noise created by new or proposed stationary noise sources, or the expansion or alteration of an existing use, shall be mitigated so as not to exceed noise level standards (Table N-1) at noise-sensitive land uses. All noise generators not in compliance with these standards will be encouraged to mitigate impacts.

N-2d **Acceptable noise levels.** New construction and retrofits at existing buildings shall include appropriate insulation, glazing, and other sound attenuation measures so that they comply with standards contained in Table N-1. These standards are intended to set levels for external noise sources that could potentially impact a new dwelling or other noise-sensitive use.

**TABLE N-1 – NOISE STANDARDS FOR NEW PROJECTS AND RETROFITS**

| LAND USE | EXTERIOR | | | INTERIOR | | |
|---|---|---|---|---|---|---|
| Noise Level Descriptor | 7am-7pm | 7-10 pm | 10pm-7am | 7am-7pm | 7pm-10pm | 10 pm-7am |
| **Residences, Transient Lodging, Hospitals, Nursing Homes** | | | | | | |
| Hourly $L_{eq}$ | 55 dB | 50 dB | 45 dB | 45 dB | 40 dB | 35 dB |
| Maximum | 75 dB | 75 dB | 70 dB | 65 dB | 65 dB | 60 dB |
| **Auditoriums, Theaters, Libraries, Schools, Churches** | | | | | | |
| Hourly $L_{eq}$ | 55 dB | 55 dB | n/a | 40 dB | 40 dB | n/a |
| Maximum | 75 dB | 75 dB | n/a | 60 dB | 60 dB | n/a |

1. The City can impose noise level standards which are up to 5 dB less than those specified above based upon determination of existing low ambient noise levels in the vicinity of the project site.
2. These noise level standards do not apply to residential units established in conjunction with industrial or commercial uses (e.g., caretaker dwellings).
3. The standards will be applied at the outdoor activity areas of the receiving land use, and at the building facade for upper floor receivers which do not have an outdoor activity area facing the noise source. Where no outdoor activity area is identified, the City has the option to apply only the interior noise level performance standards.

## POLICY N-3 TRANSPORTATION NOISE SOURCES AND LEVELS

**Objective.** Establish acceptable noise levels, for land uses and activities, that will protect community residents from the harmful effects of excessive noise exposure due to transportation noise sources. Maintain interior and exterior noise standards that will achieve land use compatibility with respect to community noise.

N-3a **New development of noise-sensitive land uses.** New development of noise receptors will not be permitted in areas exposed to existing or projected levels of transportation noise exceeding levels specified in Table N-2, unless exterior noise or noise levels in interior spaces can be reduced to meet City Standards (Table N-2).

N-3b **Transportation noise.** Transportation noise sources shall be periodically measured, and significant increases mitigated, so as not to exceed the levels specified in Table N-2 for outdoor activity areas or interior spaces of existing receptors.

**TABLE N-2 - MAXIMUM ALLOWABLE TRANSPORTATION NOISE SOURCES EXPOSURE**

| LAND USE | OUTDOOR ACTIVITY AREAS[1] $L_{dn}$/CNEL, dB | INTERIOR SPACES | |
|---|---|---|---|
| | | $L_{dn}$/CNEL,dB | $L_{eq}$, dB2 |
| Residential | 603 | 45 | -- |
| Transient Lodging | 604 | 45 | -- |
| Hospitals, Nursing Homes | 603 | 45 | -- |
| Theaters, Auditoriums, Music Halls | -- | -- | 35 |
| Churches, Meeting Halls | 603 | -- | 40 |
| Office Buildings | -- | -- | 45 |
| Schools, Libraries, Museums | -- | -- | 45 |
| Playgrounds, Neighborhood Parks | 70 | -- | -- |

1. Where the location of outdoor activity areas is unknown, the exterior noise level standard shall be applied to the property line of the receiving land use.
2. As determined for a typical worst-case hour during periods of use.
3. Where it is not possible to reduce noise in outdoor activity areas to 60 dB $L_{dn}$/CNEL or less using a practical application of the best-available noise reduction measures, an exterior noise level of up to 65 dB $L_{dn}$/CNEL may be allowed provided that available exterior noise level reduction measures have been implemented and interior noise levels are in compliance with this table.
4. In the case of hotel/motel facilities or other transient lodging, outdoor activity areas such as pool areas may not be included in the project design. In these cases, only the interior noise level criterion will apply.

N-3c **Roadway projects.** To minimize noise impacts, the following criteria may be used as a test of significance for roadway projects:

1. Where existing traffic noise levels are less than 60 dB $L_{dn}$ at the outdoor activity

areas of noise receptors, a +5 dB $L_{dn}$ increase in noise levels due to a roadway improvement project will be considered significant.

2. Where existing traffic noise levels range between 60 and 65 dB $L_{dn}$ at the outdoor activity areas of noise receptors, a +3 dB $L_{dn}$ increase in noise levels due to a roadway improvement project will be considered significant.
3. Where existing traffic noise levels are greater than 65 dB $L_{dn}$ at the outdoor activity areas of noise receptors, a + 1.5 dB $L_{dn}$ increase in noise levels due to a roadway improvement project will be considered significant.

## POLICY N-4 ACOUSTICAL ANALYSIS REQUIREMENTS

**Objective.** Establish a consistent procedure and framework for conducting and reviewing acoustical analyses.

N-4a **Noise-sensitive land uses.** Where receptor land uses are potentially exposed to existing or projected exterior noise levels exceeding the levels specified in Table N-2 or the performance standards of Table N-1, an acoustical analysis shall be required as part of the environmental review process, so that noise mitigation may be included in the project design. An acoustical analysis prepared pursuant to the Noise Element shall:

1. Be the financial responsibility of the applicant.
2. Be prepared by a qualified person experienced in the fields of environmental noise assessment and architectural acoustics.
3. Include noise level measurements, with sufficient sampling periods and locations, to adequately describe local conditions and the predominant noise sources.
4. Estimate existing and projected cumulative (twenty years) noise levels in terms of $L_{dn}$ or CNEL and/or the standards of Table NI, and compare those levels to the adopted policies of the Noise Element.
5. Recommend appropriate mitigation to achieve compliance with the adopted policies and standards of the Noise Element, giving preference to proper site planning and design over mitigation measures which require the construction of noise barriers or structural modifications to buildings which contain noise-sensitive land uses.
6. Estimate noise exposure after prescribed mitigation measures are implemented.
7. Describe a post-project assessment program which could be used to evaluate the effectiveness of the proposed mitigation measures.

## POLICY N-5 INTRUSIVE AND INTERMITTENT NOISE SOURCES

**Objective.** Protect community residents from the effects of excessive, intrusive, and intermittent noise. Set standards for intrusive and intermittent noise sources for both daytime and nighttime periods. Intrusive noise sources have a qualitative aspect that can be annoying. These sources may contain a tonal component which is absent from the existing general background noise. They may also be rhythmic, reoccurring or impulsive in nature, or comprised mainly of music or speech. Intrusive noise can result in annoyance or interference with sleep. These types of noise sources can include, but are not limited to, industrial processes, warning horns, backup alarms, and pressure release devices.

N-5a **Intrusive noise.** When intrusive noise sources have been identified, the detrimental effects (sleep interference or the potential for annoyance) shall be disclosed to neighboring receptor properties.

N-5b **Noise levels due to non-transportation sources.** Noise levels due to non-transportation sources which may be intermittent or recurring, impulsive noises, pure tones, or noises consisting primarily of speech or music, shall be subject to the criteria contained within Table N-1, with a -5 dB penalty applied to the criteria.

N-5c **Rhythmic, reoccurring, or impulsive noise sources.** When noise sources have been identified to be rhythmic, reoccurring, or impulsive in nature or comprised mainly of music or speech, they may comply with applicable noise level criteria and still be annoying to individuals. When these types of noise sources have been identified, they may be subject to additional mitigation or mediation.

N-5d **Construction site tool or equipment noise.** The following shall apply to construction noise from tools and equipment:

1. The operation of tools or equipment used in construction, drilling, repair, alteration or demolition shall be limited to between the hours of 8 A.M. and 7 P.M. Monday through Friday, and between 9 a.m. and 7 p.m. on Saturdays.
2. No heavy equipment related construction activities shall be allowed on Sundays or holidays.

This shall apply to construction noise from tools and equipment which are subject to the review of the City, and which may affect receptor uses. This policy shall not apply to emergency work of public service utilities or by variance under a noise ordinance.

N-5e **Stationary and construction equipment noise.** All stationary and construction equipment shall be maintained in good working order, and fitted with factory approved muffler systems.

N-5f **Noise Ordinance.** The City of Arcata shall develop and adopt a City-wide noise ordinance. The ordinance shall contain noise level criteria consistent with the criteria contained within the noise element.

## 6.6 IMPLEMENTATION MEASURES

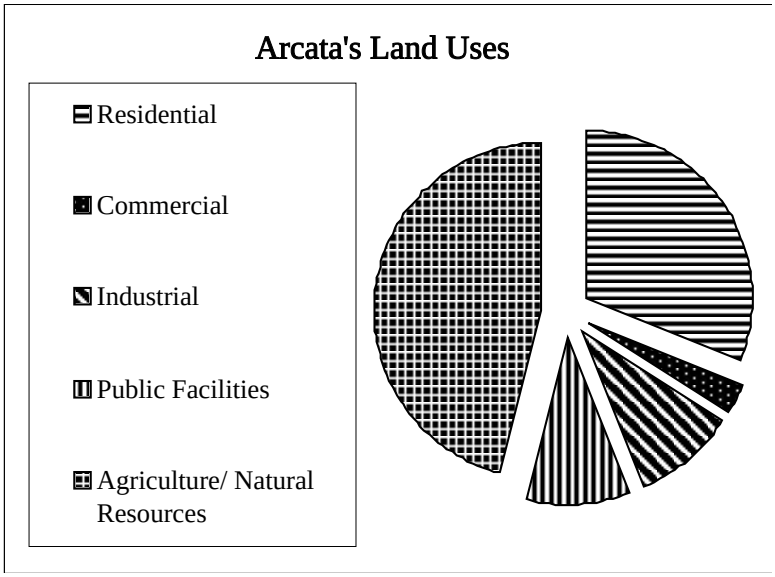
| # | IMPLEMENTATION MEASURE | RESPONSIBLE PARTY | TIME FRAME |
|---|---|---|---|
| N-1 | **Citywide and downtown noise ordinances** Adopt a citywide noise ordinance to protect public health, safety, welfare, and quiet by reducing existing noise levels and prohibiting the generation of loud noise from new sources. Amend the existing downtown noise ordinance to be consistent with Noise Element standards. | Police Department | Year 1 |
| N-2 | **Noise Control Manual** Maintain and apply a Noise Control Manual that contains techniques for soundproofing new structures and muffling equipment and motors; promotes use of acoustic materials, barriers and setbacks; and requires acoustic analysis to determine potential noise impacts. | Community Development Department/ Planning Commission | Year 1 |
| N-3 | **Education programs** The City shall maintain current information about noise monitoring and attenuation techniques effective in identifying and reducing noise. | Community Development Dept. | Ongoing |
| N-4 | **Record of noise complaints** The Arcata Police Department shall maintain a record of noise complaints. | Arcata Police Dept. | Ongoing |
| N-5 | **Noise reduction inquiry procedure** The City recognizes that many noise issues can be resolved before they get to the complaint stage, if there is a procedure for airing the issue with an impartial third party. | Community Development Dept. | Year 1 |

# ATTACHMENT 21

City of Arcata. 2000. *Land Use Element of the Arcata General Plan.*

# *LAND USE ELEMENT*

## 2.1 INTRODUCTION




**Overview of Existing Land Uses and Resources.** Arcata's land use patterns have been shaped by many factors and reflect more than one-hundred and forty years of community development. The early settlement of the town, initially called Uniontown, grew around a central plaza. Arcata's Plaza area, including a hotel, storehouse, and other commercial buildings, was originally constructed in the late 1800s and early1900s and continues to be the center of the community. The timber industry also left an indelible land use imprint on the community. Many of the lumber mills which operated in the late 1800s to mid 1900s, are now closed and the abandoned mill sites are undergoing a slow transformation to other uses. Humboldt State University occupies approximately 160 acres east of State Route 101, within walking distance of the downtown area. The northernmost campus in the California State University system, it is the community's major employer and regional education center for as many as 8,500 full-time equivalent students.

Long before Humboldt Bay was "discovered" by European-Americans, the bay and tidelands were used intensively by the Wiyot for food collection and as a site for villages. After early European settlement, Arcata's bayfront served as a community dock and shipping port. The Arcata marsh now functions as a world-renown wastewater treatment facility and wildlife refuge**.** Many residential areas of Arcata such as Sunset, Sunny Brae, Preston Ridge, and Bayside were developed while unincorporated, and then subsequently annexed to the City. Their lot sizes, subdivision designs, and street configurations reflect County, rather than City, development standards. These and other factors have influenced the existing land use characteristics of the community and will play an important role in shaping land use patterns for the future.

Arcata's residential, commercial, industrial, agricultural/natural resource, and community facility uses are similar to those found in other communities. It is Arcata's mixture of history, the diversity of uses within those land use categories, and the value placed on our history and diversity, that make the city unique. The Land Use Element contains goals, policies, and implementation measures for each land use category. These are intended to guide future land use decisions, preserve important elements of the past, and maintain the

present diversity of use and character. While the Plaza area is the commercial, cultural, social, and civic center of the community, there are several other distinct neighborhood activity centers that provide employment and services for local residents. These neighborhood centers are:

The Valley West Neighborhood Center, in the northern part of the City between State Routes 101 and 299. This area includes a shopping center, visitor-serving commercial areas along Valley West Boulevard, a mix of businesses along Giuntoli Lane, and nearby residential areas.

The Westwood/Sunset Neighborhood Center, in the western part of the City. It includes a shopping center and commercial businesses along Alliance Road, Sunset School, and surrounding residential areas.

The Sunny Brae Neighborhood Center, in the southwestern part of the City. This area includes Sunny Brae shopping center and adjacent professional offices, the Sunny Brae School, and surrounding residential areas.

The Bayside Neighborhood Center, in the southern part of the City. It includes several commercial businesses, the Jacoby Creek School, the Bayside Post Office and Grange, and surrounding low-density residential area.



The West End Employment Center, in the northeastern part of the City. This area has a mix of general and limited industrial uses, including the Aldergrove Industrial Park.

The Samoa Boulevard Employment Center, in the southern part of the City. This area includes general and limited industrial, general commercial businesses on both sides of Samoa Boulevard, vacant land west of "K" Street, and a proposed business park site south of Samoa Boulevard.

The planned distribution of land uses throughout the City and Sphere of Influence are shown on the land use diagram, which is included as Figure LU-a in the map pocket at the end of the element. In addition, the Land Use Element addresses the City's Planning Area. The Planning Area extends north to the Mad River, west to the Pacific Ocean, south into Arcata Bay, and east to include the upper watersheds of Arcata's creeks, as shown on Figure LU-b and described in the Growth Management Element.

# Figure LU-a
# Arcata General Plan: 2020

## City and Sphere of Influence
## LAND USE PLAN MAP

N

S

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

Miles

**Note:**
**Planned Development Combining Zones are located on the Zoning Map.**

**THIS IS NOT A ZONING MAP.**

**LAND USE**

- Commercial - General [C-G]
- Commercial - Central [C-C]
- Commercial - Visitor Serving [C-VS]
- Industrial - Limited [I-L]
- Industrial - General [I-G]
- Public Facility [PF]
- Residential - Very Low Density [R-VL]
- Residential - Low Density [R-L]
- Residential - Medium Density [R-M]
- Residential - High Density [R-H]
- Natural Resource [NR]
- Agriculture - Exclusive [A-E]
- Agriculture - Residential [A-R]
- Coastal Zone Boundary
- Arcata City Boundary
- Urban Services Boundary

Adopted October 4, 2000 (city17.aml)

This map is for informational purposes only.
The City of Arcata, including any employees and sub-contractors,makes no warranties, express or implied, as to the accuracy of the information contained in this map.
The City of Arcata, including any employees and sub-contractors, disclaims liability for any and all damages which may arise due to errors in the map and the user's reliance thereon.

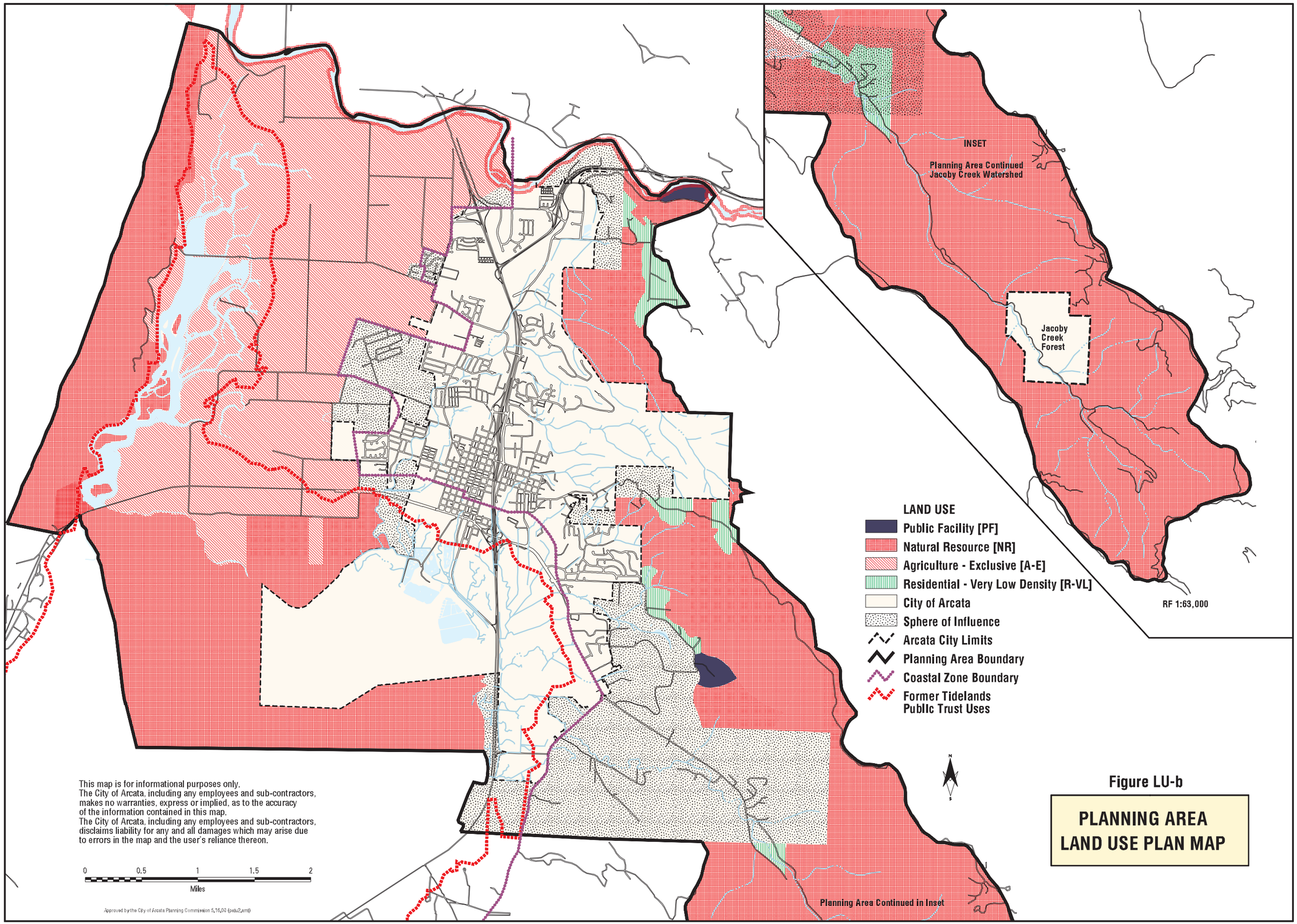



Figure LU-b

**PLANNING AREA LAND USE PLAN MAP**

## Guiding Principles and Goals.

A. Establish and maintain a greenbelt around the City that consists of agricultural, forest, and natural resource lands. Preserve, as productive natural resources areas, the open agricultural lands in the Arcata Bottom, the forests on the eastern hillsides, and aquaculture in Arcata Bay. Protect other natural resource lands along the bayfront and watercourses for their value as natural resource lands and community open space.
B. Allow for a range of housing choices that includes affordable dwellings for community residents, accommodates families as well as individuals and groups, and varies in size and type to reflect the diverse character of the community.
C. Encourage retail, service, and professional businesses to locate and stay in the Commercial–Central Area by increasing the amount of housing there.
D. Promote commercial uses in the Westwood, Valley West, Sunny Brae, Bayside, and Greenview neighborhood centers to meet day-to-day retail and service needs of nearby residents.
E. Concentrate industrial uses in existing employment centers and encourage labor intensive and technology-driven industrial and business uses in these areas rather than resource intensive uses.
F. Maintain community facilities such as schools, community centers, parks and recreation areas, and other civic uses and ensure they are located in areas that are accessible to all segments of the community.
G. Encourage infill development of vacant, brownfield, and underutilized land designated for development as a way of meeting housing and employment needs without major extensions of infrastructure and services.
H. Retain agricultural and natural resource lands within the City.
I. Promote mixed use by encouraging residential units on upper floors in commercial areas.



## 2.2 POLICIES

The Land Use Element contains the following policies:

LU-1 Overall Land Use Pattern: Land Use Plan Map
LU-2 Residential Land Use
LU-3 Commercial Land Use
LU-4 Industrial Land Use
LU-5 Public Facilities
LU-6 Agricultural and Natural Resource Lands

### POLICY LU-1 OVERALL LAND USE PATTERN: LAND USE PLAN MAP

**Objective**. Provide an overall land use arrangement that concentrates city-wide uses and functions in the central Plaza Area, linked with a series of neighborhood centers which provide a mix of commercial services, residential uses, and community facilities.

LU-1a **Land use plan diagram.** The land use plan diagram (Figure LU-a) for lands within the City and Sphere of Influence and the planning area land use map (Figure LU-b) show planned land uses for the City and surrounding areas. The land use categories, and the amount of City and Sphere of Influence land allocated for each category, are included in Table LU-1.

LU-1b **Coastal land-use plan.** The western portion of the Arcata Bottom, lands south of 7th and 8th Streets west of State Route 101, and lands south of Bayside and Old Arcata Roads east of State Route 101 are within the Coastal Zone, created by the California Coastal Act. The land use designations within the Coastal Zone are part of the City's Local Coastal Program (LCP).



LU-1c **Maintain Arcata's Plaza Area as the community's center.** The Plaza has historically been, and should continue to be, the commercial, civic, social, and cultural center of the community, and the main location for community-wide special events. The area surrounding the Plaza (Commercial–Central area) shall be planned to accommodate the greatest concentrations of retail establishments, entertainment services, restaurants, and business and professional offices within the city. High density residential use in the Commercial–Central area is encouraged. Residential units shall be included, where feasible, in all new commercial development within the Plaza Area.

## TABLE LU-1 LAND-USE PLAN CATEGORIES AND ACREAGES

| ARCATA GENERAL PLAN: 2020 LAND USE DESIGNATION | | CITY ACRES | % | SPHERE ACRES | % | TOTAL ACRES | % |
|---|---|---|---|---|---|---|---|
| **R-VL** | Residential - Very Low Density | 572 | 12 | 600 | 18 | 1172 | 15 |
| **R-L** | Residential - Low Density | 583 | 12 | 43 | 2 | 626 | 8 |
| **R-M** | Residential - Medium Density | 158 | 3 | 17 | 0 | 175 | 2 |
| **R-H** | Residential - High Density | 151 | 3 | 0 | 0 | 151 | 2 |
| **C-C** | Commercial - Central | 25 | 1 | 0 | 0 | 25 | <1 |
| **C-G** | Commercial - General | 62 | 1 | 28 | 1 | 90 | 1 |
| **C-VS** | Commercial - Visitor-Serving | 43 | 1 | 0 | 0 | 43 | 1 |
| **I-L** | Industrial - Limited | 247 | 5 | 102 | 3 | 349 | 4 |
| **I-G** | Industrial - General | 214 | 5 | 0 | 0 | 214 | 3 |
| **A-E** | Agricultural - Exclusive | 1055 | 23 | 824 | 24 | 1879 | 23 |
| **A-R** | Agriculture - Residential | 36 | 1 | 411 | 12 | 447 | 5 |
| **NR** | Natural Resource | 1038 | 23 | 1327 | 38 | 2365 | 29 |
| **PF** | Public Facility | 451 | 10 | 70 | 2 | 521 | 7 |
| | **TOTAL** | 4635 | 100 | 3422 | 100 | 8057 | 100 |

Note: The figures above do not include road rights-of-way, interchanges and the portion of Arcata Bay within the City limits, nor do they include the 565-acre Jacoby Creek Forest, a City owned non-contiguous incorporated area. These combined areas cover an additional 2,251 acres.

LU-1d **Mixed-use neighborhood centers.** The existing neighborhood centers of Westwood, Valley West, Sunny Brae, Uniontown, and Greenview are designated as multiple-use sites where additional retail establishments, personal and business services, and other neighborhood-oriented commercial services are encouraged to be developed. Substantial additions to these existing centers shall include residential units on upper floors where feasible or in separate buildings. Upgrading these centers shall include additional landscaping, improvement of parking lot designs, and provision of transit access, such as bus turnouts. Appropriate lands near these centers are designated for higher density residential uses in order to encourage walking and bicycling to neighborhood services.



LU-1e **Protection of natural resources and agricultural lands**. Agricultural [A-E] and Natural Resource [NR] designated lands make up over half of the community land base. Their productive, open space, and natural resource values are important to the community and conversion to other non-compatible uses shall be prohibited.

LU-1f **Promotion of infill development.** The City encourages appropriate redevelopment of certain parcels of land which are either underutilized, brownfields, or vacant but surrounded by existing urban development. These sites represent development opportunities using existing infrastructure, and shall have priority for development over vacant sites that are located outside the urban services boundary (designated in the Growth Management Element) which require investment in extension of infrastructure and services. Infill development may include new residential units on upper floors of commercial structures, development of second units on residential lots, and new or expansion of existing residential and commercial structures consistent with the provisions of the applicable land use plan designations. The Planned Development procedure shall be encouraged for coordinated development on larger infill sites.

LU-1g **Coastal dependent land uses.** Coastal dependent developments shall have priority over other development or uses on or near the Arcata Bay shoreline. Coastal dependent developments shall not be sited in a wetland. Where appropriate, coastal dependent developments should be accommodated within reasonable proximity to the coastal dependent uses they support.

**POLICY LU-2 RESIDENTIAL LAND USE**



**Objective**. Allow for a mix of housing types and densities to meet the physical, social, and economic needs of residents, with new and converted housing designed to be compatible with the established neighborhood character.

LU-2a **Residential Land Use Classifications.** The following land use designations are applicable to residential lands. Table LU-2 defines permitted uses, densities, lot sizes, and other development standards for each classification.

**Residential Very Low Density [R-VL].** This designation allows the lowest density residential development in areas where physical constraints, protection of natural features, or preservation of semi-rural character are important considerations. The R-VL designation is applicable primarily for lands with steep slopes and where the open space character of Arcata's hillsides and perimeter lands are to be preserved. Individual homesites are allowed in hillside areas, as long as precautions are taken to prevent the excessive removal of

vegetation and strict grading controls are enforced to prevent erosion. Development and grading on areas characterized by slopes over 25% should be avoided. Review of development proposals in all hillside areas shall ensure that seismic and geologic hazards are avoided or mitigated. More detailed hillside development standards are included in Policy PS-3c.

The R-VL designation allows creation of lots as small as 20,000 square feet, in the less-steep areas of Arcata's hillsides. Newly created lots in this zone must contain a buildable area of sufficient size and flatness to allow development without significant environmental damage or landform alteration. The development regulations for R-VL are intended to balance protection of the sensitive hillside environment with the need for quality housing sites. This designation is also intended to protect the existing rural environment in certain areas of Arcata and to provide a transition between urban uses and agricultural operations.

**Residential – Low Density [R-L].** The low density residential designation primarily provides for single-family homes on individual lots. This designation is found throughout the community, including the older, historical neighborhoods surrounding the Plaza Area, Sunny Brae, Sunset, Preston Ridge Area, and Greenview Terrace.

**Residential – Medium Density [R-M].** Medium density residential unit types typically include duplexes, townhouses, co-housing, low density apartments, and modular housing located in mobile home parks.

**Residential High Density [R-H].** The Colony Inn and Humboldt Green multi-family units are representative of R-H density. R-H density residential uses are designated in central Arcata to allow increases in density above present levels.



LU-2b **Diversity and choice in residential environments.** The land use plan map shall provide sufficient quantities of land in the various residential use categories to allow for development of a variety of types of new housing units and residential environments. The purpose shall be to maintain an appropriate balance between single-family housing on individual lots and multi-unit housing types. The City shall encourage residential developments which collectively provide a variety of choices

for housing consumers in terms of types of units, location, unit sizes, costs, design, amount of privacy, and neighborhood environment. Inclusionary measures shall be provided for affordable housing. To encourage this, the City will implement inclusionary zoning and provide incentives to developers to include low and moderate income housing units in their proposals.

**TABLE LU-2 RESIDENTIAL LAND USE CLASSIFICATIONS**

| ALLOWABLE USES | R-VL | R-L | R-M | R-H |
|---|---|---|---|---|
| RESIDENTIAL | | | | |
| Single-family dwellings | X | X | X | |
| Mobile/manufactured homes | X | X | X | X |
| Mobile home park | | | X | |
| Duplex dwellings | | X | X | X |
| Multi-family dwellings | | | X | X |
| Planned developments | X | X | X | X |
| Group residential | | X | X | X |
| SECONDARY USES | | | | |
| Small residential care facilities | X | X | X | X |
| Accessory (2nd) dwelling unit | X | X | X | X |
| Bed and Breakfast Inns | X | X | X | |
| Home Occupations | X | X | X | X |
| **DENSITY** | | | | |
| Density Range | 2 or fewer primary units per acre | From 2 to a maximum of 7.25 units per acre | From 7.26 to a maximum of 15 units per acre | From 15.01 to a maximum of 32 units per acre |

[Revised by Ordinance No. 1377, September 2008]

LU-2c **Specific considerations for certain residential areas.** Certain specific parcels have unique characteristics and/or limitations that require careful consideration when development or a change of use occurs. The considerations for the identified parcels shall be as described in Table LU-3.

**TABLE LU-3 SPECIFIC CONSIDERATIONS FOR CERTAIN RESIDENTIAL AREAS**

| AREA | SPECIFIC CONSIDERATIONS |
|---|---|
| Plum Village | Residential development shall be limited to twelve units of which three (25%) will be affordable units and the wetlands area shall be retained. [Wedemeyer/Lewis property] |
| Spear Ave. & St. Louis Rd. | Residential development shall include a mix of housing types and shall be clustered to maintain creek course and riparian areas as open space. [Sorensen property] |
| Sunset at Baldwin<br><br>APN's 505-121-021 & 505-121-019 | Residential development shall be clustered to preserve Jolly Giant Creek course and wetland areas as open space, and to reserve right-of-way for the future extension of Foster Street to Sunset Avenue. Baldwin should be extended to intersect with the extension of Foster. Access to residential development should be from Foster and Baldwin. [Franke property]<br><br>The eastern portion of the site may be used for a public facility use to allow for a new Fire Station on this site. A public facility specific consideration shall be placed on the Sunset Avenue sites per PC Resolution 08-07. |

| AREA | SPECIFIC CONSIDERATIONS |
|---|---|
| Giuntoli Lane at Hwy 299 | Residential development shall be designed to attenuate noise impacts from Hwy 299. Multifamily units shall be the predominant unit type. Special consideration should be given to internal and external access. This property has a Planned Development (PD) overlay. [Peugh-King property] |

[Revised by Ordinance No. 1377, September 2008]

LU-2d **Planned residential developments.** On vacant sites of one acre and larger designated for residential use, the Planned Development combining zone shall be required. The purpose shall be to: incorporate a mix of residential types, unit sizes, and styles in a coordinated manner to allow clustering of units; to provide larger, more usable areas of common open space; and to protect natural resources or site features, such as creekside riparian areas, wetlands, and significant vegetation such as trees. Where planned residential developments are adjacent to non-residential uses, appropriate visual and noise buffers shall be provided between the uses. Other provisions in the General Plan would assure affordable housing.




## POLICY LU-3 COMMERCIAL LAND USE

**Objective**. Provide sufficient land areas and locations for a variety of retail and commercial services, to serve the consumer needs of the community and visitors.

LU-3a **Commercial use classifications.** The following land-use plan categories are applicable to commercial lands. Table LU-4 defines permitted uses, densities, lot sizes, and coverages for each classification.

All proposed retail uses with either: (1) a floor area greater than 30,000 square feet; or (2) physical alteration of eight or more acres; or (3) generation of 1,000 or more vehicle trips per day, shall require a use permit. The use permit review shall include, at a minimum:

- Potential impact on existing and projected traffic conditions.
- Impact on municipal utilities and services.
- Impact on the physical and ecological characteristics of the site and surrounding area.
- Impact on the community.
- Fiscal impacts of the use.

**Commercial – Central [C-C]**. This designation covers most of the nineteen square blocks surrounding the Plaza and includes retail, professional office, civic, hotel, theater, residential, and similar uses. The Central-Commercial Area forms the center of the City and is designed to be a high density, pedestrian-oriented activity area, with shops and services, banks, offices, restaurants, and entertainment supporting a variety of day and night activities.

**TABLE LU-4 COMMERCIAL LAND USE CLASSIFICATIONS**

| ALLOWABLE USES | C-C | C-G | C-VS | C-M |
|---|---|---|---|---|
| SALES OF GOODS & SERVICES | | | | |
| General retail sales and services | X | X | | X |
| Specialty retail sales and services | X | X | X | X |
| Personal service establishments | X | X | | X |
| Shopping centers | X | X | | X |
| High-impact retail commercial uses | X | X | X | |
| Wholesale trade and warehousing | | X | | |
| Transient lodging | X | X | X | X |
| Travel trailer [RV] park | | | X | |
| Animal sales and services | | X | | X |
| MOTOR VEHICLE RELATED SALES & SERVICE | | X | X | |
| Motor vehicle sales and rentals | | X | X | |
| Motor vehicles services | | X | X | |
| Gas sales | | | | |
| RESTAURANTS, BARS, TAVERNS AND PUBS | X | X | X | X |
| NIGHTCLUBS | X | X | X | |
| COMMERCIAL RECREATION / ENTERTAINMENT | | | | |
| Indoor recreation services | X | X | | X |
| Outdoor recreation uses and services | | X | X | |
| Theaters | X | X | X | X |
| BUSINESS AND PROFESSIONAL OFFICES | | | | |
| Offices designed to serve customer traffic | X | X | | X |
| Offices designed to attract little customer traffic | X | X | | X |
| Health services | X | X | | X |
| EDUCATIONAL, CULTURAL & RELIGIOUS USES | | | | |
| Libraries, museums, art galleries, and similar uses | X | X | | X |
| Mortuaries and funeral homes | | X | | |
| PUBLIC & SEMI-PUBLIC USES | | | | |
| Government administrative offices | X | X | | X |
| Post offices | X | X | | X |
| RESIDENTIAL | | | | |
| Multi-family residential | X | X | | X |

[Revised by Ordinance No. 1377, September 2008]

**Commercial – General [C-G].** This designation provides the full range of retail, entertainment, and service commercial uses in Uniontown, Valley West, Westwood/Sunset, Sunny Brae, Greenview, and Bayside neighborhood centers, and other areas, such as Northtown, Giuntoli Lane, and Samoa Boulevard. C-G

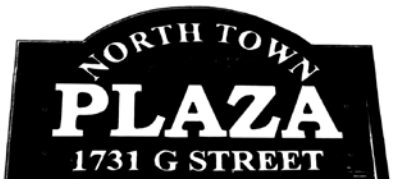
development must be compatible with the surrounding residential uses and provide convenient access for patrons arriving by bicycle, public transit, motor vehicle, or on foot. A primary difference between the C-G areas and the Plaza Area is parking. Businesses in the C-G area will be expected to provide sufficient on-site parking. C-G areas are intended to have convenient access from residential areas in order to provide for day-to-day shopping and service needs.

**Commercial – Visitor Serving [C-VS].** This land use designation permits hotels, motels, recreation vehicle parks, theaters, restaurants, auto sales centers, gas stations, mini-marts, and similar uses which attract or serve the needs of travelers, tourists, and local patrons.

The C-VS designation is not intended for general retail sales. C-VS uses are appropriate at highway interchanges where they are visible from the road and easily accessible by travelers and tourists. Similarly, C-VS uses are appropriate at locations near natural amenities or other attractions for visitors. The area designated for C-VS is at the State Route 101 and Giuntoli Lane interchange, west of Valley West Boulevard, and along Janes Road/Heindon Road.

LU-3b **Revitalization of existing commercial areas.** Reinvestment to upgrade and/or expand existing commercial centers at Sunny Brae, Westwood, Valley West, Greenview, and Uniontown shall be encouraged. Upgrades should include improvement of parking and landscaping areas; provision of facilities to accommodate bicycles, pedestrians, and transit and to reduce vehicle trips; and residential units on upper floors or in new structures.

LU-3c **Northtown Commercial Area.** The Northtown Commercial Area includes the area along "G" and "H" Streets from 11th Street to Sunset Avenue. If existing residential structures located along north "G" Street are converted to commercial use, some residential use should be required to be maintained on each site. Any conversions to commercial use should be required to provide on-site parking where feasible, in accordance with the parking standards of the Arcata Land Use Code. The design of parking areas shall maintain, or not detract from, the historical character of the existing structure.




LU-3d **Inclusion of residential uses.** Commercial developments should include residential units where feasible. Residential units should be located on upper floors or at the rear, to maintain uninterrupted commercial uses at the street level. This shall not apply to the C-VS land use category. Any residential development in new structures shall comply with the development standards of the R-M land use category.

LU-3e **Primary residential uses in Commercial – Central [C-C].** To maximize housing opportunities, residential uses are allowed as the primary use on vacant sites designated C-C, at densities consistent with the R-H designation, with a use permit.

**TABLE LU-5 SPECIFIC CONSIDERATIONS FOR CERTAIN COMMERCIAL AREAS**

| AREA | SPECIFIC CONSIDERATION |
|---|---|
| Giuntoli Lane at State Route 101 | Commercial development should include consolidated access points, parking that is screened, and setbacks from the Mad River. This property is within the urban services boundary, must be annexed, and has a Planned Development (PD) overlay [Graham Property]. |

## POLICY LU-4 INDUSTRIAL LAND USE

**Objective**. Provide for uses which will retain and generate jobs, including labor-intensive manufacturing, processing, assembly, warehousing, services, and complementary non-industrial uses, in appropriate locations.

LU-4a **Industrial uses.** The following land use designations are applicable to industrial lands. Table LU-6 defines permitted uses, densities, lot sizes, and coverages for each classification.

**Industrial – Limited [I-L]**. This land use designation is intended to provide attractive industrial areas suitable for light manufacturing and limited commercial uses. High impact industrial uses more prone to produce noise, odors, heavy truck traffic, or dust are not permitted in limited industrial areas. The I-L land use designation includes auto sales; service and repairs; sales of mobile homes, trucks and tractors; warehousing and wholesaling establishments; outdoor sales and storage lots; light industrial activities (when conducted within a building); and similar uses. Some retail sales uses and services, particularly those involving sales of products made on the premises, will be allowed as an accessory use. Residential uses may also be permitted where they are compatible with the nature of the production process, or the related sales of products made on the premises (such as artists' live/work space). The major I-L areas are the West Samoa Boulevard Employment Center, a portion of the West End Employment Center (near the State Route 299/Giuntoli Lane interchange and the Aldergrove Industrial Park), the area west of "K" Street, South "G" Street, and South "I" Street.



**Industrial – General [I-G].** This land use designation indicates areas which are appropriate for manufacturing; large-scale wood processing and storage; auto wrecking and storage yards, and all other general industrial operations. Some industrial operations generate noise, odors, or traffic which make them incompatible neighbors with residential or most commercial uses.



**TABLE LU-6 INDUSTRIAL / PUBLIC FACILITY LAND USE CLASSIFICATIONS**

| ALLOWABLE USES | I-L | I-G | PF |
|---|---|---|---|
| SALES OF GOODS AND SERVICES | | | |
| Personal services establishments | X | | |
| High impact commercial uses | X | | |
| Outdoor sales and storage of merchandise | X | | |
| Wholesale trade and warehousing | X | X | |
| Animal sales and services | X | X | |
| MOTOR VEHICLE-RELATED SALES AND SERVICES | | | |
| Motor vehicle sales and rentals | X | | |
| Motor vehicle services | X | | |
| Gas stations | X | | |
| RESTAURANTS AND NIGHTCLUBS | X | | |
| COMMERCIAL RECREATION / ENTERTAINMENT | | | |
| Indoor recreation services | X | | |
| BUSINESS AND PROFESSIONAL OFFICES | | | |
| Offices designed to serve customer traffic | X | | |
| Offices designed to attract little customer traffic | X | | |
| EDUCATIONAL, CULTURAL & RELIGIOUS USES | | | X |
| RESIDENTIAL | X | | |
| PUBLIC & SEMI-PUBLIC USES | | | X |
| HIGH IMPACT MANUFACTURING & PROCESSING | | X | |
| MODERATE IMPACT MANUFACTURING & PROCESSING | X | X | |
| LOW IMPACT MANUFACTURING & PROCESSING | X | X | |

[Revised by Ordinance No. 1377, September 2008]

LU-4b **Conversion and reuse of old industrial sites.** The City shall encourage the conversion and reuse of abandoned or inactive industrial sites such as closed lumber mill sites. An environmental site assessment will be required for sites where prior uses may have caused soil contamination. Manufacturing uses may be allowed on older I-G sites, where activities are conducted in enclosed spaces and noise, light, air quality, or traffic impacts do not significantly impact adjacent uses.

LU-4c **Incubator industrial sites.** Encourage small business incubator sites and cottage industries as part of the City's mix of industrial uses.

LU-4d **Industrial performance standards.** The City shall develop and adopt performance standards ensuring that new and upgraded industrial uses are attractively designed, keep noisy uses in enclosed spaces, do not emit light or glare off site, and contain other features that make them compatible with adjacent uses.

LU-4e **Specific areas and parcels.** Certain land areas and parcels have unique characteristics, limitations, and/or opportunities that require careful consideration when development or a change of use occurs. The considerations described below shall be made for the identified parcels.

LU-4f **South "I" Street.** Development of a new "business park" at the site of the former Little Lake Industries lumber mill on South "I" Street shall be a priority of the City. The site shall be planned as a mixed-use development. A master plan shall be prepared for the site which includes the specific considerations found in Table LU-7.

LU-4g **Coastal related resource extraction and processing.** The City of Arcata recognizes the national need for the responsible exploration, recovery, and processing of the country's energy resources. However, the City also recognizes the potential adverse impacts such activities can have on sensitive land and marine resources and on the scenic quality of coastal resources. Therefore, the City finds that, in order to minimize adverse impacts to such resources, on- and off-shore petroleum product exploration, recovery, and processing should be confined to those geographic areas which now accommodate these uses and activities. Consistent with this policy, the City shall prohibit on-shore petroleum exploration, production, and processing within its boundaries, and shall oppose the use of off-shore areas south and west of Arcata and in Humboldt County in general for such uses.

## TABLE LU-7 SPECIFIC CONSIDERATIONS FOR CERTAIN INDUSTRIAL AREAS

| AREA | EXISTING USE | CONSIDERATION |
|---|---|---|
| "K" Street Industrial Area | I-L | Provide live-work spaces; revitalize older industrial uses. |
| West End Road Corridor | I-L and I-G | Promote more intensive industrial uses. |
| Aldergrove Industrial Park | I-L | Coordinated light industrial development, with increased landscaping. |
| Giuntoli Lane/ Valley East area (Zanzi) APN's 507-141-037 & 507-141-042 | I-L and I-G | Planned Development for entire property to minimize access points on Giuntoli, and coordinate land uses, interior circulation, shared parking, and overall building layout. Constraints include setback area along Mad River. APN 507-141-042 may allow for a public facility type use to accommodate a future City park along the Mad River. A special consideration for this parcel shall include dual (Industrial Limited [IL] and/or Public Facilities [PF]) land use activities. |
| Northcoast Hardwoods site (Samoa Blvd.) | I-G | Planned Development for entire property to minimize access points on Samoa, and coordinate land uses, interior circulation, shared parking, and overall building layout. |
| Winkel Property - Little Lake Industries (South I Street) | I-L | Planned development for entire site to encourage:<br>1. An area not less than 25-feet wide adjacent and parallel to "I" Street shall be a landscape buffer between heavy manufacturing uses to the west and internal development on the site. Landscaping within the buffer strip shall include a dense planting of trees of species appropriate to the coastal environment.<br>2. A multi-use coastal access pathway shall be included along the entire landscape buffer to connect the Samoa Boulevard area to the Arcata Marsh and bay shoreline.<br>3. The former marsh areas at the southern portion of the property (south of the railroad tracks) shall be restored or recreated.<br>4. A small portion of the site adjacent to the Marsh Commons area, or along Butcher Slough, may be suitable for limited residential development.<br>5. A small portion of the site adjacent to the restored marsh area may be suitable as a site for an "eco-lodge" or other eco-tourism uses focused on coastal recreation.<br>6. The northern portion of the site east of the landscape buffer may be developed as a "business park" with light industrial and business-service uses. Comprehensive development standards for the business park area, including sidewalks, landscaping, and building design, shall be included in the master plan for the site.<br>7. A creekside conservation area shall also be required parallel to the top of the bank of Butcher Slough. |

[Revised by Ordinance No. 1377, September 2008]

## POLICY LU-5 PUBLIC FACILITIES

**Objective.** Provide appropriate locations and sites for water storage and delivery; wastewater collection and treatment; drainage; solid waste management; fire protection; parks and recreation; civic and institutional uses; and education (public and private) facilities.



LU-5a **Public Facility [PF] uses.** Public Facility land use category is applicable to those lands which are to be used for the various types of public facilities, except that some public facility uses are also allowed in other land-use categories. Public facility uses include certain uses which may be owned by private individuals, private organizations, or private institutions, as well as by government entities. Uses include schools, public services and administrative offices, wastewater and solid waste management facilities, public parking lots, parks and non-commercial recreation uses, golf courses, auditoriums, and other public assembly spaces, hospitals, cultural facilities, community gardens, communication (including telecommunications) and transportation facilities, and utilities. The types of uses allowable within this category shall be specified in Table LU-6.




LU-5b **Development standards for public facilities.** Standards applicable to development of public facility uses shall be as specified in Table LU-6.

LU-5c **Limitation of corporation yard expansion.** Development of the City corporation yard facilities shall be restricted to its existing boundaries. A landscape screen shall be maintained along with northern and eastern perimeter of the oxidation pond.

**TABLE LU-8 SPECIFIC CONSIDERATIONS FOR CERTAIN PUBLIC FACILITY AREAS**

| AREA | SPECIFIC CONSIDERATION |
|---|---|
| Mad River Hospital Area<br>APN's 507-191-033, 507-191-076, 507-291-032 & 507-191-077 | Hospital development on APN's 507-191-077 and 507-291-032, in conjunction with an overall Master Site Plan, shall retain 50% contiguous open space, have adequate provisions for on site retention of stormwater, be compatible in scale with surrounding uses, provide permanent open space or conservation easements to the City of Arcata or a land trust, and limit extent of impervious surfaces (e.g. parking lots) as much as possible through a Planned Development. A conservation easement shall address provisions to: preserve prime agriculture soils; encourage limited agriculture activities; and promote trail systems, wellness gardens, and health related outdoor activities. On APN 507-291-032, north of Wiyot Way, a residential specific consideration shall be placed on this site that would allow for development of hospital related housing, including, but not limited to: life care facilities, assisted living facilities, medical related group quarters, medical services-extended care facilities, temporary housing for family members of hospital patients, or housing for doctors, nurses, and hospital staff per PC Resolution 08-11. If a Master Site Plan for the Mad River Hospital Area is not approved by the year 2020 for a Public Facility (PF) Land Use Designated areas on APN's 507-191-077 and 507-291-032, then consideration should be given to reverting the PF designated lands back to an Agriculture Exclusive (A-E) designation. |

| AREA | SPECIFIC CONSIDERATION |
|---|---|
| M Street Fire Station Site<br>APN's 020-127-004 & 005 & 020-128-002 | Provide for a residential overlay to this site to make it compatible with adjacent residential - low density neighborhood to the west. The special consideration should be considered if a new fire station is constructed south of the intersection of Sunset Avenue at Baldwin Street. Residential overlay considerations shall be placed on the "M" Street site per PC Resolution 08-07. |

[Revised by Ordinance No. 1377, September 2008]

## POLICY LU-6 AGRICULTURAL AND NATURAL RESOURCE LANDS

**Objectives.** Preserve and promote the sustained production of natural resources; preserve and promote the agricultural, forest, and aquaculture lands; and protect public natural resource/open space lands, including stream courses, wetlands, tidelands, and open space areas. Provide for complementary uses including farm housing, processing of agricultural and aquaculture products, and access for timber harvesting, in designated areas.

LU-6a **Agricultural and Natural Resource classifications.** The following land use categories are applicable to agricultural and natural resource lands. Table LU-9 defines permitted uses, densities, lot sizes, and coverages for each category.

**Natural Resource [NR].** This designation is applied to public or private lands where protection of unique and/or sensitive natural resources, or managed production of resources, are the primary objectives. The resources element describes three subdistrict zones within the NR district which are designated: Wetland Stream Protection Zone (NR-WSPZ), Timber Production Zone (NR-TPZ), and Public Trust Zone (NR-PTZ). Examples of lands designated NR include the Community Forest (NR-TPZ), Janes Creek /McDaniel Slough Linear Park (NR-WSPZ), and the Arcata Marsh and Wildlife Sanctuary (NR-PTZ). Recreation may be considered as a secondary use when there are no adverse impacts to the protected resources. This designation is also applicable to productive resource lands, such as timber-producing forested areas (NR-TPZ) and aquaculture in Arcata Bay (NR-PTZ). The land between Humboldt State University and the Community Forest is an example of productive forest lands designated (NR-TPZ).




The NR designation is not applied to small or "pocket" wetlands, that exist on

parcels large enough to accommodate development without adversely impacting the wetlands. The designation is also not applied to wetlands used as grazed agricultural lands, or riparian areas in other zones. These resource areas are protected by applicable stream and wetlands standards.

**Agriculture Exclusive [A-E].** This designation is intended to preserve land for agricultural production. The A-E designation is appropriate for lands with prime agricultural soils and wetlands that could be used as grazed agricultural lands. Structures associated with agricultural production, such as barns and farmhouses, are appropriate uses in A-E areas.



**Agriculture Residential [A-R].** This designation allows very low density residential development on agricultural lands. Structures associated with agricultural production, such as barns and farmhouses, would be appropriate uses in these agricultural areas.

**TABLE LU-9 AGRICULTURAL AND NATURAL RESOURCE LAND USE CLASSIFICATIONS**

| ALLOWABLE USES | A-E | A-R | NR |
|---|---|---|---|
| RESIDENTIAL | | | |
| Single-family dwellings | X | X | X |
| Mobile / manufactured homes | X | X | |
| Secondary residential uses | X | X | |
| Bed & Breakfast (as secondary use with use permit) | X | X | |
| COMMERCIAL RECREATION & ENTERTAINMENT | | | |
| Coastal-dependent recreation | X | | X |
| AGRICULTURE, MINING, SILVICULTURE & AQUACULTURE | | | |
| General agriculture, except keeping confined animals | X | X | |
| Agriculture, including keeping of confined animals | X | | |
| Agriculture-related processing facilities | X | X | X |
| Commercial greenhouse operations | X | X | |
| Aggregate and other mining | | | X |
| Silvicultural operations | | | X |
| Aquacultural operations | | | X |
| NATURAL RESOURCE CONSERVATION USES | X | X | X |
| **DENSITY** | | | |
| Density Range | 1 primary residential unit per parcel (and a secondary unit) | 1 primary residential unit per parcel (and a secondary unit) | 1 unit per existing parcel |

[Revised by Ordinance No. 1377, September 2008]

LU-6b **Compatibility between agricultural and adjacent non-agricultural uses.** Agricultural practices can include spraying of herbicides, application of fertilizer, operation of farm equipment, and use of local roads by slow moving and large vehicles. These practices can cause noise, health, light, odor, and travel impacts for residents in adjacent non-agricultural areas. To minimize these impacts, development of new non-agricultural uses that locate adjacent to existing agricultural uses shall maintain setbacks and establish buffers. The potential impacts of adjacent agricultural practices shall be required to be disclosed to future residents. Where new or expanding agricultural uses locate adjacent to existing non-agricultural areas, the agricultural user shall be responsible for maintaining setbacks and establishing buffers.

LU-6c **Protection of agricultural lands and uses within the City**. Agricultural lands represent an important natural resource within the City. The protection of agricultural lands shall include the following:

1. Lands designated Agricultural Exclusive [A-E] with Grade* 1 and 2 soils are the City's prime agricultural resource; lands designated [A-E] with Grade* 3 and 4 soils support less intensive uses than lands with higher grade soils, but are still viable for resource production. A-E lands shall not be developed, except for agricultural-related uses.
2. Agricultural uses on lands designated other than A-E shall be allowed and encouraged, consistent with other General Plan policies.
3. Existing agricultural practices on seasonal wetlands shall be allowed to continue, consistent with other General Plan policies.
4. The minimum lot size for lands designated A-E shall be twenty acres, except in the coastal zone where the minimum lot size shall be sixty acres. Designated uses for agricultural lands within the coastal zone shall include the following:
    - The "Permitted Uses" section shall include: "Agricultural Structures, including greenhouses or other nursery structures erected over exposed soil."
    - The "Conditionally Permitted Uses" section shall include: Greenhouses or other nursery structures erected on concrete perimeter foundations may be permitted if no less environmentally damaging alternate is available."
    - Greenhouses on slab foundations are prohibited.

Private and public non-vehicular recreational activities such as hiking, riding, fishing, hunting, and other recreational activities which do not require permanent structures, facilities, or foundations may be permitted in areas designated A-E if they do not interfere with adjacent agricultural uses, or limit potential of the site to return to agricultural use, or displace the wildlife utilizing the area, especially in seasonal wetlands. This shall be implemented in the City's land use code.

LU-6d **Uses allowed in diked/reclaimed former tidelands**. Allowable uses and development in grazed or farmed wetlands are limited to uses compatible with the Public Trust. These uses are summarized below:

1. Agricultural operations limited to accessory structures, apiaries, field and truck crops, livestock raising, greenhouses (provided they are not located on slab foundations and crops are grown in the existing soil on site), and orchards.
2. Farm-related structures, including barns, sheds, and farmer-occupied housing, necessary for the performance of agricultural operations. Such structures may be located on an existing grazed or farmed wetland parcel only if no alternative upland location is available for such purpose and the structures are sited and designed to minimize adverse environmental effects on Public Trust resources and uses. No more than one primary and one secondary residential unit shall be allowed per parcel.
3. Restoration projects.
4. Nature study, aquaculture, and similar resource-dependent activities compatible with the Public Trust resources and uses.
5. Incidental public service purposes which may temporarily impact the resources of the area (such as burying cables or pipes).

LU-6e **Relationship with the Open Space and Resource Conservation and Management Elements.** The Open Space and Resource Conservation and Management Elements (General Plan Chapter 4) address the natural resource values of agricultural and natural resource lands. Lands designated Agriculture Exclusive [A-E] and Natural Resource [NR] are important components of City's open space, as defined in the Open Space Element. The conservation and management of these lands for their natural resource values, as well as their biological, hydrological and soil resources, are specifically addressed in the Resource Conservation and Management Element. The policies of both these elements shall apply to future agricultural and natural resource land use decisions.

**TABLE LU-10 SPECIFIC CONSIDERATIONS FOR CERTAIN AGRICULTURAL AREAS**

| AREA | SPECIFIC CONSIDERATION |
|---|---|
| Arcata Bay Storage<br>APN 021-121-010 | Provide for agriculture-related manufacturing due to aggregate fill deposits on the Arcata Bay Storage site per PC Resolution 08-09. |

[Revised by Ordinance No. 1377, September 2008]

## 2.3 IMPLEMENTATION MEASURES

| # | IMPLEMENTATION MEASURE DESCRIPTION | RESPONSIBLE PARTY | TIME FRAME |
|---|---|---|---|
| LU -1 | **Land Use Code Amendments** Revise the City Land Use Code (formerly the Land Use and Development Guide, or LUDG) zoning districts and land use regulations to be consistent with the General Plan land use designations, densities, primary and secondary uses, building intensity, lot sizes, and coverages. Add inclusionary zoning provisions for affordable housing. | Community Development Department/ Planning Commission | Year 1 |
| LU -2 | **Conversion and Reuse of Inactive Mill and other Industrial Sites** Solicit property owner cooperation and pursue funding for environmental site assessments and clean-up of abandoned or inactive mill sites. Encourage conversion of these sites when proposed reuse is consistent with General Plan goals and policies. | Community Development Department/ Property Owners | Ongoing beginning in Year 1 |
| LU -3 | **Maintain Economic Strategies Plan** The Economic Strategy Report is intended to be a guide for City actions pertaining to economic improvement. The report should be updated periodically for compliance with General Plan policies. | City Manager's Office | Every five years beginning in Year 3 |
| LU -4 | **New Business Park Master Plan** Seek funding for and prepare a business park master plan for the reuse of the South "I" Street property for mixed-use development. | Community Development Department | Year 2 |
| LU -5 | **Neighborhood Centers** City staff will communicate City policy regarding mixed use to neighborhood center owners and managers, and work proactively with them to maximize use of the centers. | Community Development Department | Year 1 |
| LU -6 | **Industrial Performance Standards** City staff will communicate City policy regarding performance standards to industrial area owners and managers and work proactively with them to improve appearances, and reduce noise, light, and glare from operations. | Community Development Department | Year 1 |
| LU -7 | **Affordable Housing** Include inclusionary zoning measures and/or incentives in the next update of the Housing Element. | Community Development Department | 2002 |

# ATTACHMENT 22

City of Arcata. 2010. *Hazardous Materials Business Plan Modules for Use with CERS Electronic Reporting.* Revised 12/14/10.

# HAZARDOUS MATERIALS BUSINESS PLAN MODULES FOR USE WITH CERS ELECTRONIC REPORTING

Complete These Modules and Use the "Upload Document" Feature in CERS to Complete Your HMBP for Electronic Submittal

## A. Emergency Response/Contingency Plan *[HSC §25504(b); 19 CCR §2731; 22 CCR §66262.34(a)(4)]*

All facilities that handle hazardous materials in HMBP quantities must have a written emergency response plan. In addition, facilities that generate 1,000 kilograms or more of hazardous waste (or more than 1 kilogram of acutely hazardous waste or 100 kilograms of debris resulting from the spill of an acutely hazardous waste) per month, or accumulate more than 6,000 kilograms of hazardous waste on-site at any one time, must prepare a hazardous waste contingency plan. Because the requirements are similar, they have been combined in a single document, provided below, for your convenience. This plan is a required module of the Hazardous Materials Business Plan (HMBP).

This site-specific Emergency Response/Contingency Plan is the facility's plan for dealing with emergencies and shall be implemented immediately whenever there is a fire, explosion, or release of hazardous materials that could threaten human health and/or the environment**. At least one copy of the plan shall be maintained at the facility for use in the event of an emergency and for inspection by the local agency.** A copy of the plan and any revisions must be provided to any contractor, hospital, or agency with whom special (i.e., contractual) emergency services arrangements have been made *(see section 3, below)*.

**1. Evacuation Plan:**

a. The following alarm signal(s) will be used to begin evacuation of the facility *(check all that apply)*:

☐ Bells; ☐ Horns/Sirens; ☒ Verbal *(i.e., shouting)*; ☐ Other *(specify* _____

b. ☒ Evacuation map is prominently displayed throughout the facility.

*Note: A properly completed HMBP Site Plan satisfies contingency plan map requirements. This drawing (or any other drawing that shows primary and alternate evacuation routes, emergency exits, and primary and alternate staging areas) must be prominently posted throughout the facility in locations where it will be visible to employees and visitors.*

**2. a. Emergency Contacts:***

| | |
|---|---|
| **Fire/Police/Ambulance** | Phone No.: **911** |
| **California Emergency Management Agency** | Phone No.: (**800**) **852-7550** |

**b. Post-Incident Contacts:***

| | |
|---|---|
| **Certified Unified Program Agency (CUPA)** | Phone No.: (**707**) **445-6215** |
| **Local Hazardous Materials Program** | Phone No.: (**707**) **441-4000** |
| **California Department of Toxic Substances Control (DTSC)** | Phone No.: (**510**) **540-3739** |
| **Cal/OSHA Division of Occupational Safety and Health** | Phone No.: (**707**) **445-6611** |
| **Air Quality Management District** | Phone No.: (**707**) **443-3093** |
| **Regional Water Quality Control Board** | Phone No.: (**707**) **576-2220** |

*** Phone numbers for agencies in Unidocs Member Agency geographic jurisdictions are available at www.unidocs.org.**

**c. Emergency Resources:**

| | | |
|---|---|---|
| **Poison Control Center*** | | Phone No.: (**800**) **876-4766** |
| **Nearest Hospital:** | Name: **Mad River Community Hospital** | Phone No.: (**707**) **822-3621** |
| | Address: **3800 Janes Road** | City: **Arcata** |

**3. Arrangements With Emergency Responders:** *(Attach additional pages, if needed.)*

If you have made special (i.e., contractual) arrangements with any police department, fire department, hospital, contractor, or State or local emergency response team to coordinate emergency services, describe those arrangements below:

## 4. Emergency Procedures:

Emergency Coordinator Responsibilities:

a. Whenever there is an imminent or actual emergency situation such as a explosion, fire, or release, the emergency coordinator *(or his/her designee when the emergency coordinator is on call)* shall:
   i. Identify the character, exact source, amount, and areal extent of any released hazardous materials.
   ii. Assess possible hazards to human health or the environment that may result from the explosion, fire, or release. This assessment must consider both direct and indirect effects *(e.g., the effects of any toxic, irritating, or asphyxiating gases that are generated, the effects of any hazardous surface water run-off from water or chemical agents used to control fire, etc.).*
   iii. Activate internal facility alarms or communications systems, where applicable, to notify all facility personnel.
   iv. Notify appropriate local authorities *(i.e., call 911).*
   v. Notify the California Emergency Management Agency at (800) 852-7550.
   vi. Monitor for leaks, pressure build-up, gas generation, or ruptures in valves, pipes, or other equipment shut down in response to the incident.
   vii. Take all reasonable measures necessary to ensure that fires, explosions, and releases do not occur, recur, or spread to other hazardous materials at the facility.

b. Before facility operations are resumed in areas of the facility affected by the incident, the emergency coordinator shall:
   i. Provide for proper storage and disposal of recovered waste, contaminated soil or surface water, or any other material that results from a explosion, fire, or release at the facility.
   ii. Ensure that no material that is incompatible with the released material is transferred, stored, or disposed of in areas of the facility affected by the incident until cleanup procedures are completed.
   iii. Ensure that all emergency equipment is cleaned, fit for its intended use, and available for use.
   iv. Notify the California Department of Toxic Substances Control, the local CUPA, and the local fire department's hazardous materials program that the facility is in compliance with requirements b-i and b-ii, above.

Responsibilities of Other Personnel:

On a separate page, list any emergency response functions not covered in the "Emergency Coordinator Responsibilities" section, above. Next to each function, list the job title or name of each person responsible for performing the function.

## 5. Post-Incident Reporting/Recording:

The time, date, and details of any hazardous materials incident that requires implementation of this plan shall be noted in the facility's operating record.

Within 15 days of any hazardous materials emergency incident or threatened hazardous materials emergency incident that triggers implementation of this plan, a written Emergency Incident Report, including, but not limited to a description of the incident and the facility's response to the incident, must be submitted to the California Department of Toxic Substances Control, the local CUPA, and the local fire department's hazardous materials program. The report shall include:

a. Name, address, and telephone number of the facility's owner/operator;
b. Name, address, and telephone number of the facility;
c. Date, time, and type of incident *(e.g., fire, explosion, etc.)*;
d. Name and quantity of material(s) involved;
e. The extent of injuries, if any;
f. An assessment of actual or potential hazards to human health or the environment, where this is applicable;
g. Estimated quantity and disposition of recovered material that resulted from the incident;
h. Cause(es) of the incident;
i. Actions taken in response to the incident;
j. Administrative or engineering controls designed to prevent such incidents in the future.

## 6. Earthquake Vulnerability: [19 CCR §2731(e)]

As an attachment to this plan, you must identify any areas of the facility and mechanical or other systems that require immediate inspection or isolation because of their vulnerability to earthquake-related ground motion.

**7. Hazard Mitigation/Prevention/Abatement:** [19 CCR §2731(c)]

As an attachment to this plan, you must include procedures that provide for mitigation, prevention, or abatement of hazards to persons, property, or the environment. These procedures must be scaled appropriately for the size and nature of the business, the nature of the damage potential of the hazardous materials handled, and the proximity of the business to residential areas and other populations.

**8. Emergency Equipment Inventory Table:** *[22 CCR §66265.52(e), as referenced by §66262.34(a)(4)]*

Complete the following Emergency Equipment Inventory Table by identifying equipment maintained on-site:

| 1. Equipment Category | 2. Equipment Type | 3. Locations * | 4. Description** |
|---|---|---|---|
| **Personal Protective Equipment, Safety Equipment, and First Aid Equipment** | ☒ Cartridge Respirators | office area | full-face particulate respirator |
| | ☐ Chemical Monitoring Equipment *(describe)* | | leak detection equipment & alarm on-site, chlorine storage discontinued |
| | ☒ Chemical Protective Aprons/Coats | office area | |
| | ☐ Chemical Protective Boots | | |
| | ☒ Chemical Protective Gloves | multiple locations | |
| | ☐ Chemical Protective Suits *(describe)* | | |
| | ☐ Face Shields | | |
| | ☒ First Aid Kits/Stations *(describe)* | office area | |
| | ☐ Hard Hats | | |
| | ☒ Plumbed Eye Wash Stations | office area | |
| | ☒ Portable Eye Wash Kits *(i.e., bottle type)* | office area & fluoride room | sterile saline wash |
| | ☐ Respirator Cartridges *(describe)* | | |
| | ☒ Safety Glasses/Splash Goggles | office area | |
| | ☐ Safety Showers | | |
| | ☐ Self-Contained Breathing Apparatuses (SCBA) | | |
| | ☒ Other *(describe)* | office area | purified air respirator |
| **Fire Extinguishing Systems** | ☐ Automatic Fire Sprinkler Systems | | |
| | ☐ Fire Alarm Boxes/Stations | | |
| | ☐ Fire Extinguisher Systems *(describe)* | | |
| | ☒ Fire Extinguishers *(describe)* | multiple locations | Type ABC throughout facility |
| | ☐ Other *(describe)* | | |
| **Spill Control Equipment and Decontamination Equipment** | ☐ Absorbents *(describe)* | | |
| | ☐ Berms/Dikes *(describe)* | | |
| | ☐ Decontamination Equipment *(describe)* | | |
| | ☐ Emergency Tanks *(describe)* | | |
| | ☐ Exhaust Hoods | | |
| | ☐ Gas Cylinder Leak Repair Kits *(describe)* | | |
| | ☐ Neutralizers *(describe)* | | |
| | ☒ Overpack Drums | fluoride room | saturators contained in overpack drums |
| | ☐ Sumps *(describe)* | | |
| | ☒ Other *(describe)* | fluoride room | fluoride bags stored on containment pallets |
| **Communications and Alarm Systems** | ☐ Chemical Alarms *(describe)* | | |
| | ☐ Intercoms/ PA Systems | | |
| | ☒ Portable Radios | | |
| | ☒ Telephones | | |
| | ☐ Tank Leak Detection Systems | | |
| | ☐ Other *(describe)* | | |
| **Additional Equipment** *(Use Additional Pages if Needed.)* | ☐ | | |
| | ☐ | | |
| | ☐ | | |
| | ☐ | | |
| | ☐ | | |

* *Use the map and grid numbers or location identifiers from your HMBP.*

** *Describe the equipment and its capabilities. If applicable, specify any testing/maintenance procedures/intervals. Attach additional pages, if needed.*

# ATTACHMENT 23

City of Arcata. 2016. *City of Arcata Risk Management Plan.* Adopted January 11, 2016.

# TABLE OF CONTENTS

Table of Contents ..... 1
Revisions Page ..... 3
Introduction ..... 5
Structure of The City of Arcata Risk Management Plan ..... 5
1. Executive Summary ..... 5
1.1. Accidental Release Prevention and Emergency Response Policies ..... 6
1.2. Regulated Substances Handled and Source Information ..... 7
1.3. Off-site Consequence Analysis (See Section 4, and Appendix A): ..... 7
1.3.1. Worst-Case Chlorine and Sulfur Dioxide Release Scenarios for Program 3 Processes ..... 8
1.3.2. Alternative Chlorine and Sulfur Dioxide Release Scenarios for the Program 3 Process ..... 8
1.4. Mitigation Measures ..... 8
1.5. Accidental Release Prevention Program (See Appendix B): ..... 9
1.5.1. Process Hazard Analysis (See Appendix C): ..... 9
1.5.2. Operating Procedures (See Appendix D). ..... 10
1.5.3. Training (See Appendix E). ..... 10
1.5.4. Mechanical Integrity (See Appendix F). ..... 10
1.5.5. Pre-startup Review (Appendix G) ..... 10
1.5.6. Management of Change (See Appendix H). ..... 11
1.5.7. Compliance Audit (Appendix I) ..... 11
1.5.8. Incident Investigation (Appendix J). ..... 11
1.5.9. Employee Participation (See Appendix K). ..... 11
1.5.10. Hot Work Permits (Appendix L). ..... 11
1.5.11. Contractors (See Appendix L). ..... 12
1.6. Chemical-specific Prevention Steps ..... 12
1.7. Five-Year Accident History (See Section 5.0) ..... 13
1.8. Emergency Response Program (See Section 8.0) ..... 13
1.9. Planned Changes to Improve Safety ..... 14
2. Registration ..... 14
2.1. Registration ..... 14

2.2. Stationary Source Locations: 15
2.3. Stationary Source Dun and Bradstreet Number: 15
2.4. Name and Dun and Bradstreet Number of the Corporate Parent Company: 15
2.5. Name, Telephone Number, and Mailing Address of the Operator: 15
2.6. Name and Title of the person responsible for Part 68 (RMP) implementation: 15
2.7. Name, Title, Telephone Number, and 24-hour Emergency Contact Number: 15
2.8. CAS Number, Maximum Quantity, SIC code, and Program Level: 15
2.9. US EPA Identifier: 16
2.10. Number of Full-time Employees at the Stationary Sources: 16
2.11. Is the Stationary Source Subject to OSHA PSM Standards? 16
2.12. Is the Stationary Source Subject to Part 355 of Title 40 of CFR? 16
2.13. Is the Stationary Source Subject to an Operating Permit Under Title V of CAA? 16
2.14. Date of last Safety Inspection 16
3. Management System (Appendix H) 16
3.1. Qualified Management Personnel 16
4. Off-Site Consequence Analysis 17
5. five year accident history 18
6. Program 3 prevention program 19
7. emergency response program (APPENDIX B) 20
7.1. Procedures for Informing the Emergency Response Agencies, and the Public 21
7.2. Emergency Response Equipment 23
7.3. Training 23
7.4. Updates 23
7.5. Chlorine Emergency Response Information, and Emergency Health Care 23
8. Certification page 27
9. List of Appendices 28

# REVISIONS PAGE

Use the following abbreviations to denote what element was revised: TOC, LOI, INT, ES, Reg, MS, OCA, 5AH, P2PP, P3PP, ERP, Cert, (A)A, (A)B, (A)C, (A)D, (A)E, (A)F, (A)G, (A)H, (A)I, (A)J, (A)K, and (A)L. Use a new line for revisions made to any of the appendices. Major revisions are noted by a change in whole numbers and are not denoted by element.

| Version | Description of Revision | Date |
|---|---|---|
| Initial plan | RMP SUBMIT- to the EPA and HCDEH | June 1999 |
| Final plan | CalARP, EPA RMP, and OSHA PSM Program | January 2001 |
| Rev 1.0 | Compliance Audit | Scheduled for Jan 04 |
| Rev 2.0 | Process Hazard Analysis | Scheduled for Jan 06 |
| 2.3 | Added date of last training procedure review revision (ecl) | |
| 2.4 | Added dates; last date of contractor service and change in equipment | March 10, 06 |
| 2.5 | Minor typo; incorporated “draft comments into entire plan | |
| 3.0 | Reworked structure globally; added brief narrative on structure of RMP. Inserted recent compliance audit. Updated Contact Information. | June 4, 09 |
| 3.1 | Added DUN #, fixed phone number for Mark André | June 19, 2009 |
| 3.2 | Minor typos, updated Water/Wastewater Superintendent information, updated section 1.6 and section 7 with current information, added list of appendices | April 12, 2011 |
| (A)B 1.5 | Appendix B Chlorine Sulfur Dioxide ERP; updated contact tables & common notifications, fixed ID#s on figure 1 and key | April 6, 2011 |
| (A)C 1.2 | Appendix C Process Hazard Analysis reviewed 2009 PHA results, updated with 2009 PHA report | April 12, 2011 |
| A(D) 1.3 | Appendix D Operating Procedures; Minor typos, reviewed and revised with operators | April 11, 2011 |
| (A)H 1.2 | Appendix H Management System; updated Water/Wastewater Supervisor | April 6, 2011 |
| 4.0 | Removed ARTS from plan; changes made throughout Executive Summary. | April 30, 2012 |
| (A)A 2.0 | Created electronic version of appendix A; removed portions of off-site consequence analysis for Alliance Road Transfer Station (ARTS). Archived ARTS sections electronically and in hard-copy | April 29, 2012 |
| (A)B 2.0 | Removed portions specific to ARTS Program 2 process; inserted Chlorine – Liquified Gas Booklet; reformatted portions for consistency with remaining RMP appendices. | April 29, 2012 |
| (A)D 2.0 | Removed portions specific to ARTS facility; reformatted portions for consistency with remaining RMP appendices. | April 29, 2012 |
| (A)E 1.1 | Created electronic version of appendix E. | April 30, 2012 |
| (A)H 2.0 | Removed “Alliance” from facility options on MOC form; minor format changes for consistency with remaining RMP appendices. | April 30, 2012 |
| (A)I 1.1 | Created electronic version of appendix I. | April 30, 2012 |

| | | |
|---|---|---|
| (A)J 2.0 | Removed portions specific to ARTS facility; removed "Alliance" from facility options on report form; minor format changes for consistency with remaining RMP appendices. | April 30, 2012 |
| (A)K 2.0 | Created electronic version of appendix K; removed portions specific to ARTS facility. | April 30, 2012 |
| (A)L 2.0 | Created electronic version of appendix L; removed portions specific to ARTS facility. | April 30, 2012 |
| (A)B 2.1 | Reviewed ERP. Rplaced MSDS with SDS for chlorine and sulfur dioxide. Updated guidebook references to 2012 printing. | 9/3/2015 |
| (A)C 1.4 | Electronic summary of changes added to PHA. Changed format for consistency with other RMP sections. Added section to checklist to prompt team to review covered program accidents, incidents and near misses that have occurred since last PHA. Established timelines for PHA report and action/recommendation implementation. | 9/3/2015 |
| (A)I 1.2 | Removed requirement for a person outside of the organization to be on the Compliance Audit team (in line with regulation) and expanded the description of persons qualified to be on the audit team. Changed corrective action implementation timeline from "timely manner" to no later than 1.5 years or next turnaround | 9/3/2015 |
| (A)J 2.1 | Added resolution timelines to Incident Investigation in accordance with regulation. Deleted reference to attachments which are not contained in the RMP | 9/3/2015 |
| (A)D 4.0 | Review and update of Operating Procedures to reflect current practice, including update of AWTF O&M manual chapter XVII. Annual certification statement signed. | 9/18/2015 |
| (A)L 2.1 | Incorporated changes in 2006 "Draft Controlled Area Hot Work Permit Policy" into Appendix L and expanded procedures to include regulatory requirements. Updated title of responsible persons. Updated Hot Work Permit form. | 9/28/2015 |
| (A)B 2.1 | Updated Emergency Notification phone list. | 12/29/2015 |
| (A)A | Updated OSCA with mitigation measure for release in an enclosed space partially open to the outside. Tables and end-point maps updated. | 1/8/2016 |
| ES | Updated Executive Summary to reflect recent changes to RMP appendices and updated list of dates. | 1/11/2016 |
| | | |

## INTRODUCTION

This California Accidental Release Prevention (Cal ARP) Program, Risk Management Plan was initially prepared by SHN Consulting Engineers & Geologists, Inc. (SHN), on behalf of The City of Arcata. This Program has been designed for the City of Arcata Wastewater Treatment Plant in accordance with the Cal ARP Program requirements, which are specified in the California Code of Regulations (CCR Title 19, Division 2, Chapter 4.9, OSHA Process Safety Management (PSM) standards (Section 5 189 of Title 8 of CCR, and Code of Federal Regulations Title 29, Section 1910.1 19).

The Wastewater Treatment Plant (WWTP) is owned and operated by the City of Arcata. The WWTP facility uses and stores regulated materials over the Federal and OSHA threshold quantities (Figure 1). Chlorine and sulfur dioxide gas are used to treat the wastewater that is processed through the WWTP facility. For facility plans see Figures 2 through 5. The following plan covers the City of Arcata WWTP and its regulated processes. The format used in producing this plan comes directly from the Cal ARP Program guidelines for completing a Risk Management Plan (RMP), and The American Water Works Association "Compliance Guidance and Model Risk Management Program for Water Treatment Plants."

## STRUCTURE OF THE CITY OF ARCATA RISK MANAGEMENT PLAN

The City of Arcata Risk Management Plan is the combination of various RMP elements that work synergistically to reduce the risk associated with using chlorine and sulfur dioxide. RMP elements are: the Introduction, Structure of the City of Arcata RMP, the summary sections 1 through 9, and the associated appendices A through L. Section 1.0 and its associated subsections provides a brief narrative and in some cases supplements the RMP appendices.

The RMP elements can be categorized as either administrative in function or as manuals to various operations and maintenances. One example of an administrative element is Appendix C; Appendix C contains documents on the hazards of the process, how the hazards specific to Arcata were determined, and generates recommendations. The recommendations made during a Process Hazard Analysis that is found in Appendix C might initiate a change in the operating procedures which are found in Appendix D which is an example of an operations manual.

# 1. EXECUTIVE SUMMARY

The City of Arcata is committed to operating in a manner that is safe for City of Arcata employees, the public, and the environment. As part of this commitment, the City of Arcata has established a system to help ensure safe operations of the processes at these facilities. One component of this system is a risk management program that helps manage the risks at City of Arcata's facilities. This RMP developed for the City of Arcata consists of three elements:

1. A hazard assessment to help understand the potential off-site consequences of hypothetical accidental releases, and accidents that have occurred during the past five years associated with the use of substances regulated by the RMP rule.

2. A prevention program to help maintain and safely operate any processes containing more than a threshold quantity of a regulated substance.

3. An emergency response program to help respond to an accidental release of regulated substances from covered processes.

Information further describing these elements is provided in this Risk Management Plan (RMP), which complies with all requirements of the California Accidental Release Prevention (Cal ARP) Program, the OSHA Process Safety Management (PSM) standards, and U.S. Environmental Protection Agency (EPA) requirements.

Although the RMP for the City of Arcata helps provide assurance that the facility is maintained and operated in a safe manner, it is only one component of the safety program. In fact, the City of Arcata has a comprehensive safety program in place establishing many levels of safeguards against release of a hazardous substance, and the injuries and damage resulting thereof.

The City of Arcata has limited the use of potentially hazardous substances being regulated. The WWTP was constructed in 1985 and is very well maintained. The facility and process equipment was designed, built, and is being operated to reduce the likelihood of an accidental release. Industry and government standards were closely adhered to in the design, construction, and operation of the facilities and equipment.

The City of Arcata trains specific employees to respond to an accidental release, reducing the consequences of a release, if it occurs. In addition, the City of Arcata works closely with the Arcata Fire Department, and with other local emergency planning teams to help ensure that injuries and/or environmental damages will be minimal, if a release does occur.

The safety program at the City of Arcata consists of a number of elements, only some of which are Cal ARP Program 3 requirements. This RMP is primarily intended to describe those parts of the safety program that are required.

## 1.1. Accidental Release Prevention and Emergency Response Policies

City of Arcata is committed to the safety of the workers and the public, and the preservation of the environment, through the prevention of accidental releases of hazardous substances. The City of Arcata implements reasonable controls to prevent foreseeable releases of hazardous substances. These controls include training programs for personnel; programs to help ensure safety in the design, installation, operation, and maintenance of processes at the facilities; and programs to evaluate the hazards at the facilities, which store and use hazardous substances. In the event of an accidental release, the City of Arcata and the Arcata Fire Department will work to control and contain the release in a manner that will be safe for the responders and the employees, and will respond immediately to prevent injury to the public and damage to the environment. The City of Arcata provides response training to specific personnel, designates an emergency response coordinator to oversee response activities, and coordinates response efforts with the Arcata Fire Department. Response activities will also be coordinated with other identified emergency planning teams (See Humboldt County's Hazardous Materials Area Plan). In order to effectively implement these policies, the City of Arcata established a management system headed by the City Manager and the Director of Environmental Services (RMP Program Manager) to oversee safety-related activities.

## 1.2. Regulated Substances Handled and Source Information

City of Arcata's WWTP serves the City of Arcata and portions of the unincorporated communities of Fieldbrook and Bayside. As part of the wastewater treatment processes, chlorine and sulfur dioxide gas is used and stored in sufficient quantities to be covered by the Cal ARP program, OSHA Process Safety Management Standards, and U.S. EPA RMP requirements.

**Table 1**
**Regulated Substances Stored at City of Arcata Facilities**

| Process | Program Level | Regulated Substances | Process Quantity |
|---|---|---|---|
| WWTP | 3 | Chlorine | 30,000 lbs |
| WWTP | 3 | Sulfur Dioxide | 12,000 lbs |

## 1.3. Off-site Consequence Analysis (See Section 4, and Appendix A):

The City of Arcata performed an off-site analysis to estimate the potential for an accidental release of a regulated substance, which may affect the public or the environment. The off-site consequence analysis consisted of evaluating both worst-case release scenarios and alternative release scenarios. A worst-case release scenario may never occur; however, the worst case and alternative release scenarios were selected to help emergency responders improve their community emergency response procedures (See Worst Case and Alternate Scenario Maps, Appendix A). The EPA defines the worst-case scenario as a 10-minute release of the largest quantity of a regulated substance from a single vessel or process line failure that results in the greatest distance to an endpoint. The distance to the endpoint is the distance a toxic vapor cloud will travel before dissipating to the point that serious injuries from short-term exposures will no longer occur. The airborne concentration is the maximum airborne concentration below which it is believed that nearly all individuals may be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.

When considering the release of a toxic substance, most people at the endpoint distance would be able to walk away from the exposure without any long-term consequences, although some short-term consequences (e.g., strong eye or throat irritation) are likely. Some people who are particularly susceptible to the substances released could be impacted.

Results for the scenarios below were derived through the use of the EPA's RMP*Comp modeling program. RMP*Comp allows the user to input release scenario and site conditions to model release scenarios including, allowing for a release in an enclosed space in direct contact with outside air, which reflects the chlorine and sulfur dioxide storage facilities utilized by the City.

### 1.3.1. Worst-Case Chlorine and Sulfur Dioxide Release Scenarios for Program 3 Processes

| Location ID | Scenario Description | Amount Released and Duration Released | Distance to End Point | | Comments on Modeling and Scenario Results |
|---|---|---|---|---|---|
| | | | Rural | Urban | |
| WWTP Program 3 | Worst-case release scenario for 2,000 lb Chlorine Container | 2,000 lb total release<br>200 lbs/min<br>10 minute duration | | | This scenario was modeled as a release over a 10-minute period from a enclosed space in direct contact with air. |
| WWTP Program 3 | Worst-case release scenario for 2,000 lb Sulfur Dioxide Container | 2,000 lb total release<br>200 lbs/min<br>10-minute duration | | | This scenario was modeled as a release over a 10-minute period from a enclosed space in direct contact with air. |

### 1.3.2. Alternative Chlorine and Sulfur Dioxide Release Scenarios for the Program 3 Process

| Location ID | Scenario Description | Amount Released and Duration Released | Distance to End Point | | Comments on Modeling and Scenario Results |
|---|---|---|---|---|---|
| | | | Rural | Urban | |
| WWTP | Alternative release scenario for 1 ton chlorine container with gas feed<br><br>Bad connection or valve failure resulting in the release of gas through a 5/16 inch diameter valve body opening. | 900 lb total release<br><br>Maximum Average sustained release rate=15 lbs/minute<br><br>60 minute duration | | | This scenario was modeled as a release from an enclosed space in direct contact with air from a horizontal cylindrical tank with the release occurring through a short pipe or valve in the top of the tank. The chlorine escapes only as a gas. |
| WWTP | Alternative release scenario for 1 ton Sulfur Dioxide container with gas feed<br><br>Bad connection, or valve failure resulting in the release of gas through a 5/16 inch diameter valve body opening | 420 lb total release<br><br>Maximum Average sustained release rate=7 lbs/minute<br><br>60 minute duration | | | This scenario was modeled as a release from an enclosed space in direct contact with air from a horizontal cylindrical tank with the release occurring through a short pipe or valve in the top of the tank. The chlorine escapes only as a gas. |

## 1.4. Mitigation Measures

On-site mitigation measures include; a wind sock at the facility; a Knox box for secure storage of facility keys and maps at the Corporation Yard entry gate, chlorine and sulfur dioxide leak detector

sensors and audible alarm systems, if not acknowledged within six minutes, then Arcata Police Department dispatch is autodialed and notified; secured and well constructed facilities and systems; proper ventilation and warning systems; valve and piping protection; short lengths of flexible gas tubing; automatic shut down at tank regulator valve (vacuum switch over valve) with vacuum loss; cylinders secured in place; trained operators, annual maintenance program; daily inspections; building alarms for entry and fire, and emergency response training and planning. The facility was constructed per code, and is maintained so that it is in good operating condition.

Off-site mitigation measures include; a wind sock the facility; conducting emergency response training exercises with the Arcata Fire Department (AFD), and the Eureka HazMat Response Team (Eureka Fire Department); completing and reviewing the Risk Management Plan; and educating the employees and emergency response team on emergency response procedures, which include public notification, evacuation procedures, and emergency first aid procedures.
If other mitigation measures are proposed, they will be scheduled for implementation (See PHA Report)

## 1.5. Accidental Release Prevention Program (See Appendix B):

The City of Arcata maintains technical documents (including Operations & Maintenance Manuals) that are used to help ensure safe operations of the WWTP processes. These documents address the physical properties of the hazardous substances handled at the facility, operating parameters of the systems, and equipment operating procedures for these processes. The City of Arcata ensures that this process safety information is available to all operators and maintenance personnel, and the emergency response team. Design documents include specific operating parameters, the design configuration of the equipment in each covered process, and the maintenance procedures. These documents are used to train employees, to perform process hazards analyses, and to help maintain the equipment. Process information is located inside the WWTP Operations Building.

Safety Data Sheets (SDS) document the physical properties of hazardous substances handled at the WWTP, including chlorine and sulfur dioxide gas (cylinders). The SDS are available at the WWTP Operations Building so that employees have ready reference to this information. In addition, SDS are provided to the emergency response team for use in developing emergency response planning. The City of Arcata's Chlorine/Sulfur Dioxide Emergency Response Plan and SDS are included in Appendix B.3

### 1.5.1. Process Hazard Analysis (See Appendix C):

The City of Arcata performs and periodically updates the Process Hazard Analyses (PHAs) of the covered processes, which should identify process hazards and generate recommendations that might improve the safe operation of the process. A team composed of personnel with engineering process operating experience, and a leader with process hazard analyses experience is assembled to analyze the hazards of the process. The City of Arcata primarily uses a "PHA Checklist" to perform the analysis. The PHA team will prepare a written report describing the results of the analysis, including a list of recommendations. Responsibility to resolve the recommendations is assigned to unit personnel and, when appropriate, changes to enhance the safety of the processes are implemented.

### 1.5.2. Operating Procedures (See Appendix D).

City of Arcata process engineers, operators, and supervisors work together to develop and maintain operating procedures to define how tasks related to process operations should be safely performed (See O & M Manuals). The operating procedures cover all phases of operations including initial startup, normal operations, normal shutdown, emergency shutdown, startup following a turnaround or emergency shutdown, and temporary operations. The operating procedures are used to train employees and serve as reference guides.

### 1.5.3. Training (See Appendix E).

The City of Arcata has a license and permits to operate the facilities, and ensures that training is provided for specific employees working with or around the chlorine and sulfur dioxide processes, so they can safely and effectively perform their assigned tasks. The training programs include; a state license exam for the operators; chemical safety training; process safety training that covers a general overview of the process, the properties, and the hazards of the substances in the processes; and a review the Risk Management Plan. The City of Arcata conducts training twice per year and training includes; the use of full face supplied air respirators, personal protective equipment (PPE); chlorine safety and use of cylinder repair kits; safe cylinder changing procedures; understanding SDS; keeping the work area clean and safe; and discussions on evacuation and emergency response procedures. The AFD conducts annual site visits so they are familiar with the facility and operations.

### 1.5.4. Mechanical Integrity (See Appendix F).

The City of Arcata maintains the mechanical integrity of process equipment to help prevent equipment failures that could endanger workers, the public, or the environment. The mechanical integrity program includes; an inspection program to help identify equipment deterioration and damage before the equipment fails, a quality assurance program to help insure that new replacement equipment meet design standards required for service in each process, and a training program to assist with safe operating procedures. The City of Arcata has a preventative maintenance program, and documents all maintenance activities and new replacements.

### 1.5.5. Pre-startup Review (Appendix G).

The City of Arcata performs a safety review of a new or modified process before the process is placed into service to help ensure that the process has been prepared to operate safely. This review includes; insuring that equipment replacements are in accordance with manufacturer's specifications; that adequate safety, operating, maintenance, and emergency procedures are in place; that employee training has been completed on the new equipment or process; and if required, a PHA will be performed for the new process or if an existing process has been modified. A pre-startup review checklist has been included in Appendix G, and will be completed, when required.

### 1.5.6. Management of Change (See Appendix H).

The City of Arcata management of change (MOC) program evaluates and approves all proposed changes to chemicals, equipment, and procedures for a covered process, to help ensure that the change does not negatively affect safe operations. Process changes that are determined to be a replacement in kind (e.g., replacing a valve with an identical valve) are allowed without implementing the full MOC program. All major changes must be confirmed through the management of change program to help ensure that inadvertent consequences of process changes are prevented, safety consequences of changes are addressed, affected process safety information and procedures are updated, and affected employees are notified of the changes.

### 1.5.7. Compliance Audit (Appendix I).

The City of Arcata performs a Compliance Audit (CA) for the covered processes, to be certain that the prevention program is effectively addressing the safety issues of the operations. The City assembles an audit team that includes personnel knowledgeable in the RMP rule, the facility, and the regulated processes. The CA team evaluates whether the prevention program satisfies the requirements of the RMP rule, and whether the prevention program is sufficient to help ensure safe operation of the processes. The results of the audit are documented, recommendations are addressed, and appropriate enhancements to the prevention program will be implemented (the most recent CA report is included in Appendix I).

### 1.5.8. Incident Investigation (Appendix J).

The City of Arcata will investigate all incidents that could reasonably have resulted in a serious injury to personnel, the public, or the environment so that similar accidents can be prevented. The City of Arcata provides training to employees to identify and report any incident requiring investigation. An investigation team will be assembled, and the investigation will be initiated within 48 hours of the incident. The results of the investigation will be documented, recommendations will be addressed, and appropriate process enhancements will be implemented.

### 1.5.9. Employee Participation (See Appendix K).

The City of Arcata has developed an employee participation program for the regulated processes to help ensure that the safety concerns of the workers are addressed. City of Arcata encourages active participation of personnel, with regard to the prevention program activities of the regulated processes. Specific employees that work with or around the chlorine and sulfur dioxide systems are consulted and informed about the RMP prevention program, including PHAs and operating procedures.

### 1.5.10. Hot Work Permits (Appendix L).

City of Arcata established a hot work permit program to control spark- or flame-producing activities that could result in fires or explosions in covered process areas at the WWTP facility. City of Arcata will use a hot work permit form to comply with OSHA requirements. Personnel who are to perform

hot work are required to fill out the Hot Work Permit Form. The supervisor will review the completed form before work can begin.

### 1.5.11. Contractors (See Appendix L).

The City of Arcata established a program to help ensure that contractor activities at the WWTP facility are performed in a safe manner. The City of Arcata hires contractors who can safely perform the desired job tasks, and explains to the contract supervisors the hazards of the process on which they and their employees will work, safe work practices, and emergency response procedures. City of Arcata WWTP facility operators inspect all contractor work activities when working near the chlorine and sulfur dioxide process areas.

## 1.6. Chemical-specific Prevention Steps

In addition to the required prevention program elements, the City of Arcata has implemented safety features specific to the regulated processes used at the WWTP. The following paragraphs describe some of these safety features.

Chlorine is supplied in DOT-approved cylinders, which are supplied by Sierra Chemical (800) 777-8965 (one-ton cylinders). Sierra Chemical provides chlorine safety training, which includes hands-on and classroom training. Training was provided in 1999, and another session is scheduled (prior to July 2001), for all City of Arcata process operators and specific Arcata Fire Department personnel, who may be working with or around chlorine and sulfur dioxide gas. Additionally, emergency response planning and training is ongoing (See Training, Appendix F).

Chemical Feed Services (707) 553-8030 and MISCO Service Advantage (503) 887-9664 had formerly been contracted by the City of Arcata to provide annual service and maintenance on all Wallace and Tiernan chlorine and sulfur dioxide equipment and systems. Telstar Instruments Inc. (925) 671-2888, is currently contracted to provide the annual service. The service includes inspections and the maintenance or repairs are completed and/or new equipment is installed, if found defective or worn. This preventative maintenance measure was last completed in December 2015. Additionally, spare parts are provided in case the maintenance crew needs to perform specific repairs. Borges & Mahoney Co., (707) 643-3300 can also assist with maintenance and training.

The City of Arcata has been handling chlorine for over 25 years and has never had a reportable release. On average there are (15) one-ton chlorine cylinders at the WWTP facility. Typically six (6) cylinders are on-line, and nine (9) cylinders are in storage. There are also six (6) sulfur dioxide containing cylinders, with (2) on-line and four (4) in storage. The WWTP facility and systems are fairly new (1985), and were constructed per code requirements.
At the WWTP, disinfection is accomplished through treated wastewater being induced with chlorine gas and detained in the chlorine contact basin. Following detention, sulfur dioxide is induced into the chlorinated wastewater for dechlorination, and the effluent is discharged to Outfall 001 (Humboldt Bay), or Outfall 002 (Arcata Marsh and Wildlife Sanctuary). The vacuum operated induction units contain sensors that provide notification upon high vacuum, low vacuum, and/or power failure status sensors, and are connected to an alarm system located at the operator's control panel, which is located within the WWTP Operations Building. There are also chlorine/sulfur dioxide leak detector sensors that alarm at the operator's panel. If these alarms are not acknowledged within six (6) minutes, Arcata

Police Dispatch is autodialed and notified. Police dispatch then contacts the operator(s) on-duty for response. The on-call operators are within 30-minute response time of the WWTP. As additional backup, there is an on-site automatic audible alarm that alerts employees and visitors to evacuate the premises. This alarm is also connected to the automated system. All alarms have uninterrupted power supplies (battery backup system). If the power is off for an extended period the portable emergency generator is put on-line.

The one-ton online containers at the WWTP are mounted onto a saddle support and chained in place. When transporting a one-ton cylinder from the storage location to the on-line cylinder storage area (using the monorail hoist system), only trained employees complete the container transfer process, and they adhere to strict guidelines.

Containers are used and stored inside, and the chlorine or sulfur dioxide gas is fed from the vacuum switchover valve (at the cylinder) through a short length of flexible tubing to the chlorinator or sulfonator, then piped to the chlorine contact basin, where it is absorbed into the process water. The length of piping containing chlorine gas is well protected and secured in place to minimize the likelihood of a release. If a release occurs downstream of the vacuum switchover valve (vacuum loss), the valve will close and only the quantity in the piping will be released.

The piping systems and supports appear to be up to the required standards, and pipe supports are securely mounted to solid structures. Flex connectors are used at locations where excessive movement can occur between the tank and the secured piping. The cylinders are located within areas that will secure them from large objects, which could fall and damage the cylinders or supply system. Equipment inspections are regularly conducted and recorded by operational staff.

In 1995, the City of Arcata investigated and evaluated disinfection alternatives to gas chlorination and dechlorination, and determined that the present method is the most viable for the current WWTP configuration. The City of Arcata has also completed an analysis of the chlorine and sulfur dioxide usage, and determined that the number of cylinders in use and storage are needed to ensure adequate disinfection, in case of unforeseen circumstances. The City of Arcata is in the planning stages of reconfiguring the WWTP and installing UV disinfection facilities. Once complete, the City will reduce the quantity of chlorine and sulfur dioxide in use and in storage but will maintain a supply to ensure adequate disinfection of wastewater in excess of 5.9 MGD.

## 1.7. Five-Year Accident History (See Section 5.0)

The City of Arcata has reported no accidents, personal injuries, or property damage in the last five years, with regard to a release of chlorine or sulfur dioxide gas. If an incident occurs, an investigation team will conduct an investigation, which will follow the incident investigation protocol. The team will suggest improvements to the process and, if appropriate, improvements will be made. Additionally, a report will be completed and will be kept on file.

## 1.8. Emergency Response Program (See Section 8.0)

The City of Arcata has established a written emergency response program to help safely respond to an accidental release of chlorine and sulfur dioxide gas. SHN, City of Arcata personnel, and the

emergency response team (Arcata Fire and Police Departments) conducted several meetings to upgrade the plan. The written chlorine emergency response plan complies with other federal contingency plan regulations (e.g., the OSHA regulations 29 CFR 191 0.39(a) (Emergency Response Plan is included in Appendix B).

The City of Arcata and the Arcata Fire Department maintains an emergency response team, which have received emergency response training. This emergency response team is trained to respond to inactive leak scenarios. The Eureka Fire Department maintains a hazardous materials response team, which has received emergency response training specific to dealing with hazardous materials. This emergency response team is training to respond to active leak scenarios. All affected City of Arcata personnel and emergency response personnel have been notified of the emergency response plan and procedures. Specific to chlorine and sulfur dioxide response, the City coordinated and participates in once per year response training drills with the emergency response teams and neighboring wastewater treatment facilities. Following training and review, operational and response procedures are revised when necessary.

## 1.9. Planned Changes to Improve Safety

The City of Arcata constantly strives to improve the safety of the regulated processes, through both the incident investigation program and a program soliciting safety suggestions from the workers and responders. Changes to improve process safety are planed or have been completed (See Chemical-specific Prevention Steps, Section 1.6).

The chlorine and sulfur dioxide process systems at the WWTP are inspected daily by the City of Arcata wastewater operators, and the preventative maintenance program ensures that the equipment and processes are operating in a safe and efficient manner.

Training is one of the most important safety measures, and the City of Arcata ensures that adequate training is provided to the process workers and the emergency response team.

# 2. REGISTRATION

## 2.1. Registration

The City of Arcata uses and stores chlorine gas and sulfur dioxide gas at the WWTP facility. See Figure 1, for the location of the WWTP and for the facility plans, see Figures 2 through 5.

## 2.2. Stationary Source Locations:

The Wastewater Treatment Plant (WWTP) is located at 601 F Street, in the City of Arcata, Humboldt County, California. The latitude and longitude at the WWTP is approximately 40 degrees, 51 minutes, 16 seconds north, and -124 degrees, 05 minutes, 54 seconds west.

The WWTP has on the average 15 one-ton chlorine cylinders, with typically 6 cylinders on-line and 9 cylinders in storage. There are also 6 one-ton sulfur dioxide cylinders, with 2 on-line and 4 cylinders in storage.

## 2.3. Stationary Source Dun and Bradstreet Number:

DUNS #004940821

## 2.4. Name and Dun and Bradstreet Number of the Corporate Parent Company:

Arcata, City of

## 2.5. Name, Telephone Number, and Mailing Address of the Operator:

City of Arcata, 736 F Street, Arcata, CA. 95521 - Telephone (707) 822-5953

## 2.6. Name and Title of the person responsible for Part 68 (RMP) implementation:

Karen Diemer, City Manager

Office: (707) 822-5953

## 2.7. Name, Title, Telephone Number, and 24-hour Emergency Contact Number:

Mark André, Director of Environmental Services (RMP Program Manager)
Office: (707) 822-8184
24 Hr. Number: (707) 845-5804 cell

Erik C. Lust, Deputy Director of Streets and Utilities
Office: (707) 825-2156
24 Hr. Number: (707) 845-5213 cell

## 2.8. CAS Number, Maximum Quantity, SIC code, and Program Level:

CAS Number: 7782-50-5 Chlorine gas, 7446-09-5 sulfur dioxide (anhydrous)

Maximum Quantity: WWTP – (15) one-ton chlorine cylinders, (6) on-line
WWTP – (6) one-ton sulfur dioxide cylinders, (2) on-line

SIC code: WWTP (4952)

Program Level: WWTP – program 3 (over 2,500 pounds)

## 2.9. US EPA Identifier:

The Wastewater Treatment Plant EPA Facility Identifier is 100000133535, and the EPA Systems Facility Identifier is CAL983601964.

## 2.10. Number of Full-time Employees at the Stationary Sources:

There are 32 persons on-site at the WWTP facility.

## 2.11. Is the Stationary Source Subject to OSHA PSM Standards?

Yes, the WWTP chlorine process is subject to this section (more than 1,500 pounds).

## 2.12. Is the Stationary Source Subject to Part 355 of Title 40 of CFR?

The WWTP is subject to the emergency response notification planning requirements as per this regulation.

## 2.13. Is the Stationary Source Subject to an Operating Permit Under Title V of CAA?

The WWTP is not subject to this Section.

## 2.14. Date of last Safety Inspection

On September 15, 2009 the Wastewater Treatment Facility chlorine area was inspected by Rus Brown of Northern California Safety Consortium. Mr. Brown is also Assistant Fire Chief for the Fortuna Volunteer Fire Department.

# 3. MANAGEMENT SYSTEM (APPENDIX H)

## 3.1. Qualified Management Personnel

Karen Diemer, City Manager
Office: (707) 822-5953

Mark André, Director of Environmental Services (RMP Program Manager)
Office: (707) 822-8184
24 Hr. Number: (707) 845-5804 cell

Erik C. Lust, Deputy Director of Streets and Utilities

Office: (707) 825-2156
24 Hr. Number: (707) 845-5213 cell

## 4. OFF-SITE CONSEQUENCE ANALYSIS

- **Worst Case Scenario** (Maps, Appendix A)

  WWTP: Chlorine gas, distance to the end point could be up to 2.2 miles
  WWTP: Sulfur dioxide gas, distance to endpoint could be up to 2.1 miles
- **Alternative Scenario** (Appendix A)

  WWTP: Chlorine gas, distance to the end point could be up to 0.2 miles
  WWTP: Sulfur dioxide gas, distance to endpoint could be up to 0.1 miles

**Chemical Name:**

Chlorine gas is always packaged as a liquefied gas under pressure in steel containers. The liquid is about one and one-half times as heavy as water (denser), and gas is about two and one-half times as heavy as air. It has an unmistakable, irritating, penetrating, and pungent odor. In its element form, chlorine is a greenish yellow gas that can be readily compressed into a clear, amber liquid.

Sulfur dioxide is a colorless gas with a characteristic pungent odor. It may be cooled and compressed to a colorless liquid. Sulfur dioxide is not flammable or explosive in either the gaseous or liquid state. Like chlorine, dry sulfur dioxide is not corrosive to ordinary metals, but in the presence of moisture is extremely corrosive.

**NFPA Ratings:** **Health (High), Fire and Reactivity (Insignificant)**

**ANALYSIS DETAILS**

| | |
|---|---|
| **Physical State:** | Liquid-gas chlorine and liquid-gas sulfur dioxide |
| **Basis of Results:** | (chlorine and sulfur dioxide release) Reference Tables and RMP*Comp modeling program |
| **Scenario:** | Toxic gas release and/or liquid to gas release |
| **Quantity Release (pounds):** | 2,000 pounds at the WWTP facility (Appendix A) |
| **Release Rate:** | 200 pounds per minute at WWTP (Appendix A) |
| **Release Duration:** | 10 minutes |
| **Meteorological Information:** | Wind Speed = 1.5 meters per second, Stability Class F |
| **Topography:** | Rural |
| **Distance to end point** | 2.2 miles chlorine gas at 0.0087 mg/L (WWTP)<br>2.1 miles sulfur dioxide (gas) at 0.0078 mg/L (WWTP) |
| **Public Receptors Within Impact Zone (Appendix A)** | Approximately 6,000 units, with 2.3 persons/unit = approximately 14,127 people<br>Public Recreational Areas (Arcata Marsh and Wildlife Sanctuary, downtown/Arcata Plaza, Arcata Community Park & Sports Complex, and several City parks)<br>Schools (Humboldt State University, Arcata High School, and several grade schools)<br>Major commercial, office, and industria1 areas, several churches<br>Waters of the State of California (Humboldt Bay) |
| **Passive Mitigation Measures** | Vented enclosures, secured areas, training programs, inspections, and preventative maintenance program. |
| **Active Mitigation Measures** | Sensors and alarms, emergency shutdown systems, ventilation system, and active emergency response training. |

## 5. FIVE YEAR ACCIDENT HISTORY

There have been no reported accidental releases resulting in death, injuries, and significant property damage, on- or off-site. Also, there have been no accidents causing off-site evacuation, sheltering in place, or environmental damage. If an accident occurs the following information will be recorded for each accident:

- Date, time, approximate duration of release
- Regulated substance release, and estimated quantity (in pounds)
- Type of release event and its source

- Weather conditions (if known)
- On- and off-site impacts
- Initiating and contributing factors
- Off-site responders notified
- Operational or process changes that resulted from event.
- A near miss occurred on 3/2/2015 during routine chlorine contact basin maintenance when the sulfur dioxide leak alarm system was triggered. An incident investigation was conducted to document the event and corrective actions. The investigation team concluded that a small release probably occurred when the vacuum stopped being applied to the tank shut off during routine shut down. The Incident Investigation Report is on file in the Environmental Compliance Office.

## 6. PROGRAM 3 PREVENTION PROGRAM

The City of Arcata has implemented the Cal ARP Program 3 Prevention Program for the WWTP facility and processes.

Process SIC and chemicals covered by this prevention program

SIC code for the WWTP facility 4952 (Sewage Treatment Facilities). The NAICS code for the WWTP is 22 132.

The WWTP facility contains fifteen (15) one-ton chlorine gas cylinders, which include six (6) on-line, and nine (9) cylinders in storage. Additionally, the WWTP facility contains six (6) one-ton sulfur dioxide gas cylinders, which include two (2) on-line, and four (4) cylinders in storage.

Date of most recent review or revision of safety information was conducted on 12/29/2015.

Date of most recent Process Hazard Analysis or update was conducted on April 12, 2011.

Date of latest review or revision of operating procedures was conducted on September 18, 2015.

Date of latest review and revision to the Emergency Response Plan was conducted on September 9, 2015.

Emergency Response Plan training occurred in September 4 and 9, 2014. The training was specifically on Corporation Yard evacuation, SCBA use, and Emergency Response. Other aspects of the emergency response plan are also trained on a regular schedule.

The most recent Risk Management Plan training procedure review or revision occurred April 30, 2012.

The most recent Risk Management Plan training occurred on December 29, 2015. The type of training was Hot Work Permits.

The most recent review or revision of maintenance procedures was conducted on September 8, 2015.The most recent equipment inspection was completed the day of this update. City of Arcata

water and wastewater operators conduct inspections of the cylinders, process areas, and critical equipment, on a daily basis.

The most recent external equipment inspection was completed by Telstar Instruments Inc. in December, 2015.

The most recent change that triggered Management of Change procedures occurred March 28, 2012.

The most recent update to the Management of Change program occurred on April 29, 2012 with an update of the Management of Change Form.

The most recent pre-startup review was conducted October 2005 when the new $SO_2$ vacuum shut-off units were placed in service.

The most recent compliance audit was completed on August 26, 2015.

The most recent update to the incident review process occurred on April 30, 2012.

The most recent incident investigation occurred on March 11, 2015 in response to a near-miss situation.

The most recent update to the employee participation program occurred on April 30, 2011.

The most recent review of the hot work permit policies occurred on December 28, 2015.

The most recent update to the contractor safety procedures occurred on February 23, 2006.

The most recent evaluation of contractor safety performance occurred on May 1, 1996.

The most recent review of external event analysis occurred on February 23, 2006.

## 7. EMERGENCY RESPONSE PROGRAM (APPENDIX B)

Mark André, Director of Environmental Services (RMP Program Manager)
City of Arcata, 736 F Street, Arcata, CA 95521
Office: (707) 822-8184
24 Hr. Number: (707) 845-5804 cell

Karen Diemer, City Manager
Office: (707) 822-5953

Erik C. Lust, Deputy Director of Streets and Utilities
Office: (707) 825-2156
24 Hr. Number: (707) 845-5213 cell

Arcata Police Department
Emergency 911 or (707) 822-2424
Non-Emergency (707) 822-2428

Arcata Fire Department
Emergency 911 or (707) 822-2424
Non-Emergency (707) 825-2000

City of Eureka Hazardous Materials Response Team (HMRT)
Emergency 911 or (707) 441-4044
Non-Emergency (707) 441-4000

The City of Arcata, Arcata Police and Fire Departments, and SHN conducted Emergency Response Team Meetings on May 4 and 23, 2000, to review and update the City's "Chlorine and Sulfur Dioxide Gas, Emergency Response Plan." On May 24, 2000, the City of Arcata conducted a public meeting to discuss the off-site consequence analysis and the emergency response plan, as it relates to the potential for an accidental release of chlorine or sulfur dioxide gas from the Wastewater Treatment Plant. Meeting notes were taken by the City of Arcata, and emergency response notifications and procedures were discussed. Other discussion items were training, personal protection equipment, chain of command, evacuation procedures, MSDS for chlorine and sulfur dioxide gas, chlorine sensors and 24 hour monitoring, and other safety features.

In December of 2000, The City of Arcata's Emergency Response Plan was formally adopted (Appendix B). This emergency response plan shall be maintained at the RMP Program Manager's office, the stationary source, at the City of Arcata's Fire and Police Departments office, and at the Eureka Hazardous Materials Response Teams office. All emergency numbers are listed with the Arcata Police Dispatch. On January 29, 2001, the Arcata Fire Department (AFD), and Eureka HazMat Response, Team (HMRT) conducted a site walk to inspect the facility and coordinate their response efforts.

This Emergency Response Plan complies with the following federal and state regulations:

- OSHA Regulations 29 CFR 1910.120, 1910.38(a), and 1910.134
- Code of Federal Regulations 40 CFR, 112, and part 355
- SARA Title 111
- NIOSH regulations 1979; ANSI %-I 17.1 (1 989)
- DOT regulations 49 CFR part 100- 1 180

## 7.1. Procedures for Informing the Emergency Response Agencies, and the Public

The WWTP vacuum operated chlorine and sulfur dioxide gas systems and equipment contain sensors that provide notification upon high vacuum, low vacuum, and/or power failure status sensors, and are connected to an alarm system located at the operator's control panel, which is located within the WWTP Operations Building. There are also chlorine/sulfur dioxide leak detector sensors that alarm at the operator's panel. If these alarms are not acknowledged within six (6) minutes, the Arcata Police

Dispatch is autodialed and notified. Police dispatch then calls operators on-duty for response. The on-call operators are within 30-minute response time of the facility. As additional backup, there is an on-site automatic audible alarm that alerts employees and visitors to evacuate the premises. This alarm is also connected to the automated system. All alarms have uninterrupted power supplies (UPS) installed.

In the event of a inactive leak or release, trained City responders will don SCBA suits prior to entering the staging area. SCBA suits are stored in the WWTP Operations Building and back-up suits are stored at a location 0.5 miles north of the facility. Prior to engaging in response activities, the Arcata Fire Department is notified for backup and a minimum of four employees must be present prior to entering the area. Two employees, wearing radios, will respond to the leak and two employees will stand-by to conduct monitoring and external communications with other emergency responder personnel. In the event of an active leak or release, the Arcata Fire Department and Eureka Hazmat Team will be called to respond to the event.

A windsock and spotlight, visible from a two mile radius is located on the primary digester top to provide a visible indicator of wind direction and intensity. The predominant wind direction flows out to the northwest towards Humboldt Bay and agricultural lands. The Humboldt Bay region typically experiences moderately cool, wet weather.

The emergency responders will conduct the emergency response/evacuation procedures as trained (See Emergency Response Plan, Appendix B). If anyone has been affected by the release, the responders will conduct the appropriate initial medical treatment, and direct another responder to call 911 (Mad River Hospital or Advanced Life), as required.

Shut off or remove any potential source of explosion, ignition, electrical shock, and/or any other process that may amplify the problem. Investigating the source will be completed only by properly trained and equipped personnel. The Arcata Fire Department (AFD) and selected City of Arcata employees have been trained in this type of hazardous materials response. The fire chief will be in command and will work with the City of Arcata's trained responders.

If the leak is minor, stop the leak (if possible) or slow down the release rate by using approved methods. If the leak is major and unsafe, follow the established emergency response procedures, monitor the area downwind, and conduct emergency response notifications and procedures until conditions are verified safe. Resume operations, only after an investigation has determined the cause of the problem, and the problem has been corrected. Then start up the system using the approved startup procedures (See Emergency Response Plan for minor and major release scenarios, Appendix B).

Emergency response drills and exercises are conducted twice annually, to insure that the chain of command is established, that all responders are properly trained, that the first response notification procedures are effective, that public notification procedures are in place and can be implemented in a timely manner, and that first aid procedures are in place and can be administered adequately.

## 7.2. Emergency Response Equipment

The City of Arcata and AFD are equipped with the listed Personnel Protection Equipment (PPE) necessary for responding to an inactive chlorine/sulfur dioxide gas release. Eureka Hazardous Materials Response Team is equipped with the listed PPE necessary for responding to an active chlorine/sulfur dioxide gas release. Emergency responders are trained in the use of a self-contained breathing apparatus, and in the use of repairing minor cylinder or piping leaks. City of Arcata has the necessary repair equipment for specific cylinder, valve, equipment, and piping leaks (See Emergency Response Plan, Appendix B).

## 7.3. Training

Specific City of Arcata (wastewater operators) and AFD personnel are trained in chlorine/sulfur dioxide gas safety, and the repair of chlorine/sulfur dioxide gas cylinders and systems. The City of Arcata and the AFD conducts additional training in the proper use of the appropriate Personal Protection Equipment (PPE), evacuation procedures, and their roles when responding (See Emergency Response Plan, Appendix B). Each training session will be documented and all those trained will be required to sign in.

## 7.4. Updates

The City of Arcata's policy is to conduct training at approximate 6-month intervals. All personnel who may be involved in handling, transporting, working with or responding to an emergency will be involved in a training session.

The Emergency Response Plan will be reviewed on an annual basis, and updated periodically, to address contact personnel changes, phone numbers, and changes in emergency response and evacuation procedures. This plan should be assessed and revised, if necessary, after drills and after the plan has been implemented in response to an incident. Any changes affecting employees and/or outside response groups should be communicated to those involved.

## 7.5. Chlorine Emergency Response Information, and Emergency Health Care

**Chlorine ($Cl_2$):**
Chlorine is an amber liquid or greenish-yellow gas with a characteristic, irritating odor. It is also a strong oxidizer and forms explosive mixtures with hydrogen (See SDS, Appendix B). Chlorine is classified by OSHA as a Class A poison and inhalation hazard, nonflammable gas. Its UN placard number is 1017. Chlorine gas carries an UN Hazard Division number 2.3 for Poison Gas. The DOT Emergency Response Guidebook guide number is 124. Chlorine gas gives off an irritating offensive odor at 0.3 ppm. Thus, it is unlikely that a person would remain in the presence of dangerous levels of chlorine unless unconscious or trapped.

**Sulfur Dioxide ($SO_2$):**
Sulfur Dioxide is a colorless gas with a characteristic pungent odor and is neither flammable nor explosive in its gaseous or liquid states (See SDS, Appendix B). OSHA classifies Sulfur Dioxide gas as a Class A poison and an inhalation hazard, nonflammable gas. Its UN placard number is 1079. Sulfur dioxide gas carries an UN Hazard Division number 2.3 for Poison Gas. The DOT Emergency Response Guidebook guide number is 125. Sulfur Dioxide gas gives off a sharp irritating odor of sulfur. No one will voluntarily remain in the presence of sulfur dioxide.

**Effects**

| **Chlorine Gas** | |
|---|---|
| 1000 ppm | Short Term Fatal |
| 30 ppm | IDLH- coughing, shortness of breath, chest pain, possible nausea and vomiting |
| 20 ppm | Very offensive, immediate coughing |
| 15 ppm | Throat irritation |
| 3 ppm | Short term exposure limit (offensive odor) |
| 1 ppm | OSHA ceiling (8 hour time weighted exposure) household bleach odor concentration |

| **Sulfur Dioxide Gas** | |
|---|---|
| 400-500 ppm | Life Threatening |
| 50-100 ppm | Considered dangerous |
| 5-10 ppm | Causes irritation of nose and throat |

**Symptoms:**

**$Cl_2$:** Burning of eyes, nose, mouth; lacrimation; rhinorreha, cough, choking; nausea; vomiting; substernal pain; headache; dizziness; syncope; pulmonary edema; pneumonia; hypoxemia; dermatitis.

**$SO_2$:** Irritation of eyes, nose, throat; rhinorreha, choking, cough; reflex bronchoconstriction; eyes, skin burns.

**First Aid:**

**Eye:** if chlorine or sulfur dioxide comes into contact with eyes, immediately wash the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention immediately. Contact lenses should not be worn when working with these chemical

**Skin:** if these chemicals come into contact with skin, immediately flush the contaminated skin with water. If the chemical penetrates the clothing, immediately remove the clothing and flush skin with water. Get prompt medical attention.

**Breath:** if a person breathes in large amounts of these chemicals, move the exposed person to fresh air at once. If breathing has stopped perform artificial respiration. Keep the affected person warm and at rest. Get immediate medical attention.

**Ingestion:** Unlikely due to physical state.

**Routes of Entry: inhalation, skin, and/or eye contact**

**Personal Protection:**

| | |
|---|---|
| Clothing: | Any possibility of skin contact ($SO_2$; prevent skin freezing) |
| Goggles: | Any possibility of skin contact |
| Wash: | Immediately upon contamination |
| Provide: | Eyewash, quick drench |
| Remove: | Immediately remove any non-impervious clothing that becomes contaminated |

**Respirator Selection (NIOSH):**

**Chlorine**

| | |
|---|---|
| 5 ppm | Chemical cartridge respirator with chemical cartridge or canister providing protection against chlorine, with eye protection (CCRFS) or supplied air (SA), or self contained breathing apparatus (SCBA) |
| 10 ppm | Powered air-purifying respirator with chemical cartridge or canister providing protection against chlorine (PAPRS) with eye protection, or CCRFS |
| 12.5 ppm | SA, continuous flow (CF) with eye protection (F), or PAPRS |
| 25 ppm | SCBA with full face piece (SCBA), or supplied air with eye protection (SAF), or air purifying respirator (gas mask) (front or back mounted or chin style canister), full face with chemical cartridge or canister providing protection against chlorine (GMFS) |
| 30 ppm | SA and pressure demand or other positive pressure (PD,PP) |

**Sulfur Dioxide (See the above descriptions for type of PPE required)**

| | |
|---|---|
| 5 ppm | SA/SCBA/CCRS; with eye protection |
| 12.5 ppm | SA; CF/PAPRS; with eye protection |
| 25 ppm | S AF/SCBA/CCRFS/GMFS |
| 30 ppm | SA and pressure demand or other positive pressure (PD,PP) |
| 100 ppm | SAF; PD,PP |

**Note:**

| | |
|---|---|
| **For emergency or planned entry in unknown concentration or IDLH:** | For emergency or planned entry in unknown concentration or IDLH (SCBA;PD,PP) any self contained breathing apparatus with full face piece operated in a pressure demand or other positive pressure mode; or (SAF; PD, PP;SCBA) any supplied air respirator with a full face piece operated in a pressure demand or other positive mode, in combination with an auxiliary self-contained breathing apparatus also operated in pressure demand or other positive pressure mode |
| **For escape:** | (GMFS) air purifying respirator (gas mask) (front or back mounted or chin style canister), full face with chemical cartridge or canister providing protection against chlorine, or (SCBA) any self-contained breathing apparatus with a full face piece |

If a release occurs and is serious enough so that emergency response procedures need to be implemented, a follow up investigation will be conducted by the City of Arcata (See Incident Investigation, Appendix J).

| **Physical Data** | **$Cl_2$** | **$SO_2$** |
|---|---|---|
| CAS# | 7782-50-5 | 7446-09-5 |
| DOT# | F02100000 | WS4550000 |
| UN placard #/Guide # | 1017 / 20 | 1079 / 16 |
| Exposure Limits | 0.5 ppm, 15 minute cell (1.5 $mg/m^3$) | 0.5 ppm (10 hour TWA) |
| IDLH | 30 ppm | 100 ppm |
| Molecular weight | 71 | 64 |
| Boiling point | -29 degree F | 14 degree F |
| Melting point | -150 degree F | -104 degree F |
| Vapor pressure | >1 atm | >1 atm |
| Solubility in water at $68^o$ F | 0.7% by weight | 10% by weight |
| Ionization potential | 11.48 eV | 12.3 eV |

## 8. CERTIFICATION PAGE

To the best of my knowledge, information, and belief formed after reasonable inquiry, the information submitted in this Risk Management Plan is true, accurate, and complete.

Name: Signature Print

The City of Arcata

Representing:

Director of Environmental Services and RMP Program Manager

Title:

Date:

## 9. LIST OF APPENDICES

- Appendix A Off-Site Consequence Analysis
- Appendix B Accidental Release Prevention Program
- Appendix C Process Hazard Analysis
- Appendix D Operating Procedures
- Appendix E Training
- Appendix F Mechanical Integrity
- Appendix G Prestartup Safety Review
- Appendix H Management System
- Appendix I Compliance Audit
- Appendix J Incident Investigation
- Appendix K Employee Participation Plan
- Appendix L Hot Work Permit (Contractor Safety, Confined Space, attached)

# ATTACHMENT 24

Carollo Engineers. 2019. *City of Arcata Final Predesign Report.*





City of Arcata

# Predesign Report

FINAL MAY 2019

carollo



City of Arcata
Wastewater Treatment Facilities Improvements

# Executive Summary
# PREDESIGN REPORT
# PHASED PROJECT

FINAL | May 2019

City of Arcata
Wastewater Treatment Facilities Improvements

# EXECUTIVE SUMMARY

# PREDESIGN REPORT

# PHASED PROJECT

FINAL | May 2019



# Contents

Executive Summary - PREDESIGN REPORT 1

1.1 Purpose 1

1.2 Background 1

1.3 Project Goals 1

1.4 Anticipated Improvements 2

1.5 Improvement Siting and Site Constraints 4

1.6 Proposed Process Flow Diagram 4

1.7 Construction and Project Costs Estimate 4

1.8 Implementation Plan and Schedule 15

1.9 Conclusion 16

## Tables

Table ES-1 Cost Estimate Breakdown by Phase and Project Needs 5

## Figures

Figure ES-1 Treatment Wetlands Site Plan 7

Figure ES-2 Enhancement Wetland Site Plan 9

Figure ES-3 Central Site Plan 11

Figure ES-4 Proposed Process Flow Diagram 13

Figure ES-5 Overall Schedule – Two Phase Project 15

## Appendices

Appendix A - TM 1 Basis of Design

Appendix B - TM 2 Flow Reconfiguration

Appendix C - TM 3 Headworks And Primary Clarifier Replacement

Appendix D - TM 4 Ponds and Wetlands Improvements

Appendix E - TM 5 Secondary Treatment and Associated Facilities

Appendix F - TM 6 Solids Handling and Digester Improvements

Appendix G - TM 7 Disinfection System

Appendix H - TM 8 Site Improvements

Appendix I - TM 9 Energy Efficiency, Electrical, and Control System

Appendix J - TM 10 Cost Estimate

Appendix K - TM 11 Implementation Plan

Appendix L - Original Executive Summary

Appendix M - Headworks Update

Appendix N - Disinfection Update

Appendix O - Cost Update by Phases

# Abbreviations

| | |
|---|---|
| AMWS | Arcata marsh wildlife sanctuary |
| AWTF | Arcata wastewater treatment facility |
| BOD | biological oxygen demand |
| Carollo | Engineers, Inc. |
| City | City of Arcata |
| NPDES | National Pollutant Discharge Elimination System |
| RWQCB | Regional Water Quality Control Board |
| SCADA | Supervisory control and data acquisition |
| TM | Technical Memorandum |

Executive Summary

# PREDESIGN REPORT

## 1.1 Purpose

The purpose of this Executive Summary is to outline the recommended improvements, new site plan and site constraints, and construction cost estimate for the City of Arcata (City) Wastewater Treatment Facilities Improvement project. The improvement project elements are detailed in a series of Technical Memorandums (TMs), briefly described below, and included as appendices in this Predesign Report.

## 1.2 Background

The City Wastewater Treatment Facility (WTF) currently discharges treated wastewater to Humboldt Bay in conjunction with enhanced treatment occurring in the Arcata Marsh Wildlife Sanctuary (AMWS). Discharges are regulated by the North Coast Regional Water Quality Control Board (RWQCB) through application of the National Pollutant Discharge Elimination System (NPDES) permit.

The AWTF operates under an NPDES permit issued in 2012 and updated in 2014, which includes requirements for disinfection, treatment processes, and outfalls. Due to compliance problems, the permit required that changes be made to improve wastewater treatment, protect beneficial uses, and reduce chemical usage. A new permit was due in 2017 and is currently expected to be issued in June 2019. It is anticipated that the new permit will introduce new lower limits for effluent ammonia. The permit will also include a Time Schedule Order compliance schedule, and revised requirements for the new ultraviolet light (UV) disinfection system.

## 1.3 Project Goals

The AWTF improvements will be sized to meet the community needs now and for growth envisioned by the City General Plan 2020. The facility design criteria are reviewed in TM No. 1. The City currently has under taken a separate program to reduce the peak wet weather flows and volumes that must be treated at the AWTF.

The overall project goal is to improve the AWTF infrastructure with the addition of a new secondary treatment system while preserving the natural treatment system of ponds and wetlands. The City has proposed to complete the project in two phases. Phase 1 will include improvements to optimize the existing oxidation ponds, improve the efficiency of the treatment wetlands and enhancement wetlands to meet the treatment requirements, and move the final discharge to the brackish marsh (Outfall Pt 003) location. The Phase 1 will also replace/update aged infrastructure within the plant and the new UV disinfection system will also be installed to eliminate the use of chlorine for disinfection. Phase 2 will include construction of a parallel secondary treatment system to meet the anticipated long-term treatment requirements. The second phase will also include upgrades and rehabilitation of the solids treatment and handling process. This two-phase project will replace, repair, or rehabilitate aging AWTF facilities to meet the community's current and future needs.

The project environmental goal is to improve water management by addressing existing and proposed NPDES requirements for wastewater treatment and by providing reliable hydraulic capacity and treatment capacity for wet weather flows.

The project will also prepare the AWTF for future infrastructure needs and will provide a resilient system that will address future concerns such as sea level rise. New facilities will be elevated above the projected flood and sea level rise elevations, and the project will be coordinate with the anticipated City project to raise the plant levees.

## 1.4 Anticipated Improvements

The phased project elements includes the anticipated improvements listed below.

Phase 1 – Flow Reconfiguration and Existing Plant Rehabilitation:

1. Flow reconfiguration to single pass system, to meet permit objectives is described in TM No. 2 and includes:
    - New outfall (Outfall 003) into brackish marsh.
    - Treatment Wetlands (TW) Pump Station rehabilitation.
    - Enhancement Wetlands (EW) Pump Station improvements and inlet structure replacement.
    - Piping modifications required for the flow reconfiguration.
2. Headworks rehabilitation/replacement and Primary Clarifier No. 2 rehabilitation to replace aging facilities and provide additional treatment capacity are described in TM No. 3 and Appendix M. The improvements include:
    - New Influent Pump Station utilizing screw type pumps.
    - New bar screens and screenings treatment
    - New grit removal system and grit handling system.
    - New influent flow metering.
    - Rehabilitate Primary Clarifier No. 2, including a new mechanism.
    - Plant water system modifications.
    - New primary sludge and scum pumping system.
3. Pond and treatment wetland improvements to provide increased treatment and hydraulic capacity are discussed in TM No. 4, and also addresses wet weather flows management. The improvements include:
    - Oxidation Pond No. 1 aeration system, up to 8 aerators. (Separate City project).
    - Oxidation Pond No. 1 transfer piping modification to allow for peak wet weather flow storage and attenuation.
    - Oxidation Pond No. 2 transfer structure improvements.
    - Oxidation Pond No. 2 aeration system, including the infrastructure for up to 24 new aerators, with installation of up to 16 aerators.
    - Oxidation Pond No. 2 baffle wall installation to reduce short circuiting. (Separate City project)
    - Installation of a new gravity transfer line from TW 5 and 6 (and future TW 7) and elimination of Pump Station No. 2.
    - Treatment Wetlands Nos. 1 to 4 regrading and revegetation. (Separate City projects).
    - Treatment Wetland No. 3 piping repairs.

- Electrical conduit for Blue Frog aerators in TW.
- Treatment Wetlands No. 7 construction. (Separate City project)
- New Treatment Wetland No. 4 pump station. (Separate City Project with electrical included in the Phase 1 project)
- Enhancement Wetlands vegetation management and excavation for the pump station improvements. (Other vegetation management will be part of a separate City Project)
- Enhancement wetlands bypass piping improvements utilizing existing infrastructure.
- Enhancement wetlands transfer structure improvement.
- Pump Station No. 1 and Pond Pump Station rehabilitation.
- Emergency Pond Pump Station maintenance improvements and interconnection to new transfer piping.

4. Disinfection system improvements to improve water quality and meet anticipated permit requirements are described in TM No. 7, and Appendix N. These include:
    - New 9.8 mgd effluent UV disinfection facility.
    - New UV and EW effluent flow meters.
5. Electrical, instrumentation and control facilities improvements described in TM No. 9 to address aging infrastructure, and designed for new Phase 1 facilities and to accommodate Phase 2 in the future buildout for a complete treatment plant facilities, and includes:
    - New plant utility service.
    - Electrical improvements including new switchgear, transformers, motor control centers and duct banks for power distribution.
    - Instrumentation improvements including new analyzers and field devices.
    - Expansion of the plant Wonder-ware SCADA system.
    - Ethernet network for plant, including hardwired facilities where possible.

Phase 2 – Secondary Treatment Additions and Solids Handling Improvements (Completed as a separate project):

1. New parallel/series secondary treatment to provide additional treatment capacity, to improve water quality and meet anticipated new permit requirements is described in TM No. 5. The proposed facilities include:
    - New oxidation ditch (design for one new and one future).
    - New secondary clarifiers (design for two new and one future).
    - RAS and WAS pumping facility.
    - Alkalinity addition facility to meet permit requirements for ammonia removal (if required).
2. Solids handling and treatment upgrades to replace aging facilities, provide additional treatment capacity is described in TM No. 6, and includes:
    - Thickener addition for waste primary and secondary sludge.
    - Digester rehabilitation and improvements.
    - Digester mixing and pumping improvements.
    - Digester heating boiler replacement.
3. Miscellaneous site improvements to address aging infrastructure, to add all the ancillary and support facilities required for a complete treatment plant, and to accommodate

corporation yard facilities impacted by new treatment plant facilities is described in TMs No. 8 and includes:

- Bus Barn, maintenance shop, and biosolids composting relocation (By City as necessary).
- Relocation and reuse of facilities for plant maintenance and parts storage facilities (By City as necessary).
- Demolish the existing chlorine contact basin and repurpose the chlorine building for storage and maintenance, depending on operation of the Phase 1 UV disinfection system (By City as necessary).
- Demolition of Primary Clarifier No. 1

4. Electrical, instrumentation and control facilities improvements described in TM No. 9 to address aging infrastructure, to accommodate Phase 2 project for a complete treatment plant facilities, and includes:
    - Electrical improvements including new motor control centers and duct banks for power distribution.
    - Instrumentation improvements including new analyzers and field devices.
    - Expansion of the plant Wonder-ware SCADA system.
    - Ethernet network for plant, including hardwired facilities where possible.

## 1.5 Improvement Siting and Site Constraints

The new treatment processes will be constructed within the existing plant site while maintaining operation of existing wastewater treatment processes. The overall site plan with the proposed location of the new facilities is presented in Figures ES-1, ES-2, and ES-3. It is assumed that the new influent pump station and headworks will be sited in the same location as the existing influent pump station and headworks.

The City will also maintain the City Corporation Yard in conjunction with the AWTF, at the treatment plant site. As noted, the corporation yard will need to be consolidated and several areas relocated to accommodate the new Phase 2 plant facilities.

## 1.6 Proposed Process Flow Diagram

The proposed process changes are outlined on the process flow diagram presented in Figure ES-4. The flow reconfiguration to discharge to the new brackish marsh outfall (003) and the new UV disinfection system are shown on the diagram. Flows up to 5.9 mgd will be pumped to the headworks for preliminary treatment and then split between the existing pond / wetland treatment and the new secondary treatment. Influent flows greater than 5.9 mgd will be sent directly to the ponds for equalization of the wet weather peaks using the existing storm and First Street pump stations. Secondary effluent flows up to 9.8 mgd will be combined and disinfected in the new UV disinfection system.

## 1.7 Construction and Project Costs Estimate

The estimated construction cost of the recommended improvements for Phase 1 is $23.3 M when escalated to the mid-point of construction of January 2021, and for Phase 2 is $24.5 M when escalated to the mid-point of construction of January 2023. A breakdown of the construction costs for the AWTF improvements is outlined in TM No. 10, with an update of the phased project costs included in Appendix O. The costs to meet the main project objectives are presented in Table ES-1.



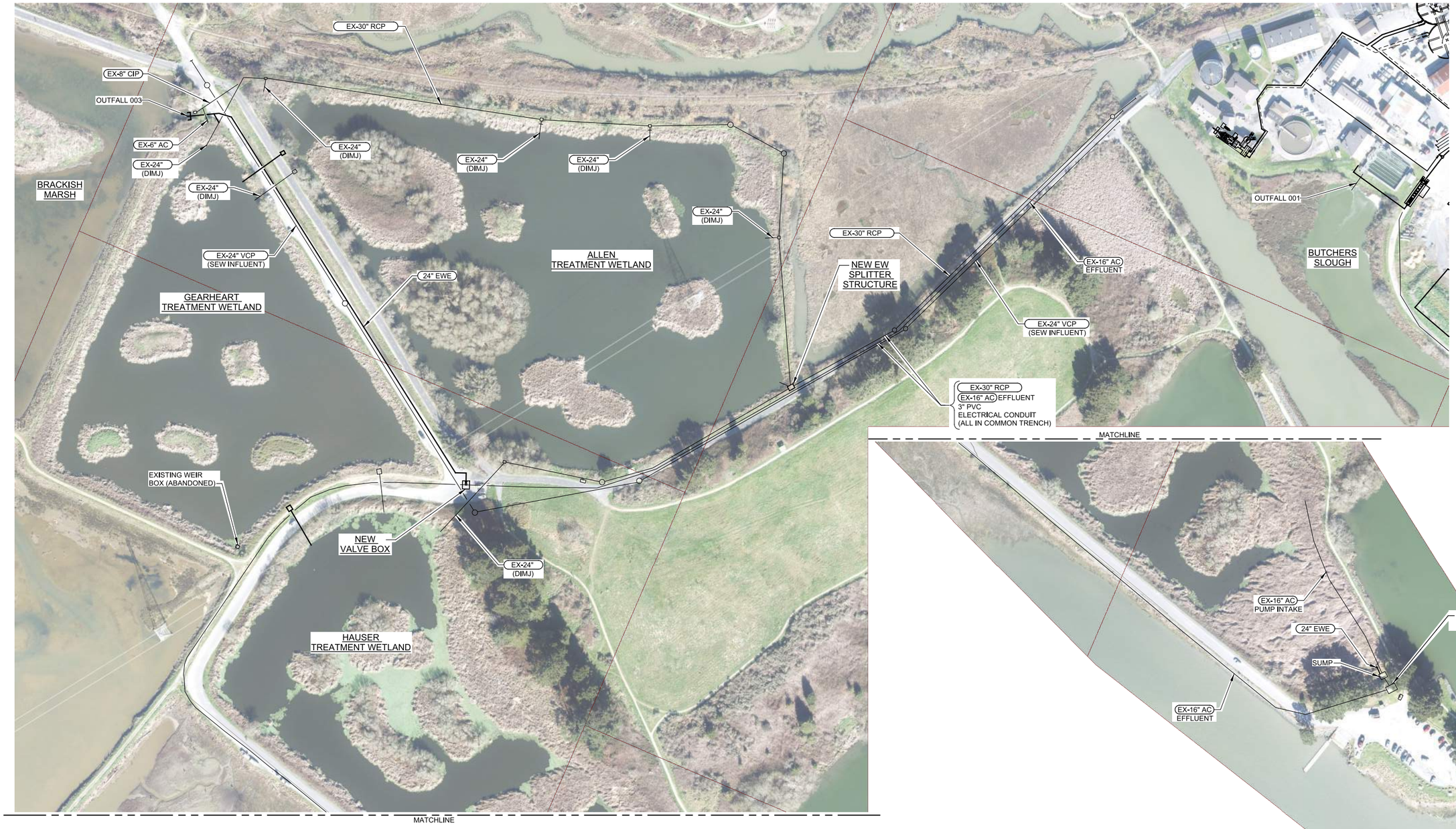

# TREATMENT WETLANDS SITE PLAN

FIGURE ES.1

CITY OF ARCATA
*WASTEWATER TREATMENT PLANT IMPROVEMENTS PROJECT*

carollo

arc0419rf2-9913.ai




LEGEND

EXISTING

NEW

FUTURE

0 50' 100' 200'

# ENHANCEMENT WETLANDS SITE PLAN

FIGURE ES.2

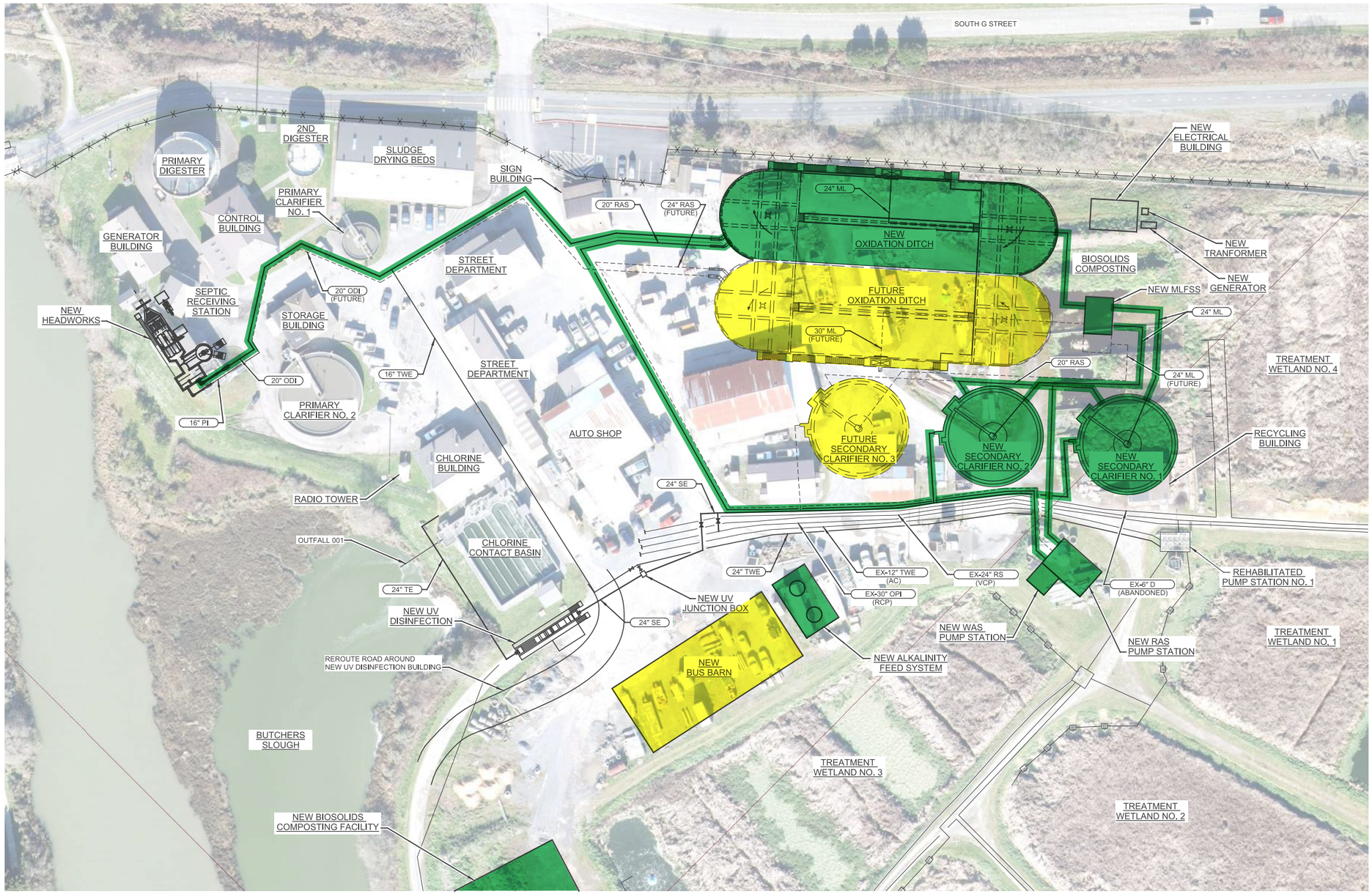
CITY OF ARCATA

*WASTEWATER TREATMENT PLANT IMPROVEMENTS PROJECT*

carollo

arc0419rf1-9913.ai

0 20' 40' 80'




LEGEND:

EXISTING

NEW

FUTURE

| LEGEND |
|---|
| Phase 2 |
| Future |

# CENTRAL SITE PLAN

FIGURE ES.3

CITY OF ARCATA

*WASTEWATER TREATMENT PLANT IMPROVEMENTS PROJECT*

carollo

arc0419rf3-9913.ai

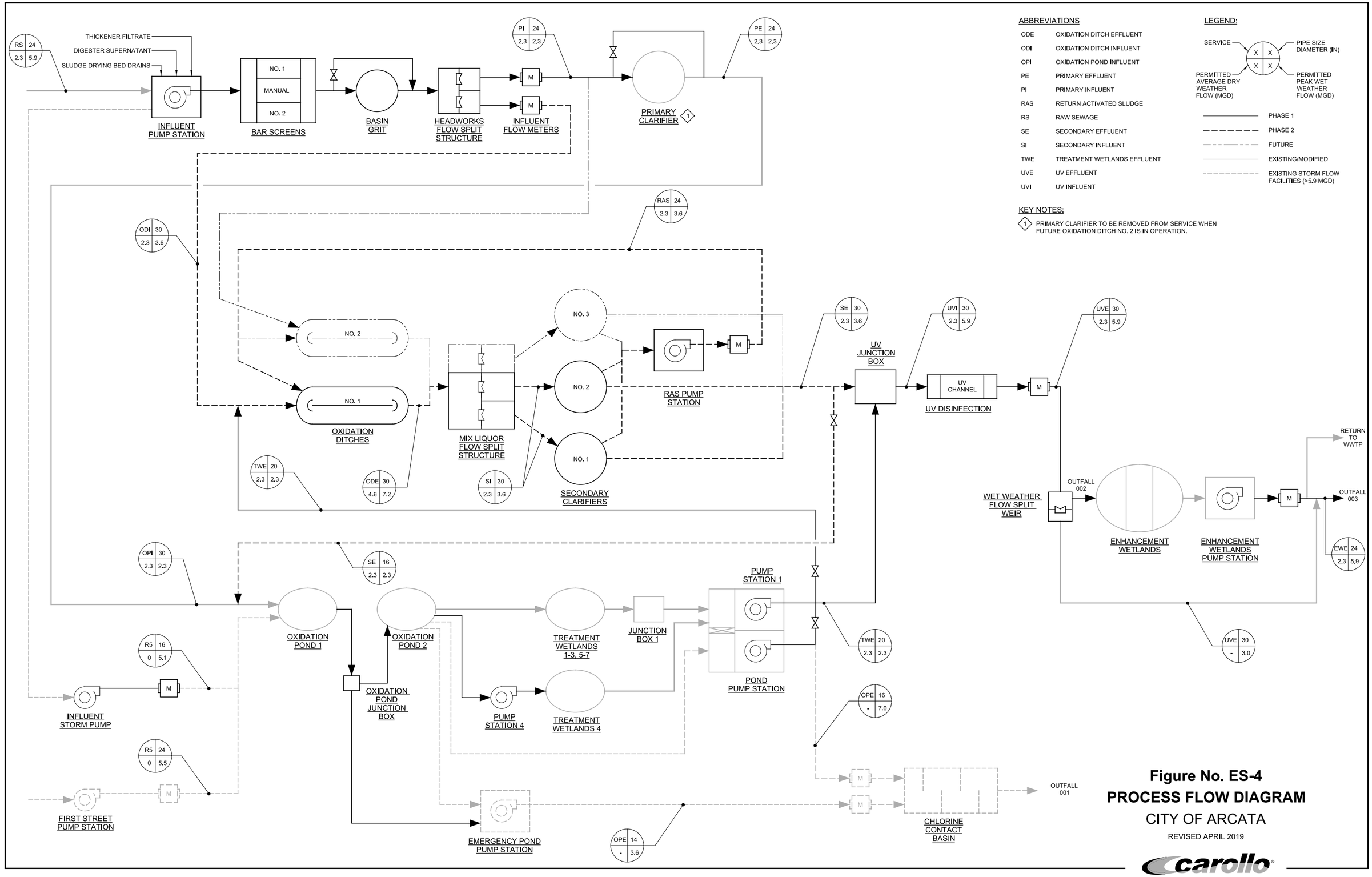



**Figure No. ES-4**
**PROCESS FLOW DIAGRAM**
CITY OF ARCATA
REVISED APRIL 2019

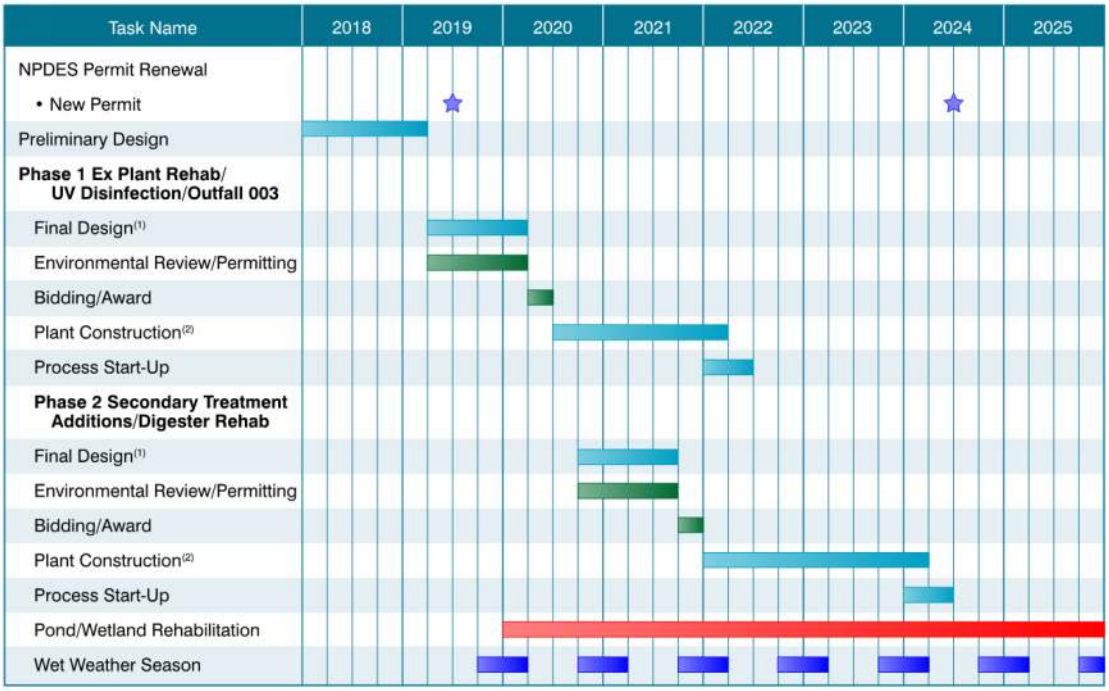
carollo

File: IP_PWP:d0794338l9913B10FIGES-4.dgn
Plot Date: 01-MAY-2019 9:10:38 AM
User: DFassbinder

Therefore the City should consider these factors when finalizing the construction cost estimate projection and the City project cost estimate used in budgeting for the project. The escalated construction cost estimate should be reviewed based on local experience and adjusted if needed to account for the current bid climate and construction cost inflation.

## 1.8 Implementation Plan and Schedule

The updated implementation schedule is outlined below in Figure ES-5. The plan has been revised based on a 2-phase construction project. The next step is to complete the Phase 1 engineering design required to develop documents to obtain construction bids. Parallel with the design activity, environmental review for CEQA compliance will be completed, and any required permits will be identified. Then the permits will be obtained for the improvements project. A financing plan including a rate study will also be developed parallel to the design activities to ensure the City can fund the project. The Phase 2 engineering design will start once the Phase 1 construction has started. The City has discussed the potential to complete the Phase 2 improvements using a design build approach. Alternative delivery methods require careful consideration as to the cost and schedule impacts and will require a consultant to develop the alternative delivery contract/bridging documents.




Notes:
(1) To be finalized after completion of the Preliminary Design.
(2) Construction schedule is preliminary, constraints to be determined in Final Design.

Figure ES-5 Overall Schedule – Two Phase Project

It is anticipated that construction documents for each phase could be prepared in about 12 months, and a project could then be bid and awarded in three or more months. The phased construction, shown in 2020 to early 2022 for Phase 1 and 2022 to early 2024 for Phase 2, includes two dry weather construction seasons for each phase. The startup would be two or three months for the mechanical portion of the plant. The startup for wetlands that might be

revegetated could take up to 12 to 18 months. In addition, it is anticipated that ongoing pond and wetland rehabilitation will continue into the future, on a regular schedule.

The City has indicated that several recommended elements of the AWTF improvements would be completed by the City as separate projects. These include:

- Oxidation Pond No. 1 aerator installation,
- Oxidation Pond No. 2 baffle wall,
- TW 7 construction,
- TW 4 construction including regrading, vegetation planting, and inlet pump station, except for the power supply for the new pump station,
- TW 1 and 4 vegetation management and grading/excavation,
- Enhancement wetlands vegetation management and excavation, except as required for pump station improvements.

These projects can be completed as maintenance projects and do not require the same level of permit review, design and construction support as the other elements.

## 1.9 Conclusion

In conclusion, it is anticipated that a combination of new plant facilities and plant rehabilitation improvements can be completed within the next five year NPDES permit cycle. The new permit, which is likely to be issued in June 2019, will set new discharge criteria, and will have a compliance schedule included for meeting water quality improvements. This preliminary design report outlines the facilities needed to comply with the anticipated new standards as well as lays out an implementation schedule that is achievable within the anticipated time schedule requirements of a five year permit window.

Appendix A

# TM 1 BASIS OF DESIGN



City of Arcata
Wastewater Treatment Facilities Improvements

# Technical Memorandum 1
# BASIS OF DESIGN

FINAL | APRIL 2019

City of Arcata

Wastewater Treatment Facilities Improvements

# TECHNICAL MEMORANDUM 1

# BASIS OF DESIGN

FINAL | APRIL 2019



# Contents

Technical Memorandum 1 1-1

Basis of Design 1-1

1.1 Purpose 1-1

1.2 Background 1-1

1.3 Project Goals 1-1

1.4 Design Influent Flows and Loads 1-2

1.4.1 Process Capacities 1-3

1.4.2 Pump Station Capacities 1-4

1.5 Anticipated Improvements 1-4

1.6 Improvement Siting and Site Constraints 1-5

1.7 Reliability Requirements 1-5

## Tables

Table 1.1 Plant Influent Flow and Loads 1-2

Table 1.2 Anticipated Discharge Permit Requirements 1-3

Table 1.3 Treatment Process Capacities 1-3

Table 1.4 Pump Station Capacities 1-4

## Figures

Figure 1.1 Existing Site Plan 1-6

Figure 1.2 Possible Impact of Climate Change 1-7

# Abbreviations

| | |
|---|---|
| AMWS | Arcata marsh wildlife sanctuary |
| AWTF | Arcata wastewater treatment facility |
| BOD | biological oxygen demand |
| Carollo | Carollo Engineers, Inc. |
| CIP | Capital Improvement Program |
| City | City of Arcata |
| MLFSS | mixed liquor flow split structure |
| NH3 | ammonia |
| NPDES | National Pollutant Discharge Elimination System |
| RWQCB | Regional Water Quality Control Board |
| SRT | solids residence time |
| TM | Technical Memorandum |
| TSS | total suspended solids |

Technical Memorandum 1

# BASIS OF DESIGN

## 1.1 Purpose

The purpose of this Technical Memorandum (TM) is to confirm the project goals, plant flow and loads, improvement siting and site constraints, and reliability requirements. In addition a regulatory kickoff workshop is proposed to review the new National Pollutant Discharge Elimination System (NPDES) requirements, compliance issues, and compliance schedule. The TM will document the Basis of Design from these meetings/workshops.

## 1.2 Background

The City of Arcata (City) Wastewater Treatment Facility (AWTF) currently discharges treated wastewater to Humboldt Bay in conjunction with enhanced treatment occurring in the Arcata Marsh Wildlife Sanctuary (AMWS). Discharges are regulated by the North Coast Regional Water Quality Control Board (RWQCB) through application of the NPDES permit.

The AWTF operates under a NPDES permit issued in 2012 and updated in 2014 which includes requirements for disinfection, treatment processes, and outfalls. Due to compliance problems, the permit required changes be made to improve wastewater treatment, protect beneficial uses, and reduce chemical usage. A new permit was due in 2017 and is expected to be issued in early 2019. It is anticipated that the new permit will introduce new limits for effluent ammonia.

A Facility Plan was prepared by LACO and Carollo Engineers in July 2017 which provided overall direction for the current permit compliance project as well as a future Capital Improvements Program (CIP) needed to maintain the treatment facility assets, repair, and rehabilitate existing assets, and modernize the facility to meet current levels of service. The findings from the facility are the basis for the information presented in this TM.

## 1.3 Project Goals

The project goals are based on addressing the ongoing NPDES permit violations and meeting the anticipated regulatory requirements by providing reliable hydraulic and treatment capacity for both wet and dry weather flows now and in the future.

This project will meet these goals by repairing or rehabilitating aging infrastructure and constructing a new influent pump station, headworks, oxidation ditches, secondary clarifiers, UV disinfection, and sludge thickening.

A community goal is to preserve the natural treatment system of ponds and wetlands. The objective is to optimize the existing oxidation ponds, treatment wetlands, and enhancement wetlands in conjunction with a parallel secondary treatment system to meet the treatment capacity requirements.

## 1.4 Design Influent Flows and Loads

The influent flows and loads used for the basis of design for the new and upgraded treatment processes are presented in Table 1.1. Current average dry weather flow is approximately 1.1 million gallons per day (mgd); however, permitted dry weather flow is 2.3 mgd. During wet weather, flows greater than 5.9 mgd will bypass the headworks and be pumped to the oxidation ponds. If necessary, the Emergency Pond Pump Station will pump to the chlorine contact basins for disinfection and discharge via Outfall 001.

Table 1.1 Plant Influent Flow and Loads

| | Current (mgd or lb/day) | Future (mgd or lb/day) | Permitted (mgd) |
|---|---|---|---|
| Minimum Flow | 0.3 (1) | 0.3 (1) | - |
| Average Dry Weather Flow | 1.1 (2) | 1.3 (3) | 2.3 (4) |
| Peak Dry Weather Flow | 1.8 (5) | 2.2 (6) | - |
| Maximum Month Flow | 3.0 (7) | 3.6 (8) | 5.0 (9) |
| Peak Wet Weather Flow | 5.9 (4) | 5.9 (4) | 5.9 (4) |
| Peak Instantaneous Flow | 16.5 (4) | 16.5 (4) | 16.5 (4) |
| BOD | 4,000 (10) | 4,800 (11) | See Table 1.2 |
| TSS (12) | 5,760 (10) | 6,910 (11) | See Table 1.2 |
| $NH_3$ | 880 (13) | 1,060 (14) | See Table 1.2 |
| TKN (15) | 1,330 | 1,610 | See Table 1.2 |

Notes:
(1) Based on City diurnal flow data from 7/23/17 through 7/30/17.
(2) 50th percentile flow during dry weather using City data from 2003 to 2015.
(3) Current Average Dry Weather Flow plus 20 percent growth.
(4) Existing permit capacity.
(5) Diurnal peaking factor of 1.6 multiplied by Average Dry Weather Flow. Peaking factor based on City diurnal flow data from 7/23/17 through 7/30/17.
(6) Current Peak Dry Weather Flow plus 20 percent growth.
(7) 92nd percentile flow using City data from 2003 to 2015.
(8) Current Maximum Month Flow plus 20 percent growth.
(9) Existing permitted Average Wet Weather Design Flow.
(10) 90th percentile load using City data from 2003 to 2015.
(11) 90th percentile load using City data from 2003 to 2015 plus 20% for growth.
(12) It is suspected that these values may be high.
(13) 90th percentile load using City data from 2013 to 2015.
(14) 90th percentile load using City data from 2013 to 2015 plus 20% for growth.
(15) Estimated based on $NH_3$ data.

The assumed discharge requirements are presented in Table 1.2. These values will be confirmed once the new permit is issued.

It is anticipated that dual or split compliance point locations will be used for permitting. One compliance point at Outfall 002 for disinfection compliance (fecal coliform), BOD, TSS, and pH, downstream of the UV discharge and before entering into the enhancement wetlands. The other compliance point at Outfall 003 for BOD, TSS, ammonia, pH, metals, etc., downstream of the enhancement wetlands.

Table 1.2 Anticipated Discharge Permit Requirements

| | Anticipated Permit Values | | |
|---|---|---|---|
| **Design Flows** | | | |
| Design Dry Weather Flow (Maximum Month Flow), mgd | | 2.3 | |
| Peak Wet Weather Flow, mgd | | 5.9 | |
| Instantons Peak Flow, mgd | | 16.5 | |
| **Effluent Limitations** | **Average Monthly** | **Average Weekly** | **Maximum Daily** |
| BOD, mg/L (4) | 30 | 45 | |
| BOD, lb/d (1) (4) | 575 | 863 | |
| TSS, mg/L (4) | 30 | 45 | |
| TSS, lb/d (1) (4) | 575 | 863 | |
| $NH_3$, mg/L (2) (4) | Varies | - | Varies |
| Fecal Coliform, MPN/100 mL (3) | 14 | - | 43 |
| Settleable Solids, mg/L (4) | 0.1 | - | 0.2 |
| Chlorine, Total Residual, mg/L (5) | 0.01 | - | 0.02 |
| pH | | 6.0-9.0 all times | |

Notes:
(1) Mass-based effluent limitations based on average dry weather design flow.
(2) Ammonia limits assumed based on correspondence with NCRWQCB. May be based on floating limit method. To be confirmed when new NPDES permit is issued.
(3) Limit at Outfall 002.
(4) Limit at Outfall 003.
(5) Interim limit for Outfall 001.

### 1.4.1 Process Capacities

The treatment capacities of the new and upgraded unit processes are presented in Table 1.3. The secondary treatment processes will be designed for a solids retention time (SRT) of 16 days and a mixed liquor suspended solids (MLSS) concentration of 1,800 mg/L at current average dry weather conditions.

Table 1.3 Treatment Process Capacities

| | Unit Process Treatment Capacity, mgd |
|---|---|
| Headworks - Bar Screens, Grit Removal, Flow Metering (New) | 5.9 |
| Primary Clarifier No. 2 (Rehabilitated) | 2.3 |
| Oxidation Ponds Nos. 1 and 2 (Upgraded) | 2.3 |
| Treatment Wetlands Nos. 1 through 6 (Existing) | 1.8 |
| Treatment Wetlands Nos. 7 (New) | 0.5 |
| Oxidation Ditch No. 1 (New) | 3.6 |
| Oxidation Ditch No. 1 and 2 (Future) (1) | 3.0, each |
| Secondary Clarifier No. 1 and 2 (New) | 1.8, each |
| Secondary Clarifier No. 1, 2, and 3 (Future) (1) | 2.0, each |
| UV Disinfection (New) | 5.9 |
| Enhancement Wetlands (Existing) | 5.9 |

Notes:
(1) Hydraulic capacities are revised for future flows and loads to account for the future unit needed and anticipated BOD and TSS loading.

### 1.4.2 Pump Station Capacities

The design pumping capacities for the existing, new, and upgraded pump stations are presented in Table 1.4. Total influent pumping capacity is proposed for the instantaneous peak wet weather flow of 16.5 mgd. Pump Station No. 2 will be removed from service as part of this project.

Table 1.4 Pump Station Capacities

| | Capacity, mgd | |
|---|---|---|
| | Duty | Standby |
| **Influent Pump Stations** | | |
| First Street Pump Station (Existing) | 5.5 | 5.5 |
| Influent Storm Pump Station (Existing) | 5.1 | 0 |
| Influent Pump Station (New) | 5.9 | 2.5 |
| **Process Pump Stations** | | |
| Pond Pump Station (Upgraded) | 7.0 | 3.5 |
| Pump Station No. 1 (Upgraded) | 2.3 | 1.2 |
| Emergency Pond Pump Station (Upgraded) | 7.2 | 0 |
| Enhancement Wetlands Pump Station (Upgraded) | 4.0 | 2.0 |

## 1.5 Anticipated Improvements

The project includes the anticipated improvements listed below.

Flow Reconfiguration to single pass, to meet permit objectives including:

- New outfall into brackish marsh.
- Treatment Wetlands Pump Station rehabilitation.
- Enhancement Wetlands Pump Station project.
- Piping for single pass flow schematic.

Headworks replacement and Primary Clarifier rehabilitation including:

- New Influent Pump Station.
- New bar screens and screenings treatment.
- New grit removal system and grit handling system.
- New influent flow meters.
- Rehabilitate Primary Clarifier No. 2.
- Demolish Primary Clarifier No. 1.
- New primary sludge and scum pumping system.

Pond and treatment wetland improvements to provide increased treatment and hydraulic capacity, while addressing wet weather flows including:

- Oxidation Pond No. 1 outlet piping and transfer structure modifications.
- Oxidation Pond No. 2 transfer structure improvements.
- Oxidation Pond No. 2 aeration system.
- Oxidation Pond No. 2 baffle wall.
- Treatment Wetlands Nos. 1 to 4 regrading and revegetation (City project).
- Treatment Wetlands No. 7 construction (City project).

- New Treatment Wetland No. 4 pump station (City project).
- Pond Pump Station rehabilitation.
- Emergency Pond Pump Station improvements.

New parallel/series secondary treatment to provide additional treatment capacity and to improve water quality and meet anticipated permit requirements including:

- New oxidation ditch (design for one new and one future).
- New secondary clarifiers (design for two new and one future).
- RAS and WAS pumping facility.

Disinfection system improvements to improve water quality and meet anticipated permit requirements including:

- New effluent UV disinfection facility.
- Chlorine system conversion to liquid chlorine system for peak wet weather flows.
- New effluent flow meters.

Solids handling and treatment upgrades to replace aging facilities, provide additional treatment scapacity, and potentially address plant energy use including:

- Thickener addition for primary and waste secondary sludge.
- Digester rehabilitation and improvements.

Miscellaneous site improvements to address aging infrastructure, to add all the ancillary and support facilities required for a complete treatment plant, and to accommodate corporation yard facilities impacted by new treatment plant facilities:

- Bus barn and biosolids composting relocation.
- Electrical and Instrumentation improvements.
- Plant water system modifications.

## 1.6 Improvement Siting and Site Constraints

The AWTF is constrained on the north and east side by the plant property boundaries and on the west and south side by treatment wetlands and Arcata Bay. Figure 1.1 shows a site plan of existing facilities as well as these constraints. Due to the facility's low elevation, sea level rise is also considered in improvement siting. Figure 1.2 shows the potential impacts of sea level rise.

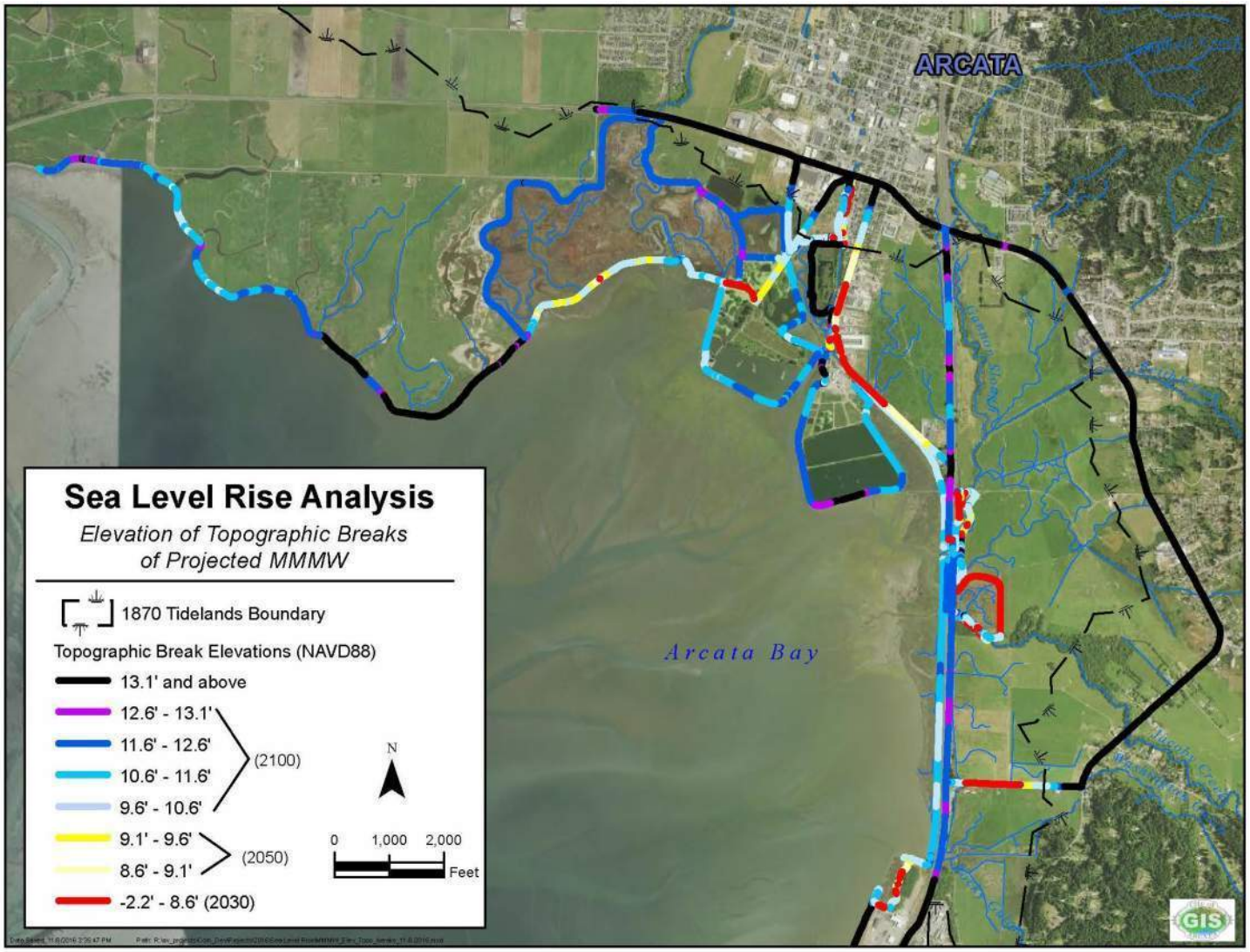
The new treatment processes will be constructed within the existing plant site while maintaining operation of existing treatment processes. New facility layouts are shown in TM No. 8, Site Improvements. It is assumed that the new influent pump station and headworks will be sited in the same location as the existing influent pump station and headworks.

## 1.7 Reliability Requirements

The treatment processes will be designed to meet BOD, TSS, ammonia, and disinfection NPDES discharge requirements for influent flows up to 5.9 mgd.




Figure 1.1 Existing Site Plan




Source: October 2017 City of Arcata Presentation "Economic Evaluation of Sea Level Rise Response

Figure 1.2 Possible Impact of Climate Change

Appendix B

# TM 2 FLOW RECONFIGURATION



City of Arcata
Wastewater Treatment Facilities Improvements

# Technical Memorandum 2
# FLOW RECONFIGURATION

FINAL | April 2019

City of Arcata
Wastewater Treatment Facilities Improvements

# TECHNICAL MEMORANDUM 2
# FLOW RECONFIGURATION

FINAL | April 2019



# Contents

Technical Memorandum 2 2-1

FLOW RECONFIGURATION 2-1

2.1 Purpose 2-1

2.2 Summary of Findings and Recommendations 2-1

2.3 Background 2-1

2.4 Flow Design Criteria 2-3

2.4.1 Diurnal Flow Variation 2-4

2.4.2 Sea Level Rise 2-4

2.4.3 Updated Process Flow Diagram 2-6

2.5 Flow Path Scenarios and Hydraulic Profiles 2-6

2.5.1 Flow Path Scenarios for Hydraulic Analysis 2-6

2.5.2 Future Flows 2-9

2.6 Recommended Improvements 2-9

2.6.1 Process Structures 2-9

2.6.2 Piping and Transfer Stations 2-15

# Tables

Table 2.1 Existing Water Surface Elevations 2-3

Table 2.2 Flow Design Criteria 2-4

Table 2.3 Current Sea Level Elevations for Humboldt Bay 2-6

Table 2.4 Sea Level Rise Projections for Humboldt Bay 2-6

Table 2.5 Proposed Weir Elevations and Lengths for Upgraded or New Facilities 2-15

Table 2.6 Design Criteria for New and Modified Piping to Accommodate Current Flows 2-16

Table 2.7 Design Criteria for New Piping to Accommodate Future Flows 2-16

Table 2.8 Preliminary Pump Sizing 2-17

# Figures

Figure 2.1 Existing Flow Schematic 2-2

Figure 2.2 Diurnal Flow Variation 2-5

Figure 2.3 Process Flow Diagram 2-7

Figure 2.4 Flow Path Scenarios 2-11

Figure 2.5 Hydraulic Profile 2-13

# Abbreviations

| | |
|---|---|
| BFE | base flood elevation |
| Carollo | Carollo Engineers, Inc. |
| CCB | chlorine contact basin |
| FSS | Flow Split Structure |
| Ft | feet |
| ft/s | feet per second |
| in | inches |
| MAMW | mean annual maximum water |
| MHW | mean high water |
| MHHW | mean higher high water |
| MLW | mean low water |
| MLLW | mean lower low water |
| MMMW | mean monthly maximum water |
| MSL | mean sea level |
| mgd | million gallons per day |
| PS | pump station |
| SLR | sea level rise |
| TM | technical memorandum |
| UV | Ultraviolet |
| WWTP | wastewater treatment plant |

Technical Memorandum 2

# FLOW RECONFIGURATION

## 2.1 Purpose

The purpose of this Technical Memorandum (TM) is to size the major hydraulic elements and to provide a preliminarily layout for new piping, meters, and flow control structures. These elements will include the piping to revise the dry weather and wet weather flow routing, incorporate the new ultra-violet (UV) disinfection system, and other new elements of the flow routing required to provide a single pass system for dry weather, and elements needed for recirculation and flow routing during wet weather flows. The pump station (PS) improvements will also be outlined in this TM. The size of required pumping elements for the flow reconfiguration, type of pumps (assumed to be submersible), pump size and arrangement, controls, screening configuration and size, and piping arrangement will be included.

## 2.2 Summary of Findings and Recommendations

The key findings and recommendations of this TM are summarized below:

- To create operational flexibility, three flow path scenarios were evaluated assuming current flows: 1) Oxidation Ponds / Treatment Wetlands First, 2) Oxidation Ditch and Secondary Clarifier First, and 3) Parallel Operations.
- To accommodate these three flow paths and future Sea Level Rise (SLR), the new headworks structure will need to be almost 6 feet higher than the current headworks structure.
- The new UV facility will be designed at a similar or slightly higher elevation than the current Chlorine Contact Tank.
- To accommodate this higher hydraulic capacity, additional weir boxes will be needed between enhancement wetlands, and weir elevations throughout the plant will need adjustment. One pipe segment will also need an increased diameter.
- To accommodate the desired operational flexibility, 13 new process pipes are needed. These pipes range in diameter from 16 to 30 inches.
- Three flow path scenarios were also evaluated for future flows. A) Gravity flow from UV to new Outfall 003 in existing pipeline, B) Gravity flow from UV to Outfall 003 in new pipeline, and C) Pumped flow from UV to Outfall 003 in existing pipeline. Of the three future flow path scenarios, only B and C would work hydraulically with the proposed system. For Scenario A, the headworks would need to be raised by an additional 3.5 feet.

## 2.3 Background

This section includes a brief summary of the existing flow configuration at the City of Arcata Wastewater Treatment Plant (WWTP). The flow configuration, as originally designed is shown in Figure 2.1. The City of Arcata WWTP was designed to treat a peak wet weather design flow of 5.9 mgd and a peak instantaneous flow of 16.5 mgd.

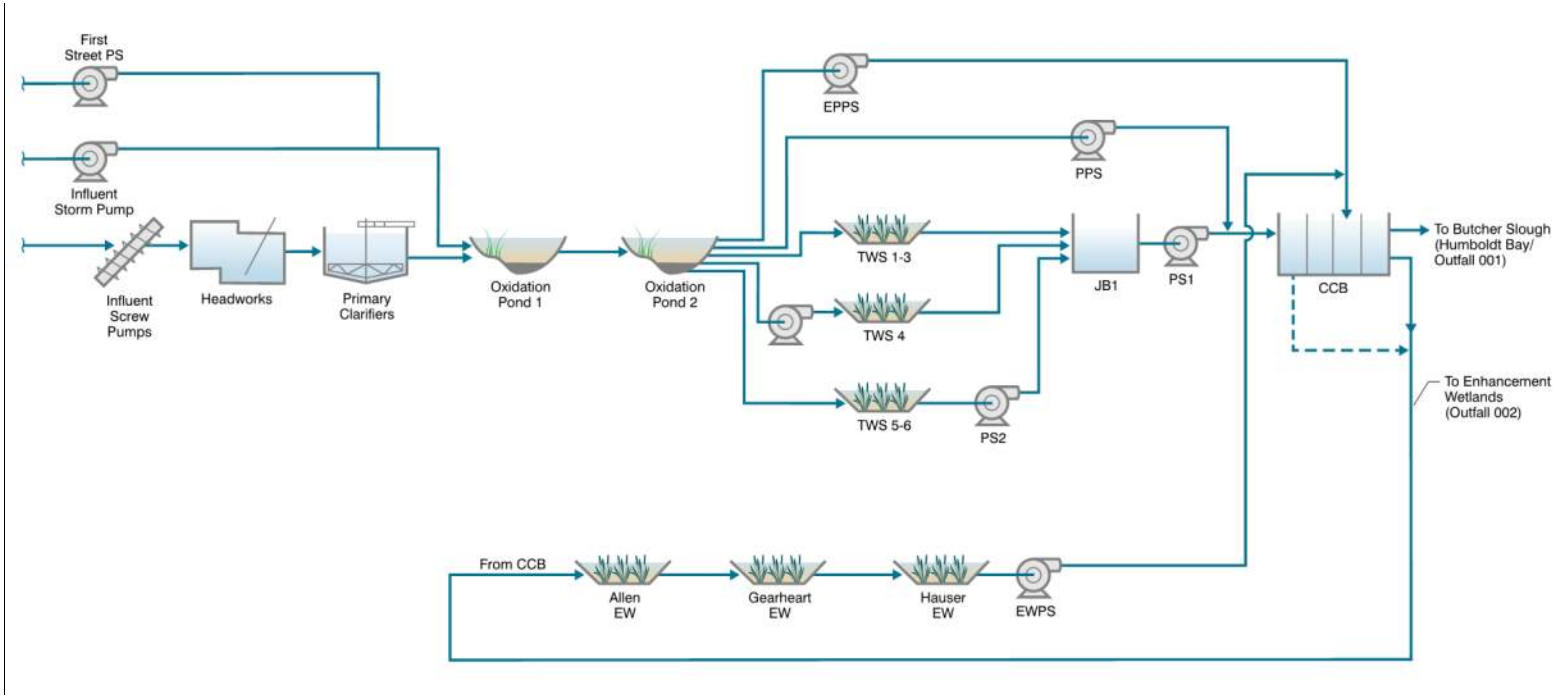



Figure 2.1 Existing Flow Schematic

Table 2.1 shows the water surface elevations through the existing system at the peak instantaneous flow rate. Note that the elevations have been converted from the elevations on the plans which are based on the NGVD 29 datum to the current NAVD 88 datum. The original elevations are converted by adding 3.35 feet to each elevation.

Table 2.1 Existing Water Surface Elevations

| Existing Facilities | Water Surface Elevation at Peak Flow (ft, NAVD 29) | Water Surface Elevation at Peak Flow (ft, NAVD 88) |
|---|---|---|
| Influent Screw Pumps Wet Well | 1.75 | 5.1 |
| Bar Screens | 15.07 | 18.42 |
| Parshall Flume | 14.99 | 18.34 |
| Grit Chamber | 13.87 | 17.22 |
| Headworks Flow Distribution Box | 13.29 | 16.64 |
| Primary Clarifier | 11.94 | 15.29 |
| Oxidation Ponds | 6.50 | 9.85 |
| Treatment Wetlands | 2.00 | 5.35 |
| Pump Station No. 1 (PS1) | 1.96 | 5.31 |
| Upstream Chlorine Contact Tank (CCT) Influent Weir | 10.02 | 13.37 |
| CCT | 8.88 | 12.23 |
| Downstream CCT Effluent Weir | 7.73 | 11.08 |
| Allen Marsh | 6.00 | 9.35 |
| Gearheart Marsh | 4.50 | 7.85 |
| Hauser Marsh | 3.50 | 6.85 |
| Wetlands Effluent Pump Station (WEPS) | -2.00 | 1.35 |

The plant hydraulics are based on a series of pump stations that pump to the ponds, from treatment wetlands to chlorine contact basin (CCB), and from enhancement wetlands back to the CCB. This allows the plant to have a fairly low hydraulic profile. The highest point is the influent bar screens and flume.

## 2.4 Flow Design Criteria

As discussed in TM 1, the flow design criteria used for the hydraulic analysis in this predesign report are shown in Table 2.2.

Table 2.2 Flow Design Criteria

| | Current Flow (mgd) | Future Flow (mgd)[1] |
|---|---|---|
| Minimum Flow | 0.3[2] | 0.3[3] |
| Average Dry Weather Flow | 1.1[4] | 1.3 |
| Peak Dry Weather Flow | 1.8[5] | 2.2 |
| Maximum Month Flow | 3.0[6] | 3.6 |
| Peak Wet Weather Flow | 5.9[7] | 5.9[7] |
| Peak Instantaneous Flow | 16.5[7] | 16.5[7] |

Notes:
(1) Future flows are based on 20 percent growth.
(2) Based on minimum minute flow recorded during 7 days in July 2017 (diurnal data received from City).
(3) As a conservative approach, it was assumed the minimum flow would not increase.
(4) Based on the 50th percentile flow during dry weather.
(5) Based on a peaking factor of 1.6. This peaking factor was calculated from the 2017 diurnal data received from the City.
(6) Based on the 91.7th percentile flow.
(7) Based on existing permitted capacity. Thus it was assumed this capacity would not increase in the future.

### 2.4.1 Diurnal Flow Variation

The diurnal, or change in flow over a 24-hour period, was reviewed for the Arcata WWTP, and is shown on Figure 2.2. The flow data was from July 2017, and represents the dry weather flow variation. The minimum daily, night time low flow is approximately 0.3 mgd, and the maximum daily day time flow is approximately 1.7 mgd. The average flow over this period was 1.0 mgd. The minimum flows need to be accounted for when sizing pumping facilities.

### 2.4.2 Sea Level Rise

Table 2.3 shows the current sea level elevations for Humboldt Bay. These elevations provide a good approximation for the water surface elevations at the new Outfall 003, located in the brackish marsh north of the enhancement wetlands. Of these sea level elevations, the highest is the Base Flood Elevation (BFE) which represents the anticipated flood water level elevation during a 100-year flood. For Humboldt Bay, the current BFE is 10.05 (NAVD 88). With sea level rise (SLR), it is anticipated that all current elevations shown in Table 2.3 will increase by 1.1 feet in 2050. SLR projections are shown in Table 2.4.

Given the City of Arcata WWTP's proximity to the bay and its low elevation, the impact of SLR was included in the evaluation of the discharge to the new Outfall 003. The design discharge elevation will be impacted by SLR and flood tide elevations. Thus the flow reconfiguration and hydraulic analysis discussed in this TM assumed the water level at the new Outfall 003 would be 11.2 (NAVD 88) to account for both the 100-year flood and the projected SLR by 2050.

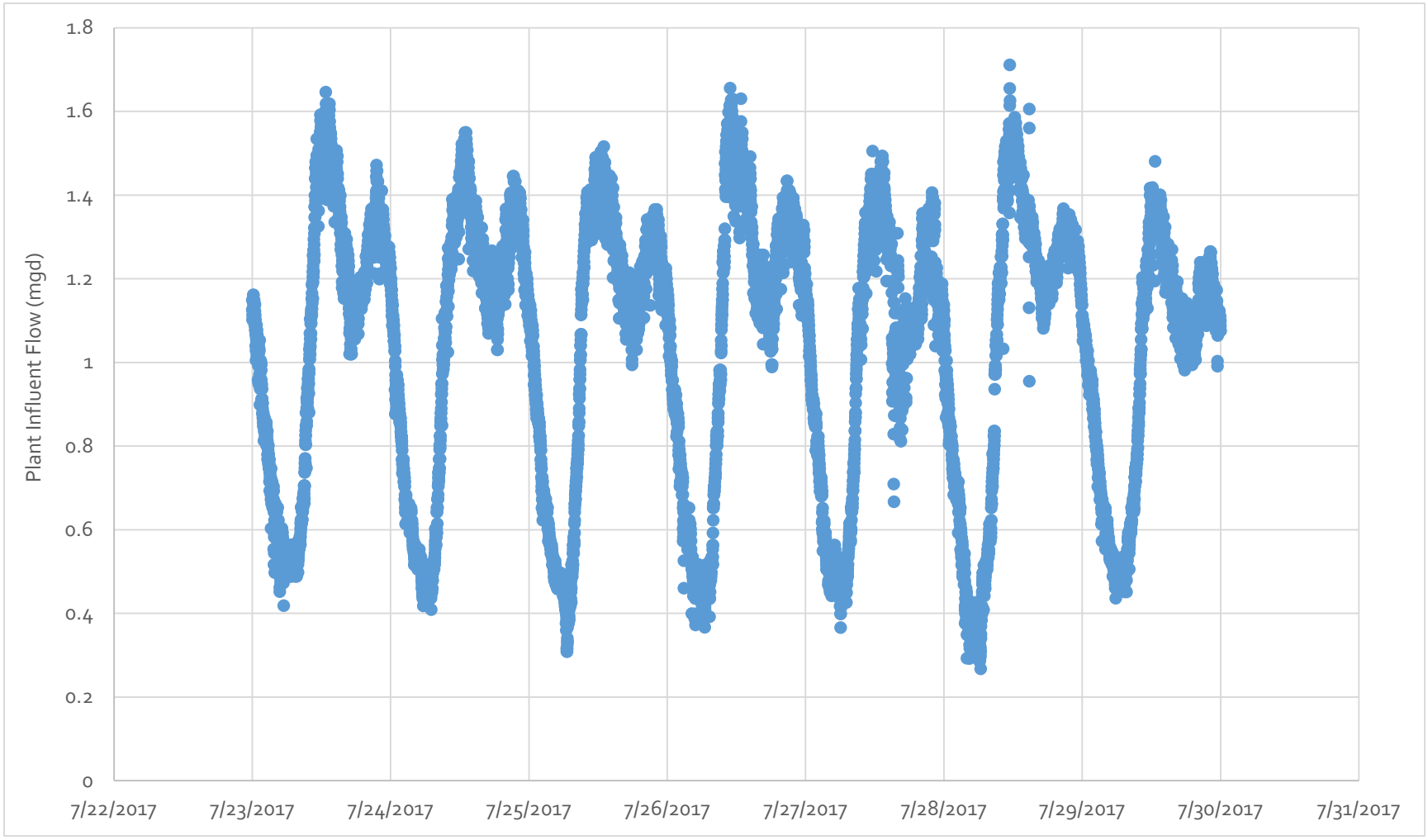



Figure 2.2 Diurnal Flow Variation

Table 2.3 Current Sea Level Elevations for Humboldt Bay

| Tidal Datum | Elevation for North Spit Tide Gage (feet, NAVD 88) |
|---|---|
| Base Flood Elevation (BFE) | 10.05 |
| Mean Annual Maximum Water (MAMW) | 8.78 |
| Mean Monthly Maximum Water (MMMW) | 7.74 |
| Mean Higher High Water (MHHW) | 6.85 |
| Mean High Water (MHW) | 5.80 |
| Mean Sea Level (MSL) | 3.70 |
| Mean Low Water (MLW) | 1.25 |
| Mean Lower Low Water (MLLW) | 0.00 |

Source: Humboldt Bay Sea Level Rise Adaptation Planning Project: Phase 2 Report, February 2015.

Table 2.4 Sea Level Rise Projections for Humboldt Bay

| Year | Low Estimate (ft) | Projected (ft) | High Estimate (ft) |
|---|---|---|---|
| 2030 | 0.4 | 0.6 | 0.9 |
| 2050 | 0.7 | 1.1 | 1.9 |
| 2100 | 2.0 | 3.2 | 5.3 |

Source: Humboldt Bay Sea Level Rise Adaptation Planning Project: Phase 2 Report, February 2015.

### 2.4.3 Updated Process Flow Diagram

The updated flow schematic is shown in Figure 2.3. This schematic is designed to provide for maximum flexibility regarding flow routing.

## 2.5 Flow Path Scenarios and Hydraulic Profiles

With the proposed flow schematic and hydraulic capacities, seven flow path scenarios were considered. These flow path scenarios are shown in Figure 2.4. From a hydraulic standpoint, a hydraulic profile was developed for a subset of these seven scenarios. The flow paths evaluated included:

### 2.5.1 Flow Path Scenarios for Hydraulic Analysis

- Dry Weather (Oxidation Ditch First) assuming 2.3 mgd through one oxidation ditch, two secondary clarifiers, and oxidation ponds.
- Dry Weather (Oxidation Pond First) assuming 2.3 mgd through oxidation ponds, one oxidation ditch, and two secondary clarifiers.
- Peak Wet Weather assuming 5.9 mgd total with 2.3 mgd through the oxidation ponds and treatment wetlands (their design capacity) and the remaining 3.6 mgd through one oxidation ditch and two secondary clarifiers.

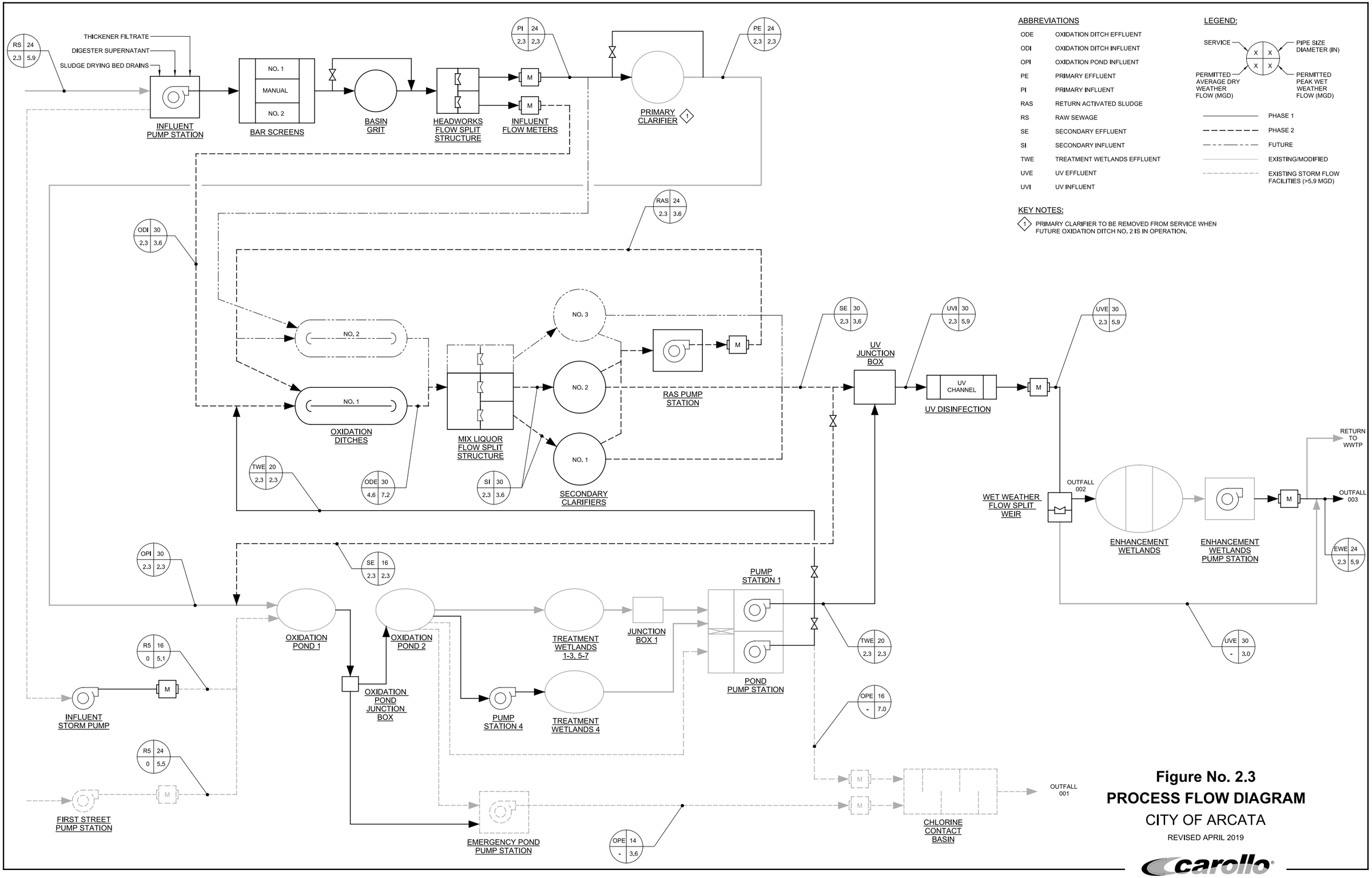



**Figure No. 2.3**
**PROCESS FLOW DIAGRAM**
CITY OF ARCATA
REVISED APRIL 2019

carollo

File: IP_PWP:d0794338l9913B10FIG2.3.dgn
Plot Date: 24-APR-2019 9:31:42 AM
User: DFassbinder

### 2.5.2 Future Flows

In the future with SLR, it is assumed that the plant flow path is revised to address the loss of the pond and wetland system for treatment. In these scenarios, it is assumed that additional an additional conventional units are added to accommodate the peak wet weather flow. The future flow path scenarios that were evaluated include:

- Future (UV First) assuming 5.9 mgd through two oxidation ditches and three secondary clarifiers. Three variations of this alternative were considered:
  - Gravity flow from the UV structure through the existing pipeline to Outfall 003.
  - Gravity flow from the UV structure through a new pipeline to Outfall 003.
  - Pumped flow from the UV structure through the existing repurposed 30 inch pipeline to Outfall 003.

Of the scenarios modeled, Scenarios 1, 2, and 3 model possible flow paths given current flows. Of these three scenarios, Scenario 3 (Peak Wet Weather) sets the required elevation for the new facilities (Headworks, Oxidation Ditch, Secondary Clarifiers, and UV Facility). The hydraulic profile for Scenario 3 is shown in Figure 2.5. This profile raises the headworks by almost 4.5 feet from its current elevation.

Of the future flow path scenarios modeled, Scenarios 4a, 4b, and 4c model four possible ways to operate the plant. It was found that Scenario 4b or Scenario 4c could operate hydraulically given the elevation set by Scenario 3 (Peak Wet Weather). However Scenario 4a would raise the hydraulic grade line through the plant.

It is recommended that the City more forward with the elevations set by Scenarios 1, 2, 3, and either 4b or 4c to avoid the additional cost of raising the hydraulic grade line through the plant. The conclusions of this TM reflect the hydraulic profile shown in Figure 2.5.

## 2.6 Recommended Improvements

This section summarizes the recommended hydraulic improvements to allow for the flow path scenarios shown above in Figure 2.4.

### 2.6.1 Process Structures

The required weir elevations and assumed weir lengths are shown in Table 2.5. These elevations and lengths are based on the Peak Wet Weather hydraulic profile.

As shown in the table, additional weir length is needed at the outlet of Allen and Gearheart Marshes to allow for 5.9 mgd of flow. Additionally, the weir elevations for the Oxidation Pond No. 1 and 2, Allen Marsh, Gearheart Marsh, and Hauser Marsh outlet boxes will need to be adjusted to the elevations shown for high flow scenarios.

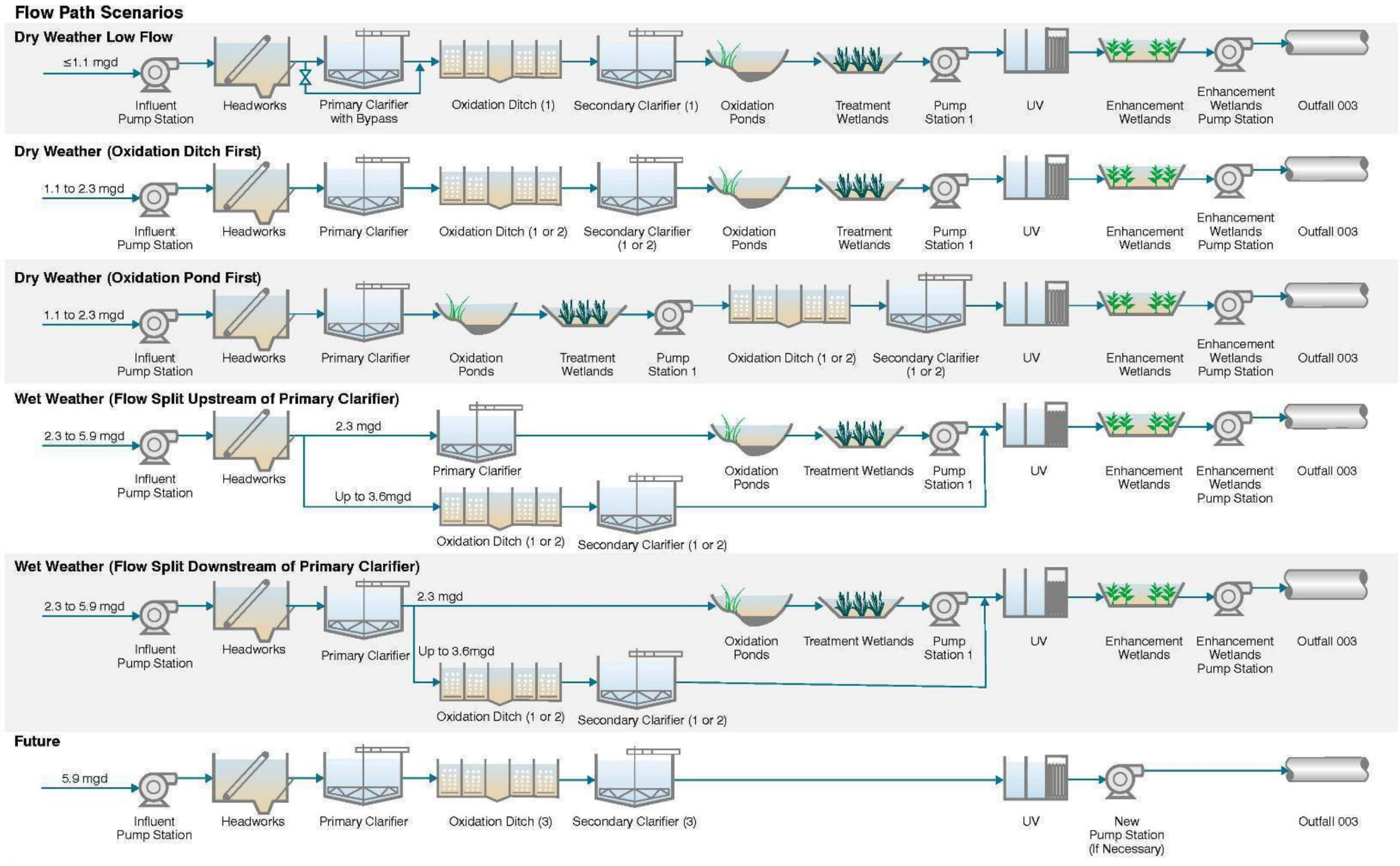
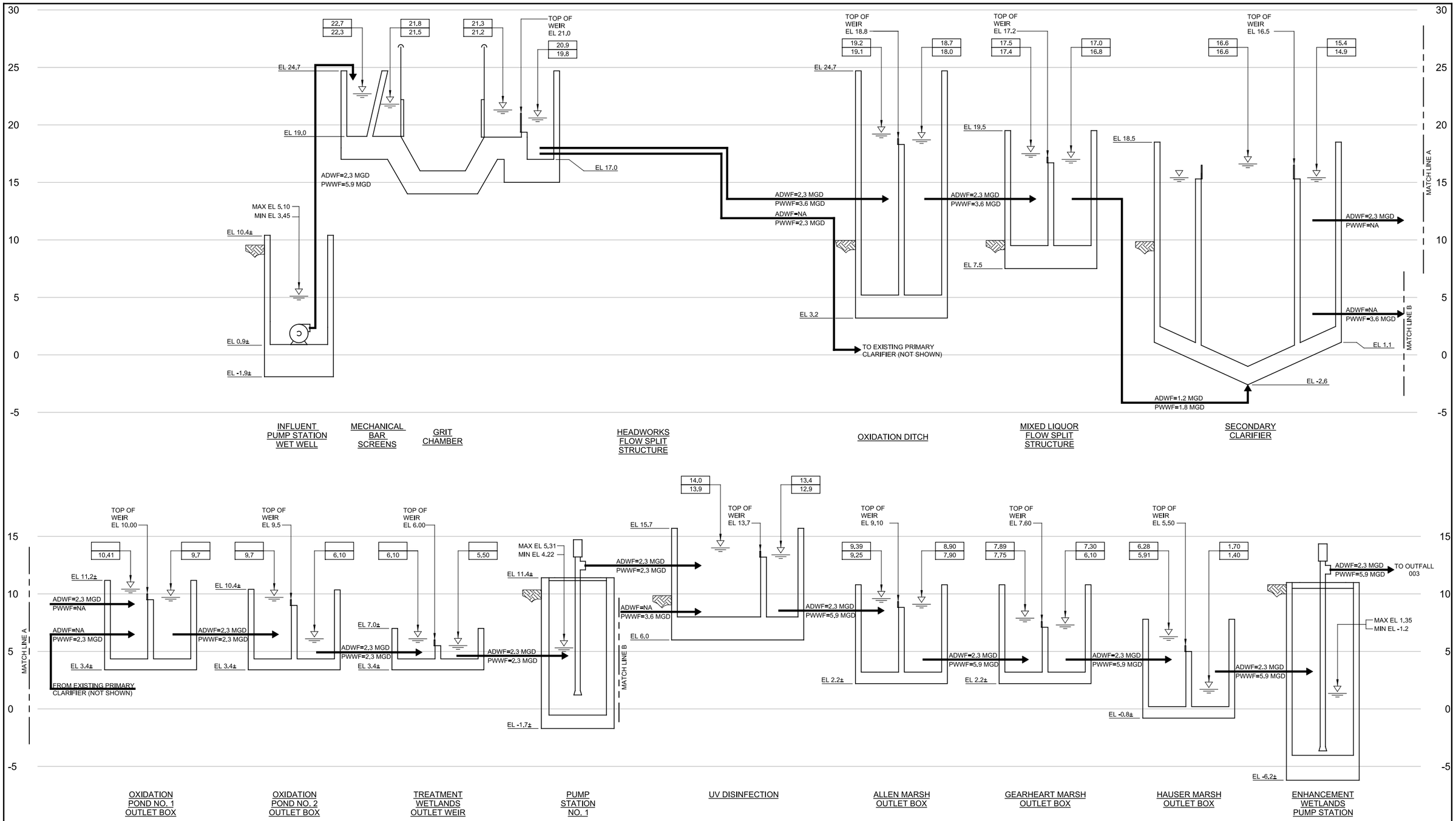



Figure 2.4 Flow Path Scenarios

File: IP_PWP:d0794338\9913B10FIG2.5.dgn
Plot Date: 08-AUG-2018 2:20:36 PM
User: gleal




LEGEND

A / B — WATER SURFACE ELEVATION AT PERMITTED PEAK WET WEATHER FLOW (PWWF)
WATER SURFACE ELEVATION AT PERMITTED AVERAGE DRY WEATHER FLOW (ADWF)

GENERAL NOTES:

1. THE EXISTING GROUND ELEVATIONS ARE APPROXIMATE.
2. THE PIPING ROUTING IS SHOWN SCHEMATICALLY. THE ELEVATIONS OF PIPES ARE NOT SHOWN TO SCALE.
3. ALL ELEVATIONS ARE BASED ON NAVD 88=NAVD 29 + 3.35

**Figure No. 2.5**
**HYDRAULIC PROFILE**
CITY OF ARCATA

carollo

Table 2.5 Proposed Weir Elevations and Lengths for Upgraded or New Facilities

| Weir | Elevation (ft, NAVD 88) | Number of Weirs | Total Length (ft) |
|---|---|---|---|
| Headworks Flow Split Structure (FSS) Weir | 21.0 | 1 New | 12 |
| Oxidation Ditch Weir | 18.8 | 1 New per Oxidation Ditch | 12 |
| Mixed Liquor FSS Weir | 17.2 | 1 New per Oxidation Ditch | 12 |
| Secondary Clarifier Weir | 16.5 | 1 New per Secondary Clarifier | 235(1) |
| Oxidation Pond No. 1 Outlet Box Weir | 10.0(2) | 1 Existing | 4 |
| Oxidation Pond No. 2 Outlet Box Weir | 9.5(3) | 1 Existing | 2.5 |
| Treatment Wetlands Outlet Box Weir | 6.0(4) | 3 to 4 Existing per TW | 2.5(4) |
| UV System Finger Weir | 13.7 | 2 New | 46(5) |
| Allen Marsh Outlet Box Weir | 9.1(6) | 1 New + 1 Existing | 18(7) |
| Gearhart Marsh Inlet Box Weir | 7.6(8) | 1 New + 1 Existing | 18(7) |
| Hauser Marsh Inlet Box Weir | 5.5(9) | 1 Existing | 4 |

Notes:
(1) Length based on a 75 foot secondary clarifier
(2) Existing weir is adjustable from 4.35 feet to 10.02 feet. Elevation set so Oxidation Pond 1 has a water surface elevation (WSE) of 10.41 at 2.3 mgd.
(3) Existing weir is adjustable from 7.85 feet to 10.35 feet. Elevation set so Oxidation Pond 2 has a WSE of 9.67 at 2.3 mgd.
(4) Existing weirs are set at an unknown elevation and have an unknown width. A width of 2.5 feet was assumed.
(5) Length based four finger weirs, each 11 foot long and 1 foot wide.
(6) Existing weir is adjustable from 3.35 feet to 10.35 feet. Elevation set so Allen Marsh has a WSE of 9.39 at 5.9 mgd.
(7) Currently one 6 foot weir is installed. One additional 12 foot weir will be needed in the future.
(8) Existing weir is adjustable from 3.35 feet to 10.35 feet. Elevation set so Gearhart Marsh has a WSE of 7.89 at 5.9 mgd.
(9) Existing weir is adjustable from 0.35 feet to 7.35 feet. Elevation set so Hauser Marsh has a WSE of 6.28 at 5.9 mgd.

### 2.6.2 Piping and Transfer Stations

The hydraulic analysis also determined the pipe diameters required for new piping as well as requirements for upsizing existing piping. Table 2.6 shows the required pipe sizing for current plant flows (new and modified piping) and Table 2.7 shows the additional required pipes for future plant flows. Future required pipes are broken down by scenario.

Table 2.6 Design Criteria for New and Modified Piping to Accommodate Current Flows

| New or Modified Pipe Run | Diameter (in) | Velocity at ADWF (ft/s) | Velocity at PWWF (ft/s) |
|---|---|---|---|
| **New Pipe Run** | | | |
| Headworks FSS to Oxidation Ditch | 20 | 0.8 (@1.1 mgd) | 2.6 (@ 3.6 mgd) |
| Oxidation Ditch to ML FSS | 24 | 1.1 (@2.2 mgd) (1) | 3.6 (@ 7.2 mgd)(1) |
| ML FSS to Secondary Clarifiers | 24 | 0.5 (@1.1 mgd) (1) | 1.8 (@ 3.6 mgd)(1) |
| Secondary Clarifiers to Oxidation Pond No. 1 | 24(2) | 0.5 (@1.1 mgd) | 1.1 (@ 2.3 mgd) |
| Secondary Clarifiers to UV Junction Box | 24(2) | 0.5 (@1.1 mgd) | 2.9 (@ 5.9 mgd) |
| UV Junction Box to UV Inlet | 24 | 0.5 (@1.1 mgd) | 2.9 (@ 5.9 mgd) |
| UV Outlet to Existing EW Pipeline | 24 | 0.5 (@1.1 mgd) | 2.9 (@ 5.9 mgd) |
| Pump Station No. 1 to UV Junction Box | 24 | 0.5 (@1.1 mgd) | 1.1 (@2.3 mgd) |
| Pump Station No. 1 to Oxidation Ditch | 16 | 1.2 (@1.1 mgd) | 2.6 (@ 2.3 mgd) |
| Oxidation Pond No. 2 to TW No. 7 | 18(3) | 0.2 (@0.2 mgd) (4) | 0.3 (@ 0.3 mgd)(4) |
| Oxidation Pond No. 2 to TW No. 4 (Force Main) | 18(3) | 0.2 (@0.2 mgd) (4) | 0.3 (@ 0.3 mgd)(4) |
| TW No. 5, 6, and 7 to Junction Box No. 1 | 16 | 0.6 (@0.5 mgd) (4) | 1.1 (@ 1.0 mgd)(4) |
| EWPS to Outfall 003 (Force Main)(5) | 24 | 0.5 (@1.1 mgd) | 2.9 (@ 5.9 mgd) |
| **Modified Pipe Run** | | | |
| Hauser Marsh to Sump Pump Box at Southern Edge of Hauser Marsh | 24 | 0.5 (@1.1 mgd) | 2.9 (@ 5.9 mgd) |

Notes:
(1) Assumes 100 percent RAS flow.
(2) Common piping.
(3) Diameter was chosen to match existing pipes from Oxidation Pond No. 2 to other TWs.
(4) Assumes even flow split among the seven TWs.
(5) New pipe connects to the existing force main from the EWPS at the western edge of the Allen Marsh. The new pipe extends to Outfall 003 along the northern edge of Allen Marsh.

Table 2.7 Design Criteria for New Piping to Accommodate Future Flows

| New Pipe Run | Diameter (in) | Velocity at Design Flow (ft/s) |
|---|---|---|
| **Scenario 4b** | | |
| UV to Outfall 003(1) | 30 | 1.9 (@5.9 mgd) |
| **Scenario 4c** | | |
| UV to Existing Pipe at Outfall 002 (Force Main)(2) | 24 | 2.8 (@5.9 mgd) |

Notes:
(1) New pipe would run from the new UV structure, across the Butcher's Slough Bridge, and along the eastern edge of Allen Marsh to Outfall 003.
(2) New pipe extends from UV structure to southern edge of Allen Marsh then connects to existing re-purposed pipe running from southern edge of Allen Marsh to northern edge of Allen Marsh along the eastern edge.

Preliminary pump sizing was also determined through the hydraulic analysis and is shown in Table 2.8.

Table 2.8 Preliminary Pump Sizing

| Pump Station | New/ Existing/ Replace Pumps | Design Flow (mgd) | Number of Pumps (Duty+Standby) | Firm Capacity (mgd) | Minimum Flow (mgd) | Required Head (ft)[2] | Speed Control | Pumps To | Pump Type |
|---|---|---|---|---|---|---|---|---|---|
| **Liquid Process Facilities** | | | | | | | | | |
| Influent Pump Station | New | 5.9 | 2+1 @ 2.5 mgd<br>1 @ 1.0 mgd | 5.9 | 0.5 | 16 | Variable | Headworks | Non-clog submersible, wet pit |
| Treatment Wetlands 4 Pump | New | 0.3 | 1 @ 0.3 mgd | 0.0 | 0.3 | 1 | Constant | Treatment Wetlands 4 | Non-clog submersible, wet pit |
| Pump Station No. 1 (PS1) | Replace | 2.3 | 2+1 @ 1.2 mgd | 2.3 | 0.5 | 19 | Variable | UV | Non-clog submersible, wet pit |
| Enhancement Wetland Pump Station (EWPS) | Replace | 5.9 | 2+1 @ 2.0 mgd | 4.0 | 1.0 | 35[3] | Variable | Outfall 003 | Non-clog submersible, wet pit |
| **Stormwater Facilities** | | | | | | | | | |
| First Street Pump Station | Existing | TBD | 1+1 @ 5.5 mgd | 5.5 | 2.8 | - | Variable | Oxidation Pond 1 | Natural gas driven vertical turbine |
| Influent Storm Pump | Replace | 5.0 | 1 @ 5.0 mgd | 0.0 | 2.5 | - | Variable | Oxidation Pond 1 | Diesel driven self-priming centrifugal |
| Pond Pump Station (PPS) | Replace | 8.4[1] | 2+1 @ 3.5 mgd | 7.0 | 1.8 | 18 | Variable | Chlorine Contact Basin | Non-clog submersible, wet pit |
| Emergency Pond Pump Station (EPPS) | Existing | 5.8[1] | 2 @ 3.6 mgd | 0.0 | 3.6 | 30 | Constant | Chlorine Contact Basin | Self-priming centrifugal |
| **Solids Handling Facilities** | | | | | | | | | |
| Primary Sludge Pump Station | New | 0.07 | 1+1 @ 50 gpm | 50 gpm | 50 gpm | 20 | Constant | Primary Digester | Progressive cavity, dry pit |
| Primary Scum Pumps | New | 0.07 | 1+1 @ 50 gpm | 50 gpm | 50 gpm | 20 | Constant | Primary Digester | Chopper, dry pit |
| RAS Pump Station | New | 3.6 | 2+1 @ 1.8 mgd | 3.6 | 0.9 | 5.5 | Variable | Oxidation Ditch | Non-clog horizontal centrifugal, dry pit |
| WAS Pump Station | New | 0.14 | 1+1 @ 100 gpm | 100 gpm | 50 gpm | 8 | Variable | Thickener | Non-clog horizontal centrifugal, dry pit |
| TWAS Pump Station | New | | | | | | | Primary Digester | Progressive cavity, dry pit |
| Secondary Scum Pumps | New | 0.07 | 1+1 @ 50 gpm per Secondary Clarifier | 50 gpm | 50 gpm | 20 | Constant | Primary Digester | Progressive cavity, dry pit |

Notes:
(1) Pumping capacity for the maximum instantaneous flow of 16.5 mgd during wet weather was split between the PPS and the EPPS (excluding 2.3 mgd that is pumped from PS1). Both of these pump stations can pump directly out of Oxidation Pond No. 2.
(2) The listed required heads are preliminary and will be refined during final design.
(3) This assumes the EWPS is pumping to Outfall 003 only.

Appendix C

# TM 3 HEADWORKS AND PRIMARY CLARIFIER REPLACEMENT



City of Arcata
Wastewater Treatment Facilities Improvements

# Technical Memorandum 3
# HEADWORKS AND PRIMARY CLARIFIER REPLACEMENT

FINAL | April 2019

City of Arcata
Wastewater Treatment Facilities Improvements

# TECHNICAL MEMORANDUM 3

# HEADWORKS AND PRIMARY CLARIFIER REPLACEMENT

FINAL | April 2019



# Contents

Technical Memorandum 3 - HEADWORKS AND PRIMARY CLARIFIER REPLACEMENT 3-1

3.1 Purpose 3-1

3.2 Summary of Findings and Recommendations 3-1

3.2.1 Headworks 3-1

3.2.2 Primary Clarifier 3-2

3.3 Background 3-2

3.3.1 Existing Influent Pump Station and Headworks 3-2

3.3.2 Existing Primary Clarifiers 3-2

3.4 Design Influent Flows and Loads 3-3

3.5 Influent Pump Station Alternatives 3-4

3.5.1 Screw Pumps 3-4

3.5.2 Submersible Pumps 3-4

3.5.3 Recommendations 3-4

3.5.4 Pump Control 3-5

3.6 Influent Headworks Alternatives 3-5

3.6.1 Influent Screening 3-6

3.6.2 Screening Washing and Compaction 3-12

3.6.3 Screenings Conveyance 3-14

3.6.4 Screenings Facility Layout and Configuration 3-15

3.6.5 Grit Removal 3-16

3.6.6 Grit Pumps 3-19

3.6.7 Grit Washing and Dewatering 3-19

3.6.8 Headworks Materials 3-21

3.6.9 Plant Influent Flow Measurement 3-21

3.7 Primary Clarifier Facilities 3-23

3.7.1 Recommended Design Parameters 3-23

3.7.2 Sludge and Scum Pumping System 3-24

3.8 Recommended Facility Design Criteria 3-24

3.8.1 Site Layout 3-26

# Appendices

Appendix A Equipment Brochures

# Tables


| | | |
|---|---|---|
| Table 3.1 | Design Influent Flows | 3-3 |
| Table 3.2 | Design Influent Loads | 3-4 |
| Table 3.3 | Influent Pump Station Configuration | 3-5 |
| Table 3.4 | Comparison of Screening Technology Alternatives | 3-11 |
| Table 3.5 | Comparison of Screening Washing and Dewatering Alternatives | 3-14 |
| Table 3.6 | Comparison of Grit Removal Alternatives | 3-17 |
| Table 3.7 | Material Recommendations | 3-21 |
| Table 3.8 | Primary Clarifier Design Parameters | 3-23 |
| Table 3.9 | Summary of Recommended Design Criteria | 3-24 |


# Figures


| | | |
|---|---|---|
| Figure 3.1 | Climber Screen | 3-8 |
| Figure 3.2 | Chain Driven Multi-Rake Screen | 3-9 |
| Figure 3.3 | Duperon Flex-Rake Screen | 3-10 |
| Figure 3.4 | Typical Washer/Compactors | 3-13 |
| Figure 3.5 | Shaftless Screw Conveyor | 3-15 |
| Figure 3.6 | Typical Aerated Grit Basins | 3-16 |
| Figure 3.7 | Typical Vortex Grit Basin | 3-18 |
| Figure 3.8 | Typical Grit Cyclone/Classifier and Vortex Grit Basin Arrangement | 3-20 |
| Figure 3.9 | Headworks Plan | 3-27 |
| Figure 3.10 | Headworks Section | 3-29 |

# Abbreviations

| | |
|---|---|
| AWTF | Arcata Wastewater Treatment Facility |
| Carollo | Carollo Engineers, Inc. |
| CCB | chlorine contact basin |
| ft | feet |
| fps | feet per second |
| gpd | gallons per day |
| gpm | gallons per minute |
| in | inches |
| LF | linear feet |
| mgd | million gallons per day |
| ppd | pounds per day |
| PS | pump station |
| SF | square feet |
| TM | technical memorandum |
| UV | Ultraviolet |
| VFD | variable frequency drive |
| WWTP | wastewater treatment plant |

Technical Memorandum 3

# HEADWORKS AND PRIMARY CLARIFIER REPLACEMENT

## 3.1 Purpose

The purpose of this Technical Memorandum (TM) is to establish preliminary design criteria, identify main components, and develop conceptual layouts for a new headworks, influent pump station, and primary clarifier rehabilitation at the City of Arcata (City) Wastewater Treatment Facility (AWTF).

This includes selection and sizing of the new influent pumps, new bar screens, and new grit removal system for the replacement headworks and developing design criteria for all support facilities including screening conveyance, grit pumping, and screenings and grit handling. New influent flow meters will be selected, including flow meter type, size, and configuration. This TM will also outline the proposed improvements for primary clarifier rehabilitation along with primary sludge and scum pumping replacement.

## 3.2 Summary of Findings and Recommendations

The key findings and recommendations of this TM are summarized below:

### 3.2.1 Headworks

- The new influent pump station and headworks will be sized for a design peak wet weather flow of 5.9 million gallons per day (mgd), an average dry weather flow of 1.1 mgd, and a minimum hour flow of 0.3 mgd.
- The new influent pump station and headworks will be located on the site of the existing influent pump station and headworks.
- The new influent pump station will utilize four non-clog submersible pumps. Three pumps will be sized for 2.5 mgd each with two duty and one standby. One pump will be sized for 1.0 mgd for low flows.
- Influent screening will be located downstream of the influent pump station. Three channels will be provided, two channels will be equipped with mechanically cleaned bar screens, and a third bypass channel will be equipped with a manually cleaned bar screen.
- The mechanically cleaned bar screens will be multi-rake moving media screens with a bar rack spacing of 3/8-inch. A shaftless screw conveyor will convey raw screenings to washer/compactor units located above a bin for disposal.
- The grit basin will be located downstream of the screens. Mechanically induced vortex grit basins with sloped bottoms will be used for grit removal. One 12-foot diameter basin will be provided with a bypass. Two recessed impeller pumps (one duty and one standby) will be used to convey grit from the vortex grit basin to a grit dewatering unit. A cyclone/classifier will be used to dewater grit.

- A fixed weir flow split structure will be located downstream of the grit basins to split flow to the primary clarifier and the oxidation ditch. Magnetic flow meters will measure the flow rates out of the headworks to the primary clarifier and to the oxidation ditch.

### 3.2.2 Primary Clarifier

- Existing Primary Clarifier No. 1 will be demolished.
- Existing Primary Clarifier No. 2 will be used to settle solids upstream of the oxidation ponds, when bypassing the oxidation ditch, for flows up to 2.3 mgd.
- Primary clarifier rehabilitation will include as needed concrete repair, FRP baffle and weir repairs, and replacing the handrail. A new scum chopper pump will replace the existing scum pump and will provide mixing, decant, and scum transfer in the scum collection well.
- Primary clarifier mechanism will require further evaluation to determine if replacing the mechanism is feasible in lieu of repairing, blasting and recoating the clarifier mechanism.
- New primary sludge pumps will replace the existing sludge pumps with duty and standby progressing cavity sludge pumps to convey primary solids to the digesters or to the new thickener.

## 3.3 Background

This section includes a brief summary of the existing influent pumps, headworks, and primary clarifier facilities.

### 3.3.1 Existing Influent Pump Station and Headworks

The existing influent pump station and headworks facility provides 5.0 mgd of capacity of pumping, screening, and grit removal of raw sewage. The facility is comprised of the following:

- Two 2.5-mgd screw pumps with 10 hp motors.
- Two 5.0-mgd mechanically-cleaned bar screens that drop screenings into a single belt conveyor for transport to a roll-off bin.
- One Parshall flume for flow metering.
- One gravity tangential flow type grit removal system including a horizontal-flow grit chamber with grit pumping and grit classification.

Influent flows greater than the 5.0-mgd headworks capacity bypass both the headworks facility and primary clarifiers and are pumped, via the First Street Pump Station (located offsite) and the Influent Storm Pump (located at the Headworks), directly to the oxidation ponds. These pumps provide peak wet weather flow capacity and redundancy for the influent screw pumps.

The influent pump station and headworks were constructed in the 1984 Wastewater Treatment Plant Modifications project (CH2M HILL, 1984). Overall, the headworks is in need of a major upgrade due to the condition of the equipment, which is approximately 30 years old and rated as poor.

### 3.3.2 Existing Primary Clarifiers

The primary treatment facilities consist of two primary clarifiers, with a total treatment capacity of 5.0 mgd. Flow from the headworks is split to the primary clarifiers after grit removal.

- Clarifier No. 1 has a 26-foot diameter, with a side water depth of 9 feet, and a design treatment capacity of 1.0 mgd. It is fed by a 12-inch diameter influent pipeline.
- Clarifier No. 2 has a 60-foot diameter, with a side water depth of 12 feet, and a design treatment capacity of 4.0 mgd. It is fed by a 24-inch diameter influent pipeline.

The clarifiers are center-feed, peripheral-withdrawal type clarifiers. In the clarifiers, suspended solids gradually settle to the bottom of the tanks as primary sludge. Mechanical scrapers collect settled sludge and skimmer arms collect floatable scum in the primary clarifiers. Three primary sludge pumps pump solids from the bottom of the primary clarifiers to the primary anaerobic digester. Scum collected on the surface of the primary clarifiers passes through a liquid/solid separator and the scum solids are transferred to a roll-off bin for disposal.

Generally, Clarifier No. 2 is used continuously and Clarifier No. 1 is used intermittently for peak wet weather flows. The units seem sufficient for the design flows, although the peak loading rates may result in reduced performance. The Clarifier No. 1 structure appears to have been built around 1957 based on records provided by the City that indicate piles for the structure were driven around that time. Clarifier No. 2 was added later, although the date is unknown. Both units are shown in drawings dated 1971. The condition of both units is poor to very poor based on the age, concrete corrosion and cracking of the effluent launders. The walkways and handrail on Clarifier No. 1 do not meet current codes for worker safety. The interior coating on both units has failed and exposed the concrete to sulfide corrosion at the water surface.

Repairs have been made to the Primary Clarifier No. 2 clarifier mechanism and the remaining metal structure may not be able to be further repaired. The Primary Clarifier No. 2 clarifier mechanism should be further evaluated for replacement or rehabilitation.

## 3.4 Design Influent Flows and Loads

The influent flows used for the basis of design for the new influent pump station, headworks, and primary clarifier processes are presented in Table 3.1. The influent loads used for the basis of design are presented in Table 3.2. During wet weather, flows greater than 5.9 mgd will bypass the headworks and be pumped directly to Oxidation Pond No. 1.

Table 3.1 Design Influent Flows

| | Current (mgd) | Future (mgd) | Permitted (mgd) |
|---|---|---|---|
| Minimum Flow | 0.3 (1) | 0.3 (1) | - |
| Average Dry Weather Flow | 1.1 (2) | 1.3 (3) | 2.3 (4) |
| Peak Dry Weather Flow | 1.8 (5) | 2.2 (6) | - |
| Maximum Month Flow | 3.0 (7) | 3.6 (8) | 5.0 (9) |
| Peak Wet Weather Flow | 5.9 (4) | 5.9 (4) | 5.9 (4) |

Notes:
(1) Based on City diurnal flow data from 7/23/17 through 7/30/17.
(2) 50th percentile flow during dry weather using City data from 2003 to 2015.
(3) Current Average Dry Weather Flow plus 20 percent growth.
(4) Existing permit capacity.
(5) Diurnal peaking factor of 1.6 multiplied by Average Dry Weather Flow. Peaking factor based on City diurnal flow data from 7/23/17 through 7/30/17.
(6) Current Peak Dry Weather Flow plus 20 percent growth.
(7) 92nd percentile flow using City data from 2003 to 2015.
(8) Current Maximum Month Flow plus 20 percent growth.
(9) Existing permitted Average Wet Weather Design Flow.

Table 3.2 Design Influent Loads

| | Current (lb/d) | Future (lb/d) |
|---|---|---|
| BOD | 4,000 (1) | 4,800 (2) |
| TSS | 5,760 (1) | 6,910 (2) |

Notes:
(1) 90th percentile load using City data from 2003 to 2015.
(2) 90th percentile load using City data from 2003 to 2015 plus 20 percent for growth.

## 3.5 Influent Pump Station Alternatives

Influent pumping is required to hydraulically lift the wastewater from the relatively deep influent gravity sewer and wet well up to the proposed screens and grit removal system in the headworks. Effluent flow from the headworks can then flows by gravity through both the primary clarifier, oxidation ponds, and treatment wetlands, and the oxidation ditch, secondary clarifiers, UV disinfection system, enhancement wetlands, and into the Enhancement Wetlands Pump Station.

There are several alternatives for the proposed influent pump station. The alternatives will be reviewed in this section. The influent pump station will be designed to pump flows of up to 5.9 mgd into the headworks. The pump station will be a wet well type, not a dry pit type, due to the space constraints and depth of the existing wet well. Screw pumps and submersible pumps were evaluated for the new influent pump station as well as the pump arrangement.

### 3.5.1 Screw Pumps

Screw pumps would match the existing influent pumps. An advantage of screw pumps is that they are reliable and relatively simple to maintain. They are also able to move larger solids than other types of pumps. Screw pumps can utilize a smaller wet well since screw pumps will continue to operate regardless of the water level or flow conditions in the wet well. However the screw pumps require a large footprint due to the size of the torque tube and flights and the required support structure. The larger footprint of the pumps means that likely only two screw pumps can fit on the site, which will reduce the redundant pumping capacity unless each pump can be sized for 5.9 mgd.

### 3.5.2 Submersible Pumps

Submersible non-clog pumps are another proven technology used in many wastewater treatment applications for pumping raw sewage. Submersible pumps offer a smaller footprint and lower capital costs than screw pumps. This low cost compared to screw pumps is due to the reduced size of the pumps and support structure required for the pumps. Their small size also allows several configurations of pump sizes and wet well layouts. Submersible pumps do require a minimum submergence that is deeper than screw pumps as well as flow conditioning to reduce turbulence into the pumps. Regular inspection and monitoring of this type of pump would require the provision of a lift or crane to pull the entire pump out of the wet well.

### 3.5.3 Recommendations

The two aspects of this project that are critical for equipment and process selection are footprint and capital costs. Submersible pumps are recommended because they allow for a smaller area for the influent pumping station and lower capital costs than screw pumps.

Submersible pumps can be laid out in a variety of pump capacities and configurations. The influent pump station submersible pump configuration alternatives evaluated are presented in Table 3.3.

Table 3.3 Influent Pump Station Configuration

| Configuration | Firm Capacity[1] mgd | Total Capacity[2] mgd | Minimum Capacity[3] mgd | Cost | Comments |
|---|---|---|---|---|---|
| 2+1 @ 2.0 mgd each | 4.0 | 6.0 | 1.0 | $ | Lowest cost, but firm capacity less than design capacity |
| 2+1 @ 3.0 mgd each | 6.0 | 9.0 | 1.5 | $$ | Low cost, but not capable of low flow pumping |
| 2+1 @ 2.5 mgd , 1 @ 1.0 mgd | 6.0 | 8.5 | 0.5 | $$$ | Good balance of capacity range and cost |
| 1+1 @ 4.0 mgd , 2 @ 1.0 mgd | 6.0 | 10.0 | 0.5 | $$$$ | Highest total capacity, but highest cost |

Notes:
(1) Capacity with one of the largest units out of service.
(2) Capacity with all units in service.
(3) 50 percent capacity of smallest unit.

A pump station layout utilizing three 2.5-mgd pumps and one 1.0-mgd pump is recommended. This configuration will provide full capacity during peak flows with one unit out of service and the 1.0 mgd can be used for low diurnal flows.

For the 2.5-mgd pumps, the manufacturer claims that pumps can turn down to less than 1.0 mgd, however we typically assume about 60 percent to 50 percent turndown of the rated capacity, so an expected turn down to about 1.3 mgd. Since there is only one 1.0-mgd, low flow pump and it will be used frequently for diurnal flows, an additional low flow pump can be stored on site as a standby. All the pumps are on rails and can be pulled and replaced with a davit crane/monorail crane.

The new influent pump station design will need to account for constructability of the new pump station with respect to keeping in operation the influent sewer and Influent Storm Pump Station. A portion of the existing wet well will be incorporated into the new influent pump station to minimize construction impacts to existing facilities and influent sewer pipeline. It is assumed that the Influent Storm Pump Station will be utilized to bypass the headworks during construction.

### 3.5.4 Pump Control

Control of the influent pumps would be based on wet well level control. Variable frequency drives (VFDs) will be utilized on the pumps to reduce the number of starts and stops for each pump and to turn down pumps during low flow. The VFDs also allow for the pumps to operate more efficiently by reducing the power demand at low flows. The VFDs and controls for the pumps will likely be installed in MCC-A located in the existing Electrical Building.

## 3.6 Influent Headworks Alternatives

The purpose of the headworks is to remove inorganics from the wastewater and to protect and reduce wear on the downstream process equipment. The headworks will be designed to

accommodate the flows presented in Table 3.1. The facility will be designed to meet the current minimum flow conditions as well as projected average dry weather and peak wet weather flows.

There are several equipment selection alternatives for the proposed headworks facilities, including the choice of screens, washer/compactor, grit removal, grit washing and separation, and hydraulic design. The various alternatives will be reviewed in this section and the recommended alternatives presented.

### 3.6.1 Influent Screening

The purpose of influent screens is to remove rags, sticks, and other large objects from the influent wastewater. Effective screening will help prevent clogging of pumps and pipelines, prevent buildup of rags on mechanical equipment such as mixers and sludge collection mechanisms, reduce accumulation of materials in downstream channels, and otherwise reduce regular maintenance for processes downstream of the headworks.

#### 3.6.1.1 Screen Opening Size

Selecting an opening size is important in establishing the design criteria for the screenings facilities. Screen opening size impacts screenings removal efficiency, dictates the size of screens, and affects plant hydraulics. In addition, screenings handling equipment needs to be sized to match the anticipated removal efficiency of the screen.

Course and fine screens are available depending on the degree of removal desired. Course screens generally have openings greater than 1/2-inch, whereas fine screens have openings less than a 1/2-inch. Course screens will allow more rags and solids to pass through. Smaller opening sizes, or closer bar spacing, will remove more solids and provide greater protection for downstream equipment. Potential reductions in maintenance provided by the screens include reduced ragging of downstream influent pumps, primary sludge pumps and digester mixing pumps. Removing inert material at the headworks reduces the buildup of this material in the digesters, reducing the frequency of digester cleaning. The removal of plastic material from the solids stream will improve the quality of biosolids for reuse.

Fine screens are recommended to remove as much of the rags and large particulates as possible to protect downstream equipment. The two most frequently utilized bar screen opening sizes used are 3/8 inch and 1/4 inch. Since the new screens are downstream of the pumps the smaller, 1/4-inch screens may work well since the pumps will create a well-mixed influent and provide come chopping of larger inorganics. However, for the new screens it is recommended that the larger, 3/8-inch bar spacing be used because this size will effectively remove most plastics and rags that can cause plugging problems but requires less headloss upstream compared to 1/4-inch bar spacing.

#### 3.6.1.2 Channel and Clear Screen Velocity

The velocity in the channel approaching the screens should be a minimum of 2.0 feet per second (fps) at average flows. Lower velocities will cause settling in the approach channel. Channel aeration may be added to the approach channel of each screen to provide agitation and resuspend any grit that settles out. Channel aeration should be further reviewed in final design.

The velocity through openings or between bars is called the clear screen velocity and is the primary criteria used to determine the number of screens required. Recommended values range between 2.0 to 5.0 fps. For the proposed screening facility it is recommended that a clear screen

velocity of 2.0 to 3.0 fps at average flows and 4.0 fps at peak hour flows be used. These velocities will provide efficient removal of screenings and limit the amount of solids that can settle. The velocity between bars at 30 percent binding should be limited to 6.0 fps.

#### 3.6.1.3 Screening Technology Alternatives

To select the best available technology for the headworks facility, a number of screening technologies were initially evaluated including perforated plate screens, band screens, step screens, and screens that utilize bar racks. It was decided that perforated plate screens, band screens, and step screens would not be considered further because all three types of screens feature lighter duty construction than screens that utilize bar racks and have more submerged moving parts and consequently increased O&M requirements.

The three types of screens that utilize bar racks that evaluated are:

- Climber screens.
- Chain driven multi-rake screens.
- Link driven multi-rake screens.

*Climber Screens*

Figure 3.1 shows a typical climber bar screen. Climber screens have a reciprocating rake mechanism that maintains all drive components out of the flow stream under normal operating conditions. When a cleaning cycle is initiated, the cogwheels, housed in the frame of the bar screen, move down stationary pin racks, also housed in the frame. The drive assembly descends from its stopped position with the rake arm extended. When the cogwheels reach the bottom, they rotate around the bottom of the pin rack, engaging the rake teeth with the bar rack. As the cogwheels walk back up the pin racks, the screenings are carried out of the wastewater flow and are discharged into screenings conveyance equipment or bins located behind the bar screen. The involute gear and pin rack system is a proven and reliable system with many successful installations.

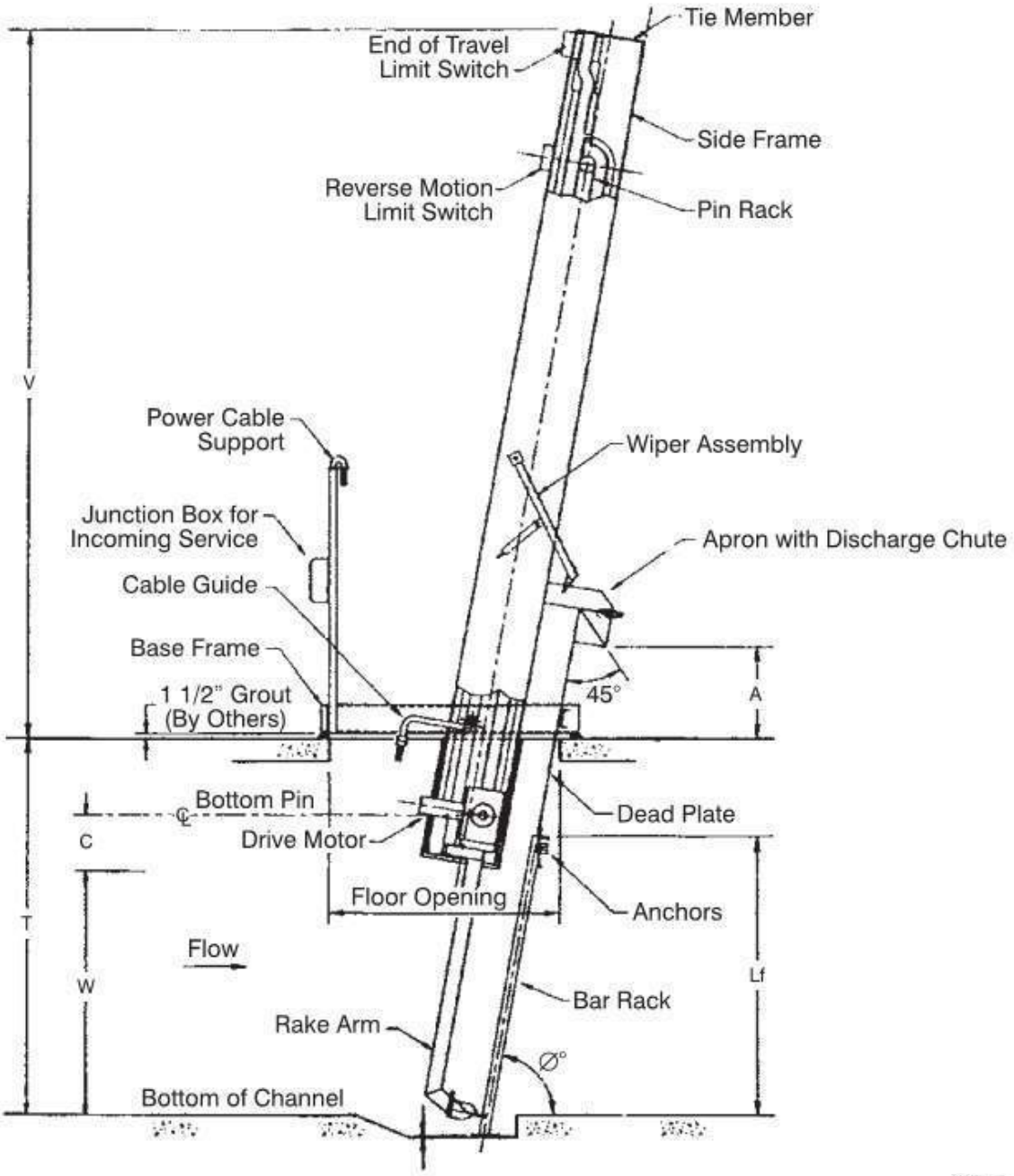
The overall height of a climber-type bar screen is determined by both the channel depth and the height of the discharge point above the operating floor. This can result in screens that are tall and more difficult to maintain. Some options to minimize the height of climber screens are to specify motors or motor housings that allow the drive to be submerged and to minimize the height of the discharge point.

The minimum recommended bar spacing for climber screens is 3/8 inch. At spacing below this dimension, the rake may experience difficulty engaging the bar rack and the rake teeth may be damaged.

*Chain Driven Multi-Rake Screens*

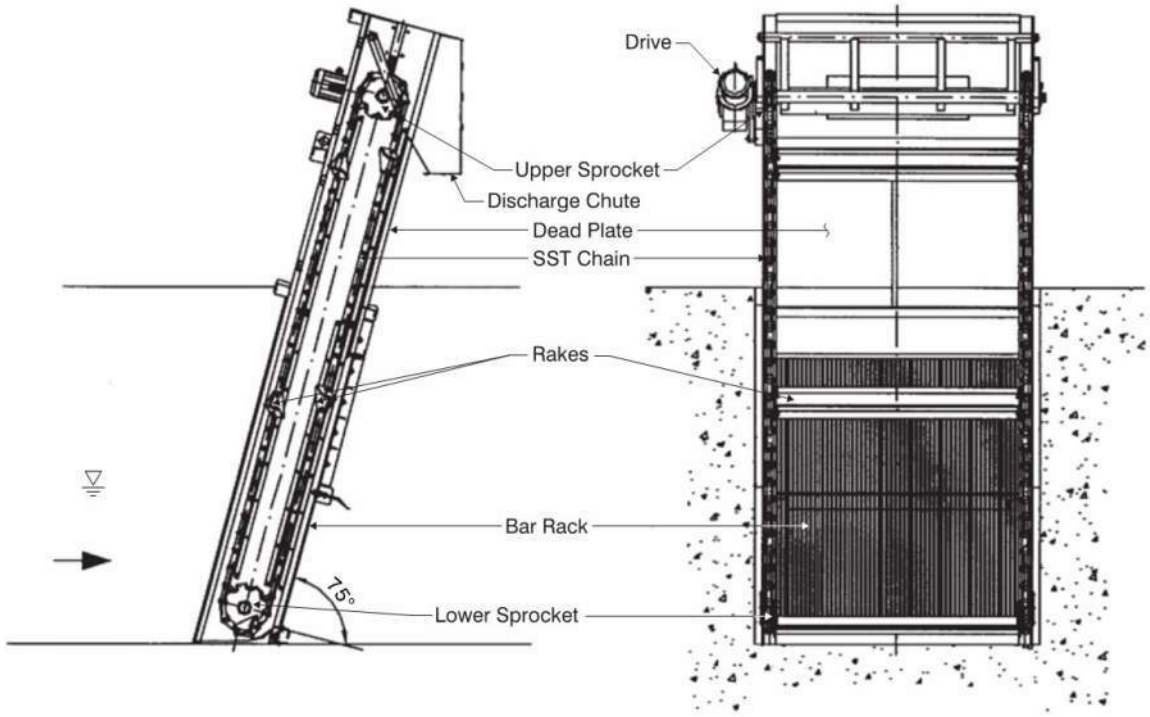
Heavy duty chain driven multi-rake screens are presented in Figure 3.2. These screens are chain-and-sprocket-type bar screens with multiple rake bars mounted onto chains on both sides of a self-contained frame. The two manufacturers we would recommend use a design with a lower sprocket assembly located in a recess at the bottom of the frame. The bearings for the lower sprockets are made of self-lubricating polyethylene material with a ceramic collar bonded onto the sprocket stub shaft. The all stainless steel chains are roller type, water lubricated, and designed for continuous submerged duty.

The screens are configured so the rakes clean and return in front of the bar rack to prevent carry over of material to the downstream channel. A two-speed drive can be provided so that raking speed can be increased to accommodate high flows or high volumes of screenings in the influent flow stream. The features of this type of screen make it capable of accommodating smaller bar rack spacing (down to 1/4 inch) than climber screens.

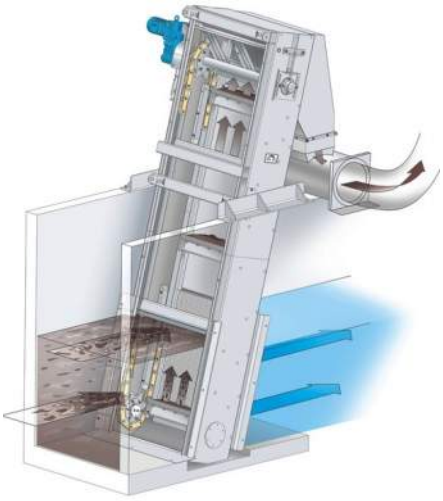



Source: Infilco Degremont

Figure 3.1 Climber Screen




Source: Headworks, Inc.

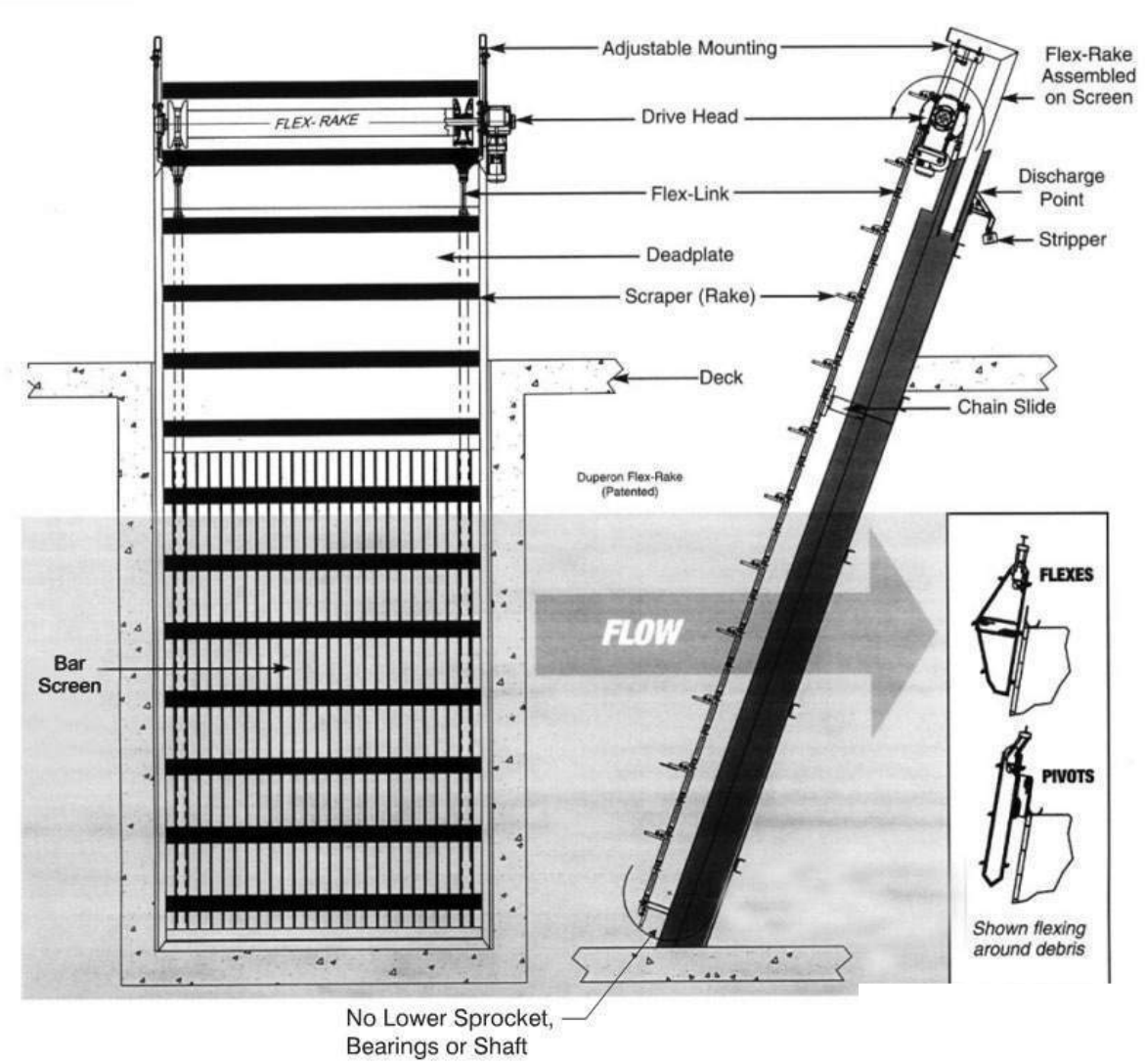


Source: Huber

Figure 3.2 Chain Driven Multi-Rake Screen

### *Link Driven Multi-Rake Screens*

Link driven multi-rake screens considered for this project are manufactured by a single manufacturer, Duperon. Figure 3.3 shows a typical Duperon FlexRake screen. Similar to chain driven multi-rake screens, this type of screen is also a front raked, front return type screen with multiple rake bars mounted onto chains on both sides of the channel. However, there are no lower sprockets and the parallel chains serve as their own frame. The chains are constructed from 316 stainless steel castings that form a bar-like chain that bends in only one direction, providing both flexibility and rigidity.




Source: Duperon

Figure 3.3 Duperon Flex-Rake Screen

### 3.6.1.4 Screenings Technology Alternative Comparison

The proposed headworks layout will accommodate any of the three screening alternatives. Table 3.4 summarizes the key advantages and disadvantages associated with each screenings technology alternative. Note that at a planning level, the relative costs difference between the screenings technologies is not significant.

Table 3.4 Comparison of Screening Technology Alternatives

| Alternative | Advantages | Disadvantages |
|---|---|---|
| Climber Screens | • No submerged moving parts.<br>• Proven and reliable technology.<br>• Maintenance can be performed above deck level so channel entry is not necessary. | • Height of equipment above discharge point makes maintenance more difficult.<br>• Minimum size 3/8 inch openings. |
| Chain Driven Multi-Rake Screens | • Multiple rakes and continuous operation facilitate frequent cleaning passes and rapid screenings removal.<br>• Can reverse directions several times to clear obstructions.<br>• Reduced height of equipment above discharge point compared to climber screens.<br>• Two-speed drive improves removal rates at peak flows. | • Permanently submerged moving parts (chains and sprockets).<br>• Maintenance of chain and bottom sprockets requires channel access. |
| Link Driven Multi-Rake Screens | • No frame, underwater sprockets, bearings, or shafts.<br>• Multiple rakes and continuous operation facilitate frequent cleaning passes and rapid screenings removal.<br>• Reduced height of equipment above discharge point compared to climber screens.<br>• Maintenance can be performed from deck level by pulling chains out of channel. | • Fewer number of installations compared to other screen technologies.<br>• Sole source procurement is required. |

The use of chain driven multi-rake screens for the new headworks is recommended for the following reasons:

- Multiple rakes and adjustable rake speed allow the rakes to respond more rapidly to high screening loading events than a climber screen.
- The screen can be retrofitted with relative ease to provide 1/4-inch bar screen spacing should the City decide to enhance screening removal in the future whereas the minimum recommended bar screen spacing for climber screens is 3/8 inch.
- The link driven multi-rake screen has limited operating experience in wastewater applications and can only be provided by a single manufacturer.

### 3.6.2 Screening Washing and Compaction

The screens will remove organic matter in addition to rags, plastic debris, and inert material. By washing the screenings, the organic matter can be separated from the inert materials before compaction and disposal and washed back into the wastewater stream. Lowering the organic content of the screenings will reduce odor generation, improve dewatering, and reduce the weight, volume, and cost of materials hauled.

Following the screenings washer, a compactor will be provided to compress and dewater the washed screenings prior to discharge to a roll-off type dumpster bin. The screen can be totally enclosed and the flow channels to and from the screens can be covered to control odors and minimize the quantity of foul air.

Screenings washing and compaction can be accomplished in a single washer/compactor unit. These units wash out the organic matter and dewater the washed screenings by compaction. Washer/compactors are available from several manufacturers and two basic types of units are available; washer/compactors with water sprays and washer/compactors with agitators. Figure 3.4 shows both typical washer/compactors with water sprays and with agitators.

Dewatering of washed screenings in both types of units is accomplished with a screw compactor. A typical unit consists of a motor driven shafted or shaftless helical screw auger, a loading hopper, and discharge tube. Turning the auger pushes the wet screenings material from the loading hopper into the discharge tube, which is tapered for a short length. The reduction in the discharge tube diameter causes a squeezing action that removes the free water from the screenings material. The water drains out of the unit through a perforated screen in the bottom and is returned to the headworks for further treatment.

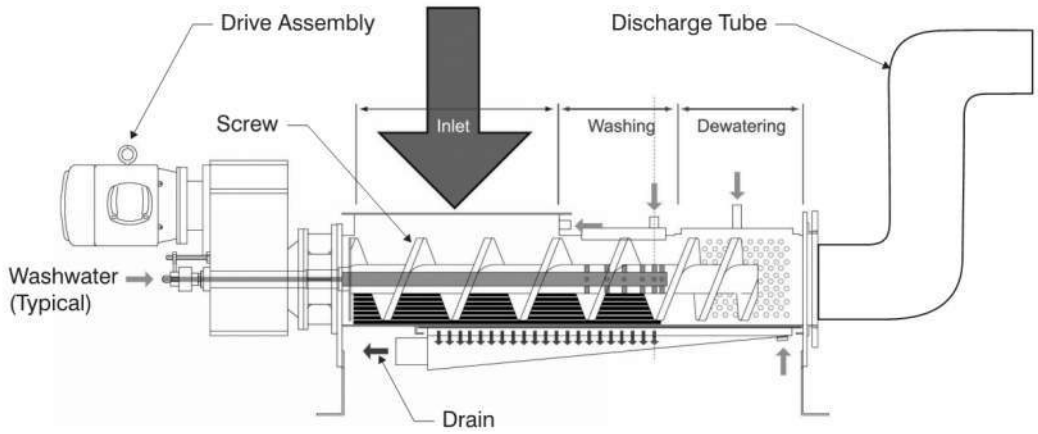
Washer/compactors that use water sprays typically apply high pressure utility water to the sides of the compactor loading hopper and to the washing zone of the compaction unit. Some units also spray water from the center shaft of the auger. Water sprays have limited success in breaking up organic matter unless the washer unit also conducts batch washing process where the auger cycles backward and forward a number of times to break the organic material apart. This type of equipment is capable of producing dewatered screenings material with a solids content of 30 to 40 percent.

Washer/compactors with in-tank agitators use mechanical agitation and a large volume of water to wash screenings. The loading hopper is first flooded with water in a batch process. The agitator breaks up the organic matter so that it can be carried out of the machine with the wash water through a fine perforated screen. The cleaned screenings material is then dewatered and discharged. Some of the more successful units are capable of reducing the weight and the volume of the raw screening by 50 to 80 percent and achieve solids content in excess of 40 percent.

Table 3.5 summarizes the key elements, advantages, and disadvantages associated with both types of washer/compactors.

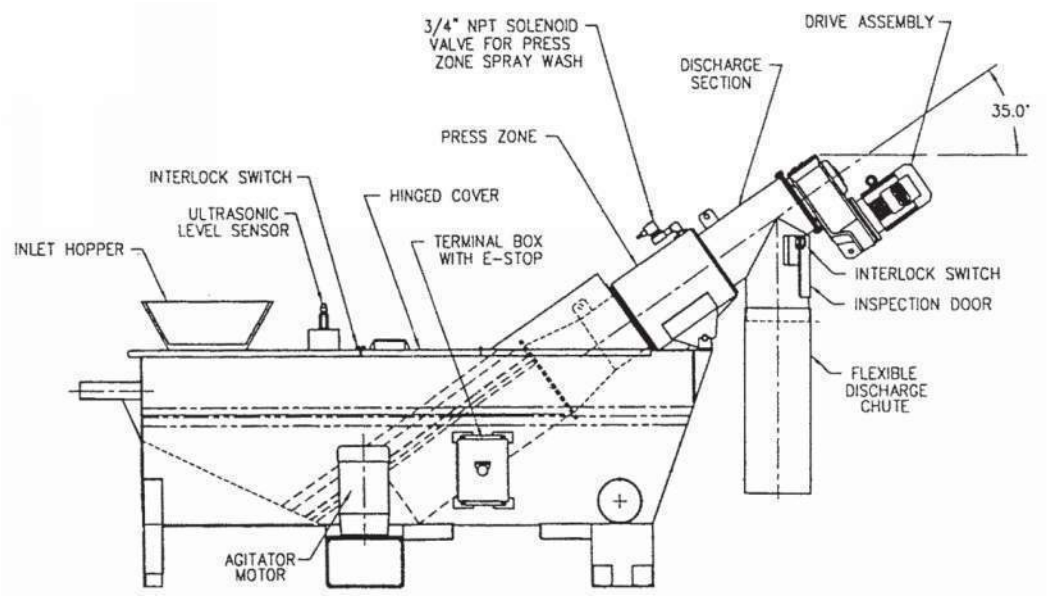
We recommend the use of a washer/compactor with water sprays that can operate in a batch washing mode. For a 3/8-inch bar screen, a unit with water sprays will provide sufficient cleaning and separation of organics from the screenings. While the washer/compactors with in-tank agitators can produce cleaner screenings materials, these units also have a higher capital cost, require more complicated control systems, and require a higher degree of operations and

maintenance attention. The additional motor and ancillary equipment on the agitator system results in slightly higher overall lifetime costs.




**Washer/Compactor with Water Sprays**

Source: Vulcan




**Washer/Compactor with Agitator**

Source: Hycor

Figure 3.4 Typical Washer/Compactors

Table 3.5 Comparison of Screening Washing and Dewatering Alternatives

| Alternative | Key Components | Advantages | Disadvantages |
|---|---|---|---|
| Washer Compactor with Water Sprays | • Use high pressure spray for separating organic matter from screenings<br>• Capable of producing dewatered screening material with solids content from 30 to 40 percent | • Simple<br>• Smaller footprint | • Not suitable for fine screening applications where large amount of organics are anticipated |
| Washer Compactor with Agitators | • Use hopper with mechanical agitator to separate organic matter from screenings<br>• Capable of producing dewatered screening material with solids content over 40 percent | • Very clean product, suitable for applications with a large amount of organics | • More complex and expensive |

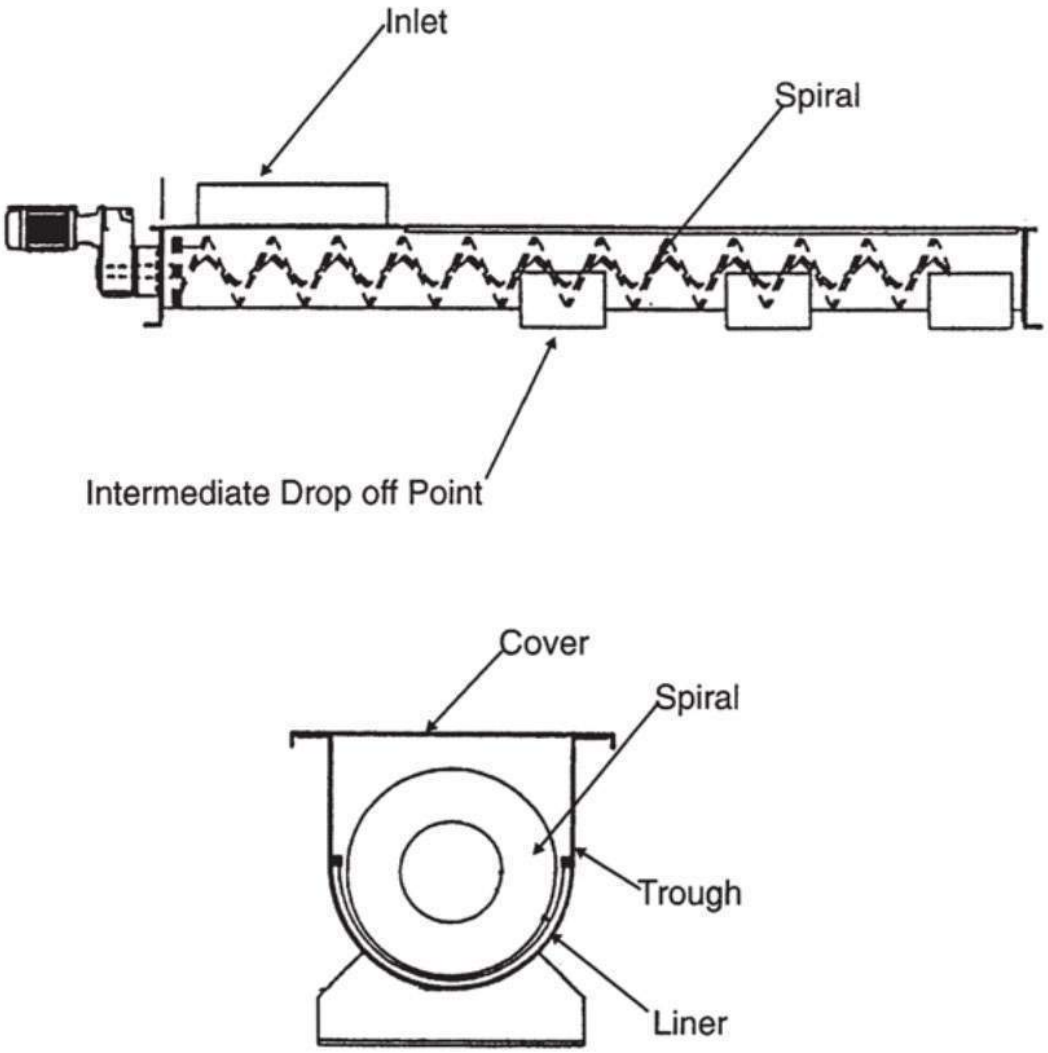
### 3.6.3 Screenings Conveyance

Conveyance technologies that can be used for screenings conveyance include belt conveyors, hydraulic sluiceways, and shaftless screw conveyors. We recommend the use of shaftless screw conveyors to collect screenings from the bar screens and convey them to the screenings washer/compactor for washing and dewatering.

Belt conveyors are not recommended for this application because they are messy and require more O&M attention that screw conveyors. Screenings material placed on conveyor belt is difficult to contain, will spill over the sides of the conveyor and requires frequent house-keeping.

A hydraulic sluiceway for screenings conveyance is also not recommended due the amount of flushing water required. Sluiceways typically require 300 to 400 gpm of clean, chlorinated flush water to convey screenings properly. Although this flow would be used in a screening washing process, it would then need to be returned to the influent flow stream and re-routed through the plant process at a cost. By comparison, a typical washer/compactor fed by a screw or belt conveyor would consume approximately 10 to 20 percent of the volume needed in a sluiceway application.

The recommended shaftless screw conveyors are a simple, proven, and reliable technology for screenings conveyance. The equipment consists of a hardened steel spiral installed in a stainless steel U-trough and driven by a motor and gearbox, as presented in Figure 3.5. The spiral rests on a replaceable ultra-high molecular weight polyethylene liner in the bottom of the U-trough. The screw conveyor is provided with removable stainless steel covers that completely enclose the screenings, containing the odors and preventing material from spilling out of the conveyor.




Source: American Bulk Conveying, Inc.

Figure 3.5 Shaftless Screw Conveyor

### 3.6.4 Screenings Facility Layout and Configuration

Three screening channels are recommend. Two channels with mechanical bar screens and one with a manual screen. Each channel will be designed for 3.0 mgd. During dry weather one mechanical bar screen may be taken out of service. The manual bar screen channel will be used to bypass a mechanical bar screen that goes out of service during wet weather.

A shaftless screw conveyor will move screenings from the bar screens to each washer compactor. Each mechanical bar screen is recommended to include a manual chute off the back side to bypass the shaftless screw convey to dump screenings directly into a bin behind the screen in the event that the shaftless screw conveyor goes out of service.

The washer compactors can be configured as duty-standby or as only a single duty washer compactor. In either configuration, it is recommended that gates on the conveyor be installed to bypass the washer compactors and discharge screenings directly to a roll-off bin in the event that the washer compactors go out of service.

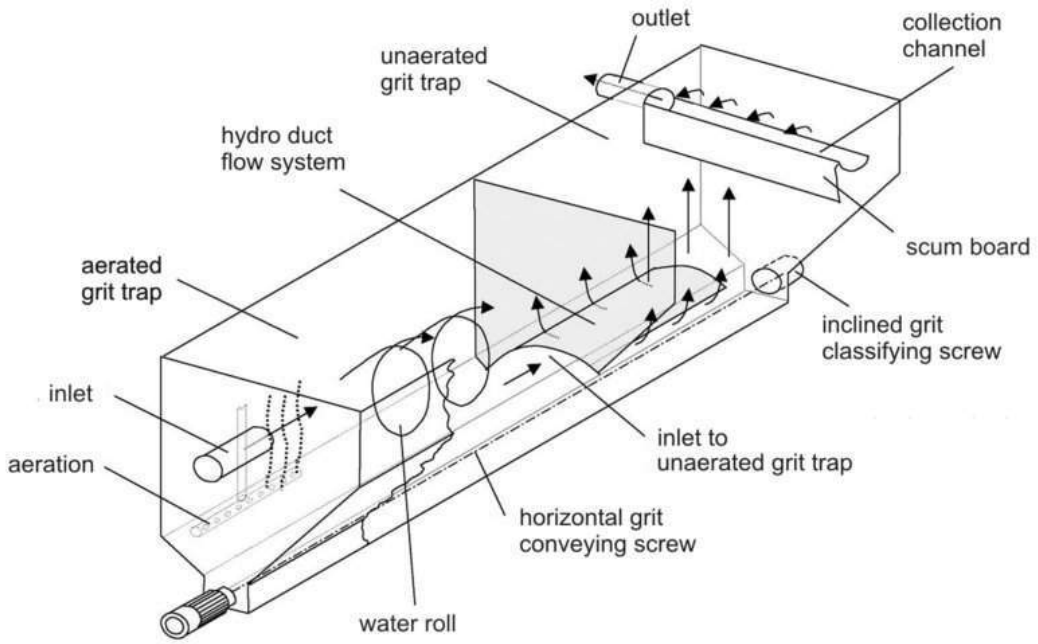
### 3.6.5 Grit Removal

The primary purpose of grit removal at a wastewater treatment plant is to reduce maintenance on downstream facilities. The benefits of grit removal include reducing grit accumulation in downstream channels, basins or oxidation ponds, and digesters. Effective grit removal will prolong the life of mechanical equipment and reduce wear and tear on mechanical equipment such as pumps, valves, and sludge collection mechanisms.

The two grit removal technologies most commonly installed today are aerated grit basins and mechanically induced vortex grit basins. These technologies are both proven grit separation processes and have been used in the majority of wastewater treatment plants to remove grit from the influent flow stream. The grit removal system is normally covered for odor control.

#### 3.6.5.1 Aerated Grit Basins

The aerated grit basin uses air to create spiral roll pattern to keep the organic solids in suspension as the grit settles out by gravity. Compressed air is typically discharged into the grit chamber along the bottom of one side creating a rising air column that causes the flow to rotate. The air rate can be adjusted to create a low enough velocity near the floor to allow the grit to settle to the bottom of the basin and into collection hoppers. Since the air rate is adjustable, grit removal can be optimized. A typical aerated grist basin is presented in Figure 3.6.




Source: Huber

Figure 3.6 Typical Aerated Grit Basins

#### 3.6.5.2 Vortex Grit Basins

The vortex type grit basin uses gravity and centrifugal action to capture grit in the center hopper of a circular tank. The influent enters at a tangent to the outside of the basin producing a spiraling doughnut-shaped flow pattern. The centrifugal action of the flow in the circular basin

pushes the heavier grit particles to the outside where rotational velocities are lower, causing the grit to settle. Impellers at the center of the basins cause a lifting action that suspends and lifts the lighter organic material that is then passed out of the basin through the effluent channel. A typical vortex grit basin is presented in Figure 3.7.

Vortex grit basins can be either 270 degree layout or a 360 degree layout. In the 270 degree layout, the flow enters and exits on the same side and elevation of the grit basin, perpendicular to flow through the headworks. For the 360 degree design, flow drops beneath the effluent channel (influent channel is submerged) and rises up through the basin to the effluent channel, creating an upward velocity component, in parallel with flow through the headworks.

#### 3.6.5.3 Comparison and Recommendation of Grit Removal Technologies

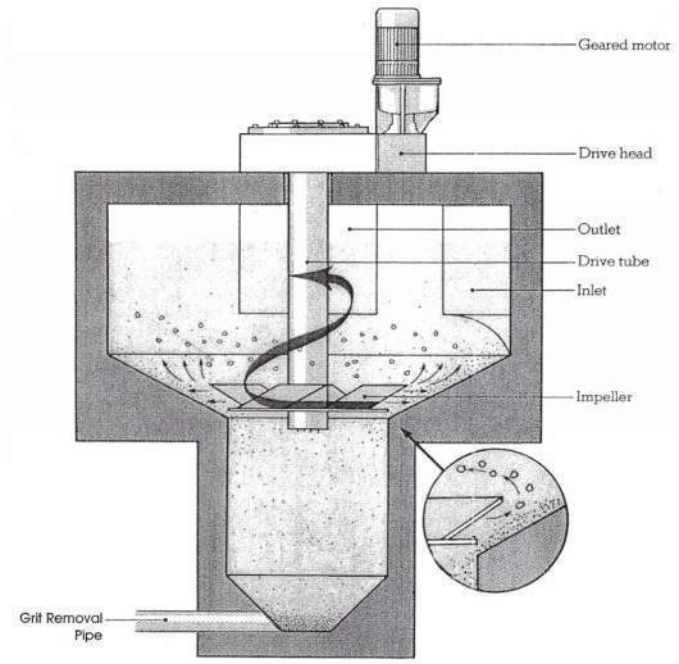
Table 3.6 presents a comparison of aerated grit basins and vortex grit basins. The use of vortex grit basins is recommended for the new headworks facility.

Table 3.6 Comparison of Grit Removal Alternatives

| Alternative | Advantages | Disadvantages |
|---|---|---|
| **Aerated Grit Basins** | • Effective grit removal<br>• Air rate can be adjusted to optimize grit removal | • Operationally more complicated<br>• Require aeration blowers<br>• Submerged piping and diffusers require regular maintenance and replacement<br>• Aerated grit chamber increases potential for odors |
| **Vortex Grit Basins** | • Simple operation<br>• Only submerged element is the impeller<br>• Smaller footprint | • Cannot be optimized after installation<br>• May not capture as much grit as an aerated grit basin unless the unit is oversized |

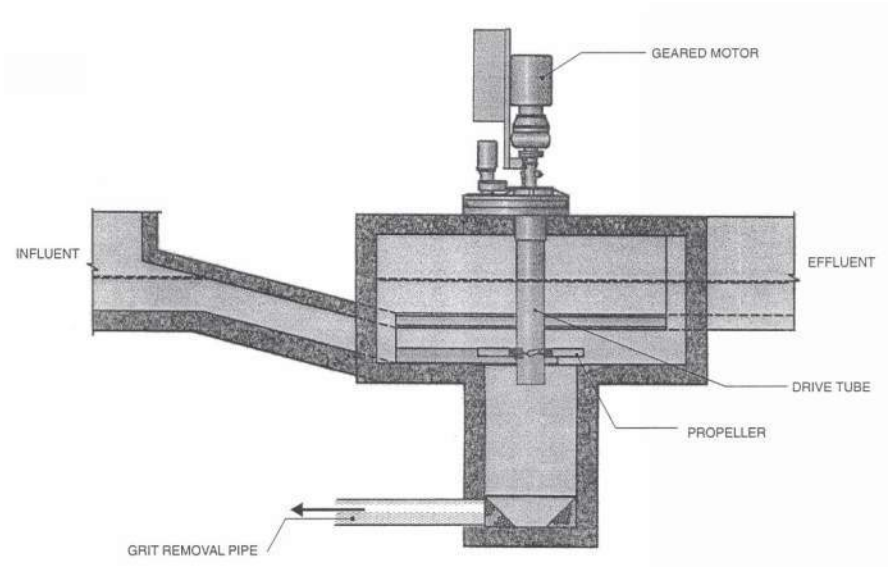
It is our experience that the manufacturer's flow rating should be de-rated by 50 percent when sizing the vortex grit process. This improves capture over the range of design flows, especially during peak flows. One 12-foot diameter vortex grit basin rated for 12 mgd is recommended. It is not anticipated that significant organics will settle out with the grit. However, organics captured with the girt will be returned to the process stream, when treated through the grit washer/classifier. It is also recommended that the grit basin include a sloped bottom to lower the potential for grit accumulation at low flows.

It is not common to take a vortex grit basin off-line. The only mechanical equipment, the impeller drive mechanism is located above the deck of the basin so regular maintenance can be accomplished without dewatering the basin. Furthermore, a vortex grit basin will continue to remove grit without an operational impeller mechanism. To address maintenance concerns, a bypass will be provided so that the basin could be taken off line and dewatered. The reliability of a single basin could also be improved by providing redundant downstream equipment such as a standby grit pump and a standby grit washer. Note that standby grit pump and grit washers are not included in the cost estimate.




**Sloped Bottom Vortex Grit Basin**

Source: Jones & Atwood




**Flat Bottom Vortex Grit Basin**

Source: Smith & Loveless

Figure 3.7 Typical Vortex Grit Basin

The equipment will be specified to include abrasion resistant materials to reduce maintenance as much as is economically possible. The final design should also carefully consider how to most easily and reliably remove the grit from the vortex grit removal system, and minimize its handling. Prior to discharging the grit to a dumpster, the grit will be washed to remove attached putrescible material.

### 3.6.6 Grit Pumps

Settled grit must periodically be removed from the bottom of the vortex basin grit hopper and transferred to grit dewatering equipment. This is typically accomplished by utilizing heavy-duty pumps with hardened wear components that can pass any large solids that may settle in the chamber. Two typical grit removal pump configurations were evaluated for this project; self-priming pumps positioned above the grit chamber liquid surface and recessed impeller pumps with flooded suctions.

Most vortex grit basin mechanism manufacturers also provide an option where a self-primed or vacuum primed pump is integrated with the basin impeller mechanism. The pump withdraws material from the bottom of the basin through an extended impeller drive shaft or torque tube. This type of configuration can save capital costs by eliminating the pump dry pit required to house flooded suction pumps. This savings becomes more significant the deeper the bottom vortex basin is positioned. One disadvantage of this type of system is its limited redundancy. It relies on single withdrawal point and a single pump so if there is any clogging in the suction or discharge lines or the pump requires maintenance, the grit basin would need to be bypassed.

Recessed impeller pumps are commonly used in grit handling applications and are both durable and reliable. The pump impellers are located out of the main flow path and the pump can pass solids almost as large in diameter as the inlet of the pump. Recessed impeller pumps require a flooded suction and would need to be positioned to one side of the grit basin in a pump gallery.

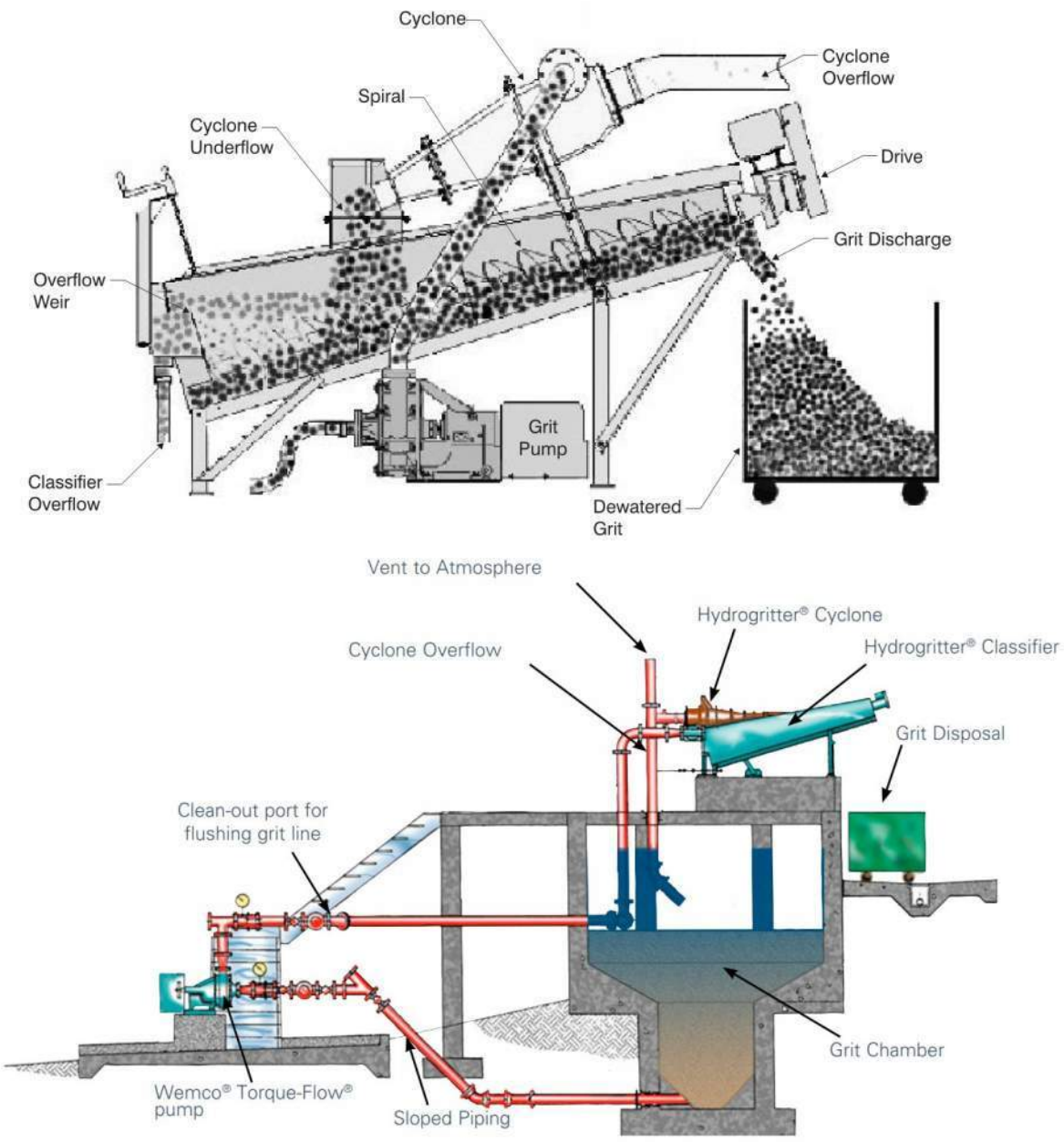
Therefore, we recommend the use of two heavy duty recessed impeller pumps in a duty standby configuration. Since the headworks and grit tanks are above grade, the grit pumps will be located at grade.

### 3.6.7 Grit Washing and Dewatering

Some organics will be captured in the grit removal process, with increased quantities during low flow periods, so grit washing and dewatering will be provided. Grit washing separates grit from organic solids and grit dewatering removes the free water from the washed grit. A lower organic content in the grit reduces odors and vector attraction while dewatering reduces the weight, volume, and cost of materials hauled. The additional organic material removed from the grit basin will be returned to the headworks and the quality of the dewatered grit to be hauled off-site will remain constant.

Two types of technologies for washing and dewatering grit removed from wastewater are the grit cyclone/classifiers and the proprietary Slurrycup™/Snail™ system. The Slurrycup™/Snail™ system is not recommended for further consideration due to potential intensive maintenance requirements and the possible reduced overall grit quality (higher amount of organics). On the other hand, cyclone/classifier systems can be supplied by several manufacturers and have a long history of successful operation at municipal wastewater treatment plants.

Grit slurry is withdrawn from the grit basin hopper and is pumped to a cyclone which is mounted on top of a classifier. The cyclone uses centrifugal force to concentrate the grit to as little as 5 percent of the total incoming flow, while draining the remaining water and some organic material back to the plant influent. The concentrated cyclone underflow discharges into the classifier below. Grit settles to the bottom of the classifier and is removed with a relatively short helical auger while water and suspended organics discharge over a weir at the back of the classifier. A typical grit cyclone/classifier and layout with a vortex grit basin is presented in Figure 3.8.




Source: Wemco

Figure 3.8 Typical Grit Cyclone/Classifier and Vortex Grit Basin Arrangement

One stainless steel cyclone/classifier grit dewatering unit located next to the grit pump station and discharging into disposal bins located at grade is recommended. Due to the corrosive nature of grit and because the classifier unit will be located outside, it should be fabricated from stainless steel. It is also recommend that the unit be covered to reduce splashing and to contain foul odors.

### 3.6.8 Headworks Materials

The recommended materials are presented in Table 3.7.

Table 3.7 Material Recommendations

| Area/Equipment | Material |
|---|---|
| Influent Wet Well Interior | Concrete walls with PVC T-lock liner |
| Hatches | Galvanized Steel |
| Channels upstream of screens | Concrete walls with PVC T-lock liner |
| Channel Covers and Gratings | FRP |
| Gates | 316 Stainless Steel or FRP |
| Stairs and Landings | Aluminum |

### 3.6.9 Plant Influent Flow Measurement

A number of devices are available that can be used to measure flow rates in open channels and closed conduits. Important criteria that must be considered in the selection of flow metering devices include type of application, proper sizing, fluid composition, accuracy, headloss, installation requirements, operating environment, and ease of maintenance. Although all of the criteria listed are important, accuracy and repeatability are critical, especially when the units' readings are used for process control.

The three types of flow measurement devices that have been evaluated include inline magnetic flow meters, Doppler flow meters, and Parshall flumes with ultrasonic level instruments.

#### 3.6.9.1 Inline Magnetic Flow Meters

Inline magnetic flowmeters, or mag meters, utilize Faraday's law governing the proportionality of induced voltage to velocity of a conductor passing through an electromagnetic field. The wastewater in the pipe acts as the conductor, and as electromagnetic fields are generated, electrodes sense induced voltages and converts them first to velocity, then to flow rate. Magnetic flowmeters are very accurate instruments, and are suitable for measuring the flow rate of most conductive liquids. The meters have no moving parts, and are shaped such that very little obstruction (equating to headloss) occurs within the pipe section. Typical mag meters range in size from 2-inch to 24-inch pipe diameter; however, larger sizes are available. The primary disadvantage is that full pipe flow is required for accurate flow measurement. This requires careful consideration of the piping arrangement design. The traditional, conservative "rule-of-thumb" for straight runs of piping for a magmeter location is five diameters of pipe upstream and two diameters of pipe downstream. Either a bypass piping run or dedicated spool piece can be provided so that the meter can be taken offline for maintenance, if required.

#### 3.6.9.2 Doppler Flow Meter

Doppler flowmeters measure flow by continuously transmitting high frequency sound (>5.0 MHz) that travels through the pipe wall and into the flowing liquid. The sound is reflected back to the sensor from solids and bubbles in the flow stream, and the echoes return at an altered frequency proportional to fluid velocity. Doppler flowmeters continuously measure this frequency shift to calculate flow. The Doppler technique only works on liquids that contain solids or gas bubbles to reflect its signal. The sensor mounts on the outside of the pipe, meaning there is no obstruction to flow, and hence no pressure drop.

#### 3.6.9.3 Parshall Flume

The Parshall flume utilizes the Venturi principle to equate flow from differential pressure measured between the flume inlet and throat. Parshall flumes provide the critical depth, and is typically coupled with some type of level instrument (i.e., ultrasonic) to measure the depth. These types of flowmeters are often used for open channel flow, and offer the advantages of low headloss and smooth hydraulic flow, which minimizes deposition. The disadvantage of the flume is that it cannot be used to measure flow in pipes under pressure. The Parshall flume offers the lowest level of accuracy of the three types of flowmeters described herein.

#### 3.6.9.4 Recommendation

Inline electromagnetic-type flowmeters are recommended for flow measurement for the following reasons:

- Smaller footprint than a Parshall flume.
- Higher performance and reliability than Doppler and Parshall flume.
- Low capital cost.
- Low maintenance.

Manufacturers for this type of flow meter include ABB, Krohne, Rosemount, and Endress+Hauser. It is anticipated that the influent flowmeters will be located on the two pipelines out of the headworks flow split structure.

The City is required to calibrate and verify the accuracy of all flow meters. The current calibration equipment only works with Siemens mag meters. The new flow meters will need to be able to be verified on-site, not requiring being sent to the manufacturer for verification. For these reasons, Siemens flow meters are recommended to match existing.

#### 3.6.9.5 Flow Meter Sizing and Location

Two flow meters will be provided, one upstream of the primary clarifier and one upstream of the oxidation ditch. The primary clarifier flow meter will need to be able to measure a range of flows from 0.3 mgd to 2.3 mgd and the oxidation ditch flow meter will need to be able to measure a range of flows from 0.3 mgd to 3.6 mgd. In general, solids-bearing liquids should have velocities between 3.0 to 10 feet/second for all flow ranges. Based on the flow ranges, an 8-inch nominal diameter magnetic flow meter is recommended for the primary clarifier and a 12-inch nominal diameter magnetic flow meter is recommended for the oxidation ditch. The flow meters should be pad mounted at grade and include valves for isolation. Piping should be arranged to keep the meter flooded at all times and to prevent liquid separation and the entrapment of air.

For best accuracy, a minimum of five pipe diameters upstream and two pipe diameters downstream of the flow meter are required. Complex piping arrangements should be avoided

such as multiple elbows, which causes swirling flows and greatly affect the meters' accuracy and flow rate.

## 3.7 Primary Clarifier Facilities

The condition of both Primary Clarifier Nos. 1 and 2 is poor to very poor based on the age, concrete corrosion, and cracking of the effluent launders. The interior coating on both units has failed and exposed the concrete to sulfide corrosion at the water surface. In the Facility Plan, it was noted that the structures likely cannot be rehabilitated for use with modern clarifier mechanisms and will need to be replaced due to age. The current recommendation is to further investigate whether the Primary Clarifier No. 2 mechanism can be rehabilitated or replaced. It is recommended that Primary Clarifier No. 1 be demolished.

### 3.7.1 Recommended Design Parameters

The design parameters for existing Primary Clarifier No. 2 are presented in Table 3.8.

Table 3.8 Primary Clarifier Design Parameters

| | Parameter | |
|---|---|---|
| Diameter, ft | 60 | |
| Side Water Depth, ft | 12 | |
| | **Future Average Dry Weather Flow** | **Peak Wet Weather Flow** |
| Flow Rate, mgd | 1.3 | 2.3 |
| Overflow Rate, gpd/SF | 460 | 813 |
| Typical Range, gpd/SF | 800 - 1,200 | 2,000 - 3,000 |
| Weir Loading Rate, gpd/LF | 6,897 | 12,202 |
| Typical Range, gpd/LF | 10,000 - 40,000 | |
| Solids Loading Rate, ppd/SF | 1.02 | 1.77 |

The existing 60 foot diameter clarifier has center fed with peripheral drawoff sludge hoppers and scum removal and will have the following rehabilitation:

- If possible, repair the clarifier mechanism structure and blast and recoat the sludge collection mechanism, including center column, skimmer arm, and scum beach.
- Or replace the clarifier mechanism.
- New launders with fiberglass v-notch weirs, fiberglass scum baffle.
- Effluent drop-box stainless steel isolation gate.
- Repair of spalled concrete.
- A spray-on protective coating will be specified for all concrete surfaces from the top of the wall to three feet below the water surface level to provide protection for the concrete.
- At grade new primary sludge pump station with duty and standby progressing cavity sludge pumps.
- At grade new scum pump station with duty and standby chopper pumps to provide mixing, decant, and scum transfer.

### 3.7.2 Sludge and Scum Pumping System

The circular clarifier sludge collection mechanism moves primary sludge from the bottom of the clarifier into a central sludge hopper located near the center column. The existing primary sludge pumping system pumps 5,440 gal/day of primary sludge from the primary clarifiers to the digesters. Two new progressive cavity pumps (one duty + one standby) with a capacity of 50 gallons per minute (gpm) each will be installed at grade to pump the sludge from the hopper to the digesters via glass-lined ductile iron pipes. The pump will run intermittently though out the day. The pumps and piping may be designed to pump primary sludge to the new thickener for co-thickening with secondary solids.

Primary scum will be collected from the new primary clarifier and drain to the existing scum well adjacent to the clarifier. A chopper pump will provide mixing, decant, and scum transfer.

## 3.8 Recommended Facility Design Criteria

Table 3.9 summarizes design criteria for the recommended influent pump station, headworks, and primary treatment facilities.

Table 3.9 Summary of Recommended Design Criteria

| | Design Criteria |
|---|---|
| **Flow Criteria** | |
| Minimum Flow | 0.3 mgd |
| Future Average Dry Weather Flow | 1.3 mgd |
| Future Peak Dry Weather Flow | 2.2 mgd |
| Future Max Month Flow | 3.6 mgd |
| Peak Wet Weather Flow | 5.9 mgd |
| **Influent Pump Station** | |
| Capacity | 8.5 mgd |
| Firm Capacity with Largest Unit Out of Service | 6.0 mgd |
| Type of Pumps | Non-clog Submersible |
| Number Pumps | 4 |
| Pump Capacity | 3 @ 2.5 mgd, 1 @ 1.0 mgd |
| **Screenings Facilities** | |
| Capacity, each | 3.0 mgd |
| Number of Channels and Screens | 3 |
| Type | Two Chain Driven Multi-rake and One Manual |
| Screen Opening | 3/8 in |
| Channel Width | 2 ft |

Table 3.9 Summary of Recommended Design Criteria (Continued)

| | Design Criteria |
|---|---|
| Velocity Through Screens | |
| Current Average Dry Weather Flow | 2.0 fps |
| Future Average Dry Weather Flow | 2.5 fps |
| Peak Wet Weather Flow | 4.5 fps |
| Screenings Washer Compactor Type | Water Sprays and Dewatering Screw |
| Screenings Conveyor Type | Shaftless Screw |
| **Grit Removal** | |
| Grit Removal Basin Type | Mechanically Induced Vortex |
| Number of Basins | 1 |
| Size | 12-foot Diameter |
| Floor Slope, vertical: horizontal | 1:1.75 |
| Rated Capacity, each | 12 mgd |
| **Grit Pumps** | |
| Type | Recessed Impeller |
| Number of Pumps | 2 (1 duty + 1 standby) |
| Grit Dewatering | |
| Type | Cyclone Classifier |
| Number | 1 |
| **Primary Clarifier (Rehabilitated)** | |
| Number of Units | 1 |
| Type | Circular |
| Diameter | 60 ft |
| **Overflow Rate** | |
| Current Average Dry Weather Flow | 389 gpd/sf |
| Future Average Dry Weather Flow | 460 gpd/sf |
| Sludge Pumping | |
| Number of Pumps | 2 |
| Pump Type | Progressive Cavity |
| Capacity, each | 50 gpm |
| **Flow Metering** | |
| Number of Units | 2 |
| Meter Type | Magnetic Flow Meter |
| Meter Size | 12-inch and 8-inch Nominal Diameter |

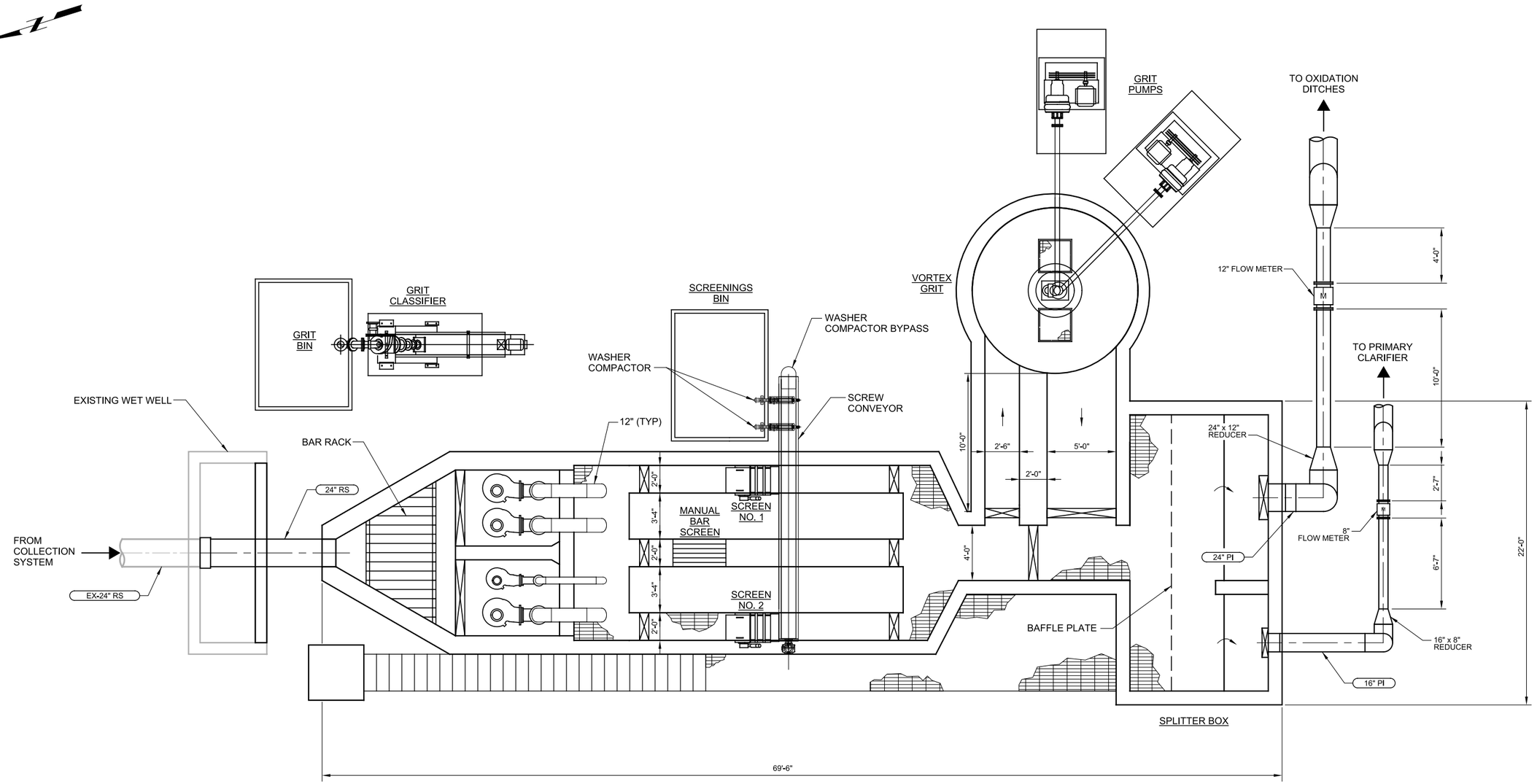
### 3.8.1 Site Layout

The proposed location of the new influent pump station and headworks facility is at the site of the existing headworks. This location is recommended since it is positioned at location of existing influent sewer and there is not space on the plant site to easily relocate the headworks. The land north of the existing headworks is not available due to limited space between the Generator Building, the fence line, and setback from the slough. In addition, the existing influent sewers and effluent pipelines below grade limit space or would have to be relocated.

For construction phasing, the intent is to bypass the headworks to Primary Clarifier No. 1 using a portion of the existing influent wet well and the Influent Storm Pump. The Primary Clarifier No. 2 upgrades and the headworks replacement construction should not be concurrent. Primary Clarifier No. 2 should be upgraded and then used to capture grit and solids while the headworks is offline. This construction activity will have to occur during dry weather. Once the new headworks is online, Primary Clarifier No. 2 can be taken out of service for girt removal.

It is possible to pump directly from the First Street Pump Station to the oxidation ponds for bypassing the headworks during construction. However it will likely be beneficial to send all flows that bypass the headworks to Primary Clarifier No. 1 to limit grit and solids sent to the ponds. The plan and section for the proposed headworks is presented in Figure 3.9 and 3.10.

File: E:\ICSforPDFWorking\168477794338_1\9913B10FIG3.9.dgn
Plot Date: 31-MAY-2018 10:30:02 AM
User: svcPW



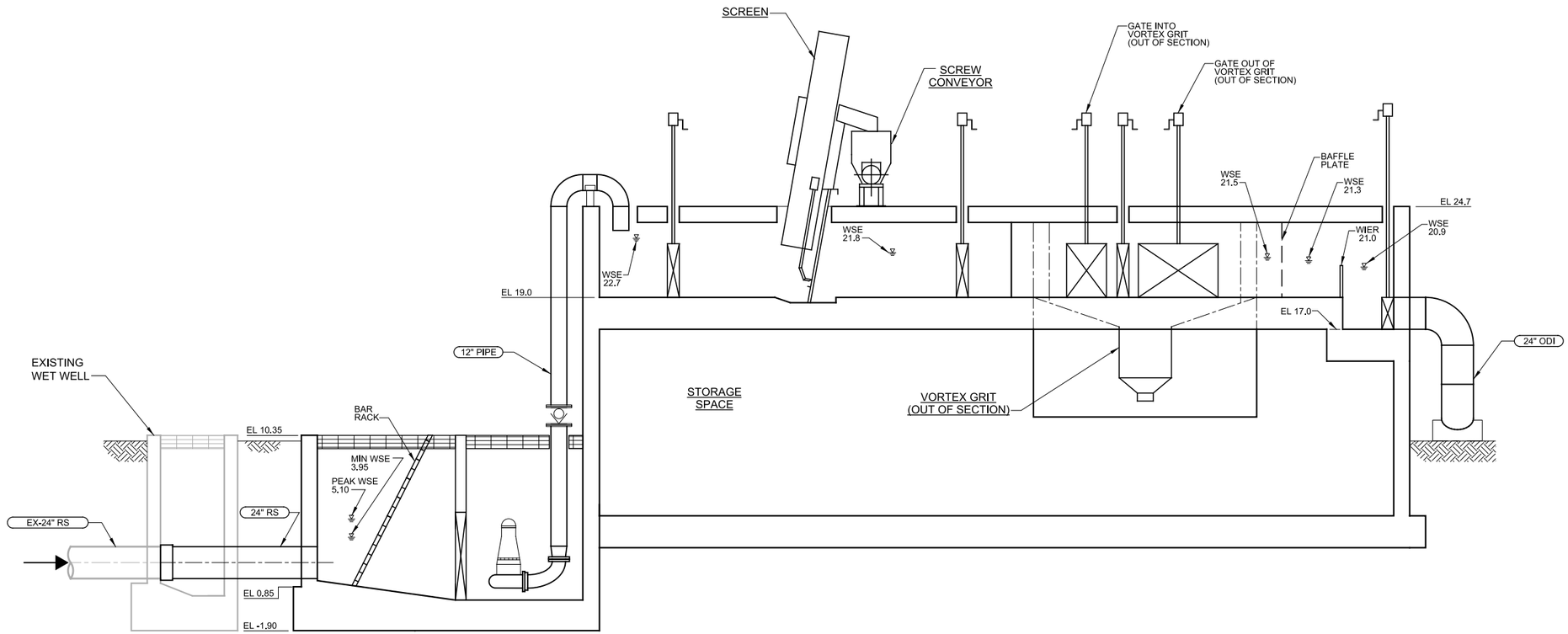

**A** - **HEADWORKS PLAN**
SCALE: 1/8"=1'-0"
FILE: 9913B10000M110

**Figure No. 3.9**
**HEADWORKS PLAN**
CITY OF ARCATA

carollo

GENERAL NOTES:

1. WATER SURFACE ELEVATIONS AT PEAK WET WEATHER FLOW.




B 3.9 **HEADWORKS SECTION**
SCALE: 1/8"=1'-0"
FILE: 9913B10FIG02.2dm

**Figure No. 3.10**
**HEADWORKS SECTION**
CITY OF ARCATA

carollo

File: E:\ICSforPDFWorking\278511794338_2\9913B10FIG3.10.dgn
Plot Date: 08-AUG-2018 2:43:42 PM
User: svcPW

Appendix A

# EQUIPMENT BROCHURES

# Headworks Process Equipment









ISO 9001 CERTIFIED
WesTech
Quality System

WESTECH
Process Equipment. Process Driven.

# Get More Out of Your Headworks



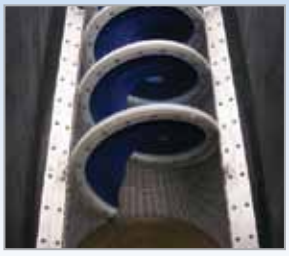
WesTech engineers and manufactures a full line of headworks equipment. Our experience and our service-driven approach help you find the right solutions to get the most out of your headworks. The more debris and grit you can remove, the more efficient your downstream equipment and processes will become. Your wastewater treatment facility will save time and money with WesTech preliminary treatment equipment.

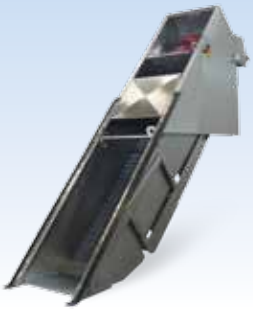
## *Getting the Job Done with Experience and Options*

Since every job is unique, we take a comprehensive approach by assessing conditions and determining the particular requirements of downstream equipment and processes. The result is improved solids removal even when circumstances are less than ideal.

With multiple options in equipment selection, WesTech provides the best solution to your particular needs. With hands-on experience and hundreds of installations, we are committed to providing timely and practical consultation from initial design through project startup.











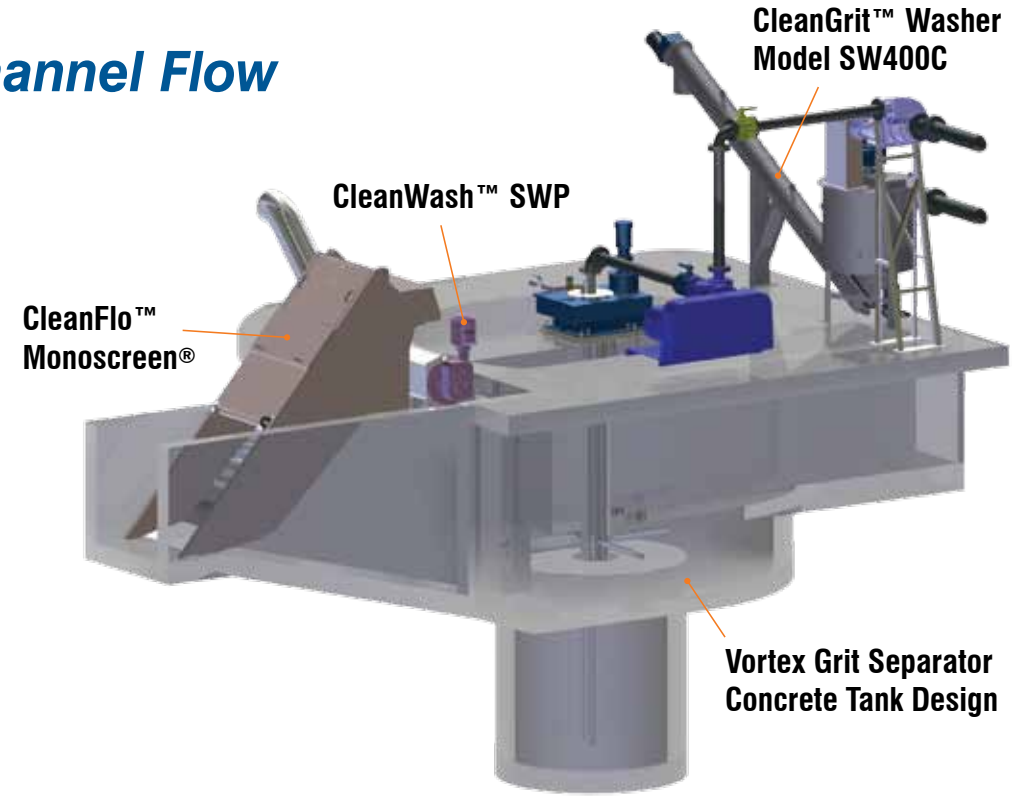
## *Building Upon the Past, Designing for the Future*

WesTech's efficient and intelligent designs are a result of years of engineering and manufacturing within municipal and industrial markets. This experience creates the best solution — and the best value — for our customers.

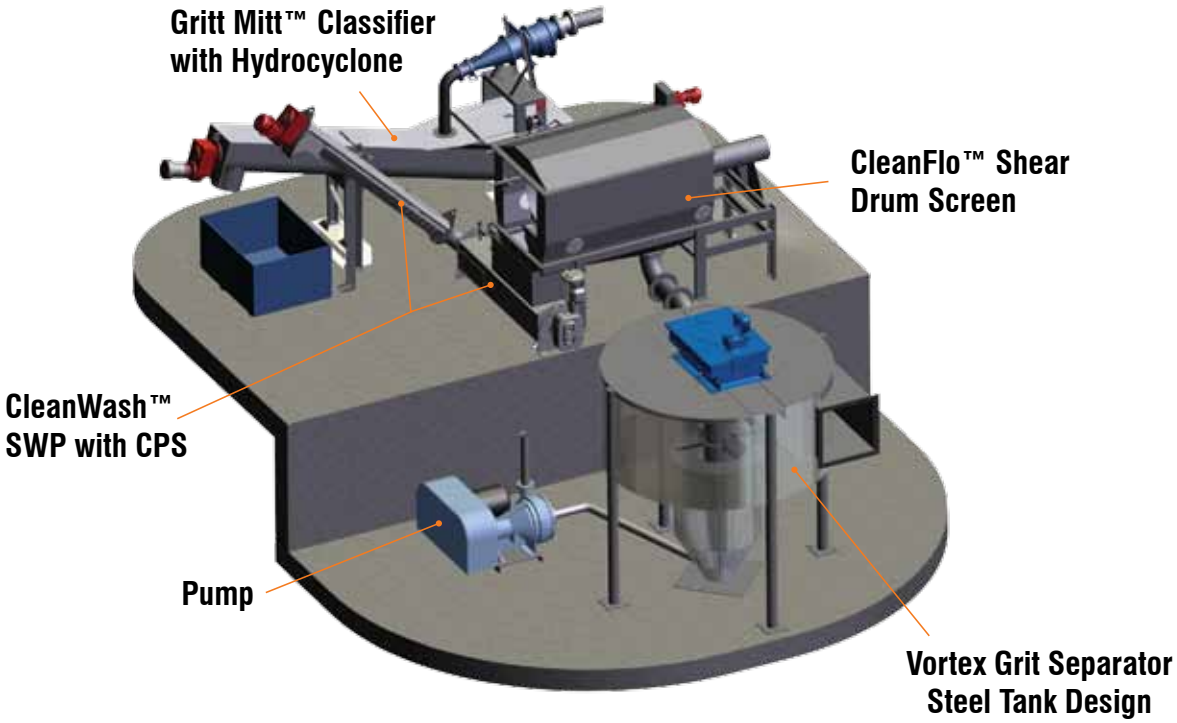
- **Shaftless spiral screens**
- **High capture filter step screens**
- **Internally fed rotary drum screens**
- **Controllable pressure for maximum screenings washing and dewatering**

*WesTech provides single-source systems for your headworks specifications. Whether in-channel gravity or pumped flows, WesTech can apply the right equipment solution for both large and small installations.*

## In-Channel Flow




## Pumped Flow



# Screening

***Screening is the first step in every headworks operation. The efficient removal of solids ensures proper protection to your downstream equipment and plant processes.***



- **Shaftless spiral operation**
- **Openings 3 – 6 mm**
- **Installed in channels or tanks**

## *CleanFlo™ Spiral*

For plants with flows under 10 MGD, the WesTech CleanFlo Spiral screens, conveys, and dewaters simply and economically in a single unit. The stainless steel screen basket is automatically cleaned by durable segmented brushes attached to the shaftless spiral auger. An expanded discharge zone provides unrestricted solids discharge and the hinged top mounted door allows clean and easy access.



## *CleanFlo™ Vertical Spiral*

Specifically designed in a vertical orientation, the CleanFlo Vertical Spiral is ideal for pump wetwells or confined short channels. The screen is composed of a cylindrical 3 or 6 mm perforated basket with an integral shaftless spiral and conveyor tube. The unit provides screening and conveyance of solids and can provide additional dewatering of material.

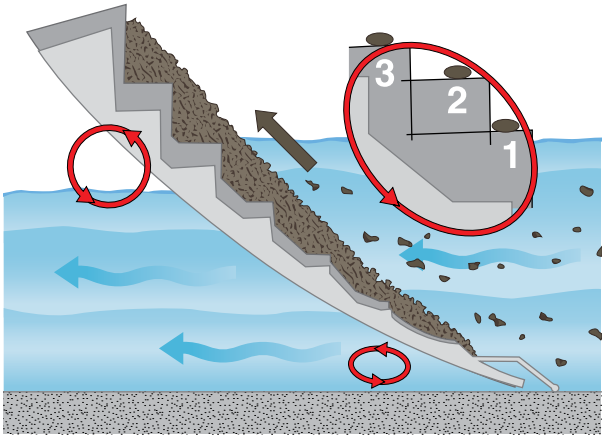
- **Vertical conveyance**
- **Optional rail support allows removal without entering wetwell**
- **Pump station screen**
- **Comminutor replacement**





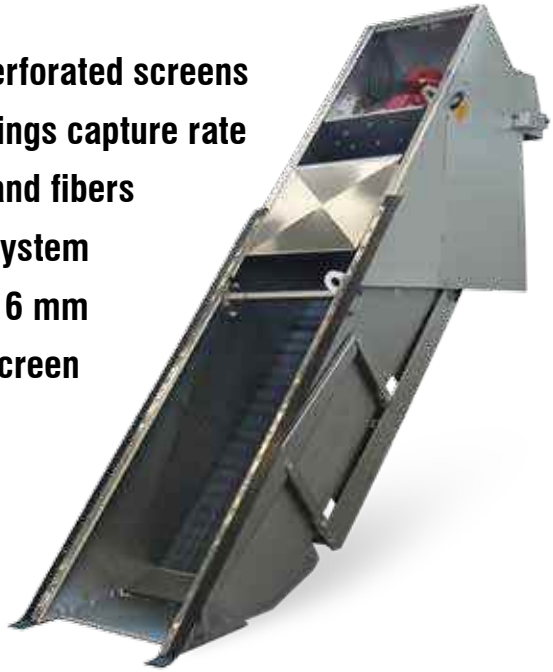
## CleanFlo™ Monoscreen®

The CleanFlo Monoscreen works on the same principle as a precoat filter. The screened material forms a mat that bridges the bars. The formation of this mat efficiently captures particles smaller than the bar opening, while still allowing flow to pass. The unique motion and progressive step design of the Monoscreen minimizes the "cleaning breakthrough effect" resulting in a 50% higher capture rate than traditional step screens.




*The blades in the lower part of the unit move in an elliptical horizontal motion, while the blades in the upper section move in the traditional circular motion. This progressive motion moves the captured solids (precoat solids) up the screen at a slower and more even rate.*

- **Outperforms perforated screens**
- **Highest screenings capture rate**
- **Removes hair and fibers**
- **Linkage drive system**
- **Slot widths 1 – 6 mm**
- **Patented fine screen**





## CleanFlo™ Rotoscreen®

Designed specifically for facilities with limited space, the CleanFlo Rotoscreen delivers powerful results while managing high flow.

- **Ideal for limited space**
- **Slot widths 1 – 6 mm**
- **Robust screen design**
- **High capacity**
- **Available with simple chain drive or linkage system**



# Screening

## *Internally Fed Rotary Drum Screens*
## *CleanFlo™ Shear*

Drum screens eliminate debris carryover. Other moving media screens experience some carryover due to inefficient cleaning, lower seals, or poor distribution. Drum screens keep all of the debris inside the rotating drum until it is discharged.

- **Rugged direct drive unit**
- **Protects debris-sensitive membranes**
- **Ease of maintenance**
- **Low operating costs**





## *Direct Drive for Drum Screens*

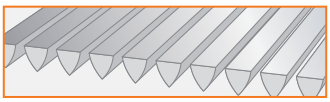
By eliminating the chain drive, WesTech removes common problems such as chain stretch, chain corrosion, chain lubrication, and tracking problems.

Maintenance is simplified and the annual or biannual expense of chain replacement is eliminated.

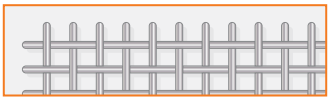
## *Applications:*

- **Pre-MBR screening — no bypass or carryover of solids for maximum protection of membranes**
- **Preliminary treatment**
- **Sludge thickening — with chemical addition**
- **Single screen throughput up to 20 MGD**

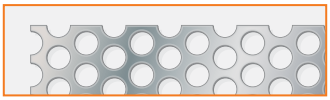
## *Screen Mediums*



Wedge Wire
0.010 – 0.120”



Woven Mesh
0.5 – 1 mm



Perforated Plate
0.6 – 25 mm

## *CleanFlo™ Infloscreen*

Internally fed drum screening with the convenience of in-channel installation.

- **In-channel installation**
- **Inclined and horizontal orientations**
- **Low operating costs**



## *Deep Channel Screens*
## *CleanFlo™ MultiRake Bar Screen*

The CleanFlo MultiRake Bar Screen is a strong, versatile, and economical fine or coarse screen with bar spacing available from 6 – 50 mm (0.25 – 2 inches). The screen is ideal for a wide range of channel sizes — up to 13 feet wide and 50 feet in depth, with installation angles from 70 – 80 degrees.

A single screen has the ability to handle flows over 150 MGD. The rake speed is available at a fixed rate or adjustable via VFD control. This ensures fast cleaning and eliminates the risk of flooding during high flow events.





- **Strong multiple rake design**
- **Eliminate upstream coarse screens**
- **High screenings load without high headloss**
- **Rake speed up to 50 ft/min**
- **Designed to automatically clear jams**
- **Variable speed operation to handle storm flows / high flow events**

## *CleanFlo™ Element Screen*

The CleanFlo Element Screen features a unique self-cleaning action of the filter elements, making the screen suitable for a wide range of flows. The Cleanflo Element is ideal for screening of particles from 1 – 30 mm in size in deep channels.

Like most screens, the operation is intermittent and based on water level. As debris builds on the screen media and the water level rises, the screen media advances to present a clean screen surface to the incoming flow. Slowly, the debris will be lifted to the top of the screen. At this point the fingers of the screen retract within each other and are efficiently scraped clean.

- **No submerged bearings**
- **Self-cleaning elements**
- **Inclinations up to 85 degrees**



# Screenings Washing and Dewatering



## *CleanWash™ SWP/CPS*

Unlike screw wash presses in which the design of the discharge pipe creates the back pressure necessary to dewater screenings, WesTech's CleanWash Screw Wash Press and Counter Pressure Screw regulates just the right amount of back pressure to meet the highly variable influent. The positive conveyance of the screenings after each washing cycle delivers up to 70% dry solids without fear of plugging through 10, 20 or even 30 feet of discharge piping.





*75% less weight per cubic foot*





- **Superior dewatering**
- **Dry solids content of up to 70%**
- **Volume reduction of up to 80%**
- **No plug = No plugging**
- **Patented CPS design**

## *CleanWash™ SWP*

Using a conventional discharge pipe, the CleanWash SWP is capable of producing light gray, relatively odorless material without using expensive, maintenance-intensive mechanical agitators.



# Grit Removal

## *Vortex Grit Separator*

The WesTech Vortex Grit Separator is a forced-vortex type grit separator. The influent enters the vortex chamber tangentially and flows around the upper chamber, exiting at either 270 or 360 degrees from the influent point.

The main advantage of this type of separator is that its footprint is much less than other types of grit separators such as aerated grit chambers and detritors.

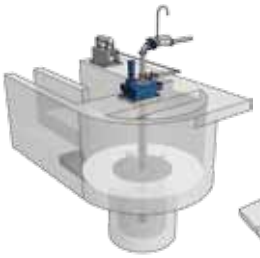




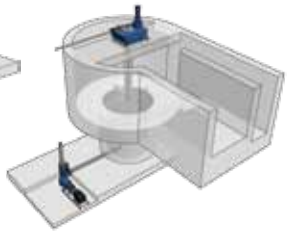
## *Pump Options*



***Self-Priming Pump***



***Air Lift Pump***



***Flooded Suction Pump***

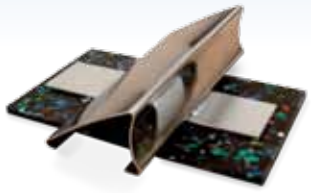
## *ZICKERT Shark™ Grit Removal*

The ZICKERT Shark bottom scraper is a proven design to continuously remove and transport grit to a hopper or sump. The Shark is based on the forward and return movement of the hydrodynamically designed scraper profiles.

- **Few moving parts**
- **Low maintenance**
- **Optional grease removal skimmer**
- **Easy to adapt to existing tanks**
- **Replaces submerged screws or chain and flight systems**

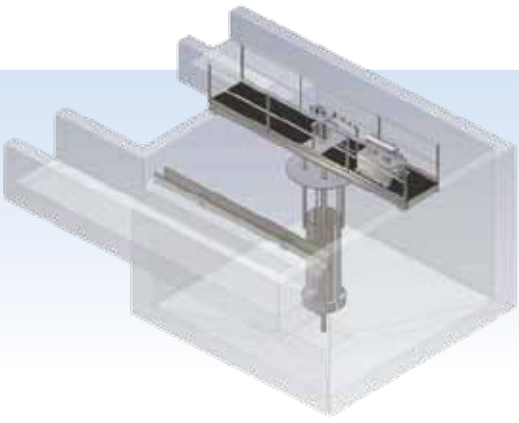


*The specially designed scrapers are welded together to form a single unit so it functions as a moving floor in the tank. The Shark is easy to install and requires very little maintenance.*



## *Aerated Grit Chamber*

This style of grit separator uses air injection to create a rolling pattern in the chamber causing heavy solids to settle to the floor and lighter organics to remain in suspension.



# Grit Washing and Dewatering

## *CleanGrit™ Washer*

WesTech CleanGrit products remove organic matter from grit collected at the headworks of a wastewater plant. Unwashed grit can consist of up to 80% organics.

Removal of the organic matter from grit will reduce disposal costs and nuisance odor complaints while improving biological plant processes. WesTech offers the largest variety of grit washing systems available in the North American market.

- **Less than 5% organics discharge**
- **Dry solids discharge greater than 85%**
- **Odor reduction**
- **Reduce grit disposal by 50%**





## *CleanGrit™ SW400C*

The CleanGrit™ Model SW400C rinses organic matter from dewatered grit or a concentrated grit slurry by incorporating a hydrocyclone. Organic matter is loosened mechanically by an agitator and rinsed by an upcurrent backwash water process. Cleaned grit is discharged by the shaftless spiral conveyor for disposal.

The CleanGrit Model SW400C is our most compact model to wash organic material from dewatered grit.

## *CleanGrit™ SWA Series*

The CleanGrit SWA Series is designed to dewater and wash grit from grit collection tanks, without the need for a hydrocyclone.

The SWA series features multiple sizes of washing tanks and disposal screws to meet a wide variety of flows and solids loading.

- **Flows of up to 500 gpm**
- **Solids handling capacities of up to 100 cubic feet per hour**



## Gritt Mitt™ Classifiers

The WesTech grit removal system is not only available with the CleanGrit Washer but is also offered with either the WesTech Gritt Mitt Shaftless or Shafted Grit Classifier. The WesTech classifiers are designed with a range of hopper sizes, screw diameters, and screw lengths to meet any specification. The classifier system produces very good quality dewatered grit suitable for most landfills.

The WesTech classifier can be equipped with a hydrocyclone to optimize performance in systems with mechanical grit pumps.

The cyclone reduces the flow entering the classifier hopper by 80 – 90% and allows a smaller footprint to be used to handle the same pumped flow.



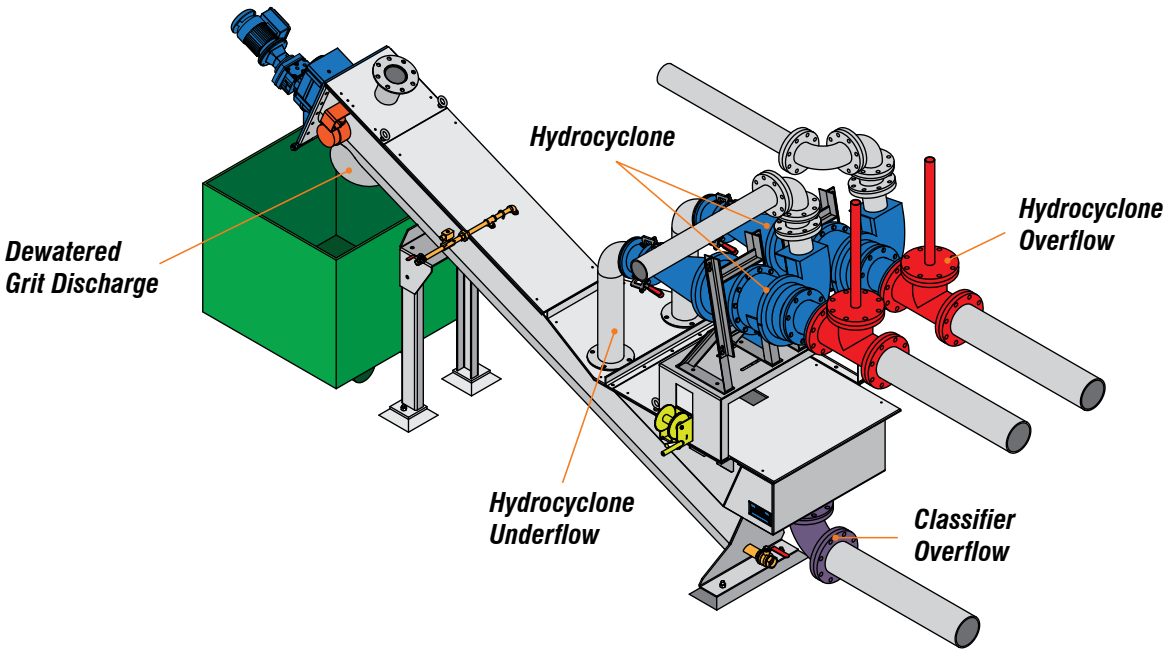


## Gritt Mitt™ Shaftless Classifier

- **No submerged bearing**
- **Hardened carbon steel or stainless steel shaftless screw**
- **Screw supported by stainless steel wear bars**

## Gritt Mitt™ Shafted Classifier

- **Heavy duty design perfect for high capacity applications**
- **Continuous operation allows increased solids transport**
- **Optional wear shoes available**



# Specialty Systems

## *CleanFlo™ All-In-One*

The CleanFlo All-In-One unit combines screening, grit removal, and solids dewatering all in a single system. The CleanFlo All-In-One is suitable for indoor or outdoor installation with capacities from 0.3 – 3 MGD.

- **Integrated approach**
- **Small footprint**
- **Eliminates complex concrete structures**



## *Septage Receiving*

WesTech supplies packaged systems specifically designed for septage receiving applications. These versatile units can be especially beneficial when haulers discharge downstream of the plant headworks, or at remote plant entry points.

### *Optional features include:*

- **Magnetic flow meter**
- **Hauler access station**
- **Management software for full integration, tracking, billing and record keeping**
- **Automated rock removal**



## *See more WesTech process equipment at: westech-inc.com*

Aerators
Anaerobic Digestion
Biological Treatment
Clarification
Combined Sewer Overflow
Dewatering
Dissolved Gas Flotation
Drive Units
Filtration
Flocculation
Headworks
Membranes
Oil / Water Separators
Package Plants
Residuals Handling
Septage and Receiving
Thickeners
Parts and Field Service
Systems and Turnkey
Laboratory Testing

WesTech
*Process Equipment. Process Driven.*

Tel: 801.265.1000
westech-inc.com
info@westech-inc.com
Salt Lake City, Utah, USA

Represented by:

© WesTech Engineering, Inc. 2012

HUBER TECHNOLOGY
WASTE WATER Solutions

# Multi-Rake Bar Screen RakeMax®




Sturdy bar screen with traveling rakes:

– for coarse to fine screening
– for combined or separate sewer systems
– for deep and very deep channels
– for high screenings loads

# Features

The RakeMax® is a bar screen with a spacing from $^1/_4$" to 6" (6 to 150 mm). Its bars have either a streamlined tear drop profile (spacing ≤ 12 mm) or a rectangular shape (spacing > 12 mm).

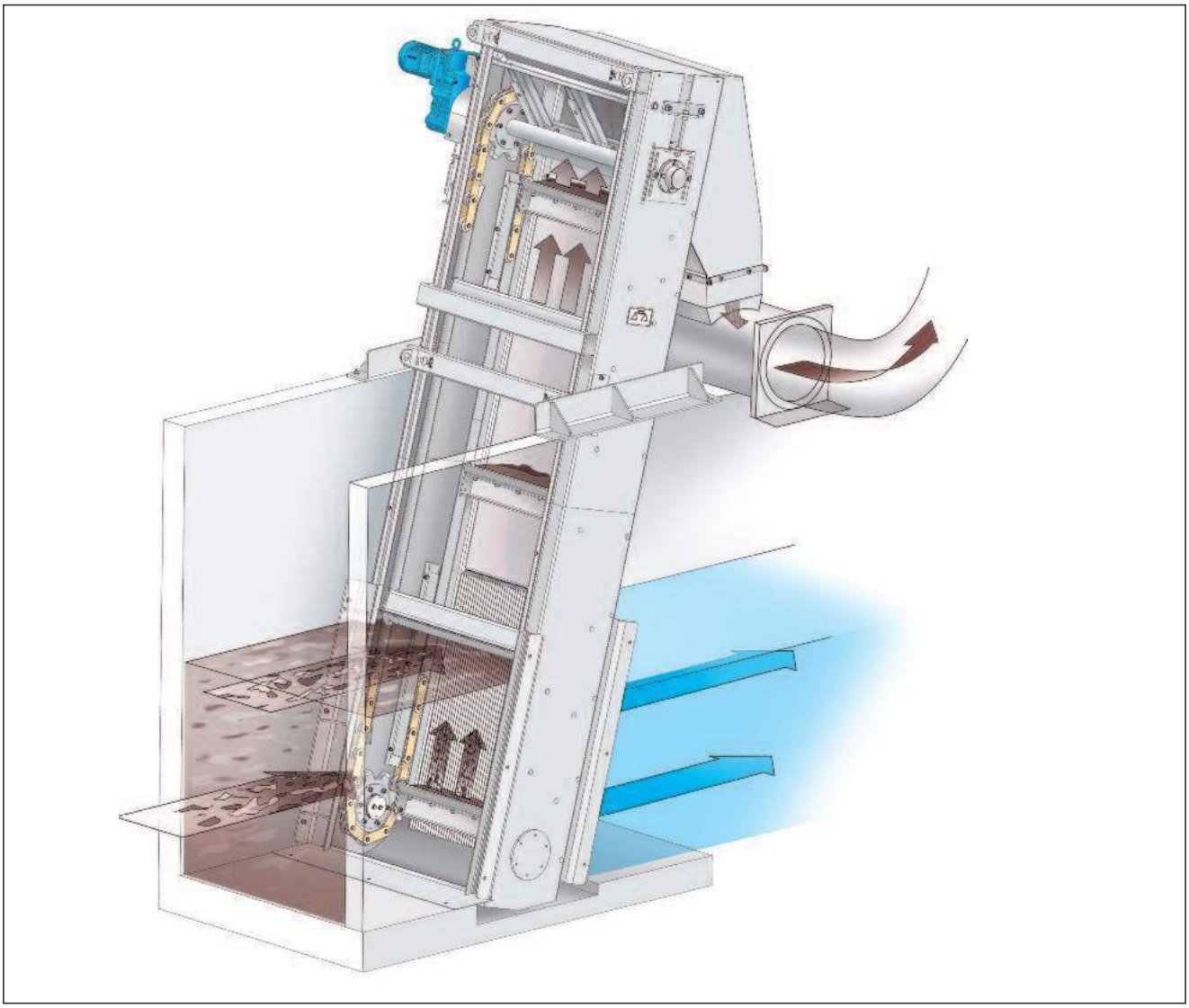
The bar rack is an integral part of the sturdy frame, which ensures perfect meshing of the rake teeth with the bar spaces. Positive and reliable cleaning is thus guaranteed.

A multitude of rake bars are bolted at selectable distances to a pair of drive chains. With short distances between its rakes, the RakeMax® is able to remove extremely high screenings loads. The rake blades are made of sections that are bolted to the rake bars, thus facilitating easy replacement of a segment in case that its teeth should become damaged or worn.

Chain rollers, made of wear-resistant polyamide, guide the chains exactly within the frame. The chains are driven by a pair of cogwheels. The plastic rollers also prevent wear between the chains and the cogwheels. The drive is connected with the frame through a spring; if the torque exceeds a certain value, due to any obstruction in the bar rack, a switch is pushed and the movement is reversed back and forth until the obstruction is loosened. Should the obstruction persist several reversals, an alarm is triggered. Self-destruction of the screen is thus prevented.

Chains and cogwheels are made of hardened, zinc galvanized and chromated steel to combine great wear-resistance with excellent corrosion-protection. They are also available in stainless steel. The maintenance-free ceramic bearings of the lower cogwheels are well-proven in thousands of ROTAMAT® installations.

The RakeMax® has a small height above the operating floor. In spite of its outstanding discharge height of up to 65 ft (20 m) above the channel floor, the RakeMax® fits into virtually any building.



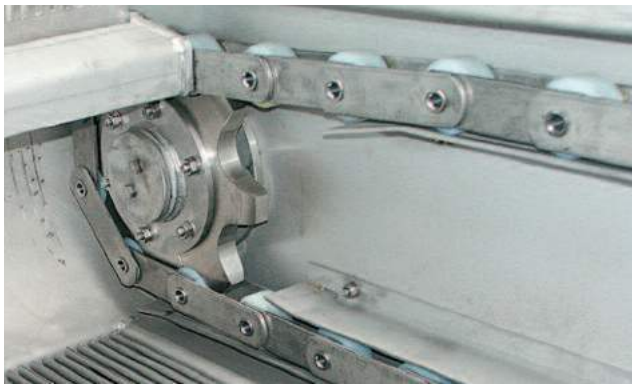
## Benefits

- Fine to coarse screen with low head loss
- Removal of extremely high screenings loads
- Unimpaired by grit
- Low height above operating level
- Enclosure prevents odor nuisance
- Frame-mounted bar rack for exact rake engagement and reliable cleaning
- Mechanical overload-prevention and automatic reverse
- Easily accessible chain tensioning system
- Independently replaceable rake bars and blade sections
- Well-proven, maintenance-free lower ceramic bearings
- Sturdy design, excellent manufacturing with small tolerances
- Made of stainless steel, pickled in an acid bath for perfect finishing and corrosion protection

## Details



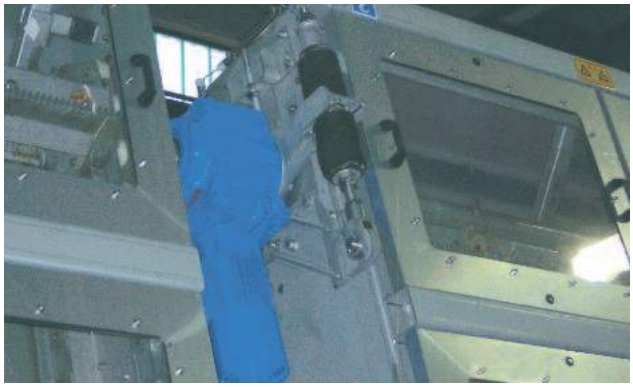
*Traveling rakes are bolted to the drive chains; individual sections of the rake blades can be exchanged in case that teeth should become damaged or worn; the ceramic bearings are maintenance-free (no lubrication)*



*Cog wheel and chain are made of hardened, wear-resistant steel that is zinc -galvanized and chromated for long-term corrosion protection; alternatively, wheels and chains can be made of stainless steel*



*Bar rack with a spacing of 1/4 inch (6 mm); the bars have a streamlined tear drop profile resulting in low head loss and avoiding jamming; RakeMax screens are unimpaired by grit and gravel*



*A torque restrictor reliably protects the screen against damage. The screen's controls combine reliability with adjustability.*

## Installation Examples




*60 ft long and 6 ft wide RakeMax after successful factory testing*




*Complete enclosure for odor control; the chain tensioning system at the side of the frame is easily accessible*

## Applications

The RakeMax® is the ideal screen for the following applications:

- Combined sewer systems
- Deep to very deep channels
- High screenings loads
- Combined sewer overflows (CSO) and sanitary sewer overflows (SSO)



*1/4 inch (6 mm) RakeMax feeding into a Super-Launder Washpress WAP/SL for perfect screenings washing and compaction*

## Dimensions

| | |
|---|---|
| Bar spacing: | ≥ 1/4" (≥ 6 mm) |
| Channel width: | Up to 13.1 ft (4 m) |
| Discharge height above channel floor: | Up to 65 ft (20 m) |
| Inclination: | 70° to 85° |


## HUBER TECHNOLOGY, Inc.

9735 NorthCross Center Court STE A · Huntersville, NC 28078
Phone: (704) 949 - 1010 · Fax: (704) 949 - 1020
huber@hhusa.net · http://www.huber-technology.com



Subject to technical modification
0,0 / 7 – 3.2011 – 8.2004


HUBER Multi-Rake Screen
RakeMax®

50 YEARS of EXCELLENCE

JMS

JIM MYERS & SONS, INC.

# Bio-SCREW
## Screw Conveyor System

Proven ... Process ... Performance

*Drive Assembly*







*Shafted Screw*

JIM MYERS & SONS, INC.

Since being established in 1962, Jim Myers & Sons, Inc. (JMS) has grown continually and today is recognized as one of the nation's leading designers and manufacturers of water and wastewater treatment equipment and systems. We have reached this point by incorporating equal parts innovation, quality and reliability into every component bearing the JMS name. We maintain that leadership position through one of the most comprehensive, solution-driven product offerings available.



Utilizing the latest software for BIM-compliant mechanical and structural design with commercial and proprietary analysis programs, our professional engineering staff makes concepts reality by providing solutions to complex problems.




True to our roots, our 72,000 sq. ft. Charlotte facility is the site for all fabrication, manufacturing, machining, and testing. There, the JMS commitment to excellence, a part of our DNA, manifests itself every day with the promise to continue for generations to come.

# Bio-SCREW
## Screw Conveyor System

### *Proven ... Process ... Performance*

It is not possible to sum up in a few words what has taken better than half a century to achieve, but these three come the closest. Our Bio-SCREW (Screw Conveyor System) design is already proven in applications throughout the U.S. and abroad. JMS in-depth knowledge of both the water and wastewater treatment markets allows us to fully understand your process and provide solutions like the Bio-SCREW, solutions designed with operational efficiency in mind. Like all JMS products, our Bio-SCREW offers an unsurpassed level of performance geared around the longest possible component life and the lowest maintenance demands of any comparable system.

Just three words: Proven, Process, Performance, speak volumes. JMS has the answers you want, the solutions you need, and the support you deserve.



*Bio-SCREW Installation in Sacramento, CA*

### *Positive Progress*

Screw technology has a long history of usefulness. Screw conveyors are currently used in many industries as they represent one of the most flexible bulk material conveyance methods available. Simple in design, the conveyor screw initiates a smooth, continuous forward movement of material. Both shafted and shaftless screw conveyors are used in the municipal water and wastewater industries to convey dewatered biosolids, sludge, screenings or grit.

Screw conveyors are compact in design, and are easily adapted to congested locations for conveyance of materials in the horizontal, inclined, or vertical directions. They offer several advantages for environmental applications such as total enclosure of materials for odor and spillage control, and the ability to handle a wide variety of materials from wet to dry, and slow-moving to free-flowing.



*Conveyor Analysis Software*

Screw conveyors are available in a variety of materials of construction. The ability to have multiple entry and discharge points and many options for flow control often make this type of conveyor a key component of larger material handling systems.

## Why Use a Screw?

JMS is one of the largest and most established suppliers of screw conveyors for municipal and large industrial applications in North America. We use our extensive knowledge of conveyors and systems to provide custom solutions that can save dollars and maximize operational efficiency. JMS Bio-SCREW conveyors are manufactured to accepted CEMA standards, taking advantage of JMS half century of design and manufacturing experience. JMS can design shafted or shaftless conveyors in multiple configurations to meet the needs of your process, and provide heat tracing and insulation if desired. Using the latest in materials and manufacturing technology, hundreds of JMS Bio-SCREW conveyors are still in operation.

## Advantages: Bio-SCREW

- Shafted and shaftless designs available in several configurations and live bottom
- Complete enclosure during conveyance eliminates spilling and odors, so less housekeeping is required
- Perfect for congested locations
- Wide range of capabilities, with multiple inlets and discharges as needed
- Can handle high temperature, abrasive, and sticky materials
- Wide capacity range, and can be used to mix or meter materials
- Special safety features

## Advantages: JMS

- Professional Engineers on staff
- Integrated solutions provider
- Use of Conveyor Analysis Design Software for conveyors of most any length, geometry, or drive configuration
- CEMA manufacturer, JMS high level of CEMA involvement helps set standards for the future
- Project management expertise
- Experienced service personnel and OEM replacement parts available
- Longevity with hundreds of conveyors currently in service



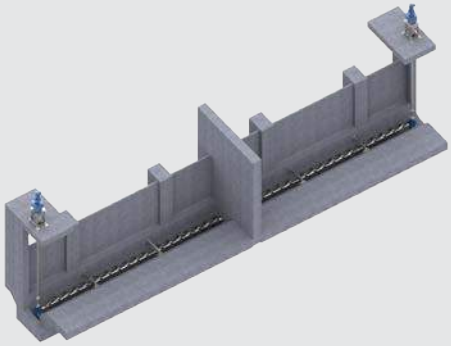
*Horizontal*



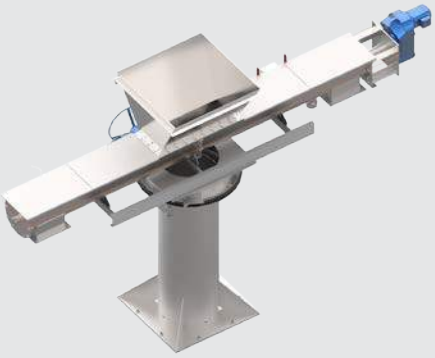
*Inclined*



*Horizontal to Inclined*



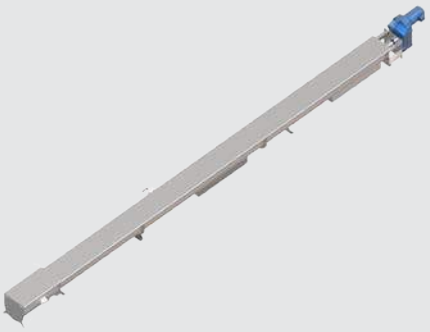
*Submerged Screw*



*Center Pivot*



*Tail Pivot*



*Compacting Head*



*Truck Load-Out*

## Shafted Screw Conveyors



### Shafted Screw

A robust versatile option that can handle a variety of highly abrasive and viscous materials. The best choice for systems that need reversing capabilities.



### CEMA 226 Hanger Bearing

Designed for flush mounting inside the trough, this configuration promotes contaminant-proof operation and reduces the obstruction of material flow in high capacity conveyors.



### JMS Flexible Hanger Bearing

This special JMS stainless steel flexible element accommodates misalignment of the shaft and has a longer service life than a standard CEMA 226 journal bearing.



### Covers

- Numerous cover hold down mechanisms are available ranging from bolted to spring and toggle clamps
- A full range of options allows JMS to configure equipment to meet your specific needs

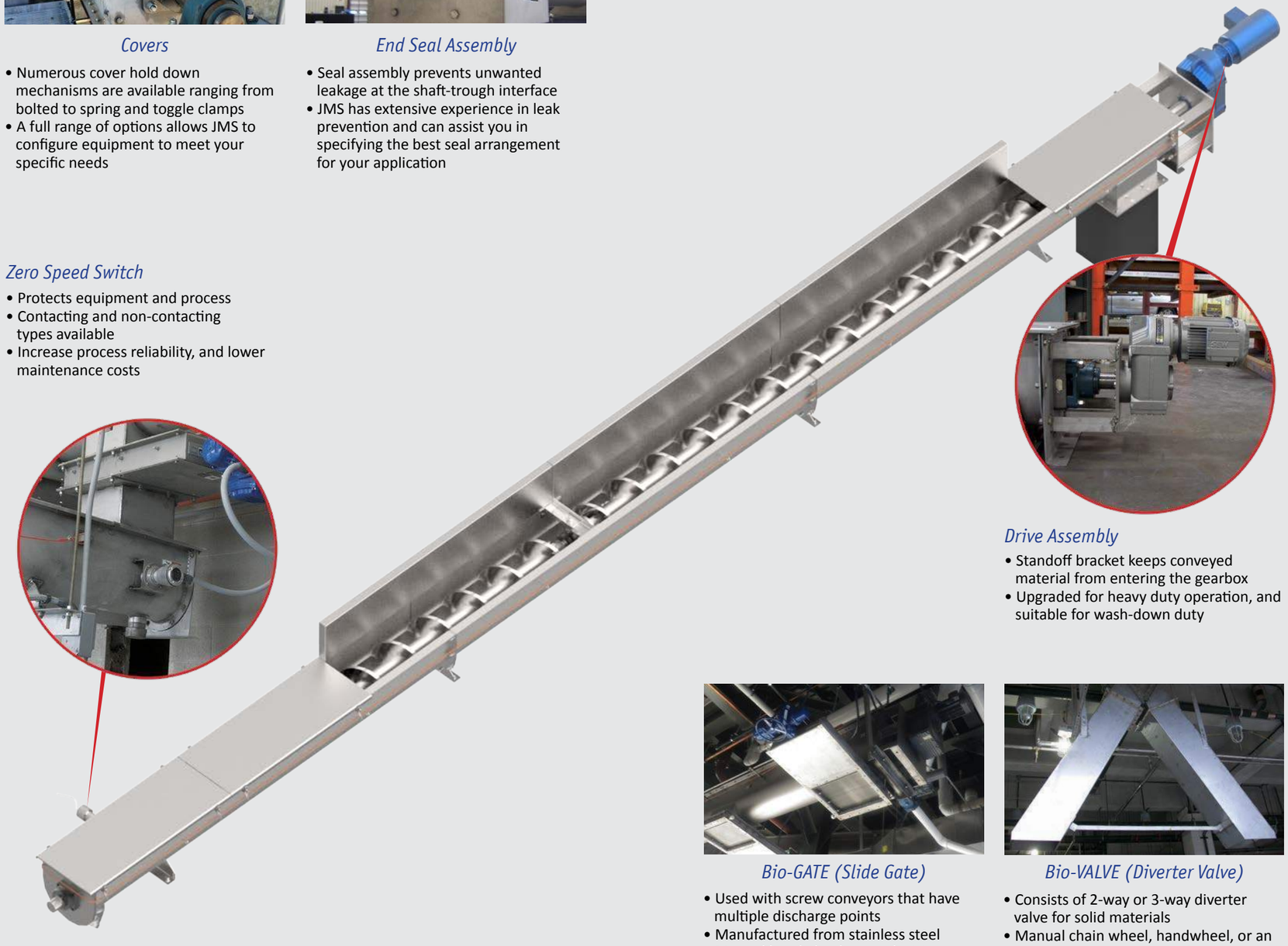


### End Seal Assembly

- Seal assembly prevents unwanted leakage at the shaft-trough interface
- JMS has extensive experience in leak prevention and can assist you in specifying the best seal arrangement for your application

### Zero Speed Switch

- Protects equipment and process
- Contacting and non-contacting types available
- Increase process reliability, and lower maintenance costs





### Drive Assembly

- Standoff bracket keeps conveyed material from entering the gearbox
- Upgraded for heavy duty operation, and suitable for wash-down duty



### Bio-GATE (Slide Gate)

- Used with screw conveyors that have multiple discharge points
- Manufactured from stainless steel
- Manual handwheel or an electric, pneumatic, or hydraulic actuator



### Bio-VALVE (Diverter Valve)

- Consists of 2-way or 3-way diverter valve for solid materials
- Manual chain wheel, handwheel, or an electric, pneumatic, or hydraulic actuator available

## Shaftless Screw Conveyors



### Shaftless Screw

This design eliminates hanger bearings. Spirals are formed from nickel-alloy steel with high hardness providing a combination of corrosion and abrasion resistance.



### Liners

Specialty ultra-high molecular weight two color liners provide a visual indication of wear. Premium blends and abrasion resistant wear bars can also be used to extend working life.



### End to End

Since no end bearing is required, two shaftless conveyors can be connected end to end, reducing required elevation and simplifying transfers.



## *Success Stories*

Tallahassee, FL is nestled in the rolling hills of northwest Florida. This area is the location of the Wakulla Springs, one of the world's largest freshwater springs. The shallow aquifer is vulnerable to pollution including stormwater runoff and nitrates from wastewater treatment. The city of Tallahassee's main wastewater treatment plant, Thomas P. Smith WRF, is located near the springs.

In the early 2000s the city began a study to determine how to improve the quality of reuse water and to protect the water quality of Wakulla Springs. Under the guidance of engineering giant Hazen and Sawyer a plan was developed for upgrading the system. As a part of the process, biosolids are separated from the liquid and dried for eventual use as a Class A Biosolid.

Conveyance of biosolids within the dewatered sludge building and to the dryer building is an important part of the process. For the project, six JMS Bio-SCREW conveyors of various lengths and configurations were purchased. After three years of operation, Warren Shepherd, a long-time manager of the Biosolids area, reports that all conveyors have been running full-time without issues and that he could not be more pleased with the equipment.



## *System Integration*

In addition to Bio-SCREW, JMS expertise extends to a host of other products and systems listed at right. Having such a broad and varied range of experience means your water and wastewater needs, whether individual component or full system, are understood. Optimized efficiency and process performance are yours for the asking. **Contact JMS today.**

Bio-HANDLING
Material Handling Systems

Bio-HANDLING
Material Handling Systems

Bio-BELT
Belt Conveyor System

Bio-SCREW
Screw Conveyor System

Bio-HOPPER
Live Bottom Hopper

Bio-VALVE
Diverter Valve

Bio-GATE
Slide Gate

Mega-TREATMENT
Water Treatment Systems

Delta-SEPARATION
Separation Systems

Eco-AIR
Low Profile Cascade Aerator

Your JMS Sales Representative:

JIM MYERS & SONS, INC.

Jim Myers & Sons, Inc.
PO Box 38778, Charlotte, NC 28278
Phone: 704-554-8397 Fax: 704-554-9113
Email: sales@jmsequipment.com
Web: www.jmsequipment.com

*"Making a Difference for Generations"*




# Flygt N-pump Series

SELF-CLEANING PUMPS WITH SUSTAINED HIGH EFFICIENCY

FLYGT
a xylem brand

# Sustained high efficiency is priceless

Flygt N-pumps take on the toughest applications and get the job done. Every component is designed and manufactured to deliver sustained high efficiency. Thanks to the patented N-technology with its innovative self-cleaning impeller, Flygt N-pumps deliver the highest total efficiency – lowering your energy bill and reducing unplanned maintenance costs. That adds up to total peace of mind – and big savings over the long term.




Our vast fluid handling knowledge and dedication to research and development lead to technological advances and continuous improvement.

That's why our Flygt N-pumps are at work in more than a hundred thousand installations worldwide. They have proven to be the best and most reliable choice for both dry and submersible installations far and away over our competition.

**Robust and reliable**
Every Flygt N-pump is tested in the factory to ensure high performance and premium quality. Flygt products deliver outstanding, cost-effective performance that has been proven in applications such as:

- Wastewater
- Stormwater
- Sludge
- Industrial effluent
- Raw water
- Cooling water



THE N-PUMP ADVANTAGE

- Patented technology
- Innovative design
- Sustained high efficiency
- Self-cleaning ability
- Modular design
- Reliable
- Fewer unplanned service calls



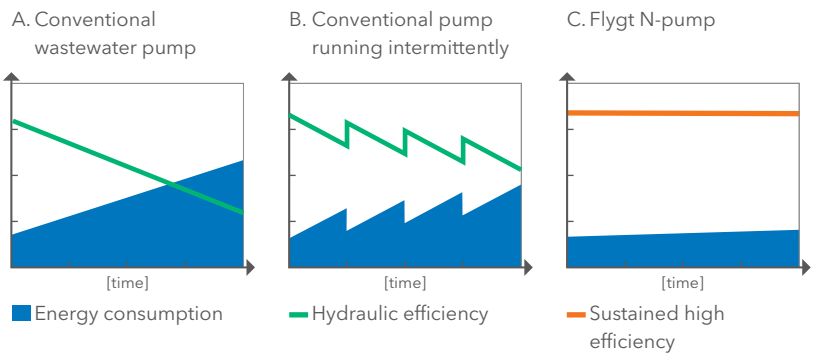
BROAD RANGE CAPACITY

- Ratings from 2.2 hp to 870 hp
- Discharges up to 20" (500 mm)
- Flows up to 16,000 US GPM (1,000 l/s)
- Heads up to 400 ft (120 m)
- Submersible and dry installations
- Every Flygt pump is performance tested in the factory
- Can handle dry solids up to 8%

# Self-cleaning N-pump saves money

**Sustained high efficiency**

When solid objects such as stringy fibrous material and modern trash enter the inlet of a conventional pump, they tend to get caught on the leading edges of the impeller vanes. This buildup reduces the impeller's efficiency, resulting in increased power consumption (Fig. A) and generating increased energy charges.







As solids continue to build up inside the impeller, motor thermal protection can trip causing the pump to stop and leading to costly unplanned service calls. If a conventional wastewater pump runs intermittently, the solids buildup will be removed by backflushing when the pump is shut off at the end of the operating cycle. When the next cycle begins, efficiency returns to its initial value since the impeller is free from solid objects (Fig B).

The high efficiency of the Flygt N-pump is sustained over time due to its self-cleaning ability, keeping energy costs to a minimum (Fig. C ).

All Flygt N-pumps have the same self-cleaning performance regardless of duty point.

THE SELF-CLEANING CONCEPT

Stage 1. Most solid objects entering the pump will pass through the impeller between the impeller vanes. If an object gets caught on the leading edge of one of the vanes, it will slide along the backswept shape towards the perimeter of the inlet.



Stage 2. The solid object will slide along the tip of the impeller vane inside the relief groove. The guide pin in the insert ring will push all types of solids away from the center of the impeller, along the leading edge and out through the relief groove.



# Broad capacity range to suit your application

**Flexible and modular design**
Flygt N-technology enables you to tailor the hydraulics to meet the requirements of virtually any application. Choose the hardened cast iron version for typical wastewater applications and the chopper ring version for cutting long fibers or solids. The Hard-Iron™ version should be used in abrasive applications and waters that could cause erosion corrosion due to high oxygen content.

Whatever you choose, you never sacrifice pump efficiency – and you can easily switch the module if the operating conditions change.

Cast iron



Cast iron impeller with hardened edges and insert ring for typical pumping applications.

Hard-Iron™ (60 HRC)

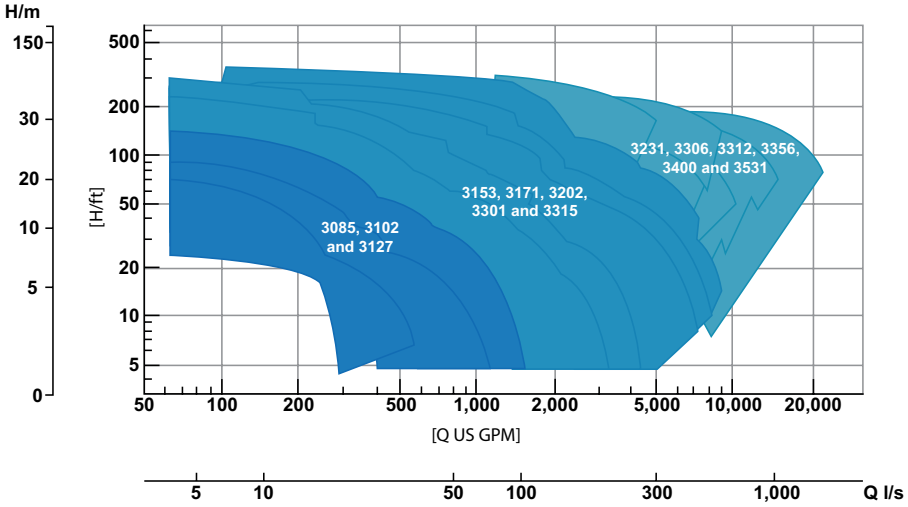


Extra durable option for abrasive and erosion corrosion applications.

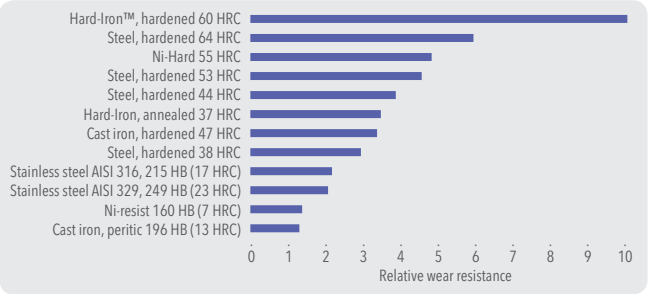
Chopper ring for cutting long fibers or solids.

**Top performance with a broad capacity range**

- Large capacity pumps
- Medium capacity pumps
- Low capacity pumps




Composite curves for comparison purposes only. Consult engineering data for exact flow and head capabilities.




HARD-IRON™ (60 HRC) FOR THE TOUGHEST WASTEWATER CHALLENGES

Accelerated wear tests prove that Hard-Iron™ hydraulic components keep on working efficiently with minimal wear after pumping water with a very high concentration of coarse sand (2,400 tons).

Flygt N-pumps with Hard-Iron™ components continue to deliver sustained high efficiency without clogging or erosion corrosion, prolonging lifetime by 200 percent compared to standard hardened cast iron hydraulics.

# Designed and engineered for longer life



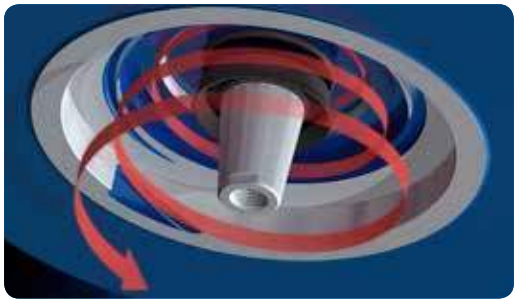
Xylem specially designs and manufactures Flygt N-pump components, such as the motor, seals and shaft, to optimize operation and prolong pump service life.

**Motor**
The Class H squirrel-cage induction motor delivers outstanding performance and superior heat transfer in submersible and dry installations. Heat losses are concentrated around the shrink-fitted stator, which is cooled by means of the surrounding water. The motor has a NEMA Class B maximum operating temperature rise of 80°C (176°F) to ensure long service life. All motors are capable of fully utilizing the available power while operating on a variable frequency drive.

For an even higher overall efficiency, premium efficiency motors IE3 are available.

**Long-life seals**
Durable tungsten carbide seals offer exceptional mechanical strength as well as superior sliding properties even when running dry. These low-friction seals withstand thousands of hours of high-pressure operation under extreme conditions without cracking, seizing up or showing signs of unacceptable wear.

**Low shaft deflection**
To minimize vibration, promote quiet operation, and prolong seal and bearing life, all Flygt N-pumps feature a short shaft overhang to reduce shaft deflection.

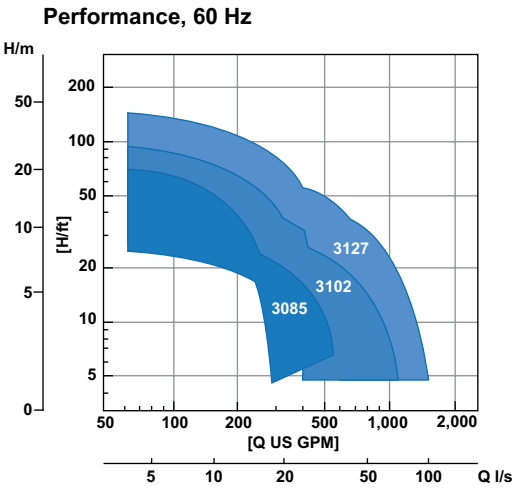


SPIN-OUT™ SEAL PROTECTION FOR PUMPS WITH CAVITIES IN THE SEAL CHAMBER

The patented Spin-out™ design expels abrasive particles from the seal chamber, providing protection against wear of the outer seal. As an integral part of the seal chamber, Spin-out™ is as simple as it is effective.

# Low capacity pumps






This series of Flygt N-pumps includes three models that handle capacities up to 1,600 US GPM (100 l/s). Like all Flygt N-pumps, these contribute to reducing the total life cycle costs of your installation.

## Power ratings and size

| Model | 3085 | 3102 | 3127 |
|---|---|---|---|
| Rating, hp | 2.2–4 | 5–6 | 7.5–11 |
| Discharge, in | 3" (80 mm) | 3" (80 mm) | 3" (80 mm) |
| | | 4" (100 mm) | 4" (100 mm) |
| | | 6" (150 mm) | 6" (150 mm) |

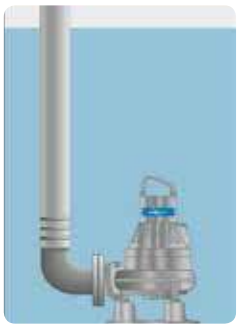
## Methods of installation

P



For semi-permanent wet well installations. The pump is installed with twin guide bars on a discharge connection.

S



A semi-permanent freestanding installation. Transportable version with pipe or hose connection.

T



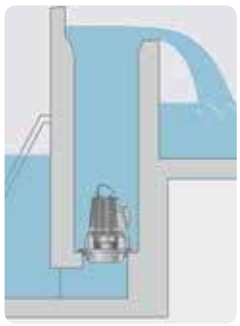
A vertically-mounted, permanent dry well or in-line installation with flange connections for suction and discharge pipework.

Z



A horizontally-mounted, permanent dry well or in-line installation with flange connections for suction and discharge pipework.

L



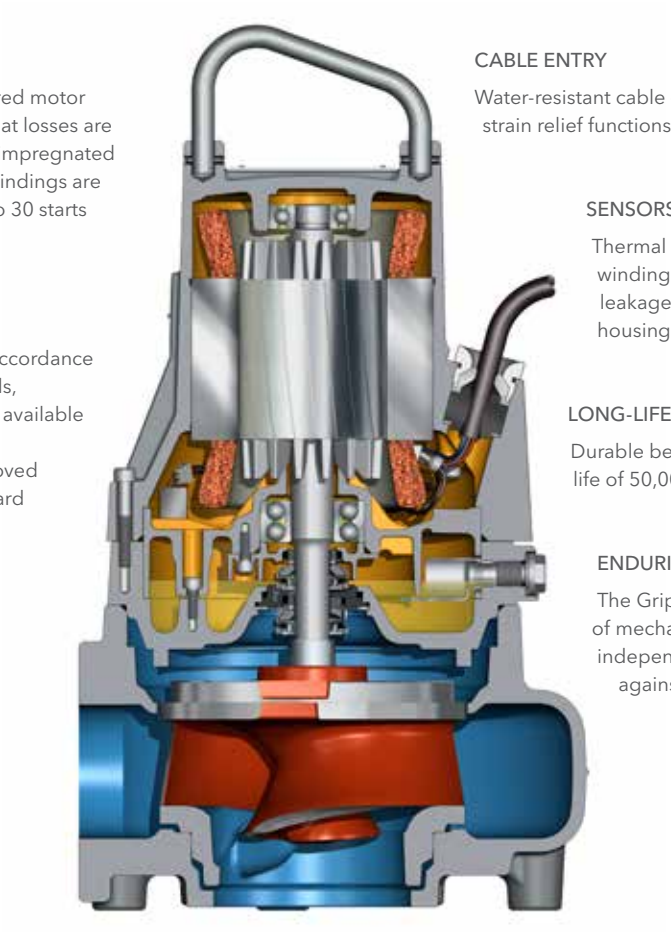
A semi-permanent installation of a pump within a vertical steel or concrete column.

### BETTER HEAT TRANSFER

Our specially designed and manufactured motor provides enhanced cooling because heat losses are concentrated around the stator. Trickle impregnated in resin (Class H insulation), the stator windings are rated at 180°C (355°F) and enable up to 30 starts per hour.

### COMPLIANCE

Each pump is tested and approved in accordance with national and international standards, including 60034-1 and CSA. Pumps are available in explosion-proof versions for use in hazardous environments, and are approved by the Factory Mutual, European Standard and IEC.



### CABLE ENTRY

Water-resistant cable entry provides both sealing and strain relief functions to ensure a safe installation.

### SENSORS

Thermal sensors embedded in the stator windings prevent overheating. Optional leakage sensors in the stator and oil housings are also available.

### LONG-LIFE BEARINGS

Durable bearings provide a minimum service life of 50,000 hours.

### ENDURING SEALS

The Griploc™ system consists of two sets of mechanical shaft seals that operate independently to provide double security against leakage.



**Griploc™ seal**

With a robust design, Griploc™ seals offer consistent performance and trouble-free operation in challenging environments. Solid seal rings minimize leakage and the patented griplock spring, which is tightened around the shaft, provides axial fixation and torque transmission. In addition, the Griploc™ design facilitates quick and correct assembly and disassembly.

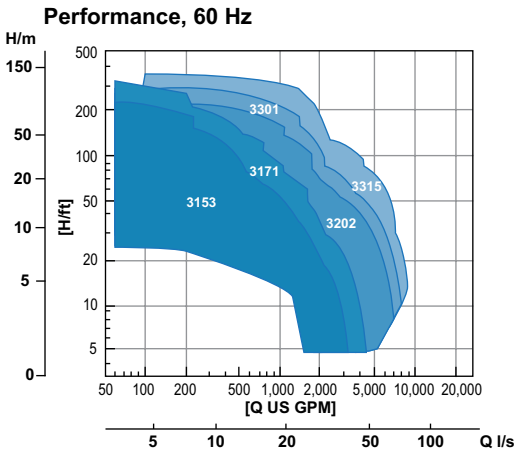
**Adaptive N-impeller**

The Flygt N3085 – N3127 feature an adaptive self-cleaning N-impeller that can move axially to enable easy passage of large solids through the pump.



# Medium capacity pumps






For demanding pumping duties, five models handle fluid transport for capacities up to 8,000 US GPM (500 l/s). Highly efficient, these heavy-duty models provide clog-free performance in order to achieve the best overall life cycle cost.

## Power ratings and size

| Model | 3153 | 3171 | 3202 | 3301 | 3315 |
|---|---|---|---|---|---|
| Rating, hp | 12–23 | 25–35 | 35–75 | 60–105 | 85–160 |
| Discharge, in | 3" (80 mm) | 4" (100 mm) | 4" (100 mm) | 6" (150 mm) | 6" (150 mm) |
| | 4" (100 mm) | 6" (150 mm) | 6" (150 mm) | 10" (250 mm) | 10" (250 mm) |
| | 6" (150 mm) | 10" (250 mm) | 8" (200 mm) | 12" (300 mm) | 12" (300 mm) |
| | 8" (200 mm) | | | 14" (350 mm) | 14" (350 mm) |
| | 10" (250 mm) | | | | |

## Methods of installation

P



For semi-permanent wet well installations. The pump is installed with twin guide bars on a discharge connection.

S



A semi-permanent freestanding installation. Transportable version with pipe or hose connection.

T

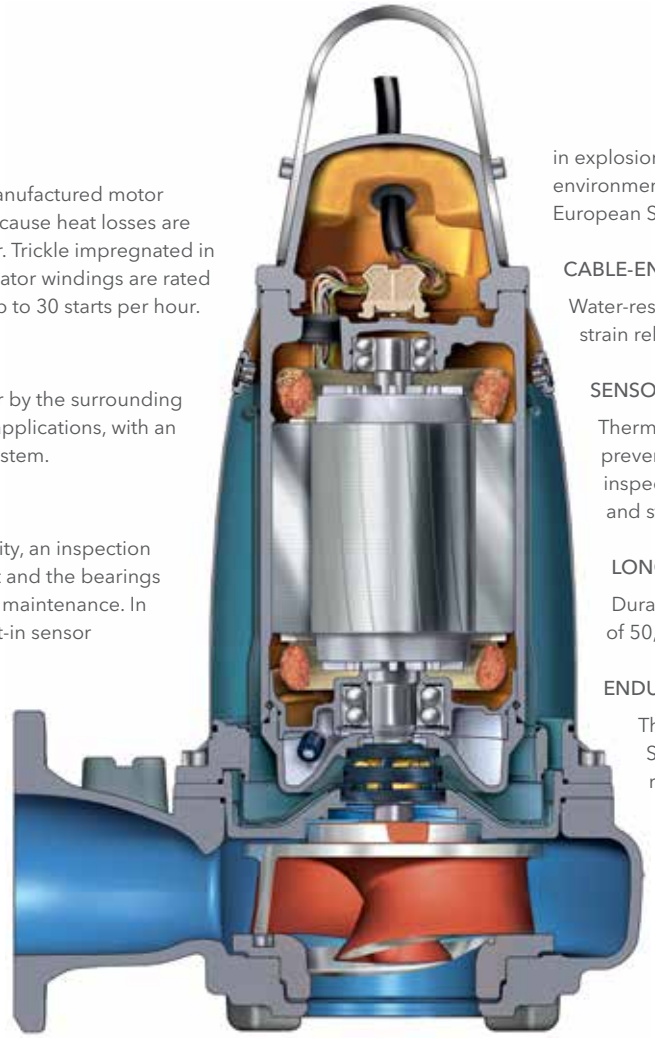


A vertically-mounted, permanent dry well or in-line installation with flange connections for suction and discharge pipework.

Z



A horizontally-mounted, permanent dry well or in-line installation with flange connections for suction and discharge pipework.



### BETTER HEAT TRANSFER

Our specially designed and manufactured motor provides enhanced cooling because heat losses are concentrated around the stator. Trickle impregnated in resin (Class H insulation), the stator windings are rated at 180°C (355°F) and enable up to 30 starts per hour.

### EFFICIENT COOLING

These pumps are cooled either by the surrounding liquid or, in more demanding applications, with an internal closed-loop cooling system.

### INSPECTION CHAMBER

To increase operational reliability, an inspection chamber between the seal unit and the bearings enables rapid spot checks and maintenance. In the case of a seal failure, a built-in sensor provides an early warning of any fluid buildup, thus reducing the risk of expensive repair work.

### COMPLIANCE

Each pump is tested and approved in accordance with national and international standards, including IEC60034-1 and CSA. Pumps are available in explosion-proof versions for use in hazardous environments, and are approved by the Factory Mutual, European Standard and IEC.

### CABLE-ENTRY

Water-resistant cable entry provides both sealing and strain relief functions to ensure a safe installation.

### SENSORS

Thermal sensors embedded in the stator windings prevent overheating, and a leakage sensor in the inspection chamber minimizes the risk for bearing and stator failure.

### LONG-LIFE BEARINGS

Durable bearings provide a minimum service life of 50,000 hours.

### ENDURING SEALS

The Flygt Plug-in™ seal with the Active Seal™ system offers increased sealing reliability and zero leakage into the motor, thereby reducing the risk of bearing and stator failure.

**Flygt Plug-in™ seal with Active Seal™ system**
The Flygt Plug-in™ seal is a seal unit that eliminates the risks associated with incorrect installation and careless handling. It comprises the Active Seal™ system in one easy-to-handle unit.

The Active Seal™ system is a patented zero-leakage double-seal system that actively prevents liquid from entering the motor cavity, thereby reducing the risk for bearing and stator failure. It comprises a unique inner seal that acts as a micro-pump and an outer seal that prevents leakage of pumped media into the buffer chamber.



Inner seal with laser-cut spiral grooves.

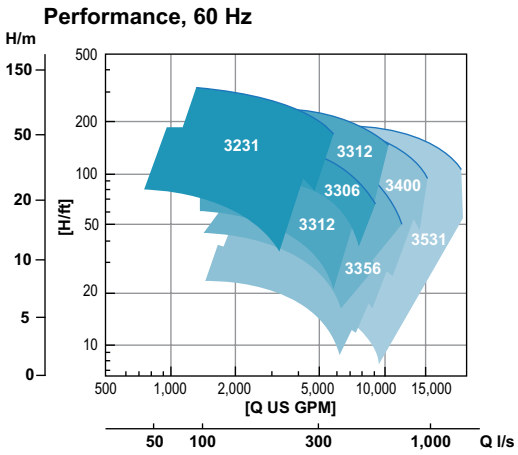


Laser-cut grooves on the inner seal create a hydrodynamic pumping effect that prevents any leakage from entering the motor. This translates into enhanced sealing reliability, reduced downtime and fewer unscheduled maintenance checks. In addition, regular service inspections can be prolonged in many applications.

# Large capacity pumps



When higher capacity is required, the Flygt N-pump series has five pumps to do the job. These models deliver unprecedented pumping power – reliably and efficiently.




### Power ratings and size

| Model | 3231 | 3306 | 3312 | 3356 | 3400 | 3531 |
|---|---|---|---|---|---|---|
| Rating, hp | 90–335 | 70–280 | 90–470 | 70–280 | 60–470 | 60–870 |
| Discharge, in | 8" (200 mm) | 12" (300 mm) | 12" (300 mm) | 14" (350 mm) | 16" (400 mm) | 20" (500 mm) |

### Methods of installation

P



For semi-permanent wet well installations. The pump is installed with twin guide bars on a discharge connection.

S



A semi-permanent freestanding installation. Transportable version with pipe or hose connection.

T



A vertically-mounted, permanent dry well or in-line installation with flange connections for suction and discharge pipework.

Z



A horizontally-mounted, permanent dry well or in-line installation with flange connections for suction and discharge pipework.

BETTER HEAT TRANSFER

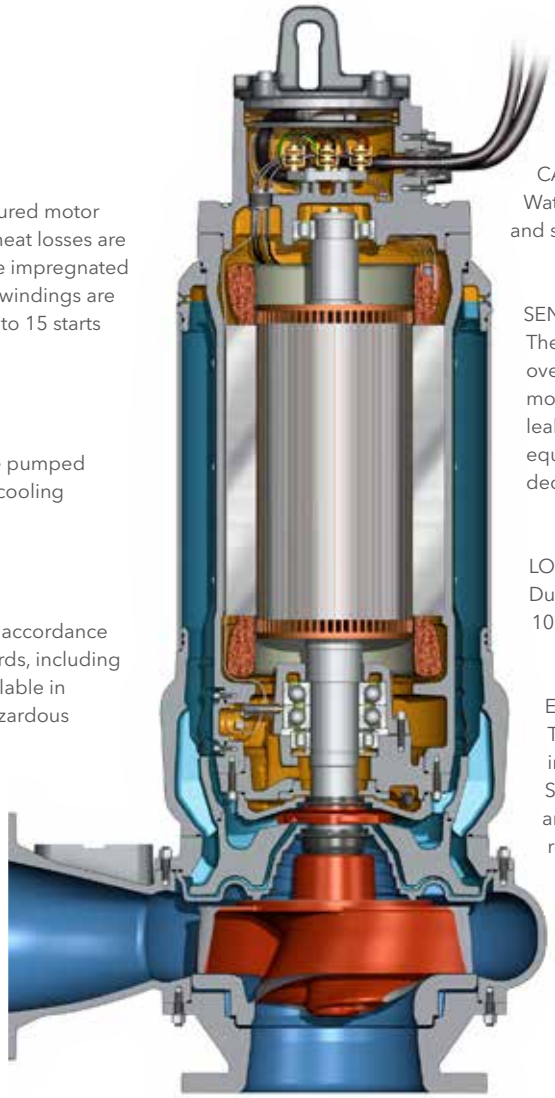
Our specially designed and manufactured motor provides enhanced cooling because heat losses are concentrated around the stator. Trickle impregnated in resin (Class H insulation), the stator windings are rated at 180°C (355°F) and enable up to 15 starts per hour.

EFFICIENT COOLING

These pumps are cooled either by the pumped liquid or with an internal closed-loop cooling system.

COMPLIANCE

Each pump is tested and approved in accordance with national and international standards, including IEC 60034-1 and CSA. Pumps are available in explosion-proof versions for use in hazardous environments, and are approved by the Factory Mutual, European Standard and IEC.



CABLE ENTRY

Water-resistant cable entry provides both sealing and strain relief functions for a safe installation.

SENSORS

Thermal sensors in the stator windings prevent overheating, and an analog temperature sensor monitors the lower bearing. The stator housing/ leakage chamber and the junction box are equipped with leakage sensors. The sensors decrease the risk of bearing and stator failure.

LONG-LIFE BEARINGS

Durable bearings provide a minimum service life of 100,000 hours.

ENDURING SEALS

Two sets of mechanical shaft seals work independently for double security. The Active Seal™ system offers increased sealing reliability and zero leakage into the motor, thereby reducing the risk of bearing and stator failure.

**Zero leakage into the motor cavity**

The Active Seal™ system is a patented zero-leakage double-seal system that actively prevents liquid from entering the motor cavity, thereby reducing the risk for bearing and stator failure. It comprises a unique inner seal that acts as a micro-pump and an outer seal that prevents leakage of pumped media into the buffer chamber.



Laser-cut grooves on the inner seal create a hydrodynamic pumping effect that prevents any leakage to enter the motor.

This translates into enhanced sealing reliability, reduced downtime and fewer unscheduled maintenance checks. In addition, regular service inspections can be prolonged in many applications.

# Complete solutions for your needs



**Ready-to-install pre-engineered, prefabricated pumping solutions**

Flygt offers several packaged solutions combining our premium N-pumps with dedicated monitoring and control options and pre-fabricated pump stations designed for your needs. The prefabricated pump stations are available in a range of designs and sizes, all supplied complete with the necessary materials and equipment to allow ease and speed of installation and commissioning.

Our packaged solutions have a self-cleaning design and are tested as a system to work perfectly together to give you the ultimate performance within wastewater pumping.



Flygt SmartRun™



Flygt Multismart™

MONITORING AND CONTROL

Our state-of-the-art solutions are designed to ensure pumps work at optimum efficiency, to provide key data, to increase reliability and to prevent pump breakdown.

Our monitoring and control systems are designed for use in a variety of pumping applications. It is the specific conditions at each pump station that help you decide the best monitoring and control solution for your needs. Whether it's wastewater, stormwater, effluent, RAS, WAS, lightly contaminated water or clean water, it all demands a different solution. Naturally each system is designed to work well on its own. However, our pumps and monitoring & control systems are optimized to work even better together.





All Flygt monitoring and control equipment integrate easily into SCADA control systems for remote monitoring and control. Flygt PumpView puts you in Total Control, Your Way.

**Engineered pumping solutions**

Flygt's standard pump station designs are based on our long history in wastewater pumping. Our engineers work closely with you, from design and system analysis to selection of pumps, installation and monitoring & control solutions. Whether we recommend a proven Flygt standard design or develop a custom solution for you, we can offer you reliable and cost-effective pumping solutions that meet your specific requirements.



FLYGT N-PUMPS: SUBMERSIBLE AND DRY INSTALLATIONS

Flygt N-pumps are an excellent choice for handling solids in dry-pit installations. Originally designed for submersible conditions, our pumps eliminate the risk of damage to the motor due to station flooding. Submersible or dry-installed Flygt N-pumps deliver superior clog-free operation with minimal maintenance and substantial energy savings.

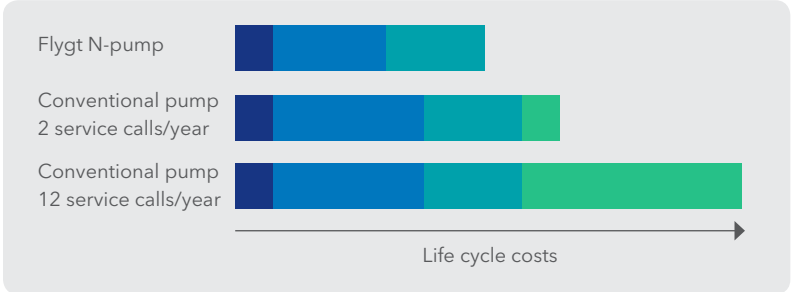
# The power to adapt

## Options table

Customize your Flygt N-pump with optional equipment.

| Flygt N-pump model | 3085 | 3102 | 3127 | 3153 | 3171 | 3202 | 3301 | 3315 | 3231 | 3306 | 3312 | 3356 | 3400 | 3531 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Option/Product* | | | | | | | | | | | | | | |
| **Motor** | | | | | | | | | | | | | | |
| Premium efficiency (IE3) | ◖ | ◖ | ◖ | ◖ | ◖ | ◖ | ◖ | | ◫ | ◫ | ◫ | ◫ | ◫ | ◫ |
| **Hydraulic** | | | | | | | | | | | | | | |
| Guidepin | ● | ● | ● | ◐ | ◐ | ◫ | | | | | | | | |
| Hard-Iron™ | ◐ | ◐ | ◐ | ◐ | ◐ | ◐ | ◐ | ○ | ○ | | ○ | ○ | | ○ |
| Chopper | | | ○ | ◫ | ◫ | ◫ | | | | | | | | |
| Adaptive N | ● | ● | ● | | | | | | | | | | | |
| **Seal system** | | | | | | | | | | | | | | |
| Griploc™ seal | ● | ● | ● | | | | | | | | | | | |
| Plug-in™ seal | | | | ● | ● | ● | ● | ● | | | | | | |
| Active Seal™ | | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Spin-out™ | ● | ● | ● | ● | ● | ● | ● | ● | ◖ | ◖ | ◖ | ◖ | ◖ | ◖ |
| Seal flush | | | | | | | | | ○ | ○ | ○ | ○ | ○ | ○ |
| **Cooling system** | | | | | | | | | | | | | | |
| 1. w/o cooling jacket | ● | ● | ● | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| 2. Closed Loop Cooling | | | | ● | ● | ● | ● | ● | ◫ | ◫ | ◫ | ◫ | ◫ | ◫ |
| 3. Pump media | | | | | | | | | ● | ● | ● | ● | ● | ● |
| 4. External | | | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| **Installation** | | | | | | | | | | | | | | |
| P | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| S | ● | ● | ● | ● | ● | ● | ◐ | ◐ | ● | ● | ● | ◫ | ◫ | ◫ |
| T | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Z | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| L | | ● | ● | | | | | | | | | | | |
| **Accessories** | | | | | | | | | | | | | | |
| Flush valve | ○ | ○ | ○ | ◫ | ◫ | ◫ | ◫ | ◫ | | | | | | |
| **Pump monitor** *Prepared for* | | | | | | | | | | | | | | |
| – Mini CAS | ● | ● | ● | ● | ● | ● | ● | ● | | | | | | |
| – MAS | | | | | ○ | ○ | ○ | ○ | ● | ● | ● | ● | ● | ● |
| **Pump control** | | | | | | | | | | | | | | |
| – SmartRun™ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | | | | | | |
| – MultiSmart™ | | | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| – FGC | ○ | ○ | | | | | | | | | | | | |

● = Standard
○ = Optional
◐ = Standard but also optional depending on model
◖ = Standard or not available depending on model
◫ = Optional or not available depending on model




SELF CLEANING SAVES MONEY

Schematic overview of calculations made on a 30kW Flygt N-pump

Purchase cost
Energy cost
Service cost
Unplanned maintenance cost

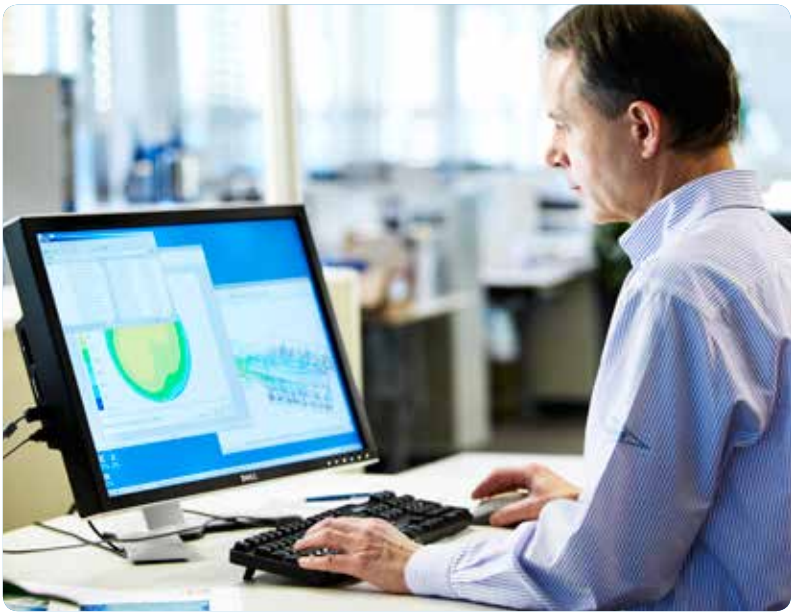
# Supporting your business, every step of the way

**Extensive engineering know-how**
Xylem has extensive knowledge of fluid dynamics and vast practical experience in designing, operating and maintaining efficient wastewater transport systems. We provide a broad range of engineering services, including:

- System analysis and calculations
- Sump design
- Water hammer calculations
- Pump start analysis
- Transient analysis
- Computational Fluid Dynamics (CFD)
- Scale model testing

In short, we can assist you with everything you need for optimal performance and economical, energy-efficient operation.

**Empower your system**
With Flygt monitoring and control products, you can control and optimize the performance of every component of your system. This helps reduce stress on pumps, valves and mains, enable reliable, efficient operation, and prolong service lifetime.



**Support for your Flygt pumps**
Our global network of local service centers and service partners provide integrated services to support safe, efficient and reliable operation. To ensure trouble-free operation and minimal downtime, count on us for quick, professional response and quality maintenance services, using genuine Flygt spare parts.



EXTENSIVE MONITORING AND CONTROL

We supply hardware and software for complete process systems – from individual pump drives, starters, sensors and controllers to system software and scalable SCADA systems.



GENUINE FLYGT SPARE PARTS AND WARRANTY

When downtime isn't an option, rely on our global service network to deliver genuine Flygt spare parts to you – quickly and efficiently. All Flygt spare parts are backed by a solid 15-year availability guarantee. Large capacity pumps offer a 20-year availability guarantee.

# Xylem [ˈzīləm]

1) The tissue in plants that brings water upward from the roots
2) A leading global water technology company

We're 12,000 people unified in a common purpose: creating innovative solutions to meet our world's water needs. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. We move, treat, analyze, and return water to the environment, and we help people use water efficiently, in their homes, buildings, factories and farms. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise, backed by a legacy of innovation.

For more information on how Xylem can help you, go to xyleminc.com.

FB002 • Flygt N - Pump Series Brochure • 7/2015 • NACT

xylem
Let's Solve Water

Xylem, Inc.
14125 South Bridge Circle
Charlotte, NC 28273
Tel 704.409.9700
Fax 704.295.9080
855-XYL-H2O1 (855-995-4261)
www.xyleminc.com

Flygt is a trademark of Xylem Inc. or one of its subsidiaries.
© 2015 Xylem, Inc. JULY 2015

HUBER TECHNOLOGY
WASTE WATER Solutions

# HUBER Vortex Grit Chamber VORMAX



Grit separation through constant radial flow

- High grit separation through tangential feed introduction at bottom level
- High throughput capacity of up to 3,000 l/s
- Worldwide well-proven, reliable technology

## Design and function

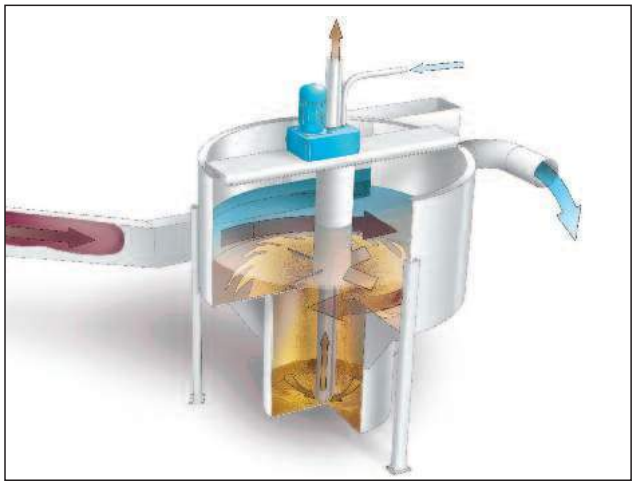
Grit separation from wastewater helps prevent operational problems such as grit sedimentation, increased wear and blockages.

Grit separation with the HUBER Vortex Grit Chamber VORMAX starts already in the inlet channel to the grit trap. Like in an unaerated longitudinal grit trap the grit sinks downs to the channel bottom from where it is transported into the circular grit trap along with the wastewater flow. A tangential rotational movement is generated due to the curved design of the (mostly concreted customer's) concrete tank. A constantly rotating stirrer helps support the wastewater circulation within the grit chamber ensuring a constant velocity of rotation within the complete grit trap system even with greatly varying hydraulic conditions. Due to the constant radial rotation, caused by a secondary flow near to the bottom, the solids are very quickly collected within the centre of the grit chamber from where thy then pass into the bottom of the grit collection tank. The grit-free wastewater then exits and flows onto the next treatment step.

Centrifugal or airlift pumps can then deliver the collected solids from the grit collection tank into a grit classifier or grit washer where the solids can then be subsequently separated and dewatered and organic particles removed.

## Benefits

- Compact, space-saving design
- High grit separation efficiency
- Low energy demand
- Throughput capacity up to 3,000 l/s
- Low pressure loss
- Variable inlet and outlet arrangement
- Minimum wear, reduced maintenance
- Optional subsequent grit washing



*Flow diagram of a HUBER Vortex Grit Chamber VORMAX*

## Installation examples



*HUBER Vortex Grit Chamber VORMAX installation with HUBER Grit Classifier RoSF3*



*Reliable bull gear drive for the stirrer*


HUBER SE

Industriepark Erasbach A1 · D-92334 Berching
Phone: + 49 - 84 62 - 201 - 0 · Fax: + 49 - 84 62 - 201 - 810
info@huber.de · Internet: www.huber.de



Subject to technical modification
0,15 / 5 – 5.2016 – 8.2005

# MONSTER WASH PRESS



The Monster Wash Press is JWC Environmental's latest generation of washer compactors. The Monster Wash Press processes screenings to separate water and organics from the solids. The result is a clean, dry, light and compact discharge which reduces the amount of waste to be dumped, ultimately saving treatment facilities time and money.

The Monster Wash Press may be outfitted with a Muffin Monster® grinder to pre-condition the screenings before they enter the washer compactor. The grinder breaks open rags, plastics and trash to promote washing and removal of soft organics during the wash cycle. Additionally, pre-conditioned screenings result in superior compaction, reducing the volume of discharge that must be hauled away.

Discharge from the pre-conditioning Muffin Monster or directly from the screen enters a Pre-Wash Zone where the debris is soaked to begin the process of separating organics from the solids. An auger rotor transports the soaked debris into the Active Wash Zone of the Monster Wash Press where a paddle spiral rotor* agitates the material, enhancing wash water penetration throughout the debris. The results is the effective washing of soft organics from the solids. The soft organics pass through a screen and are returned to the plant's waste stream for treatment. The washed solids are moved to the Dewater and Compaction Zone where water is removed from the solids and the solids are compacted. The resultant discharge emerges from the Monster Wash Press as a dry, solid plug.

## FEATURES AND BENEFITS

### Dual Shafted Grinder (optional)

- 30K Muffin Monster grinds screenings discharge for the best washing and compacting
- Easy to retrofit grinderless Monster Wash Press with Muffin Monster

### Pre-Wash Zone

- Soaks screenings to jump-start separation of organics from solids
- Brushless auger rotor to promote free movement of debris to active wash zone

### Active Wash Zone

- Paddle spiral rotor* mixes and break-ups debris in wash zone to optimize separation of soft organics from solids
- Brushed rotor keeps screen clean
- Customer defined 2, 3, or 6 mm perforated screen to separate solids from organics

### Easy Maintenance

- Segmented auger rotor brush allows in situ brush replacement
- Removable top cover and drive end plate* minimizes clearance space needed to remove rotor and screen
- Field replaceable screen
- Multiple inspection ports for easy examination of equipment and operation

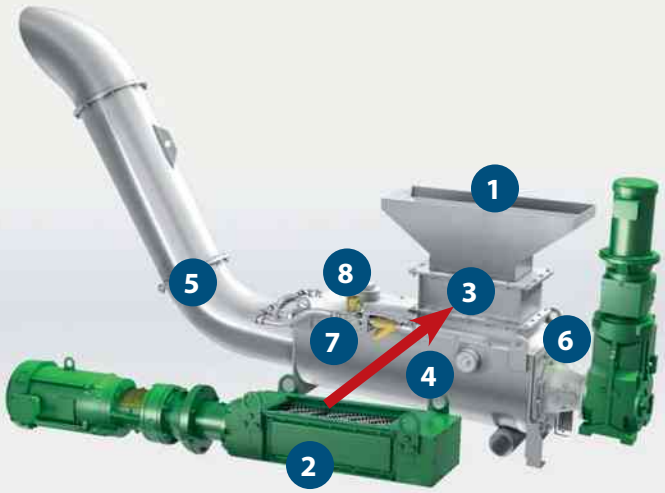






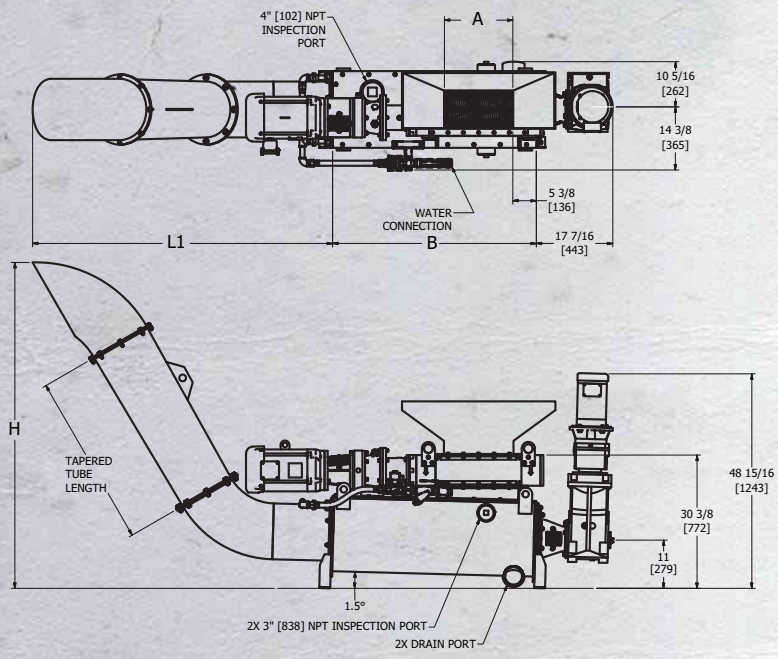
* Patent Pending

www.jwce.com




# MONSTER WASH PRESS DETAILS

1. Hopper collect screenings
2. Muffin Monster grinds up material (optional)
3. Easy to install grinder later
4. Active Wash Zone cleans screenings
5. Cleaned discharge is dewatered and compacted
6. Removable top cover and drive end plate for easy removal of rotor and screen
7. Segmented rotor brush for in-situ brush replacement
8. Inspection ports




## STANDARD CONSTRUCTION

- Hopper, Tank, Screen and Discharge Tube: 304 stainless steel
- Auger rotor: Alloy steel
- Grinder with MWP3018: Ductile iron housing, hardened alloy steel cutters

## OPTIONAL EQUIPMENT

- 316 stainless steel hopper, tank, screen and discharge tube
- Stainless steel auger rotor
- Discharge bagger
- Stainless steel roller base
- Discharge tip
- Customized hopper
- Customized discharge transport assembly

| MWP Model | Basic Model Dimensions - inches (mm) | | Drain Port Size - inches (mm) |
|---|---|---|---|
| | A | B | |
| MWP0018 | 15-5/8 (396) | 46-13/16 (1189) | 4" (102) NPT |
| MWP3018 | 15-5/8 (396) | 46-13/16 (1189) | 4" (102) NPT |

| Discharge Dimensions @60° - inches (mm) | | |
|---|---|---|
| Taper Length | H | L1 |
| 39-3/8 (1000) | 74-1/4 (1886) | 68-1/2 (1740) |
| 49-1/4 (1250) | 82-7/8 (212) | 73-3/8 (1864) |
| 59 (1500) | 91-3/8 (2321) | 78-1/4 (1988) |
| 69 (1750) | 100 (2540) | 83-1/4 (2115) |
| 78-3/4 (2000) | 108-1/2 (2756) | 88-1/8 (2238) |

| FEATURES | | |
|---|---|---|
| | MWP0018 | MWP3018 |
| Grinder Motor, hp (kW) | N/A | 7.5 (5.6) |
| Compaction Screw Motor, hp (kW) | 3 (2.2) | 3 (2.2) |
| Upgradable to Add Grinder | Yes | Grinder Included |

| PERFORMANCE | | |
|---|---|---|
| | MWP0018 | MWP3018 |
| Continuous Throughput - $ft^3/hr$ ($m^3/hr$) | 200 (5.7) | 80 (2.3) |
| Batch Output - $ft^3/hr$ ($m^3/hr$) | 75 (2.1) | 40 (1.1) |

JWC Environmental®
Trust Monster Quality™

**Headquarters**
**2850 S. Red Hill Ave., Suite 125**
**Santa Ana, CA 92705 USA**
toll free: **800.331.2277**
phone: **949.833.3888**
fax: **949.833.8858**
email: **jwce@jwce.com**

Muffin Monster | MONSTER INDUSTRIAL | IPEC | FRC

**www.jwce.com**

©2017 JWC Environmental. JWCE's Santa Ana California facility is registered by UL to ISO9001:2008 #10001313 QM8. JWC International Congleton, UK is registered by QAS to ISO9001:2008 File #A13056. U.S. patents apply: 4,919,346; 5,060,872; 5,320,286; 5,333,801; 5,354,004; 5,478,020; 5,505,388; 5,593,100; 6,176,443; 6,332,984; 7,073,433; 7,080,650; 7,081,171; 7,086,405; 7,383,842; 7,771,589; RE37,550E; RE37,349E; RE40,422; RE39,948E. Additional patents pending and international patents also apply. All rights reserved. JWC Environmental is not liable for damages that may result from any information provided in or omitted from this publication, under any circumstances. JWC Environmental reserves the right to make adjustments to this publication at any time, without notices or obligation. Please check the JWC Environmental website (www.jwce.com) for the most up-to-date information or speak to your local rep.

(MWP-2pg-NA-JWCE-0917)

Appendix D

# TM 4 PONDS AND WETLANDS IMPROVEMENTS



City of Arcata
Wastewater Treatment Facilities Improvements

# Technical Memorandum 4
# PONDS AND WETLANDS IMPROVEMENTS

FINAL | April 2019

City of Arcata
Wastewater Treatment Facilities Improvements

# Technical Memorandum 4
# POND AND WETLANDS IMPROVEMENTS

FINAL | April 2019

This document is released for the purpose of information exchange review and planning only under the authority of Michelle Trinh, November 2018, CA No. C77172 and Steven McHaney, November 2018 CA No. C47590.

# Contents

Technical Memorandum 4
PONDS AND TREATMENT WETLANDS IMPROVEMENTS 4-1
4.1 Purpose 4-1
4.2 Summary of Findings and Recommendations 4-1
4.3 Background 4-2
4.4 Oxidation Ponds and Wetlands Process Utilization 4-3
4.5 Oxidation Pond, Treatment Wetland, and Enhancement Wetland Overview 4-3
4.6 Oxidation Ponds 1 and 2 Improvements 4-4
4.6.1 Equalization 4-5
4.6.2 Pond 1 and 2 Aeration 4-7
4.6.3 Pond 1 Sludge Management 4-8
4.6.4 Pond 2 Baffling 4-9
4.7 Treatment Pump Station Improvements 4-10
4.7.1 Eliminate Pump Station 2 4-11
4.7.2 EPPS Standby Pump and Generator Connection 4-12
4.7.3 Construct TW4 Pump Station 4-13
4.7.4 PPS Capacity Upgrades 4-14
4.7.5 PS1 Capacity Upgrades 4-14
4.7.6 New Force Main From PS1 to UV Basin 4-15
4.8 Treatment Wetlands Improvements 4-15
4.8.1 Selective Excavation 4-16
4.8.2 Selective Vegetation Management 4-17
4.8.3 Selective Baffling 4-18
4.8.4 Conduits for "Blue Frogs" 4-18
4.8.5 Treatment Wetland 3 Piping Repairs 4-18
4.8.6 Treatment Wetland 4 Improvements 4-19
4.8.7 Treatment Wetland 7 Construction 4-19
4.9 Enhancement Wetlands Improvements 4-20
4.9.1 Flow Reconfiguration and Routing 4-22
4.9.2 Flow Conveyance 4-23
4.9.3 Enhancement Wetland (EWPS or Hauser) Pump Station Upgrades 4-23

4.9.4 EWPS Conveyance Upgrades 4-24
4.9.5 Selective Excavation 4-24
4.9.6 Selective Vegetation Management 4-24
4.9.7 Selective Baffling 4-25
4.10 Implementation Strategies and Potential Sequencing 4-26

## Appendices

Appendix A Figure A1: Existing Pond and Wetland Piping,
Figure A2: Pond and Wetland Improvements
Appendix B Performance Expected and Operational Requirements for the Arcata, CA, Wastewater Treatment Facility (E. Joe Middlebrooks, PE, PhD, BCEE, 2016)
Appendix C Preliminary Process Design Report Aerated Lagoon System Design # 17-3-7175 (Aeration Industries International, 3/10/17)
Clean Water Oxygen Transfer Test AIRE-O2 TRITON® TR Series Process Aerator/Mixer TR10 Model (September 2015)
Appendix D Sludge Characterization Preliminary Information on BOD, COD, and Decay Rates-Draft (amri, 2018)

## Tables

Table 4.1 Pond 1 and 2 Improvements 4-5
Table 4.2 Treatment Pump Station Improvements 4-10
Table 4.3 Treatment Wetland Improvements 4-15
Table 4.4 Enhancement Wetland Improvements 4-21

## Figures

Figure 4.1 New Pond 1 and 2 Equalization Structures and Piping 4-6
Figure 4.2 Pond 1 Sludge Accumulation (AMRI 2017) 4-8
Figure 4.3 Pond 2 Sludge Accumulation (AMRI 2017) 4-8
Figure 4.4 Pond 2 Baffle Layout 4-9
Figure 4.5 Pump Station 2 4-12
Figure 4.6 Emergency Pond Pump Station (EPPS) 4-13
Figure 4.7 PPS and PS1 4-14
Figure 4.8 Soil Obstructing Flow at TW 1 Outlet Weirs (Photo courtesy of Gearheart, 2018) 4-17
Figure 4.9 TW1 and TW2 Vegetation Removal and Baffles 4-17

| | | |
|---|---|---|
| Figure 4.10 | Blue Frog Units in TW3 | 4-18 |
| Figure 4.11 | TW4 Improvements | 4-19 |
| Figure 4.12 | New TW7 Construction | 4-20 |
| Figure 4.13 | Flow Reconfiguration and Routing Improvements | 4-22 |
| Figure 4.14 | Flow Conveyance between Wetlands | 4-23 |
| Figure 4.15 | EWPS Intake Overgrown with Vegetation | 4-24 |
| Figure 4.16 | EW Vegetation Removal | 4-25 |
| Figure 4.17 | EW New Baffling | 4-25 |

# Abbreviations

| | |
|---|---|
| AMRI | Arcata March Research Institute |
| AWTF | Arcata Wastewater Treatment Facility |
| BOD | Biochemical Oxygen Demand |
| Carollo | Carollo Engineers, Inc. |
| CCB | chlorine contact basin |
| City | City of Arcata |
| EPPS | Emergency Pond Pump Station |
| EWPS | Enhancement Wetland (Hauser) Pump Station |
| EW | enhancement wetland |
| JB1 | Junction Box 1 |
| mgd | million gallons per day |
| mg/l | Milligrams per liter |
| pond | oxidation pond |
| PS | pump station |
| PPS | Pond Pump Station |
| PS1 | Pump Station 1 |
| PS2 | Pump Station 2 |
| RWQCB | Regional Water Quality Control Board |
| SCADA | supervisory control and data acquisition |
| TM | technical memorandum |
| TSS | Total Suspended Solids |
| TW | treatment wetland |
| UV | Ultraviolet |
| VFD | variable frequency drive |
| WWTP | Wastewater Treatment Plant |
| wetlands | enhancement and treatment wetlands |

Technical Memorandum 4

# PONDS AND TREATMENT WETLANDS IMPROVEMENTS

## 4.1 Purpose

The Arcata Wastewater and Treatment Facility (AWTF) has been using oxidation ponds and wetlands as part of the wastewater treatment system for decades.

The purpose of this Technical Memorandum (TM) is to identify maintenance and improvement projects for the Oxidation Pond (Pond) and Treatment and Enhancement Wetland (Wetland) system consistent with the findings of the previously completed and adopted Facilities Plan to improve treatment and performance, and address selected maintenance issues. The work on the oxidation ponds and wetlands is intended to be completed in concert with mechanical treatment plant upgrades addressed under separate TM's.

## 4.2 Summary of Findings and Recommendations

The key findings and recommendations of this TM are summarized below:

Oxidation Ponds No. 1 and 2

- Piping and transfer structure additions/modifications for flow equalization.
- Pond 2 Baffling.
- Pond 1 and 2 Aeration.
- Pond 1 Sludge Management.

Pond Pump Station/Pump Station 1

- Eliminate Pump Station 2 (PS2).
- EPPS standby pump and generator connection.
- Construct TW4 pump station (City project).
- Pond Pump Station (PPS) capacity upgrades.
- Pump Station 1 (PS1) capacity upgrades.
- New Force Main from PS1 to Ultraviolet (UV) Basin.

Treatment Wetlands

- Selective Excavation.
- Selective Vegetation Management.
- Selective Baffling.
- Conduits for "Blue Frogs".
- Treatment Wetland 3 Piping Repairs.
- Treatment Wetland 4 Improvements (City project).
- Treatment Wetland 7 Construction (City project).

Enhancement Wetlands

- Flow Reconfiguration and Routing.
- Flow Conveyance.
- Enhancement Wetland (EWPS or Hauser) Pump Station Upgrades.
- EWPS Conveyance Upgrades.
- Selective Excavation.
- Selective Vegetation Management.
- Selective Baffling.

The main features of the existing pond and wetland system are presented in Figure A1 and near term recommended improvements are presented in Figure A2. These oversized figures are provided in Appendix A for convenience.

## 4.3 Background

The oxidation ponds and wetlands have served as the main treatment system for the City of Arcata for more than 30 years. As is usually the case with wastewater regulations, they have become more stringent over time and it has become increasingly more difficult to meet all regulatory requirements at all times given the variable flow and environmental conditions, and the inherent variable performance of a natural treatment system. The natural variations in performance are often not an issue with modest discharge standards, but the ever more strict requirements are more difficult to meet at all times with the natural system. If the past is any indication of the future, regulations will become even more difficult to meet in the future with a natural system alone. Any such future system that includes pond and wetland treatment elements will need to recognize the potential seasonal variability in performance in these components and any final negotiated permit should recognize this as well.

The Facilities Plan summarizes a number of issues and opportunities at the existing wastewater treatment facility in the context of meeting anticipated regulations. Following several iterations, the City decided to develop an oxidation ditch mechanical treatment system to address what was expected to be lower discharge limits while also incorporating the value the pond and wetland system offers for wastewater management and environmental enhancement.

It is important to clarify the role of the pond and wetland system and the relationship to the planned mechanical upgrades and to identify targeted improvements to the oxidation ponds and wetlands to enhance the value they bring to the overall wastewater management strategy.

While the Regional Board has yet to release an updated permit for the facility, discussions with board staff indicate effluent limits will be more stringent. From a pond and wetland perspective, the most significant new limit being proposed is for ammonia. Although the final limits are not known at this time, indications are they are likely to be below what oxidation ponds and wetlands can typically reliably achieve on their own. This is one of the drivers for adding mechanical treatment that can be configured to meet lower limits. Therefore, the new mechanical system and the upgraded oxidation ponds and wetlands are intended to work together.

## 4.4 Oxidation Ponds and Wetlands Process Utilization

There is significant potential flexibility in how the overall system operates. The main roles that the oxidation ponds and wetlands are anticipated to serve include the following:

**Sludge Management:** The oxidation ponds have decades of accumulated sludge and the oxidation ponds with enhanced aeration can help to redistribute and digest the sludge.

**Flow Equalization:** The variable volume in the oxidation ponds can be used to help manage flows into the treatment wetlands and can be used to moderate overall plant flows.

**Treatment:** Oxidation ponds and wetlands add treatment capacity. With enhanced aeration and baffling in Pond 2, the oxidation ponds can provide more effective treatment for BOD/TSS/Ammonia removal. Moderate improvements to the treatment wetlands can help with operations and effluent polishing as well.

As discussed in TM5, the oxidation ditch system is sized to treat flows up to 3.6 million gallons per day (mgd). While this represents a majority of the flow conditions, there are times when influent flows are higher during wet weather events and additional capacity provided by the oxidation ponds and wetlands is needed for equalization and treatment. In addition, oxidation ponds and wetlands are part of a natural treatment system that can be operated at lower energy requirements than typical mechanical systems.

The goal is to provide flexibility within the entire system so that operations staff have the ability to incorporate the use of the oxidation ponds and wetlands to optimize overall system performance. This includes the ability to combine mechanical effluent and pond and wetland effluent prior to disinfection. The balance of the flow between the two systems will depend on the influent flow and load conditions, treatment objectives, and operational preferences. In addition, there will be significant periods of time when influent flow is less than the oxidation ditch capacity and piping can be provided to recirculate treatment wetland effluent into the oxidation ditch for further treatment prior to disinfection.

The purpose of the pond and wetland improvements is to complement the new mechanical system components and provide added capacity, flexibility, reliability, and options for operations. This TM focuses on pond and wetland upgrades to help achieve this purpose.

## 4.5 Oxidation Pond, Treatment Wetland, and Enhancement Wetland Overview

The recommended near term improvements shown in Figure A2 in the Appendix can be grouped into the following four areas:

- Pond 1 and 2.
- Treatment Pump Stations.
- Treatment Wetlands.
- Enhancement Wetlands.

These improvements to the overall pond and wetland treatment system are intended to be completed as part of the broader mechanical wastewater treatment system improvements, such as headworks, oxidation ditch, clarification, and solids management systems. These mechanical upgrades are addressed under separate TMs.

While the new oxidation ditch treatment system is intended to handle dry and wet weather flows up to 3.6 mgd and achieve treatment objectives including, BOD, TSS, and ammonia removal, the

oxidation ponds and wetlands serve an important function for managing higher flows, providing effluent polishing, and providing enhancement.

Use of the Enhancement Wetlands is critical to the Arcata WWTP's ability to comply with the Enclosed Bays and Estuaries (EBE) Policy and meet Regional Board permit requirements. The Regional Board has indicated that to meet the definition of enhancement under the EBE policy, all flows up to 5.9 mgd may need to pass through the enhancement wetlands prior to discharge. Therefore, the new mechanical systems must work in concert with the upgraded oxidation ponds and wetlands systems to achieve regulatory compliance.

In prior studies (Middlebrooks, Appendix B) the anticipated effluent ammonia from treatment oxidation ponds was projected to be between 4 and 6 milligrams per liter (mg/l) after all the proposed improvements are made. These levels of effluent ammonia are typical of optimized pond systems. The treatment and enhancement wetlands can provide some additional ammonia removal, however the extent of potential removal depends on circumstances. The effluent ammonia levels are anticipated to vary depending on influent ammonia conditions, temperature, aeration, and other factors. If wastewater is introduced into the enhancement wetlands with very low ammonia (for example effluent from a highly aerobic mechanical treatment system that reduces ammonia to less than 1 mg/l), it is possible that the natural biological activities in the wetland will increase ammonia levels. This is because the influent ammonia levels are so low and natural wildlife activities contribute ammonia to the aquatic system. Ammonia levels are also expected to vary to some degree throughout the year as the influent and weather conditions vary. Achieving the overall desired treatment system performance for the entire plant will depend on the discharge requirements as they relate to dry weather and wet weather conditions, compliance point requirements, influent flow conditions, distribution of flow between natural and mechanical components and recirculation, the mixing of pond and wetland effluent with mechanical treatment system effluent, and other factors. Therefore, providing flexibility in operations allows plant staff to adjust how the oxidation ponds and wetlands contribute to meeting discharge requirements based on actual conditions.

The oxidation ponds and wetlands provide a number of important benefits to the overall system. A discussion of the near term strategies and improvements along with potential longer term adaptive management strategies and improvements is presented in the sections below.

## 4.6 Oxidation Ponds 1 and 2 Improvements

The oxidation ponds provide a series of treatment and flow management benefits as demonstrated through decades of service. The investments made in the oxidation ponds can continue to provide value to the City for many years to come. However, the oxidation ponds warrant both maintenance work and upgrades to improve their overall performance and utility in the overall wastewater management strategy.

Recommended Pond 1 and Pond 2 improvement items include the following:

- Piping and transfer structure additions/modifications for flow equalization.
- Pond 2 Baffling.
- Pond 1 and 2 Aeration.
- Pond 1 Sludge Management.

The overall near term improvements and longer term adaptive management strategies for Pond 1 and Pond 2 are summarized in Table 4.1 and are further discussed below.

Table 4.1 Pond 1 and 2 Improvements

| Near Term Strategy/Improvements | Longer Term Adaptive Management/Improvements |
|---|---|
| **Equalization** | |
| • Provide options to equalize wet weather flow in Pond 1 and 2 under three potential strategies:<br>– Pond 1 higher than Pond 2<br>– Pond 1 and Pond 2 at the same elevation<br>– Pond 1 lower than Pond 2 | Staff to determine how and when to use the three different equalization strategies based on experience with actual flow conditions and the performance of the oxidation ponds and wetlands. |
| **Pond 1 and 2 Aeration** | |
| • Provide conduits, mooring, spaces for starters, expandable electrical capacity, for 24 aerators in Pond 2, but install only 16 initially (or even fewer).<br>• Temporarily install up to 8 aerators into Pond 1 to digest the sludge (or even fewer).<br>• Allow operators flexibility to adjust aerator/blower speed and timing based on conditions.<br>• Reuse Pond 1 aerator electrical conduits, conductors, and other equipment as appropriate to support the new temporary Pond 1 aerators. | Monitor overall treatment effectiveness in Pond 1 and Pond 2. Over time, either transfer Pond 1 aerators to empty slots in Pond 2 or install additional aerators in Pond 2 and finish out electrical as required. The overall amount of mechanical aeration and the placement of aerators can be adjusted through adaptive management decisions. |
| **Pond 1 Sludge Management** | |
| Digest backlogged sludge through temporary aeration of Pond 1. | Adjust aerator locations and operation over time, and/or ultimately dredge oxidation ponds if warranted. |
| **Pond 2 Baffling** | |
| Install baffle wall down center of Pond 2. Divide pond into "Horse Shoe" to improve hydraulics and reduce short circuiting. | None |

### 4.6.1 Equalization

Based on the work of AMRI and Dr. Gearheart, the wetlands perform best when operating at lower flows and essentially steady state conditions (i.e. relatively constant flow of less than 2.3 mgd). This conclusion is based in part on data collected by AMRI from the TW's and findings that TW 4 has consistently shown the best performance. TW4 is fed water at essentially a constant low rate from a pump, while the gravity wetlands, TW's 1, 2, 3, 5, and 6, are fed from Pond 2 based on variable influent flows. AMRI has concluded that the higher variable flows through the gravity wetlands leads to lower treatment performance and that improving equalization of flow to reduce flow variability through the gravity wetlands will lead to better performance.

Flows greater than 5.9 mgd are bypassed directly to the Chlorine Contact Basin (CCB) using the Emergency Pond Pump Station (EPPS) and do not have the benefit of additional treatment through Treatment and Enhancement wetland systems.

Currently, weir boards are used in a box between Pond 1 and Pond 2 to manage flow and create differential elevations between the oxidation ponds to partially desync the influent flow rate from the flow rate through the gravity wetlands. This weir also causes a hydraulic restriction between the oxidation ponds and impedes peak flows. Motor operated weirs between Pond 2 and the gravity wetlands are also intended to help maintain more constant flow into the gravity wetlands, however some fine tuning of the weir operation is necessary to achieve better weir operation and flow control.

In order to provide better flow equalization in the oxidation ponds, and therefore the wetlands, it is recommended that flow control upgrades be completed to allow the operation of the oxidation ponds under the following three strategies:

1. Pond 1 higher than Pond 2.
2. Pond 1 and Pond 2 at the same elevation.
3. Pond 1 lower than Pond 2.

These operational strategies allow the oxidation ponds to better mute the peak flows and send water to the gravity treatment wetlands at a more consistent rate. It should be noted that AMRI has completed analysis of historical flows and the potential to adequately equalize future wet weather flows under Options 1 and 2 above. While AMRI has concluded that this should be sufficient, it is recommended that additional piping improvements be made to allow for Option 3 as further described below.

The recommended improvements to relieve the hydraulic restrictions and provide operational flexibility to implement these three equalization strategies are shown in Figure 4.1 below:

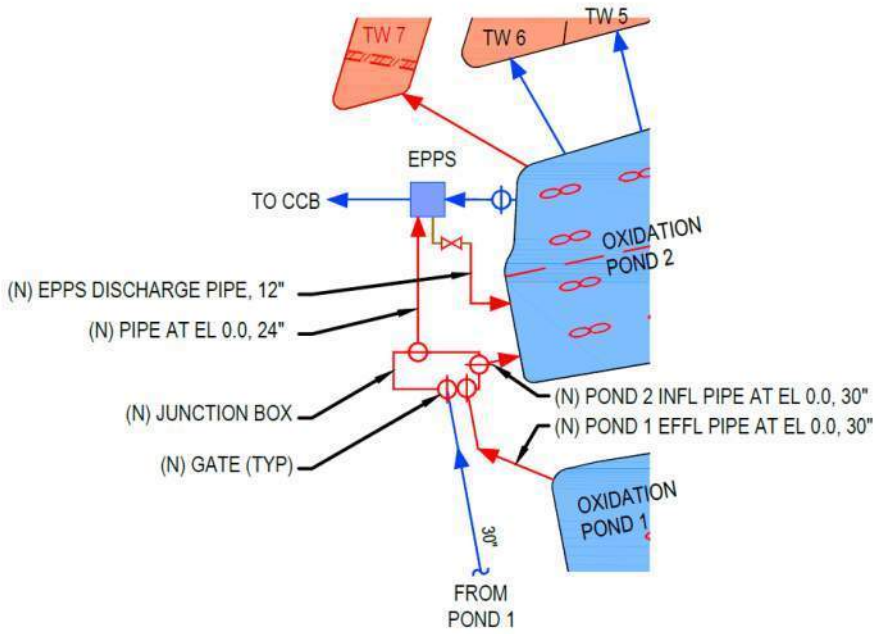



Figure 4.1 New Pond 1 and 2 Equalization Structures and Piping

The overall modifications can be summarized as follows:

- Construct a new junction box with gates to receive Pond 1 effluent.
- Install a new pipe from Pond 1 at El 0.0 to the junction box (Pond 1 effluent) and pipe from the junction box to Pond 2 (Pond 2 influent).
- Install a new pipe from the junction box to the EPPS wet well at El 0.0.
- Install a new EPPS discharge pipe to the influent end of Pond 2.
- Remove existing weir in transfer pipe between Pond 1 and 2.

The new structures and piping would allow the City to choose between the three strategies. The gates in the junction box allow operations staff to prevent water from running backwards from Pond 2 into Pond 1 when the EPPS is being used to lower the elevation of Pond 1. The Supervisory Control and Data Acquisition (SCADA) system could be used to manage the weirs between Pond 2 and the Treatment Wetlands to help maintain more constant flows into the wetlands while utilizing the equalization strategies.

### 4.6.2 Pond 1 and 2 Aeration

During the Facilities Planning process, an independent analysis of the oxidation ponds and recommended improvements to the system. The conclusions included recommendations to install aerators to be operated as needed depending on the flow rate, seasonal changes, and actual performance.

A proposal for aerating Pond 2 based on the recommendations is included in Appendix C. It was recommended that 24 aspirating aerators be installed in Pond 2 only and no aerators were initially planned for Pond 1. However, during the more detailed analysis in the predesign phase and further discussions with Dr. Gearheart and operations staff, it was concluded that the recommended level of aeration could be installed in a more flexible fashion and allow for more adaptive management potential, while achieving the general intent of Middlebrooks. The recommended approach is to design out Pond 2 for 24 aerators and initially install conduits and mooring posts, allowing space and capacity for the required electrical and control systems. In addition, it is recommended to design out Pond 1 for 8 aerators including conduits and mooring posts. The concept is to provide capacity for up to 24 aerators which could be distributed between Pond 1 and Pond 2, with flexibility in numbers and placement over time. This allows for significant flexibility and adaptive management capabilities. One advantage of initially installing a number of aerators in Pond 1 is this arrangement provides some aeration directly into Pond 1, which receives the influent wastewater and hence provides additional oxygen up front to aid in treatment. Another is that aeration in Pond 1 can aid in management of the sludge in Pond 1 as further discussed below. The aerators in Pond 1 could be moved to Pond 2 in the future, or additional aerators could be added to Pond 2 depending on how actual flow and load conditions and the performance of the oxidation ponds with the initial aerator configuration. This strategy provides the City with additional flexibility to implement alternative aerator configurations or add additional aerators with relatively minor effort. In addition, this concept allows the City to include the installation of various levels of aeration as additive bid items to better manage the bidding and financing process. For example, the aeration support infrastructure could be included in the base bid, while the aerators, conductors, starters, and controls, could be additive items.

### 4.6.3 Pond 1 Sludge Management

Sludge has accumulated in certain areas of each pond, as shown in the preliminary sludge characterization surveys conducted in 2017 by AMRI (Appendix D). The sludge is most concentrated in the corners, up to 4.2 feet high. AMRI staff estimated that 54,800-yd$^3$ of accumulated sludge in Pond 1 and 43,000-yd$^3$ of accumulated sludge in Pond 2, resulting in approximately 27 percent of the total pond volume. Pond 1 has more accumulated sludge than Pond 2 based on AMRI's research.

The AMRI GIS contour plots of the sludge accumulated in Pond 1 and Pond 2 are shown in Figures 4.2 and 4.3 respectively below.

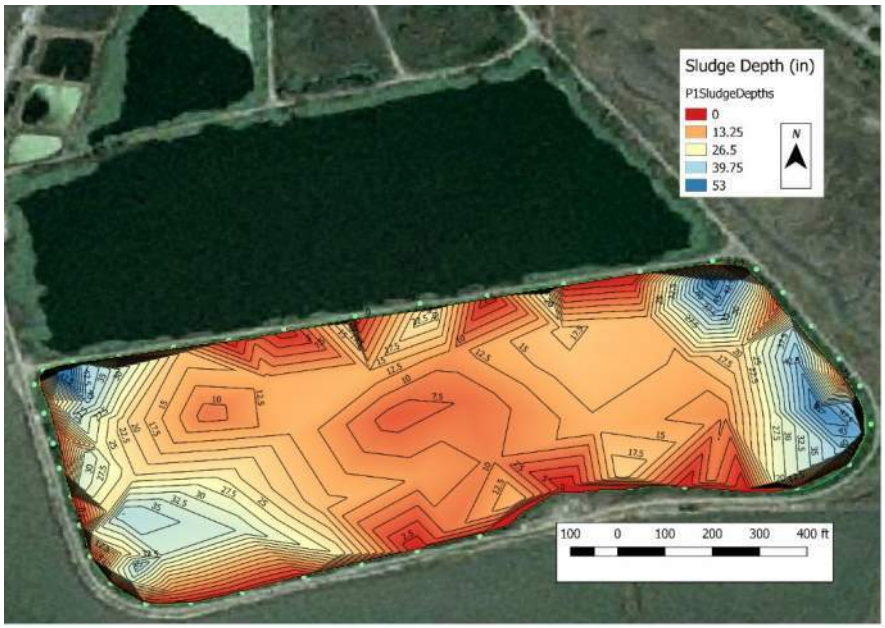



Figure 4.2 Pond 1 Sludge Accumulation (AMRI 2017)

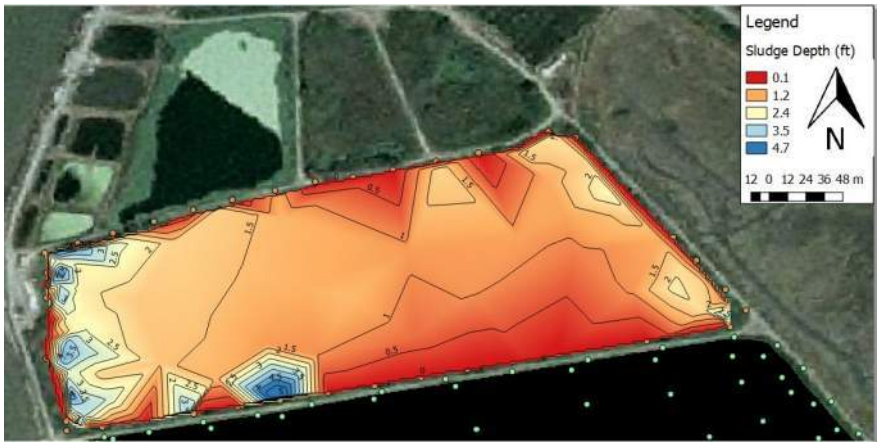



Figure 4.3 Pond 2 Sludge Accumulation (AMRI 2017)

Typical sludge removal options include using a floating dredge to pump the sludge out of the pond, dewatering the sludge onsite, and hauling the sludge offsite for disposal. The cost for removal of the sludge can be very expensive due to the low solids content from dredged sludge and the difficulty in dewatering to a manageable cake. In some applications, oxidation ponds are taken out of service and the sludge is allowed to solar dry in place. The solar drying process is typically enhanced through mixing with heavy equipment. This strategy is effective in areas of lower groundwater and high solar insolation, and with the ability to allow a pond to be out of service for months. However, given the fact that the oxidation ponds are built within the bay, there will likely be groundwater issues and the weather is typically cool and foggy in the summer, and so it may not be possible to work the sludge with heavy equipment and dry it in place. Alternatively, the sludge could be resuspended using aerators and be further digested within the oxidation ponds prior to the Treatment Wetlands (TW). This concept was originally proposed by AMRI as a practical cost savings approach.

As discussed above, the proposed strategy is to configure the improvements to allow for the installation of up to 8 aerators in Pond 1 to help manage the sludge. Operations staff could periodically adjust the location and use of the aerators as needed to achieve sludge digestion and treatment objectives. If required, dredging or other form of sludge removal could be employed in the future. However, given the anticipated reduced flow into the oxidation ponds, the rate of sludge deposition in the future is expected to be significantly less than in the past and additional sludge management tactics may not be necessary for decades.

### 4.6.4 Pond 2 Baffling

The work of Dr. Joe Middlebrooks as summarized in a 2016 report (Appendix B) included the concept of dividing Pond 2 into two equal cells to improve hydraulic flow through the pond and reduce short circuiting. This can be achieved by installing a baffle down the center of Pond 2 to create a horseshoe configuration as shown schematically in Figure 4.4 below:

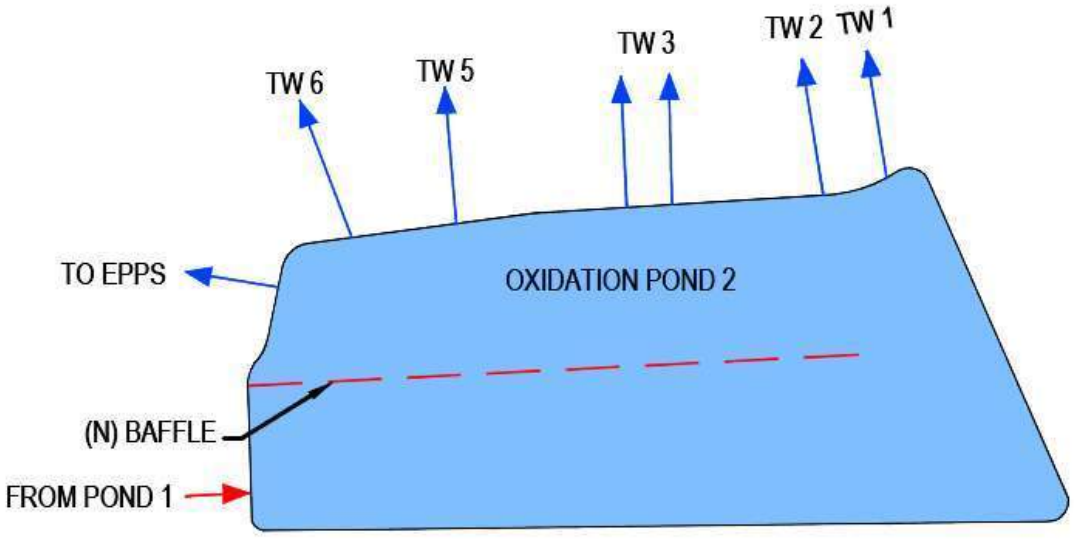



Figure 4.4 Pond 2 Baffle Layout

There are several types of baffle systems available in the market. One system use vinyl or FRP sheet piles that are pushed into the soil to form a rigid baffle. Another is to use a floating boom with a suspended curtain that is anchored to the bottom. Such baffling systems are relatively simple to install and the plastic sheet piling approach has been used in several of the Treatment Wetlands. Vinyl sheet pile baffles are more robust than floating baffle curtains and are the recommended option for the open water of Pond 2, although floating baffles could be considered further during final design as an initial cost saving measure.

## 4.7 Treatment Pump Station Improvements

The operation of the oxidation ponds and wetlands requires the use of a number of pump stations and pipelines for normal dry weather flow operations as well as peak wet weather operations. Based on the existing system configuration and the overall treatment system modifications, the following pond and wetland pump station improvements are recommended:

- Eliminate Pump Station 2 (PS2).
- EPPS standby pump and generator connection.
- Construct TW4 pump station.
- Pond Pump Station (PPS) capacity upgrades.
- Pump Station 1 (PS1) capacity upgrades.
- New Force Main From PS1 to Ultraviolet (UV) Basin.

The overall near term improvements and longer term adaptive management strategies for the treatment pump stations are summarized in Table 4.2 and are further discussed below.

Table 4.2 Treatment Pump Station Improvements

| Near Term Strategy/Improvements | Longer Term Adaptive Management/Improvements |
|---|---|
| **Eliminate PS2** | |
| PS2 pumps TW5 and TW6 effluent to CCB. Wet well is not deep enough to flow by gravity from TW5, TW6 and Future TW7. Install new pipe from TW5 and TW6 to flow by gravity to JB1 and PS2, and then to CCB. | None |
| **Emergency Pond Pump Station (EPPS) Standby Pump and Generator Connection** | |
| The EPPS currently has two electric pumps with a total of 5.8 mgd capacity and a space for a third pump initially planned to be engine driven. Along with other pump stations, the capacity of EPPS is sufficient based on actual operational practice. Existing pumps have relatively low hours. No need for additional capacity at this time. As discussed above, the EPPS could also be used to lower the elevation of Pond 1 for additional equalization with completion of piping modifications. | Currently both existing electric pumps could be used to manage pond elevations during extreme wet weather events. As a separate project, the City could install a third electric pump as a standby as the existing electrical feed is sufficient only for two. Could include a manual transfer switch and generator connection to power the third pump as well from a portable generator. Also, use the EPPS for equalization as appropriate under the conditions. |

Table 4.2 Treatment Pump Station Improvements (Continued)

| Near Term Strategy/Improvements | Longer Term Adaptive Management/Improvements |
|---|---|
| **Construct TW 4 Pump Station (TW4 PS)** | |
| Construct minor pump station with 0.3 mgd capacity to include a small wet well with submersible pump. | None |
| **Pond Pump Station (PPS) Capacity Upgrades** | |
| Design PPS for 7.0 mgd firm capacity (with additional standby pump) to handle storm flows. Replace pumps with submersible rail mounted pumps. | Future modifications possible as necessitated by future conditions.<br>Possibly install new pipe from PPS to CCB as part of a future phase instead of near term phase. |
| **Pump Station 1 (PS1) Capacity Upgrades** | |
| Design PS1 for 2.3 mgd firm capacity (with additional standby pump) based on upper flow capacity through the Treatment Wetlands. Replace pumps with submersible rail mounted pumps. (Integrate with the adjacent PPS improvements) | Future modifications possible as necessitated by future conditions. Pond effluent may not be high enough quality for effective UV disinfection and so consider chlorine option, which will require a new pipe from PS1 to CCB. |
| **New Force Main From PS1 to UV Basin** | |
| New 24" force main is needed to convey 2.3 mgd of wetland effluent from PS1 to the UV basins and to provide separate discharge lines between the PPS and PS1.<br>A new pipe will branch off the new 30-inch force main to convey flow from the Treatment Wetland effluent to the Oxidation Ditches (alternative flow path). | None |

### 4.7.1 Eliminate Pump Station 2

Pump Station 2 (PS2) currently pumps effluent from TW5 and TW6 to either the CCB or Junction Box 1 (JB1) using an above grade temporary pipe. Pump Station 2 is shown in Figure 4.5 on the following page. PS2 is has reached the end of its useful life and could be eliminated by the conversion to gravity flow.

For the TW5, TW6 and future TW7 effluent to flow by gravity into JB1, which eventually flows to PS1 and the CCB, it is recommended that a new buried pipe be installed between TW5/6/7 and JB1 to allow for gravity flow and eliminate the need for Pump Station 2.



Figure 4.5 Pump Station 2

Figure 4.5 above shows Pump Station 2 and Blue Frog treatment units in the background.

### 4.7.2 EPPS Standby Pump and Generator Connection

The EPPS is used to pump water from Pond 2 directly to the Chlorine Contact Basin when influent flows exceed 5.9 mgd. The EPPS currently has two electric pumps with a total of 5.8 mgd capacity and a space for a third pump initially planned to be engine driven. Based on discussions with staff and a review of the historical operations and near term requirements, the current capacity of the two pumps is adequate. Since the pump station is used only during high flow conditions, the two pumps have relatively few hours of run time. Therefore, the pumps appear to have additional useful life.

The EPPS building is of wood frame construction and is in need of maintenance to repair some rot in the siding. A number of other minor maintenance projects should be included as well releveling a slab outside the building.

The major recommended modification to the EPPS is the reconfiguration of the piping as previously shown in Figure 4.1 to achieve the equalization goals.

The EPPS has two installed pumps as shown below in Figure 4.6. Long term improvements could include installing a third electric pump to be used as a standby pump for peak wet weather flows, however, electrical power capacity upgrades would be required to supply power to all three pumps at once. A future third pump could also be powered by a permanent generator if a manual transfer switch and generator connection were installed or it could be powered using a portable generator. It does not appear that additional pumping capacity is currently needed and so the potential for a third pump can be considered as a future adaptive management strategy.



Figure 4.6 Emergency Pond Pump Station (EPPS)

### 4.7.3 Construct TW4 Pump Station

Part of the flow from Pond 2 to TW1 is routed to TW4 using a small pump. The potential to lower the elevation of TW4 and install a gravity pipe to eliminate the pump was considered, but there are grade conflicts with the existing main influent pipes and significant earthwork would be required. Instead, it is more practical and cost effective to construct a small duplex pump station with a wet to pump flow into an upgraded TW4.

### 4.7.4 PPS Capacity Upgrades

The PPS is used to bypass effluent from Pond 2 to the CCB during wet weather events. The PPS will be designed for 7.0 mgd firm capacity to handle wet weather events using two pumps, with an additional standby pump. The current pumps are vertical turbine pumps, and they will be replaced with submersible rail mounted pumps located in the wet well. Flow will be directed to the CCB. Additional piping modifications could also allow for treatment wetland effluent to be recirculated to the oxidation ditch under lower flow conditions if additional ammonia removal were required.

### 4.7.5 PS1 Capacity Upgrades

PS1 receives flow from JB1, which receives flow from all of the treatment wetlands. PS1 is located next to the PPS and shares the same wet well and it is shown in Figure 4.7 below. PS1 pumps are currently vertical turbine pumps and will be replaced with submersible rail mounted pumps. The new pumps will be rated for 2.3 mgd based on the maximum flow capacity through the treatment wetlands. Improvements at the PS1 should be coordinated with the improvements at the PPS.

Pond 2 effluent may not always be of high enough water quality for effective UV disinfection, so it may beneficial install a new pipe to the CCB for bypassing flows during wet weather. Chlorine addition has been an effective strategy for meeting permit limits through oxidation. Pond 2 effluent quality should be evaluated based on full scale performance after the proposed upgrades and the additional pipe to the CCB could be considered as part of a future adaptive management project if warranted. Alternatively, the option could be provided to pipe Pond 2 effluent to the oxidation ditch for additional treatment, which can be evaluated during final design.



Figure 4.7 PPS and PS1

### 4.7.6 New Force Main From PS1 to UV Basin

A new UV system will be installed to provide disinfection for the wetland and oxidation effluent. A new 24-inch force main is needed to convey 2.3 mgd of wetland effluent from PS1 to the UV basins and to provide separate discharge lines between the PPS and PS1.

In addition, a new pipe will branch off the new 24-inch force main to convey Treatment Wetland effluent to the Oxidation Ditches, if needed for additional treatment. This would be an alternate flow path to provide flexibility in system operations for treatment.

## 4.8 Treatment Wetlands Improvements

The Treatment Wetland recommended improvements include:

- Selective Excavation.
- Selective Vegetation Management (City project).
- Selective Baffling.
- Conduits for "Blue Frogs".
- Treatment Wetland 3 Piping Repairs.
- Treatment Wetland 4 Improvements (City project).
- Treatment Wetland 7 Construction (City project).

The main purpose of the treatment wetlands is polishing of BOD, TSS, and ammonia from the oxidation ponds. The overall near term improvements and longer term adaptive management strategies for the treatment wetlands are summarized in Table 4.3 and are further discussed below.

Table 4.3 Treatment Wetland Improvements

| Near Term Strategy/Improvements | Longer Term Adaptive Management/Improvements |
|---|---|
| Selective Excavation | |
| Selectively excavate material near inlets and outlets of TW 1 and TW2 to eliminate current obstructions. Excavation near inlets will also help improve performance of Blue Frogs to be placed in the future. Regrade /place fill in deep area of TW1. Excavate mounds near outlets to reduce short circuiting. | Longer term solids management and regrading based on continued performance monitoring and future needs. |
| Selective Vegetation Management | |
| Selectively clear strip across TW 1 and TW 2. One Strip was cleared from TW 1 in 2017 to improve flow/treatment characteristics. This improvement could potentially be completed before other major construction as a separate project. | Longer term vegetation management based on continued performance monitoring and future needs. |
| Selective Baffling | |
| Install sheet pile or floating baffles in TW1 and TW2 to improve flow/treatment characteristics. All Baffling could be installed through adaptive management. | Possible longer term baffling improvements based on continued performance monitoring and future needs. |

Table 4.3 Treatment Wetland Improvements (Continued)

| Near Term Strategy/Improvements | Longer Term Adaptive Management/Improvements |
|---|---|
| Conduits for "Blue Frogs" | |
| The City installed Blue Frog treatment units currently in TW3. The equipment provides low energy circulation and aeration for sludge digestion in shallow oxidation ponds and wetlands. These units can be relocated when needed. Install conduits (no conductors) along inlet ends of TW 1, 2, 3, 5, 6, 7 in combination with other trenching work along the berm to allow for moving Blue Frogs every few years between TW's. | Determine when and where to move Blue Frogs based on continued monitoring and future needs and install conductors as needed. |
| Treatment Wetland 3 | |
| The inlet piping of TW3 was damaged during previous vegetation clearing and needs to be repaired and reconfigured. | Same longer term vegetation and solids strategies as other TW's. |
| Treatment Wetland 4 | |
| TW4 has an inefficient configuration, and less than optimum plant community. Remove plants to compost. Use excess soil to build exterior berms and submerged berms. Divide interior with three sheet pile baffles. Replant with desired species mix. | Same longer term vegetation and solids strategies as other TW's. |
| Treatment Wetland 7 | |
| Construct TW 7 with earthwork, sheet pile baffles, and transfer structures within environmental constraints to increase TW capacity and overall reliability and redundancy. The configuration will in part depend on how goby mitigation is addressed. | Same longer term vegetation and solids strategies as other TW's. |

### 4.8.1 Selective Excavation

Solids and soil material at the inlets and outlets at TW 1 and TW2 is obstructing the flow path, affecting equalization and causing short circuiting. For example, soil excavated to install the TW 1 outlet weirs was placed in front of the weirs and is obstructing the approach flow to the weirs as shown in Figure 4.8. It is recommended that soil be excavated as needed to clear the flow path to and from the weirs.

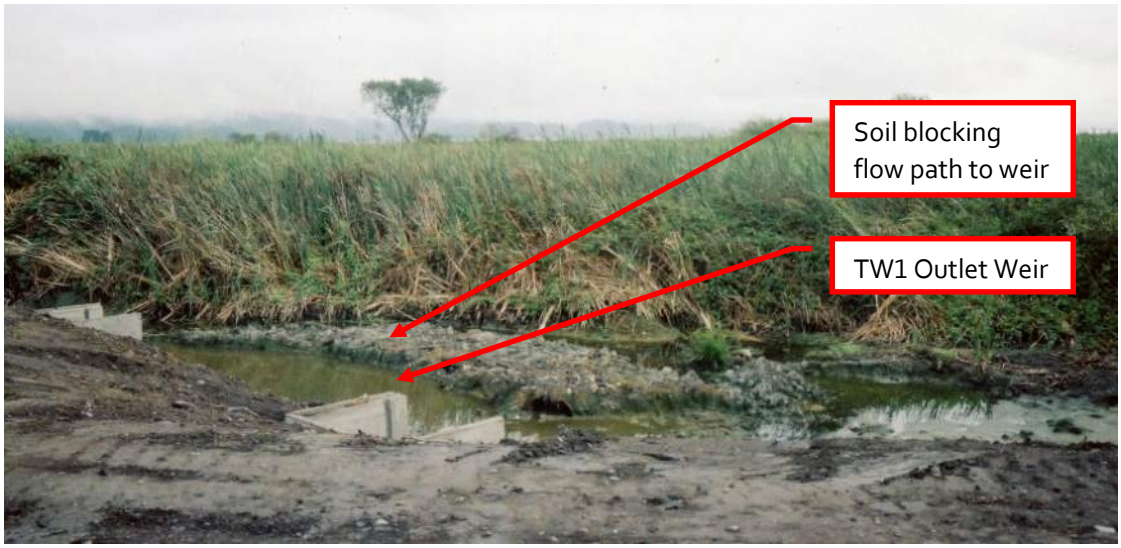



Figure 4.8 Soil Obstructing Flow at TW 1 Outlet Weirs (Photo courtesy of Gearheart, 2018)

### 4.8.2 Selective Vegetation Management

TW 2 has very dense vegetation across its entire area and TW1 has dense vegetation except for a recently cleared strip in the middle. Solid vegetation can cause restrictions in flow capacity. Open water areas help facilitate remixing of water and growth of algae for reoxygenation that improves treatment. It is proposed that vegetation in TW1 and TW2 be removed in several strips across the entire wetland width as shown in Figure 4.9 to allow for better flow and treatment below.

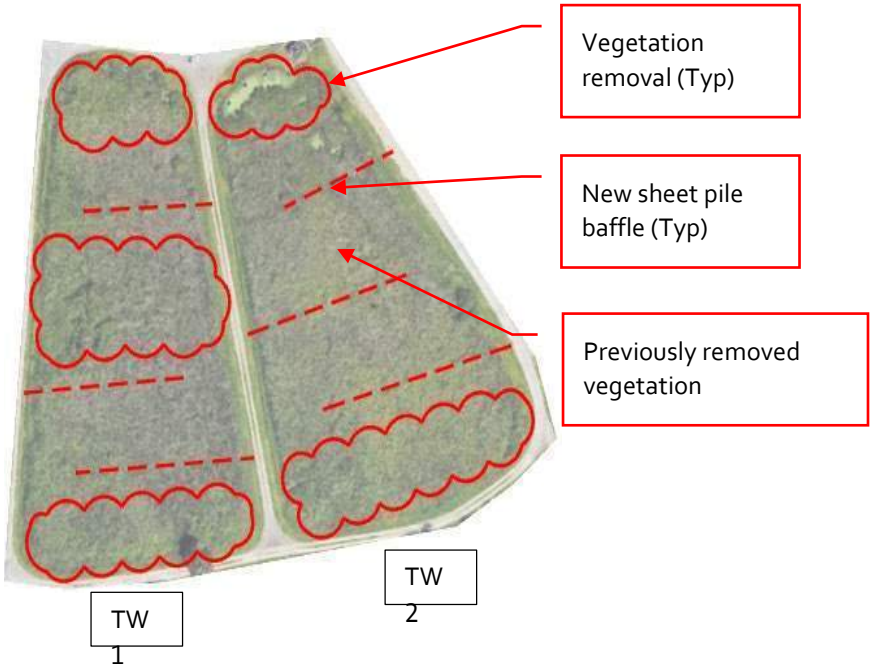



Figure 4.9 TW1 and TW2 Vegetation Removal and Baffles

### 4.8.3 Selective Baffling

In conjunction with the vegetation removal, it is recommended that sheet pile baffles be installed in TW1 and TW2 to facilitate improved flow and treatment through the wetlands. The proposed locations of the baffles are shown above in Figure 4.9. The baffles will create a longer flow path, prevent short circuiting and improve treatment. The performance of the wetlands should be monitored over the long term to determine if further adaptations with additional baffles is warranted.

### 4.8.4 Conduits for "Blue Frogs"

Blue Frog units are intended to provide low energy circulation of water and resuspension of sludge to improve mixing and treatment. Two Blue Frog units are currently located in TW3 as shown in Figure 4.10 and provide passive aeration and mixing at the influent end of the wetland in order to improve solids management and water treatment. Based on recommendations from AMRI, the City is interested in moving the Blue Frogs to different treatment wetlands every few years. The units require power and so it is recommended that conduits, without conductors, be installed at the inlet ends of TW 1, 2, 3, 5, 6, and 7 in the event that the Blue Frogs are relocated to different treatment wetlands. The conduit installation is relatively economical since other trenching work is already required for the AWTF Improvements Project. Conductors could be installed as needed when the Blue Frogs are relocated in the future.



Figure 4.10 Blue Frog Units in TW3

### 4.8.5 Treatment Wetland 3 Piping Repairs

The inlet piping of TW3 was damaged during vegetation clearing. The piping needs to be repaired and reconfigured as part of the overall wetland upgrades.

### 4.8.6 Treatment Wetland 4 Improvements

TW4 was created as a pilot wetland system with a series of small cells separated by earth berms. TW4 was modified and is operated as a full-scale treatment wetland currently, but the overall configuration and plant community is inefficient. Based on concepts developed by AMRI it is recommended that the overall wetland be reconfigured and that the existing dividing berms that take up significant surface area and volume be removed and be replaced with plastic baffle walls to provide more efficient flow and increased surface area and volume. In addition, contouring of bottom elevations and use of submerged berms will allow for a better diversity of shallow and deep areas for improved mixing and treatment. Vegetation improvements include removing the existing plants for composting and replanting the wetland with more desirable plant species. Excess soil at the bottom of the wetland can be removed to build up the exterior berms and to add new submerged berms. The overall concept for TW4 is shown in Figure 4.11 below.




Figure 4.11 TW4 Improvements

### 4.8.7 Treatment Wetland 7 Construction

Five small, unused wetland cells are located west of TW6. These were formerly used for wastewater purposes , but have not been in service for a number of years. It is proposed that these marshes be combined and converted into a new TW7 as shown in Figure 4.12 below. The final configuration would be determined during final design, but it is envisioned that sheet pile baffles or berms would separate areas and promote mixing.

There are potential permitting issues with the reconfiguration and reintroducing wastewater treatment uses to these small ponds formerly used as oxidation ponds and wastewater based aquaculture. The City is currently in the permitting process for TW7.

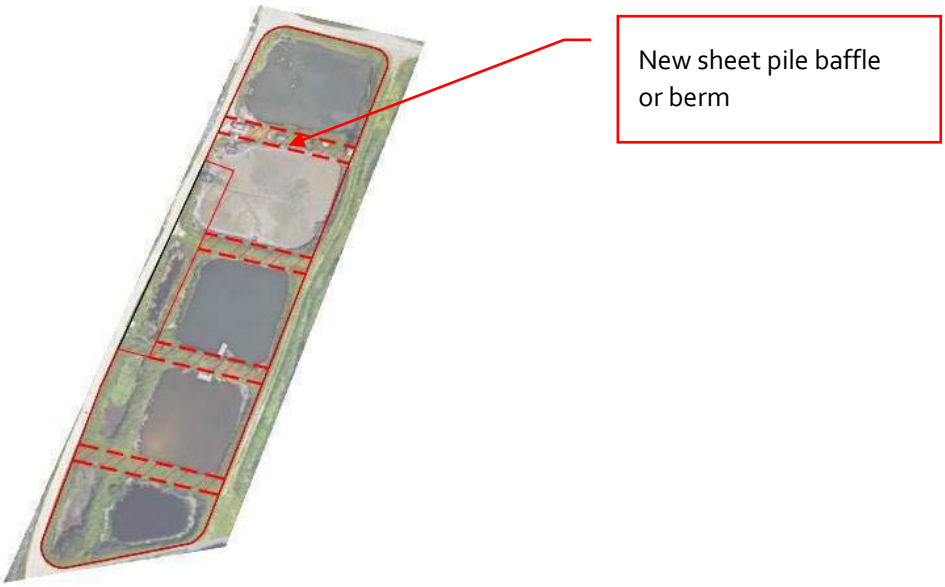



Figure 4.12 New TW7 Construction

## 4.9 Enhancement Wetlands Improvements

The Enhancement Wetlands are critical for compliance with the EBE policy for meeting the enhancement definition. In the future, the NPDES permit may require all flows up to 5.9 mgd to flow through the Enhancement Wetlands prior to discharge. As pointed out by AMRI, the existing Enhancement Wetlands were not designed for plug flow and there are areas of short-circuiting and excess vegetation. In addition, the system was not designed for 5.9 mgd of flow and therefore hydraulic improvements will be required to handle these high flows. Even with hydraulic improvements, operational flexibility should be provided to bypass some flow directly to outfall 003 as might be allowed by future permits if high flows will degrade water quality. Recommended improvements include:

- Flow Reconfiguration and Routing.
- Flow Conveyance.
- Enhancement Wetland (EWPS or Hauser) Pump Station Upgrades.
- EWPS Conveyance Upgrades.
- Selective Excavation City project).
- Selective Vegetation Management (City project).
- Selective Baffling.

The overall near term improvements and longer term adaptive management strategies for the enhancement wetlands are summarized in Table 4.4 and are further discussed below.

Table 4.4 Enhancement Wetland Improvements

| Near Term Strategy/Improvements | Longer Term Adaptive Management/Improvements |
|---|---|
| **Flow Reconfiguration and Routing** | |
| Provide splitter structure near 002 to allow operators the option to potentially split a portion of the 5.9 mgd peak flow directly to 003 while conveying the remainder through the enhancement wetlands. Flow split would be based on achieving water quality objectives. (This depends on approval by RWQCB, may move over to a longer term adaptive measure if it cannot be permitted in this phase of work)<br>Install new pipe down I Street to 003. | Operation of the flow split structure could be changed over time through management of weirs etc. Flows might be increased through the enhancement wetlands as various improvements are made to the wetlands over time and as longer-term performance testing demonstrates effectiveness. |
| **Flow Conveyance** | |
| Add capacity for flow transfer between enhancement wetland cells, including outlet box and pipe under I Street. | N/A |
| **Enhancement Wetland Pump Station (EWPS or Hauser Pump Station) Upgrades** | |
| Design intake system and EWPS for 5.9 mgd peak. Will operate at lower flow for dry weather. Replace pumps with submersible rail mounted pumps. Complete intake modifications to increase capacity and reduce vegetation clogging. Upsize intake pipe to 24". | Future upgrades may include additional vegetation management strategies and features to reduce pump station operations and maintenance requirements. |
| **EWPS Conveyance Upgrades** | |
| Install new pipeline from I street from the existing 16" EW effluent pipe to 003 to allow conveyance of up to 5.9 mgd from the EWPS. Assess condition of existing 16" pipe. | Allow flexibility in junction with existing 16" EW effluent pipe to allow potential for flows to route back to the plant through the existing pipe for added flexibility. |
| **Selective Excavation** | |
| Excavation within the EW's generally not needed. Rather, use selective vegetation management approach. | Longer-term solids management and selective excavation based on continued performance monitoring and future needs. |
| **Selective Vegetation Management** | |
| Selectively clear areas of vegetation in EW Allen along I Street and in EW Hauser along Mt. Trashmore and cut swath in vegetation mat near outlet of EW Hauser similar to TW 1 to improve flow/treatment characteristics. | Longer-term vegetation management based on continued performance monitoring and future needs. |
| **Selective Baffling** | |
| Install sheet pile baffles in EW Allen, Gearheart, and Hauser to improve flow/treatment characteristics. | Possible longer term baffling improvements based on continued performance monitoring and future needs. |

### 4.9.1 Flow Reconfiguration and Routing

Flow reconfiguration and routing is required in order to convey flows to the new Outfall 003 and to provide operational flexibility. The overall proposed configuration is shown in Figure 4.13 below.

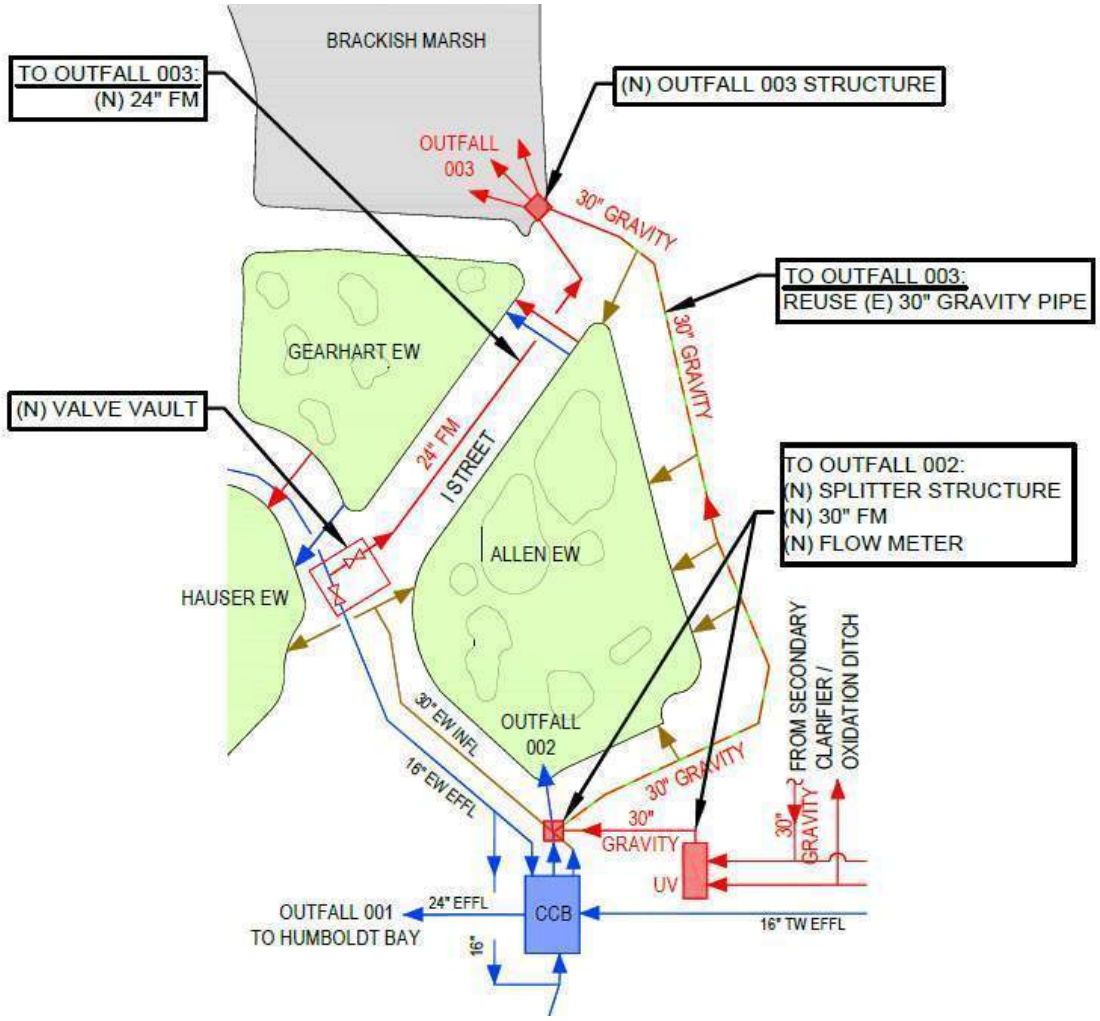



Figure 4.13 Flow Reconfiguration and Routing Improvements

The new NPDES permit (due in 2019) is expected to require conveyance of up to 5.9 mgd through the enhancement wetland system and to outfall 003. This will require an additional pipeline from the UV system to outfall 002 located in Allen EW. The hydraulics will be designed for 5.9 mgd, but the EW's were never designed for such high flows and have never been run at such high flows. Actual operational experience may show a decrease in water quality through the EW's at high flows. Therefore, it is important to provide operational flexibility in managing the 5.9 mgd flow. It is proposed that a new splitter structure be constructed at outfall 002 that allows operators to determine how much of the 5.9 mgd effluent flows through the EW's and how much is bypassed directly to outfall 003 through the existing unused 30-inch gravity line around the eastern side of Allen EW. Additional piping will be needed down I street to outfall 003. How such a bypass system would be used depends on the final permit conditions and actual operating conditions and so the use of this system is part of the overall adaptive management. In addition,

permitting and approval of this approach would be required by the RWQCB. This may be considered a long term adaptive measure depending on regulatory approval.

### 4.9.2 Flow Conveyance

Additional capacity is needed to transfer the flow between the enhancement wetland cells to achieve the 5.9 mgd capacity target. One new transfer structure is proposed between Allen and Gearheart, and one new transfer structure is proposed between Gearheart and Hauser enhancement wetlands as shown in Figure 4.14 below.

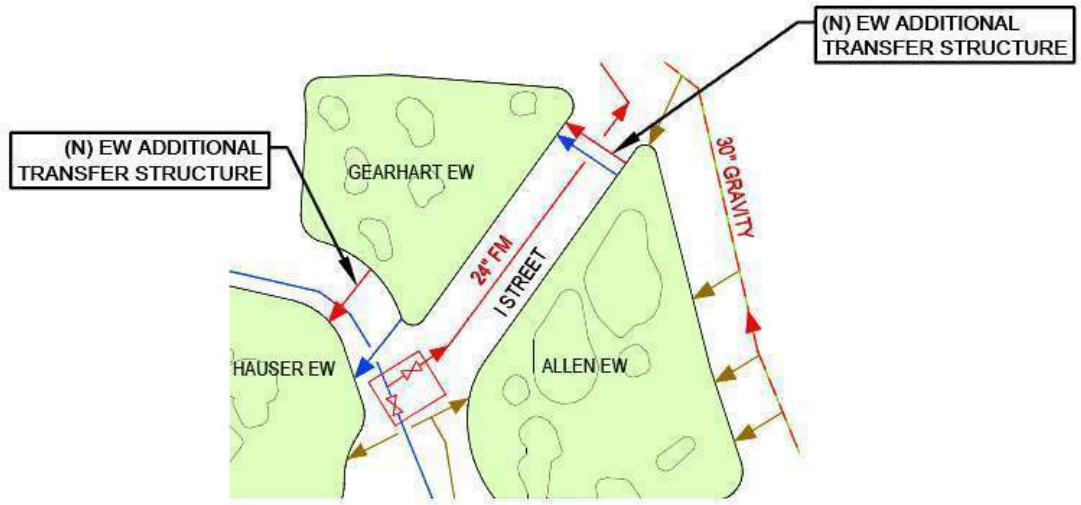



Figure 4.14 Flow Conveyance between Wetlands

### 4.9.3 Enhancement Wetland (EWPS or Hauser) Pump Station Upgrades

The pump station at the downstream end of the Hauser EW (EWPS) currently pumps the final effluent back to the treatment plant for discharge and ultimately will pump it to outfall 003. Conveyance upgrades to pump to outfall 003 are discussed in the following section while pump station upgrades are discussed here.

The EWPS will need to be upgraded to provide 5.9 mgd capacity. The two existing pumps will be replaced with three submersible rail mounted pumps (2 duty, 1 standby), rated nominally for 2.95 mgd each. The design capacity of the pump station will be 5.9 mgd for peak wet weather flow with two pumps running. However, the pump station will typically operate only one pump at lower flows during dry weather. The pumps will be equipped with variable frequency drives (VFDs) to adjust pumping based on overall treatment system flows.

The intake is currently overgrown with vegetation as shown in Figure 4.15 on the following page. The existing intake screens frequently clog and need regular cleaning. The overall intake system will be upgraded to provide better screening of wetland detritus and management of vegetation around the intake such as including a concrete pad leading up to the inlet.

In addition to intake screening modifications, the overall hydraulic capacity of the intake piping will be increased to a 24-inch pipe to meet the 5.9 mgd pumping capacity. The overall intake system will be replaced to provide both the increased hydraulic capacity as well as the screening capability. To improve flow characteristics, several intake locations will be constructed along the downstream end of Hauser EW.

Future improvements could include additional vegetation management strategies and operational strategies based on experience with higher peak flows.




Figure 4.15 EWPS Intake Overgrown with Vegetation

### 4.9.4 EWPS Conveyance Upgrades

As discussed above and as shown previously in Figure 4.14, a new segment of pipe is needed to intercept the existing force main from the EWPS and convey the EW effluent up I street and to outfall 003. It is proposed that the connection be made in a valve vault to allow for potential conveyance of EW effluent back to the treatment plant. This flexibility may be needed in the future, for example, if maintenance work is needed on outfall 003 and the City could temporarily use outfall 001.

### 4.9.5 Selective Excavation

Selective excavation with the enhancement wetlands is generally not required, although during the final design process some targeted areas for selective excavation may be identified. Long-term solids management and selective excavation can be determined based on continued water quality performance monitoring and wetland observations and can be undertaken under an adaptive management approach as required.

### 4.9.6 Selective Vegetation Management

The overall flow path and capacity through the EWs could be improved through selective vegetation management as shown in Figure 4.16 on the following page. These areas include several densely overgrown areas that cause flow restrictions. These and other areas of the EW's should be monitored over time and additional selective vegetation management should be undertaken as warranted to maintain desired flow and open water characteristics.

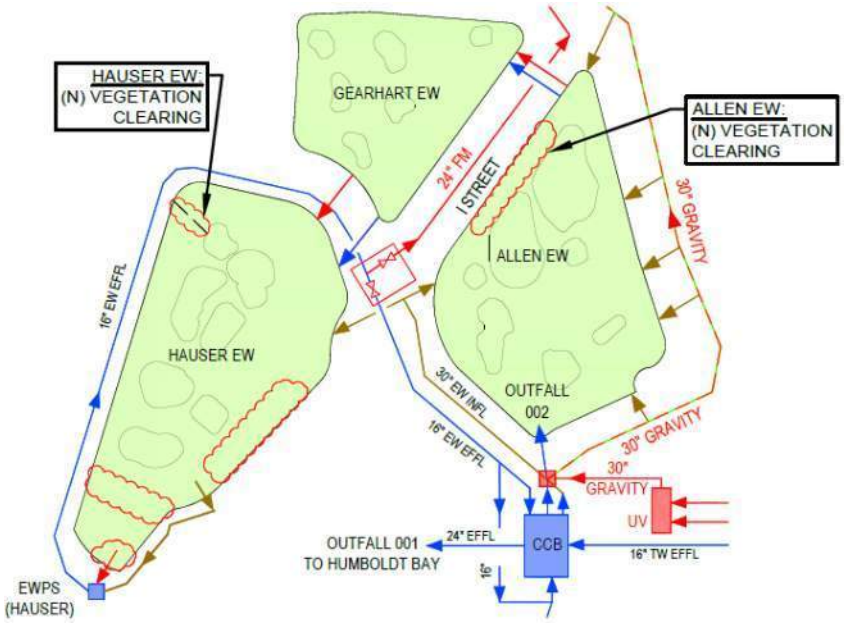



Figure 4.16 EW Vegetation Removal

### 4.9.7 Selective Baffling

In addition to the new transfer structures and vegetation clearing, several new baffles are recommended to be installed in Allen, Gearheart and Hauser EW to promote a better serpentine flow, reduce short-circuiting, and improve treatment performance. The baffling would be similar to what has been installed in the TW's and as proposed for Pond 2. The baffles could be sheet pile type as proposed for Pond 2, but floating curtain baffles would likely be simpler to install and less expensive for the wetlands. Proposed baffle locations are shown below in Figure 4.17.

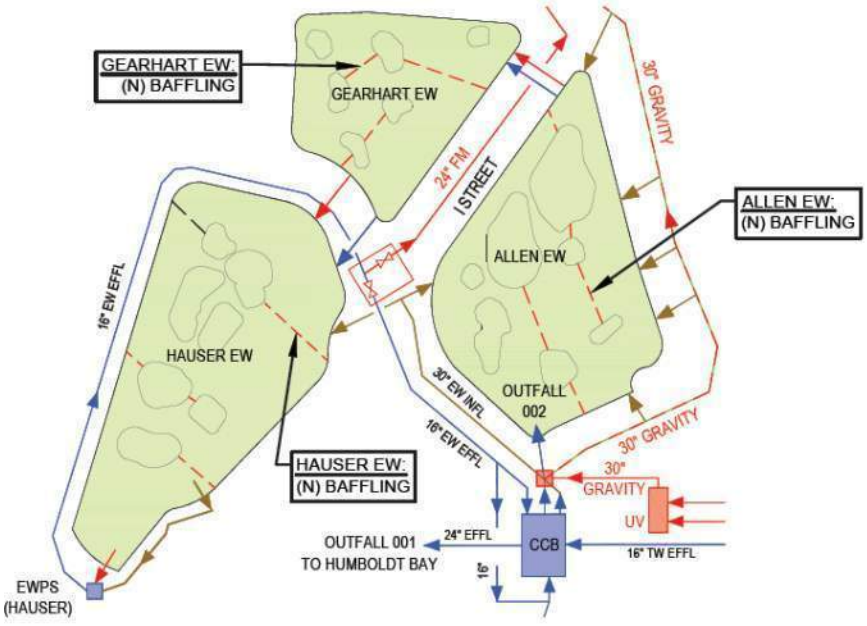



Figure 4.17 EW New Baffling

## 4.10 Implementation Strategies and Potential Sequencing

At the conclusion of the facility planning process, the City Council selected a project based on implementing both mechanical system upgrades and pond and wetland system upgrades with the intent of the two systems working together to ultimately achieve permit compliance objectives. This approach was confirmed with City staff through this predesign process. City staff have indicated that some of the pond and wetland improvements could be implemented separately from other mechanical system upgrades as may be logical from a timing, funding, and performance standpoint. Based on consultation with City Staff, the following elements can be implemented by the City separate from the other system upgrades:

- TW 7 construction.
- TW 4 construction.
- TW 1 and 2 selective vegetation management and excavation.
- EW selective vegetation management and excavation.

Implementation of these improvements early can provide additional treatment capacity and system robustness to help facilitate the construction of the mechanical system improvements.

The sequencing of pond and wetland components should be considered in the larger context of the sequencing of the broader treatment plant improvements considering all major components and maintaining hydraulic and performance characteristics consistent with regulatory requirements, practical operations, and site constraints.

Decisions regarding sequencing of pond and wetland improvements depends in part on Regional Board permit requirements and the sequencing and implementation requirements for the mechanical upgrades.

In addition to the improvements outlined above that the City could implement prior to mechanical upgrades, the following main elements of pond and wetland improvements should be integrated into in the overall treatment plant upgrade sequencing:

- Pond 1 and 2 Aerators.
- Pond 2 Baffle.
- Pond 1 and 2 Flow Equalization Junction Box and Piping.
- EPPS Maintenance Improvements.
- Eliminate PS2 and Install Conveyance Pipe.
- Yard Piping Improvements to Connect to UV.
- TW Baffling Improvements.
- Outfall 003 and Conveyance Pipeline Down I Street.
- TW Piping Improvements, EWPS Upgrades.

A variety of other support improvements would be needed for individual groupings including electrical, SCADA, various piping and interconnections.

Appendix A

# FIGURE A1: EXISTING POND AND WETLAND PIPING

# FIGURE A2: POND AND WETLAND IMPROVEMENTS

TO HUMBOLDT BAY

BRACKISH MARSH

GEARHART EW

I STREET

30" EW INFL

ALLEN EW

HAUSER EW

16" EW EFFL

30" EW INFL

OUTFALL
002

16" EW EFFL

30" EW INFL

FROM FIRST
STREET PS

FROM PRIMARY
CLARIFIERS

24" STORMWATER BYPASS

30" PRIMARY EFFL

OUTFALL 001
TO ARCATA BAY

24" EFFL

CCB

16" OR 20" TW EFFL

16"

16" OR 20" TW EFFL

EWPS
(HAUSER)

BYPASS TO
DISINFECTION

TW 3

PPS

TEMP PIPE

PS2

JB1

PS1

TW
4

TW
1

TW
2

TW
6

TW
5

MARSHES

TW4
PS

14" BYPASS TO DISINFECTION

EPPS

OXIDATION POND 2

24" STORMWATER BYPASS

30" PRIMARY EFFL

SPILLWAY

30"

OXIDATION POND 1

LEGEND

| | |
|---|---|
| EW | ENHANCEMENT WETLAND |
| TW | TREATMENT WETLAND |
| CCB | CHLORINE CONTACT BASIN |
| PS1 | PUMP STATION 1 |
| PS2 | PUMP STATION 2 |
| PPS | POND PUMP STATION |
| EPPS | EMERGENCY POND PUMP STATION |
| EWPS | ENHANCEMENT WETLAND PUMP STATION |
| JB1 | JUNCTION BOX 1 |
| TW4 PS | TREATMENT WETLAND 4 PUMP STATION |
| INFL | INFLUENT |
| EFFL | EFFLUENT |
| | ACTIVE PIPELINE |
| | INACTIVE / LOW USAGE PIPELINE |
| | EXISTING SHEET PILE BAFFLE |
| | EXISTING ISLAND |
| | EXISTING FLOW GATE |

Filename: \\ghdnet\ghd\US\Eureka\Projects\11\11151221 Arcata WWTP Design\06-CAD\Figures\11151221 TM4 Figure - Pipelines.dwg

Plot Date: 29 June 2018 - 11:47 AM

Last Saved: mrinh - 6/29/2018 11:47 AM

DRAFT

N

**Figure No. 1**

**EXISTING POND AND WETLAND PIPING**

CITY OF ARCATA

GHD

carollo

TO HUMBOLDT BAY

BRACKISH MARSH

TO OUTFALL 003:
(N) 24" FM

(N) OUTFALL 003 STRUCTURE

OUTFALL
003

GEARHART EW:
(N) BAFFLING

30" GRAVITY

(N) EW ADDITIONAL
TRANSFER STRUCTURE

TO OUTFALL 003:
REUSE (E) 30" GRAVITY PIPE

(N) EW ADDITIONAL
TRANSFER STRUCTURE

GEARHART EW

30" GRAVITY

(N) VALVE VAULT

24" FM

I STREET

ALLEN EW:
(N) VEGETATION CLEARING
(N) BAFFLING

ALLEN EW

TO OUTFALL 002:
(N) SPLITTER STRUCTURE
(N) 24" GRAVITY

16" EW EFFL

HAUSER EW

30" EW INFL

16" EW EFFL

OUTFALL
002

30" GRAVITY

FROM SECONDARY
CLARIFIER /
OXIDATION DITCH

FROM PRIMARY
CLARIFIERS

FROM FIRST
STREET PS

(N) FM FROM PS1
TO UV

TW 5-7: (N) GRAVITY
PIPE TO JB1

PPS/PS1: REPLACE
AND UPSIZE PUMPS

24"
GRAVITY

30"
GRAVITY

UV

30" FM

TW 1 & 2:
(N) VEGETATION
CLEARING & EXCAV.
(N) BAFFLING

OUTFALL 001
TO HUMBOLDT BAY

24" EFFL

CCB

16"

16" TW EFFL

TW3: REPAIR
INLET PIPING

TW 4: (N) GRADING,
BAFFLING, SUBMERGED
BERMS AND VEGETATION

EWPS
(HAUSER)

HAUSER EW:
(N) VEGETATION CLEARING
(N) BAFFLING

TW 3

30" FM

PPS

16"

JB1

PS1

TW 4

EWPS (HAUSER):
(N) UPGRADE PUMPS TO 5.9 MGD.
(N) INTAKE SCREENING AND
UPSIZED 24" INTAKE PIPE.
(N) ELECTRICAL IMPROVEMENTS.

DEMOLISH (E) PS 2 AND PIPING

14" BYPASS TO
DISINFECTION

TW 1

TW 2

TW 6

TW 5

TW4
PS

TW4: (N) TW4 PS

TW7: POTENTIAL
GOBY HABITAT AREA

TW 7

TW 7: (N) GRADING,
SUBMERGED BERMS,
STRUCTURES,
AND PLANTING

POND 2: (N) WEIR
IMPROVEMENTS
FOR EQ

EPPS

OXIDATION POND 2

24" STORMWATER BYPASS

TW 2-3, 5-7: (N) CONDUIT
FOR BLUE FROGS (FUTURE)

30" FROM PRIMARY

EPPS: (N) POND 1
EFFLUENT PIPE AT EL 0.0
TO (N) JUNCTION BOX, (N)
PIPE TO EPPS WET WELL,
AND (N) DISCHARGE PIPE
TO POND 2.

SPILLWAY

POND 2: (N) BAFFLE WALL
(N) 16 AERATORS
(SETUP FOR 24 AERATORS)

30"

OXIDATION POND 1

POND 1: (N) 8 TEMPORARY
AERATORS FOR SLUDGE
MANAGEMENT

LEGEND

| | |
|---|---|
| (E) | EXISTING |
| (N) | NEW |
| EW | ENHANCEMENT WETLAND |
| TW | TREATMENT WETLAND |
| CCB | CHLORINE CONTACT BASIN |
| PS1 | PUMP STATION 1 |
| PS2 | PUMP STATION 2 |
| PPS | POND PUMP STATION |
| EPPS | EMERGENCY POND PUMP STATION |
| EWPS | ENHANCEMENT WETLAND PUMP STATION |
| JB1 | JUNCTION BOX 1 |
| TW4 PS | TREATMENT WETLAND 4 PUMP STATION |
| INFL | INFLUENT |
| EFFL | EFFLUENT |

ACTIVE PIPELINE
INACTIVE / LOW USAGE PIPELINE
NEW PIPELINE
REUSE (E) PIPELINE
EXISTING SHEET PILE BAFFLE
NEW SHEET PILE BAFFLE
NEW SUBMERGED BERM
NEW VEGETATION CLEARING
NEW AERATORS
EXISTING ISLAND
FLOW GATE

DRAFT

N

**Figure No. 2**

**POND AND WETLAND IMPROVEMENTS**

CITY OF ARCATA

GHD

carollo

Filename: \\ghdnet\ghd\US\Eureka\Projects\11\11151221 Arcata WWTP Design\06-CAD\Figures\11151221 TM4 Figure - Pipelines.dwg

Plot Date: 29 June 2018 - 9:00 AM

Last Saved: mrinh - 6/29/2018 8:59 AM

Appendix B

# PERFORMANCE EXPECTED AND OPERATIONAL REQUIREMENTS FOR THE ARCATA, CA, WASTEWATER TREATMENT FACILITY

## (E. JOE MIDDLEBROOKS, PE, PHD, BCEE, 2016)

# Performance Expected and Operational Requirements for the Arcata, CA, Wastewater Treatment Facility

By

E. Joe Middlebrooks, PE, PhD, BCEE

After reviewing several possible modifications to the Pond system at Arcata, CA, it was decided that the most feasible and dynamic approach is to use Pond 1 as an equalization basin and divide Pond 2 into two cells designed as partial mix aerated ponds (Ponds 2A and 2B). With control of the I/I in Pond 1, coupling the ponds with the upgraded wetlands should provide an effluent quality that will meet the proposed regulatory requirements. The system could perform well for many years at the proposed average flow rate of 2.3 mgd after the I/I problems are controlled or solved.

Following are presentations discussing the proposed design and operational requirements to make the system successful. All results are based on information and data provided by the City of Arcata and information found in the report by Carollo Engineering.

Discussions of several performance situations are presented in the following sections. A summary of the most severe controlling situation at the average design flow of 2.3 mgd will be presented first.

## Worst Case Scenario

It seemed best to start with the likely severe design load that will enter Pond 2A during average design flow. The expected performance for the worst case scenario for the design of Ponds 2A and 2B receiving a flow rate of 2.3

mgd is shown in Table 1. It is assumed that Pond 1 will serve as an equalization pond, and that the equalization pond will not remove any BOD or ammonia-N, transferring the entire load from the clarifier to Pond 2A.

The greatest stress on Ponds 2A and 2B will occur when the water temperature is 6 degrees Celsius and microorganism growth rate is at its lowest. BOD removal in Pond 2A and Pond 2B should average approximately 70 and 27 mg/l, respectively. Ammonia-N conversion to $NO_3$-N likely will be minimal in Pond 2A, but it is expected that the effluent from Pond 2B will contain between 4 and 6 mg/L at the 2.3 mgd flow rate and an influent ammonia-N concentration of 55.2 mg/L. Theoretical calculations and experience with aerated ponds indicate that this level of ammonia conversion is feasible at 6 degrees Celsius (Gearheart, 2016).

Maximum power requirements as shown in Table 1 will be controlling in both cells during the warm months because of the lower solubility of oxygen at higher temperatures. The power requirements shown in Table 1 are produced by a design program that determines the controlling oxygen demand (Middlebrooks, 2005). The requirements during the cold months will be less because of the increase in solubility of oxygen and the reduced BOD and ammonia-N removed. Automated equipment should be installed to reduce the operating time for aerators used during the cold months and when power requirements might be lower after dilution of the influent during the rainy season.

During the summer and fall seasons when the flow rate is approximately 1.6 mgd, the aeration power requirements will be much less; therefore, it is essential that the aeration system be designed for control of each aerator. This will not only reduce the power consumption, but also provide better control of system performance. As pointed out above for Pond 1, the operators must be fully committed to good operation, be well informed and receive good training. There is no substitute for good operators.

As pointed out in Table 1, the power requirements are estimates that require refinement by equipment manufacturers; however the kg $O_2$/hr requirements must be provided by the equipment suppliers. The kg $O_2$/hr requirement is based on the environmental and microorganism requirements.

Based upon experience, it is best to install larger numbers of smaller aerators rather than fewer larger aerators. This approach provides better mixing, and when one or more are out of service, the power level is less affected.

## Alkalinity Requirement

Because of the low concentration of alkalinity (approximately 60 mg/L) in the wastewater, to ensure good conversion of the ammonia-N to nitrate-N it will be necessary to add alkalinity to Ponds 2A or 2B. The calculation of the alkalinity needed is shown in Table 2. The adjustment to pH normally observed in facultative or lightly aerated ponds due to growth of algae will be much less prevalent than in facultative ponds and in partial-mix aerated ponds; therefore, there will be a need to supplement the limited supply of alkalinity in the wastewater. There will be a reduced concentration of algae in the aerated ponds that might help buffer the wastewater, but it is necessary to maintain the pH at 7 to maximize ammonia-N conversion.

During the summer and fall when the flow rate averages approximately 1.6 mgd, the needed alkalinity will be less, and the dosage will vary with the influent ammonia-N concentration and the influent flow rate. The influent alkalinity will vary significantly with the seasons; therefore, careful monitoring of the influent alkalinity will be needed to control costs for chemicals.

With an influent alkalinity of 60 to 100 mg/L there would be enough to convert approximately 8 to 14 mg $NH_4$/L to $NO_3$-N, respectively. Using all of the alkalinity would reduce the pH value below 7, the optimum for conversion.

Alkalinity also will be required with a carousel activated sludge process. If this was mentioned in the Corolla report I overlooked it.

## Influence of I/I

As the flow increases during the rainy season, the performance in Ponds 2A and 2B will be significantly influenced by the control of the water transferred from Pond 1. Assuming good control of discharges from Pond 1, the pond system could produce a good quality effluent; however, the impact of solids washout into Pond 2A could be problematic with the first large surge of influent. Without diligent control of transfer of wastewater from Pond 1, the most dramatic effect on Ponds 2A and 2B will occur when a large rainfall occurs and washes the solids from Pond 1 into Pond 2A. Solids in Pond 1 are not similar or biologically active as those in Pond 2A and would dilute the active mass of organisms in Pond 2A. By controlling discharge from Pond 1 as diligently as possible, the system should function reasonably well throughout the year. It is imperative that washout of the active mass of solids be controlled constantly. It is essential that the operating staff be trained and educated about the urgency of flow control, and then monitor the system constantly.

With dilution of large inflow, the effects should not overwhelm the system provided the suspended solids in the pond ae not reduced to the point of biological inactivity. Also, the dramatic effect on the hydraulic retention time would significantly affect the efficiency of the system. Control of the depth of water in Pond 1 is critical if Ponds 2A and 2B are to function adequately during the rainy season. An automated depth control device is essential.

### Storage Available

Normal operation of equalization ponds recommends that the depth of the pond not be drawn down below two feet to prevent odors. Following this advice, at a pond depth of 5.5 feet the volume in Pond 1 is approximately 45

MG, and at a depth of 2 feet the volume is approximately 16 MG. This leaves 29 MG for storage, which provides adequate room to control the discharge from Pond 1 if careful monitoring is exercised. Because the high rainfall occurs during the cool months, it is likely that odor control should not be a problem. Although redundant, it cannot be over emphasized that careful control of Pond 1 will determine how well Ponds 1, 2A and 2B perform; therefore, as stated above, automatic level control is highly recommended.

## Impact of High Flow Rates

### Flow Rate = 4.3 mgd

Assuming that the influent flow rate to Pond 2A is increased to 4.6 mgd and the BOD reduced by 50 percent, the effluent BOD would be less than that observed for the worst case scenario as shown in Table3. If the ammonia-N entering Pond 2B were also reduced to half of the influent to Pond 2A, the performance should also be equal to the worst case or less. These assumptions require a serious caveat: The accuracy of these projected effluent concentrations is dependent on to what degree the suspended solids in Ponds 2A and 2B are washed out. Doubling the flow to 4.6 with the diluted wastewater by very careful introduction of wastewater from Pond 1 that did not reduce the suspended solids concentration in the aerated pond, by more than 5 to 10 %, the performance predicted in Table 3 would likely produce an effluent quality similar to that shown. However, with aerated pond suspended solids reductions beyond the 5 to 10 %, the reduction in efficiency likely will be directly proportional to the percentage that the solids are diluted in Ponds 2A and 2B. As mentioned below, the success of the proposed system is directly related to the degree of success with controlling the discharge from Pond 1.

### Flow Rate = 5.9 mgd

Assuming an influent flow rate of 5.9 mgd and dilution of the pond influent BOD and ammonia-N by a ratio of 2.565 (5.9 MGD/2.3 MGD), the design concentrations for BOD and ammonia are 71 and 21.5 mg/L, respectively.

The results of this analysis are shown in Table 4. All of the concerns apply here that were expressed in the caveat in the 4.3 mgd section. Also, there are concerns about the significant increase in flow rate that would wash out an excess quantity of suspended solids in Pond 2A unless there is careful control of discharge from Pond 1.

## Projected Performance

Diligently implementing the above suggestions, the total system could produce effluent concentrations as follows: BOD < 30 mg/L, TSS 30 to 40 mg/L, ammonia-N 4 to 6 mg/L, and a pH value 7.0. The system could provide an effluent that will meet the regulatory requirements for the 20% growth projected for Arcata.

## Recommendations and Comments

1. **Use Pond 1 as an equalization basin and divide Pond 2 into two cells of equal volume and designed as partial mix aerated ponds as described in this report (Ponds 2A and 2B).**
2. **Practice diligent control and use the recommendations for the pond system, and the system coupled with the upgraded wetlands could satisfy the anticipated effluent standards for many years.**
3. **Correct the I/I problem and the entire treatment system will function well without the careful control of Pond 1, and will provide treatment for the projected 20% growth to an average flow rate of 2.3 mgd for many years.**
4. **Install control equipment that will provide flexibility in control of depth in Pond 1. This is essential to ensure good performance in Ponds 2A and 2B.**

5. **Install aeration equipment with controls that will provide flexibility in operation during all seasons of the year.**
6. **Install chemical feed equipment to add alkalinity to Pond 2A with controls that will provide flexibility in operation during all seasons.**
7. **Maintain a minimum pH value of 7.0 in Ponds 2A and 2B.**
8. **Provide excellent training for the operators. Careful operation is required for peak performance from the pond system and other components of the system.**

## References


Gearheart, Robert and Swanson, Chuck. 2016. Facultative Oxidation Pond Aeration,

Project Description, EIT, AMRI, January 15, 2016.

Middlebrooks, E. Joe. 2005. Program for Partial-Mix Aerated Wastewater Stabilization Pond Design, With Known Temperature and Hydraulic Detention Time.

## Table 1. Expected treatment in Pond 2A and 2B at design flow rate of 2.3 mgd at various water temperatures when Pond 2 is divided into two equal cells.

**Assuming Pond 1 Does Not Remove any BOD or NH3-N. (Worst Case Scenario). Design based on average design flow rate of 2.3 mgd , and assuming 30% BOD removal in primary tank influent of 260 mg/L.**

| Water Temperature Degrees Celsius | Pond 2A Effluent BOD Flow Rate = 2.3 mgd Inf. BOD = 182 mg/L mg/L | Pond 2A Dissolved Oxygen Requirement for BOD Without Correction for Equipment Efficiency[a] kg $O_2$/hr[b] | kW Required In Pond 2A for BOD at 2.3 mgd kW[b] |
|---|---|---|---|
| 6 | 69.38 | 153.56 | 80.82 |
| 10 | 63.41 | 156.95 | 82.61 |
| 15 | 56.32 | 160.06 | 84.24 |
| 20 | 49.68 | 161.98 | 85.25 |
| 25 | 43.56 | 162.92 | 85.75 |
| 30 | 37.97 | 163.12 | 85.85 |
| 35 | 32.93 | 162.74 | 85.65 |

[a]Excludes correction for equipment efficiencies , but Includes environmental corrections and multiplying factor of 1.5 for BOD removal.

[b]Controlled by Summer Temperature.

[c]These power req. are approximate values and are used for the preliminary selection of equipment. These values are used in conjunction with equipment manufacturers catalogs to select the proper equipment.

## Table 1 Cont. Expected treatment in Pond 2A and 2B at design flow rate of 2.3 mgd at various water temperatures when Pond 2 is divided into two equal cells.

**Assuming Pond 1 Does Not Remove any BOD or NH3-N. (Worst Case Scenario). Design based on average design flow rate of 2.3 mgd , and assuming 30% BOD removal in primary tank influent of 260 mg/L.**

| Pond 2B Effluent BOD Flow Rate = 2.3 mgd Inf. BOD = Col. B mg/L | Pond 2B Dissolved Oxygen Requirement for BOD Without Correction for Equipment Efficiency[a] kg $O_2$/hr[b] | kW Required In Pond 2B for BOD at 2.3 mgd kW[b] | Pond 2B Dissolved Oxygen Requirement for $NH_3$-N Without Correction for Equipment Efficiency[a] kg $O_2$/hr[b] |
|---|---|---|---|
| 26.45 | 51.55 | 27.13 | 132.39 |
| 22.10 | 48.03 | 25.28 | 135.32 |
| 17.45 | 43.34 | 22.81 | 138.00 |
| 13.56 | 38.54 | 20.28 | 139.66 |
| 10.42 | 33.84 | 17.81 | 140.46 |
| 7.92 | 29.39 | 15.47 | 140.64 |
| 5.96 | 25.30 | 13.32 | 140.31 |

[a]Excludes correction for equipment efficiencies , but Includes environmental corrections and multiplying factor of 1.5 for BOD removal.

[b]Controlled by Summer Temperature.

[c]These power req. are approximate values and are used for the preliminary selection of equipment. These values are used in conjunction with equipment manufacturers catalogs to select the proper equipment.

## Table 1 Cont. Expected treatment in Pond 2A and 2B at design flow rate of 2.3 mgd at various water temperatures when Pond 2 is divided into two equal cells.

**Assuming Pond 1 Does Not Remove any BOD or NH3-N. (Worst Case Scenario). Design based on average design flow rate of 2.3 mgd , and assuming 30% BOD removal in primary tank influent of 260 mg/L.**

| kW Required In Pond 2B for NH3-N at 2.3 mgd<br>kWb | Total Oxygen Demand for Pond 2B Flow rate = 2.3 mgd<br>kg O2/hrb | Total kW Required for Pond 2 Flow Rate = 2.3 mgd<br>kWb | Total hp Required for Pond 2 Flow Rate = 2.3 mgd<br>hpb |
|---|---|---|---|
| 69.68 | 337.5 | 177.63 | 238.20 |
| 71.22 | 340.3 | 179.11 | 240.19 |
| 72.63 | 341.4 | 179.68 | 240.95 |
| 73.50 | 340.18 | 179.03 | 240.08 |
| 73.93 | 337.22 | 177.49 | 238.01 |
| 74.02 | 333.15 | 175.34 | 235.13 |
| 73.65 | 328.35 | 172.62 | 231.48 |

**aExcludes correction for equipment efficiencies , but Includes environmental corrections and multiplying factor of 1.5 for BOD removal.**

**bControlled by Summer Temperature.**

**cThese power req. are approximate values and are used for the preliminary selection of equipment. These values are used in conjunction with equipment manufacturers catalogs to select the proper equipment.**

## Table 2. Alkalinity in the wastewater is consumed during the process; therefore, must calculate needed alkalinity for 2.3 mgd.

| | | |
|---|---|---|
| Flow rate = | 8706.5 | $m^3/d$ |
| Influent Alkalinity | 60 | mg/L |
| Influent Total Nitrogen = | 55.2 | mg/L |
| Assumed conversion = | 0.96 | |
| $NO_3$ = TN - Ne | 53.0 | mg/L |
| Influent Alkalinity | 60 | mg/L |
| Alk. used for nitrif. = (7.14 g $CaCO_3/gNH_4$-N)($NO_x$) = | 378 | mg/L used as $CaCO_3$ |
| Alkalinity Residual needed to maintain pH at 7 = | 80 | mg/L as $CaCO_3$ |
| Alk to maintain pH at approx. 7 = Alk Used + Residual Alk. to maintain pH 7 - Inf. Alk | 398.4 | mg/L as $CaCO_3$ |
| | | |
| Alkalinity Needed = | 3468 | kg/d as $CaCO_3$ |

## Table 3. Expected treatment in Ponds 2A and 2B at Various Temperatures and 4.6 mgd.

| Water Temperature | Pond 2A Effluent BOD | Pond 2A | Pond 2B Effluent BOD | Pond 2B | Pond 2B Dissolved Oxygen |
|---|---|---|---|---|---|
| Degrees Celsius | Flow Rate =4.6 mgd<br>Inf. BOD = 91 mg/L | kg O2/hr Required at | Flow Rate = 4.6 mgd<br>Inf. BOD = 2A Effluent | kg O2/hr Required at | Requirement for $NH_3$-N<br>Influent = 27.6 mg/L |
| | mg/L | 4.6 mgd | mg/L | 4.6 mgd | kg $O_2$/hr |
| 6 | 50.23 | 153.55 | 27.73 | 74.65 | 122.04 |
| 8 | 48.63 | 155.35 | 25.99 | 73.03 | 123.47 |
| 10 | 47.03 | 156.95 | 24.30 | 71.24 | 124.74 |
| 15 | 43.01 | 160.06 | 20.33 | 66.20 | 127.21 |
| 20 | 39.03 | 161.98 | 16.74 | 60.55 | 128.74 |
| 25 | 35.14 | 162.92 | 13.57 | 54.61 | 129.49 |
| 30 | 31.41 | 163.12 | 10.84 | 48.64 | 129.65 |
| 35 | 27.88 | 162.74 | 8.54 | 42.85 | 129.35 |

## Table 4. Expected treatment in Ponds 2A and 2B at Various Temperatures and 5.9 mgd.

| Water Temperature | Pond 2A Effluent BOD | Pond 2A | Pond 2B Effluent BOD | Pond 2B | Pond 2B Dissolved Oxygen |
|---|---|---|---|---|---|
| Degrees Celsius | Flow Rate = 5.9 mgd | kg O2/hr Required at | Flow Rate = 5.9 mgd Inf. BOD = 2A Effluent | kg O2/hr Required at | Requirement for $NH_3$-N |
| | Inf. BOD = 91 mg/L | | | | Influent = 27.6 mg/L |
| | mg/L | 5.9 mgd | mg/L | 5.9 mgd | kg $O_2$/hr |
| 6 | 34.69 | 196.95 | 13.22 | 66.12 | 156.4 |
| 8 | 33.18 | 199.26 | 12.1 | 63.91 | 156.4 |
| 10 | 31.71 | 201.31 | 11.05 | 61.61 | 156.4 |
| 15 | 28.16 | 205.29 | 8.71 | 55.59 | 156.4 |
| 20 | 24.84 | 207.76 | 6.78 | 49.43 | 156.4 |
| 25 | 21.78 | 208.17 | 5.21 | 47.89 | 156.4 |
| 30 | 18.98 | 209.22 | 3.96 | 37.70 | 156.4 |
| 35 | 16.46 | 208.74 | 2.98 | 32.45 | 156.4 |

Appendix C

# PRELIMINARY PROCESS DESIGN REPORT AERATED LAGOON SYSTEM DESIGN # 17-3-7175 (AERATION INDUSTRIES INTERNATIONAL, 3/10/17)

# CLEAN WATER OXYGEN TRANSFER TEST AIRE-O2 TRITON® TR SERIES PROCESS AERATOR/MIXER TR10 MODEL (SEPTEMBER 2015)

# PRELIMINARY PROCESS DESIGN REPORT

## AERATED LAGOON SYSTEM

Quote and Calcs for Pond 2 aeration

Project Name: Arcata, CA

Design # 17-3-7175

Option: AIRE-$O_2$ Triton®

3/10/2017

Designed by: Alan Rice, EIT, Aeration Industries International, LLC.

The enclosed information is based on preliminary data provided by the owner/engineer. This data has been reviewed and has been utilized as the basis of the following design recommendations. There may be unknown factors which would alter the design recommendation. Aeration Industries International assumes no responsibility for the validity or any risks associated with the use of modeling software or industry standard assumptions. Aeration Industries International assumes no responsibility for or liability resulting from the use of the recommendations provided as part of the subject design.

Copyright 2016, Aeration Industries International

Aeration Industries International
AIRE-$O_2$

# 1. Design Specifications

## 1.1 Average Flow Rates

The biological process unit has been designed for a 24 hour / 7 day flow.

The maximum hydraulic flow is assumed to be hydraulic only and does not represent an increase in the design organic load.

| DESIGN PARAMETER | FLOW | UNITS |
|---|---|---|
| Design Flow (Annual Average) | 2.3 | MGD |
| Average Winter Flow (Maximum Hydraulic) | 5.9 | MGD |

## 1.2 Influent Water Quality

The influent water quality has been provided by the engineer, and is shown in the table below.

| PARAMETER | INFLUENT | UNITS |
|---|---|---|
| $BOD_5$ | 181 | mg/L |
| TSS | 181 | mg/L |
| $NH_3$-N | 55 | mg/L |

## 1.3 Effluent Water Quality

Aeration equipment was selected based on the oxygen demand required to meet the effluent values shown below.

Actual degree of treatment achieved may depend on hydraulic retention time, water temperature, settling quality, and other factors.

| PARAMETER | EFFLUENT | UNITS |
|---|---|---|
| $BOD_5$ | 30 | mg/L |
| TSS | 30 | mg/L |
| $NH_3$-N | 6 | mg/L |

Aeration Industries International
AIRE-$O_2$

# 2. Design Considerations

## 2.1 Pre-Biological Unit Process

Neutralization is recommended / required ahead of the biological unit process if the pH is expected to fall outside of 6.5 – 8.5 for significant durations.

1/4" fine screen solids removal / reduction is recommended prior to the biological unit process (by others).

## 2.2 Biological Unit Process Aeration

The aeration system has been designed to provide 2.0 lbs $O_2$/lb $BOD_5$ removed and 4.6 lbs $O_2$/lb ammonia removed at the design flow. No surface credits, algae credits, or assimilation credits have been assumed.

The aeration system has been designed to support a process oxygen demand (AOR) of 10,155lb $O_2$ / day.

10155 lb O2/day / 24 hrs / 12 HP / 24 aerators = 1.47 lb O2 / HP-hr

## 2.3 Process Conditions

Sufficient alkalinity is required for nitrification at approximately 7.1 mg alkalinity (as $CaCO_3$) for each mg of $NH_3$-N nitrified. If the raw water alkalinity cannot support this consumption while maintaining a residual concentration of 50 mg/l supplemental alkalinity shall be provided (by others).

To achieve nitrification a minimum water temperature of 10°C is required. Although nitrification may occur at lower temperatures, reaction rates may be slower and ammonia removal will be unreliable.

## 2.4 Process Description

Aeration Industries recommends installing twenty-four (24) TR10 (12HP) Triton Aerators throughout pond 2 (cells 2a and 2b) to achieve the required oxygen transfer and mixing.

Aeration Industries has designed this lagoon aeration system to provide sufficient oxygen for BOD treatment and ammonia removal based on values provided by the engineer. Additionally, Aeration Industries has designed this system to achieve a partial mix within cell 2a and 2b.

## 2.5 Process Calculations

See attached.

Aeration Industries International
AIRE-O2

## 3. Equipment Summary

**Twenty-four (24) TR10 (12HP) AIRE-O$_2$ Triton® Aerators**, consisting of:

- 10 HP, 230/460 volt, 3 phase, 60 Hz, 900 RPM, TEFC motor
- 2 HP regenerative blower
- Field replaceable, water lubricated lower bearing
- Field replaceable, wear-resistant sleeve
- 316 SS Dual-bladed primary PowerMix™ propeller
- 304 SS Saturn Ring diffuser
- 304 SS housing, mounting flange, & hollow shaft

  Note: Aerators shall arrive fully assembled for immediate mounting

**Twenty-four (24) Universal Four-Float Assemblies**, consisting of:

- Four (4) molded, low-density polyethylene, closed cell, foam filled pontoons
- Stainless steel rails and mounting hardware
- Floating vortex shield cabled to the frame

  Note: Flotation devices require field assembly

**Twenty-four (24) Stainless Steel and FRP Float Walkways**
**Twenty-four (24) Anti-erosion Baffles**

**One (1) Lagoon Control System,** consisting of:

- Main fuse disconnect
- 480/240-120VAC control transformer
- 480/120VAC IEC starters
- Circuit protection
- Alarm and run lights
- H-O-A selectors
- Thermal cutoff and heater protection

**5000'** **1/2" SS Mooring Cable**
**Fourteen (14)** **Cable End Assemblies and Turnbuckles**

**Field Service (1 trip, 5 days)**
**Three (3) Year Warranty (see terms and conditions)**
**Freight FOB Jobsite** ← I think freight included

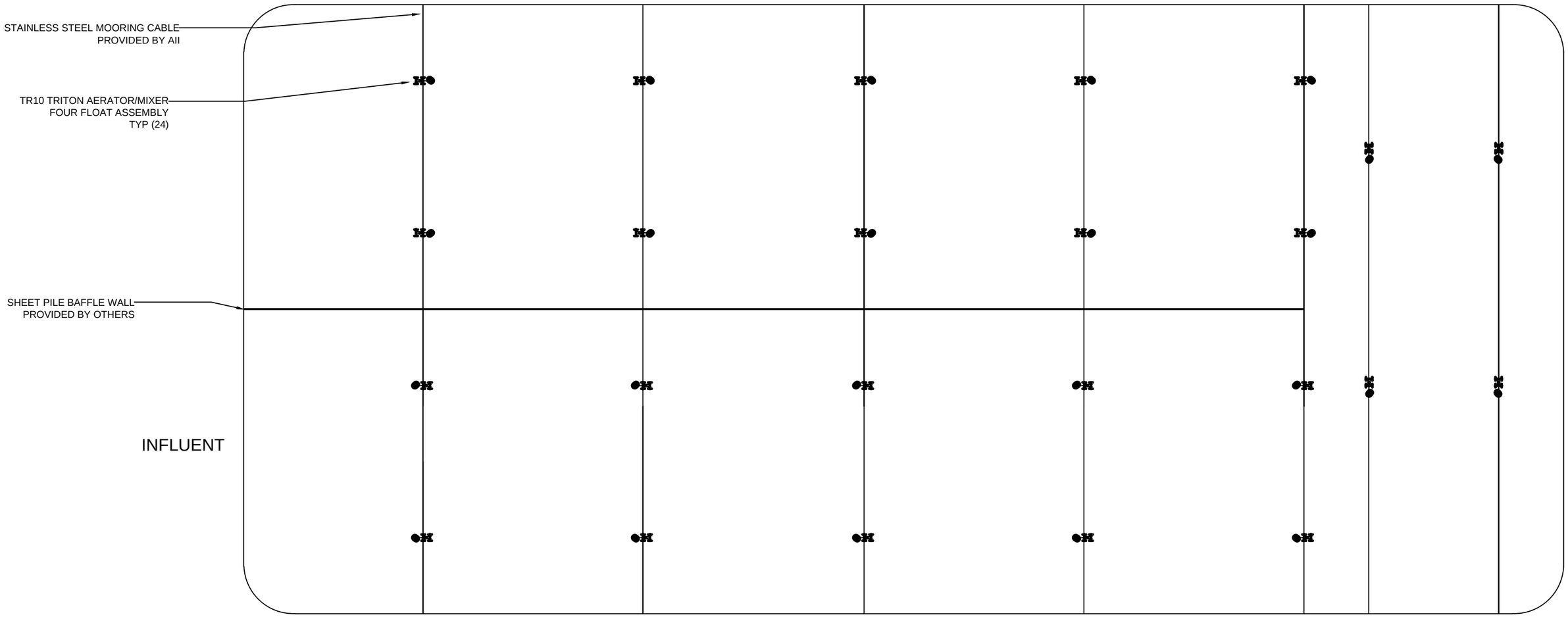
**BUDGETARY PRICE: $982,200**

$982200/24 = $40925 each + tax 8.5% = $44404 each

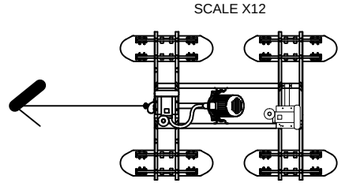
EXCLUSIONS: Installation, duties and taxes are not included. Electrical cable, DO controls and instrumentation, cord grips, baffle wall, mooring posts, and all items not specifically listed above are excluded.

NOTE: If required, submittals will be done six weeks from receipt of purchase order.
Delivery is fourteen to eighteen weeks from submittal approval.
Quotation valid for 30 days.
Three year non prorated warranty

TERMS: General Terms and Conditions Attached (2 pages).




SCALE X12



NOTES

ELECTRICAL CABLE PROVIDED BY OTHERS
JUNCTION BOXES PROVIDED BY OTHERS
SHEET BAFFLE PROVIDED BY OTHERS

UNIT LAYOUT IS DEPENDENT ON SHEET BAFFLE AS DRAWN. ALTERNATIVE CONFIGURATIONS MAY BE REQUIRED FOR DIFFERENT BAFFLE GEOMETRIES.

Aeration Industries' International, LLC.
4100 Peavey Rd, Chaska, MN 55318•USA www.aireo2.com
Phone: +1-952-448-6789 • Fax: +1-952-448-7293
ail@aireo2.com

DRAWN BY: APR DATE: 3/10/2017
CHECKED BY: - DATE: -
SCALE: -

| REV. | DATE: | BY: | DESCRIPTION: |
|---|---|---|---|
| - | - | - | - |
| - | - | - | - |
| - | - | - | - |
| - | - | - | - |
| - | - | - | - |
| - | - | - | - |

CLIENT: -

DRAWING STATUS:
- ☐ INFORMATION ONLY
- ☒ PRELIMINARY
- ☐ APPROVAL
- ☐ CERTIFIED FOR CONSTRUCTION
- ☐ AS-BUILT

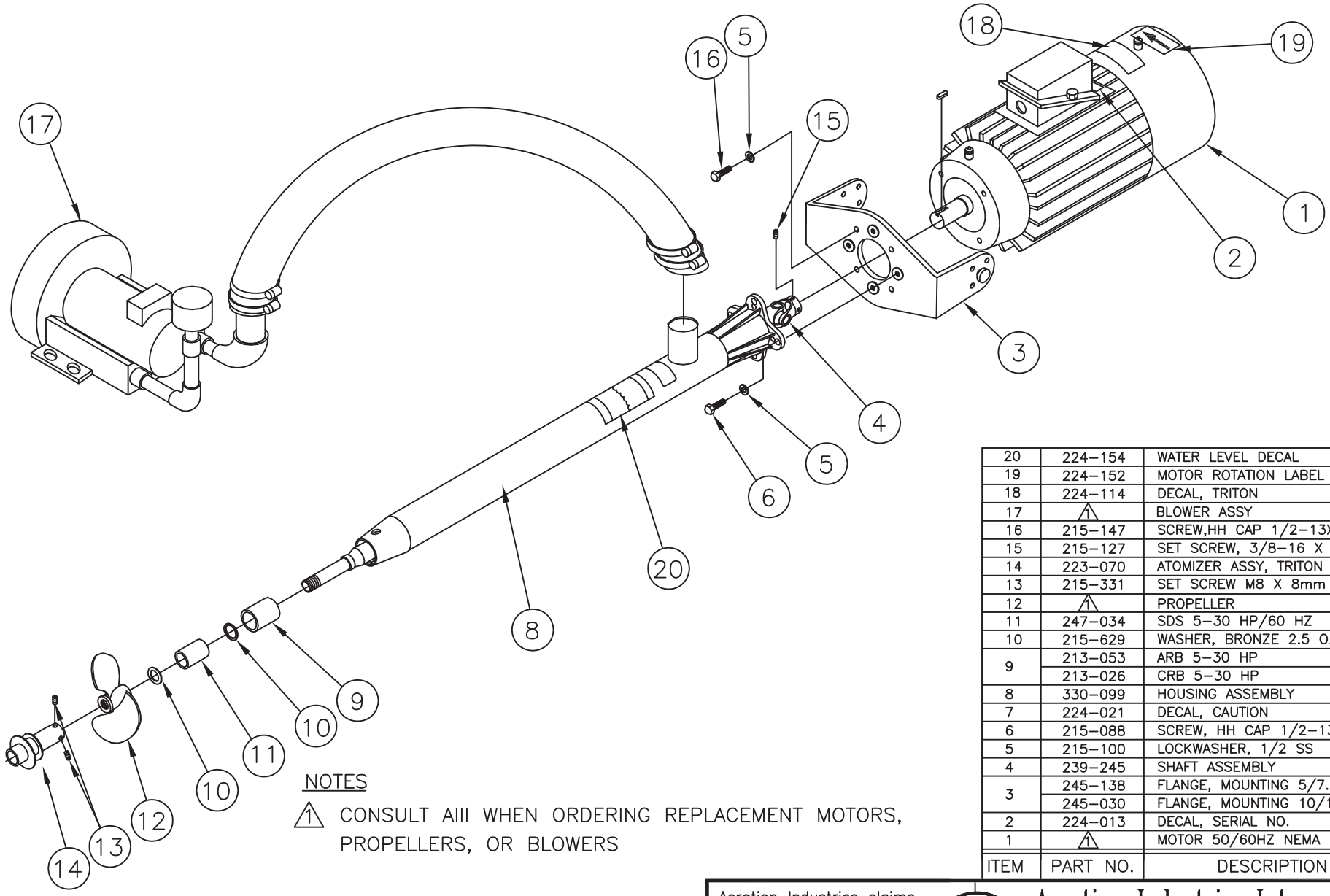
Aeration Industries claims proprietary rights to the material disclosed herein. This drawing is issued for Engineering purposes only and may not be used to manufacture anything shown herein without written permission.
© 2011 Aeration Industries Int'l, LLC.
All Rights Reserved.

TITLE:
ARCATA, CA
AIRE-O2 TRITONS
RECOMMENDED LAYOUT

SHEET 1 OF 1

PROJECT NUMBER:

REV: -




NOTES

1. CONSULT AIII WHEN ORDERING REPLACEMENT MOTORS, PROPELLERS, OR BLOWERS

| ITEM | PART NO. | DESCRIPTION | QTY. |
|---|---|---|---|
| 20 | 224-154 | WATER LEVEL DECAL | 1 |
| 19 | 224-152 | MOTOR ROTATION LABEL | 1 |
| 18 | 224-114 | DECAL, TRITON | 1 |
| 17 | 1 | BLOWER ASSY | 1 |
| 16 | 215-147 | SCREW,HH CAP 1/2-13X1 1/4 SS | 4 |
| 15 | 215-127 | SET SCREW, 3/8-16 X 5/16 | 2 |
| 14 | 223-070 | ATOMIZER ASSY, TRITON | 1 |
| 13 | 215-331 | SET SCREW M8 X 8mm LG S.S. | 2 |
| 12 | 1 | PROPELLER | 1 |
| 11 | 247-034 | SDS 5-30 HP/60 HZ | 1 |
| 10 | 215-629 | WASHER, BRONZE 2.5 O.D.X2.0 I.D. | 2 |
| 9 | 213-053 | ARB 5-30 HP | 1 |
| | 213-026 | CRB 5-30 HP | |
| 8 | 330-099 | HOUSING ASSEMBLY | 1 |
| 7 | 224-021 | DECAL, CAUTION | 1 |
| 6 | 215-088 | SCREW, HH CAP 1/2-13X1 SS | 4 |
| 5 | 215-100 | LOCKWASHER, 1/2 SS | 8 |
| 4 | 239-245 | SHAFT ASSEMBLY | 1 |
| 3 | 245-138 | FLANGE, MOUNTING 5/7.5 HP | 1 |
| | 245-030 | FLANGE, MOUNTING 10/15 HP | |
| 2 | 224-013 | DECAL, SERIAL NO. | 1 |
| 1 | 1 | MOTOR 50/60HZ NEMA | 1 |

| REV. | ECO NO. | DESCRIPTION OF CHANGE | BY | DATE |
|---|---|---|---|---|
| F | 10-2316 | ADDED 224-154 | RH | 2-26-10 |
| E | 10/2310 | 245-138 WAS 330-028 | CY | 1/26/10 |
| D | 09-2219 | 215-331 WAS 215-190 | RH | 4-23-09 |
| C | 07-2036 | 215-190 QTY. WAS 1 | RH | 5-16-07 |
| B | 07-2027 | 239-245 WAS 239-239 REMOVED 215-642 | RH | 3-30-07 |
| A | 06-1934 | 223-070 WAS 223-048, 215-190 QTY WAS 2 | RH | 3-28-06 |
| - | 05-1819 | RELEASED FOR PRODUCTION | RH | 2-25-05 |

Aeration Industries claims proprietary rights to the material disclosed herein. This drawing is issued for Engineering purposes only and may not be used to manufacture anything shown heron without written permission.

DRAWN RVH DATE 2-25-05

APPROVED DATE

Aeration Industries International, Inc.
P.O. Box 59144 Minneapolis, MN 55459 USA
Telephone: 1(612)448-6789 Telex: 9105780838 Facsimile: 1(612)448-7293

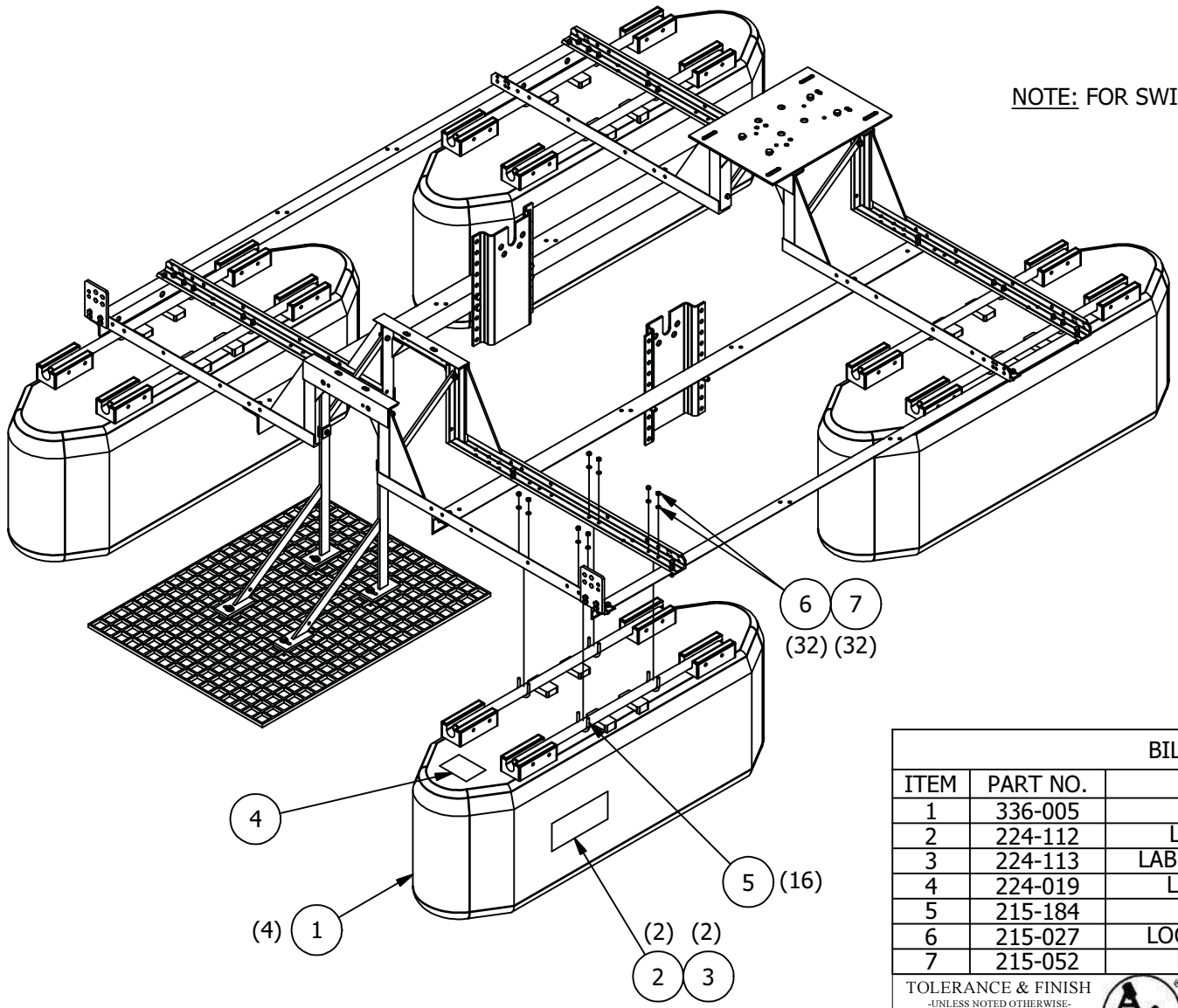
TITLE

# TRITON ASSEMBLY
# 5-15HP 50/60HZ NEMA

| DRAWING NO. | PROJECT NO. | REV. |
|---|---|---|
| 360-287 | | F |

| SCALE | PLOT | SHEET | OF |
|---|---|---|---|
| | | 1 | 1 |

| REVISION HISTORY | | | | |
|---|---|---|---|---|
| REV | ECO NO. | DESCRIPTION | BY | DATE |
| - | 15-2727 | RELEASED FOR PRODUCTION | JFW | 11-02-15 |




NOTE: FOR SWING ARM OPTION SEE SHEET #3.

| BILL OF MATERIAL | | | |
|---|---|---|---|
| ITEM | PART NO. | DESCRIPTION | QTY. |
| 1 | 336-005 | PONTOON ASSY. S.S. | 4 |
| 2 | 224-112 | LABEL, PHONE # DOMESTIC | 2 |
| 3 | 224-113 | LABEL, PHONE # INTERNATIONAL | 2 |
| 4 | 224-019 | LABEL, FLOATATION SAFETY | 1 |
| 5 | 215-184 | U-BOLT, 5/16-18UNC S.S. | 16 |
| 6 | 215-027 | LOCK WASHER, 5/16-18UNC S.S. | 32 |
| 7 | 215-052 | HEX NUT, 5/16-18UNC S.S. | 32 |

TOLERANCE & FINISH
-UNLESS NOTED OTHERWISE-

FRACTIONS ± 1/32
ANGLE ± 1°
FINISH 125

WELDMENTS
ONE PLACE ± 0.06 | 2 PLACE ± 0.03 | 3 PLACE ± 0.015

MACHINED PARTS
ONE PLACE ± 0.03 | 2 PLACE ± 0.01 | 3 PLACE ± 0.005

DRAWN: Joe.Widman | DATE: 12/4/2015
REVISED | DATE

Aeration Industries claims proprietary rights to the material disclosed herein. This drawing is issued for Engineering purposes only and may not be used to manufacture anything shown heron without written permission. C 2011 Aeration Industries Int'l, LLC. All Rights Reserved

DIMENSIONS AND TOLERANCES SHALL BE INTERPRETED IN ACCORDANCE WITH ANSI Y14.5-2009 STANDARDS

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

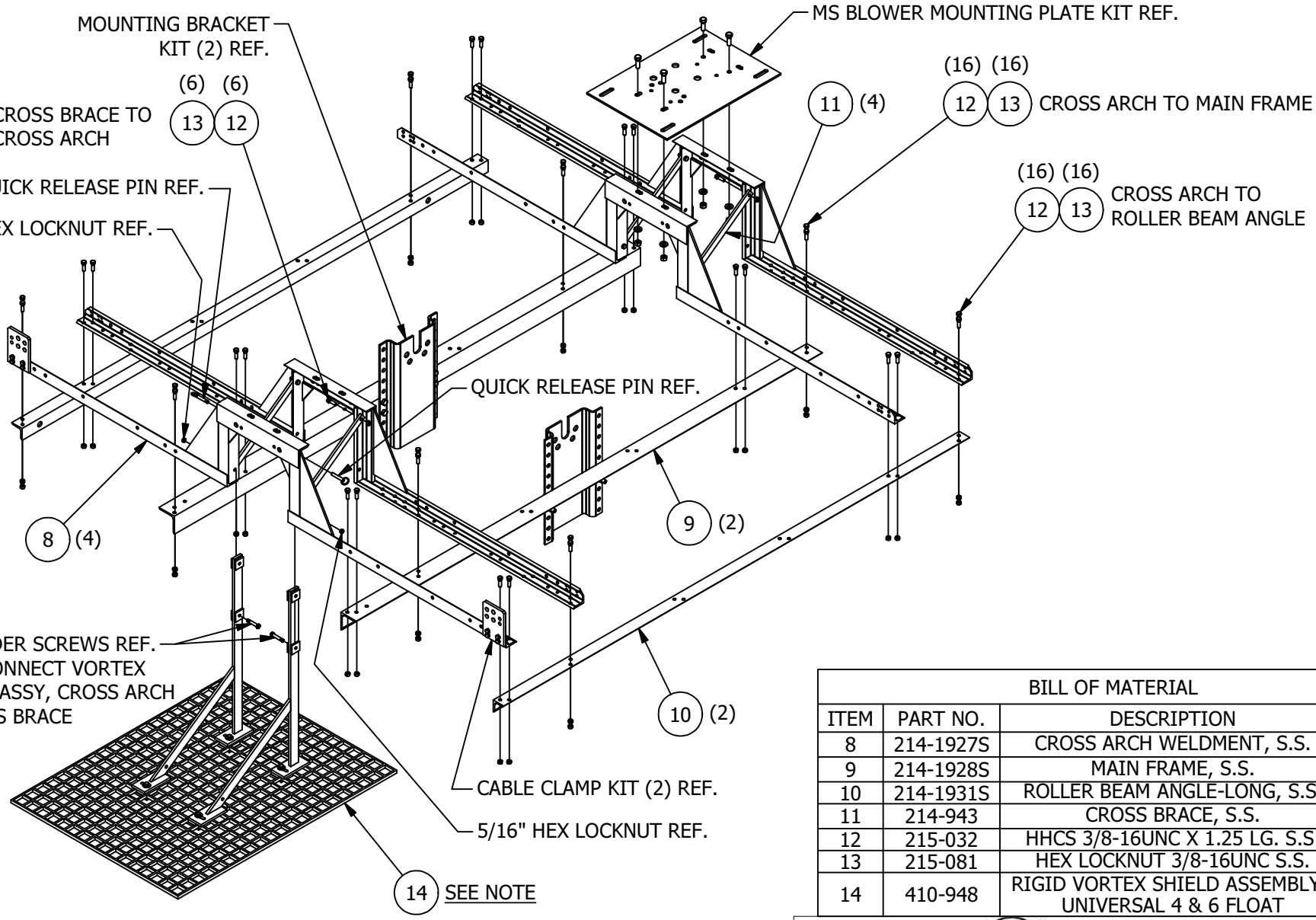
BREAK ALL SHARP EDGES AND REMOVE BURRS

Aeration Industries International, LLC.
4100 Peavey Rd, Chaska MN 55318 USA. www.aireo2.com
Phone: +1-952-448-6789. Fax: +1-952-448-7293. aii@aireo2.com

TITLE
UNIVERSAL 4-FLOAT ASSEMBLY, WITHOUT ROLLERS, S.S.

DRAWING NO. 360-633S | REV. -

SCALE - | SIZE A4 | SHEET 1 OF 3




| BILL OF MATERIAL | | | |
|---|---|---|---|
| ITEM | PART NO. | DESCRIPTION | QTY. |
| 8 | 214-1927S | CROSS ARCH WELDMENT, S.S. | 4 |
| 9 | 214-1928S | MAIN FRAME, S.S. | 2 |
| 10 | 214-1931S | ROLLER BEAM ANGLE-LONG, S.S. | 2 |
| 11 | 214-943 | CROSS BRACE, S.S. | 4 |
| 12 | 215-032 | HHCS 3/8-16UNC X 1.25 LG. S.S. | 38 |
| 13 | 215-081 | HEX LOCKNUT 3/8-16UNC S.S. | 38 |
| 14 | 410-948 | RIGID VORTEX SHIELD ASSEMBLY-UNIVERSAL 4 & 6 FLOAT | 1 |

NOTE: USE (2) QUICK RELEASE PINS, (2) SHOULDER SCREWS & (2) 5/16" HEX LOCKNUTS PROVIDED IN VORTEX SHIELD ASSEMBLY TO ATTACH TO CROSS ARCH AS SHOWN.

Aeration Industries claims proprietary rights to the material disclosed herein. This drawing is issued for Engineering purposes only and may not be used to manufacture anything shown heron without written permission. C 2011 Aeration Industries Int'l, LLC. All Rights Reserved

DIMENSIONS AND TOLERANCES SHALL BE INTERPRETED IN ACCORDANCE WITH ANSI Y14.5-2009 STANDARDS

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

BREAK ALL SHARP EDGES AND REMOVE BURRS

TOLERANCE & FINISH
-UNLESS NOTED OTHERWISE-
FRACTIONS ± 1/32
ANGLE ± 1°
FINISH 125
WELDMENTS
ONE PLACE ± 0.06 | 2 PLACE ± 0.03 | 3 PLACE ± 0.015
MACHINED PARTS
ONE PLACE ± 0.03 | 2 PLACE ± 0.01 | 3 PLACE ± 0.005

DRAWN Joe.Widman DATE 12/4/2015
REVISED DATE

Aeration Industries International, LLC.
4100 Peavey Rd, Chaska MN 55318 USA. www.aireo2.com
Phone: +1-952-448-6789. Fax: +1-952-448-7293. aii@aireo2.com

TITLE
UNIVERSAL 4-FLOAT ASSEMBLY, WITHOUT ROLLERS, S.S.

DRAWING NO. 360-633S
REV. -
SCALE -
SIZE A4
SHEET 2 OF 3

# Aeration Industries International

*Volume Calculator*

**Basin Geometry - Rectangular, Side Slopes**

| | | | | |
|---|---|---|---|---|
| Number of Basins | 1 | | | |
| Length | 1300.0 | ft | 396.2 | m |
| Width | 600.0 | ft | 182.9 | m |
| Water Depth | 5.0 | ft | 1.5 | m |
| Freeboard | 1.0 | ft | 0.3 | m |
| End 1 Slope (H:V) | 3 | * | | |
| End 2 Slope | 3 | * | | |
| Side 1 Slope | 3 | * | | |
| Side 2 Slope | 3 | * | | |
| Volume | 27.70 | MG | 104,860 | $m^3$ |

* indicates assumed values

**Aeration Industries' calculations for determining the aeration equipment required to fulfill the oxygen and/or mixing demand of biological wastewater treatment systems**

*Note: The methods and data presented here are intended for use by the designer to estimate the power requirement for the oxygen demand using AIRE-$O_2$ aeration equipment. This method is not intended to cover every application. Questions can be answered by contacting AIII at 1-800-328-8287*

| | Input Data (Blue Cells) | | | Description |
|---|---|---|---|---|
| 1 | Flowrate = | 2.30 | MGD | *Input flowrate* |
| 2 | Volume = | 27.70 | MG | *Input volume* |
| 3 | BOD in = | 182 | mg/l | *Influent BOD* |
| 4 | BOD out = | 30 | mg/l | *Design output BOD* |
| 5 | $NH_4$-N Removal = | 49 | mg/l | *Design ammonia or TKN removal* |
| 6 | Other = | 0.00 | mg/l | |
| 7 | BOD net = | 152.0 | mg/l | *line 7 = (line 3) - (line 4)* |
| 8 | BOD net = | 2915.7 | lb/day | *line 8 = (line 7) x (line 1) x 8.34* |
| 9 | $NH_4$-N net = | 939.9 | lb/day | *line 9 = (line 5) x (line 1) x 8.34* |
| 10 | Other = | 0.0 | lb/day | *line 10 = (line 6) x (line 1) x 8.34* |

**ASSUMPTIONS**

| | | | | |
|---|---|---|---|---|
| 11 | $O_2$ : BOD = | 2.0 | lb $O_2$ / lb BOD | *Typically varies between 1 and 2* |
| 12 | $O_2$ : $NH_3$-N= | 4.6 | lb $O_2$ / lb $NH_4$-N | *Typical value is 4.6* |
| 13 | $O_2$ : Other = | 0 | lb $O_2$ / lb Other | *Depends on species* |

**$O_2$ REQUIREMENT UNDER FIELD CONDITIONS (AOR)**

| | | | | |
|---|---|---|---|---|
| 14 | $O_2$ for BOD = | 5831.3 | lb $O_2$ / day | *line 14 = (line 11) x (line 8)* |
| 15 | $O_2$ for $NH_4$-N = | 4323.6 | lb $O_2$ / day | *line 15 = (line 12) x (line 9)* |
| 16 | $O_2$ for Other = | 0.0 | lb $O_2$ / day | *line 16 = (line 13) x (line 10)* |
| 17 | AOR = | **10155.0** | lb $O_2$ / day | *line 17 = (line 14) + (line 15) + (line 16)* |
| 18 | AOR = | **423.1** | lb $O_2$ / hour | *line 18 = (line 17) / (24)* |

**CORRECTION FACTORS TO DETERMINE $O_2$ REQUIREMENT UNDER STANDARD CONDITIONS (SOR)**

| | | | | |
|---|---|---|---|---|
| | Air Temperature = | 90 | °F | *Input Air temperature* |
| 19 | Basin Temperature = | 90 | °F | *Input Basin temperature* |
| 20 | Elevation = | 0 | feet above msl | *Input Basin elevation* |
| 21 | $C_w$ = | 2.0 | mg/l | *Operating $O_2$ conc. of wastewater* |
| 22 | $\alpha$ = | 0.85 | | *Correction factor for type of waste* |
| 23 | $\beta$ = | 0.95 | | *Correction factor for salinity, TDS, etc.* |
| 24 | $C_{s20}$ = | 9.09 | mg/l | *$O_2$ saturation conc. at 68 deg F* |
| 25 | $\tau$ = | 0.78 | | *Temperature correction factor* |
| 26 | $\Omega$ = | 1.00 | | *Altitude correction factor* |
| 27 | $C_s$ = | 7.1 | mg/l | *$O_2$ saturation conc. at field conditions* |
| 28 | **(Standardized) SOR =** | **709.6** | **lb $O_2$ / hour** | $SOR = \frac{(AOR) * (C_{s20})}{(\alpha)*\{\beta * C_s - C_w\} * (1.024)^{T-20}}$ |

**Project Name:**

Arcata, CA

**Project Number:**

17-3-7175

**Notes:**

Organic removal values are used to calculate oxygen demand. Actual performance may depend on hydraulic retention time, temperature, and other factors.

2.0lb O2 / lb BOD accounts for the complete treatment of BOD and stabilization of biomass.

Oxygen demand for BOD treatment and ammonia removal are calculated on a removed, not applied, basis.

Surface action and algae credits were not assumed in this design.

Assimilation and stripping credits were not assumed in this design.

**HP REQUIREMENTS**

| | | | |
|---|---|---|---|
| 32 | AIRE-$O_2$ Triton | **266.1** | **HP** |
| 33 | AIRE-$O_2$ Aspirator | **354.8** | **HP** |

**MIXING**

| Process | Triton | Aspirator | |
|---|---|---|---|
| Activated Sludge | 60 | 120 | HP / MG |
| Complete Mix Lagoon | 30 | 60 | HP / MG |
| Partial Mix Lagoon | 10 | 20 | HP / MG |
| Facultative Lagoon | 5 | 10 | HP / MG |
| Chosen Process: | Partial Mix Lagoon | | |

| | | | |
|---|---|---|---|
| AIRE-$O_2$ Triton | **277.0** | **HP** | *process (HP/MG) * V* |
| AIRE-$O_2$ Aspirator | **554.0** | **HP** | *process (HP/MG) * V* |
| HRT | **12.04** | **Days** | *volume / flow* |

**RECOMMENDATIONS**

Based on the information provided, this system is MIXING limited. AII recommends installing twenty four (24) TR10 (12HP) AIRE-$O_2$ Triton aerators to supply the oxygen and mixing required for treatment.

## Aeration Industries International

### *Lagoons in Series Design Calculations*

| | | | |
|---|---|---|---|
| Project Name: | City of Arcata, CA WWTP | Date | 3/10/2017 |
| Project No.: | 17-3-7175 | Prepared By | APR |
| | | Revision: | 4 |

| | | | | |
|---|---|---|---|---|
| Design Flow = | 2,300,000 | gpd = | 8705.5 | m3/d |
| Lagoon Water Depth = | 5.0 | ft = | 1.5 | m |

**BOD Removal Zone**

| | | | | |
|---|---|---|---|---|
| Total Lagoon Volume = | 27.70 | MG = | 104845 | m3 |
| Total HRT = | 12.04 | days | | |

**Suspended Growth BOD Removal Calculations**

**Aerated Lagoon Reactors In Series**
(Metcalf & Eddy, 4th Ed., p.271)

$$S = S_o / [1 + (k_T / n) * \tau]^n$$

where
S = effluent BOD concentration, mg/l
$S_o$ = influent BOD concentration, mg/l
τ = total retention time, days
T = wastewater temperature, C
$k_T$ = reaction coefficient, days-1
n = number of reactors

$$k_T = k_{20} (\theta^{T-20})$$

where
$k_{20}$ = reaction coefficient at 20 deg. C = 1.00 $days^{-1}$ Source: Metcalf and Eddy, 4th ed., Table 8-29
θ = temperature factor = 1.036

**REACTORS IN SERIES**

Number of Reactors = 1

| **Min. Lagoon Temperature** | | | **Max. Lagoon Temperature** | | |
|---|---|---|---|---|---|
| T = | 10 | C | T = | 20 | C |
| τ = | 12.04 | days | τ = | 12.04 | days |
| So = | 182 | mg/l | So = | 182 | mg/l |
| $k_T$ = | 0.70 | $days^{-1}$ | $k_T$ = | 1.00 | $days^{-1}$ |
| S = | 19 | mg/l | S = | 14 | mg/l |

**Aeration Industries International**

***Lagoons in Series Design Calculations***

| | | | |
|---|---|---|---|
| Project Name: | City of Arcata, CA WWTP | Date | 3/10/2017 |
| Project No.: | 17-3-7175 | Prepared By | APR |
| | | Revision: | 4 |

| | | | | |
|---|---|---|---|---|
| Design Flow = | 5,900,000 | gpd = | 22331.5 | m3/d |
| Lagoon Water Depth = | 5.0 | ft = | 1.5 | m |

**BOD Removal Zone**

| | | | | |
|---|---|---|---|---|
| Total Lagoon Volume = | 27.70 | MG = | 104845 | m3 |
| Total HRT = | 4.69 | days | | |

**Suspended Growth BOD Removal Calculations**

**Aerated Lagoon Reactors In Series**
(Metcalf & Eddy, 4th Ed., p.271)

$$S = S_o / [1 + (k_T / n) * \tau]^n$$

where
S = effluent BOD concentration, mg/l
$S_o$ = influent BOD concentration, mg/l
τ = total retention time, days
T = wastewater temperature, C
$k_T$ = reaction coefficient, days-1
n = number of reactors

$$k_T = k_{20} (\theta^{T-20})$$

where
$k_{20}$ = reaction coefficient at 20 deg. C = 1.00 $days^{-1}$ Source: Metcalf and Eddy, 4th ed., Table 8-29
θ = temperature factor = 1.036

**REACTORS IN SERIES**

Number of Reactors = 1

| **Min. Lagoon Temperature** | | | **Max. Lagoon Temperature** | | |
|---|---|---|---|---|---|
| T = | 10 | C | T = | 20 | C |
| τ = | 4.69 | days | τ = | 4.69 | days |
| So = | 71 | mg/l | So = | 71 | mg/l |
| $k_T$ = | 0.70 | $days^{-1}$ | $k_T$ = | 1.00 | $days^{-1}$ |
| S = | 17 | mg/l | S = | 12 | mg/l |

Aeration Industries International
AIRE-O2



# Aire-O$_2$ Triton® TR Series

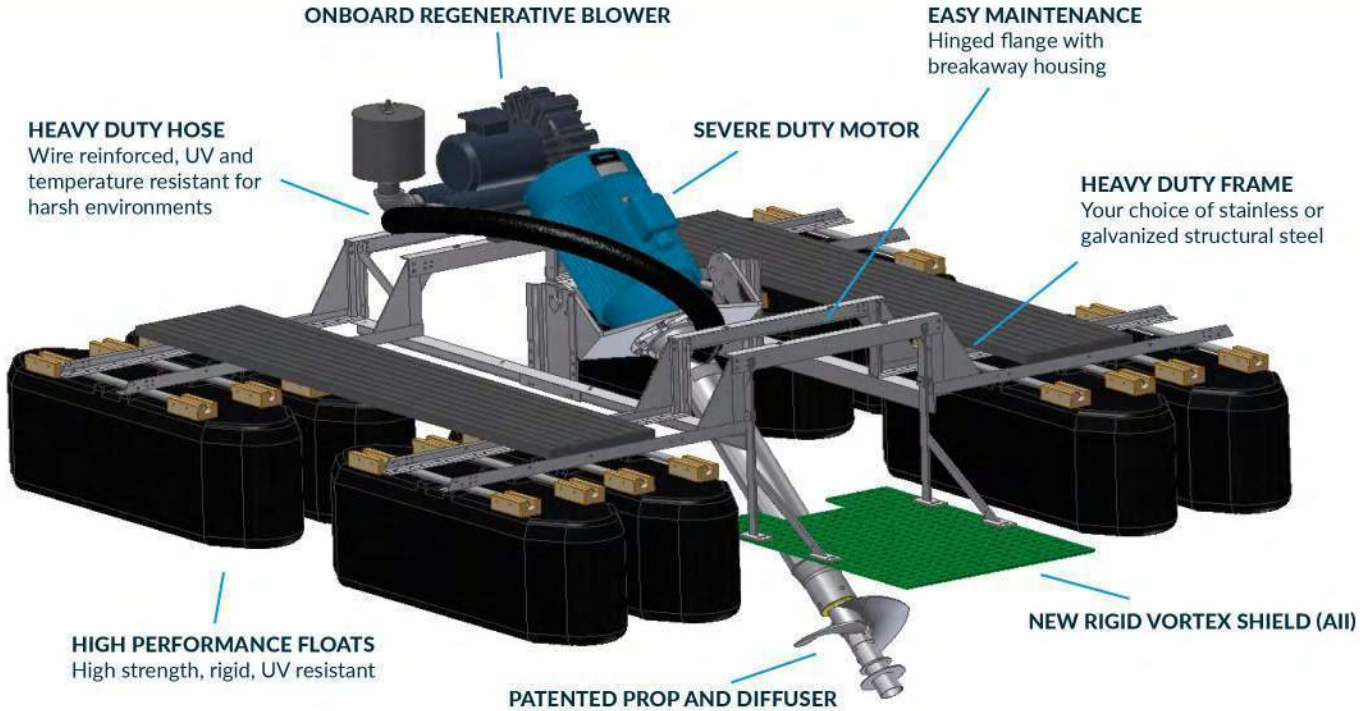
*The effective, reliable solution to deliver more oxygen*

Unique features allow the Triton® TR Series to perform in harsh conditions, while optimizing performance, efficiency and maximizing oxygen transfer and mixing capabilities.

## WHY CHOOSE THE TRITON?

- Delivers more oxygen capacity per unit with upgraded propeller
- Trusted performance
- Maintain without removing or draining the basin
- Performs in challenging, heavy debris conditions
- Fine bubble aeration with a mixing only option for BNR applications
- Mixing capabilities
- Operates for years with minimal maintenance
- Surface mounted, horizontal mixing provides better dispersion, directional control with no splashing or aerosoling
- More than 72,000 units delivered in the US and over 93 countries since 1974

# *The trusted way to deliver oxygen*




*Universal Mounts available to fit wall or bridge geometries.*

## FEATURING

- High efficiency TEFC, 8-pole severe duty motor (900 RPM 60HZ/ 750 RPM 50 HZ)
- Tropicalized/anodized blower to prevent corrosion
- Stainless steel dual-bladed Power Mix™ propeller
- Field replaceable, water lubricated lower bearing with wear resistant sleeve
- Hoses and fittings with UV protection built in for harsh environments
- Option of galvanized or stainless steel float mounts, blower pedestal, and bridge or wall mount
- Stainless steel Saturn Ring™ diffuser
- Available in 5-60hp (4-52.5kW/50Hz) sizes with worldwide voltage and frequency combinations
- Variable mounting angle offers flexibility

*Rentals* ***available!****

**Check for availability*

Aeration Industries® International | +1-952-448-6789 | 4100 Peavey Road Chaska, MN 55318 | aii@aireo2.com
www.aerationindustries.com | © 2016, Aeration Industries International, LLC. All Rights Reserved.

## AERATION INDUSTRIES INTERNATIONAL, LLC

## General Terms and Conditions

1. **Price.** Published prices are subject to change without notice and shall not be binding on Seller until reduced to writing signed by Seller. All prices are F.O.B. Chaska, MN, and do not include transportation cost or charges relating to transportation, which costs and charges shall be solely the responsibility of Purchaser. Prices quoted include standard packing according to Seller's specifications. Special packing requested by Purchaser, including packing for exports, shall be paid by the Purchaser as an additional charge.

2. **Taxes.** To the extent legally permissible, all present and future taxes, imposed by any Federal, State, Local or foreign authority, which Seller may be required to pay or collect upon or with reference to the sale, purchase, transportation, delivery, storage, use or consumption of goods or services, including taxes upon, or measured by the receipts therefrom, shall be paid by Purchaser. Amounts covered hereby shall be added to the price, or billed as a separate item as the law may require or as the Seller may determine. No offset against or reduction in price shall be allowed Purchaser by reason of taxes owed, paid or payable by Purchaser, or charged by Purchaser's account.

3. **Credit and Payment.** Credit accounts will be opened only with firms or individuals approved by Seller's Credit Department. Unless otherwise provided, in any case where delivery is made on credit, Purchaser shall have thirty (30) days from date of the invoice in which to make payment for the goods. Seller reserves the right at any time upon notice to Purchaser, to alter or suspend credit, or to change the credit terms provided herein, when in its sole opinion the financial condition of the Purchaser so warrants. In addition, the Seller may at any time, with or without notice to Purchaser, and at its option, suspend work and shipment under this contract if, in the Seller's sole opinion, the financial condition of the Purchaser so warrants. In such cases, in addition to any other remedies herein, or by law provided, cash payment or satisfactory security from the Purchaser may be required by the Seller before credit is restored or Seller continues performance. If the Purchaser fails to make payment or fails to furnish security satisfactory to Seller, then Seller shall also have the right to enforce payment of the full contract price of the work completed and in process. Upon default by Purchaser in payment when due, Purchaser shall pay immediately to Seller the entire unpaid amounts for any and all shipments made to purchaser irrespective of the terms of said shipment and whether said shipments are made pursuant to this contract or any other contract of sale between Seller and Purchased, and Seller may withhold all subsequent shipments until the full account is settled. Acceptance by the Seller of less than full payment shall not be a waiver of any or its rights hereunder. The seller reserves the right, at its discretion, to charge up to 1½% per month for amounts not paid within stated terms.

4. **Cancellation.** Cancellation of orders once placed with and accepted by us can only be made by us. Should the Purchaser, due to change in design or other good and sufficient cause, desire to effect cancellation of the order, same will be accepted on the following basis:

Purchaser shall pay in full the costs of all material, dies, tools, patterns and fixtures provided for this order, that are on hand or for which we are obligated, together with all labor and other expense incurred in connection therewith. Invoices covering said costs shall be due and payable immediately upon our acceptance of cancellation.

5. **Patents.** To the best of our knowledge, the articles purchased hereunder do not infringe any Letters Patent granted to others by the United States of America or by any country foreign thereto. We do not assume any responsibility or liability for any claim of infringement brought against the Purchaser, its successors, assigns, customers or udders of its product. The Purchaser agrees to hold us harmless against any claim of infringement which arises out of compliance by us with specifications furnished by Purchaser.

6. **Risk of Loss, Title.** The risk of loss of the goods shall pass to the Purchaser as soon as they are deposited with the carrier for shipment to the Purchaser, but title to the goods shall remain in the seller until the purchase price therefore has been paid.

7. **Shipment.** All shipments shall be F.O.B. Chaska, MN, and the date of shipment shall be contingent upon the date of acceptance of Seller's offer. Seller's obligation with respect to shipments of the goods shall not extend beyond a) putting the goods in the possession of such a carrier and making such a contract for the transportation thereof as may be reasonable having regard to the nature of the good; b) obtaining and delivering within a reasonable time such documents as may be necessary for Purchaser to obtain possession of goods; and c) notifying the Purchaser of the shipment within a reasonable time. Seller shall have the right to ship all of the goods at one time or in portions from time to time within the time of shipment. This contract shall be deemed separable as to the goods sold. Purchaser may not refuse to accept any lot or portion of the goods shipped hereunder on the grounds that there has been a failure to ship any other lot or that goods in any other lot were nonconforming. Any such default by Seller will not substantially impair the value of this contract as a whole and will not constitute a breach of the contract as a whole. The goods shall be deemed to have been tendered to Purchaser when they have been deposited with the carrier.

8. **Inspection and Acceptance.** Purchaser shall have the right to inspect the goods upon receipt of them and shall have the opportunity, at that time, to run adequate tests to determine whether the goods shipped conform to the specification of this contract.

Purchaser shall recompense Seller, at the contract price, for all goods used in testing and Purchaser shall bear any expense incurred in the inspection of the goods used in testing, whether or not the goods are non-conforming. Failure to inspect the goods or failure to notify the Seller in writing that the goods are nonconforming with ten (10) days of the receipt of the goods by Purchaser, shall constitute a waiver of Purchaser's rights of inspection and rejection for nonconformity and shall be equivalent to an irrevocable acceptance of the goods by Purchaser. Acceptance – Unless we receive notification to the contrary promptly from you, we will consider the foregoing conditions as been acceptable to you.

9. **Excuse in Seller's Performance.** This contract is subject to an the Seller shall not be responsible or liable for any delay directly or indirectly resulting from or contributed limitations on Seller's production, capabilities, prompt settlement of all details relating to the materials covered by this proposal, and to delays due to fires, explosions, acts of God, strikes or other differences with workmen, shortage of utility, facility, components or labor, delay in transportation, breakdown or accident, war and acts of war, compliance with or other action taken to carry out the intent of purposes of any law or regulation, changes, or revisions, accidents or any other causes or contingencies not caused by Seller or other which Seller had no reasonable control. In the event that any one or more deliveries hereunder is suspended or delayed by reason of any one or more of the occurrences or contingencies aforesaid, any and all deliveries so suspended or delayed shall be made after such disabilities have ceased to exist, and nothing herein contained shall be construed as lessening in any event the full amount of goods herein purchased and sold, but only as deferring delivery and payment in the events and to the extent herein provided for. Neither shall any delay in shipment be considered as a default under this contract or give rise to any liability on the part of Seller for items of incidental, special consequential damage unless such delay was directly and proximately caused by the willful and wanton act of gross negligence of Seller. Acceptance of material on delivery shall constitute a waiver of any claims against seller for damages on accounts of delay.

10. **Warranty.** Seller warrants that it will, at its option, repair or replace the goods, or return the purchase price thereof, which are found to be defective in material or workmanship or not in conformity with the contract requirements provided that, within three (3) year of shipment thereof, Purchaser gives written notice of such defect to Seller, the Purchaser returns the goods to Seller at point of original manufacture, with transportation charges prepaid by Purchaser, and an examination by Seller discloses to its satisfaction the existence of such defect or nonconformity with the contract requirements. In no event shall Seller be liable for any incidentals, special or consequential damages resulting from said effects or nonconformity. This warranty specifically excludes all labor charges that could be incurred.

THE FOREGOING DOES NOT APPLY TO COMPONENTS WHERE WERE NOT MANUFACTURED BY SELLER, AND IS EXPRESSLY IN LIEU OF OTHER WARRANTIES EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE OR USE. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE FOREGOING, NO AGENT, EMPLOYEE OR REPRESENTATIVE OF THE SELLER HAS ANY AUTHORITY TO BIND THE SELLER TO ANY AFFIRMATION, REPRESENTATION OR WARRANTY CONCERNING THE GOODS SOLD UNDER THIS SALES CONTRACT, AND UNLESS AN AFFIRMATION, REPRESENTATION OR WARRANTY MADE BY AN AGENT EMPLOYEE OR REPRESENTATIVE IS SPECIFICALLY INCLUDED WITHIN THIS WRITTEN AGREEMENT, IT SHALL NOT BE ENFORCEABLE TY THE PURCHASER.

11. **Remedies of Purchaser.** If goods are tendered which do not conform with the specifications under the sales contract and these goods are rejected by Purchaser, Seller shall have the right to cure the tender by either correcting the goods or substituting conforming goods. In the event that such substituted goods fail to conform to the contract or in the event of any other breach or repudiation of this contract by Seller, Purchaser shall not be entitled to recover any incidental or consequential damages as those terms are defined in Section 2-715 of the Minnesota Uniform Commercial Code and Purchaser's right to damages shall be limited to the difference between the contract and the market price of the goods as provided in Section 2-713 of the Minnesota Uniform Commercial Code. Purchaser shall not have the right to "cover" as provided in Section 2-712 of the Minnesota Uniform commercial code nor any rights to recover damages for any loss resulting in the ordinary course of events from nonconformity of tender as contained in Section 2-714(1) of the Minnesota Uniform Commercial Code.

12. **Assignments.** No right to interest in this contract shall be assigned by Purchaser, without the written permission of Seller, and no delegation of any obligation owned by Purchaser shall be made without permission of the Seller. Any attempted assignment of delegation shall be wholly void and totally ineffective for all purposed.

13. **Alterations, Interpretations and Definitions.** This contract shall be governed by the laws of Minnesota and is intended also as a complete and exclusive statement of the terms of their agreement. No course of prior dealings between the parties, and no usage of the trade shall be relevant to supplement or explain any term used in this contract. Acceptance or acquiescence to a course of performance rendered under this contract shall not be relevant to determine the meaning of this contract, even though the accepting or acquiescing party has knowledge of the nature of the performance and an opportunity for objection. Waiver by Seller of a breach by Purchaser of any provision of this contract shall not be deemed a waiver of future compliance therewith, and such provision shall remain in full force and effect. Any term used in this contract which is not defined herein shall have the same definition as that contained in the Minnesota Uniform Commercial Code.

# *Clean Water Oxygen Transfer Test*

## AIRE-$O_2$ TRITON® TR Series Process Aerator/Mixer

## TR10 Model

## September 2015

**Certified By:**

SUN-NAN HONG, PH.D., P.E.

Private Consultant
105 James River Rd.
Cary, NC 27511
Cellphone: (919)-349-7708
E-mail: SUNNAN.HONG@gmail.com

**INDEX**

**1. Introduction** ..... **2**
**2. Test Condition** ..... **2**
**3. Oxygen Transfer Test** ..... **3**
3.1 O2 Transfer Test Protocol ..... 3
3.2 Preparation ..... 3
3.3 Test Procedure ..... 4
3.4 Data Analysis ..... 5
3.5 Calculation Description ..... 6
**4. Test Results** ..... **9**
4.1 Power Consumption ..... 9
4.2 Oxygen Transfer ..... 10
**5. Certification** ..... **12**
**Appendix A: ASCE DO PAR Results** ..... **13**
**Appendix B: Layout Drawings** ..... **16**
**Appendix C: Blower Specifications** ..... **17**
**Appendix D: Mixer Motor Specifications** ..... **19**
**Appendix E: YSI Optical DO Probe Sensor Cap Validation Data** ..... **20**
**Appendix F: Power Meter Specification** ..... **24**
**Appendix G: SUN-NAN HONG'S CV** ..... **27**



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

## 1. Introduction

Aeration Industries International, LLC, conducted a test and assessment of an Aire-$O_2$ TR10 Triton surface aerator in a test basin at its facility located in Chaska, Minnesota, USA, on September 1st, 2015.

This testing is essential to determine the oxygen transfer efficiency under clean water conditions according to the American Society of Civil Engineers (ASCE) "Measurement of Oxygen Transfer in Clean Water" [ASCE/EWRI 2-06].

## 2. Test Condition

| Type: | AIRE-$O_2$ Triton | | Blower |
|---|---|---|---|
| Voltage (*V*) | 480 | | 480 |
| Frequency (*Hz*) | 60 | | 60 |
| Motor speed (*RPM*) | 900 | | 3500 |
| Blower Discharge Pressure (*In -WG*) | 33.8 | | |
| | Run 1 | Run 2 | Run 3 |
| Test Water Temperature ( ℃) | 19.4 | 19.5 | 19.7 |
| Barometric Pressure (*kPa*) | 98.8 | 98.8 | 98.8 |
| TDS (*mg/L*) | 1014 | 1086 | 1147 |
| Test Pool Volume ($m^3$) | 352 | | |

**Table 1: Test Conditions**

The drawings in Figure 1 illustrate the basin and probe arrangement. See Appendix A for detailed drawings.

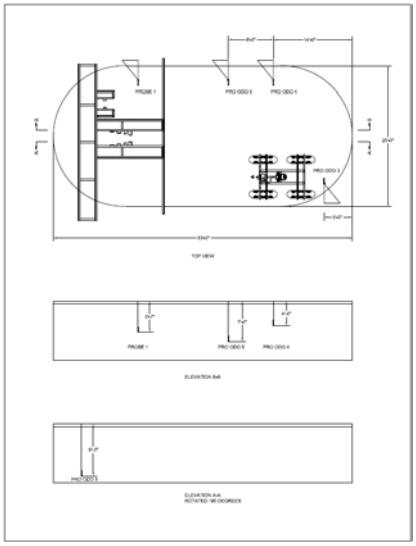


**Figure 1: Plan and Profile View of Test Basin**



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

## 3. Oxygen Transfer Test

### 3.1 O2 Transfer Test Protocol

The following test procedure follows the ASCE standard "Measurement of Oxygen Transfer in Clean Water" [ASCE/EWRI 2-06].

### 3.2 Preparation

1) Verify availability of required test equipment and order equipment as needed.
2) Inspect and verify all test equipment meets quality and tolerance requirements.
3) Test mechanical operation of equipment for quality and tolerance requirements.
4) Designate the appropriate mounting type and position of the equipment in a plan and profile view drawing.
5) Order required chemicals for the designated quantity of test series and runs.
    a. Technical grade sodium sulfite:
        i. 62 lbs/run at temperatures greater than 18°C.
        ii. 72 lbs/run at temperatures less than 18°C.
    b. Reagent grade cobalt chloride:
        i. 0.25 lbs/series
6) Remove all YSI probes from the basin.
    a. Verify calibration of pressure readings;
        i. Compare pressure readings from the probes to a barometer in the same area.
        ii. If the difference in readings are ≤ 1%, the pressure sensors are considered in good condition.
        iii. If there is no barometer available for pressure check, compare the readings between YSI probes.
        iv. If the difference in readings are ≤ 1%, the pressure sensors can be considered in good condition.
        v. If the difference in readings is > 1% for item i. or iii., probe(s) must be sent back to the manufacturer for pressure calibration.
        vi. Complete once for each test series.
    b. Verify calibration of temperature readings:
        i. Compare temperature reading from the probes to a thermometer in the same area.
        ii. If the difference in readings are ≤ 1%, the temperature sensors are considered in good condition.
        iii. If there is no thermometer available for temperature check, compare the readings between YSI probes.
        iv. If the difference in readings are ≤ 1%, the temperature sensors can be considered in good condition
        v. If the difference in readings are > 1% for item i. or iii., probe(s) must be sent back to the manufacturer for temperature calibration. .
        vi. Complete once for each test series.
7) Calibrate conductivity on the YSI galvanic probe. Refer to YSI ProODO Professional Series Probe manual for detail conductivity calibration instructions.



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

a. Use a beaker or other container capable of fully submerging the probe full of YSI conductivity calibration solution. Note: The conductivity sensor is located within the small recess at the top of the probe.
b. Fill the beaker or container with YSI conductivity calibration solution (1,000 microsiemens/cm), so that the probe will be completely submerged.
c. Insure probe is connected to the handheld controller.
d. Use the controller programming to finalize calibration.
e. Complete once for each test series.

8) Calibrate YSI Probe DO readings.
   a. Air-saturation calibration method. Refer to YSI ProODO Optical Probe manual for detail one point air-saturation calibration instructions.
      i. Designate a lead probe.
      ii. Use the sleeve including a water-saturated sponge in it to fully cover the probe
      iii. Insure the probe is connected to the handheld controller.
      iv. Use the controller programming to finalize the calibration.
      v. Match calibration of the subsequent probes to the lead probe.
   b. Winkler Titration Method
      i. Prepare the HANNA kit. Refer to HANNA Winkler kit for detail operation details.
      ii. Prepare a bucket of oxygen saturated test basin sample water.
      iii. Take DO measurement of the water sample by YSI probe.
      iv. Take DO measurement of the water sample by Winkler Titration Method.
      v. Compare the DO reading from YSI probe and Winkler Titration Method. If the difference in readings are within +/-5%, the YSI air-saturation calibration method can be used for the DO probe calibration with subsequent tests in the same series.
   c. Calibrate probes using the appropriate method each time the loggers are shut off, disconnected from the probe.
9) Calibrate YSI Probe TDS readings.
   a. Collect water sample for lab evaluation of TDS for probe verification at the beginning each test series
   b. Calibrate YSI galvanic probe cell constant of TDS based on the lab TDS result at the beginning of each test series. Refer to YSI ProODO Professional Series Probe manual for TDS cell constant setting details.
10) Calibrate Annubar differential pressure readings to 0.

### 3.3 Test Procedure

1) Turn off basin filter system, water inlets and outlets if any.
2) Connect Annubar and selected blower to the mixing device.
3) Position four optical YSI probes in designated locations within the testing basin.
4) Set run name/number on all loggers
5) Set salinity value on the optical probes to the salinity value recorded from the galvanic probe.
6) Initiate mixing device
7) Add 0.25 lbs Cobalt each time after the test pool is refilled. If a different test basin is used, the quantity of Cobalt should be determined by test basin volume and a target Cobalt solution concentration of 0.1mg/L ~ 0.5mg/L



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

8) Continue mixing for 20 minutes
9) Set time interval on all loggers
10) Start logging DO concentration at all determination points
11) Add 62lbs technical grade sodium sulfite if water temperature is above 18$^{o}$C. Add 72lbs technical grade sodium sulfite if water temperature is below 18°C.
12) Keep mixing until sodium sulfite has depressed the DO concentration to less than 0.5 mg/L at all determination.
13) Keep mixing for 2~5 minutes before turning on the blower or Aerator
14) Turn on blower if it is a Triton under test. Turn off mixing device and turn on the Aerator if it is an Aspirator under test.
15) Observe and record electrical data from panel for the mixer and blower motors in 15 second intervals for two minutes after test unit is turned on for at least 10 minutes
    a. Power in kW or W.
    b. Power factor, non-dimensional.
    c. Current in Amps.
    d. Voltage.
16) Record Annubar readings, including gauge pressure, differential pressure, temperature and flow rate.
17) Record TDS readings and salinity readings from YSI galvanic probe
18) Continue test until DO reaches 98% saturation on all loggers.
19) Stop logging on all loggers.
20) Turn off blower.
21) Turn off mixer.
22) Upload data to computer.
23) The first test of the total series is considered a pool conditioning run. Only data from the second test and all consecutive tests should be used in performance evaluation.
24) Test series are considered valid under the following conditions:
    a. TDS ≤ 2,000 mg/L.
    b. Temperature of 10°C-30°C.
25) Repeat step 1) to 24) for consecutive test. At least four valid tests are required to obtain average SOTR and SAE

### 3.4 Data Analysis

1) Excel file 'ASCE DO PAR VERSION 3.0.1' is used for SAE, SOTR calculation
2) All four optical probe data should be processed before copying into 'ASCE DO PAR VERSION 3.0.1.'
    a. Probe data should start from the same time point.
    b. The start time point should be the time when the first probe DO value reaches 2.0 mg/L to eliminate residual sodium sulfite impact on testing.
    c. The total number of data point should not exceed 495.
3) TDS Correction
    a. A TDS correction formula developed by Aeration Industries is used for TDS correction on $Kl_a$.
    b. TDS is calculated throughout the duration of the test series using mass balance equations.



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

4) The spatial variation of average determination point Kla20 values computed in each test should be limited so that three fourth of values are within +/- 10% of the mean value of the tank.
5) Final SAE and SOTR value are required to be the average value of at least four valid repeating test. The SOTR result from repeating test are considered valid if variation in between results are less than +/- 15%
6) A +/- 5% tolerance in electrical readings is allowed in final result

### 3.5 Calculation Description

Calculation of Mass Transfer Rate: ($K_La$)

The test method is based upon removal of dissolved oxygen (DO) from the water volume by sodium sulfite followed by reoxygenation to near the saturation level. The DO inventory of the water volume is monitored during the reaeration period by measuring DO concentrations at several determination points selected to best represent tank contents. These DO concentrations are sensed in situ using DO probes. The method specifies a minimum number, distribution, and range of DO measurements at each determination point. The data obtained at each determination point are then analyzed by a simplified mass transfer model to estimate the apparent volumetric mass transfer coefficient, $K_La$ and the steady-state DO saturation concentration, $C^*_\infty$. The basic model is described by:

$$C = C^*_\infty - (C^*_\infty - C_0)\, exp(-K_lat) \quad \text{(Eq. 1)}$$

Where:

$C$ = DO concentration, *mg/L*

$C^*_\infty$ = determination point value of the steady-state DO saturation concentration as time approaches infinity, *mg/L*

$C_0$ = DO concentration at time zero, *mg/L*

$K_La$ = determination point value of the apparent volumetric mass transfer coefficient

Nonlinear regression is employed to fit Eq. 1 to the DO profile measured at each determination point during reoxygenation. In this way, estimates of $K_La$ and $C^*_\infty$ are obtained at each determination point. These estimates are adjusted to standard conditions, and the standard oxygen transfer rate (mass of oxygen dissolved per unit time at a hypothetical concentration of zero DO) is obtained as the average of the products of the adjusted determination point $K_La$ values, the corresponding adjusted determination point $C^*_\infty$ values, and the tank volume.

Calculation of Standard Oxygen Transfer Rate: (SOTR)

By convention, the oxygen transfer capacity of an oxygenation system is usually expressed as the rate of oxygen transfer predicted by the model at zero dissolved oxygen under standard conditions of temperature and pressure, usually 1.00 atm (101.3 kPa) and 20°C. This is termed the standard



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

oxygen transfer rate (SOTR). The SOTR value shall be determined by correcting the values of $K_L a$ and C*.

$K_L a\ 20 = K_L a \theta^{(20-T)}$ (Eq. 2)

$C^*_{\infty}20 = C^*_{\infty}\ (1/\tau\Omega)$ (Eq. 3)

Where:

$K_L a$ = determination point value of apparent mass transfer coefficient, $min^{-1}$.

$K_L a_{\ 20}$ = determination point value of KLa corrected to 20°C, $min^{-1}$.

Θ = empirical temperature correction factor, defined by Eq. 2 shall be taken equal to 1.024 unless proven to have a different value for the aeration system and tank tested.

$C^*_{\infty}$ = determination point value of steady-state DO saturation concentration estimated, *mg/L*.

$C^*_{\infty 20}$ = determination point value of steady-state DO saturation concentration corrected to 20°C and a standard barometric pressure of 1.00 atm (101.3 kPa).

$\tau$ = temperature correction factor= $C^*_{st}/\ C^*_{\infty 20}$.

$C^*_{st}$ =tabular value of dissolved oxygen surface saturation concentration at the test temperature, a standard total pressure of 1.00 atm (I 01.3 kPa) and 100% relative humidity, *mg/L*.

$C^*s_{20}$ = tabular value of dissolved oxygen surface saturation concentration at 20°C, a standard total pressure of 1.00 atm (101.3 kPa) and 100% relative humidity, *mg/L*.

$\Omega$ = pressure correction factor = $P_b/P_s$ for tanks under 20ft (6.1 m) [for deeper tanks or elevation changes greater than 2,000 ft (610 m).

$P_b$ = barometric pressure at test site during test, *kPa*.

$P_s$ = standard barometric pressure of 1.00 atm, *kPa*

$T$ = water temperature during test, $^{o}C$.

The average value of SOTR shall be calculated by averaging the values at each of the n determination points by:

$$SOTR = \frac{V}{n} \sum_{i=1}^{n} K_L\, a_{20i}\, C^*_{\infty 20i} \qquad \text{( Eq. 4)}$$

$$SOTR\ = 1/n\ \sum_{i=1}^{n} SOTR_i \qquad \text{( Eq. 5)}$$



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

Where:

$$SOTR_i = K_L a_{20i} C^*_{\infty 20i} V \qquad \text{( Eq. 6)}$$

$V$ = liquid volume of water in the test tank with aerators turned off, $m^3$

*SOTR* = standard oxygen transfer rate, *kg/hr*



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

# 4. Test Results

## 4.1 Power Consumption

To evaluate the oxygen transfer efficiency, AII obtained wire power readings for four separate test runs using a calibrated power measurement apparatus (Schneider Electric Power Logic PM5560 Power Meter) to show the aerator power consumption. The installation and calibration of the power meter was completed within 6 months to this report date. See Appendix F for power meter installation and calibration date.

The wire power readings taken from the power measurement apparatus were used in conjunction with the equipment efficiencies to calculate delivered (shaft) horsepower. The equipment efficiencies used in delivered horsepower calculation include mixer motor efficiency, drivetrain efficiency and blower efficiency. Drivetrain efficiency was selected based on typical experience number for similar mechanism, which is 92%. Mixer motor efficiency and blower efficiency are provided by manufacturer specification. See Appendix C&D for mixer motor and blower data sheet. See Table 2 for mixer and blower power readings for each test run.

| Run | MIXER | | | BLOWER | | | | TOTAL | |
|---|---|---|---|---|---|---|---|---|---|
| | MIXER VOLTAGE (V) | MIXER WIRE POWER (kW) | MIXER DELIVERED POWER (kW) | $\Delta P$ (In-WG) | BLOWER VOTAGE (V) | BLOWER WIRE POWER (kW) | Blower DELIVERED POWER (kW) | WIRE POWER (kW) | DELIVERED POWER (kW) |
| 1 | 480 | 8.7 | 7.1 | 33.8 | 480 | 1.4 | 0.7 | 9.1 | 7.8 |
| 2 | 480 | 8.7 | 7.1 | | 480 | 1.4 | 0.7 | 9.1 | 7.8 |
| 3 | 480 | 8.7 | 7.1 | | 480 | 1.4 | 0.7 | 9.1 | 7.8 |

**Table 2: TR10 Triton Power and Pressure Reading**



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

### 4.2 Oxygen Transfer

Table 3 below summarizes the results for each test run, using the output categories from ASCE DO Par Version 3.0.1. To evaluate the oxygen transfer efficiency, AII obtained DO readings for four separate test runs using a calibrated YSI optical DO Probe. The installation and calibration of the probe sensor caps were completed within 1 year to this report date. See Appendix E for installation and calibration date.

Result

| Run | Probe | ASCE Program Outputs @ Standard Conditions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | $K_{La,20}$ *($hr^{-1}$)* | $C^*_{\infty 20}$ *(mg/L)* | SOTR *(kg/hr)* | SOTR *(lb/hr)* | Deviation from Avg. $K_{La,20}$ | * Avg. SOTR *(kg/hr)* | Avg. SOTR *(lb/hr)* | ** Avg. $SAE_{delivered}$ *(kg/hr-kW)* | Avg. $SAE_{delivered}$ *(lb/hr-hp)* |
| **1** | 1 | 4.41 | 9.29 | 14.4 | 31.8 | -1% | **14.7** | **32.4** | **1.9** | **3.1** |
| | 2 | 4.45 | 9.40 | 14.7 | 32.5 | 0% | | | | |
| | 3 | 4.54 | 9.30 | 14.9 | 32.8 | 2% | | | | |
| | 4 | 4.48 | 9.30 | 14.7 | 32.4 | 0% | | | | |
| **2** | 1 | 4.45 | 9.27 | 14.5 | 32.0 | 2% | **14.3** | **31.5** | **1.8** | **3.0** |
| | 2 | 4.25 | 9.40 | 14.1 | 31.0 | -2% | | | | |
| | 3 | 4.29 | 9.31 | 14.1 | 31.0 | -1% | | | | |
| | 4 | 4.41 | 9.29 | 14.4 | 31.8 | 1% | | | | |
| **3** | 1 | 4.46 | 9.47 | 14.9 | 32.8 | 2% | **14.6** | **32.1** | **1.9** | **3.1** |
| | 2 | 4.16 | 9.55 | 14.0 | 30.8 | -5% | | | | |
| | 3 | 4.31 | 9.49 | 14.4 | 31.8 | -1% | | | | |
| | 4 | 4.50 | 9.44 | 15.0 | 33.0 | 3% | | | | |

**Table 3: SOTR/SAE Results and Reproducibility of $K_{La,20}$**

*: *The variation in between result of SOTR from repeating test are less than +/- 15%*

**: *The variation in between result of $SAE_{delivered}$ from repeating test are less than +/- 5%*



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

| Run | ASCE Program Outputs @ Standard Conditions | | | | | | |
|---|---|---|---|---|---|---|---|
| | $K_{La,20}$ *($s^{-1}$)* | $C^*_{\infty 20}$ *(mg/L)* | SOTR *(kg/hr)* | Average SOTR *(kg/hr)* | Average SOTR *(lb/hr)* | Average $SAE_{delivered}$ *(kg/hr-kW)* | Average $SAE_{delivered}$ *(lb/hr-hp)* |
| 1 | **4.47** | **9.32** | **10.2** | **14.5** | **32.0** | **1.9** | **3.1** |
| 2 | **4.35** | **9.32** | **10.4** | | | | |
| 3 | **4.36** | **9.49** | **10.3** | | | | |

**Table 4: Final SOTR and SAE Results**



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

## 5. Certification

The undersigned certify that the following are accurate:

I. The protocol identified in Section 3 meets the minimum requirements of the ASCE "Measurement of Oxygen Transfer in Clean Water" [ASCE/EWRI 2-06].

II. The Clean Water Oxygen Transfer Test referenced in this Report, to measure and calculate the results reported in Section 4 and in item III, were conducted as specified in the protocol identified in Section 3.

III. The results summarized in Section 4 are accurate based on the data collected from the Clean Water Oxygen Transfer Test completed and reported in this Report.

| Model | **AIRE-O2 TRITON® Process Aerator/Mixer** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | Wire Power | | Delivered Power | | Average SOTR | | Average $SAE_{delivered}$ | |
| Unit of Measure | *kW* | *hp* | *kW* | *hp* | *(kg/hr)* | *(lb/hr)* | *(kg/hr-kW)* | *(lb/hr-hp)* |
| Value | 9.1 | 12.2 | 7.8 | 10.5 | 14.5 | 32.0 | 1.9 | 3.1 |

**Table 5: Summary of SOTR and SAE Results**

Printed Name: Sun-Nan Hong, Ph.D., P.E.

Organization: Private Consultant

Title:

Signature:

Date: Oct. 22, 2015



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

## Appendix A: ASCE DO PAR Results

**Table 6: Run 1**

| Iterations by Exponential method | | | | | | | |
|---|---|---|---|---|---|---|---|
| Iteration | | $C^*_\infty$ | $C_0$ | $K_{La}$ | Sum of residuals | Sum of squares | RMS |
| Probe 1 | 0 | 8.490 | 1.125 | 0.0656 | 105.8698 | 111.635 | 0.8379 |
| | 1 | 9.272 | 1.018 | 0.0671 | 3.0528 | 21.223 | 0.3653 |
| | 2 | 9.323 | 1.019 | 0.0671 | -3.7105 | 20.600 | 0.3599 |
| | 3 | 9.325 | 1.019 | 0.0671 | -4.0567 | 20.583 | 0.3598 |
| | 4 | 9.326 | 1.019 | 0.0671 | -4.0761 | 20.582 | 0.3598 |
| | 5 | 9.326 | 1.019 | 0.0671 | -4.0772 | 20.582 | 0.3598 |
| | 6 | 9.326 | 1.019 | 0.0671 | -4.0772 | 20.582 | 0.3598 |
| Probe 2 | 0 | 8.689 | 1.099 | 0.0657 | 98.4583 | 99.000 | 0.7891 |
| | 1 | 9.399 | 1.023 | 0.0676 | 2.2522 | 21.638 | 0.3689 |
| | 2 | 9.443 | 1.023 | 0.0677 | -3.7559 | 21.092 | 0.3642 |
| | 3 | 9.446 | 1.023 | 0.0677 | -4.0719 | 21.076 | 0.3641 |
| | 4 | 9.446 | 1.023 | 0.0677 | -4.0892 | 21.075 | 0.3641 |
| | 5 | 9.446 | 1.023 | 0.0677 | -4.0901 | 21.075 | 0.3641 |
| | 6 | 9.446 | 1.023 | 0.0677 | -4.0902 | 21.075 | 0.3641 |
| Probe 3 | 0 | 8.596 | 1.109 | 0.0663 | 97.1471 | 96.987 | 0.7810 |
| | 1 | 9.292 | 0.969 | 0.0689 | 2.9860 | 19.454 | 0.3498 |
| | 2 | 9.338 | 0.968 | 0.0691 | -3.5251 | 18.856 | 0.3444 |
| | 3 | 9.340 | 0.968 | 0.0691 | -3.8516 | 18.838 | 0.3442 |
| | 4 | 9.340 | 0.968 | 0.0691 | -3.8697 | 18.837 | 0.3442 |
| | 5 | 9.340 | 0.968 | 0.0691 | -3.8706 | 18.837 | 0.3442 |
| | 6 | 9.340 | 0.968 | 0.0691 | -3.8707 | 18.837 | 0.3442 |
| Probe 4 | 0 | 8.524 | 1.148 | 0.0661 | 105.1928 | 111.464 | 0.8373 |
| | 1 | 9.293 | 1.032 | 0.068 | 2.953 | 21.861 | 0.371 |
| | 2 | 9.342 | 1.032 | 0.068 | -3.769 | 21.229 | 0.365 |
| | 3 | 9.345 | 1.032 | 0.0681 | -4.1096 | 21.211 | 0.3652 |
| | 4 | 9.345 | 1.032 | 0.0681 | -4.1284 | 21.211 | 0.3652 |
| | 5 | 9.345 | 1.032 | 0.0681 | -4.1294 | 21.210 | 0.3652 |
| | 6 | 9.345 | 1.032 | 0.0681 | -4.1294 | 21.210 | 0.3652 |

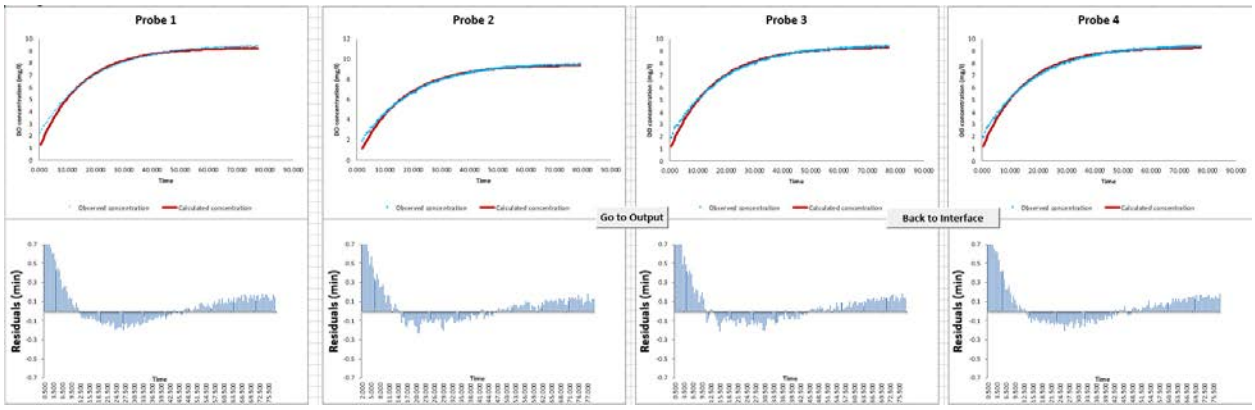



**Figure 2: Run 1 Plots**



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

**Table 7: Run 2**

| Iterations by Exponential method | | | | | | | |
|---|---|---|---|---|---|---|---|
| Iteration | | $C^*_\infty$ | $C_0$ | $K_{La}$ | Sum of residuals | Sum of squares | RMS |
| Probe 1 | 0 | 8.490 | 1.125 | 0.0656 | 105.8698 | 111.635 | 0.8379 |
| | 1 | 9.272 | 1.018 | 0.0671 | 3.0528 | 21.223 | 0.3653 |
| | 2 | 9.323 | 1.019 | 0.0671 | -3.7105 | 20.600 | 0.3599 |
| | 3 | 9.325 | 1.019 | 0.0671 | -4.0567 | 20.583 | 0.3598 |
| | 4 | 9.326 | 1.019 | 0.0671 | -4.0761 | 20.582 | 0.3598 |
| | 5 | 9.326 | 1.019 | 0.0671 | -4.0772 | 20.582 | 0.3598 |
| | 6 | 9.326 | 1.019 | 0.0671 | -4.0772 | 20.582 | 0.3598 |
| Probe 2 | 0 | 8.689 | 1.099 | 0.0657 | 98.4583 | 99.000 | 0.7891 |
| | 1 | 9.399 | 1.023 | 0.0676 | 2.2522 | 21.638 | 0.3689 |
| | 2 | 9.443 | 1.023 | 0.0677 | -3.7559 | 21.092 | 0.3642 |
| | 3 | 9.446 | 1.023 | 0.0677 | -4.0719 | 21.076 | 0.3641 |
| | 4 | 9.446 | 1.023 | 0.0677 | -4.0892 | 21.075 | 0.3641 |
| | 5 | 9.446 | 1.023 | 0.0677 | -4.0901 | 21.075 | 0.3641 |
| | 6 | 9.446 | 1.023 | 0.0677 | -4.0902 | 21.075 | 0.3641 |
| Probe 3 | 0 | 8.596 | 1.109 | 0.0663 | 97.1471 | 96.987 | 0.7810 |
| | 1 | 9.292 | 0.969 | 0.0689 | 2.9860 | 19.454 | 0.3498 |
| | 2 | 9.338 | 0.968 | 0.0691 | -3.5251 | 18.856 | 0.3444 |
| | 3 | 9.340 | 0.968 | 0.0691 | -3.8516 | 18.838 | 0.3442 |
| | 4 | 9.340 | 0.968 | 0.0691 | -3.8697 | 18.837 | 0.3442 |
| | 5 | 9.340 | 0.968 | 0.0691 | -3.8706 | 18.837 | 0.3442 |
| | 6 | 9.340 | 0.968 | 0.0691 | -3.8707 | 18.837 | 0.3442 |
| Probe 4 | 0 | 8.524 | 1.148 | 0.0661 | 105.1928 | 111.464 | 0.8373 |
| | 1 | 9.293 | 1.032 | 0.068 | 2.953 | 21.861 | 0.371 |
| | 2 | 9.342 | 1.032 | 0.068 | -3.769 | 21.229 | 0.365 |
| | 3 | 9.345 | 1.032 | 0.0681 | -4.1096 | 21.211 | 0.3652 |
| | 4 | 9.345 | 1.032 | 0.0681 | -4.1284 | 21.211 | 0.3652 |
| | 5 | 9.345 | 1.032 | 0.0681 | -4.1294 | 21.210 | 0.3652 |
| | 6 | 9.345 | 1.032 | 0.0681 | -4.1294 | 21.210 | 0.3652 |

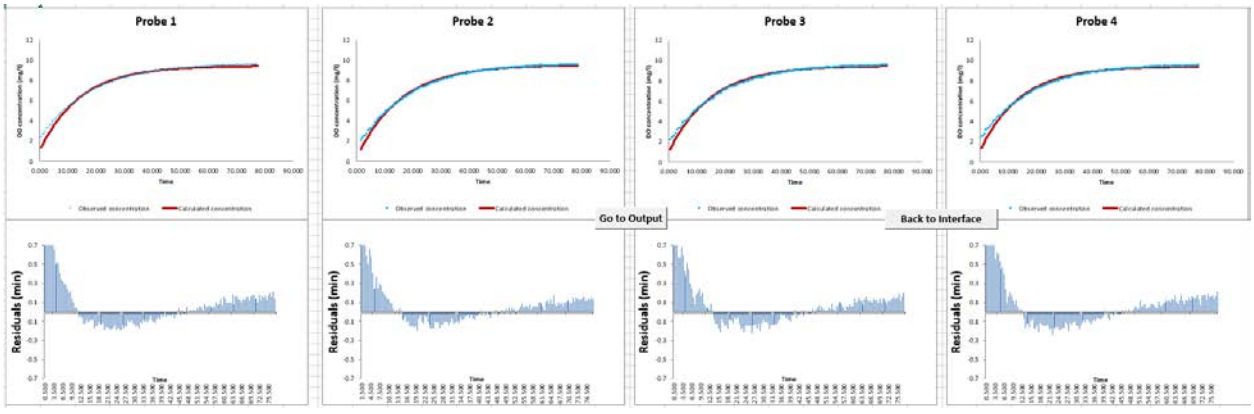



**Figure 3: Run 2 Plots**



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

**Table 8: Run 3**

| Iterations by Exponential method | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Iteration | $C^*_\infty$ | $C_0$ | $K_{La}$ | Sum of residuals | Sum of squares | RMS |
| Probe 1 | 0 | 8.490 | 1.125 | 0.0656 | 105.8698 | 111.635 | 0.8379 |
| | 1 | 9.272 | 1.018 | 0.0671 | 3.0528 | 21.223 | 0.3653 |
| | 2 | 9.323 | 1.019 | 0.0671 | -3.7105 | 20.600 | 0.3599 |
| | 3 | 9.325 | 1.019 | 0.0671 | -4.0567 | 20.583 | 0.3598 |
| | 4 | 9.326 | 1.019 | 0.0671 | -4.0761 | 20.582 | 0.3598 |
| | 5 | 9.326 | 1.019 | 0.0671 | -4.0772 | 20.582 | 0.3598 |
| | 6 | 9.326 | 1.019 | 0.0671 | -4.0772 | 20.582 | 0.3598 |
| Probe 2 | 0 | 8.689 | 1.099 | 0.0657 | 98.4583 | 99.000 | 0.7891 |
| | 1 | 9.399 | 1.023 | 0.0676 | 2.2522 | 21.638 | 0.3689 |
| | 2 | 9.443 | 1.023 | 0.0677 | -3.7559 | 21.092 | 0.3642 |
| | 3 | 9.446 | 1.023 | 0.0677 | -4.0719 | 21.076 | 0.3641 |
| | 4 | 9.446 | 1.023 | 0.0677 | -4.0892 | 21.075 | 0.3641 |
| | 5 | 9.446 | 1.023 | 0.0677 | -4.0901 | 21.075 | 0.3641 |
| | 6 | 9.446 | 1.023 | 0.0677 | -4.0902 | 21.075 | 0.3641 |
| Probe 3 | 0 | 8.596 | 1.109 | 0.0663 | 97.1471 | 96.987 | 0.7810 |
| | 1 | 9.292 | 0.969 | 0.0689 | 2.9860 | 19.454 | 0.3498 |
| | 2 | 9.338 | 0.968 | 0.0691 | -3.5251 | 18.856 | 0.3444 |
| | 3 | 9.340 | 0.968 | 0.0691 | -3.8516 | 18.838 | 0.3442 |
| | 4 | 9.340 | 0.968 | 0.0691 | -3.8697 | 18.837 | 0.3442 |
| | 5 | 9.340 | 0.968 | 0.0691 | -3.8706 | 18.837 | 0.3442 |
| | 6 | 9.340 | 0.968 | 0.0691 | -3.8707 | 18.837 | 0.3442 |
| Probe 4 | 0 | 8.524 | 1.148 | 0.0661 | 105.1928 | 111.464 | 0.8373 |
| | 1 | 9.293 | 1.032 | 0.068 | 2.953 | 21.861 | 0.371 |
| | 2 | 9.342 | 1.032 | 0.068 | -3.769 | 21.229 | 0.365 |
| | 3 | 9.345 | 1.032 | 0.0681 | -4.1096 | 21.211 | 0.3652 |
| | 4 | 9.345 | 1.032 | 0.0681 | -4.1284 | 21.211 | 0.3652 |
| | 5 | 9.345 | 1.032 | 0.0681 | -4.1294 | 21.210 | 0.3652 |
| | 6 | 9.345 | 1.032 | 0.0681 | -4.1294 | 21.210 | 0.3652 |

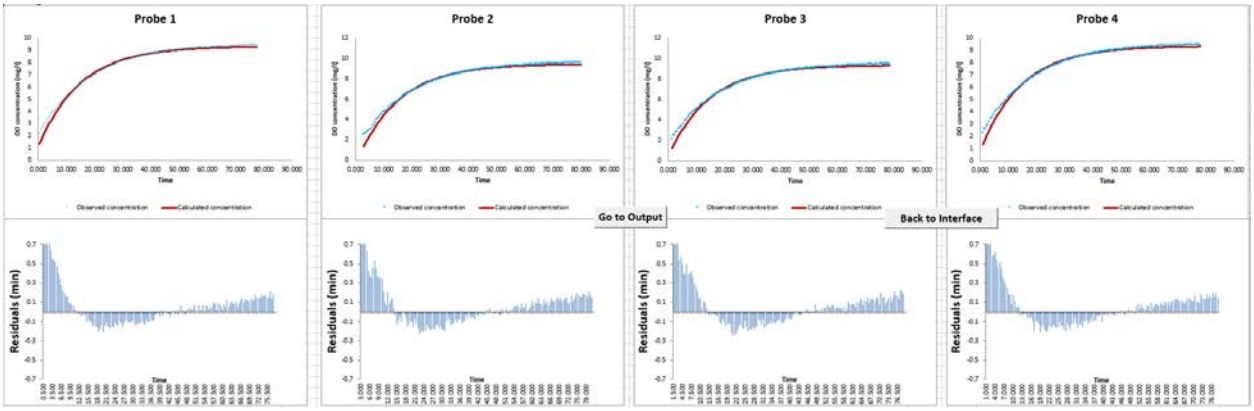


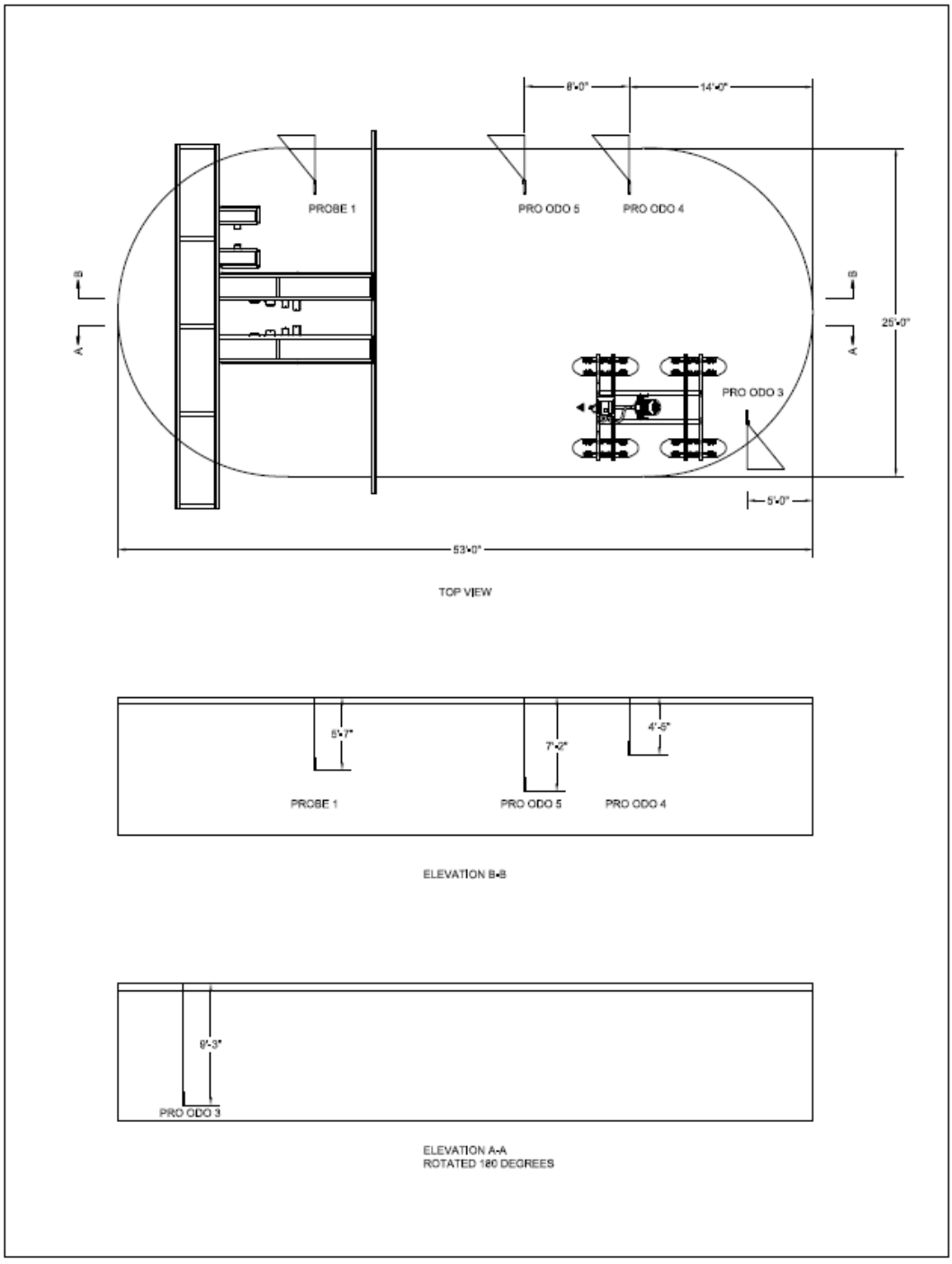

**Figure 4: Run 3 Plots**



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

## Appendix B: Layout Drawings

Plan and Profile View of Test Basin






*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

## Appendix C: Blower Specifications

Data Sheet

FPZ BLOWER TECHNOLOGY

SERIES **MS** – RANGE **MOR**
USA VERSION

**PRESSURE**

| Model | N 3500 rpm [Hp] | N 2900 rpm [Hp] | Q max 3500 rpm [cfm] | Q max 2900 rpm [cfm] | ΔP max 3500 rpm [In WG] | ΔP max 2900 rpm [In WG] | Leq[1] 3500 rpm (Lp) [dB(A)] | Leq[1] 2900 rpm (Lp) [dB(A)] | Weight[2] max [Lbs] |
|---|---|---|---|---|---|---|---|---|---|
| K03-MS | 0.75 | 0.75 | 52 | 43 | 64 | 60 | 62 | 60 | 24.3 |
| | 1 | 1 | 52 | 43 | 95 | 77 | 62.3 | 60.3 | 26.5 |
| K04-MS | 1.5 | 1.5 | 97 | 80 | 58 | 80 | 64.8 | 62.8 | 36.4 |
| | 2 | 2 | 97 | 80 | 85 | 100 | 65 | 63 | 43 |
| | 3 | - | 97 | 80 | 120 | - | 65.2 | - | 49.6 |
| K05-MS | 2 | 2 | 155 | 129 | 52 | 70 | 70.5 | 68.5 | 51.8 |
| | 3 | 3 | 155 | 129 | 90 | 110 | 70.8 | 68.8 | 58.4 |
| | 4 | 4 | 155 | 129 | 128 | 120 | 71.1 | 69.1 | 67.2 |
| K06-MS | 3 | 3 | 215 | 178 | 50 | 65 | 73 | 71 | 68.7 |
| | 4 | 4 | 215 | 178 | 75 | 95 | 73.3 | 71.3 | 71.65 |
| | 5.5 | 5.5 | 215 | 178 | 110 | 140 | 73.6 | 71.6 | 77.6 |
| | 6.2[*] | - | 215 | 178 | 132 | - | 73.9 | - | 77.6 |
| K07-MS | 4 | 4 | 294 | 243 | 50 | 63 | 78.7 | 76.7 | 103 |
| | 5.5 | 5.5 | 294 | 243 | 75 | 86 | 79 | 77 | 107 |
| | 7.5 | 7.5 | 294 | 243 | 130 | 138 | 79.3 | 77.3 | 145.7 |
| | 10 | 10 | 294 | 243 | 181 | 161 | 79.6 | 77.6 | 154.5 |
| K08-MS | 5.5 | 5.5 | 381 | 315 | 40 | 52 | 79.7 | 77.7 | 115.7 |
| | 7.5 | 7.5 | 381 | 315 | 68 | 90 | 80 | 78 | 154.3 |
| | 10 | 10 | 381 | 315 | 115 | 125 | 80.3 | 78.3 | 163.1 |
| | 15 | 15 | 381 | 315 | 181 | 181 | 80.6 | 78.6 | 184 |
| K09-MS | 7.5 | 7.5 | 471 | 390 | 50 | 63 | 80.2 | 78.2 | 166.5 |
| | 10 | 10 | 471 | 390 | 80 | 95 | 80.5 | 78.5 | 175.1 |
| | 15 | 15 | 471 | 390 | 140 | 155 | 81 | 79 | 196.2 |
| | 20 | 20 | 471 | 390 | 181 | 181 | 81.3 | 79.3 | 269 |
| K10-MS | 7.5 | 7.5 | 556 | 460 | 36 | 51 | 80.1 | 78.1 | 170.9 |
| | 10 | 10 | 556 | 460 | 64 | 80 | 80.5 | 78.5 | 179.5 |
| | 15 | 15 | 556 | 460 | 120 | 135 | 81 | 79 | 200.6 |
| | 20 | 20 | 556 | 460 | 167 | 191 | 81.4 | 79.4 | 273.4 |
| | 25 | 25 | 556 | 460 | 211 | 201 | 81.6 | 79.6 | 298.7 |
| K11-MS | 10 | 10 | 650 | 538 | 40 | 53 | 82 | 80 | 194.9 |
| | 15 | 15 | 650 | 538 | 82 | 97 | 82.4 | 80.4 | 216 |
| | 20 | 20 | 650 | 538 | 125 | 141 | 82.7 | 80.7 | 288.8 |
| | 25 | 25 | 650 | 538 | 162 | 201 | 85.6 | 83.6 | 313.1 |
| K12-MS | 15 | 15 | 726 | 601 | 52 | 90 | 82.9 | 80.9 | 223.7 |
| | 20 | 20 | 726 | 601 | 85 | 130 | 83.2 | 81.2 | 296.5 |
| | 25 | 25 | 726 | 601 | 140 | 160 | 86.1 | 84.1 | 320.8 |

[*] No cURus motor.

**INSTALLATION**

- For proper use, the blower should be equipped with Inlet FILTER and Flow Relief VALVE; other accessories available on request
- Ambient temperature from -15° to +40°C (+5° to +104° F)
- Specifications subject to change without notice
- Before installation read carefully all instructions

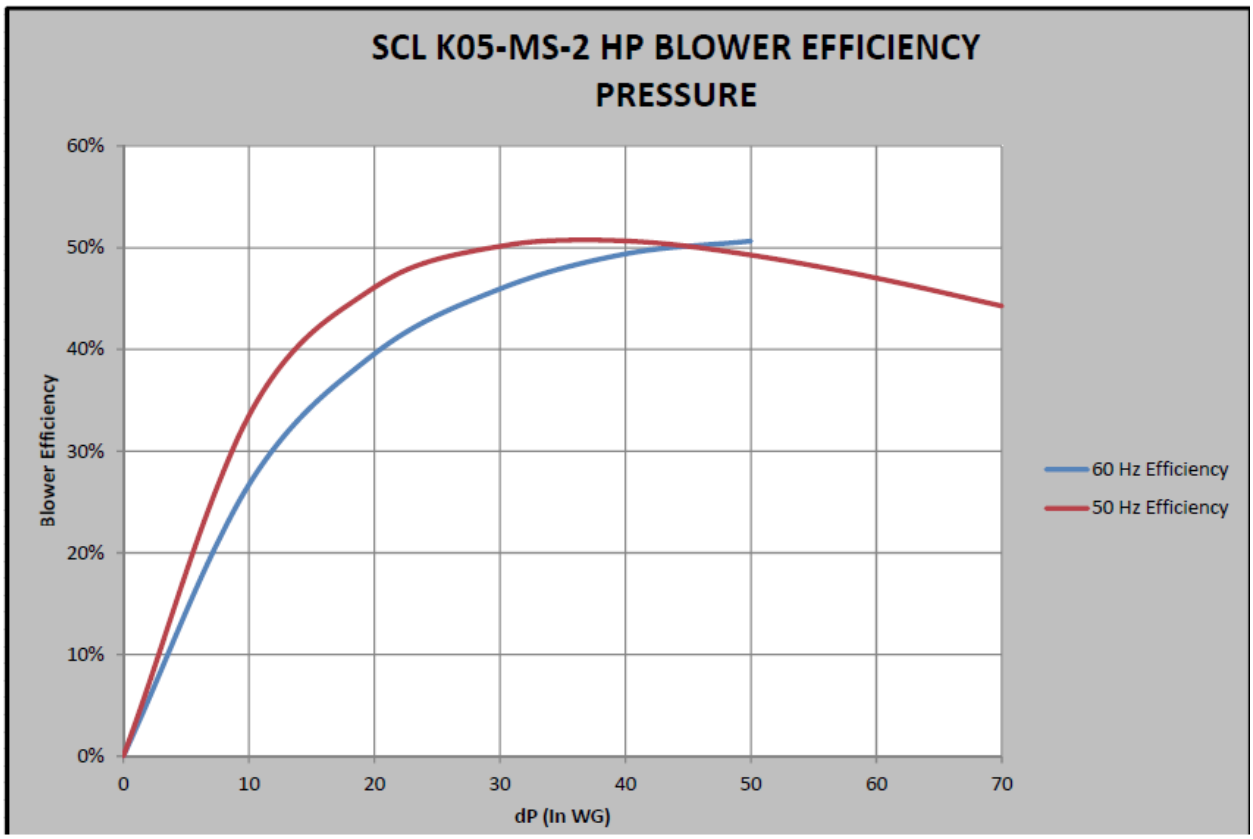
[1] Noise measured at 1 m distance with inlet and outlet ports piped, in accordance to ISO 3744
[2] Value refers to the weight of the machine with 3 Phase motor if MOR range, without motor if GOR or GVR range.
N: Installed motor power Q: Flow rate ΔP: Differential pressure Leq: Sound

Pg 2



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

Efficiency Curve






*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

## Appendix D: Mixer Motor Specifications

Data Sheet

No.: 123
Date: 12-SEP-2014

### DATA SHEET
Three-phase induction motor - Squirrel cage rotor

| | |
|---|---|
| Customer | : Aeration Industries |
| Product line | : W22 High Efficiency |

| | |
|---|---|
| Frame | : 284T |
| Output | : 10 HP |
| Frequency | : 60 Hz |
| Poles | : 8 |
| Full load speed | : 880 |
| Slip | : 2.22 % |
| Voltage | : 230/460 V |
| Rated current | : 26.0/13.0 A |
| Locked rotor current | : 148/74.1 A |
| Locked rotor current (Il/In) | : 5.7 |
| No-load current | : 11.0/5.50 A |
| Full load torque | : 58.9 lb.ft |
| Locked rotor torque | : 200 % |
| Breakdown torque | : 220 % |
| Design | : B |
| Insulation class | : F |
| Temperature rise | : 80 K |
| Locked rotor time | : 30 s (hot) |
| Service factor | : 1.25 |
| Duty cycle | : S1 |
| Ambient temperature | : -20°C - +40°C |
| Altitude | : 1000 |
| Degree of Protection | : IP55 |
| Approximate weight | : 373 lb |
| Moment of inertia | : 7.1992 sq.ft.lb |
| Noise level | : 54 dB(A) |

| | D.E. | N.D.E. |
|---|---|---|
| Bearings | 6311 C3 | 6211 C3 |
| Regreasing interval | 20000 h | 20000 h |
| Grease amount | 18 g | 11 g |

| Load | Power factor | Efficiency (%) |
|---|---|---|
| 100% | 0.82 | 88.6 |
| 75% | 0.77 | 88.6 |
| 50% | 0.67 | 87.6 |

Notes:

Performed by | Checked



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

## Appendix E: YSI Optical DO Probe Sensor Cap Validation Data

Probe 2 Calibration Code

### ProODO™ Sensor Cap Instruction Sheet

This instruction sheet includes the calibration coefficients specific to your Sensor Cap. New Probe/Cable assemblies are shipped with the sensor cap already installed on the sensor and the calibration coefficients preloaded into the probe at the factory. The Sensor Cap will need to be replaced about once per year, but may last longer. If you are replacing your Sensor Cap, follow the installation and setup instructions below. IMPORTANT - Be sure to save this sheet in case you need to reload the calibration coefficients.

YSI Incorporated Yellow Springs, Ohio 45387 USA
Cap Lot#: 14L100463 Position: 6
Calibration Code
K1: C01789CA K2: 41B2B0CC
K3: 40378C20 K4: 3D8D38E1
K5: B0E1886F KC: D9

All NOTES:
Pro ODO 2 Sensor Cap
Installed: 07/06/2015
Expires: 07/06/2016

### Sensor Cap Replacement

The replacement ODO™ Sensor Cap is shipped in a humidified container and the package should not be opened until immediately before sensor cap replacement. Once the sensor cap has been installed on the ODO sensor as described below, it is important to keep the sensor in a 100% humid environment. Therefore, the ODO sensor should be stored either in the grey calibration/storage sleeve with the sponge moistened or immersed in water. If the sensor dries out, refer to the manual for instructions on how to rehydrate the sensor cap.

Refer to Figures 1 and 2 below when following the instructions for replacing the cap.

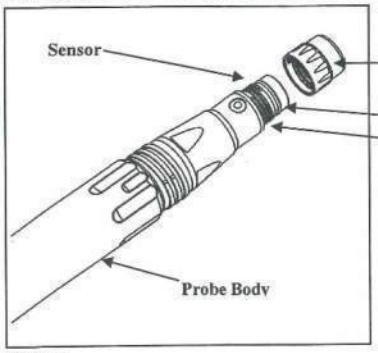



Figure 1

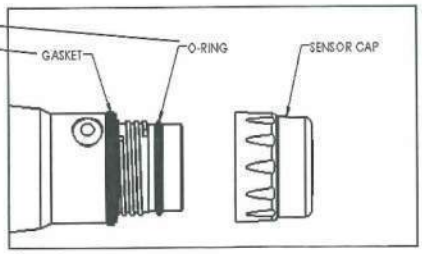



Figure 2

Caution: Avoid touching the sensing end of the sensor cap during the following maintenance procedures.

1. Remove the old sensor cap assembly from the probe by grasping the probe body with one hand and then rotating the sensor cap counterclockwise until it is completely free. Do not use any tools for this procedure.
2. Inspect the o-ring on the probe for damage. If there is any indication of damage, carefully remove the o-ring and replace it with the new o-ring included with the replacement Sensor Cap. Do not use any tools to remove the o-ring.
3. Ensure that the o-ring installed on the probe is clean. If necessary, wipe clean with a lint free cloth or replace the o-ring as described in the previous step.
4. Locate the o-ring lubricant included with the new Sensor Cap. Apply a thin coat of o-ring lubricant to the installed o-ring. After application, there should be a thin coat of o-ring lubricant on the o-ring only. Remove any excess o-ring lubricant from the o-ring and/or probe with a lens cleaning tissue.

YSI Inc., 1700/1725 Brannum Lane, Yellow Springs, OH 45387
800-897-4151, +1 937-767-7241, Fax: +1 937-767-9353
www.ysi.com, environmental@ysi.com

626321 • Drawing # A626321
February 2011 • Rev C
Page # 1 of 2



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

Probe 3 Calibration Code

a xylem brand **YSI ODO Sensor Cap Instruction Sheet**

This instruction sheet includes the calibration coefficients specific to your sensor cap. New probe/cable assemblies are shipped with the sensor cap already installed on the sensor and the calibration coefficients preloaded into the probe at the factory. The sensor cap will need to be replaced about once per year, but may last longer. If you are replacing your sensor cap, follow the installation and setup instructions below. IMPORTANT - Be sure to save this sheet in case you need to reload the calibration coefficients.

**Cap Lot#: 15F101071**

| | | |
|---|---|---|
| **Position: 7** | **K1: C015C5F7** | **K2: 41B692E3** |
| | **K3: 403624E0** | **K4: 3D7D12D8** |
| | **K5: 60F18ACF** | **KC: 3B** |

Retain for future reference

AII NOTES:
Pro ODO 3 Sensor Cap
Installed: 07/06/2015
Expires: 07/06/2016

## Sensor Cap Replacement

The replacement ODO sensor cap is shipped in a humidified container. This container should not be opened until immediately before the user replaces the old sensor cap. Once the sensor cap has been installed on the ODO sensor as described below, it is important to keep the sensor in a 100% humid environment. Therefore, the ODO sensor should be stored either in the grey calibration/storage sleeve with the sponge moistened or immersed in water. If the sensor dries out, refer to the manual for instructions on how to rehydrate the sensor cap.

Refer to Figures 1 and 2 below when replacing the sensor cap.

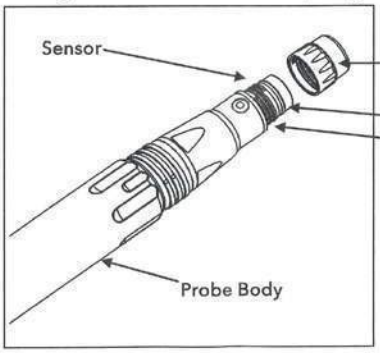



Figure 1

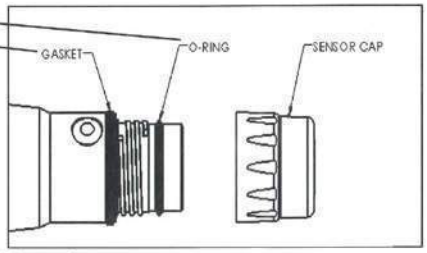



Figure 2

Caution: Avoid touching the sensing end of the sensor cap during the following maintenance procedures.

1. Remove the old sensor cap assembly from the probe by grasping the probe body with one hand and rotating the sensor cap counterclockwise until it is completely free. Do not use any tools for this procedure.
2. Inspect the o-ring on the probe for damage. If there is any indication of damage, carefully remove the o-ring and replace it with the new o-ring included with the replacement sensor cap. Do not use any tools to remove the o-ring.

YSI, 1700/1725 Brannum Lane, Yellow Springs, OH 45387
800-897-4151, +1 937-767-7241, Fax: +1 937-767-9353
ysi.com, info@ysi.com

626321 • Drawing # A626321
December 2014 • Rev D
Page # 1 of 2



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

Probe 4 Calibration Code

a xylem brand **YSI ODO Sensor Cap Instruction Sheet**

This instruction sheet includes the calibration coefficients specific to your sensor cap. New probe/cable assemblies are shipped with the sensor cap already installed on the sensor and the calibration coefficients preloaded into the probe at the factory. The sensor cap will need to be replaced about once per year, but may last longer. If you are replacing your sensor cap, follow the installation and setup instructions below. IMPORTANT - Be sure to save this sheet in case you need to reload the calibration coefficients.

**Probe S/N: 000000010**
**Cap Lot#: 15F101069**

| | | |
|---|---|---|
| **Position: 5** | **K1: C0198E6B** | **K2: 41AA8118** |
| | **K3: 402B187D** | **K4: 3D269708** |
| | **K5: 60F18ACD** | **KC: 00** |

Retain for future reference

AII NOTES:
Pro ODO 4 Sensor Cap
Installed: 07/06/2015
Expires: 07/06/2016

## Sensor Cap Replacement

The replacement ODO sensor cap is shipped in a humidified container. This container should not be opened until immediately before the user replaces the old sensor cap. Once the sensor cap has been installed on the ODO sensor as described below, it is important to keep the sensor in a 100% humid environment. Therefore, the ODO sensor should be stored either in the grey calibration/storage sleeve with the sponge moistened or immersed in water. If the sensor dries out, refer to the manual for instructions on how to rehydrate the sensor cap.

Refer to Figures 1 and 2 below when replacing the sensor cap.

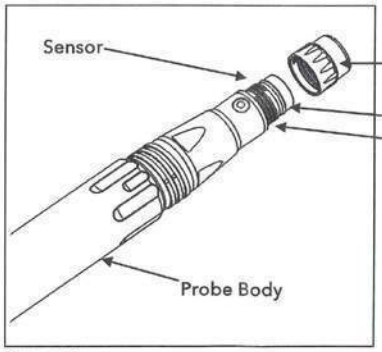



Figure 1

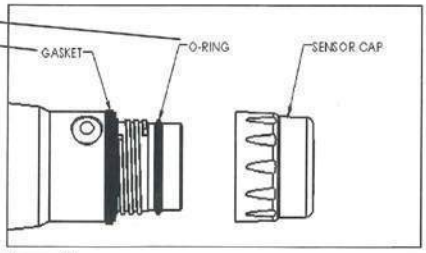



Figure 2

Caution: Avoid touching the sensing end of the sensor cap during the following maintenance procedures.

1. Remove the old sensor cap assembly from the probe by grasping the probe body with one hand and rotating the sensor cap counterclockwise until it is completely free. Do not use any tools for this procedure.
2. Inspect the o-ring on the probe for damage. If there is any indication of damage, carefully remove the o-ring and replace it with the new o-ring included with the replacement sensor cap. Do not use any tools to remove the o-ring.

YSI, 1700/1725 Brannum Lane, Yellow Springs, OH 45387
800-897-4151, +1 937-767-7241, Fax: +1 937-767-9353
ysi.com, info@ysi.com

626321 • Drawing # A626321
December 2014 • Rev D
Page # 1 of 2



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

Probe 5 Calibration Code

a xylem brand **YSI ODO Sensor Cap Instruction Sheet**

This instruction sheet includes the calibration coefficients specific to your sensor cap. New probe/cable assemblies are shipped with the sensor cap already installed on the sensor and the calibration coefficients preloaded into the probe at the factory. The sensor cap will need to be replaced about once per year, but may last longer. If you are replacing your sensor cap, follow the installation and setup instructions below. IMPORTANT - Be sure to save this sheet in case you need to reload the calibration coefficients.

Probe S/N: 000000009
Cap S/N: 15F100206
Position: 4

| | |
|---|---|
| K1: C021B482 | K2: 41A22A2A |
| K3: 40287EB9 | K4: 3D5205AF |
| K5: 60F1876D | KC: 8B |

Retain for future reference

All NOTES:
Pro ODO 5 Sensor Cap
Installed: 07/06/2015
Expires: 07/06/2016

## Sensor Cap Replacement

The replacement ODO sensor cap is shipped in a humidified container. This container should not be opened until immediately before the user replaces the old sensor cap. Once the sensor cap has been installed on the ODO sensor as described below, it is important to keep the sensor in a 100% humid environment. Therefore, the ODO sensor should be stored either in the grey calibration/storage sleeve with the sponge moistened or immersed in water. If the sensor dries out, refer to the manual for instructions on how to rehydrate the sensor cap.

Refer to Figures 1 and 2 below when replacing the sensor cap.

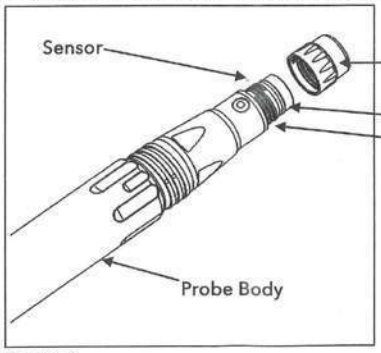



Figure 1

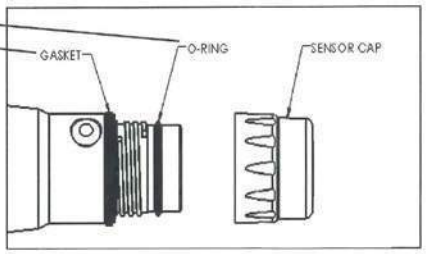



Figure 2

Caution: Avoid touching the sensing end of the sensor cap during the following maintenance procedures.

1. Remove the old sensor cap assembly from the probe by grasping the probe body with one hand and rotating the sensor cap counterclockwise until it is completely free. Do not use any tools for this procedure.
2. Inspect the o-ring on the probe for damage. If there is any indication of damage, carefully remove the o-ring and replace it with the new o-ring included with the replacement sensor cap. Do not use any tools to remove the o-ring.

YSI, 1700/1725 Brannum Lane, Yellow Springs, OH 45387
800-897-4151, +1 937-767-7241, Fax: +1 937-767-9353
ysi.com, info@ysi.com

626321 • Drawing # A626321
December 2014 • Rev D
Page # 1 of 2



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

## Appendix F: Power Meter Specification

Data Sheet

Product data sheet
Characteristics

# METSEPM5560

PM5560 powermeter w 1mod2eth - upto 63th H - 1,1M 4DI/2DO 52alarms - flush mount




### Main

| | |
|---|---|
| Range of product | PowerLogic PM5000 |
| Device short name | PM5560 |
| Product or component type | Power meter |

### Complementary

| | |
|---|---|
| Power quality analysis | Up to the 63rd harmonic |
| Device application | WAGES metering<br>Power monitoring |
| Type of measurement | Active and reactive power<br>Energy<br>Power factor<br>Frequency<br>Voltage<br>Current |
| Supply voltage | 125...250 V DC<br>100...480 V AC (45...65 Hz) |
| Network frequency | 45...65 Hz |
| Power consumption in VA | 10 VA at 480 V |
| Display type | Backlit LCD |
| Display resolution | 128 x 128 |
| Sampling rate | 128 samples/cycle |
| Measurement current | 5 mA...10 A |
| Analogue input type | Voltage (impedance 5 MOhm)<br>Current (impedance 0.3 mOhm) |
| Measurement voltage | 20...400 V AC 45...65 Hz between phase and neutral<br>35...690 V AC 45...65 Hz between phases |
| Number of inputs | 4 current transformer<br>4 digital |
| Measurement accuracy | +/- 0.15 °C current<br>+/- 0.05 % power factor<br>+/- 0.1 % voltage<br>+/- 0.2 % active power<br>+/- 1 % reactive energy<br>+/- 0.2 % active energy<br>+/- 0.05 % frequency<br>+/- 0.5 % apparent power |
| Accuracy class | Class 1 (reactive energy according to IEC 62053-24)<br>Class 0.2S (active energy according to IEC 62053-22) |
| Number of outputs | 2 digital |
| Information displayed | Tariff 8 |
| Communication port protocol | Ethernet Modbus TCP/IP daisy chain : 10/100 Mbps, insulation: 2500 V<br>RS485 : 2 wires, 9.6, 19.2 and 38.4 kbauds, even/odd or none, insulation: 2500 V |

The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein.
This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications.
It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof.
Neither Schneider Electric Industries SAS nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein.





*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

| | |
|---|---|
| Data recording | Data logs<br>Event logs<br>Min/Max of instantaneous values<br>Time stamping<br>Alarm logs<br>Maintenance logs |
| Memory capacity | 1.1 MB |
| Mounting mode | Flush-mounted |
| Mounting support | Framework |
| Standards | IEC 60529<br>IEC 61557-12<br>IEC 62053-22<br>EN 50470-1<br>EN 50470-3<br>IEC 62053-24 |
| Product certifications | CULus conforming to UL 61010-1<br>CE conforming to IEC 61010-1 |
| Width | 96 mm |
| Depth | 72 mm |
| Height | 96 mm |
| Product weight | 450 g |

## Environment

| | |
|---|---|
| Electromagnetic compatibility | • immunity to voltage dips, conforming to IEC 61000-4-11<br>• surge immunity test class 4, conforming to IEC 61000-4-5<br>• immunity to fast transients class 4, conforming to IEC 61000-4-4<br>• immunity to radiated fields, conforming to IEC 61000-4-3<br>• electrostatic discharge class 4 (8 kV ), conforming to IEC 61000-4-2<br>• limitation of voltage changes, voltage fluctuations and flicker in low-voltage, conforming to IEC 61000-3-3<br>• conducted and radiated emissions class class B, conforming to EN 55022<br>• immunity to magnetic fields class 4, conforming to IEC 61000-4-8<br>• conducted radio-frequency immunity test class 3, conforming to IEC 61000-4-6<br>• harmonics class class A, conforming to IEC 61000-3-2 |
| IP degree of protection | IP30 (body) conforming to IEC 60529<br>IP52 (front) conforming to IEC 60529 |
| Relative humidity | 5...95 % 50 °C |
| Pollution degree | 2 |
| Ambient air temperature for operation | -25...70 °C |
| Ambient air temperature for storage | -40...85 °C |
| Operating altitude | 3000 m |





*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

Calibration Confirmation

REVERE

Jing Huang
Mechanical Engineer - Aeration Industries International
4100 Peavey Road | Chaska, MN 55318 USA
+1 952-448-6789 Ext 735

Dear Jing,

Revere Control Systems performed commissioning and calibration on the two VFDs and a power meter on 7/28/14 and 7/29/14. The power meter and drives performed correctly.

Equipment part numbers:
25 Hp VFD – Schneider Electric

| | |
|---|---|
| ATV71HD18N4 | 25HP 480V Constant Torque Drive, 41A Continuous Output, 150% Overload. Product contains an internal DC choke, inductance 2–3%. |

125 Hp VFD – Schneider Electric

| | |
|---|---|
| ATV71HD90N4 | 125HP 480V Constant Torque Drive, 179A Continuous Output, 150% Overload. Product contains an internal DC choke, inductance 2–3%. |

Power Meter – Schneider Electric

PM5560, part number - METSEPM5560

Measurement accuracy:
- +/- 0.15 °C current
- +/- 0.05 % power factor
- +/- 0.1 % voltage
- +/- 0.2 % active power
- +/- 1 % reactive energy
- +/- 0.2 % active energy
- +/- 0.05 % frequency
- +/- 0.5 % apparent power

Thank you for allowing Revere Control Systems to participate in this project.

Thanks,

**Ben Lamar**, CEM, PMP
2240 Rocky Ridge Road
Birmingham, AL 35216
Office: (205) 271-9798
Cell: (205) 533-0425





*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

## Appendix G: SUN-NAN HONG'S CV


# Sun-Nan Hong, Ph.D., P.E.

105 James River Road

Cary, NC 27511

(919) 469-1958 (H), (919) 677-8310 (O)

(919) 469-1958 (FAX-H), (919) 677-0082 (FAX-O)

(919) 349-7708(Cell)


## PERSONAL DATA

| | |
|---|---|
| Birthplace: | Taipei, Taiwan |
| Health: | Excellent |
| Family Status: | Married, three children |

## EDUCATION

B.S. in Chemical Engineering, National Taiwan University, 1963

M.S. in Chemical Engineering, Kansas State University, 1967

Ph.D. in Chemical Engineering, Kansas State University, 1970

M.S. in Environmental Engineering, University of Rhode Island, 1972

## PROFESSIONAL SOCIETIES AND HONORARIES

American Institute of Chemical Engineering

Water Environmental Federation

Chinese Institute of Engineers/USA

The Greater New York Chapter, President 1985/1986



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

National Council, Chairman, 1989

The Friendship Award, State Council, People's Republic of China, 1996

Overseas Chinese Environmental Engineers and Scientist Association

Pollution Abatement Technical Advisor Committee, Industrial Technology Research Institute, Taiwan, ROC

## PROFESSIONAL REGISTRATION

Professional Engineer - Rhode Island, No. 3364

## PATENTS AND PUBLICATIONS

See Attachment.

## PROFESSIONAL EXPERIENCE

**Retired from Kruger on July 1, 2013.**

**2007 – June, 2013**

**Executive Vice President for Risk Assessment and Business Development**

**Kruger Inc/A Veolia Water Company**.

Also I have been serving as an in-house consultant on various new technologies such as:

- IFAS/MBBR (Integrated Fixed-film Activated Sludge / Moving Bed Biological Reactor)
- Anammox process for high strength ammonia concentration
- OSTARA process for recovery of phosphorus in centrate from anaerobic digester



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

## August, 1992 – September, 2007

### Vice President - Engineering,

### Kruger Inc./A Veolia Water Company

Originally as a US subsidiary of Kruger A/S of Denmark, Kruger Inc was established in 1989. In June of 1991, Kruger Inc purchased all wastewater treatment technologies owned by Air Products and Chemicals, Inc. and I was invited to join the then 6 person company in August, 1992. I was the only Process Engineer in the company at that time. Kruger Inc. successfully commercialized the technologies purchased from Air Products and Chemicals, Inc. and those imported from Denmark in mid 1990s. Subsequently, Kruger Inc became a part of OTV and Vivendi and now Veolia Water. During the past fifteen years, Kruger Inc has commercialized many new technologies developed by Veolia Water and grown to a 120 person company. During this period of time, I have been the Vice President in charge of overall engineering work.

Highlights of my professional responsibilities and accomplishments as VP of Engineering in Kruger, Inc. are briefly summarized below:

- ACTIFLO – High Rate Ballasted Clarification Process

  Approximately 150 plants have been installed in the US in the last 15 years. The process was originally utilized as pretreatment of surface water for turbidity removal in drinking water treatment systems. The applications of the process were expanded to include treatments of CSO/SSO (combined and sanitary sewer overflow), industrial process water supplies, tertiary phosphorus removals, chemical precipitation of metals in industrial wastewater, etc.

- BIOSTYR – Aerated Biological Filter Process

  The process is characterized with a short detention time of about 1 hour and no requirement of secondary clarifier for municipal wastewater treatment. A total of 12 systems have been installed in the US for secondary and tertiary nitrification and denitrification.

- A/O, BioDenitro and BioDenipho - Biological Treatment Systems for Municipal Wastewater Treatment



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

These processes have been implemented in many municipal wastewater treatment systems through out the US for BOD, TSS, nitrification, denitrification and biological phosphorus removals.

- OASES – Pure Oxygen Activated Sludge Process

  Twenty contracts during the last 15 years had been completed. The process was utilized for municipal and pulp and paper wastewater treatment. Combined with the A/O selector technology, the process was also used for phosphorus and nitrogen removals. The recent contract for Detroit, MI valued $9.7MM which is the biggest contract in Kruger's history.

- ATAD – Auto-Thermophilic Aerobic Digester Process

  The process treated municipal wasted sludge to meet Class A requirement with pathogen killed and 38% volatile solids destruction. Twenty one plants had been constructed in the US.

- Hydrotech Discfilter – A filtration device for solids removal

  Many units had been installed in the US for tertiary filtration in place of conventional sand filters. The equipment had been Title 22 certified by California Health Department for water reuse applications.

- BioCon – Sludge drying process

  This is a Danish technology with low temperature, air to air heat transfer and a slow moving belt for drying municipal waste sludge. The process has been certified as Class A process by US EPA. One system is in operation in Minnesota and 3 other systems have been contracted.

During this period of time, I continued and successfully developed A/O or OASES licenses to the following international companies:

Nippon Sanso Corporation – Japan on OASES

Hyundai Heavy Industries Co., LTD – South Korea on A/O

EuroChem, Inc – Tailand on A/O

Kaifeng Air Separation Group Co., LTD – People's Republic of China on OASES

Those license agreements provided Kruger Inc a significant income.



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

During the last three years, I have devoted a significant amount of effort in developing/commercializing MBR (Membrane Biological Reactor) process with flat sheet membrane manufactured by Toray in Japan, and on pilot studies of ceramic membrane manufactured by NGK in Japan for drinking water treatment.

**March, 1974 – July, 1992**

**Senior Process Manager**

**Environmental/Energy Division**

**Air Products and Chemicals, Inc.**

As Senior Process Manager, I managed a process group of eight professionals and was responsible for process design, start-up and operation of the following technology areas:

- A/O Process - Anaerobic biological selector process for nutrient removal.
- OASES Process - An oxygen activated sludge system.
- Ozone for drinking water and wastewater disinfection.
- Turn-key privatization for municipal wastewater treatment.

I was also actively involved in providing technical presentations to various clients in support of Sales' efforts.

During the period of 1984 - 1992, I directed the design of more than forty-five full-scale wastewater treatment systems using pure oxygen activated sludge process and anaerobic selector process. Applications of these systems include BOD/Nocardia control/nutrient removal of municipal wastewater, BOD/COD removal of wastewaters from pulp and paper industries, and specialty chemicals manufacturing. Also, I personally developed and delivered Technology Transfer to the A/O licensees of the following companies:

Super Max Engineering Company – Republic of China

NGK Insulators, LTD. – Japan

Japan Organo Co., LTD. – Japan

Dragados Y Construcciones, S.A. – Spain

AnperOX Viz-e szennyviztechnologiai kft. - Poland



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

During the period of 1974 - 1984, I was responsible for overall development work for the Environmental Products Department. I successfully directed a 1.5 million dollar project in 1979 for the construction and one-year operation demonstration of the first full-scale A/O system. I developed critical patents contributing to the improvement of the A/O process. Also, I directed pilot plant tracer studies and, subsequently, developed a Control Back Mixing System which led to the patented process of the OASES sludge process. I also developed a computer model for design of ozone disinfection systems.

☐ pure oxygen

**March , 1973 – March, 1974**

**Assistant Project Engineer**

**Roy F. Weston, Inc.**

Served as a member of a coordination team in the development of effluent guidelines for the organic chemical industry for the EPA. Performed conceptual and process designs of industrial wastewater treatment facilities.

**February, 1972 – March, 1973**

**Project Engineer**

**Southeastern Regional Planning and Economic Development District**

**Tauton, Massachuset**

Served as a coordinator in the development of a comprehensive regional solid wastes disposal project.



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

# PATENTS AND PUBLICATIONS

## PATENTS

| | |
|---|---|
| US4,081,368 | Activated Sludge System with Staggered Partition Basin. |
| US4,488,967 | Treatment of Wastewater Containing Phosphorus Compounds. |
| US4,488,968 | Removal of Phosphates and BOD from Wastewaters. |
| US4,552,663 | Process for the Removal of Ammoniacal Nitrogen in the BOD Sorption Zone of Wastewater Treatment Plant. |
| US4,556,491 | Avoidance of Rising Sludge in Biological Wastewater Treatment Clarifiers. |
| US4,650,585 | Method for Minimizing Diurnal Swing in Phosphorus Content of Effluent Streams from Wastewater Treatment Plants. |
| US5,650,069 | Dual-Stage Biological Process for Removing Nitrogen from Wastewater |
| US6,685,834B1 | Method for Conditioning and Dewatering Thermophilic Aerobically Digested Sludge |
| US6,830,689B2 | Process for Removing Phosphorus from Wastewater Utilizing a Triple Basin Wastewater Treatment System |
| US7,001,516B1 | Process for Removing Phosphorus from Wastewater Utilizing a Triple Basin Wastewater Treatment System |
| US7,147,778B1 | Method and System for Nitrifying and Denitrifying Wastewater |
| Pending | Method for Controlling Fouling of a Membrane Filter |

## PUBLICATIONS

1. "Heat Transfer to Non-Newtonian Fluids in Laminar Flow Through Concentric Annuli," Int. J. Heat Mass Transfer, 12, 1699, 1969.



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

2. "Distributed Discharge of Cooling Water Along Direction of Stream Flow," Water Resources, Bulletin, 8, 1031, 1972.

3. "Development Document for Proposed Effluent Limitations Guidelines and New Source Performance Standards for the Major Organic Products," EPA 440/1-73/009.

4. "Design and Operation of a Full-Scale Biological Phosphorus Removal System," WPCF Conference, Houston, TX, 1979.

5. "Controlled Back-Mixing for Activated Sludge System," Mixing Conference, Henniken, NH, 1979.

6. "Generations of Ozone from Oxygen for Drinking Water Treatment," New England Water Works association, Boston, MA, 1979.

7. "A Biological Wastewater Treatment System for Nutrient Removal," WPCF Conference, Detroit, MI, 1981.

8. "An Innovative Biological Nutrient Removal System," The Proceedings of the Conference on Environmental Engineering, ASCE, 1981.

9. "Biological Nutrient control Plant Demonstration," The Proceedings of the Specialty Conference on Water Forum, ASCE, 1981.

10. "A Biological Wastewater Treatment System for Nutrient Removal," Workshop on Biological Phosphorus Removal in Municipal Wastewater Treatment, sponsored by EPA, Indianapolis, MD, 1983.

11. "Recent Advances on Biological Nutrient Control by the A/O Process," WPCF Conference, Atlanta, GA, 1983.

12. "Biological Phosphorus and Nitrogen Removal Via the A/O Process: Recent Experience in the United States and United Kingdom," Water Science Technology, Vol. 16, pp. 151-172, 1984.



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

13. "The A/O Nutrient Removal Process - Theory and Operation," Post Conference, IAWPRC, Paris, France, 1984.

14. "A Year's Low Temperature Operation in Michigan of the A/O System for Nutrient Removal, " WPCF Conference, Kansas City, MO, 1985.

15. "The A/O Nutrient Removal Process - Theory and Operation," WPCF Conference, Kansas City, MO, 1985.

16. "A Comprehensive Kinetic Model for Biological Phosphorus Removal," WPCF Conference, Los Angeles, CA, 1986.

17. "Improvement in Operation of Oxygen Activated Sludge System Using Selector Technology," WPCF Conference, Dallas, TX, 1988.

18. "Upgrading Wastewater Treatment Plants with Anaerobic Selectors," IAWPRC/EWPCA, Munich, Germany, 1989.

19. "Application of Anaerobic Selector Technology in Activated Sludge Systems," WPCF Conference, San Francisco, CA, 1989.

20. "Experience on Biological Phosphorus Removal System at Titusville, Florida", Florida WPCF, 1989.

21. "Full-Scale Demonstration of the A/O Process at the Ypsilanti Community Utilities Authority Wastewater Treatment Plant," WPCF Conference, Ontario, Canada, 1991.

22. "Anaerobic Selector Technology for Wastewater Treatment," World Congress III, Beijing, China, 1993.

23. "Assessment of Activated Sludge BNR Process Configurations Utilizing Advanced Mathematical Simulation Model," WEF Conference, Anaheim, California, 1993.



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

24. "Converting a Single Sludge Oxygen Activated Sludge system for Nutrient Removal," WEF Conference, Anaheim, California, 1993.

25. "Sequencing Biofilm Reactor with Continuous Biological Phosphorus Removal", WEF Conference, Chicago, Illinois, 1994.

26. "Full-Scale Experience with Nutrient Removal in a Fixed Film System", Biological wastewater Treatment Fundamentals and Modeling Symposium, Roanoke, Virginia, Sept., 1996.

27. "Treatment of Combined Sewer Overflow with High Speed Microsand Settling", WEF Conference, Dallas, Texas, 1996.
28. "Enhancing Denitrification in the Secondary Anoxic Zone by RAS Addition: A Full Scale Evaluation", WEF Conference, Chicago, Illinois, 1997.

**PATENTS AND PUBLICATIONS** (continued)

29. "Environmental Protection through Innovative Wastewater and Sludge Treatment Strategies in Florida", WEF Conference, Orlando, Florida, 1998.

30. "Pilot and Full Scale Experience with Nutrient Removal in a Fixed Film System", WEF Conference, Orlando, Florida, 1998.

31. "The Effect of Adding Industrial Waste with High Phosphorous and Nitrogen Concentrations to a Phased BNR Treatment System: A Case Study", WEF Conference, Orlando, Florida, 1998.

32. "Evaluation of the Amount of Nitrogen Removal due to Simultaneous Nitrification and Denitrification in A/O Type BNR Processes", Proceedings of 76 th Annual Florida Water Resources Conference, Jacksonville, FL, 2001.

33. "Determination of Phase Length of BioDenipho Process Using Ammonia and Nitrate On-Line Alalyzers", CWEA Annual Conference, Ontario, CA, 2003.

34. "Demonstration of Phase Length Control of BioDenipho Process Using On-Line Ammonia and



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

Nitrate Analyzers at Three Full-Scale Wastewater Treatment Plants", Proceedings of WEFTEC'04, New Orleans, LA, 2004.

35. "Pilot Evaluation of Florida of Floating Media Biological Aerated Filters(BAFs) to Achieve Stringent Effluent Nutrient Discharge Requirements", Porceedings of IWA 2006, Beijing, China, 2006.

36. "Current Biological Filter Applications in Municipal Wastewater Treatment", Maryland WEF, Maryland, 2007.

37. "Improving Nitrogen Removal by RAS Addition to the Secondary Anoxic Zone: Results of Full Scale Implementation", WEFTEC, San Diego, CA, 2007.



*This document is proprietary and confidential. No part of this document may be disclosed in any manner to a third party without the prior written consent of Aeration Industries International.*

Appendix D

# SLUDGE CHARACTERIZATION PRELIMINARY INFORMATION ON BOD, COD, AND DECAY RATES-DRAFT (AMRI, 2018)

# Sludge Characterization preliminary information on BOD, COD, and Decay Rates

## Sludge Accumulation in the Oxidation Ponds

Oxidation Ponds 1 and 2 are facultative ponds which have been in operation for over 30-yrs. During this time, solids have accumulated on the bottoms of the ponds. They consist primarily of residual waste solids from the primary clarifier effluent which is pumped into Pond 1, and algal solids. In Pond 1 there are an estimated 54,800-$yd^3$ of solids, mostly in the corners of the pond (Figure 1). 43,000-$yd^3$ of accumulated sludge are estimated to be within Pond 2 (Figure 2). This volume accounts for 27% of the total pond volume. This sludge depth data for both ponds was collected during surveys conducted in 2017.

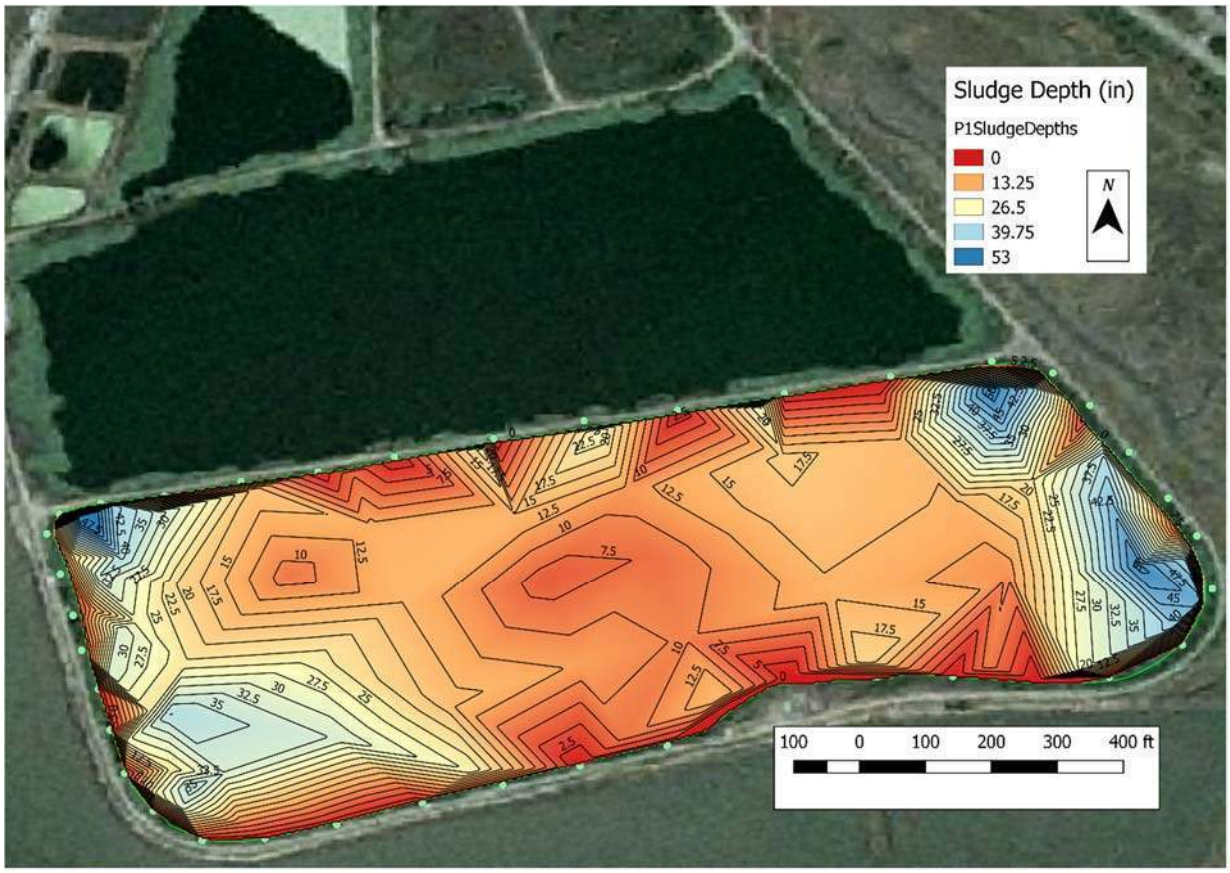



*Figure 1: GIS contour plot of surveyed sludge depths in Pond 1.*

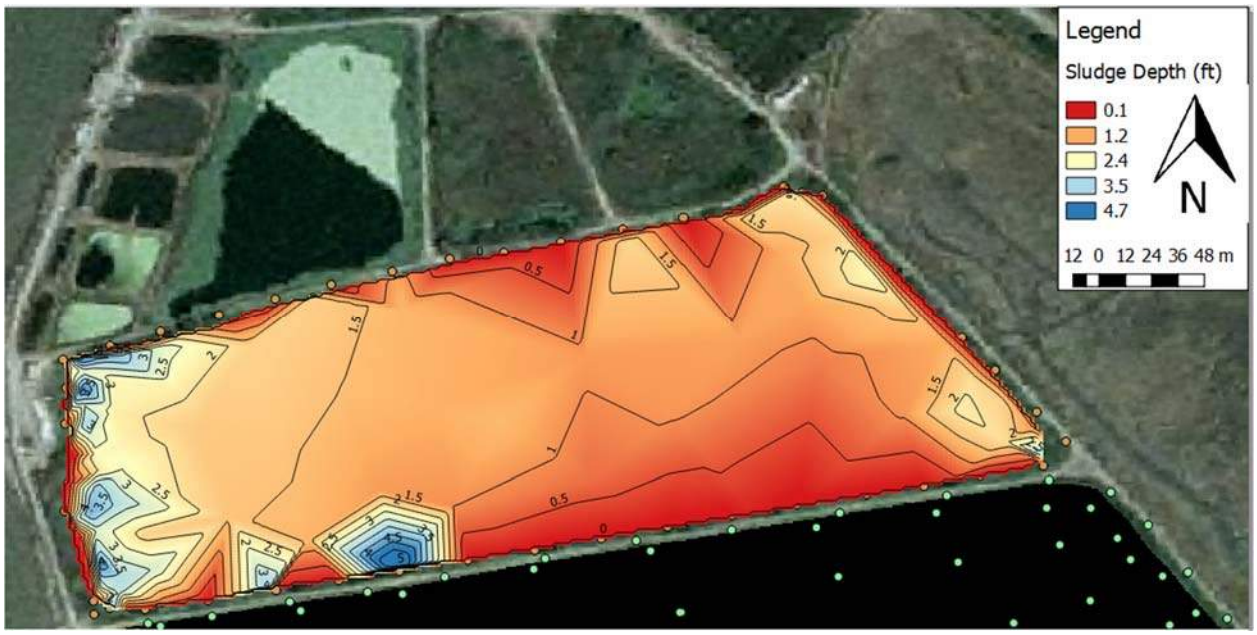



*Figure 2: GIS contour plot of surveyed sludge depths in Pond 2.*

## Oxidation Pond Sludge Characteristics

Several studies have been performed by AMRI staff to characterize the sludge present in Pond 1 and Pond 2. Between June and July of 2016, an aeration tank was filled with a mixture of sludge and Pond 2 water to see how aeration would decrease BOD, and cause nitrification in the water column and in the sludge. The study ran from 6/1/2017 to 7/13/2016 and is therefore an ideal case due to increased summer temperatures for nitrification and reduction in BOD. Nitrification occurred within one week (Figure 3), and BOD dropped from 416-mg/L to 44-mg/L in one month.

A rate study is being conducted using Oxitop BOD testing to take daily BOD measurements on the sludge from Ponds 1 & 2. The results from two runs with triplicate samples show that the BOD in Pond 1 Sludge is approximately 3,300-mg/L, with 2,800-mg/L CBOD. The BOD decay rate is 0.1 in Pond 1. BOD is appproximately 3,500-mg/L with 2,400-mg/L CBOD in Pond two with a decay rate of 0.2. Pond 1 sludge was tested for ammonia levels using an electrode probe. Ammonia levels were between 200-400-mg/L throughout the five sample points where sludge ammonia levels were tested in Pond 1.

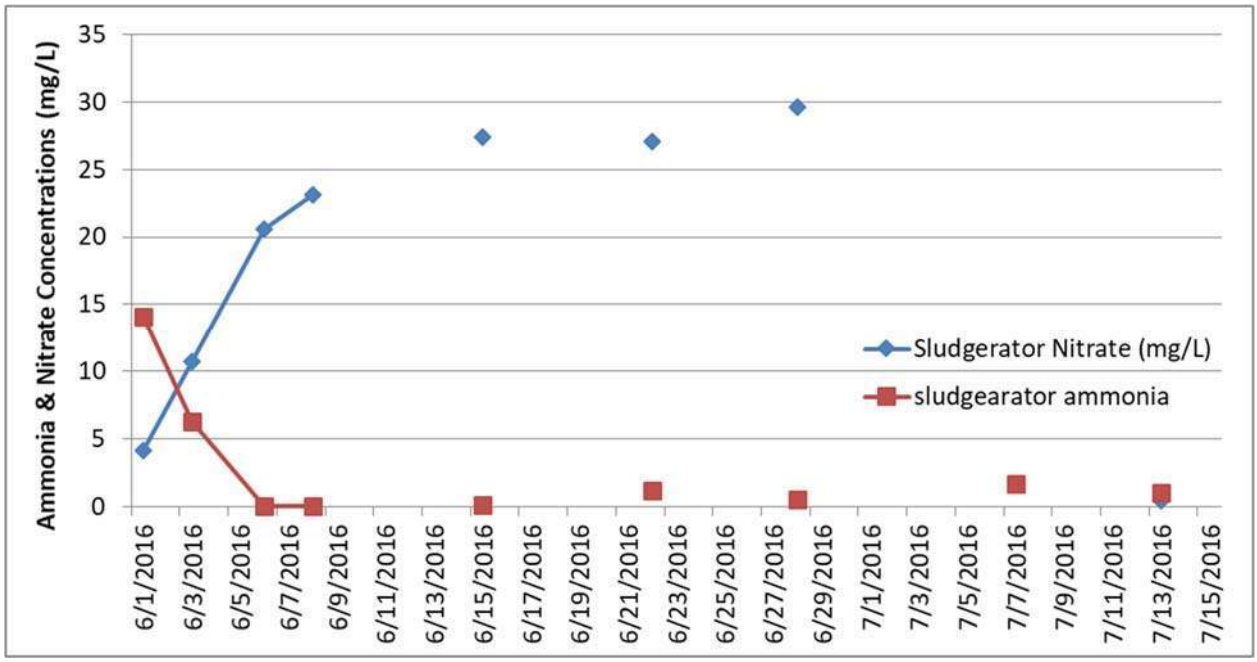



*Figure 3: Ammonia and nitrate concentrations in mg/L plotted over the course of the sludge aeration study from 2016.*

Appendix E

# TM 5 SECONDARY TREATMENT AND ASSOCIATED FACILITIES



City of Arcata
Wastewater Treatment Facilities Improvements

# Technical Memorandum 5
# OXIDATION DITCHES, SECONDARY CLARIFIERS, AND ASSOCIATED FACILITIES

FINAL | April 2019

City of Arcata
Wastewater Treatment Facilities Improvements

# Technical Memorandum 5

# OXIDATION DITCHES, SECONDARY CLARIFIERS, AND ASSOCIATED FACILITIES

FINAL | April 2019



# Contents

Technical Memorandum 5 5-1

Oxidation Ditches, Secondary Clarifiers, and Associated Facilities 5-1

5.1 Purpose 5-1

5.2 Summary of Findings and Recommendations 5-1

5.3 Background 5-2

5.4 Design Influent Flows and Loads 5-2

5.5 Recommended Facilities 5-3

5.5.1 Oxidation Ditches 5-4

5.5.2 Mixed Liquor Flow Split Structure 5-14

5.5.3 Secondary Clarifiers 5-14

5.5.4 RAS Pumping System 5-16

5.5.5 WAS Pumping System 5-16

5.5.6 Alkalinity Feed Facility 5-17

5.6 Potential for Phasing 5-17

# Appendices

Appendix 5A Process Model Results

Appendix 5B Vendor Brochures and Cost Proposals

Appendix 5C Alkalinity Feed System

# Tables

Table 5.1 Design Influent Flows 5-3

Table 5.2 Design Influent Loads 5-3

Table 5.3 Oxidation Ditch Design Parameters 5-11

Table 5.4 Oxidation Ditch Aeration System Design Parameters 5-11

Table 5.5 Mixed Liquor Flow Split Structure Design Parameters 5-14

Table 5.6 Secondary Clarifier Design Parameters 5-15

Table 5.7 RAS Pumping System Design Parameters 5-16

Table 5.8 WAS Pumping System Design Parameters 5-16

Table 5.9 Chemical Addition Facility Design Parameters 5-17

# Figures


| | | |
|---|---|---|
| Figure 5.1 | Typical "Orbal Type" Oxidation Ditch Configuration | 5-5 |
| Figure 5.2 | Typical "Carousel Type" Oxidation Ditch Configuration | 5-6 |
| Figure 5.3 | Oxidation Ditch Plan | 5-7 |
| Figure 5.4 | Oxidation Ditch Section | 5-9 |
| Figure 5.5 | Proprietary Disk Aerator | 5-12 |
| Figure 5.6 | Surface Aerator | 5-13 |

# Abbreviations

| | |
|---|---|
| AWTF | Arcata Wastewater Treatment Facility |
| BOD | biological oxygen demand |
| Carollo | Engineers, Inc. |
| DO | dissolved oxygen |
| deg C | degrees Celsius |
| ft | feet |
| FRP | fiberglass reinforced plastic |
| gpd | gallons per day |
| hrs | hours |
| HRT | hydraulic retention time |
| MG | million gallons |
| mg/L | milligrams per liter |
| mgd | million gallons per day |
| NH3-N | ammonia expressed as nitrogen |
| ppd | pounds per day |
| lb | pound |
| RAS | return activated sludge |
| SRT | solids retention time |
| TKN | total kjeldahl nitrogen |
| TM | technical memorandum |
| TSS | total suspended solids |
| WAS | waste activated sludge |

Technical Memorandum 5

# OXIDATION DITCHES, SECONDARY CLARIFIERS, AND ASSOCIATED FACILITIES

## 5.1 Purpose

The purpose of this Technical Memorandum (TM) is to outline the details of the proposed oxidation ditches, secondary clarifiers, and return activated sludge (RAS) and waste activated sludge (WAS) pumping system for the City of Arcata (City) Wastewater Treatment Facility (AWTF). Design criteria were developed for all secondary treatment facilities and the recommended configuration, sizing, controls, layout, components, and features are detailed in this TM. Additionally a preliminary process model for these additional secondary treatment processes was prepared and the results of this modeling effort are included in this TM. This TM is based on the addition of one oxidation ditch and two secondary clarifiers now, with the possible addition of a second oxidation ditch and a third secondary clarifier in the future.

## 5.2 Summary of Findings and Recommendations

The key findings and recommendations of this TM are summarized below:

Oxidation Ditch:

- One new oxidation ditch is required for a peak flow of 3.6 million gallons per day (mgd).
- The new oxidation ditch will be constructed on the southeast part of the corporation yard at the location of the existing compost storage area. It will have volume of 1.6 million gallons (MG) and a side water depth of 14 feet.
- The oxidation ditch will be designed as a carrousel type ditch with vertical walls and two surface aerators. The oxidation ditch will be designed for both carbonaceous biochemical oxygen demand (BOD) and ammonia removal.

Secondary Clarifiers:

- Two new secondary clarifiers are required for a combined peak flow of 3.6 mgd.
- The two new 75-foot diameter circular secondary clarifiers will be constructed on the corporation yard site, near the existing bus barn location.
- The clarifier will have a 14-foot side water depth at the exterior walls and 1:12 slope toward a deep center sludge collection hopper.
- The sludge collection mechanism will include a center column, an energy dissipating inlet, a larger diameter flocculating feed well, spiral scraper sludge collectors, skimmer arm, and all epoxy coated steel construction.
- A scum collection well with a chopper pump will provide mixing, decant, and scum transfer.

Flow Split Structures:

- One new flow split structure upstream of the secondary clarifiers (mixed liquor flow split structure) will be constructed to provide an even flow distribution among the two new secondary clarifiers.
- The flow split structure will be made of concrete with a T-lock protective coating.
- The flow split structure will be located west of the new oxidation ditch.

RAS and WAS Pump Stations:

- Three new horizontal non-clog centrifugal pumps will be installed in a new RAS pump station to convey RAS to the oxidation ditch via glass-lined ductile iron pipes.
- Two new horizontal non-clog centrifugal pumps will be installed to convey WAS to the sludge thickener prior to the digesters via glass-lined ductile iron pipes.

Alkalinity Feed Facility:

- A new alkalinity feed facility may be required and would be constructed just south of the existing sludge drying beds across the entrance roadway. The need for the facility will determined in final design.
- The alkalinity feed facility will store sodium hydroxide, which is needed to provide sufficient alkalinity for the secondary treatment process.

## 5.3 Background

At present the AWTF uses two existing oxidation ponds run in series and six existing treatment wetlands run in parallel to provide secondary treatment. As described in TM 1 - Basis of Design, the capacity of this secondary treatment system is limited to 2.3 mgd for the oxidation ponds and 1.8 mgd for the existing treatment wetlands. With the addition of Treatment Wetland No. 7 described in TM 4 - Pond and Treatment Wetland Improvements, the capacity of the oxidation pond and treatment wetland system will be 2.3 mgd. This is not sufficient to treat peak wet weather flows of 5.9 mgd. Thus, additional secondary capacity is needed. This TM summarizes the proposed facilities needed for this additional secondary capacity.

## 5.4 Design Influent Flows and Loads

The influent flows used for the basis of design for the new secondary treatment processes are presented in Table 5.1. The influent loads used for the basis of design are presented in Table 5.2. The secondary effluent must be high quality and meet discharge permit requirements, with a treatment goal of less than 30 milligrams per liter (mg/L) BOD5 and TSS on an average monthly basis. Nutrient removal will be provided although the specific discharge requirements are not yet set. The treatment goal assumed for this TM is 4 mg/L NH3-N (ammonia nitrogen) on an average monthly basis.

A steady-state process model was developed for the AWTF to evaluate secondary process capacity and aeration requirements. The model was calibrated with plant operating data. See Appendix 5A for detailed calculations and model outputs for various operating conditions.

Table 5.1 Design Influent Flows

| | Current (mgd) | Future (mgd) | Permitted (mgd) |
|---|---|---|---|
| Minimum Flow | 0.3 (1) | 0.3 (1) | - |
| Average Dry Weather Flow | 1.1 (2) | 1.3 (3) | 2.3 (4) |
| Peak Dry Weather Flow | 1.8 (5) | 2.2 (6) | - |
| Maximum Month Flow | 3.0 (7) | 3.6 (8) | 5.0 (9) |
| Peak Wet Weather Flow | 5.9 (4) | 5.9 (4) | 5.9 (4) |

Notes:
(1) Based on City diurnal flow data from 7/23/17 through 7/30/17.
(2) 50th percentile flow during dry weather using City data from 2003 to 2015.
(3) Current Average Dry Weather Flow plus 20 percent growth.
(4) Existing permit capacity.
(5) Diurnal peaking factor of 1.6 multiplied by Average Dry Weather Flow. Peaking factor based on City diurnal flow data from 7/23/17 through 7/30/17.
(6) Current Peak Dry Weather Flow plus 20 percent growth.
(7) 92nd percentile flow using City data from 2003 to 2015.
(8) Current Maximum Month Flow plus 20 percent growth.
(9) Existing permitted Average Wet Weather Design Flow.

Table 5.2 Design Influent Loads

| | Current (lb/d) | Future (lb/d) |
|---|---|---|
| BOD | 4,000 (1) | 4,800 (2) |
| TSS (3) | 5,760 (1) | 6,910 (2) |
| $NH_3$ | 880 (4) | 1,060 (5) |
| TKN (6) | 1,330 | 1,610 |

Notes:
(1) 90th percentile load using City data from 2003 to 2015.
(2) 90th percentile load using City data from 2003 to 2015 plus 20 percent for growth.
(3) It is suspected that these values may be high.
(4) 90th percentile load using City data from 2013 to 2015.
(5) 90th percentile load using City data from 2013 to 2015 plus 20 percent for growth.
(6) Estimated based on $NH_3$ data.

## 5.5 Recommended Facilities

This section summarizes recommended facilities and design criteria for the project. Secondary treatment includes biological and physical treatment to reduce the organic content of the wastewater, typically to less than 30 mg/L BOD and suspended solids. Secondary treatment facilities include an oxidation ditch, secondary clarifiers, RAS and WAS pump stations, an alkalinity feed facility, and a mixed liquor flow split structure. The proposed system will add treatment capacity necessary to nitrify and meet low ammonia limits year-round.

In the oxidation ditch, oxygen is supplied through vertical surface aerators. Microorganisms in the oxidation ditches will provide $BOD_5$ reduction and nitrification (ammonia removal) of the wastewater. The secondary clarifiers will remove the biological solids and provide return of the biological solids (return activated sludge, or RAS) to the aeration process. Excess solids or waste

activated sludge (WAS) will be removed and sent to the aerobic digester for further stabilization. The sections below describe each component of this process and the associated design criteria.

### 5.5.1 Oxidation Ditches

An oxidation ditch is an activated sludge treatment process that uses long solids retention times (SRTs) and long hydraulic retention times (HRTs) to remove organics. Typically an oxidation ditch is configured in a ring- or racetrack- shaped channel. The channel is aerated to increase the concentration of dissolved oxygen (DO) and to help circulate the wastewater and RAS around the ditch, promoting unidirectional channel flow. As the mixed liquor passes the aerator, the concentration of DO increases rapidly and then declines as biomass uptake oxygen as the flow travels through the remaining channel section. This fluctuation in DO helps promote nitrification and BOD removal. The addition of an anoxic zone can also provide denitrification.

There are two main types of advanced oxidation ditches with biological nutrient removal: 1) "Orbal type" and 2) "carrousel type". The Orbal type, shown in Figure 5.1, is designed in concentric loops that provide simultaneous nitrification and denitrification. This system is marketed by Evoqua. The "carrousel type" oxidation ditch is designed in a racetrack configuration, as shown in Figure 5.2. This type of oxidation ditch has two main vendors: Ovivo and WesTech. Because the "carrousel type" oxidation ditches have fewer aerators and drives that requiring maintenance and multiple vendors, this type is recommended.

The oxidation ditch proposed for the AWTF will be designed for both carbonaceous BOD and ammonia (nitrification) removal. The configuration will also be based on a vertical wall oxidation ditch. The preliminary configuration, including plan and section, is shown in Figures 5.3 and 5.4.

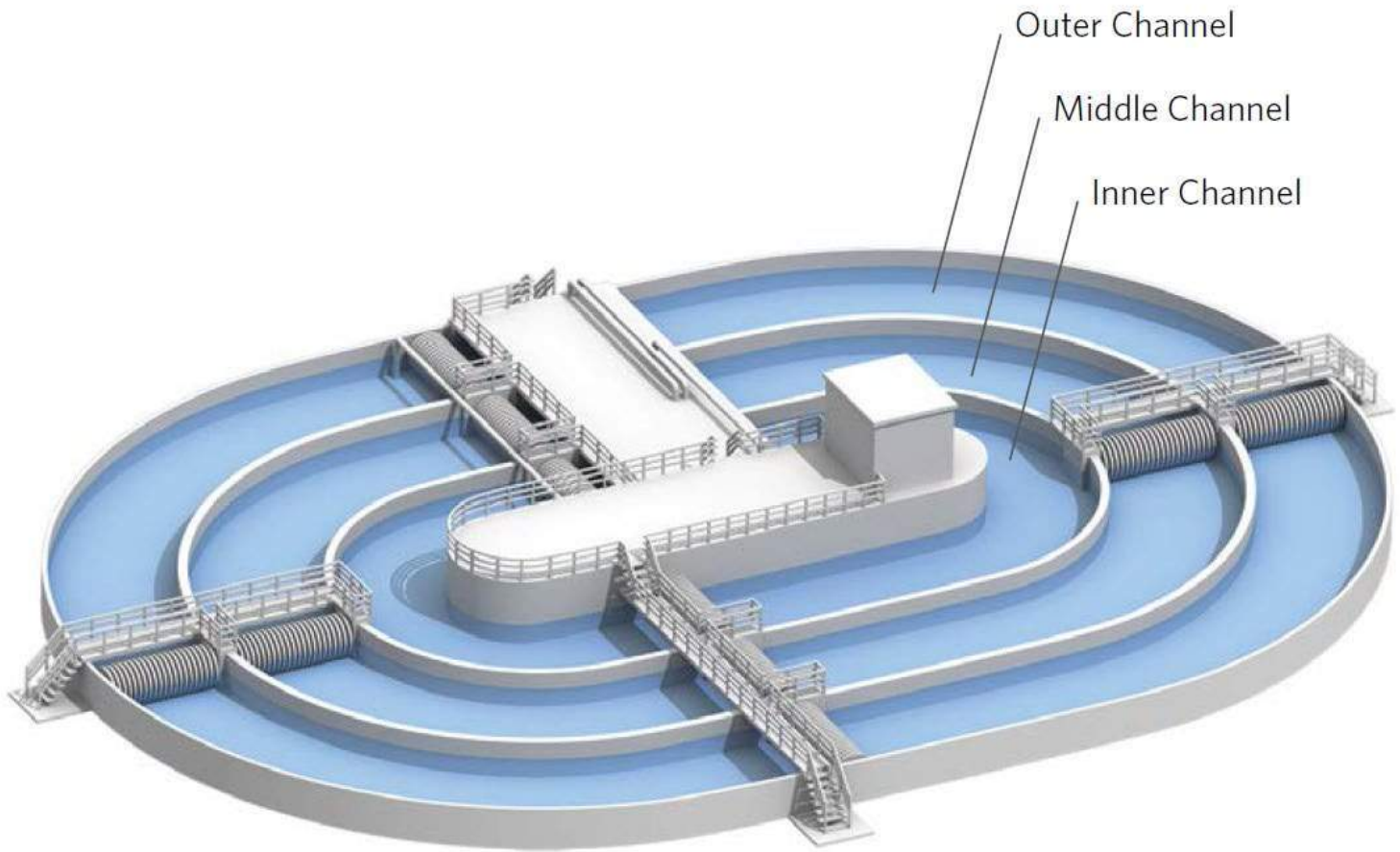
The design criteria for the oxidation ditch are shown Table 5.3. Appendix 5B provides vendor brochures and cost proposals for the proposed oxidation ditch.

#### 5.5.1.1 Aeration

There are four main types of aeration used in oxidation ditches: surface aerators, disc aerators, draft tube aerators, or fine bubble diffusers. For the "Orbal type" oxidation ditch, described in the preceding section, aeration is provided through proprietary disk aerators, shown in Figure 5.5. The "carrousel type" oxidation ditch, meanwhile, uses vertical shaft surface aerators located at each end of the ditch. These aerators are shown in Figure 5.6.

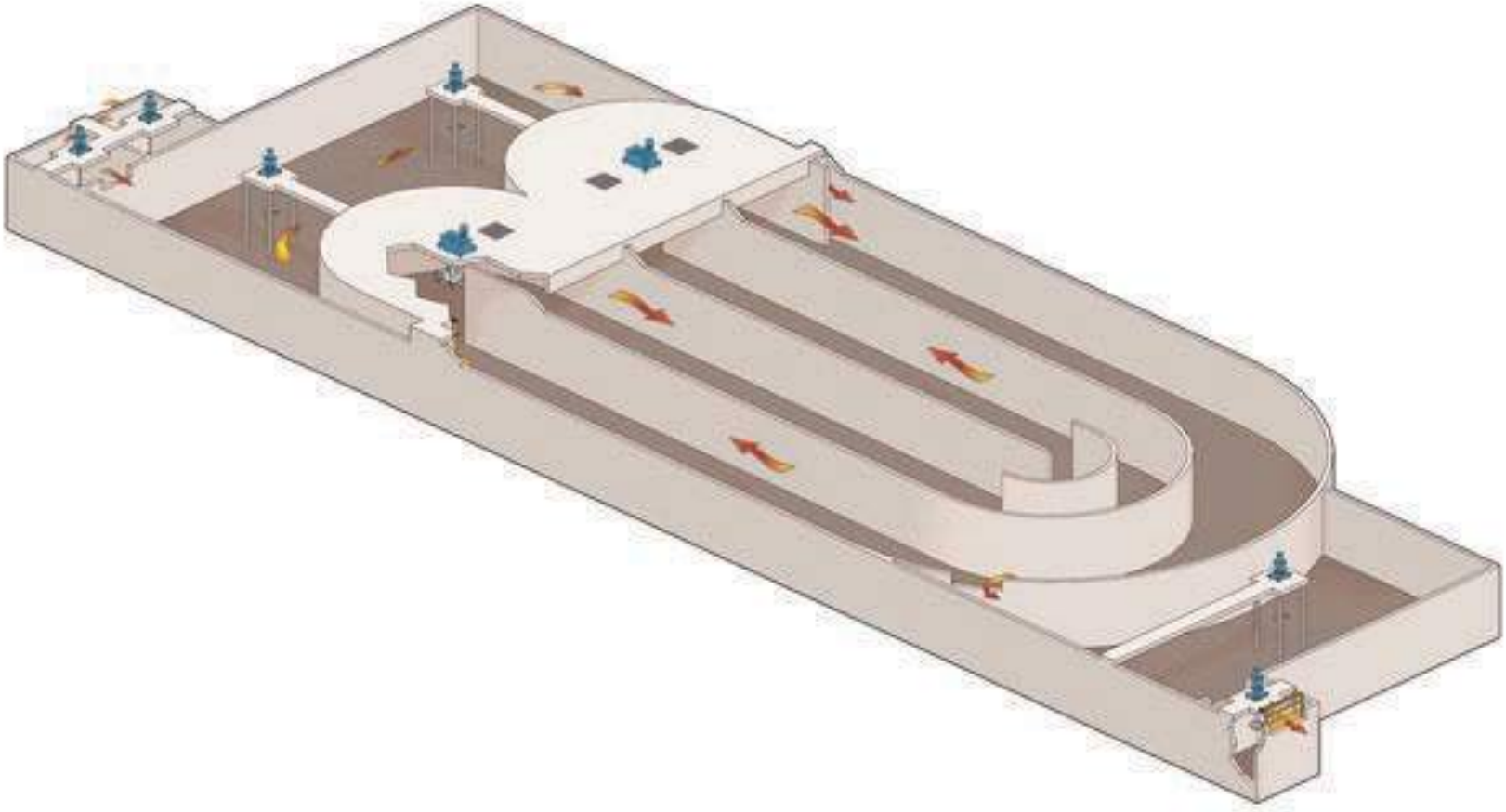
As described above, vertical shaft aerators are recommended. The aeration equipment will be sized for both the BOD loading and ammonia loading, noted above. For the proposed oxidation ditch, two vertical surface aerators are recommended, one at each end of the structure. Partial aeration redundancy would be provided, as each aerator would be designed to provide 75 percent of the total oxygen demand.

The design criteria for the aeration system design criteria are shown in Table 5.4.



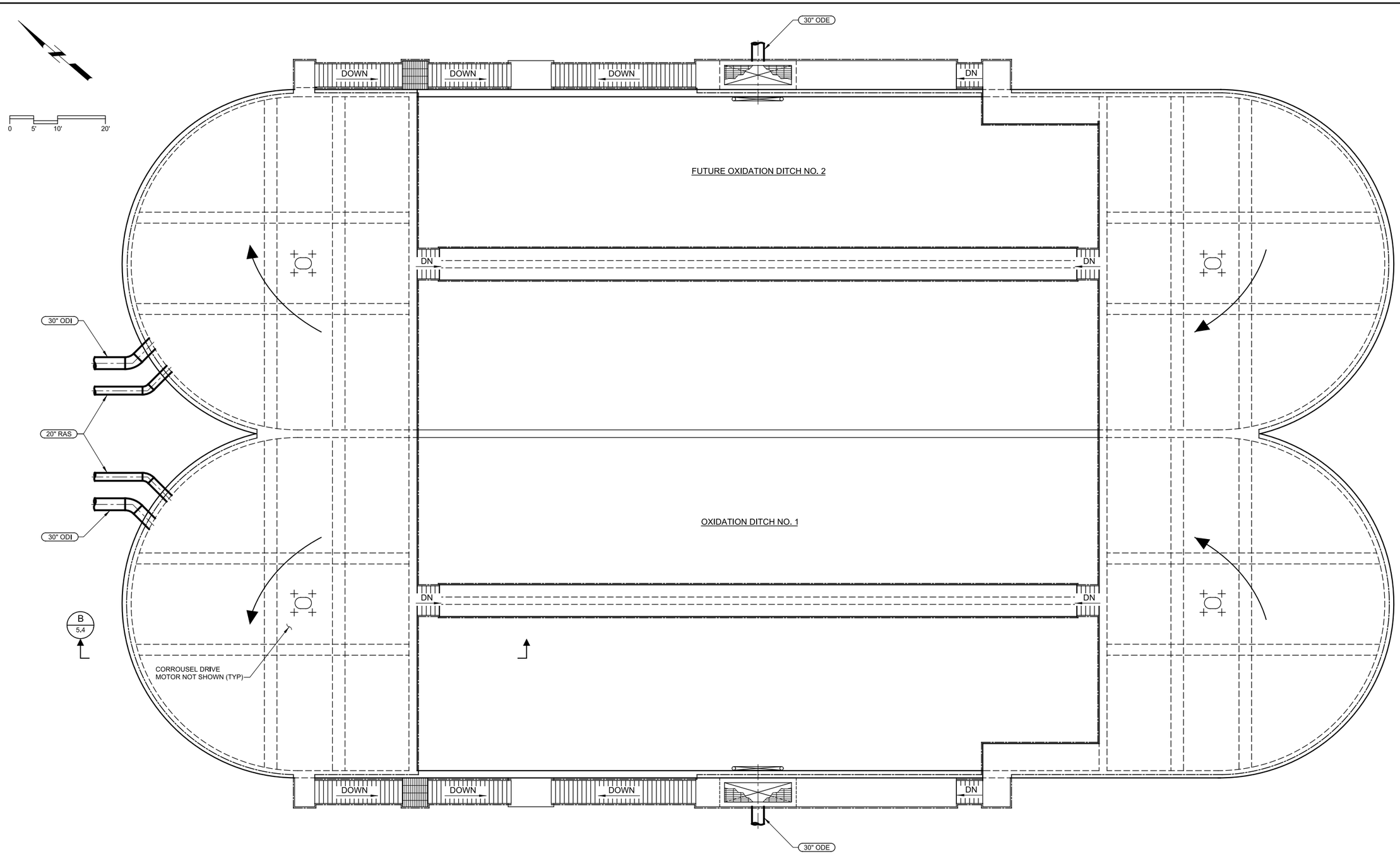

Source: Envirex an Evoqua brand

Figure 5.1 Typical "Orbal Type" Oxidation Ditch Configuration



Source: WesTech

Figure 5.2 Typical "Carousel Type" Oxidation Ditch Configuration

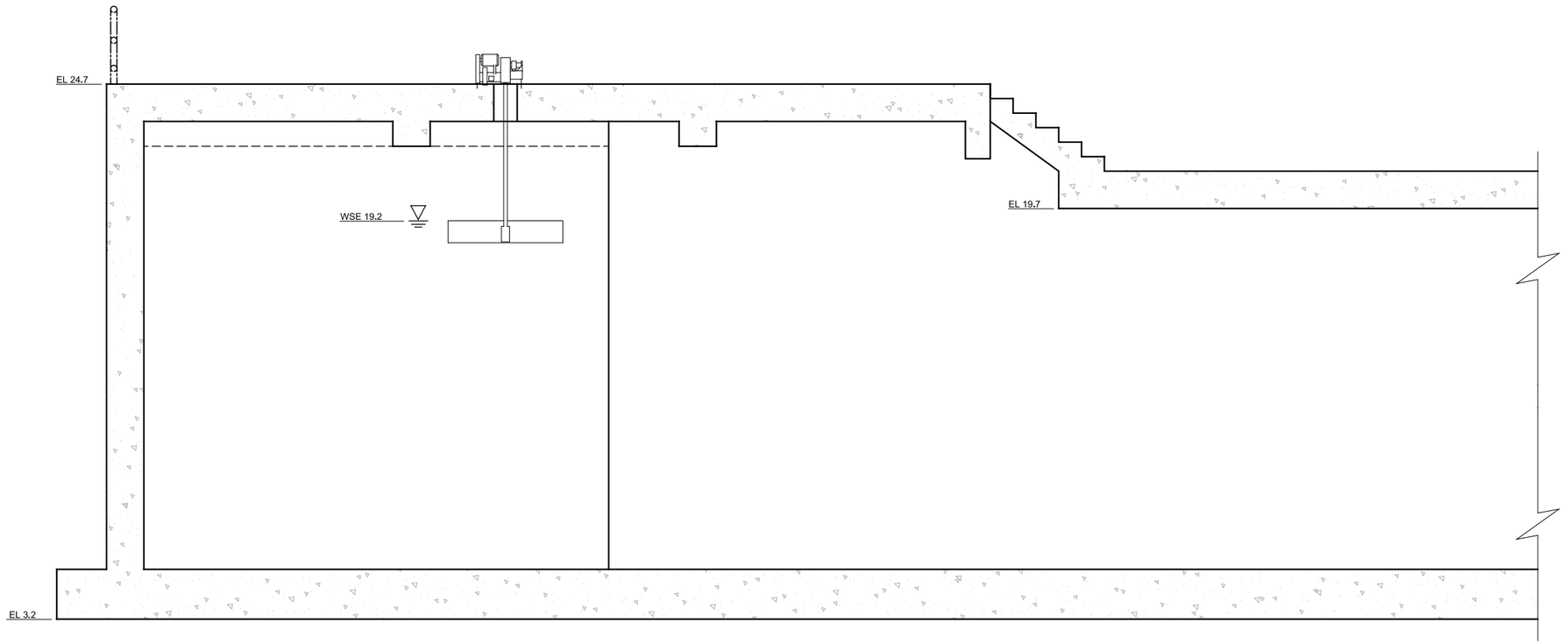



A **PLAN**
FILE: 9913B1000M100

**Figure No. 5.3**
**OXIDATION DITCH PLAN**
CITY OF ARCATA

carollo

$$$$FILE$$$$
Plot Date: 01-JUN-2018 2:06:00 PM
User: mlamagna




**B** 5.3 **SECTION**
SCALE: 3/8" = 1'-0"
FILE: 9913B1000M300

**Figure No. 5.4**
**OXIDATION DITCH SECTION**
CITY OF ARCATA

carollo

File: E:\ICSforPDFWorking\27856\794338_12\9913B10FIG5.4.dgn
Plot Date: 08-AUG-2018 2:12:24 PM
User: svcPW

Table 5.3 Oxidation Ditch Design Parameters

| Criteria | Unit | Value | |
|---|---|---|---|
| Number | -- | 1 + 1 future | |
| Type | -- | Vertical Wall Carousel | |
| Temperature | deg C | 10 - 20 | |
| Volume, each | MG | 1.6 | |
| Side Water Depth | ft | 14 | |
| | | **Current Average Dry Weather Flow** | **Current Peak Wet Weather Flow** |
| Flow Rate | mgd | 1.1 | 3.6[(1)] |
| Hydraulic Detention Time | hrs | 35 | 11 |
| Typical Range [(2)] | hrs | 24 | |
| Solids Retention Time | days | 16 | 15 |
| Typical Range [(2)] | days | 20 - 30 | |
| MLSS | mg/L | 1,800 | 2,900 |
| Typical Range [(3)] | mg/L | 1,500 - 5,000 | |
| Sludge Yield | lb TSS/lb BOD | 1 | 1 |
| Typical Range [(3)] | lb TSS/lb BOD | 0.65 | |

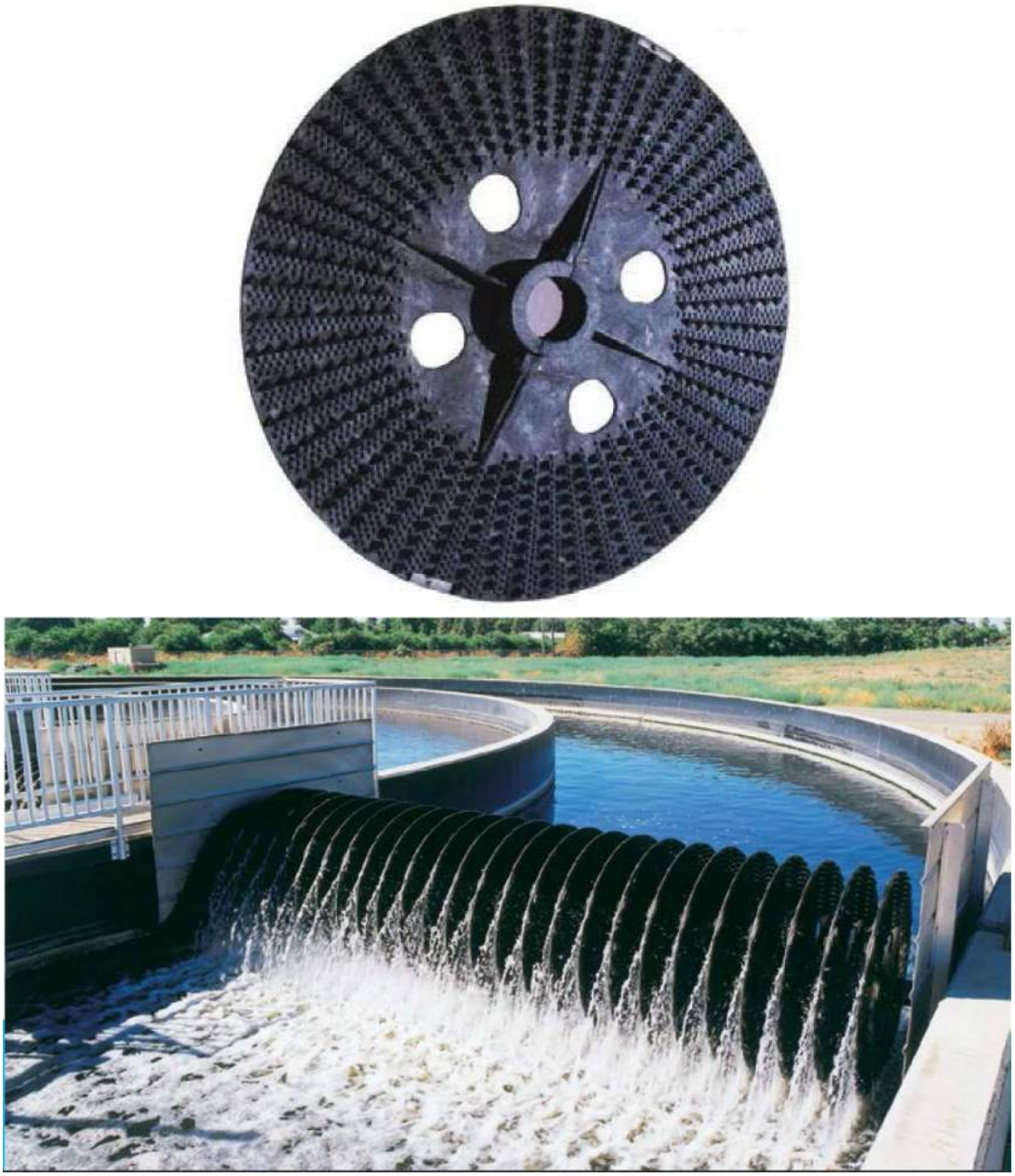
Notes:
(1) Current Peak Wet Weather Flow is 5.9 mgd; however, it is assumed that at peak flow conditions flow is split between the existing oxidation ponds and wetlands (2.3 mgd) and the new conventional secondary treatment system (3.6 mgd).
(2) MOP 8, 5th Edition.
(3) Wastewater Technology Fact Sheet: Oxidation Ditches, EPA, 2000.

Table 5.4 Oxidation Ditch Aeration System Design Parameters

| Criteria | Unit | Value |
|---|---|---|
| Number, per ditch | -- | 2 |
| Type | -- | Vertical Surface Aerator |
| Motor Size | Hp | 125 |
| Drive Type | -- | Variable Frequency |

#### 5.5.1.2 Monitoring Equipment

Oxidation ditches are typically monitored for DO concentration using DO probes. This DO concentration sets the required aerator speed, and thus the amount of oxygen added to the ditch. The concentration of DO present in the ditch indirectly monitors the nitrification and denitrification occurring.



Source: Envirex an Evoqua brand

Figure 5.5 Proprietary Disk Aerator



Source: WesTech

Figure 5.6 Surface Aerator

Alternatively, oxidation ditches can be monitored for ammonia and nitrate directly. This approach provides real-time nitrogen and ammonia removal performance, further optimizing the required aerator speed.

The desired control strategy, either oxygen-based or nitrogen-based, will be determined during final design.

#### 5.5.1.3 Materials of Construction

The oxidation ditch structure would be made of concrete. The concrete under the aerator platform could be coated with a T-lock protective coating. Concrete surfaces from the top of the wall to three feet below the water surface level would be coated to provide protection.

The aerators would be made of high performance coated steel and the effluent weir gate would be made of aluminum.

### 5.5.2 Mixed Liquor Flow Split Structure

To passively split flow between the two proposed secondary clarifiers, a flow split structure is needed. The design criteria for this passive flow split structure are shown in Table 5.5. This flow split structure would be made of concrete. The concrete would be coated with a T-lock protective coating and specified for all concrete surfaces from the top of the wall to three feet below the water surface level to provided protection.

Table 5.5 Mixed Liquor Flow Split Structure Design Parameters

| Criteria | Unit | Value |
|---|---|---|
| Design Capacity | mgd | 7.2 |
| Weir Length per Secondary Clarifier | ft | 12.0 |

### 5.5.3 Secondary Clarifiers

Circular secondary clarifiers are recommended for the final secondary process to remove suspended solids. A summary of the design criteria and recommended clarifier design is listed in Table 5.6. Appendix 5B provides vendor brochures and cost proposals for the proposed secondary clarifiers.

#### 5.5.3.1 Clarifier Inlet Design

The standard inlet design for a center feed circular clarifier typically consists of an energy dissipating inlet located around the perimeter of the center column and a larger diameter flocculating feed well that prevents short circuiting of the influent flow. The submergence and diameter of the center feed well will be established during the final design.

#### 5.5.3.2 Sludge Collection Mechanism

The secondary activated sludge will be allowed to accumulate in the clarifier by maintaining a sludge blank level. This will compact the sludge, thereby thickening the secondary activated sludge. The floor of the clarifier will have 1:12 slope toward the deep center sludge collection hopper.

Table 5.6 Secondary Clarifier Design Parameters

| Criteria | Unit | Value | |
|---|---|---|---|
| Number | -- | 2 + 1 future | |
| Type | -- | Circular | |
| Diameter | ft | 75 | |
| Side Water Depth | ft | 14 | |
| Sludge Collector Type | -- | Rapid sludge drawoff | |
| | | **Current Average Dry Weather Flow** | **Current Peak Wet Weather Flow** |
| Flow Rate | mgd | 1.1 | 3.6[(1)] |
| Surface Overflow Rate | gpd/sf | 240 | 800 |
| Typical Range [(2)] | gpd/sf | 400 - 700 | 1,000 - 16,000 |
| Solids Loading Rate | ppd/sf | 6 | 34 |
| Typical Range [(2)] | ppd/sf | 20 - 30 | 40 - 50 |
| Weir Loading Rate | gpd/ft | 2,330 | 7,640 |
| Typical Range [(2)] | gpd/ft | 20,000 - 30,000 | |

Notes:
(1) Current Peak Wet Weather Flow is 5.9 mgd; however, it is assumed that at peak flow conditions flow is split between the existing oxidation ponds and wetlands (2.3 mgd) and the new conventional secondary treatment system (3.6 mgd).
(2) MOP 8, 5th Edition.

The sludge collection mechanisms typically used in secondary clarifiers are spiral scrapers. With this configuration, spiral blades are coupled with a rotating sludge collection drum at the center of the clarifier to rapidly remove settled sludge.

#### 5.5.3.3 Materials of Construction

Circular clarifier mechanisms can be fabricated from either stainless steel or carbon steel with either a high performance coating or corrosion protection. The estimated capital cost of the stainless steel mechanism is much higher than that of the carbon steel mechanism. The carbon steel mechanism will require corrosion protection in either the form of a high performance coating or cathodic protection. Coated carbon steel mechanisms require periodic recoating and repair, while cathodic protection systems require regular testing and sacrificial anode replacement throughout the life of the mechanism. Consequently, a carbon steel mechanism has higher maintenance costs than a stainless steel mechanism. In order to reduce capital costs, a carbon steel clarifier mechanism with a high performance coating is recommended.

The peripheral weir and scum baffle will be constructed of FRP and the scum baffle supports will be fabricated from Type 316 stainless steel.

#### 5.5.3.4 Scum Pumping System

Secondary scum will be collected from the new secondary clarifiers and drain to a new scum well adjacent to each clarifier. A chopper pump will provide mixing, decant, and scum transfer.

### 5.5.4 RAS Pumping System

Design criteria for the proposed RAS pump station is listed in Table 5.7. The RAS system capacity will be based on 100 percent RAS recycle at peak flow. Vertical or horizontal non-clog centrifugal pumps will be used.

Table 5.7 RAS Pumping System Design Parameters

| Criteria | Unit | Value |
|---|---|---|
| Number and Capacity of Pumps (duty + standby) | -- | -- |
| Average Dry Weather Flow Rate | -- | 1 + 1 @ 1.2 mgd |
| Maximum Month Flow Rate | -- | 1 @ 3.0 mgd |
| Type | -- | Horizontal Non-Clog Centrifugal |
| Discharge Head | ft | 6 |
| Motor Size | Hp | 5 |
| Drive Type | -- | VFD |

With the proposed design, RAS pumps would take suction directly from the secondary clarifiers. A common RAS pump station would pump RAS from both clarifiers via variable-speed driven pumps to meet the desired RAS flow rate. A standby pump would serve as the common backup for the two clarifiers. The pump speeds, and consequently flow output, would be controlled based on the RAS flow rate as measured by a flow meter located on the discharge side of the associated RAS pumps. An inline magnetic flow meter is recommended for this application due to its lower cost, smaller footprint, and higher performance than other flow measuring devices. During the first phase of the project, where only one oxidation ditch exists, the RAS pumps would discharge flow directly to the oxidation ditch, via glass-lined ductile iron pipes. In the future, if an additional ditch is constructed, the RAS pumps would discharge flow to a future RAS splitter box where RAS would then flow by gravity to each of the two oxidation ditches.

The new RAS pumps will be located in a pump pit adjacent to the secondary clarifiers. The pump suction will be located to minimize piping from the clarifiers to the pumps.

### 5.5.5 WAS Pumping System

Design criteria for the proposed WAS pump station is listed in Table 5.8. Based on the expected solids production, a maximum WAS withdrawal capacity of 0.05 mgd is recommended. Horizontal or vertical non-clog centrifugal pumps will be used.

Table 5.8 WAS Pumping System Design Parameters

| Criteria | Unit | Value |
|---|---|---|
| Number of Pumps (duty + standby) | -- | 1 + 1 |
| Type | -- | Horizontal Non-Clog Centrifugal |
| Capacity, each | mgd | 0.05 |
| Discharge Head | ft | 8 |
| Motor Size | Hp | 0.1 |
| Drive Type | -- | VFD |

With the proposed design, two variable speed WAS pumps (one duty, one standby) would take WAS directly from the RAS pump station and pump WAS via glass-lined ductile iron pipes to the new thickener described in TM 7 - Solids Handling and Digester Improvements.

### 5.5.6 Alkalinity Feed Facility

The secondary process will consume alkalinity from the raw wastewater in order to nitrify (remove ammonia). Currently, raw wastewater alkalinity is not regularly measured. It is noted that some recent data indicates that alkalinity may not be necessary year-round. Additional data collection will be required to determine seasonal fluctuations, if any, in influent alkalinity. The more data collected on alkalinity loading, the more effectively the new alkalinity addition facilities can be designed, if even necessary. A wastewater alkalinity around 60 mg/L was assumed in the process modeling done in this predesign report.

With the assumption that the wastewater alkalinity is around 60 mg/L, the raw wastewater alkalinity will not provide sufficient alkalinity for the secondary treatment process, so supplemental alkalinity needs to be added to the wastewater. Commonly caustic soda, magnesium hydroxide, or hydrated lime is use to provide alkalinity and adjust wastewater effluent pH. The required chemical amount for each of these three chemicals is discussed in Appendix 5C. In each case, the dose for the alkalinity addition was modelled to maintain a neutral pH for the secondary process effluent. Recommended design criteria for a hydrated lime slurry ($Ca(OH)_2$) facility are shown in Table 5.9. The tank volume is based on approximately 14 days storage at peak use. Final chemical selection will be determined during final design.

Table 5.9 Chemical Addition Facility Design Parameters

| Criteria | Unit | Value |
|---|---|---|
| Dose (max) | mg/L | 260 |
| **Bulk Chemical Storage** | | |
| Type | -- | Bulk Liquid Tank |
| Number | -- | 2 |
| Volume, each | gal | 6,000 |
| **Feed Pumps** | | |
| Type | -- | Diaphragm Metering Pump |
| Number (duty + standby) | -- | 1 + 1 |
| Capacity, each | gpd | 1,000 |

## 5.6 Potential for Phasing

The system described in this predesign report assumes that at peak wet weather flows (5.9 mgd), flow can be split between the existing oxidation ponds and treatment wetlands (2.3 mgd) and the new oxidation ditch and secondary clarifiers (3.6 mgd). However, with sea level rise, it is expected that at some point in the future the existing natural system will no longer be able to provide treatment capacity. At this future time, additional treatment capacity will be needed and can be provided via a second oxidation ditch and third secondary clarifier. These additional facilities will allow the full 5.9 mgd of peak wet weather flow to be treated in the conventional secondary treatment process.

Appendix 5A

# PROCESS MODEL RESULTS

| | Current ADWF | Current MM (13-d SRT) | Current Peak Split | Future ADWF | Future MM (10-d SRT) | Future Peak Split | Future Peak (2 ditches) |
|---|---|---|---|---|---|---|---|
| **Influent** | | | | | | | |
| Flow, mgd | 1.1 | 3 | 5.9 | 1.3 | 3.6 | 5.9 | 5.9 |
| TBOD, ppd | *1467* | 4000 | 4000 | *1733* | 4800 | 4800 | 4800 |
| TSS, ppd | *2112* | 5760 | 5760 | *2495* | 6910 | 6910 | 6910 |
| NH3, ppd | *323* | 880 | 880 | *383* | 1060 | 1060 | 1060 |
| *TKN, ppd* | *489* | *1333* | 1333 | *580* | *1606* | 1606 | *1606* |
| | | | | | | | |
| *TBOD, mg/L* | *159.9* | *159.9* | *81.3* | *159.9* | *159.9* | *97.5* | *97.5* |
| *TSS, mg/L* | *230.2* | *230.2* | *117.1* | *230.1* | *230.1* | *140.4* | *140.4* |
| *NH3, mg/L* | *35.2* | *35.2* | *17.9* | *35.3* | *35.3* | *21.5* | *21.5* |
| *TKN, mg/L* | *53.3* | *53.3* | *27.1* | *53.5* | *53.5* | *32.6* | *32.6* |
| | | | | | | | |
| BioWin COD Input | | | | | | | |
| Flow, mgd | 1.10 | 3.00 | 5.90 | 1.30 | 3.60 | 5.90 | 5.90 |
| *TCOD, mg/L* | *354.8* | *354.8* | *180.4* | *354.8* | *354.8* | *216.5* | *216.5* |
| *TKN, mg/L* | *53.3* | *53.3* | *27.1* | *53.5* | *53.5* | *32.6* | *32.6* |
| TP, mg/L | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| NO3-N, mg/L | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| pH | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 |
| Alk, mmol/L | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| *ISS, mg/L* | *68.0* | *68.0* | *34.6* | *68.0* | *68.0* | *41.5* | *41.5* |
| SCa, mg/L | 80.0 | 80.0 | 80.0 | 80.0 | 80.0 | 80.0 | 80.0 |
| SMg, mg/L | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 |
| DO, mg/L | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | |
| BioWin Output | | | | | | | |
| **Ox Ditch** | | | | | | | |
| RS Flow, mgd | 1.1 | 3.0 | 3.6 | 1.3 | 3.6 | 3.6 | 5.9 |
| Flow Bypassing, mgd | 0.0 | 0.0 | 2.3 | 0.0 | 0.0 | 2.3 | 0.0 |
| | | | | | | | |
| TCBOD Load, ppd | 1468 | 4003 | 2443 | 1735 | 4804 | 2931 | 4804 |
| *ppd / 1000 cf* | *6.8* | *18.5* | *11.3* | *8.0* | *22.2* | *13.5* | *11.1* |
| TKN Load, ppd | 489 | 1334 | 814 | 580 | 1607 | 979 | 1605 |
| VSS Load, ppd | 1483 | 4044 | 2468 | 1573 | 4853 | 2961 | 4853 |
| TSS Load, ppd | 2111 | 5758 | 3514 | 2495 | 6910 | 4217 | 6911 |
| | | | | | | | |
| # of Ditches | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| Total Vol, mg | 1.62 | 1.62 | 1.62 | 1.62 | 1.62 | 1.62 | 3.24 |
| Vol per BioWin Reactor, mg | 0.1350 | 0.1350 | 0.1350 | 0.1350 | 0.1350 | 0.1350 | 0.2700 |
| *HRT, hrs* | *35.3* | *13.0* | *10.8* | *29.9* | *10.8* | *10.8* | *13.2* |
| | | | | | | | |
| # of Aerators per Ditch | 2 | 3 | 2 | 2 | 2 | 2 | 2 |
| *# of Aerators Total* | 2 | 3 | 2 | 2 | 2 | 2 | 4 |
| *Power per Aerator, hp* | *28.5* | *45.1* | *45.8* | *33.6* | *74.2* | *54.2* | *38.2* |
| *Power per Ditch, hp* | *57.1* | *135.4* | *91.6* | *67.3* | *148.3* | *108.4* | *76.4* |
| *Total Aerator Power, hp* | *57.1* | *135.4* | *91.6* | *67.3* | *148.3* | *108.4* | *152.8* |
| Total Aerator Power, kW | 42.61 | 101.04 | 68.38 | 50.21 | 110.69 | 80.87 | 114.06 |
| *hp / ppd BOD* | 0.0389 | 0.0338 | 0.0375 | 0.0388 | 0.0309 | 0.0370 | 0.0318 |
| *hp / MG* | 35.2 | 83.6 | 56.6 | 41.5 | 91.6 | 66.9 | 47.2 |
| | | | | | | | |
| Aerated Zones DO, mg/L | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| | | | | | | | |
| Avg DO (All Zones), mg/L | 1.16083 | 0.64917 | 0.95917 | 1.1 | 0.55167 | 0.85167 | 0.54 |
| Total OTR, lb/hr | 121 | 287 | 194 | 143 | 315 | 230 | 324 |
| Total SOTR, lb/hr | 183 | 433 | 293 | 216 | 475 | 347 | 489 |
| | | | | | | | |
| lb O2 / hp-hr | 3.20 | 3.20 | 3.19 | 3.21 | 3.20 | 3.20 | 3.20 |
| | | | | | | | |
| MLSS, mg/L | 1752 | 3990 | 2926 | 2070 | 4110 | 3517 | 2696 |
| SRT, days | 15.9 | 13 | 15 | 14.9 | 10 | 15 | 13.75 |
| WAS, mgd | 0.0463 | 0.0542 | 0.0412 | 0.0459 | 0.07 | 0.0412 | 0.0934 |
| WAS TSS, mg/L | 3981 | 9195 | 6816 | 4722 | 9472 | 8193 | 6220 |
| WAS TSS, ppd | 1538 | 4156 | 2341 | 1807 | 5137 | 2815 | 4849 |
| | | | | | | | |
| Combined PS + WAS TSS, ppd | 1538 | 4156 | 2341 | 1807 | 5137 | 2815 | 4849 |
| Yield (TSS Produced per BOD Destroyed) | 1.04768 | 1.03822 | 0.95825 | 1.0415 | 1.06932 | 0.96042 | 1.00937 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sec Clar** | | | | | | | |
| Quantity | 1 | 2 | 1 | 1 | 2 | 2 | 2 |
| Diameter (ea), ft | 75 | 75 | 75 | 75 | 75 | 75 | 75 |
| Area (total), sf | 4418 | 8836 | 4418 | 4418 | 8836 | 8836 | 8836 |
| RAS % | 75 | 75 | 75 | 75 | 75 | 75 | 75 |
| RAS, mg/L | 3981 | 9195 | 6816 | 4722 | 9472 | 8193 | 6220 |
| SOR, gal/sf/d | 239 | 333 | 806 | 284 | 400 | 403 | 657 |
| SLR, lb/sf/d | 6.22 | 19.63 | 34.41 | 8.71 | 24.2 | 20.68 | 26.05 |
| | | | | | | | |
| **State Point Analysis (outside BioWin, SN Method)** | | | | | | | |
| Flow, mgd | 1.1 | 3.0 | 3.6 | 1.3 | 3.6 | 3.6 | 5.9 |
| SVI, mL/g | 150 | 150 | 150 | 150 | 150 | 150 | 150 |
| Safety Factor | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |
| | | | | | | | |
| **Effluent** | | | | | | | |
| NH3, mg/L | 0.38 | 0.6 | 0.38 | 0.38 | 1.03 | 0.39 | 0.72 |
| NO3, mg/L | 32.56 | 19.79 | 14.69 | 32.11 | 11.93 | 16.47 | 7.6 |
| NO2, mg/L | 0.11 | 0.34 | 0.13 | 0.11 | 2.83 | 0.14 | 0.57 |
| TN, mg/L | 35.13 | 23.09 | 16.89 | 34.72 | 18.18 | 18.88 | 10.56 |
| TP, mg/L | 2.61 | 2.55 | 3.89 | 2.62 | 2.42 | 3.66 | 3.57 |
| TSS, mg/L | 6.25 | 14.07 | 10.24 | 7.36 | 14.5 | 12.3 | 9.5 |
| TCBOD, mg/L | 2.29 | 3.95 | 2.91 | 2.46 | 4.83 | 3.25 | 2.85 |
| | | | | | | | |
| **Alkalinity Addition to Ditch (outside BioWin)** | | | | | | | |
| Influent Alkalinity, mg/L | 60 | 60 | 60 | 60 | 60 | 60 | 60 |
| Desired Residual, mg/L | 75 | 75 | 75 | 75 | 75 | 75 | 75 |
| *Ammonia Oxidized, mg/L* | *34.8* | *34.6* | *17.5* | *34.9* | *34.3* | *21.2* | *20.8* |
| *Alkalinity Consumed, mg/L* | *248* | *247* | *125* | *249* | *245* | *151* | *149* |
| *Nitrate Reduced, mg/L* | *2* | *15* | *3* | *3* | *22* | *5* | *13* |
| *Alkalinity Recovered, mg/L* | *7* | *45* | *9* | *9* | *69* | *14* | *41* |
| *Required Dose, mg/L* | *257* | *216* | *131* | *256* | *191* | *152* | *123* |
| Specific Gravity | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 |
| Slurry Concentration, % | 30% | 30% | 30% | 30% | 30% | 30% | 30% |
| *Required Flow, gph* | *29* | *68* | *49* | *35* | *72* | *57* | *76* |
| *Required Flow, gpd* | *707* | *1628* | *1185* | *833* | *1724* | *1368* | *1820* |

Appendix 5B

# VENDOR BROCHURES AND COST PROPOSALS

# WESTECH OXIDATION DITCH QUOTE



# Arcata WWTP

**California**

**Engineer**
Carollo Engineers

**Furnished by**
Adrian Williams
awilliams@westech-inc.com

**Represented by**
Mike Tooley
MISCOwater
Pleasanton, California
(925) 225-1900
mtooley@miscowater.com

WesTech Opportunity Number: 1860245
Thursday, June 14, 2018

# Item A – Two (2) OxyStream™ Biological Oxidation Systems
# WesTech Equipment Model AES2A3

## Process Design

| Description | Unit | Dimension/Capacity |
|---|---|---|
| Flow (Design) | MGD | 3.0 |
| BOD (Influent/Effluent) | mg/L | 160/30 |
| TSS (Influent) | mg/L | 230 |
| TKN (Influent) | mg/L | 53 |
| Ammonia (Effluent) | mg/L | < 4 |
| Waste Temp (Min/Max) | °C | 10/20 |
| Site Elevation | ft. above sea level | 100 |

## Equipment

| Description | Type | Quantity |
|---|---|---|
| Aerators | Landy7 | 2 |
| Adjustable Effluent Weir | Manual | 1 |
| DO Control System | LDO | 2 Probes, 1 Controller |

## Equipment Description (Aerators)

| Description | Unit | Dimension/Capacity |
|---|---|---|
| Aerator | | |
| Motor Power | HP | 150 |
| Motor Voltage | V/Ph/Hz | 480/3/60 |
| Motor Speed | rpm | 1800 |
| Motor Frame | - | TEFC, C-Face |
| Motor B-10 Bearing Life | hours | 100,000 |
| Motor Heater | V | 120 |
| Reducer Service Factor | - | 2.5 |
| Reducer B-10 Bearing Life | hours | 100,000 |
| Reducer B-10 Life (Output) | hours | 250,000 |
| Reducer Oil Heater | V | 120 |
| Impeller Diameter | mm | 2900 |
| Impeller Thickness | inches | 3/8 |
| Impeller Material | - | A36 Steel |
| Jackstuds Material | - | A307 ZP |
| Mounting Bars Material | - | A36 Steel |

| Equipment Description (Effluent Weir Gate) | | |
|---|---|---|
| **Description** | **Unit** | **Dimension/Capacity** |
| Effluent Weir Gate | | |
| Manual/Automated | - | Manual |
| Weir Gate Material | - | Aluminum |
| Weir Length | ft | 10 |
| Vertical Weir Travel | in | 30 |

| Equipment Description (DO Control System) | | |
|---|---|---|
| **Description** | **Unit** | **Dimension/Capacity** |
| DO Probes | | |
| Probe Type | - | LDO |
| Mounting Configuration | - | Pole Mount |
| Cable Length | ft | 33 |
| Range | mg/L | 0 – 20.0 |
| Accuracy | - | ± 0.05 ppm below 1 ppm<br>± 0.1 ppm below 5 ppm<br>± 0.2 ppm above 5 ppm |
| DO Controller | | |
| Communication Protocol | - | MODBUS 232/485<br>Profibus DP |
| 4-20 mA Outputs | - | 2 |
| Display | in | 1.89 x 2.67 |

## Option A-1 – VFD and PLC Controls

| Equipment | | |
|---|---|---|
| **Description** | **Type** | **Quantity** |
| VFD | Stand Alone Panel | 2 |
| PLC-Based Control | HMI Interface | 1 |

| Equipment Description (Variable Frequency Drives) | | |
|---|---|---|
| **Description** | **Unit** | **Dimension/Capacity** |
| Variable Frequency Drives | | |
| Power | HP | 150 |
| Power Feed | V/Ph/Hz | 480/3/60 |
| Enclosure Type | - | NEMA 12 |
| Enclosure Cooling | - | 6 |
| VFD Rectifier | 6/12/18 Pulse | 6 |
| dv/dt Filter | Y/N | N |

| Equipment Description (PLC Control System) | | |
|---|---|---|
| **Description** | **Unit** | **Dimension/Capacity** |
| PLC Control System | | |
| Power Feed | V/Ph/Hz | 120/1/60 |
| Enclosure Type | - | NEMA 12 |
| UPS | Y/N | N |
| HMI Size | Inches | 10 |
| HMI Manufacturer | - | Allen Bradley |
| PLC Manufacturer | - | Allen Bradley |
| PLC Model | - | 1769 CompactLogix |

## Coatings

All steel items, with the exception of the drive mechanism, will be prepared per SSPC-SP10 and coated with one (1) coats Tnemec N140 epoxy, 3-5 mils each. The drive mechanism will be finished painted in the shop with the manufacturer's recommended paint system.

## On-Site Services

| WesTech Trips to the Site | |
|---|---|
| Number of Trips | 2 |
| Number of Days | 4 |

## Field Service

Included field service is for installation inspection, startup, and operator training. Any additional trips that the customer may request can be purchased at the standard WesTech daily rates plus travel and living expenses.

| Spare Parts | |
|---|---|
| Low Oil Cutout Switch | 1 |
| High Speed Coupling | 1 |

## Comments and Clarifications

The proposed system was designed based on the information provided and WesTech's standard equipment. The proposed equipment is backed by a 1 Year warranty.

The proposed system was designed to treat the design loadings for BOD and ammonia removal in a single basin with one (1) aerator duty, one (1) stand-by.

Option A-1 includes VFD and PLC controls.

## Items Not Included in WesTech's Base Scope of Supply

- Electrical Wiring
- Conduit
- Piping
- Valves/Fittings
- Lubricating Oil/Grease
- Field Welding
- Field Erection

*This proposal has been reviewed and is approved for issue by Cody Maxfield on June 14, 2018.*

# Budget Pricing

Proposal Name: Arcata WWTP
Proposal Number: 1860245
Thursday, June 14, 2018

## 1. Bidder's Contact Information

| | |
|---|---|
| Company Name | WesTech Engineering, Inc. |
| Contact Name | Adrian Williams |
| Phone | 801.265.1000 |
| Email | awilliams@westech-inc.com |
| Address: Number/Street | 3665 S West Temple |
| Address: City, State, Zip | Salt Lake City, UT 84115 |

## 2. Pricing

| | | |
|---|---|---|
| Currency | | US Dollars |
| **Scope of Supply** | | |
| A | (2) OxyStream™ Biological Oxidation Systems Model AES2A3 | $294,600 |
| A-1 | VFD and PLC Controls | $204,700 |
| | Taxes (sales, use, VAT, IVA, IGV, duties, import fees, etc.) | Not Included |

Prices are for a period not to exceed 30 days from date of proposal.

| | |
|---|---|
| **Field Service** | |
| Daily Rate | $1,200 |

Prices do not include field service unless noted, but it is available at the daily rate plus expenses. The customer will be charged for a minimum of three days for time at the jobsite. Travel will be billed at the daily rate. Any canceled charges due to the customer's request will be added to the invoice. The greater of visa procurement time or a two week notice is required prior to trip departure date.

## 3. Payment Terms

| | |
|---|---|
| Submittals Approved | 15% |
| Release for Fabrication | 35% |
| Net 30 days from Shipment | 50% |

All payments are net 30 days. Partial shipments are allowed. Other terms per WesTech proforma invoice.

## 4. Schedule

| | |
|---|---|
| Submittals, after PO receipt | 6 to 8 Weeks |
| Customer Review Period | 2 weeks |
| Ready to Ship, after Submittal Approval | 18 to 20 weeks |
| **Total Weeks from PO to Shipment** | **26 to 30 weeks** |

**Terms & Conditions:** This proposal, including all terms and conditions contained herein, shall become part of any resulting contract or purchase order. Changes to any terms and conditions, including but not limited to submittal and shipment days, payment terms, and escalation clause shall be negotiated at order placement, otherwise the proposal terms and conditions contained herein shall apply.

**Freight**: Prices quoted are **F.O.B. shipping point** with freight allowed to a readily accessible location nearest to jobsite. All claims for damage or loss in shipment shall be initiated by purchaser.

**Paint:** If your equipment has paint included in the price, please take note to the following. Primer paints are designed to provide only a minimal protection from the time of application (usually for a period not to exceed 30 days). Therefore, it is imperative that the finish coat be applied within 30 days of shipment on all shop primed surfaces. Without the protection of the final coatings, primer degradation may occur after this period, which in turn may require renewed surface preparation and coating. If it is impractical or impossible to coat primed surfaces within the suggested time frame, WesTech strongly recommends the supply of bare metal, with surface preparation and coating performed in the field. All field surface preparation, field paint, touch-up, and repair to shop painted surfaces are not by WesTech.

# OxyStream Layout and Concrete Estimate

## Project Information

| | | | |
|---|---|---|---|
| Project Name: | Arcata, CA | Project Number: | 1860245 |
| Engineer: | Carollo | Completed by: | CTM |
| Date: | 6/14/2018 | Checked by: | Preliminary |

## Design Parameters

### Ditch Parameters

| | | |
|---|---|---|
| # of Ditches | 1 | |
| Aerators/Ditch | 2 | |
| Depth | 15.5 | ft |
| Channel Width | 31 | ft |
| Straight Length | 176.66 | ft |
| Channel Freeboard | 1.5 | ft |
| Aeration Freeboard | 6 | ft |

### Assumptions

| | | | |
|---|---|---|---|
| Exterior Walls | 15.5 | in | thick |
| Interior Walls | 12 | in | thick |
| Deck | 12 | in | thick |
| Floor | 10 | in | thick |
| Footings | 18 | in | thick |
| Footings | 60 | in | tall |

### Volume

| | | |
|---|---|---|
| Aerobic | 1.62 | Mgal |

### Footprint

| | Width | Length | |
|---|---|---|---|
| Aerobic | 63.00 | 238.66 | ft |
| TOTAL (1 ditch) | 65.58 | 241.24 | ft |

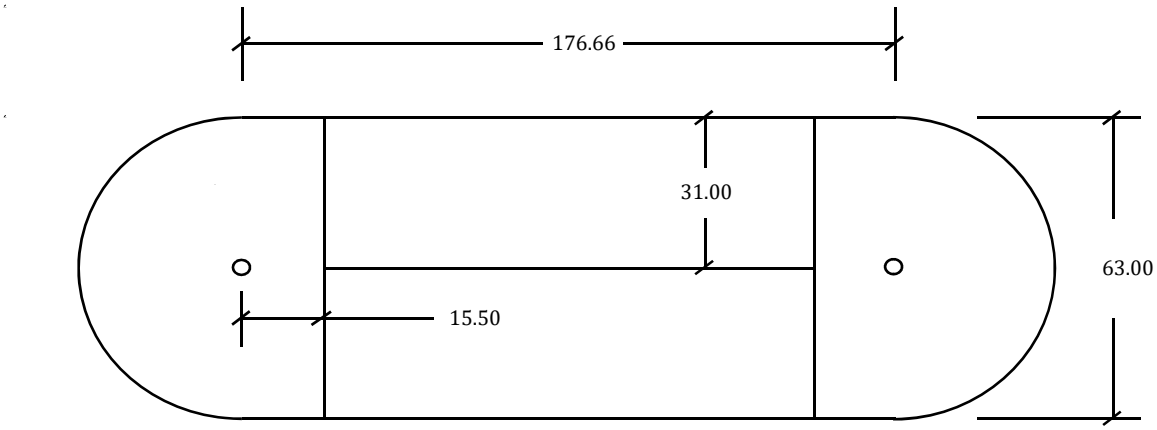
## Concrete Estimate

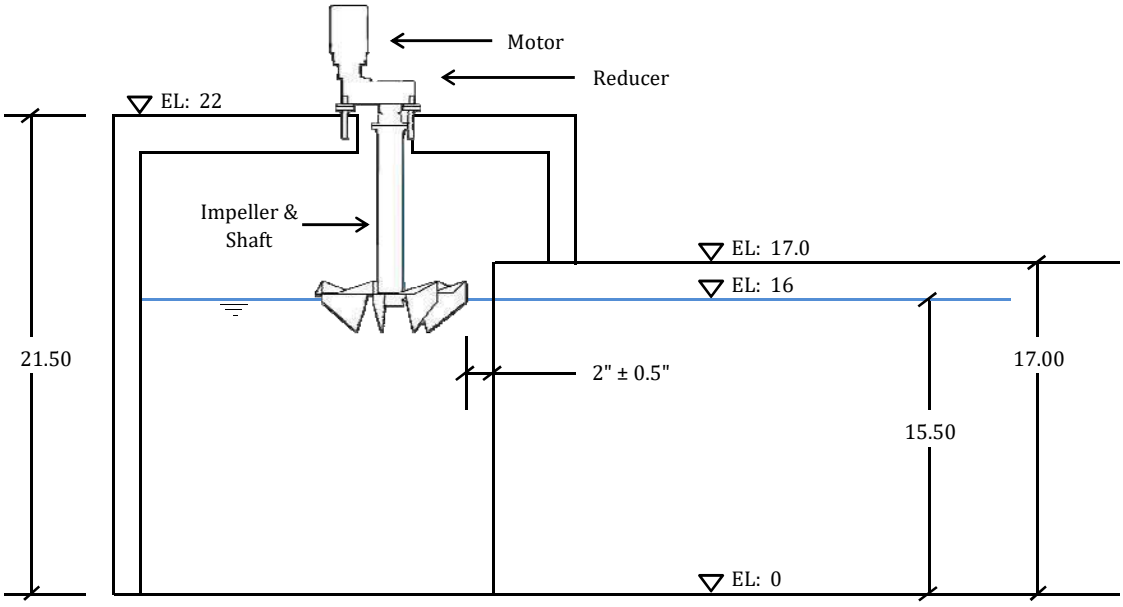
| | | |
|---|---|---|
| OxyStream BASIN OUTER WALLS | 536 | cu-yd |
| OxyStream BASIN INNER WALLS | 135 | cu-yd |
| OxyStream BASIN FLOOR | 440 | cu-yd |
| OxyStream BASIN FOOTINGS | 201 | cu-yd |
| Aerator Deck(s) | 188 | cu-yd |
| **Total Estimated Concrete** | **1499** | **cu-yd** |

## Ditch Layout

Drawing Not To Scale
Dimensions Given in Feet
Dimensions listed are interior dimensions

Ditches Shown: 1 of 1



# OVIVO OXIDATION DITCH QUOTE






# Carrousel® System Preliminary Proposal

Design Type:

## Carrousel® System

For

## Arcata, CA

Provided on June 19, 2018

By
Ovivo USA, LLC
4246 Riverboat Drive, Suite 300
Salt Lake City, Utah
84123
USA
www.ovivowater.com

For confidential use only, not for circulation, distribution or reproduction without prior written permission by Ovivo USA, LLC.
Copyright© 2018 by Ovivo – All Rights Reserved.
Carrousel® is a registered trademark of DHV, B.V

Ovivo USA, LLC
4246 Riverboat Drive, Suite 300
Salt Lake City, Utah
84123
USA

Telephone: 801.931.3000
Facsimile: 801.931.3080

www.ovivowater.com

# Project Summary Letter

June 19, 2018

Elizabeth Charbonnet, P.E.
Carollo Engineers, Inc.
2700 Ygnacio Valley Road, Suite 300
Walnut Creek, CA 94598

Subject: Arcata, CA Carrousel® System Proposal

Dear Elizabeth

Based on the revised design criteria for Arcata WWTP, CA, we have come up with a single train design. We have provided two 125 HP VFD-controlled Excell Aerators in the basin, considering one of the aerators as a complete spare for current max. month design condition.

We have included clarifier size recommendation considering one clarifier in operation and both the clarifier in operation.

We have proposed our Oculus control system along with Water Expert App. Oculus control system shall enable operators to boost aerators based on the DO set points.

Ovivo USA provides this proposal for confidential use by you and your client. Given the ease of transferring information today, we appreciate your help in maintaining confidentiality. If you have any questions relating to this proposal, you may reach Tom at (801) 931-3242 (Mountain Time).

Very truly yours,

Mayur Chikhaliya
Product Manager
Carrousel® Systems
E: Mayur.Chikhaliya@ovivowater.com

Tom Leland, P.E.
Aeration Processes Group Manager
Carrousel® Aerostrip® Cleartec®
T : 801.931.3242
C : 801.573.6948
E : tom.leland@ovivowater.com

## Scope of Supply:

Qty 2 - 125 HP Excell Aerator II w/ Excell Velocity Enhancer (EVE) made of concrete
- Single speed 1800 motor, 460 V/60Hz/3 Ph, Inverter duty, 1.15 SF on sine wave power, TEFC.
- Motor includes thermostats and space heater.
- Reducer w/ minimum 2.5 SF, Mechanical Oil Pump, Low oil Pressure switch.
- A36 Impellers, shaft, mounting, Zinc Plated Jack studs.

Qty 2 - 125 HP VFD(s), 6-pulse, 115 VAC control power transformers
- Not included: Harmonic, DV/dT filters, Bypass, Load reactor, surge Suppressor.
- Ethernet communication module and 115v for control interface.
- Configurable isolated I/O, digital Operator Interface module w/LCD digital display.

Qty 1 - Control System Type: Oculus w/ VFD, dedicated 480V/3 Ph/60 Hz feed.
- NEMA 1 MCC, installed in climate-controlled building.
- PLC is a CompactLogix.
- HMI is a 15in Windows HMI.
- (2) DO Analyzer w/ (1) Probe(s)
- (1) Water Expert App

# Design Summary (Max. Month Flow Condition)

**Design Basis**

The Carrousel® system described in this proposal has been designed to treat an influent wastewater flow of **3.0 MGD** with the following wastewater characteristics, in a flow sheet with no primary clarification.

| Parameter | Influent | Effluent | Notes |
|---|---|---|---|
| Flow (MGD) | 3.0 | - | |
| BOD – Biochemical Oxygen Demand (mg/L) | 160 | 5 | |
| TSS – Total Suspended Solids (mg/L) | 230 | 15 | |
| TKN – Total Kjeldahl Nitrogen (mg/L) | 53 | 2.0 | |
| $NH_3$-N – Ammonia Nitrogen (mg/L) | - | 1.0 | |

**Design Criteria**

| Design Parameter | Design Value |
|---|---|
| Process SRT – Nitrification (days) | 15.0 |
| Minimum Wastewater Temperature (°C) | 12.0 |
| Maximum Wastewater Temperature (°C) | 25.0 |
| MLSS Concentration (mg/L) | 4,000 |
| Net Yield (lb TSS/lb $BOD_{removed}$) | 0.93 |
| Oxygen Coefficient | |
| lb $O_2$ / lb $BOD_{removed}$ | 1.21 |
| lb $O_2$ / lb $N_{oxidized}$ | 4.60 |
| Alpha (α) | 0.92 |
| Beta (β) | 0.97 |
| Elevation (feet above sea level) | 23 |
| Design Standard Oxygen Transfer Rate (lbs O2/motorHP/Hr) | 3.65 |

**Aeration Power Requirement** **= 162 HP without accounting for denitrification**

**Aeration Power Proposed** **= 2 units at 125 HP each = 250 HP Total**

# Design Summary (Average Daily Flow Condition)

**Design Basis**

The Carrousel system described in this proposal has been designed to treat an influent wastewater flow of **1.100 MGD** with the following wastewater characteristics, in a flow sheet with no primary clarification.

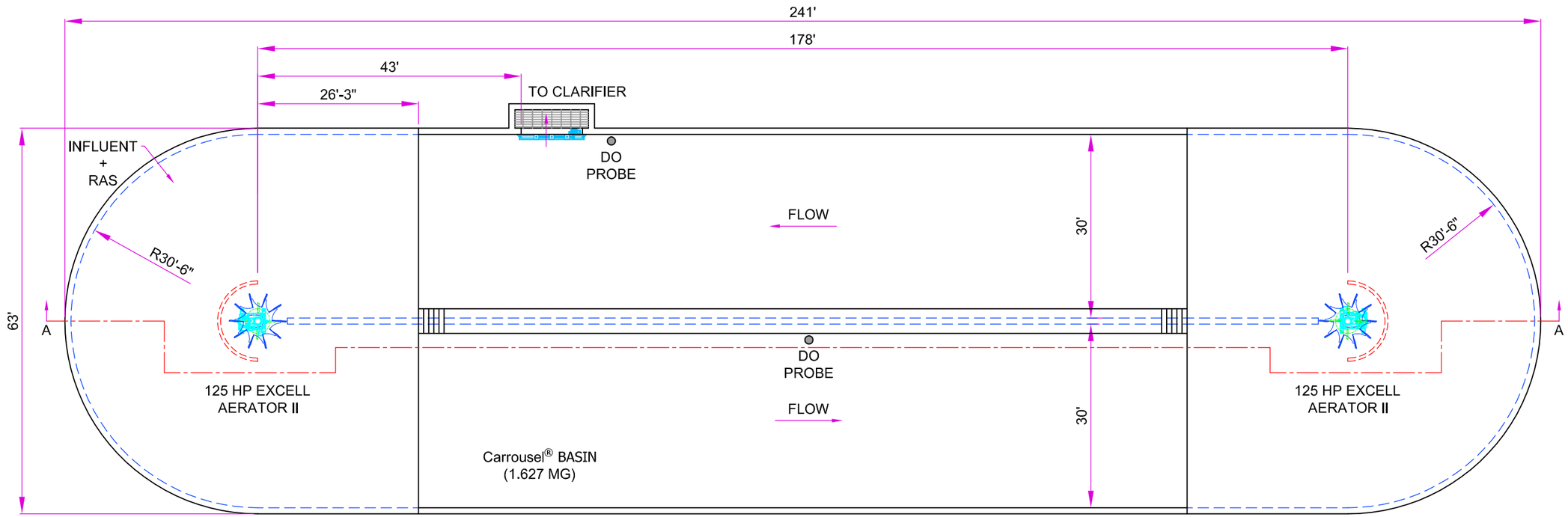
| Parameter | Influent | Effluent | Notes |
|---|---|---|---|
| Flow (MGD) | 1.10 | - | |
| BOD – Biochemical Oxygen Demand (mg/L) | 160 | 5 | |
| TSS – Total Suspended Solids (mg/L) | 230 | 15 | |
| TKN – Total Kjeldahl Nitrogen (mg/L) | 53 | 2.0 | |
| $NH_3$-N – Ammonia Nitrogen (mg/L) | - | 1.0 | |

**Design Criteria**

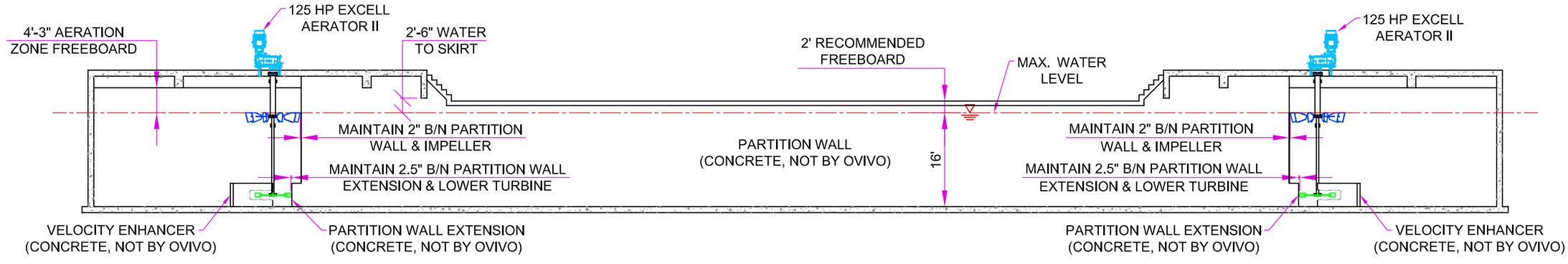
| Design Parameter | Design Value |
|---|---|
| Process SRT – Nitrification (days) | 29.3 |
| Minimum Wastewater Temperature (°C) | 12.0 |
| Maximum Wastewater Temperature (°C) | 25.0 |
| MLSS Concentration (mg/L) | 2,500 |
| Net Yield (lb TSS/lb $BOD_{removed}$) | 0.82 |
| Oxygen Coefficient | |
| lb $O_2$ / lb $BOD_{removed}$ | 1.38 |
| lb $O_2$ / lb $N_{oxidized}$ | 4.60 |
| Alpha (α) | 0.94 |
| Beta (β) | 0.97 |
| Elevation (feet above sea level) | 23 |
| Design Standard Oxygen Transfer Rate (lbs O2/motorHP/Hr) | 3.65 |

**Aeration Power Requirement** **= 63 HP without accounting for denitrification**

**Aeration Power Proposed** **= 2 units at 125 HP each = 250 HP Total**




ARCATA, CA BASIN LAYOUT
SWD = 16 FT




SECTION A-A

**Carrousel®**

| Volumes | Carrousel® Basin |
|---|---|
| Volume Per Train | 1.627 MG |
| No Trains | 1 ea |
| Total Volume | 1.627 MG |

| Concrete | Outer Wall Thickness | Inner Wall Thickness | Floor Slab Thickness | Footings | Bridges and Covers |
|---|---|---|---|---|---|
| Size of Component | 12 inches | 12 inches | 12 inches | 2.0 feet by 3.5 feet | 12 inches |
| Concrete Volumes | 425 CY | 125 CY | 500 CY | 189 CY | 211 CY |
| | | | Concrete volumes are per basin. | Total Per Basin | 1450 CY |

©COPYRIGHT 2010 GLV
ALL RIGHTS RESERVED - REV E

D

THIRD ANGLE PROJECTION

THIS DRAWING CONTAINS CONFIDENTIAL PROPRIETARY INFORMATION OF OVIVO, AND ITS AFFILIATES, AND IS NOT TO BE DISCLOSED NOR TO BE USED EXCEPT FOR EVALUATING PROPOSALS OF OVIVO OR INSTALLING, OPERATING OR MAINTAINING OVIVO EQUIPMENT, UNLESS OTHERWISE AUTHORIZED IN WRITING BY OVIVO. UNCONTROLLED COPY IF PRINTED

OVIVO
Bringing water to life

ARCATA, CA WWTP
BASIN LAYOUT
-

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| INITIAL RELEASE | - | - | - | –/– | DRAWN | PKP | ORIGINAL S.O. | DWG. NO. | - | SHEET 1 OF 1 | REV |
| REVISION | EN/ECO | BY | CHECK'D | DATE | CHECK'D | MAC | - | | | | |

REF. FROM: - DO NOT SCALE PRINTS
DATE (mm/dd/yyyy) 06/19/2018 WORKMANSHIP STANDARD ES0001 APPLIES

**Clarifier Recommendations (Two Clarifiers in Operation)**

| Design Parameter | Design Value |
|---|---|
| Clarifier Design Type | Spiral Blade |
| Average Flow (MGD) | 1.1 |
| Peak Flow (MGD) | 3.6 |
| Maximum RAS (% ADF) | 250% |
| Maximum RAS (MGD) | 2.75 |

**Clarifiers Proposed** **= 2 @ 75 ft Diameter at 16 ft Side Water Depth**

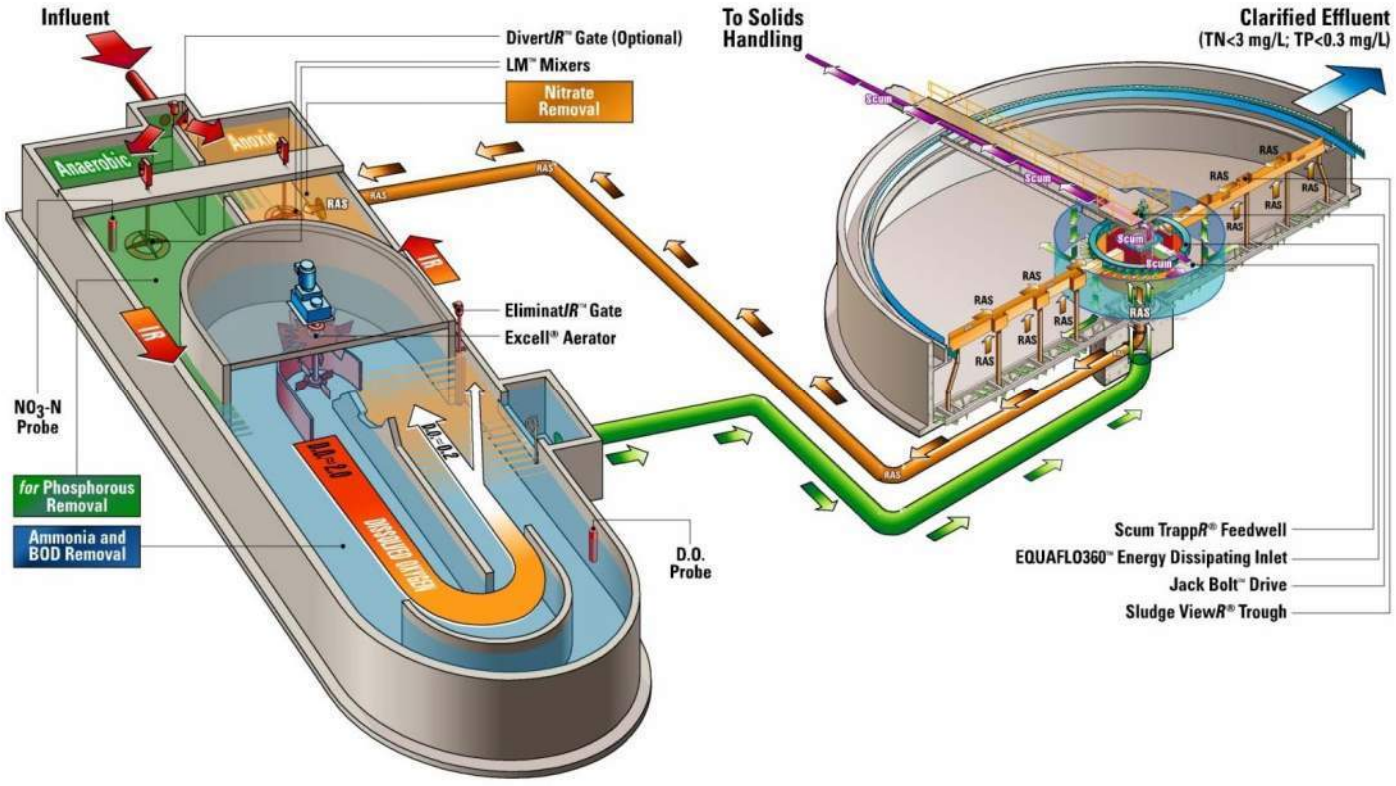



***Figure: Carrousel® AlternatIR™ System and Carrousel®Proset™ Clarifier***

**Clarifier Recommendations (One Clarifier in Operation)**

| Design Parameter | Design Value |
|---|---|
| Clarifier Design Type | Spiral Blade |
| Average Flow (MGD) | 1.1 |
| Peak Flow (MGD) | 3.6 |
| Maximum RAS (% ADF) | 150% |
| Maximum RAS (MGD) | 1.65 |

**Clarifiers Proposed** **= 1 @ 75 ft Diameter at 16 ft Side Water Depth**

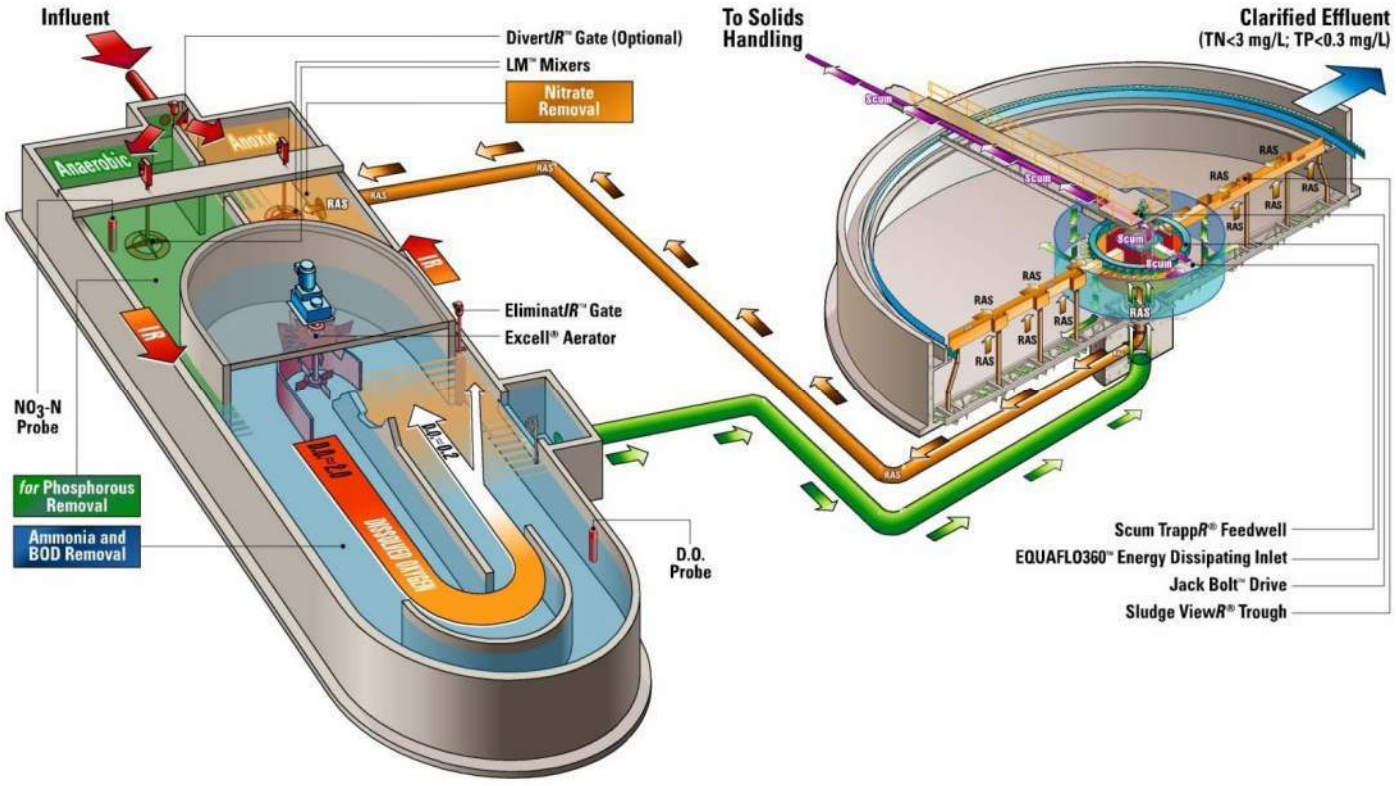



*Figure: Carrousel® AlternatIR™ System and Carrousel®Proset™ Clarifier*

## Ovivo Experience

| Ovivo Carrousel® Systems | Benefits |
|---|---|
| **700 U.S. Carrousel® Installations** | **Expertise in Basin Design:**<br>• Sizing and basin layout incorporating proprietary geometry and hydraulics<br>• Sizing of Aerator impeller size, type and speed **to maximize propulsion and oxygen transfer efficiency.** |
| **200 U.S. Carrousel® Biological Nutrient Removal Installations** | **Extensive database relating to:**<br>• Proper Aeration and Mixing Equipment selection<br>• Basin design and our equipment maximize N and P removal |
| **130 U.S. Carrousel® Dual Impeller Installations** | **Extensive database to design lower turbine and gear box**<br>• **Maximize equipment longevity**<br>• **Maximum process power turndown capability** (our equipment is proven to operate at 10-20% nameplate power and maintain mixing) |
| **5 Full-Time Biological Process Engineers dedicated to the support of Carrousel® customers** | For the past 25 years Ovivo engineers have assisted operators and engineers.<br>• Optimization of plant effluent quality and operating costs<br>• Free on-site and telephone support<br>• Process support lasts a lifetime. |
| **>40 Carrousel® Bardenpho® System Installations** | Experience With Multi Stage Design To Meet 5:5:3:1:<br>• Maintaining proper DO control<br>• maintaining sufficient channel velocities |
| **Nearly 2,000 Aerators Installed and Operating**<br><br>**>500 Aerators in Continuous Service for Over 15 Years** | A large installation base provides you with:<br>• **proven performance**<br>• **documented equipment longevity** |

## Award Winning Plants

Almost every year, an Ovivo Carrousel® plant wins a national EPA award!

| Year | Plant | Flow (MGD) |
|---|---|---|
| **1988** | Dothan Alabama (First Place) | 5.00 |
| **1992** | Green Forest, AR (Second Place) | 2.80 |
| **1993** | Vernon, NJ (Second Place) | 2.50 |
| **1994** | Faulkenburg Rd, FL (First Place) | 6.00 |
| **1994** | Denver SE, CO (First Place) | 1.00 |
| **1995** | Martinez, TX | 2.60 |
| **1995** | Little River , GA (Second Place) | 1.00 |
| **1996** | Wadena, MN (Second Place) | 0.75 |
| **1996** | So Central Brevard Co., FL (First Place) | 5.50 |
| **1996** | Pole Bridge Creek, GA (First Place) | 20.00 |
| **1997** | Fort Lupton, CO (First Place) | 2.75 |
| **1998** | Dyer, IN (Second Place) | 1.80 |
| **1999** | Edgartown, MA (first Place) | 0.75 |
| **1999** | Sweetwater Creek, GA (First Place) | 3.00 |
| **1999** | Togus, ME (Second Place) | 0.20 |
| **2001** | Denver SE, CO (Second Place) | 1.00 |
| **2003** | New Canaan, CT (Second Place) | 1.20 |
| **2004** | Central Davis, Kaysville, UT (First Place) | 1.40 |
| **2005** | North Conway, NH (First Place) | 1.65 |
| **2007** | Flat Creek WWTP, Gainsville, GA (Second Place) | 18.00 |
| **2007** | Southern Ute, Ignacio, CO (First Place) | 0.80 |

***Plus dozens of other national, state and local awards!***

# Calculations for Biological Basins (Max. Month Flow Condition)

### *1. DESIGN CONDITIONS*

| Design Parameter | Design Value | Design Effluent | Notes |
|---|---|---|---|
| Flow (MGD) | 3.0 | - | |
| BOD – Biochemical Oxygen Demand (mg/L) | 160 | 5 | |
| TSS – Total Suspended Solids (mg/L) | 230 | 15 | |
| TKN – Total Kjeldahl Nitrogen (mg/L) | 53 | 2.0 | |
| $NH_3$-N – Ammonia Nitrogen (mg/L) | - | 1.0 | |

### *2. DESIGN ASSUMPTIONS*

| Design Parameter | Design Value |
|---|---|
| Process SRT – Nitrification (days) | 15.0 |
| Minimum Wastewater Temperature (°C) | 12.0 |
| Maximum Wastewater Temperature (°C) | 25.0 |
| MLSS Concentration (mg/L) | 4,000 |
| Net Yield (lb TSS/lb $BOD_{removed}$) | 0.93 |
| Oxygen Coefficient | |
| lb $O_2$ / lb $BOD_{removed}$ | 1.21 |
| lb $O_2$ / lb $N_{oxidized}$ | 4.60 |
| Alpha (α) | 0.92 |
| Beta (β) | 0.97 |
| Elevation (feet above sea level) | 23 |

***3. PROCESS CALCULATIONS (Max. Month Flow Condition)***

**a. AERATION VOLUME**

BOD Removal $= Q \times (BOD_{in} - BOD_{eff}) \times 8.34$

$= 3.000 \times (160 - 5) \times 8.34$

$= 3{,}878 \ {}^{\text{lbs BOD}}/_{\text{day}}$

Sludge Production $= Y \times Q \times (BOD_{in} - BOD_{eff}) \times 8.34$

$= 0.93 \times 3.000 \times (160 - 5) \times 8.34$

$= 3{,}619 \ {}^{\text{lbs TSS}}/_{\text{day}}$

System Mass $= SRT \times Y \times Q \times (BOD_{in} - BOD_{eff}) \times 8.34$

$= 15.0 \times 0.93 \times 3.000 \times (160 - 5) \times 8.34$

$= 54{,}285$ lbs TSS

Carrousel Volume $= \dfrac{SRT \times Y \times Q \times (BOD_{in} - BOD_{eff})}{MLSS}$

$= \dfrac{15.0 \times 0.93 \times 3.000 \times (160 - 5)}{4{,}000}$

$= 1.627$ M. G.

BOD loading /kft3/day aer. $= \dfrac{Q \times BOD_{in} \times 8.34 \times 7.481 \times 1{,}000}{\text{Carrousel Volume} \times 10{,}00{,}000}$

$= \dfrac{3.0 \times 160 \times 8.34 \times 7.481 \times 1000}{1.627 \times 1000000}$

$= 18.4$ lbs BOD/kft3/day

**b. AERATION POWER**

Nitrogen Synthesis $= 5.6\%$ of WAS

$= 8.1\ {}^{mg}/_{L}$

Nitrogen Oxidized ($N_{ox}$) $= TKN_{in} - TKN_{eff} - N_{assimilation}$

$= 53 - 2.0 - 8.1$

$= 42.9\ {}^{mg}/_{L}$

$= 1{,}074\ {}^{lbs \cdot N}/_{day}$

Actual Oxygen Requirement @ $1.21\ {}^{lbs\ O_2}/_{lbs\ BOD_{removed}}$ & $4.60\ {}^{lbs\ O_2}/_{lbs\ N_{oxidized}}$

AOR $= (1.21 \times 3{,}878) + (4.60 \times 1{,}074)$

$= 9{,}632\ {}^{lbs\ O_2}/_{day}$

STD $O_2$Requirement $= AOR \times \frac{9.02}{\alpha \times (\beta \times C_{SW} - C_0)} \times 1.024^{(20-TMAX)}$

$\alpha = 0.92 \quad \beta = 0.97 \quad C_0 = 2.0$

$C_{SW}$at 25.0°C and 23 feet elevation $= 8.17\ {}^{mg}/_{L}\ O_2$

SOR $= 9{,}632 \times \frac{9.02}{0.92 \times (0.97 \times 8.17 - 2.0)} \times 1.024^{(20-25.0)}$

$= 14{,}159\ {}^{lbs\ O_2}/_{day}$

Power Required $= \frac{14{,}159}{3.65 \times 24}$

$= 162$ HP  2 @ 125.0 HP = 250 HP Installed

# Calculations for Biological Basins (Average Daily Flow Condition)

### *1. DESIGN CONDITIONS*

| Design Parameter | Design Value | Design Effluent | Notes |
|---|---|---|---|
| Flow (MGD) | 1.100 | - | |
| BOD – Biochemical Oxygen Demand (mg/L) | 160 | 5 | |
| TSS – Total Suspended Solids (mg/L) | 230 | 15 | |
| TKN – Total Kjeldahl Nitrogen (mg/L) | 53 | 2.0 | |
| $NH_3$-N – Ammonia Nitrogen (mg/L) | - | 1.0 | |

### *2. DESIGN ASSUMPTIONS*

| Design Parameter | Design Value |
|---|---|
| Process SRT – Nitrification (days) | 29.3 |
| Minimum Wastewater Temperature (°C) | 12.0 |
| Maximum Wastewater Temperature (°C) | 25.0 |
| MLSS Concentration (mg/L) | 2,500 |
| Net Yield (lb TSS/lb $BOD_{removed}$) | 0.82 |
| Oxygen Coefficient | |
| lb $O_2$ / lb $BOD_{removed}$ | 1.38 |
| lb $O_2$ / lb $N_{oxidized}$ | 4.60 |
| Alpha (α) | 0.94 |
| Beta (β) | 0.97 |
| Elevation (feet above sea level) | 23 |

***3. PROCESS CALCULATIONS (Average Daily Flow Condition)***

**a. AERATION VOLUME**

BOD Removal $= Q \times (BOD_{in} - BOD_{eff}) \times 8.34$

$= 1.100 \times (160 - 5) \times 8.34$

$= 1{,}422 \ {}^{\text{lbs BOD}}/_{\text{day}}$

Sludge Production $= Y \times Q \times (BOD_{in} - BOD_{eff}) \times 8.34$

$= 0.82 \times 1.100 \times (160 - 5) \times 8.34$

$= 1{,}160 \ {}^{\text{lbs TSS}}/_{\text{day}}$

System Mass $= SRT \times Y \times Q \times (BOD_{in} - BOD_{eff}) \times 8.34$

$= 29.3 \times 0.82 \times 1.100 \times (160 - 5) \times 8.34$

$= 33{,}944$ lbs TSS

Carrousel Volume $= \dfrac{SRT \times Y \times Q \times (BOD_{in} - BOD_{eff})}{MLSS}$

$= \dfrac{29.3 \times 0.82 \times 1.100 \times (160 - 5)}{2{,}500}$

$= 1.628$ M. G.

BOD loading per kft3 aer. vol. $= \dfrac{Q \times BOD_{in} \times 8.34 \times 7.481 \times 1{,}000}{\text{Carrousel Volume} \times 10{,}00{,}000}$

$= \dfrac{1.10 \times 160 \times 8.34 \times 7.481 \times 1000}{1.628 \times 1000000}$

$= 6.75$ lbs BOD/kft3/day

**b. AERATION POWER (Average Daily Flow Condition)**

Nitrogen Synthesis $= 5.0\%$ of WAS

$= 6.3\ {}^{mg}/_{L}$

Nitrogen Oxidized ($N_{ox}$) $= TKN_{in} - TKN_{eff} - N_{assimilation}$

$= 53 - 2.0 - 6.3$

$= 44.7\ {}^{mg}/_{L}$

$= 410\ {}^{lbs \cdot N}/_{day}$

Actual Oxygen Requirement @ $1.38\ {}^{lbs\ O_2}/_{lbs\ BOD_{removed}}$ & $4.60\ {}^{lbs\ O_2}/_{lbs\ N_{oxidized}}$

AOR $= (1.38 \times 1{,}422) + (4.60 \times 410)$

$= 3{,}853\ {}^{lbs\ O_2}/_{day}$

STD $O_2$Requirement $= AOR \times \frac{9.02}{\alpha \times (\beta \times C_{SW} - C_0)} \times 1.024^{(20-TMAX)}$

$\alpha = 0.94 \quad \beta = 0.97 \quad C_0 = 2.0$

$C_{SW}$at 25.0°C and 23 feet elevation $= 8.17\ {}^{mg}/_{L}\ O_2$

SOR $= 3{,}853 \times \frac{9.02}{0.94 \times (0.97 \times 8.17 - 2.0)} \times 1.024^{(20-25.0)}$

$= 5{,}543\ {}^{lbs\ O_2}/_{day}$

Power Required $= \frac{5{,}543}{3.65 \times 24}$

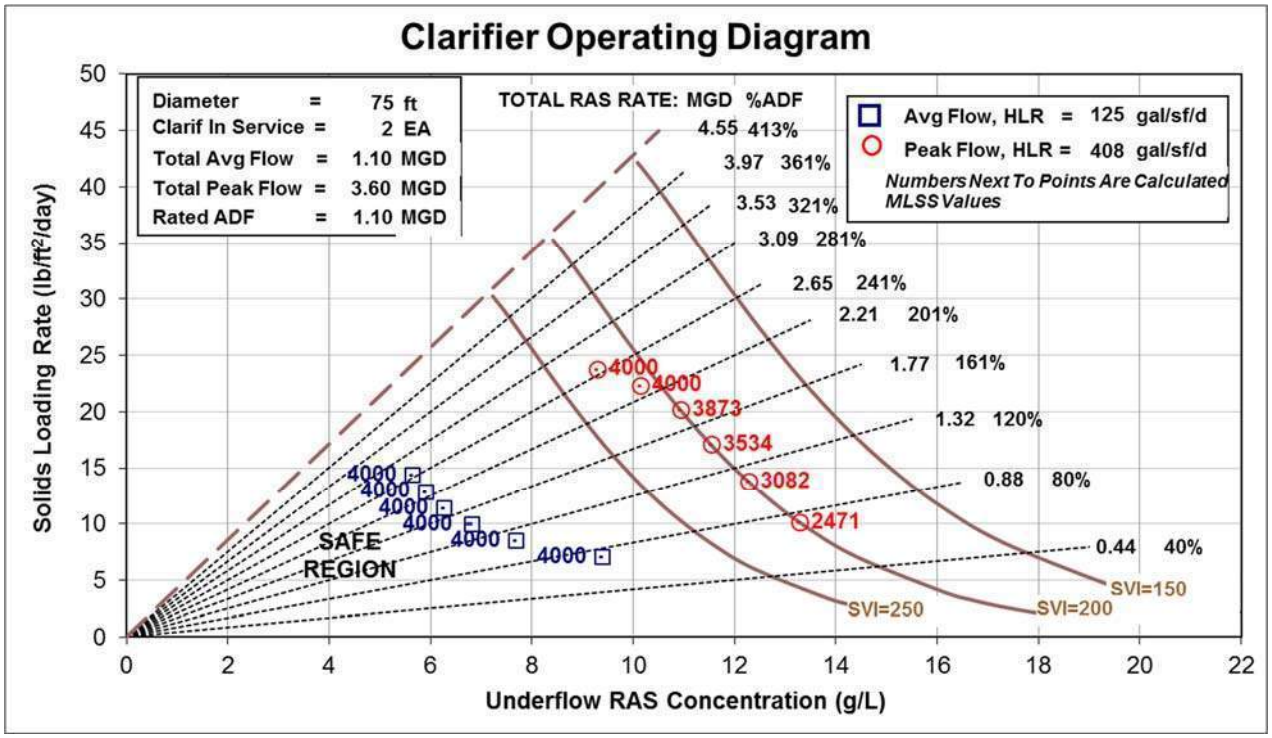
$= 63$ HP  2 @ 125.0 HP = 250 HP Installed

## *4. CLARIFIER CALCULATIONS (Two Clarifier in Operation)*

**SUMMARY OF SECONDARY CLARIFIER DESIGN RECOMMENDATION**
**Arcata, CA**

| SUMMARY OF CLARIFIER DESIGN | | | |
|---|---|---|---|
| **Number of clarifiers operating** | **2** | | |
| Diameter, ft. | 75 | Biological Basin Vol (MG) | 1.627 |
| Side water depth, ft. | 16 | SVI (mL/g) | 200 |
| Average Design Flow (ADF), MGD | 1.10 | Target MLSS | 4,000 |
| Mechanism type | Scraper | | |

| Operating Parameters | Units | Average Flow Design RAS | Peak Flow Design RAS | Peak Flow Max RAS |
|---|---|---|---|---|
| Flow Used In Evaluation | MGD | 1.10 | 3.60 | 3.60 |
| RAS rate | MGD | 0.83 | 0.83 | 2.75 |
| RAS rate | %ADF | 75% | 75% | 250% |
| Hydraulic loading | gal/sf-day | 125 | 408 | 408 |
| Solids loading | lb/sf-day | 7.3 | 10.3 | 24.0 |
| RAS solids | g/l | 9.3 | 13.2 | 9.3 |
| Increase in sludge blanket | ft | - | 2.8 | 0.0 |
| Aeration MLSS | mg/l | 4,000 | 2,471 | 4,000 |

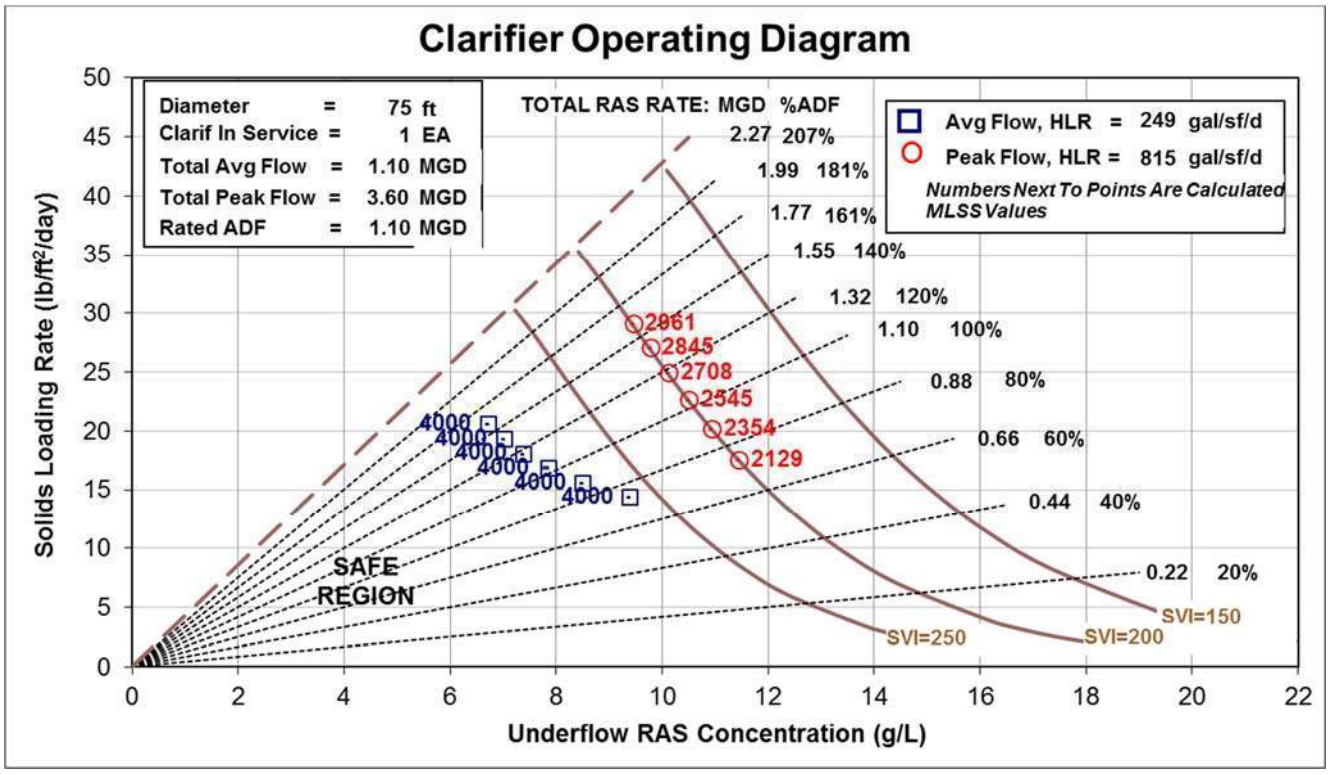


## *4. CLARIFIER CALCULATIONS (One Clarifier in Operation)*

**SUMMARY OF SECONDARY CLARIFIER DESIGN RECOMMENDATION**
**Arcata, CA**

| SUMMARY OF CLARIFIER DESIGN | | | |
|---|---|---|---|
| **Number of clarifiers operating** | **1** | | |
| Diameter, ft. | 75 | Biological Basin Vol (MG) | 1.627 |
| Side water depth, ft. | 16 | SVI (mL/g) | 200 |
| Average Design Flow (ADF), MGD | 1.10 | Target MLSS | 4,000 |
| Mechanism type | Scraper | | |

| Operating Parameters | Units | Average Flow Design RAS | Peak Flow Design RAS | Peak Flow Max RAS |
|---|---|---|---|---|
| Flow Used In Evaluation | MGD | 1.10 | 3.60 | 3.60 |
| RAS rate | MGD | 0.83 | 0.83 | 1.65 |
| RAS rate | %ADF | 75% | 75% | 150% |
| Hydraulic loading | gal/sf-day | 249 | 815 | 815 |
| Solids loading | lb/sf-day | 14.5 | 17.8 | 29.3 |
| RAS solids | g/l | 9.3 | 11.4 | 9.4 |
| Increase in sludge blanket | ft | - | 8.1 | 5.4 |
| Aeration MLSS | mg/l | 4,000 | 2,129 | 2,961 |

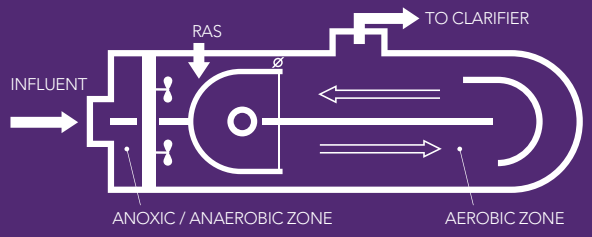


OVIVO®
Bringing water to life®

# MAXIMUM TREATMENT, MINIMUM EFFORT

## HOW IT CAN MEET YOUR NEEDS:

- Meets the **Most Stringent Effluent Nutrient Requirements**
- **Simple** to Operate and **Easy** to Maintain
- **Eliminate** Chemical Dependency
- **Reduce** Energy Use
- **Proven Technology** – 700+ U.S. installations

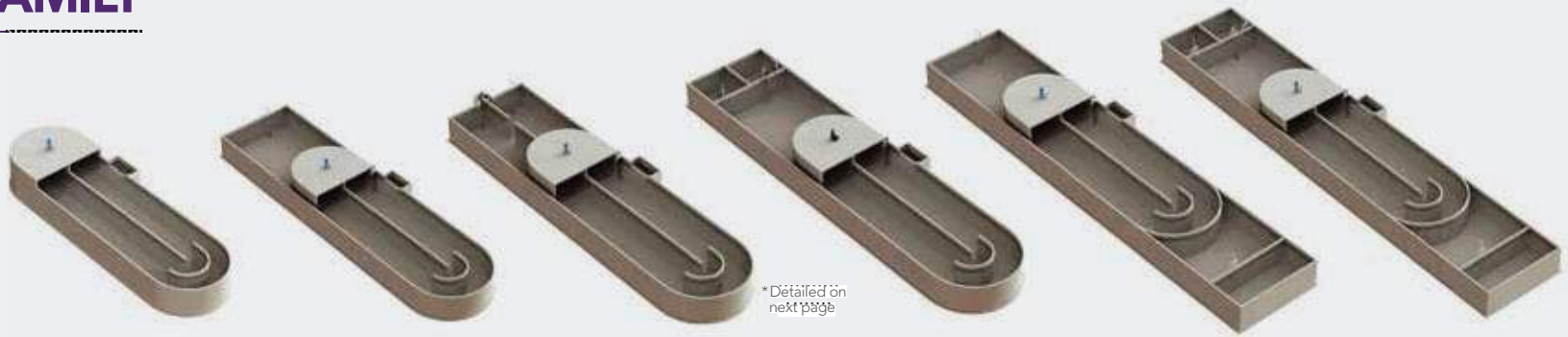





# CARROUSEL® SYSTEMS

OVIVO | NUTRIENT REMOVAL

# THE CARROUSEL® PROCESS FAMILY




| | 1-STAGE | 2-STAGE | 2-STAGE | 3-STAGE | 4-STAGE | 5-STAGE |
|---|---|---|---|---|---|---|
| | BASIC CARROUSEL® SYSTEM | denit*IR*® CARROUSEL® SYSTEM | Alternat*IR*™ SYSTEM | A²C™ SYSTEM | BARDENPHO® CARROUSEL® SYSTEM | BARDENPHO® CARROUSEL® SYSTEM |
| **ANAEROBIC** | | | ✓ | ✓ | | ✓ |
| **1ST ANOXIC** | | ✓ | ✓ | ✓ | ✓ | ✓ |
| **AEROBIC** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **2ND ANOXIC** | | | | | ✓ | ✓ |
| **RE-AERATION** | | | | | ✓ | ✓ |
| **EFFLUENT (mg/L)** | BOD≤5<br>NH3-N≤0.5 | BOD≤5<br>NH3-N≤0.5<br>TN≤5-8 | BOD≤5<br>NH3-N≤0.5<br>TN≤5-8<br>TP≤0.3* | BOD≤5<br>NH3-N≤0.5<br>TN≤5-8<br>TP≤0.3* | BOD≤5<br>NH3-N≤0.5<br>TN≤3 | BOD≤5<br>NH3-N≤0.5<br>TN≤3<br>TP≤0.3* |

*May require trim doses of metal salts

## OVIVO: AN ENGINEERING PROCESS POWERHOUSE

The Ovivo Carrousel Process Team, which consists of decades of biological wastewater treatment plant design and innovation, has provided expertise and design assistance for wastewater treatment plants consisting of all shapes, sizes, and effluent permits.

## CAPABILITIES:

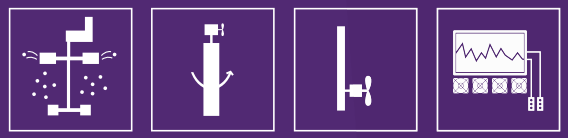
- Detail Design Support
- Process Calculations
- Equipment Sizing
- Process Guarantees
- Extended Warranties
- Retrofit Expertise
- Process Training
- Equipment Startup
- Ovivo Connect (Asset Management)

# THE CARROUSEL® ALTERNAT*IR*™ SYSTEM

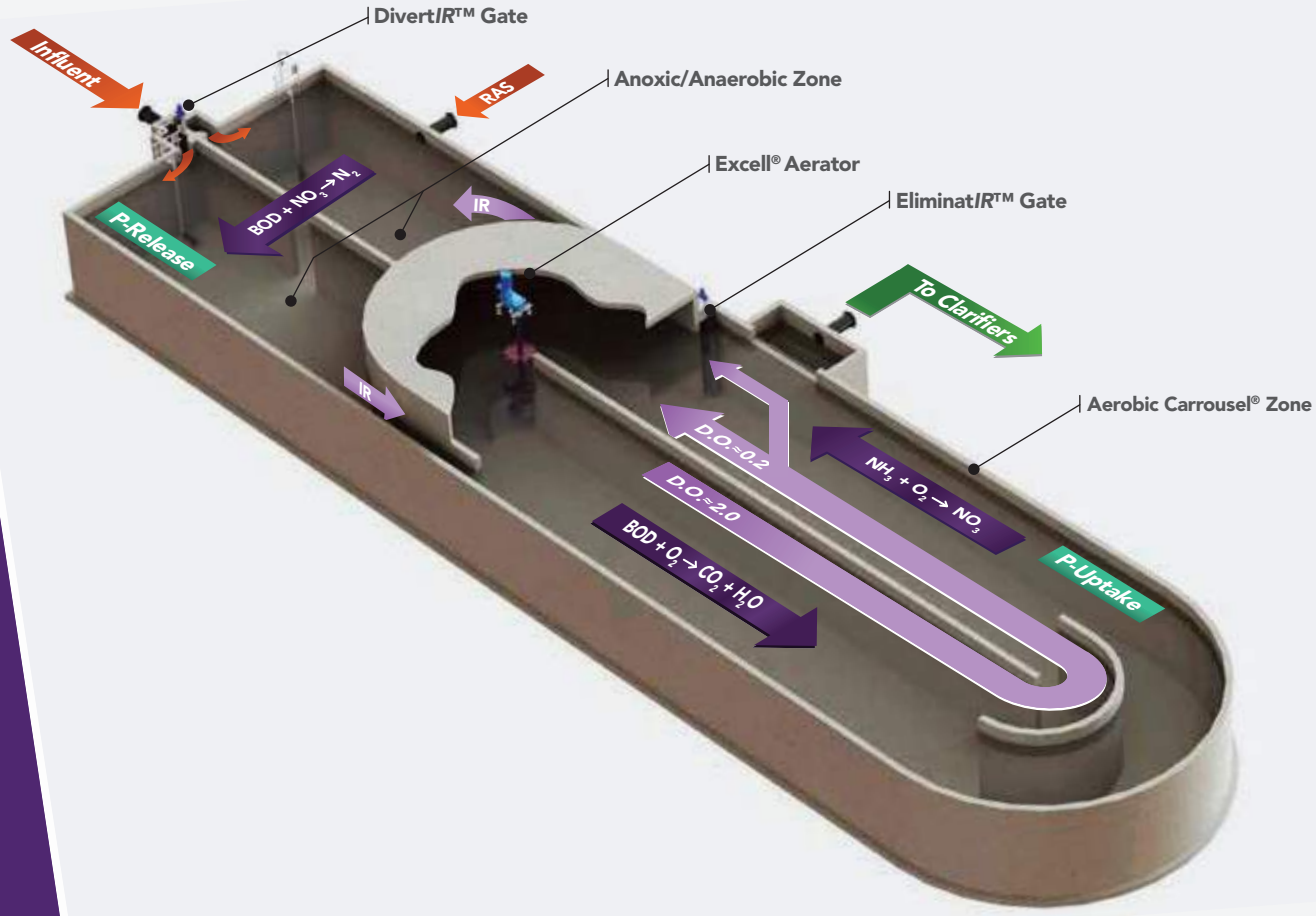
In the denit*IR*® Carrousel® System an integral anoxic basin is added for Total Nitrogen removal without supplemental carbon addition. The internal recycle (IR) is large (6-15Q) and requires no additional power, taking advantage of the propulsion generated by the Excell® Aerator.

The automatically controlled Eliminat*IR*™ Gate can be used to create anaerobic cycles in the anoxic zone in order to achieve phosphorus removal as well. This is called the Alternat*IR*™ System.

In the aerobic (Carrousel®) stage, BOD and ammonia oxidation (nitrification) proceed to completion. The Excell® Aerator provides all aeration and mixing required for the aerobic stage at all influent loading conditions.



EXCELL® AERATOR | ELIMINAT*IR*™ GATE | MIXING | OVIVO™ CONTROLLER




## OVIVO: A HISTORY OF EXCELLENCE

**1979** — Installs 1st Carrousel® System in the USA

**1983** — Installs 1st BNR System in the USA

**1988** — Develops and installs 1st denitIR® Carrousel® System

**1991** — Develops and installs 1st Dual-Impeller Aerator

**1998** — Develops and installs 1st ACE™ Control System to conserve energy

## EXCELL® AERATOR

- Efficiently provides all of the aeration and mixing required for the Carrousel Basin.
- 3.85 lb O2/HP-hr
- Power Turndown Up to 90%
- 1 man day of maintenance/year
- You Stay Clean! - No maintenance below the deck







## OCULUS™ SYSTEM

- The Process "All Seeing Eye"
- User Friendly Interface
- Efficient Aeration Control
- Optimized Nutrient Removal
- Save Energy
- Reduce Chemical Dependency
- Remote Access

## ELIMINAT*IR*™ GATE

- Internal Recycle (IR) Control
- Automatically adjusts to maximize Denitrification
- IR rates between 0-12Q
- Anaerobic Cycling for Phosphorus Removal





**2001** — Develops and installs 1st Deep Tank Carrousel® System: 23 ft-SWD

**2006** — Installs 600th Carrousel® System in the USA

**2007** — Introduces the Excell® Aerator II: Our most efficient Dual-Impeller Aerator for BNR Systems to date!

**2009** — Introduces the Elimina*IR*™ Gate to maximize, optimize and automate BNR

**2010** — Introduces the Oculus™ BNR Control System

**2012** — Develops and installs the first Full BNR optimization Oculus™ MCC

**2013** — Introduces Ovivo® Connect℠ Asset Management System

**2014** — Introduces Carrousel® SwingIR™ System

# CARROUSEL® SYSTEMS:

## A FORWARD LOOKING APPROACH

A leading technology in wastewater treatment and biological nutrient removal, the Carrousel® system is universally praised for it's durability, operational simplicity, low operating and maintenance costs, and consistently high effluent quality.

Carrousel Systems offer the lowest number of aerators per basin compared to other oxidation ditch systems, such as those that use horizontal shaft aerators. This greatly simplifies installation and maintenance requirements.

At a minimum, a Carrousel System consists of a "racetrack" style reactor basin with at least one vertical shaft, low-speed mechanical aerator, the Excell® Aerator, installed in the center of one of the turns. The basic Carrousel System is capable of full BOD and Ammonia reduction. Nutrient removal is easily added to a Carrousel System via the addition of anoxic and anaerobic selector zones, or even with simple, optimized operational strategies.

The Carrousel System utilizes the Modified Lutzack-Ettinger (MLE) configuration for highly efficient denitrification. This process is known as the denitIR® System, where internal recycle (IR) flow is directed into the anoxic zone via a slip-stream channel using propulsion generated by the Excell Aerator. No additional energy for IR pumping is required. IR flowrate is varied by the EliminatIR™ Gate. The Oculus™ Control System automatically controls the aeration rate and IR flow.





**Top:** The Excell® Aerator is installed at one or more of the channel turns and provides all aeration and mixing required for full nitrification and BOD removal.

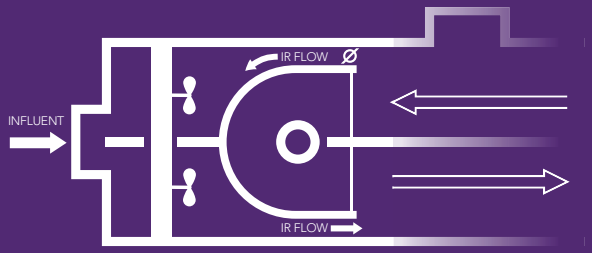
**Bottom:** Anoxic and anaerobic basins are easily added for Total Nitrogen and Total Phosphorus removal in Ovivo's denitIR® configuration.

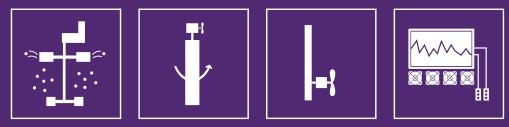
**ACTIVATED SLUDGE TREATMENT AND BIOLOGICAL NUTRIENT REMOVAL**

35 **YEARS OF CARROUSEL® SYSTEMS**
**1979 - present**

**Total Phosphorus ≤ 0.3 mg/L**
**Total Nitrogen ≤ 3 mg/L**

- Virtually eliminates $NO_3$-N
- Dedicated environments maximize N and P removal
- Optimization eliminates or greatly reduces metal salt addition
- No IR pumps required
- No supplemental carbon required
- Full nitrification to $NH_3$-N < 0.5 mg/L in all U.S. climates



EXCELL® AERATOR | ELIMINAT*IR*™ GATE | MIXING | OCULUS™ CONTROLLER

# RETROFITS:

OVIVO OFFERS COMPETITIVE TURNKEY AND TRADITIONAL UPGRADE AND RETROFIT PATHWAYS FOR YOUR EXISTING SYSTEMS, EVEN IF YOU DON'T ALREADY HAVE A CARROUSEL SYSTEM.

Upgrading your existing Carrousel System has never been easier or more worthwhile. Improve your efficiency, reduce your maintenance, or automate your process.

Ovivo provides estimates for services and return on investment with a custom-made appraisal of your existing infrastructure.

You won't be disappointed you called.



## ovivo®connect℠

Ovivo® Connect℠ portal is an innovative and intuitive application that allows our customers to use 'SmartTags' installed on our equipment (or a web URL) to access a personalized customer zone. Access your equipment documentation, find contract references, track service logs, manage spare parts, and plan your next maintenance to get the most out of your equipment.

NEED **ACCESS** TO YOUR **O&M MANUAL**?
NEED **SPARE PARTS**?
WANT THE **LATEST TIPS AND NEWS** ON YOUR ASSET?



**GET CONNECTED!**
ovivo.co



WATCH VIDEO
**The Ovivo Carrousel System**

Carrousel® is a registered trademark of HaskoningDHV Nederland B.V

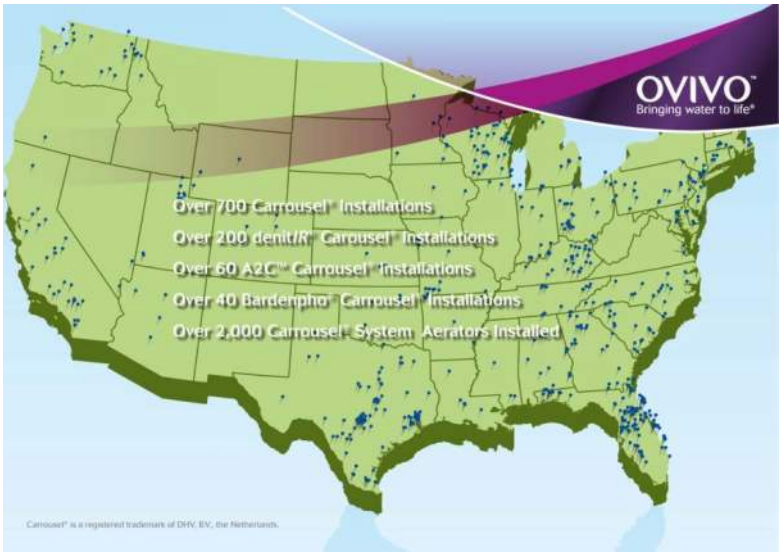
**1-855-GO-OVIVO**

**info@ovivowater.com**
**ovivowater.com**

OVIVO
Bringing water to life

# Ovivo Carrousel® Systems

Ovivo (formerly Eimco Water Technologies) has been providing Carrousel Systems since 1979. With over 700 installations, we have continuously improved the technology over the last 35 years.




We have many plants now achieving a Total Nitrogen of less than 2 mg/L and a Total Phosphorus of less than 0.2 mg/L. No supplemental carbon is ever required, and usually only sporadic trim doses of alum are required.

We have also greatly improved energy efficiency and power turndown capability with our latest aeration equipment designs.

The Oculus control System keeps a tight rein on dissolved oxygen, ORP, nitrate, and ammonia, with several operational strategies available.

Ovivo Carrousel Systems stand out in the industry due to our long history of investment, innovation and improvement

In the attached pages, we have presented several of the latest improvements available for Carrousel Systems that are included in our proposal.

Feel free to contact our Salt Lake City office at (801) 931 – 3000 and ask for anyone on the Carrousel Team.

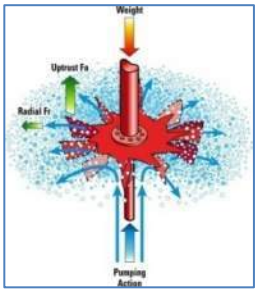


# The Excell®Aerator

**Aeration and Propulsion**



The Excell®Aerator, located at one or more of the channel turns in the Carrousel® Basin, uses the most efficient aerating surface impeller available. The clean water oxygen transfer efficiency is 3.8 lb $O_2$/ HP-hr. DHV, B.V., the inventor of Carrousel Systems and the singular authority for testing and certifying Carrousel® aerators has approved the Excell®Aerator.




The 10-bladed surface impeller acts as a pump, efficiently maintaining propulsion throughout the channel zones. The unique star plate design with integrated blades acts as a stabilizer, reducing Fa and Fr loads to the mechanical gear reducer that drives the unit, lengthening the service life of the reducer.

The lower turbine is driven by the same mechanical equipment that drives the surface impeller and requires no additional bearings. The lower turbine with the velocity enhancement baffle increases floor scouring velocity, particularly important during periods of low loading (e.g., at night, when actual influent loading is less than design). The lower turbine is connected to the surface impeller by 6 bolts. Many facilities appreciate the ease of basin draining after adding the lower turbine as solids are kept in suspension during draining.

**Power Turndown**



Excell®Aerator at 30Hz
(20% power; 80% turndown)



Excell®Aerator at 60Hz
(100% power; 0% turndown)

Power turndown is critical for proper operation of biological nutrient removal facilities and for cost efficiency. A properly designedCarrouselSystem equipped with the Excell®Aerator allows for power turndown of 80-90% *without* mixing limitations!

**Successful Installations**

Ovivo has recently installed ExcellAerator retrofits at Ocala, FL; Greenwood Lakes, FL; Baraboo, WI; Flagler Beach, FL; Pearsall, TX; Apopka, FL and over 100 other facilities. Each of these facilities had different reasons for choosing our dual impeller unit – better power turndown, enhanced nutrient removal, easier basin draining operations, energy savings.

# The Eliminat*IR*™ Gate

## Easy Control With No Pumps



Placed at the entry to the internal recycle (IR) channel, the Eliminat***IR*** gate replaces expensive IR pumps and older manual gates. Either the center pivot or the end pivot (common for manual IR gates currently installed) designs are available.



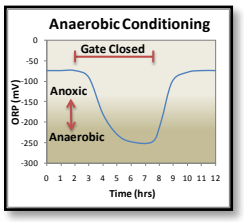
The flow through the IR channel is controlled with an electric actuator that either restricts or increases the flow through the IR channel. This is typically automated based on measured conditions in the anoxic basin (e.g., ORP, nitrate) using the Ovivo Oculus™ Control System.

The Eliminat***IR*** gate provides real time enhanced control of nitrate reduction in your facility.

## Real Time Automation

The Eliminat***IR*** gate works with our Oculus control System to optimize Total Nitrogen removal. By preventing 'washout' or excessive DO from entering the anoxic zone, effluent nitrogen can be lowered by several parts per million.




Our system can also convert your existing anoxic zone into a fermentation zone by strategically closing the gate throughout the day for Total Phosphorus removal.

## Successful Installations

The Eliminat***IR*** Gate can be retrofitted using existing IR gates as it was at Ocala, FL. The Eliminat***IR*** gate was added at Mt Holly Springs, NJ to provide phosphorus removal without the need to build additional fermentation basins, and at Zions Crossroads, VA; Edgewater, FL; and Spring Hill, TN in a Bardenpho® configuration.

OVIVO
Bringing water to life

# The Energy Optimizer

**Optimizing Impeller Submergence and Speed**



For many years, surface aeration control was accomplished by raising and lowering the effluent weir to control impeller submergence. The lower the weir, the lower the submergence, and corresponding less HP was pulled by the motor and less oxygen was imparted to the water. Conversely, raising the weir increased HP and oxygen delivery. While this method was impractical in responding to diurnal variations in oxygen demand, it did allow for some operational adjustments.



Today, changing oxygen delivery is largely accomplished by variable frequency drives (VFDs). VFDs adjust the motor speed, and thus the impeller rotational speed, adjusting HP draw and oxygen delivery. This is an important component of Carrousel systems, as VFDs can allow for power turndown of 90%. With the dual impeller ExcellAerator, mixing remains sufficient at these large power turndowns, which are often required for start-up and nighttime flows in nutrient removal plants where overaeration means failure.



Ovivo now offers a system that automatically adjusts both the weir and the aerator speed, the Energy Optimizer. By adjusting both, the Energy Optimizer finds the most optimum energy usage for delivering oxygen to the wastewater, while maintaining dissolved oxygen setpoints. Not all HP is created equal: an aerator drawing 50 HP, for example, at low submergence/high speed may deliver more oxygen than the same aerator drawing 50 HP at high submergence/low speed. The Energy Optimizer continuously tracks kW usage with respect to influent loading, and optimizes submergence and speed to its most efficient point. The result is excellent treatment at the lowest possible energy costs.

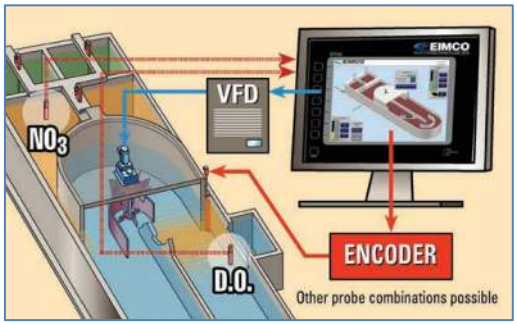
**Successful Installations**

The Energy Optimizer has been installed in Spring Hill, TN and Mt Holly Springs, PA with several others under construction.

# The Oculus™ System

**Your Carrousel SCADA**

The Oculus System is the "all-seeing eye" that maximizes nutrient removal, minimizes power costs, and monitors selected process variables and equipment. The Oculus System analyzes and reports signals from a combination of dissolved oxygen (DO), oxidation-reduction-potential (ORP), ammonia (NH4-N) and nitrate (NO3-N) probes to control the Excell®Aerator power input and the EliminatIR™ gate and effluent weir position in the Carrousel®System. The probes provided are site-specific.



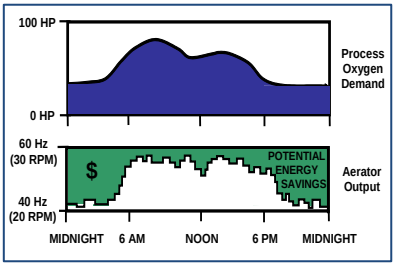

The operator can access all control functions, setpoints, and trendcharting from a custom, touch-screen interface. Each Oculus System can be equipped with a modem for on-line monitoring and quick access to our industry-leading and free process support team. The system is now available on tablets and smartphones.

**Optimizes Nutrient Removal**

Two key requirements for optimizing nutrient removal are, (1) providing adequate nitrate delivery to the anoxic zone and (2) protecting all anoxic and anaerobic tanks from excessive D.O. Through the use of ORP or nitrate monitoring, the Oculus System efficiently meets the first requirement by regularly adjusting the position of the EliminatIR gate. This allows for control of nitrate delivery from the aerobic zone to the anoxic zone in response to diurnal fluctuations as well as nitrate loading from other sources, such as return activated sludge (RAS) and digester decants. This is especially critical for P removal plants, which must prevent both continuous and slug loads of nitrate from entering anaerobic zones.

**Minimizes Power Costs**

Minimizing the aeration energy required in the activated sludge process is the most effective way to reduce power costs in a wastewater treatment plant. Using proper D.O. and effluent weir set points determined from Ovivo's extensive experience with Carrousel® nutrient removal plants, the Oculus System balances the need to minimize power consumption with the paramount need for adequate aeration capacity. Ammonia probes may also be added for continuous feedback of nitrification performance.



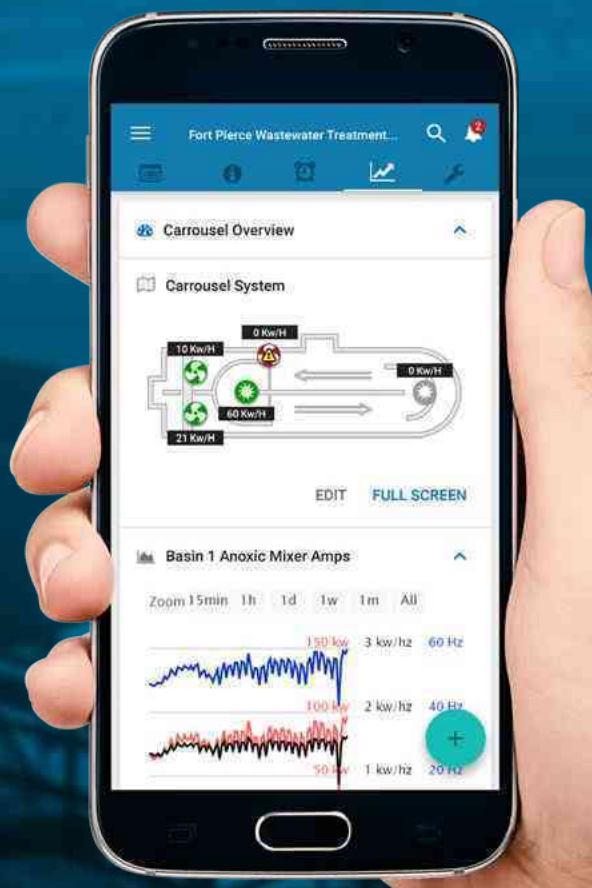

**Successful Installations**

Some of the sites where Ovivo has provided the Oculus System are Ocala, FL; Spring Hill, TN; Zion's Crossroads, VA; Mt Holly Springs, PA; Inverness, FL, and Edgewater, FL. References and site visits are available.

WaterExpert™
YOUR WATER TREATMENT HUB

# Get Live Data from Your Equipment Instantly, Anywhere.

Get your team on the same page. Upload and share documents & media. Create and manage service logs and maintenance schedules. Monitor data from your plant to optimize performance and prevent failures.




Preserve your workforce's expertise by uploading media & procedures.

Access itemized OEM operator manuals for all of your Ovivo Installations.

Create & update service logs, maintenance schedules, performance alerts and more.

Get instant access to expert support.

Monitor equipment performance with live data readings and receive emails or SMS text alerts when your custom parameters are met or exceeded.



**CAPTURE YOUR WORKFORCE'S KNOWLEDGE**



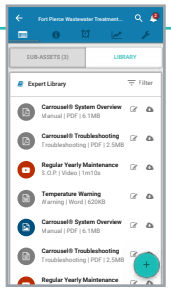
**TRACK EQUIPMENT SUB-ASSETS**

## INTERESTED?

Visit **waterexpert.com** to learn more.

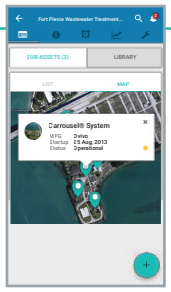
## QUICKLY SEARCH EXTENSIVE MANUALS

Keep your equipment library on your device, easily search for relevant information and upload your own media.



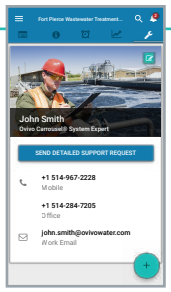
## YOUR PLANT, MAPPED OUT

Never confuse your installs again. Zoom in and select the right equipment on a customizable satellite map of your plant.



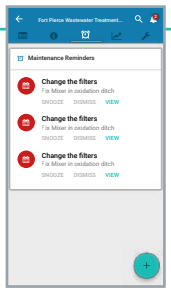
## EXPERT SUPPORT IS JUST A TAP AWAY

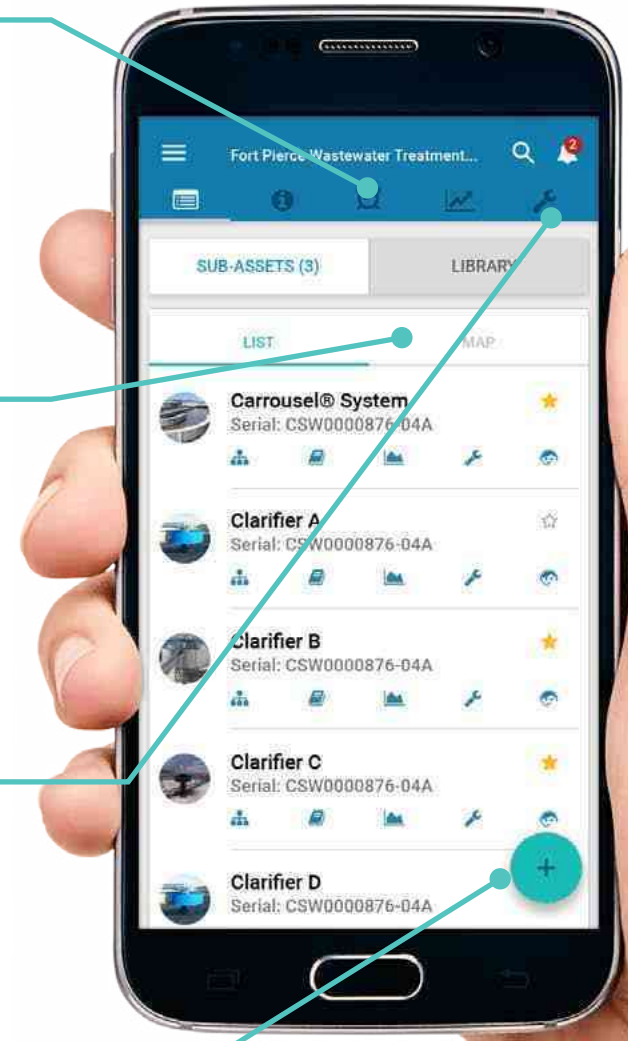
Send detailed support requests with pictures and video from your phone at any time.

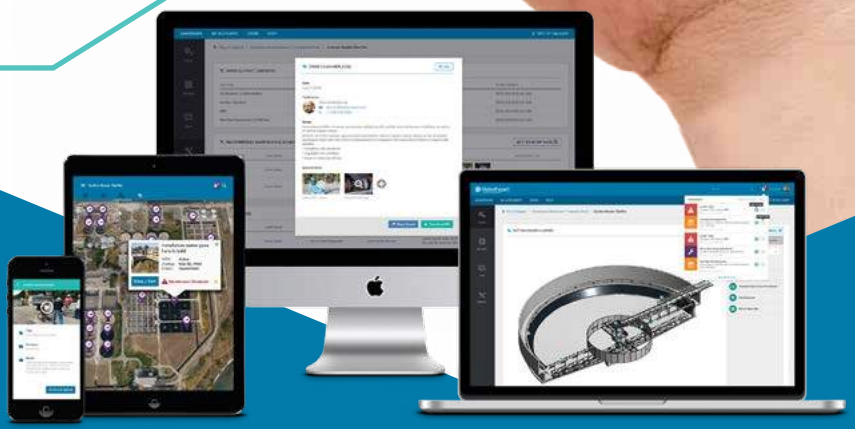



## CREATE SERVICE REMINDERS & LOGS

Set your own maintenance reminders for your team to review and create service logs once completed





Access your plant data from any device and sync for your whole team so everyone's always up-to-date!

WaterExpert™
YOUR WATER TREATMENT HUB

**Learn more at waterexpert.com**

waterexpert.com is powered by Ovivo

# OVIVO SECONDARY CLARIFIER QUOTE

**Ovivo USA, LLC**
4246 Riverboat Road, Suite 300
Salt Lake City, Utah
84123
USA

**Telephone**: 801.931.3000
**Facsimile**: 801.931.3080

**www.ovivowater.com**

OVIVO Worldwide Experts in Water Treatment

---

To: Brad Leidecker – CHC

From: Tyson Beaman, Product Manager Sedimentation Group

Phone: 801-931-3241 Email: tyson.beaman@ovivowater.com

Date: 6/18/18

Subject: Arcata, CA -- Two (2) 75ft Diameter Spiral Bladed Secondary Clarifiers - Budget Price.

Brad,

I have prepared budget pricing for the adding new secondary clarifiers for the Arcata, CA plant. The budget pricing is based on the following parameters:

| | |
|---|---|
| Number of Clarifiers | 2 (NEW) |
| Clarifier Diameter: | 75 ft |
| SWD: | 14 ft |
| Freeboard: | 2 ft |
| Clarifier Types: | C4D (Spiral Blade Clarifier) |
| Slope: | 1:12 |

The preliminary budget pricing is as follows:

| | |
|---|---|
| Base Price = Two (2) 75 ft Type C4D clarifier (Carbon Steel W/ Prime Paint) | $329,000 |
| Optional add: Full Trough Skimming in lieu of the Conventional Skimming System (2 units) | $7,000 |
| Optional add: FRP Weirs and Baffles (2 units) | $24,000 |
| Optional add: FRP Density Current Baffles (2 units) | $37,000 |
| Optional add: NEMA 4X Control Panel (2 units) | $21,400 |

Prices for mild steel mechanisms include surface preparation and one (1) manufactures standard prime coat. Finish coat not included in base price.

See Table 1 for the scope of supply for this option.

Let me know if you need any additional information.

Sincerely,

*Tyson Beaman PE*
Product Manager
Sedimentation Group
(801) 931-3241 (Direct)

**THIS BUDGETARY PROPOSAL CONSTITUTES A NON-BINDING ESTIMATE OF PRICE(S) FOR CERTAIN GOODS AND/OR SERVICES THAT MAY BE PROVIDED BY OVIVO USA, LLC FROM TIME TO TIME, BUT SHALL NOT BE CONSTRUED AS AN OFFER BY OVIVO USA, LLC TO PROVIDE SUCH GOODS AND/OR SERVICES.**

# TABLE 1

Arcata, CA WWTP
(2) 75’ diameter Secondary Clarifiers type C4D
COLUMN SUPPORTED UNITS

This budget price includes per clarifier:

- Construction materials shall be Carbon Steel unless noted otherwise.
- C40HT Clarifier Drive.
- 3ft wide steel beam supported walkway extending from the tank wall to the center operating platform decked with I-Bar grating.
- 8ft square drive platform decked with I-Bar grating.
- Aluminum 2-rail handrail around platform and walkway.
- Influent column, 24” diameter x 1/4” thick.
- Feedwell, 18ft diameter x 5’-0” submerged depth.
- Energy dissipating inlet well, 7ft diameter x 2’-7” submerged depth.
- Center cage,
- Two full radius rake arms with a tapering spiral blade on each arm.
- One sludge collection manifold
- Surface scum skimming equipment with one (1) 4ft wide scum trough and two (2) skimming mechanisms. **See Optional Adder for Full Trough Skimming**.
- Anchor bolts, 304 stainless steel.
- Assembly fasteners, 304 stainless steel.
- Drive finish painted per manufacturer standard painting scheme.
- Mechanism manufacturer prime painted only.
- Freight FCA jobsite.
- Services 3d/3t total
- O&M manuals

Items not included in the budget pricing:

- Full Trough Skimming in lieu of Conventional Skimming (Unless purchased by optional adder)
- Effluent weir plates and scum baffle (Unless purchased by optional adder)
- Density current baffles. (Unless purchased by optional adder)
- Control panel. (Unless purchased by optional adder)
- Launder covers.
- Stairways
- Spray Systems
- Demolition or installation.
- Tank or tank modifications.
- Unloading.
- Field welding.
- Finish painting.
- Lamp posts.
- VFD controller.
- Lubricants.
- Electrical controls.
- Handrail around tank.

# Spiral Scraper Clarifier

## Key features & benefits

- Special design developed for faster sludge removal
- Best performance on 1:12 floor slope
- Better control of sludge blanket

## How we create value

- Low maintenance requirements
- Trouble-free installation
- Long lasting durable design



www.ovivowater.com © Copyright 2010 GLV. All rights reserved

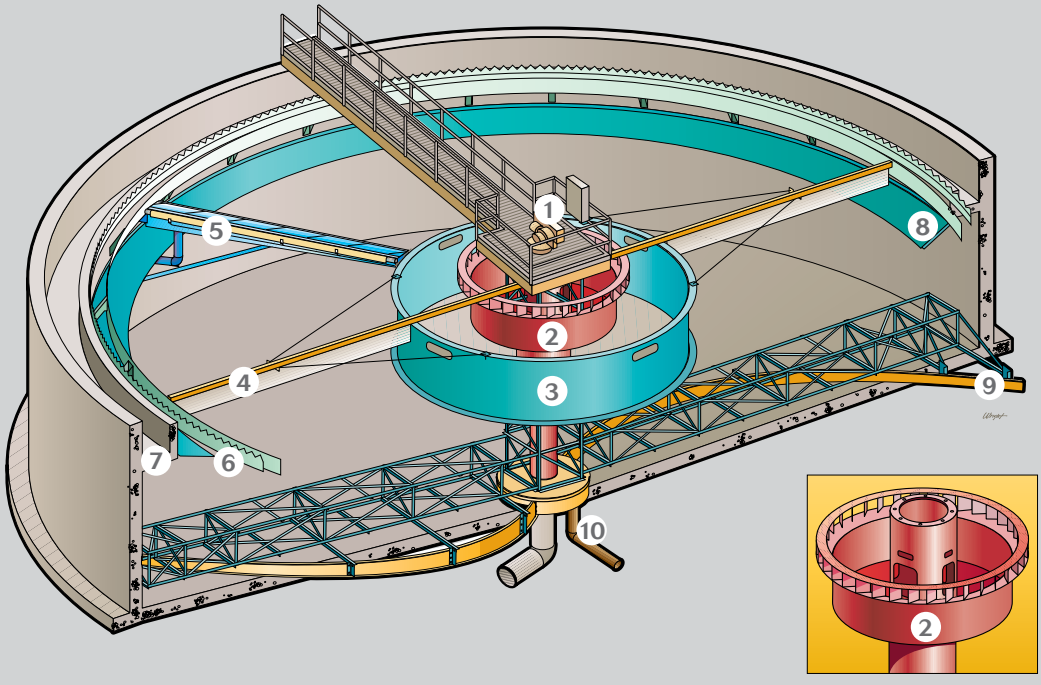
# Spiral Scraper Clarifier

## Features

Ovivo's Spiral Scraper Clarifier (C4-FTS) offers rapid sludge removal with spiral blades and a rotating sludge collection drum. The Spiral Scraper Clarifier offers full radius skimming and an enhanced energy dissipation well: the EquaFlo 360™.

Our clarifier design includes the most common components of the scraper clarifier as well as competitive innovations such as the EquaFlo 360™ EDI (Energy Dissipating Inlet) or the rotating sludge collection drum.

1. Drive
2. EquaFlo 360™
3. Flocculation feedwell
4. Full radius surface skimming
5. Full radius trough skimmer with radial ramp
6. Effluent weir and baffle
7. Inboard effluent launder
8. Density Current Baffle
9. Spiral rake blade
10. Rotating sludge collection drum







 www.ovivowater.com © Copyright 2010 GLV. All rights reserved

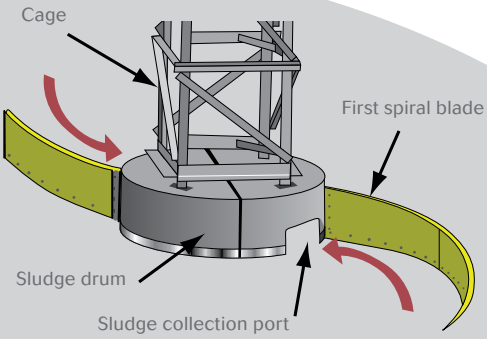
## Spiral Blades and Sludge Collection Drum

The Spiral Blade Clarifier features a spiral blade design coupled to a rotating sludge collection drum. The blades are constructed to a logarithmic spiral curve with a constant 30 degree angle of attack. They are supported by two sludge removal arms of steel truss construction. Blades are equipped with adjustable 20 gauge 304 stainless steel squeegees for a better resistance to abrasion. Blade depth varies with the clarifier size and the bottom slope; the best raking performance is achieved with 1:12 floor slope.

The mechanism is designed for rapid sludge removal. Ovivo can provide an optional variable frequency drive for the adjustment of the raking speed and a better control of the sludge blanket.

The sludge drum is a circular manifold attached to the bottom end of the center cage. It is sealed around the center column and to the tank floor. The drum rotates with the cage and turns above the openings of the RAS (Returned Activated Sludge) pipe. The drum has one opening located in front of each rake blade, 180 degrees apart.

The sludge drum removes highly concentrated sludge that is brought by the spiral blades to the center of the tank. Shipped to the site in just two pieces, the sludge drum is easy to handle and install. The drum does not clog and requires little maintenance.




Rotating sludge drum is especially designed to remove concentrated sludge brought by the spiral blades to center of the tank







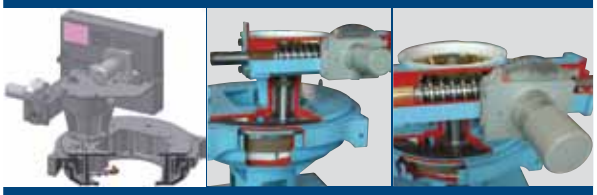


## Drive Units

Ovivo provides strong, highly reliable drive mechanisms. The strength of our drives is due to their design, the materials used, full oil bath lubrication and the proper alignment of their components.

**Drive**

- Cast iron housing
- Oil lubrication
- Deep oil reservoir
- Strip liner bearings
- Worm gear reducer
- Single pinion
- Solid one piece main gear
- Meets latest AGMA standards

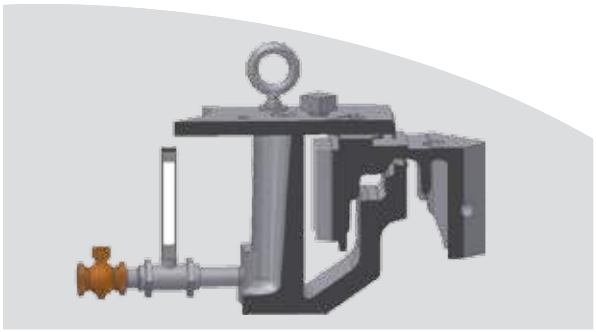




**Cast Iron**

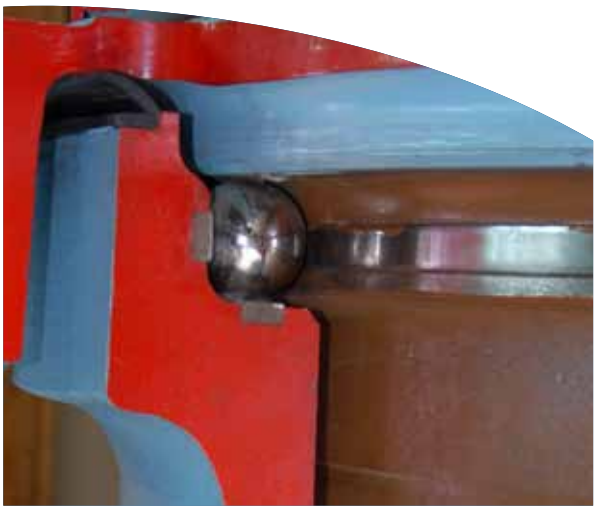
Our drives are built in cast iron per ASTM A48 Class 40A. Cast iron offers:

- Excellent corrosion protection. Cast iron has a natural resistance to corrosion and will not rust
- Resistance to heavy loads. Complex cross sections with a high degree of structural rigidity are more precisely formed than fabricated plates. Sections are easily varied to provide massive support in high load areas.
- Full inner and outer walls form a deep 'U' cross section, offering exceptional rigidity and an ample oil reservoir.
- Extra bulk under the main bearing, pinion bearing and intermediate reducer mounting surfaces ensures proper alignment under peak loads.



**Oil Lubrication**

Ovivo drive design includes a deep oil reservoir with full side wall. This design offers many advantages. The full sidewall avoids the possibility of oil leaking and provides good weather protection for the gear. The deep oil reservoir minimizes heat buildup, provides an area for condensate to accumulate well away from the main gear and bearings and allows complete immersion in the lubricant. The drain is located away from the main pinion gear at the lowest point to allow extraction of contaminants.



**Strip Liner Bearings**

Ovivo drives use strip liner bearings and the largest chrome alloy bearing balls on the market. The strip liners are specially designed for wastewater treatment applications. These high quality strips are manufactured in AISI E4140, vacuum degassed and carbon deoxidized steel and offer high strength (43-46 Rc hardness).

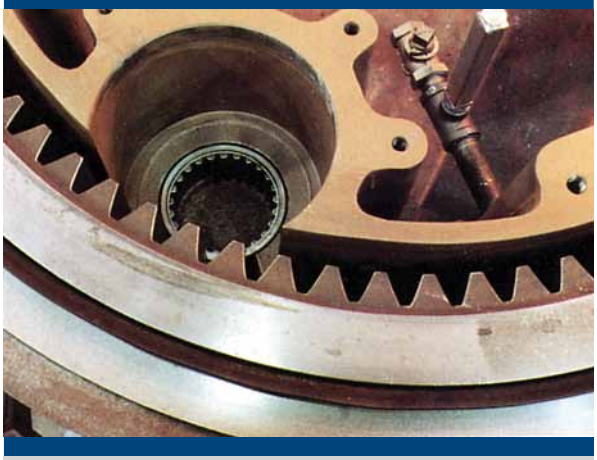

www.ovivowater.com © Copyright 2010 GLV. All rights reserved

**Quality Components**
EWT drives are equipped with bearings, worms and pinion mounted on a precisely machined surface. In every drive a high quality solid pinion maintains alignment and gives better resistance to bending and deflection under loads. Mating parts are machined to precise tolerances to assure precise fit and alignment. Every drive part is fully restrained (top and bottom) with no overhung loads. Main bearings are fully restrained into base.

**AGMA Standards**
Worm gear reducer, single solid pinion, single solid worm / worm shaft and main gear all meet the latest AGMA (American Gear Manufacturers' Association) standards.

**Drive Control**
Each drive is equipped with an overload control device activated by thrust from the worm shaft. This drive control includes a clear plastic enclosure and a weatherproof enclosure of epoxy coated aluminum construction with electro-mechanical switches.

| Drive Components Material | |
|---|---|
| Main gear housing | Cast iron ASTM A48 |
| Worm gear housing | Cast iron ASTM A48 |
| Main gear | Ductile iron ASTM-A536 class 100-70-03 |
| Worm gear | Cast alloy bronze |
| Worm | Alloy Steel AISI 4140/42H |
| Pinion | Alloy steel 4150 (26-33 Rc) |
| Strip liners | Steel AISI E4140 |
| Bearing ball | Chrome alloy steel |
| Control enclosure | Cast aluminium |







## EquaFlo 360™ Energy Dispersing Inlet

The EquaFlo 360 Energy Dissipating Inlet (EDI) for clarifiers differs substantially from conventional practice by using the entire EDI circumference to discharge flow rather than just a few openings in the EDI shell. The quiescent tangential flow that results provides a uniform velocity profile and promotes flocculation within the feedwell.

**EDIs: uses**
The influent discharges from the center column at relatively high energy levels must be dissipated to reduce the influent velocity in feedwell and provide a uniform distribution in the clarification zone.

**Existing EDIs**
Scoop design, baffled design or TEE outlets design dissipate energy but produce flow streams. Flow streams cause turbulences and preferential jets in the feedwell resulting in reduced clarifier performance. These designs are also associated with deep feedwells to reduce the possibility of short circuiting under the feedwell.

**The EquaFlo 360™**
With its extended inner rim and evenly spaced tangentially oriented vanes along the entire 360 degrees of the EDI circumference and, the new EquaFlo 360 offers the following advantages:

- Eliminates the distributing effects of the discrete flow streams jetting into the feedwell from the EDI
- Produces uniform flow into the feedwell around its full 360 degree circumference
- Achieves a controlled tangential flow velocity which promotes flocculation in the feedwell
- Minimizes the depth of the inlet discharge into the feedwell so the feedwell can have a minimum depth in the clarifier to avoid scouring of the sludge blanket on the clarifier floor
- Creates a tapered velocity profile for the flow that enters the clarification zone
- Increases the active clarification volume and retention efficiency of the clarifier through the use of a tangential discharge from the feedwell.

### Features & benefits

- Discharge on full 360
- Evenly spaced tangentially orientated vanes
- Extended inner rim
- Double set of influent ports on influent column
- No stream jetting
- Enhanced flocculation
- Shallower feedwell
- No sludge scouring



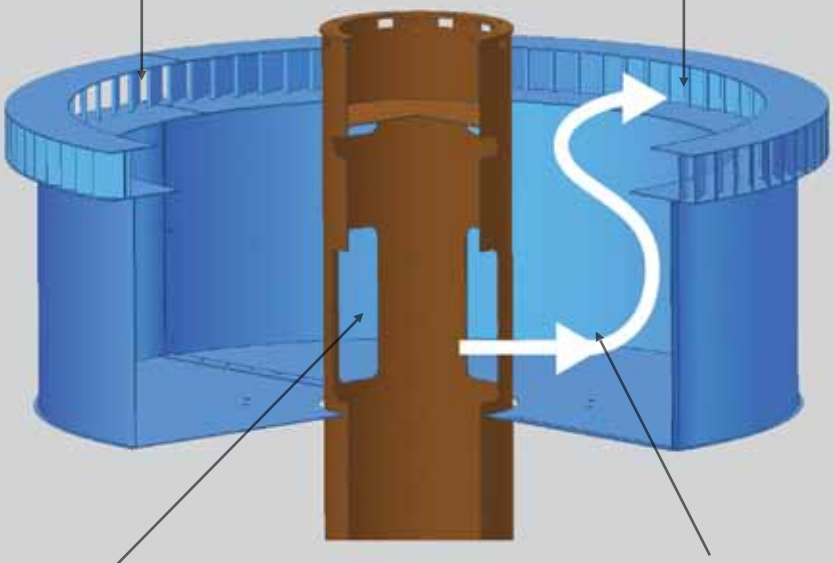




 © Copyright 2010 GLV. All rights reserved

The EquaFlo 360™ EDI discharge is ringed with evenly spaced tangentially orientated vanes along the entire 360 degree of the EDI circumference

The lower rim of the vane support ring extends back towards the column, forming a lip that provides additional flow baffling and energy dispersion



The influent column discharge ports are set below the EDI vanes, providing immediate containment and baffling of the influent via the EDI floor and cylindrical shell

Flow leaving the column ports encounters the EDI wall, then must travel around the lower support ring prior to quiescently discharging into the feedwell trough tangentially orientated vanes

# Full Trough Skimmer (FTS)

**Key features & benefits**

- Heavy duty skimmer arms
- Increased removal rate decreases odor
- Prevents surface scum carry-over into effluent stream
- Effective removal of heavy surface scum loads in one pass
- Can be retrofitted into existing bridge and column mounted clarifiers and thickeners
- Flush valve assembly mounted at the feedwell end automatically rinses out the scum trough
- Heavy duty skimmer arms do not have pivots, hinges or springs that wear out and break
- Can be customized to fit any manufacturer's mechanism
- Eliminates the need to direct scum to the tank periphery with a hose or spray system
- Radial design enables the full length of the skimmer wiper to make simultaneous and continuous contact with the entire ramp at each revolution of the skimmer arm

The Full Trough Skimmer (FTS) mechanism is a performance enhancing skimming design that has been effectively proven and retrofitted into many existing clarifiers. This mechanism covers the entire annular space between feedwell and scum baffles and can eliminate scum quickly and effectively, at a rate faster that that of the standard scum box and skimmer design. This innovative design incorporates a radial approach ramp and an automatic flush valve. The (FTS) is an effective device that will enhance the overall performance of any clarifier of 110' in diameter or smaller.







www.ovivowater.com

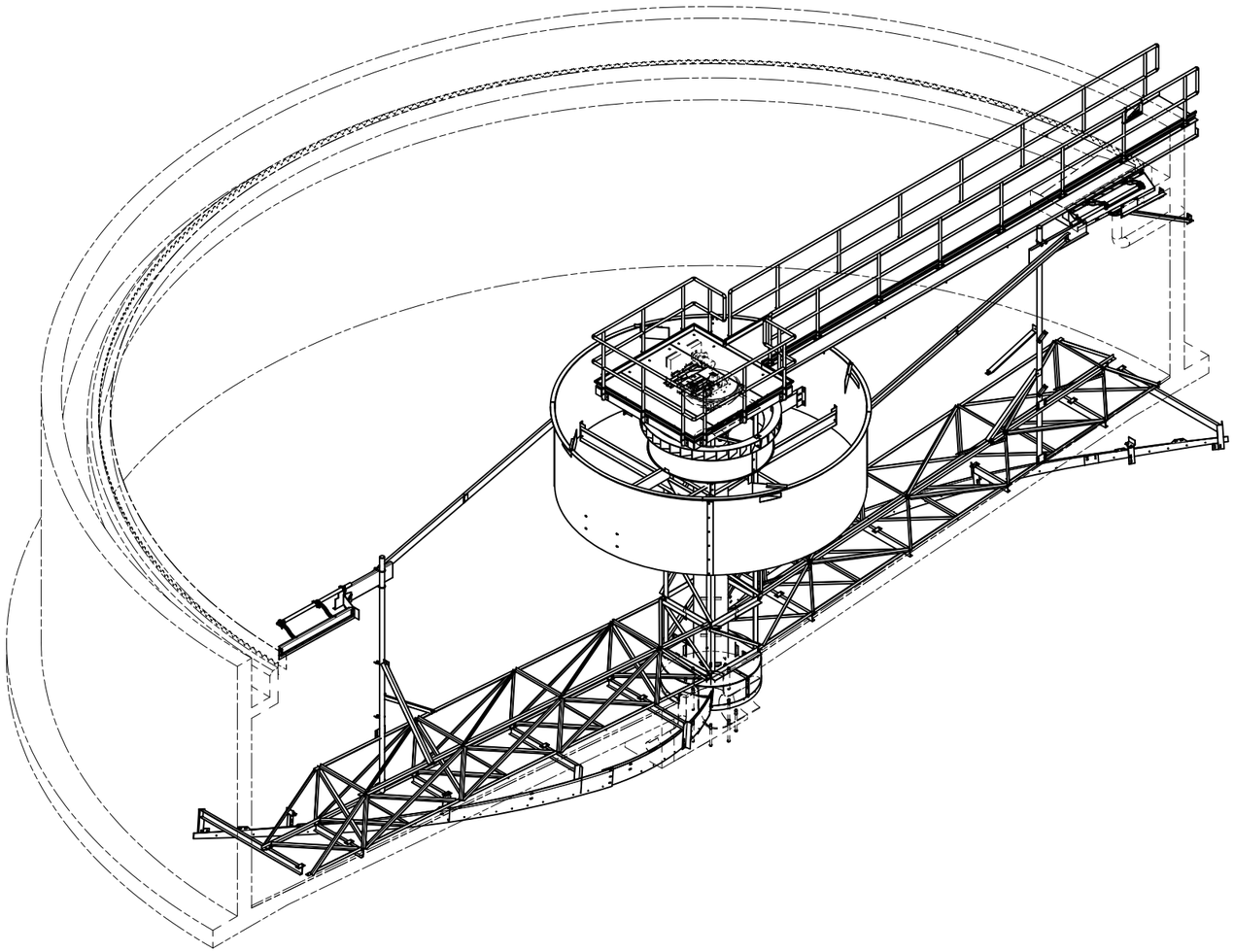
© Copyright 2010 GLV. All rights reserved

100.66.1024.092010

OVIVO

**WORLDWIDE EXPERTS IN WATER TREATMENT**

# 75'-0" DIA. C4



| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| INITIAL RELEASE | | | | | A | **DRAWN** | TJG | ORIGINAL S.O. | **DWG. NO.** |
| REVISION DESCRIPTION | EN/ECO | BY | CHECK'D | DATE | REV | **CHECK'D** | | **SALES ASSIST** | |

**D**

©COPYRIGHT 2010 GLV
ALL RIGHTS RESERVED – REV E

THIRD ANGLE PROJECTION

THIS DRAWING CONTAINS CONFIDENTIAL PROPRIETARY INFORMATION OF OVIVO, AND ITS AFFILIATES, AND IS NOT TO BE DISCLOSED NOR TO BE USED EXCEPT FOR EVALUATING PROPOSALS OF OVIVO OR INSTALLING, OPERATING OR MAINTAINING OVIVO EQUIPMENT. UNLESS OTHERWISE AUTHORIZED IN WRITING BY OVIVO. UNCONTROLLED COPY IF PRINTED

| | | |
|---|---|---|
| **REF. FROM** | **CSW1045-201** | DO NOT SCALE PRINTS |
| **DATE** (mm/dd/yyyy) | **1/24/2017** | WORKMANSHIP STANDARD ES0001 APPLIES |

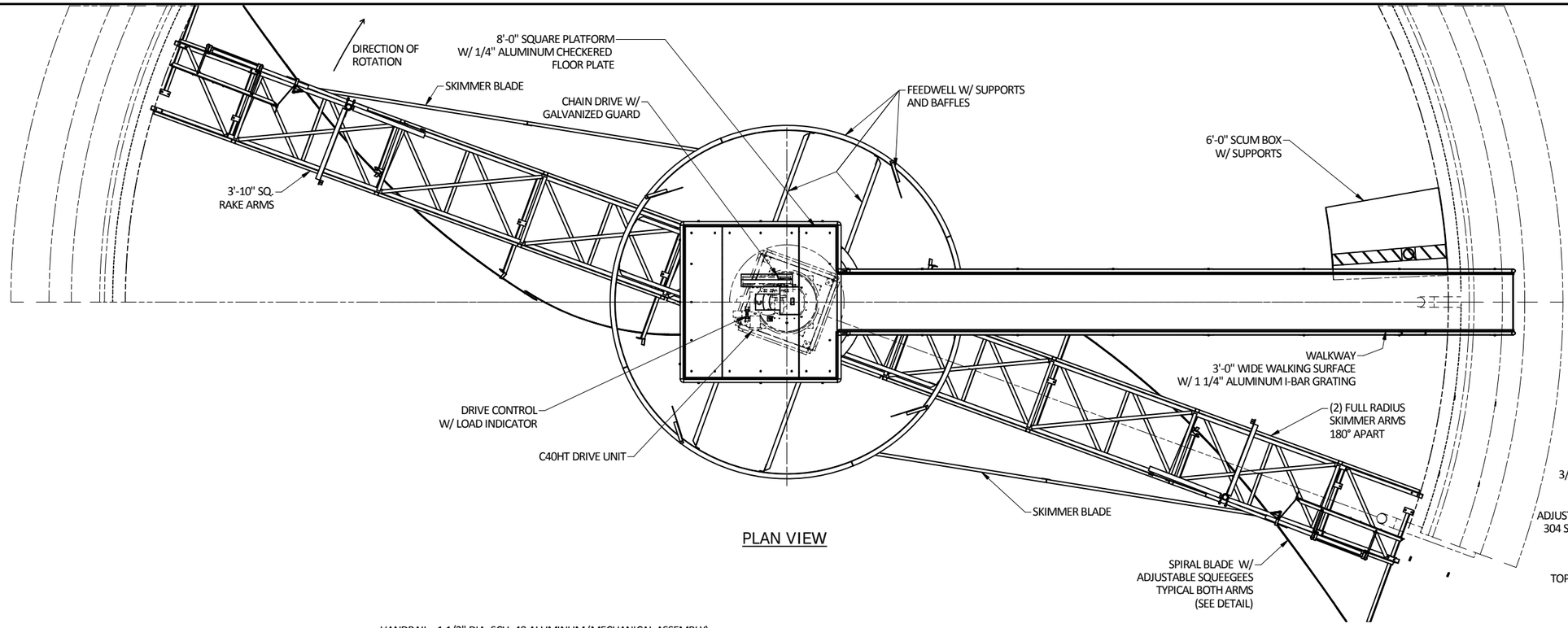
OVIVO
Bringing water to life

**GENERAL ARRANGEMENT**
**75'-0" DIA. C4**
**W/ EQUAFLO EDI**

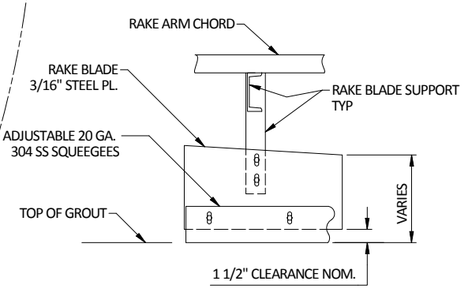
**SALES ASSIST**

SHEET **1** OF **2**

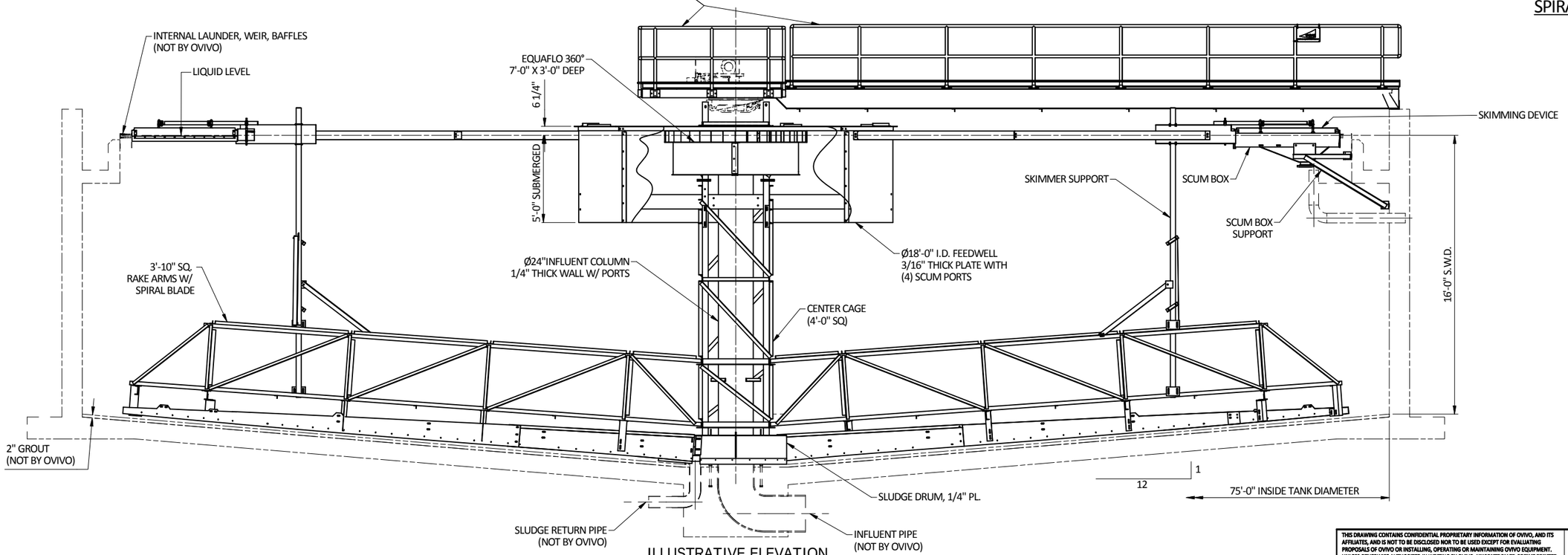
REV **A**




PLAN VIEW




SPIRAL RAKE BLADE
DETAIL




ILLUSTRATIVE ELEVATION

THIS DRAWING CONTAINS CONFIDENTIAL PROPRIETARY INFORMATION OF OVIVO, AND ITS AFFILIATES, AND IS NOT TO BE DISCLOSED NOR TO BE USED EXCEPT FOR EVALUATING PROPOSALS OF OVIVO OR INSTALLING, OPERATING OR MAINTAINING OVIVO EQUIPMENT. UNLESS OTHERWISE AUTHORIZED IN WRITING BY OVIVO. UNCONTROLLED COPY IF PRINTED

OVIVO
Bringing water to life

D

©COPYRIGHT 2010 BY GLV
ALL RIGHTS RESERVED - REV E

DO NOT SCALE PRINTS
WORKMANSHIP STANDARD ES0001 APPLIES

DWG. NO. SALES ASSIST

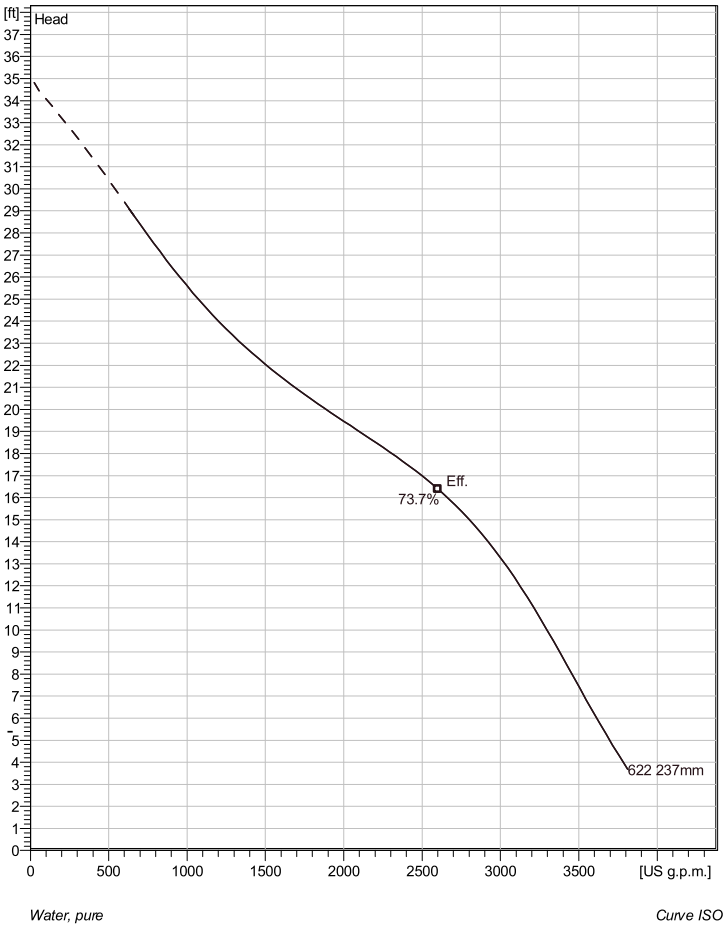
SHEET 2 OF 2

REV A

# FLYGT INFLUENT PUMP QUOTE

# NP 3153 LT 3~ 622

## Technical specification




*Water, pure* *Curve ISO*



*Note: Picture might not correspond to the current configuration.*

### General

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.

### Impeller

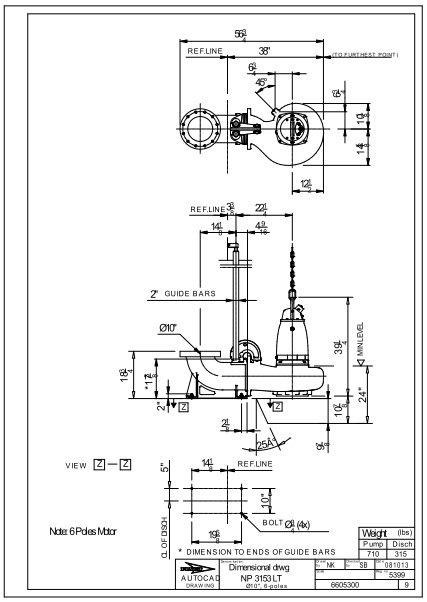
| | |
|---|---|
| Impeller material | Hard-Iron |
| Discharge Flange Diameter | 9 13/16 inch |
| Suction Flange Diameter | 9 13/16 inch |
| Impeller diameter | 237 mm |
| Number of blades | 3 |

### Motor

| | |
|---|---|
| Motor # | N3153.095 21-18-6AA-W 15hp FM |
| Stator variant | 5 |
| Frequency | 60 Hz |
| Rated voltage | 460 V |
| Number of poles | 6 |
| Phases | 3~ |
| Rated power | 15 hp |
| Rated current | 22 A |
| Starting current | 101 A |
| Rated speed | 1155 rpm |
| Power factor | |
| 1/1 Load | 0.73 |
| 3/4 Load | 0.67 |
| 1/2 Load | 0.55 |
| Motor efficiency | |
| 1/1 Load | 87.0 % |
| 3/4 Load | 88.0 % |
| 1/2 Load | 87.5 % |

### Configuration

**Installation: P - Semi permanent, Wet**




| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3153 LT 3~ 622

## Performance curve

### Pump

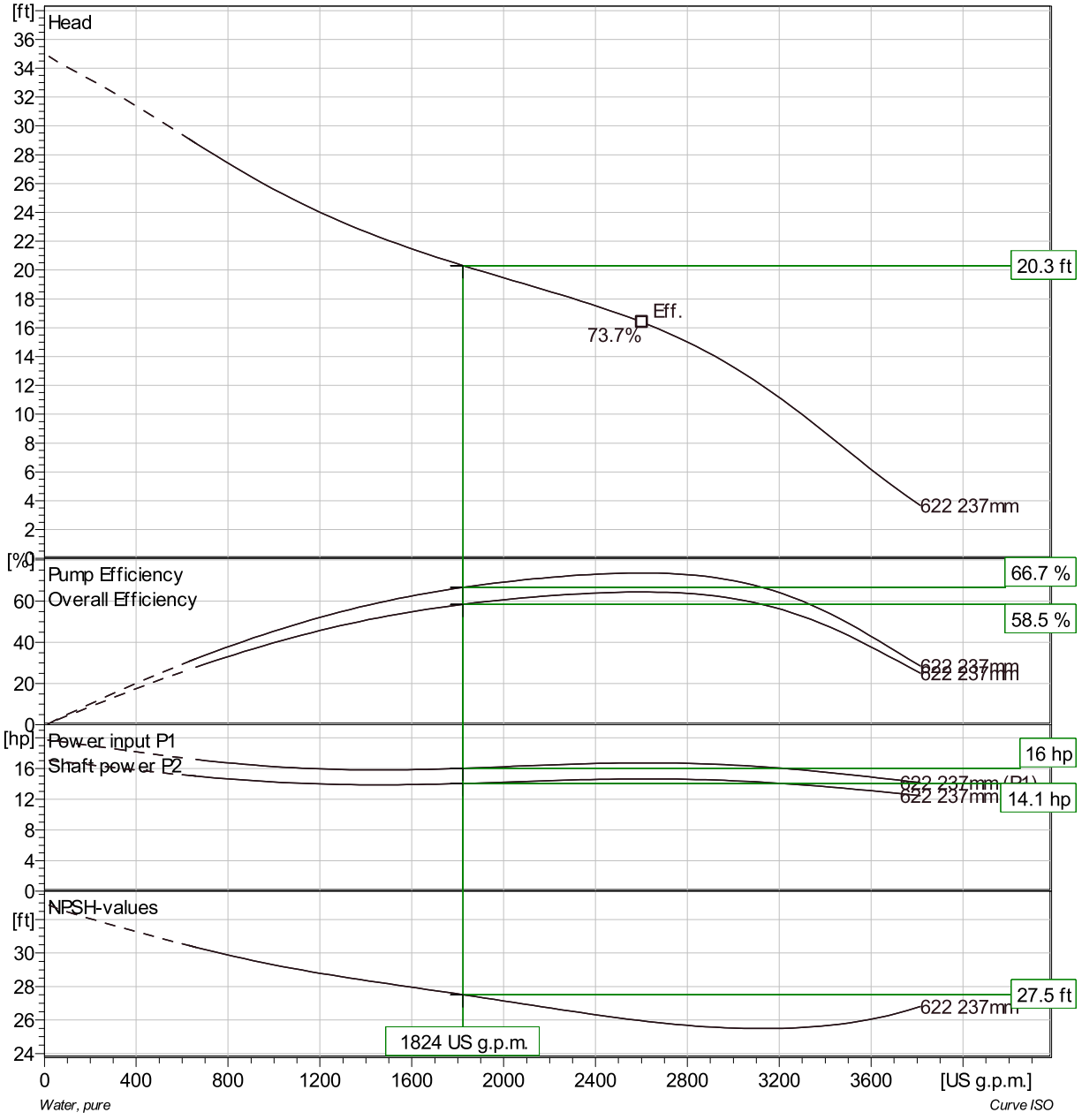
| | |
|---|---|
| Discharge Flange Diameter | 9 13/16 inch |
| Suction Flange Diameter | 250 mm |
| Impeller diameter | $9^{5}/_{16}$" |
| Number of blades | 3 |

### Motor

| | |
|---|---|
| Motor # | N3153.095 21-18-6AA-W 15hp |
| Stator variant | 5 |
| Frequency | 60 Hz |
| Rated voltage | 460 V |
| Number of poles | 6 |
| Phases | 3~ |
| Rated power | 15 hp |
| Rated current | 22 A |
| Starting current | 101 A |
| Rated speed | 1155 rpm |

| Power factor | |
|---|---|
| 1/1 Load | 0.73 |
| 3/4 Load | 0.67 |
| 1/2 Load | 0.55 |

| Motor efficiency | |
|---|---|
| 1/1 Load | 87.0 % |
| 3/4 Load | 88.0 % |
| 1/2 Load | 87.5 % |

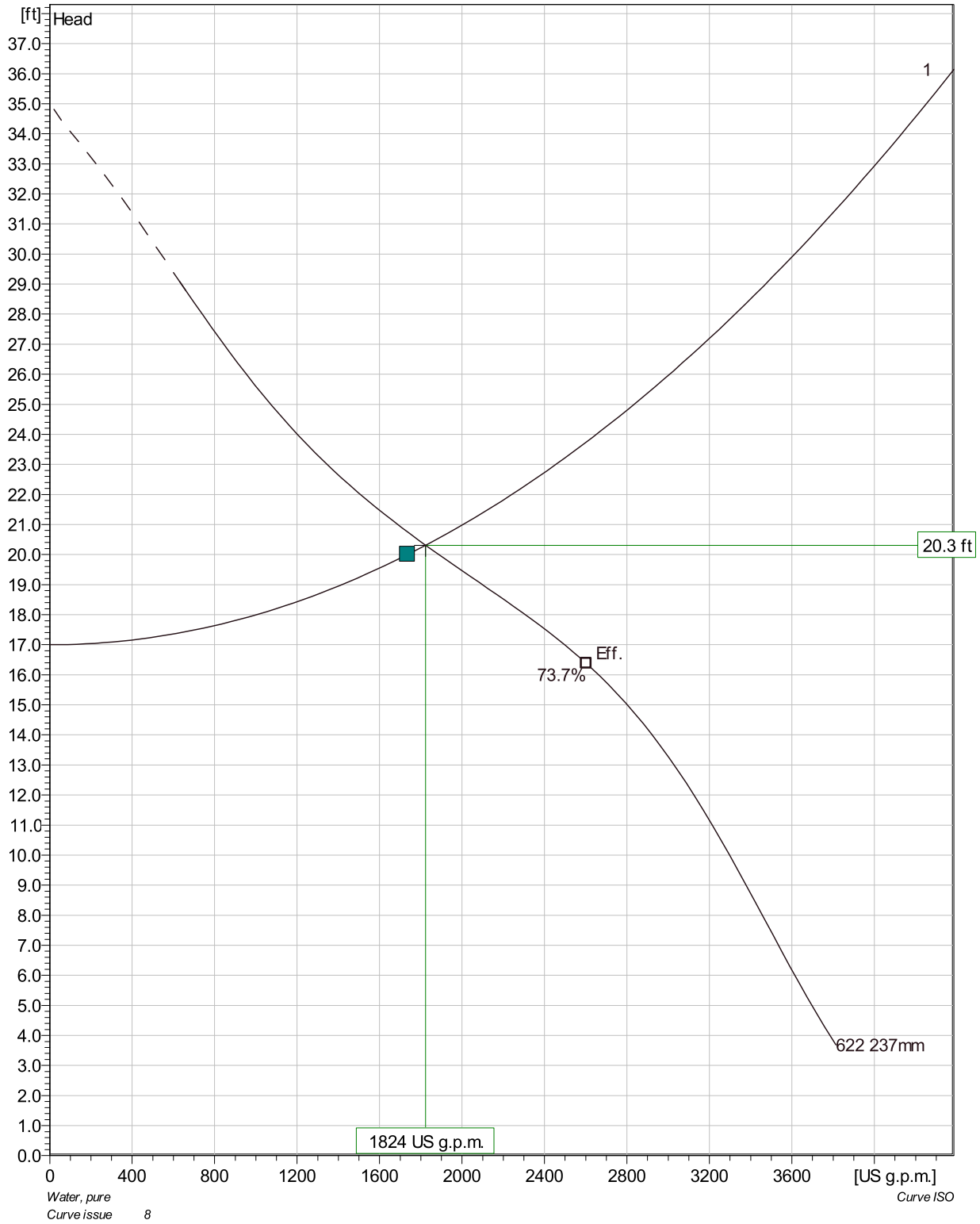



| Duty point | | Guarantee |
|---|---|---|
| Flow | Head | |
| 1740 US g.p.m. | 20 ft | No |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3153 LT 3~ 622

## Duty Analysis

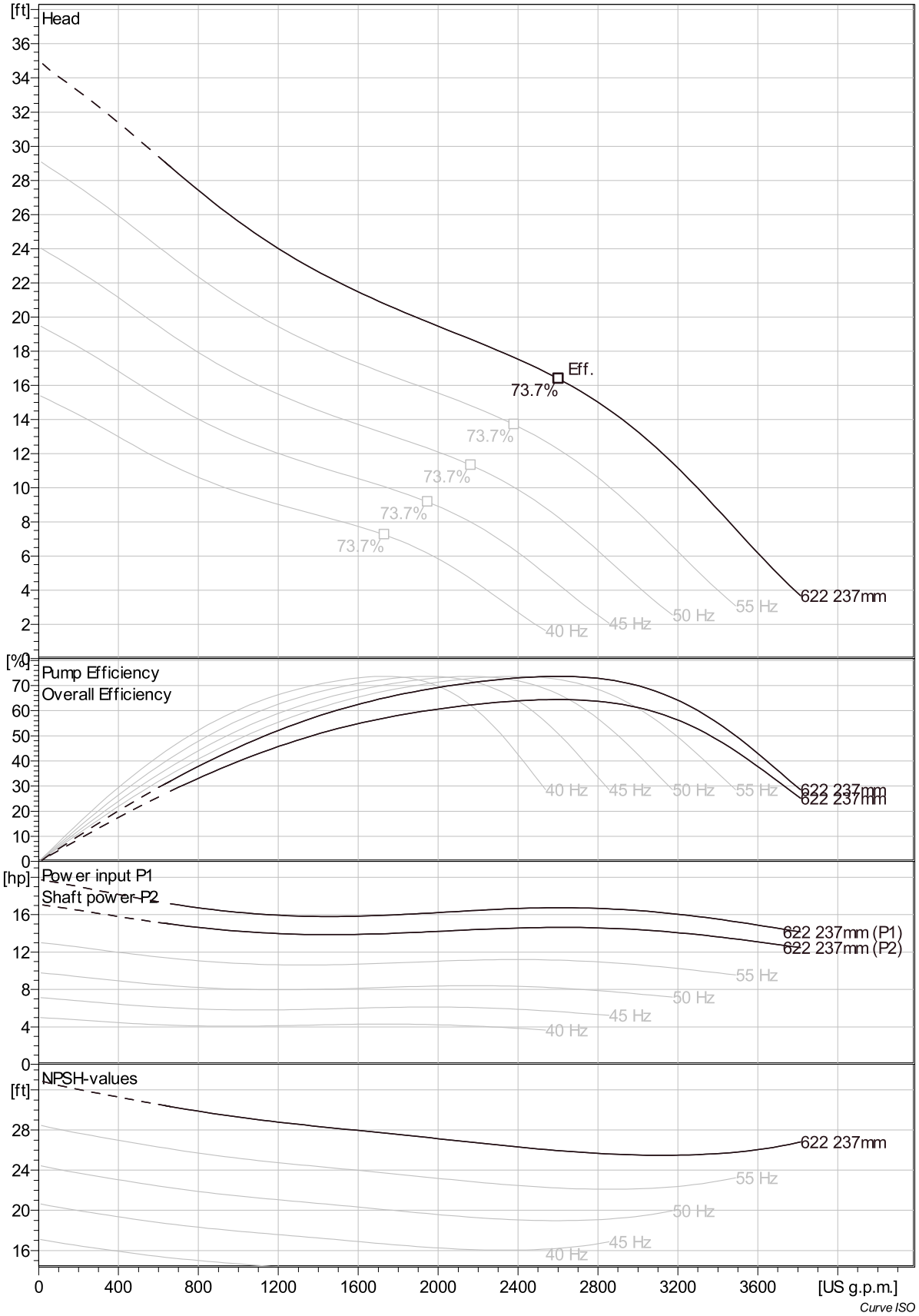



| Pumps running /System | Individual pump Flow | Head | Shaft power | Total Flow | Head | Shaft power | Pump eff. | Specific energy | NPSHre |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1820 US g.p.m. | 20.3 ft | 14.1 hp | 1820 US g.p.m. | 20.3 ft | 14.1 hp | 66.7 % | 109 kWh/US MG | 27.5 ft |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3153 LT 3~ 622

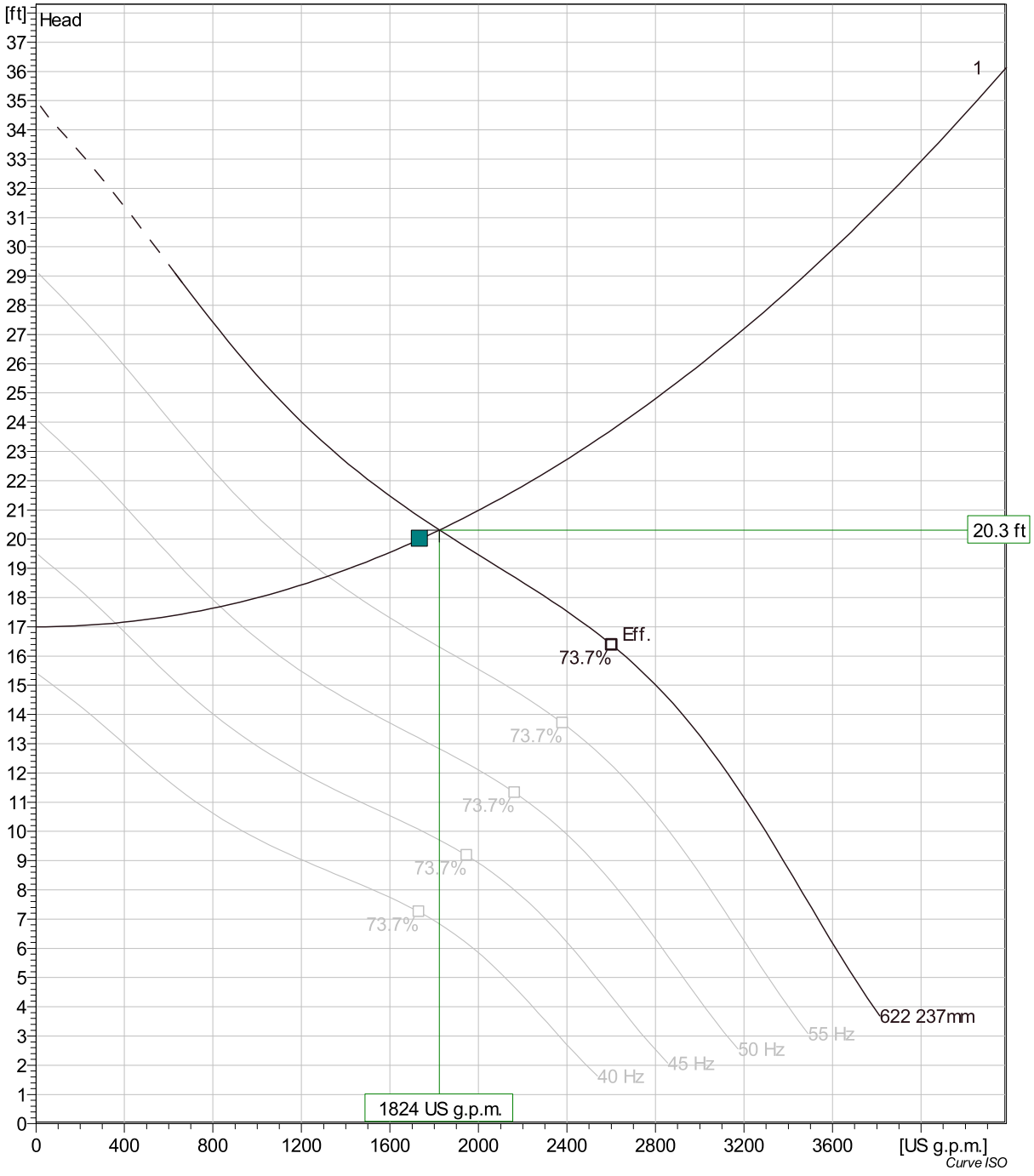
## VFD Curve




| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3153 LT 3~ 622

## VFD Analysis

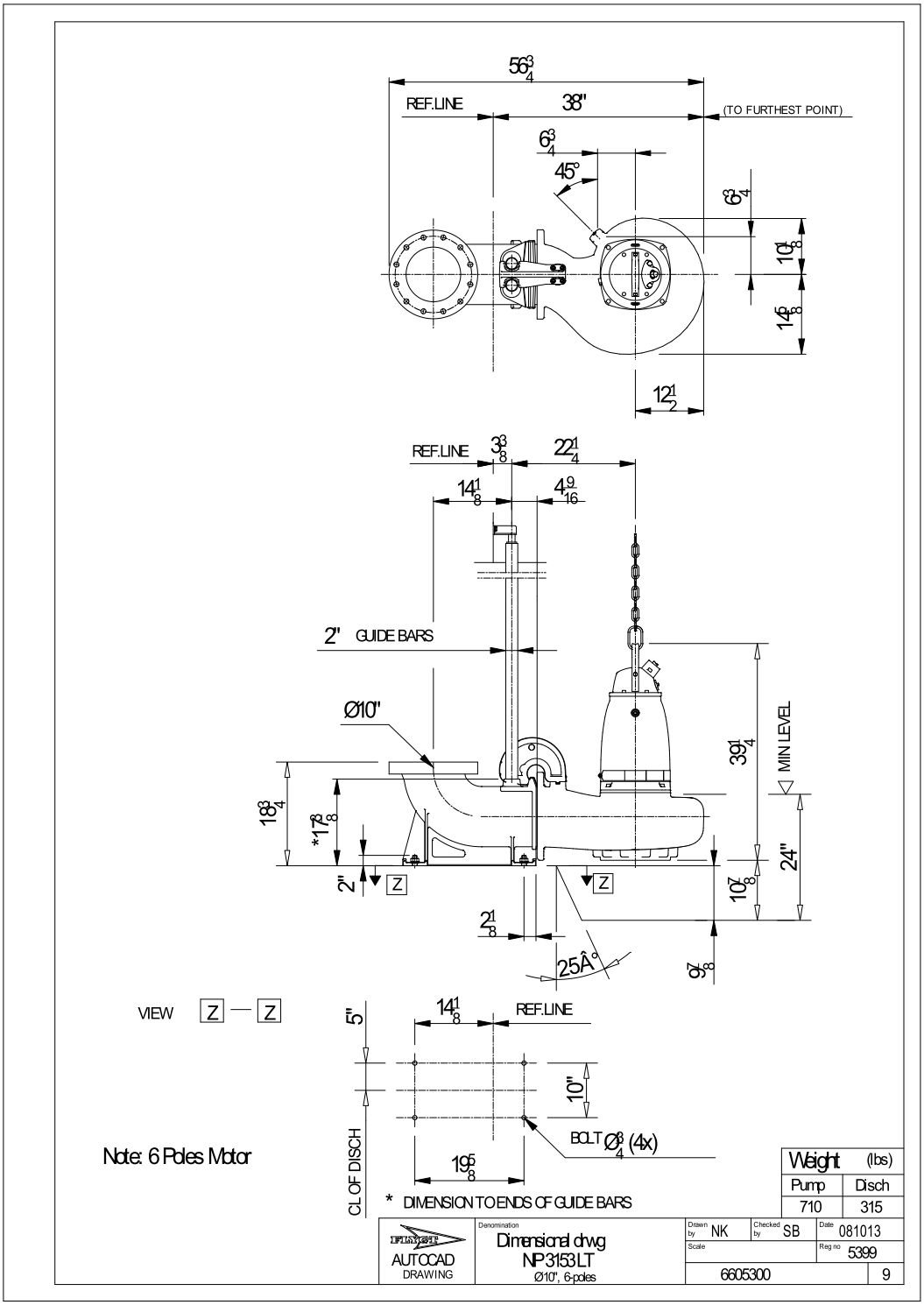



| Pumps running /System | Frequency | Flow | Head | Shaft power | Flow | Head | Shaft power | Hyd eff. | Specific energy | NPSHre |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 60 Hz | 1820 US g.p.m. | 20.3 ft | 14.1 hp | 1820 US g.p.m. | 20.3 ft | 14.1 hp | 66.7 % | 109 kWh/US MG | 27.5 ft |
| 1 | 55 Hz | 1320 US g.p.m. | 18.7 ft | 10.6 hp | 1320 US g.p.m. | 18.7 ft | 10.6 hp | 58.9 % | 113 kWh/US MG | 24.5 ft |
| 1 | 50 Hz | 833 US g.p.m. | 17.7 ft | 8.19 hp | 833 US g.p.m. | 17.7 ft | 8.19 hp | 45.5 % | 139 kWh/US MG | 21.8 ft |
| 1 | 45 Hz | 359 US g.p.m. | 17.1 ft | 6.51 hp | 359 US g.p.m. | 17.1 ft | 6.51 hp | 23.9 % | 259 kWh/US MG | 19.5 ft |
| 1 | 40 Hz | | | | | | | | | |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3153 LT 3~ 622

## Dimensional drawing



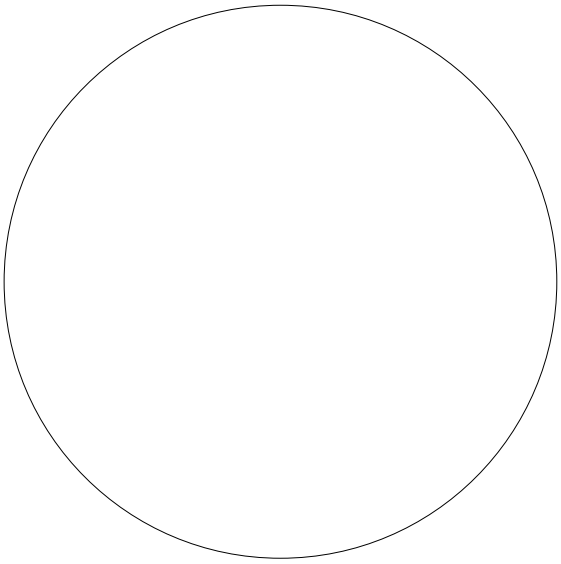

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3153 LT 3~ 622

## Life cycle costs (LCC)

| | | | |
|---|---|---|---|
| Total lifetime | 15 | Inflation rate (rate of price increases) | 2 % |
| Annual operating time | 5600 | Interest rate (for investment) | 3 % |
| Energy cost per kWh | 0.00 USD | | |
| Power input P1 | | | |

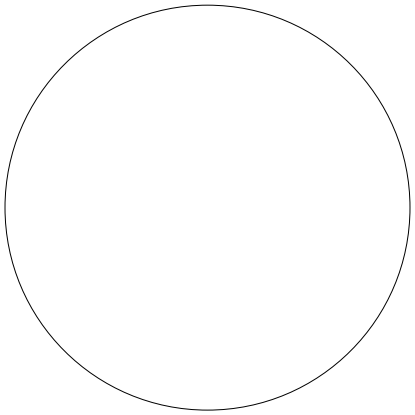
### Total costs



**0.00**
**USD**

| | | |
|---|---|---|
| 0% | **0.00 USD** | Energy |
| 0% | **0.00 USD** | Investment costs |
| 0% | **0.00 USD** | Installation & commissioning |
| 0% | **0.00 USD** | Operating cost |
| 0% | **0.00 USD** | Maintenance & repair |
| 0% | **0.00 USD** | Downtime |
| 0% | **0.00 USD** | Environmental |
| 0% | **0.00 USD** | Decommissioning |

### First year costs



**0.00**
**USD**

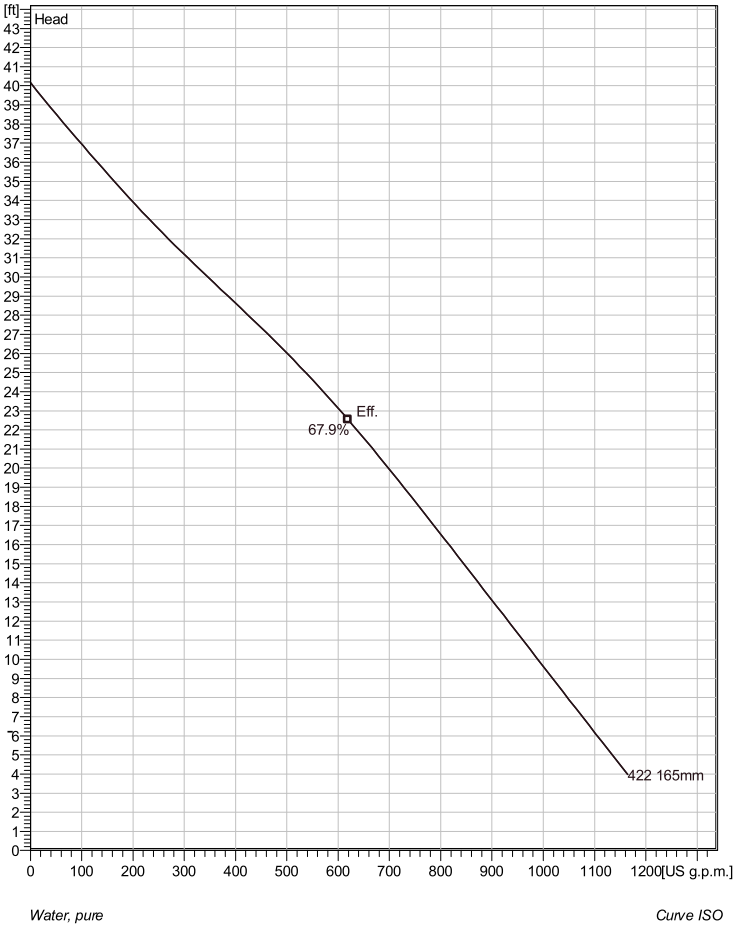
| | | |
|---|---|---|
| 0% | **0.00 USD** | Energy (1st year) |
| 0% | **0.00 USD** | Investment costs (1st year) |
| 0% | **0.00 USD** | Installation & commissioning (1st year) |
| 0% | **0.00 USD** | Operating cost (1st year) |
| 0% | **0.00 USD** | Maintenance & repair (1st year) |
| 0% | **0.00 USD** | Downtime (1st year) |
| 0% | **0.00 USD** | Environmental (1st year) |
| 0% | **0.00 USD** | Decommissioning (1st year) |

*Disclaimer: The calculations and the results are based on user input values and general assumptions and provide only estimated costs for the input data. Xyleminc can therefore not guarantee that the estimated savings will actually occur.*

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | **6/23/2018** | |

# NP 3102 LT 3~ Adaptive 422

## Technical specification




*Water, pure* *Curve ISO*



*Note: Picture might not correspond to the current configuration.*

### General

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.

### Impeller

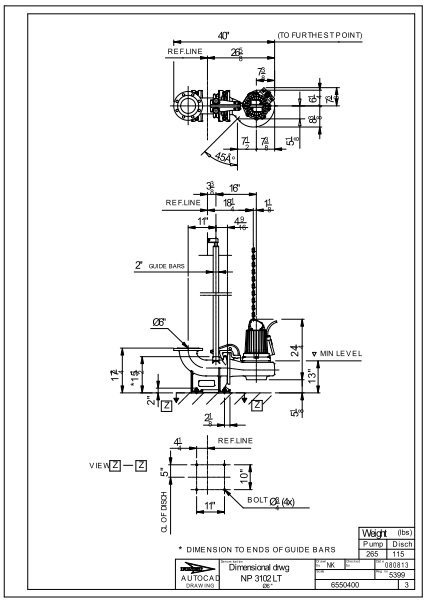
| | |
|---|---|
| Impeller material | Hard-Iron |
| Discharge Flange Diameter | 5 7/8 inch |
| Suction Flange Diameter | 5 7/8 inch |
| Impeller diameter | 165 mm |
| Number of blades | 2 |

### Motor

| | |
|---|---|
| Motor # | N3102.930 18-11-4AS-W IE3 5.5hp FM |
| Stator variant | 1 |
| Frequency | 60 Hz |
| Rated voltage | 460 V |
| Number of poles | 4 |
| Phases | 3~ |
| Rated power | 5.5 hp |
| Rated current | 6.2 A |
| Starting current | 42 A |
| Rated speed | 1800 rpm |
| Power factor | |
| 1/1 Load | 0.90 |
| 3/4 Load | 0.86 |
| 1/2 Load | 0.75 |
| Motor efficiency | |
| 1/1 Load | 91.9 % |
| 3/4 Load | 91.5 % |
| 1/2 Load | 90.1 % |

### Configuration

**Installation: P - Semi permanent, Wet**




| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3102 LT 3~ Adaptive 422

## Performance curve

### Pump

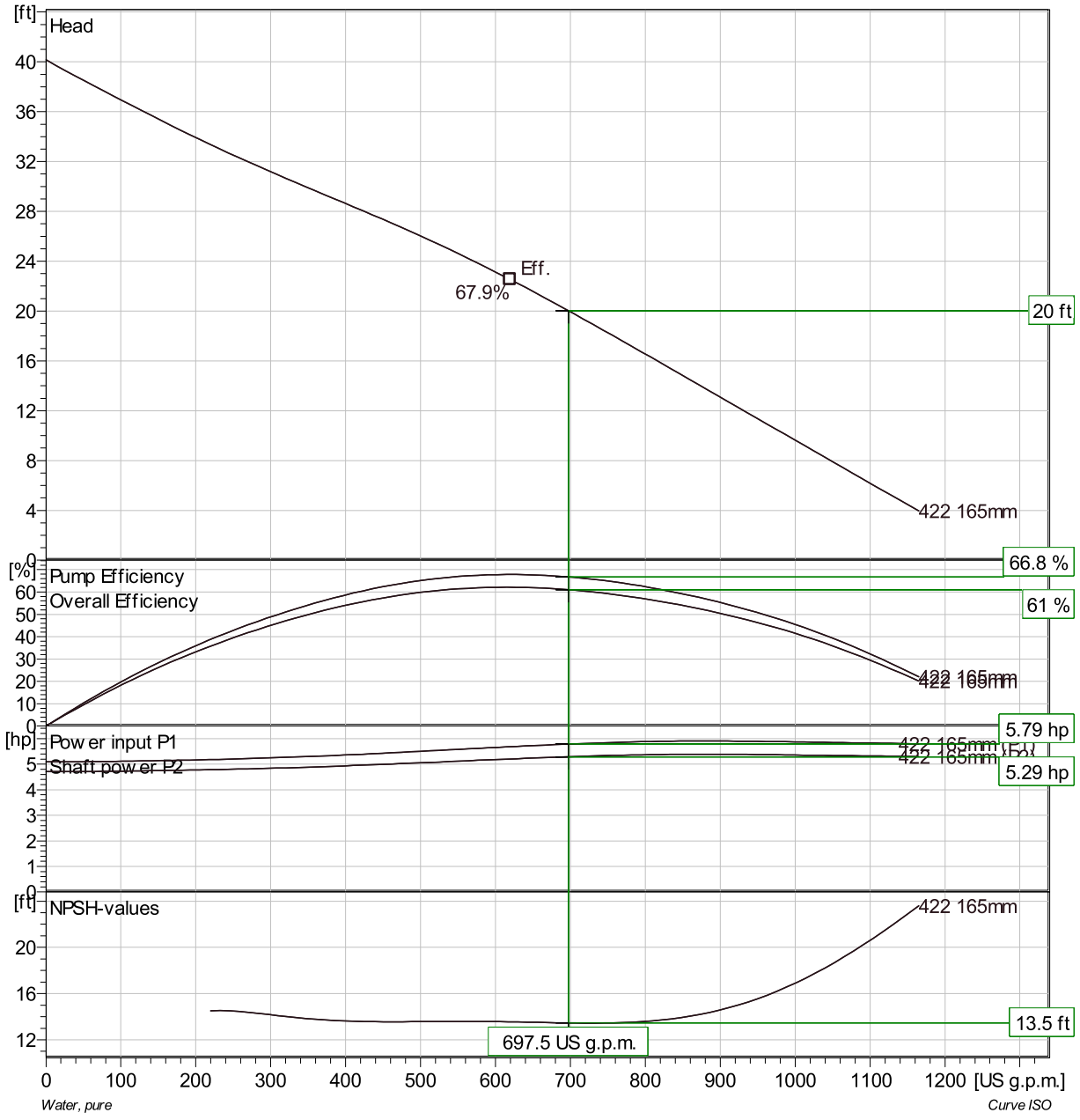
| | |
|---|---|
| Discharge Flange Diameter | 5 7/8 inch |
| Suction Flange Diameter | 150 mm |
| Impeller diameter | 6½" |
| Number of blades | 2 |

### Motor

| | |
|---|---|
| Motor # | N3102.930 18-11-4AS-W IE3 5.5hp |
| Stator variant | 1 |
| Frequency | 60 Hz |
| Rated voltage | 460 V |
| Number of poles | 4 |
| Phases | 3~ |
| Rated power | 5.5 hp |
| Rated current | 6.2 A |
| Starting current | 42 A |
| Rated speed | 1800 rpm |

| Power factor | |
|---|---|
| 1/1 Load | 0.90 |
| 3/4 Load | 0.86 |
| 1/2 Load | 0.75 |

| Motor efficiency | |
|---|---|
| 1/1 Load | 91.9 % |
| 3/4 Load | 91.5 % |
| 1/2 Load | 90.1 % |

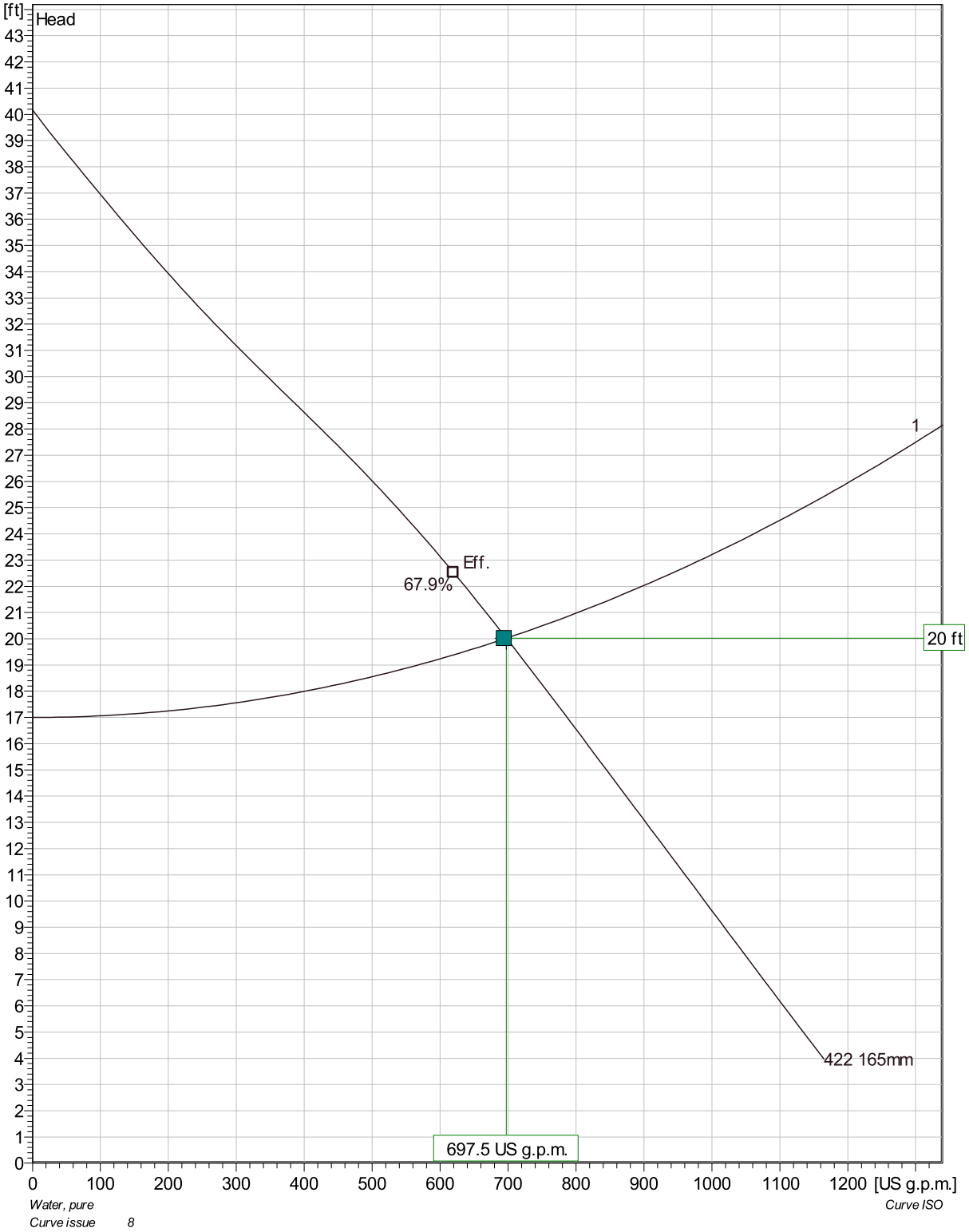



| Duty point | | Guarantee |
|---|---|---|
| **Flow** | **Head** | |
| 695 US g.p.m. | 20 ft | No |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | **6/23/2018** | |

# NP 3102 LT 3~ Adaptive 422

## Duty Analysis

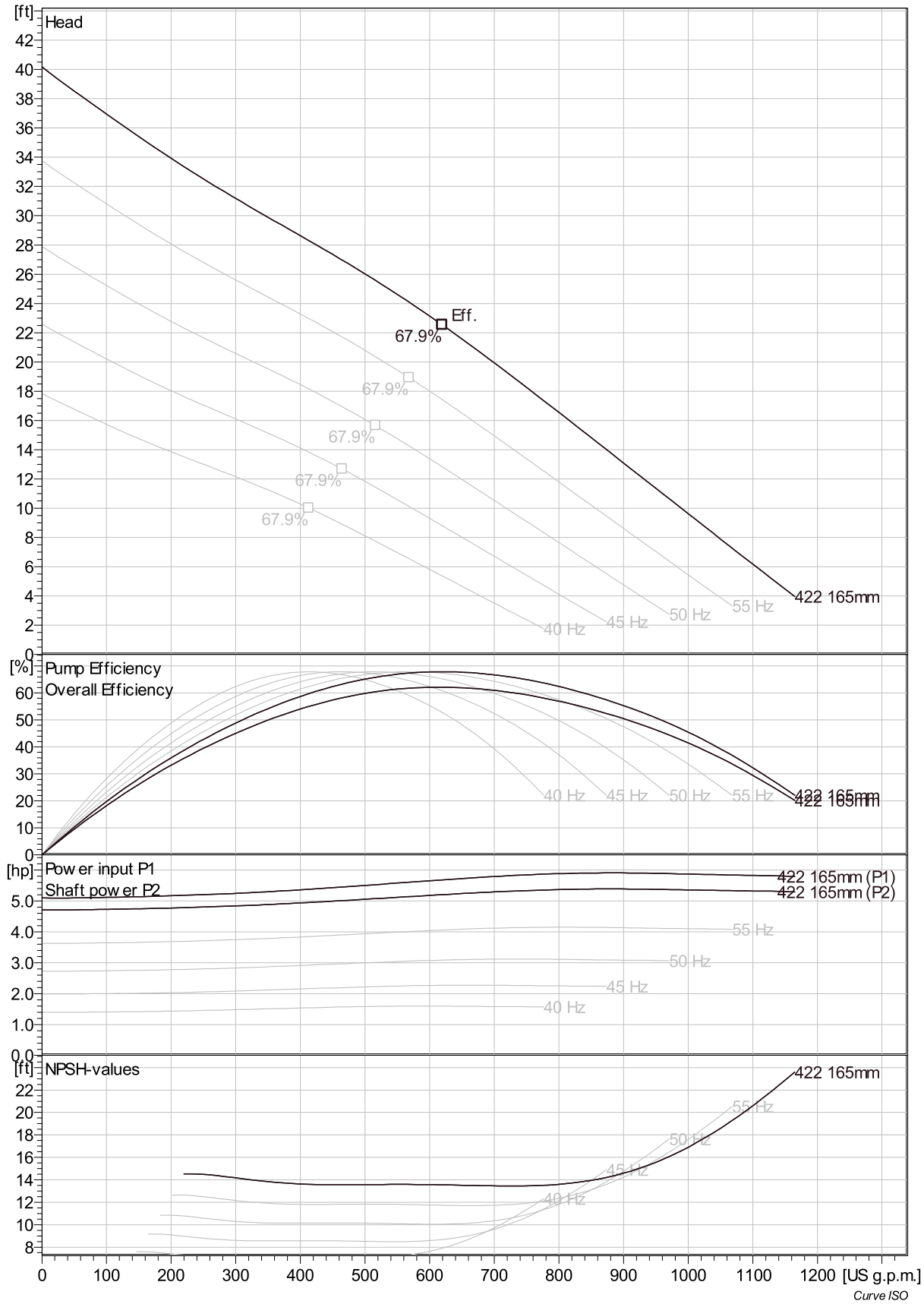



| | Individual pump | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pumps running /System | Flow | Head | Shaft power | Flow | Head | Shaft power | Pump eff. | Specific energy | NPSHre |
| 1 | 698 US g.p.m. | 20 ft | 5.29 hp | 698 US g.p.m. | 20 ft | 5.29 hp | 66.8 % | 103 kWh/US MG | 13.5 ft |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3102 LT 3~ Adaptive 422

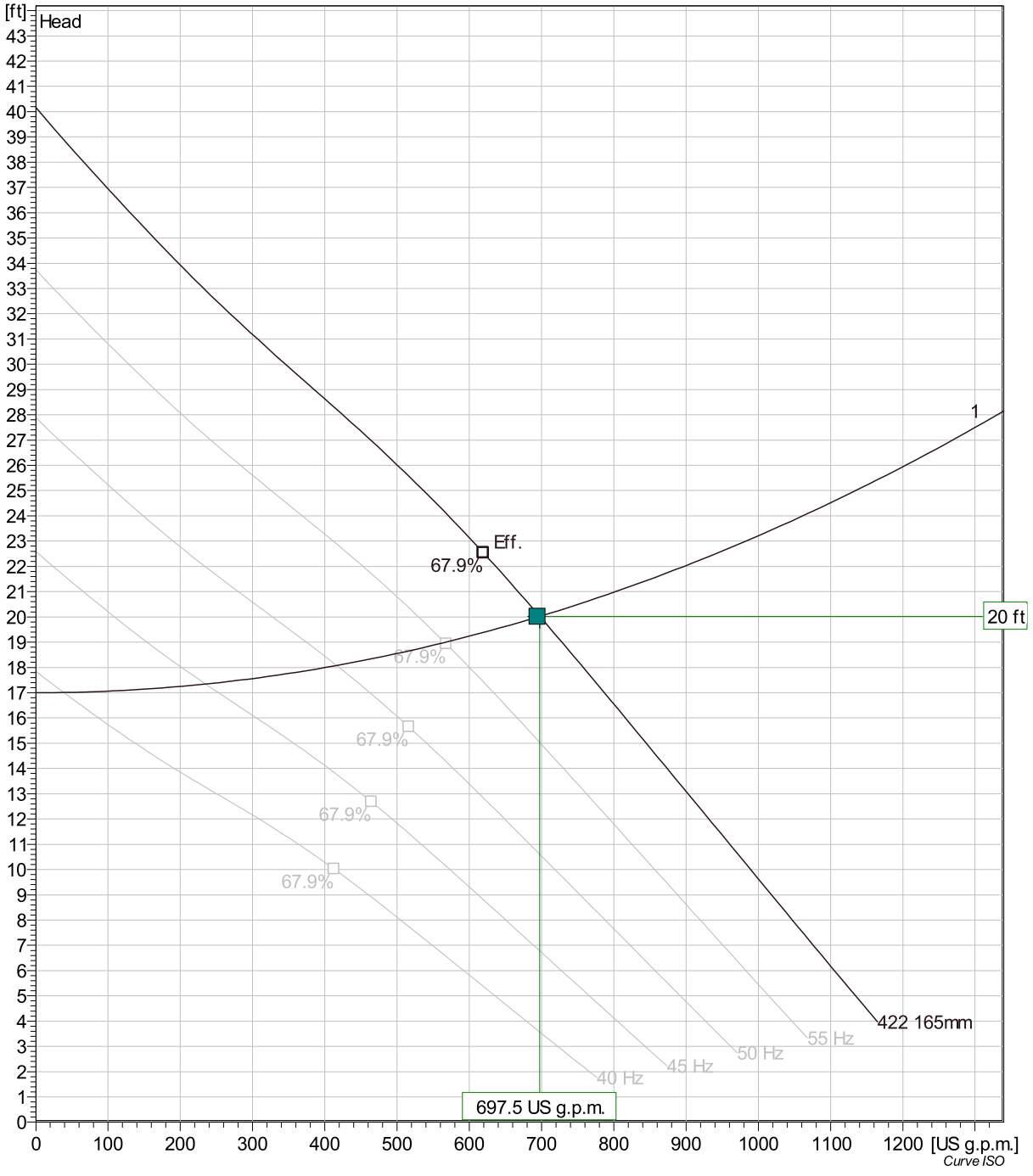
## VFD Curve




| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3102 LT 3~ Adaptive 422

## VFD Analysis

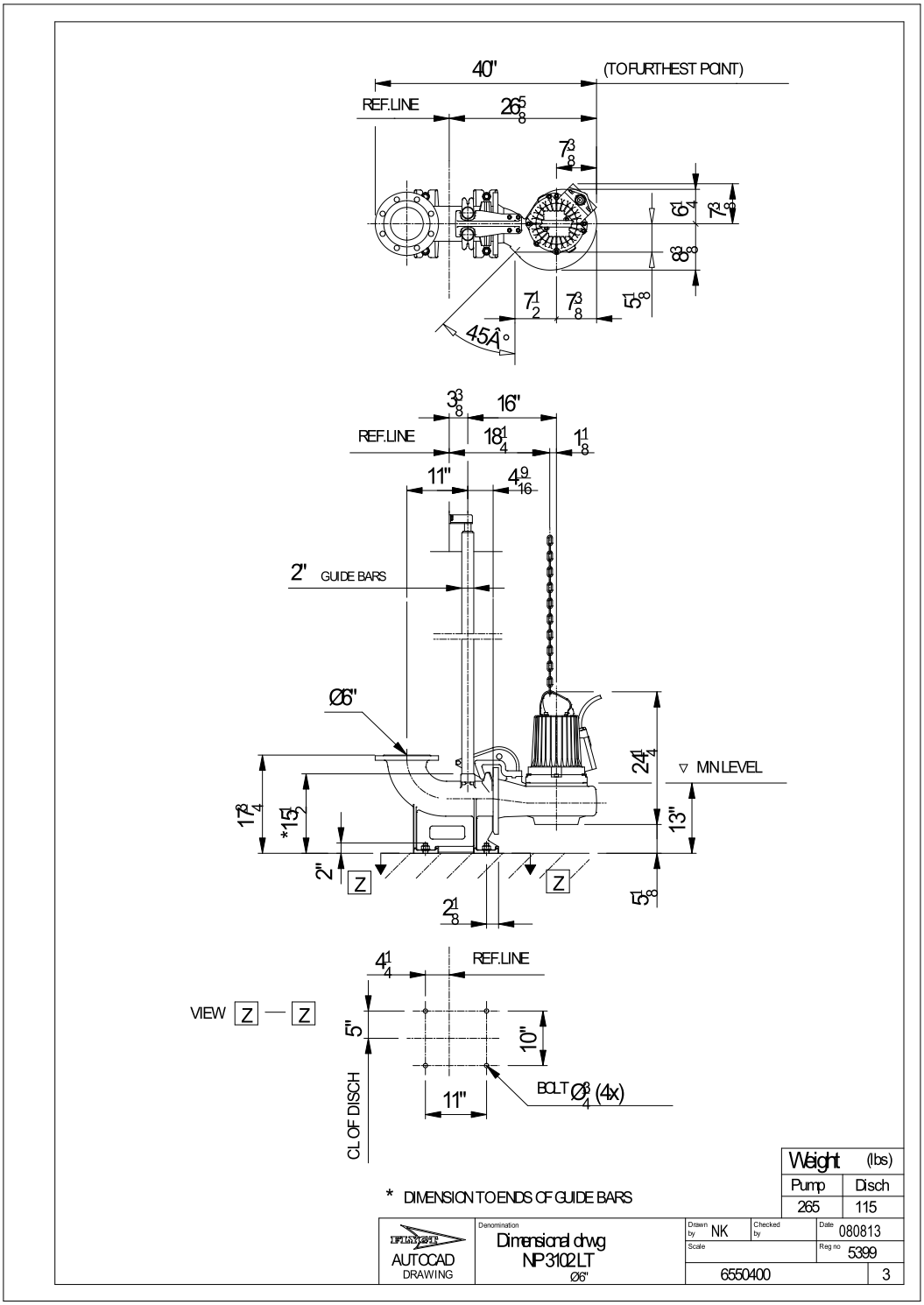



| Pumps running /System | Frequency | Flow | Head | Shaft power | Flow | Head | Shaft power | Hyd eff. | Specific energy | NPSHre |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 60 Hz | 698 US g.p.m. | 20 ft | 5.29 hp | 698 US g.p.m. | 20 ft | 5.29 hp | 66.8 % | 103 kWh/US MG | 13.5 ft |
| 1 | 55 Hz | 566 US g.p.m. | 19 ft | 4.01 hp | 566 US g.p.m. | 19 ft | 4.01 hp | 67.9 % | 95.1 kWh/US MG | 11.8 ft |
| 1 | 50 Hz | 416 US g.p.m. | 18.1 ft | 2.92 hp | 416 US g.p.m. | 18.1 ft | 2.92 hp | 65.1 % | 97.8 kWh/US MG | 10.1 ft |
| 1 | 45 Hz | 235 US g.p.m. | 17.3 ft | 2.05 hp | 235 US g.p.m. | 17.3 ft | 2.05 hp | 50.4 % | 124 kWh/US MG | 8.88 ft |
| 1 | 40 Hz | 38.6 US g.p.m. | 17 ft | 1.4 hp | 38.6 US g.p.m. | 17 ft | 1.4 hp | 11.9 % | 514 kWh/US MG | |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3102 LT 3~ Adaptive 422

## Dimensional drawing



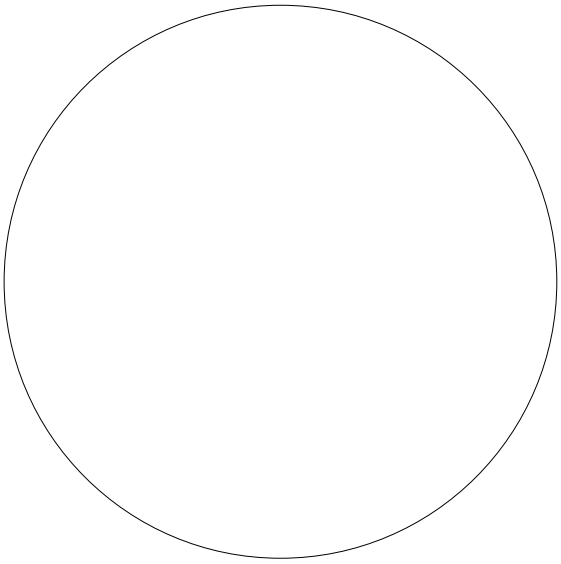

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3102 LT 3~ Adaptive 422

## Life cycle costs (LCC)

| | | | |
|---|---|---|---|
| Total lifetime | 15 | Inflation rate (rate of price increases) | 2 % |
| Annual operating time | 5600 | Interest rate (for investment) | 3 % |
| Energy cost per kWh | 0.00 USD | | |
| Power input P1 | | | |

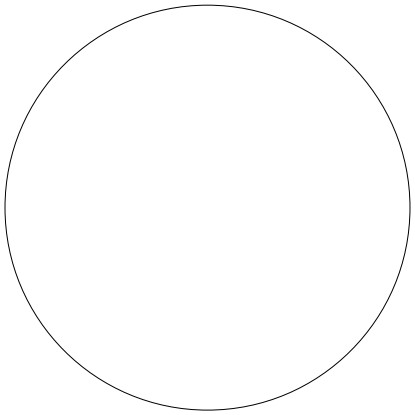
### Total costs



**0.00**
**USD**

| | | |
|---|---|---|
| 0% | **0.00 USD** | Energy |
| 0% | **0.00 USD** | Investment costs |
| 0% | **0.00 USD** | Installation & commissioning |
| 0% | **0.00 USD** | Operating cost |
| 0% | **0.00 USD** | Maintenance & repair |
| 0% | **0.00 USD** | Downtime |
| 0% | **0.00 USD** | Environmental |
| 0% | **0.00 USD** | Decommissioning |

### First year costs



**0.00**
**USD**

| | | |
|---|---|---|
| 0% | **0.00 USD** | Energy (1st year) |
| 0% | **0.00 USD** | Investment costs (1st year) |
| 0% | **0.00 USD** | Installation & commissioning (1st year) |
| 0% | **0.00 USD** | Operating cost (1st year) |
| 0% | **0.00 USD** | Maintenance & repair (1st year) |
| 0% | **0.00 USD** | Downtime (1st year) |
| 0% | **0.00 USD** | Environmental (1st year) |
| 0% | **0.00 USD** | Decommissioning (1st year) |

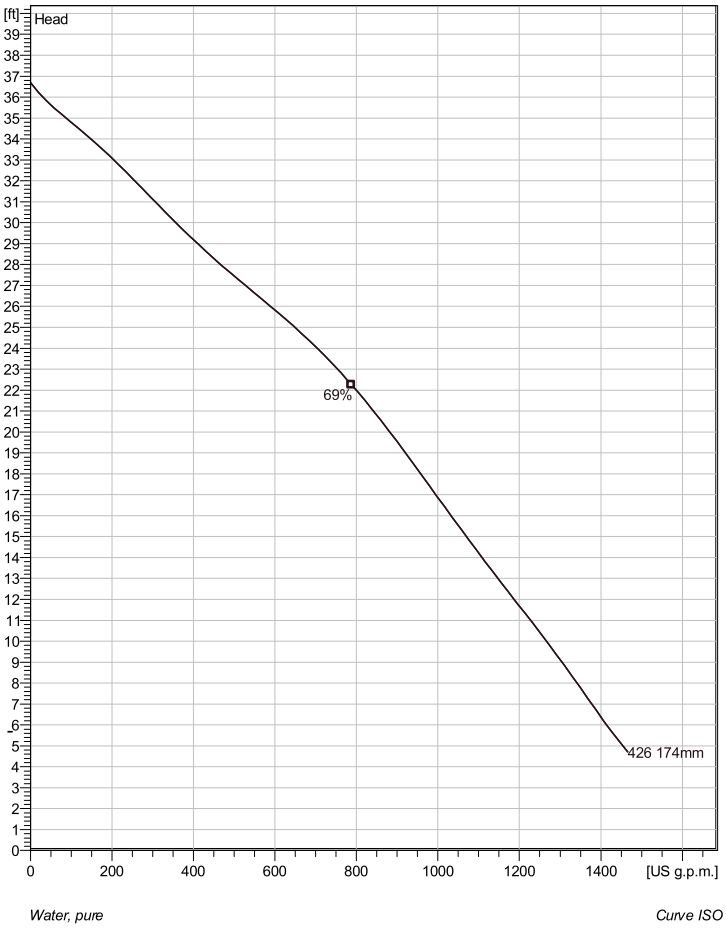
*Disclaimer: The calculations and the results are based on user input values and general assumptions and provide only estimated costs for the input data. Xyleminc can therefore not guarantee that the estimated savings will actually occur.*

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | **6/23/2018** | |

# FLYGT PUMP STATION 1 QUOTE

# NP 3127 LT 3~ Adaptive 426

## Technical specification




*Water, pure* *Curve ISO*



*Note: Picture might not correspond to the current configuration.*

### General

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.

### Impeller

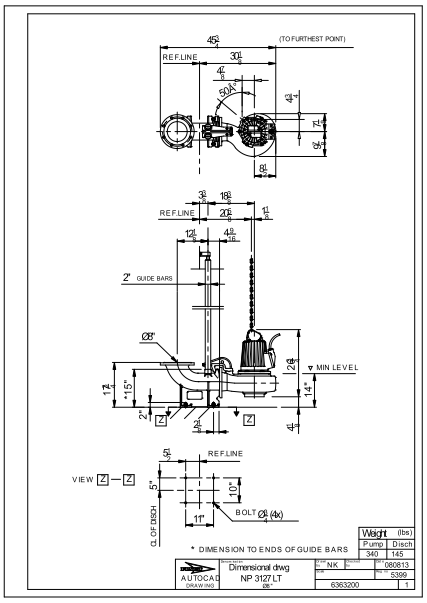
| | |
|---|---|
| Impeller material | Hard-Iron |
| Discharge Flange Diameter | 5 7/8 inch |
| Suction Flange Diameter | 5 7/8 inch |
| Impeller diameter | 174 mm |
| Number of blades | 2 |

### Motor

| | |
|---|---|
| Motor # | N3127.070 21-10-4AL-W 7.5hp FM |
| Stator variant | 12 |
| Frequency | 60 Hz |
| Rated voltage | 460 V |
| Number of poles | 4 |
| Phases | 3~ |
| Rated power | 7.5 hp |
| Rated current | 9.6 A |
| Starting current | 52 A |
| Rated speed | 1740 rpm |
| Power factor | |
| 1/1 Load | 0.88 |
| 3/4 Load | 0.85 |
| 1/2 Load | 0.77 |
| Motor efficiency | |
| 1/1 Load | 83.8 % |
| 3/4 Load | 84.7 % |
| 1/2 Load | 83.7 % |

### Configuration

**Installation: P - Semi permanent, Wet**




| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3127 LT 3~ Adaptive 426

## Performance curve

### Pump

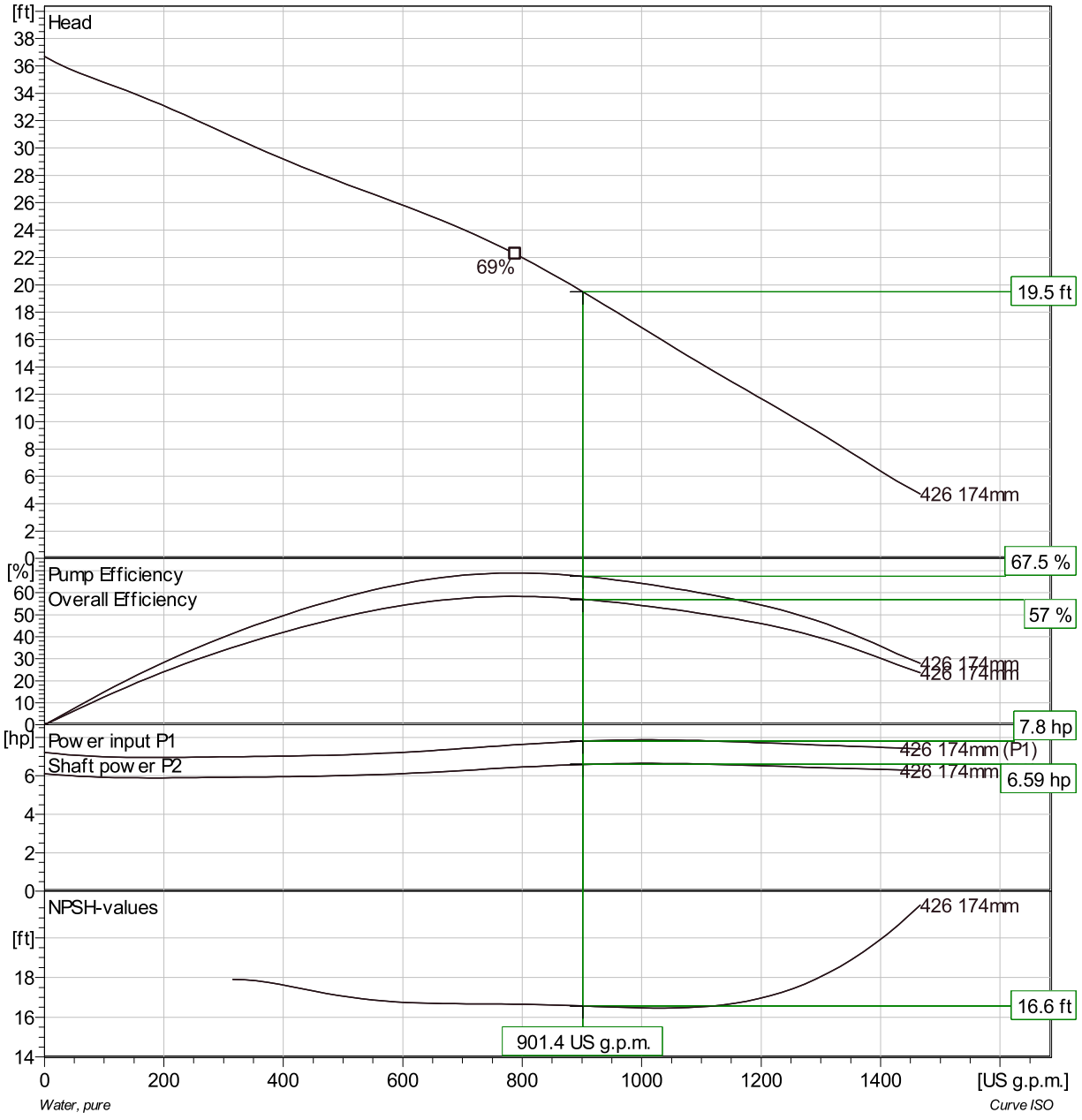
| | |
|---|---|
| Discharge Flange Diameter | 5 7/8 inch |
| Suction Flange Diameter | 150 mm |
| Impeller diameter | $6^{7}/_{8}$" |
| Number of blades | 2 |

### Motor

| | |
|---|---|
| Motor # | N3127.070 21-10-4AL-W 7.5hp |
| Stator variant | 12 |
| Frequency | 60 Hz |
| Rated voltage | 460 V |
| Number of poles | 4 |
| Phases | 3~ |
| Rated power | 7.5 hp |
| Rated current | 9.6 A |
| Starting current | 52 A |
| Rated speed | 1740 rpm |

| Power factor | |
|---|---|
| 1/1 Load | 0.88 |
| 3/4 Load | 0.85 |
| 1/2 Load | 0.77 |

| Motor efficiency | |
|---|---|
| 1/1 Load | 83.8 % |
| 3/4 Load | 84.7 % |
| 1/2 Load | 83.7 % |

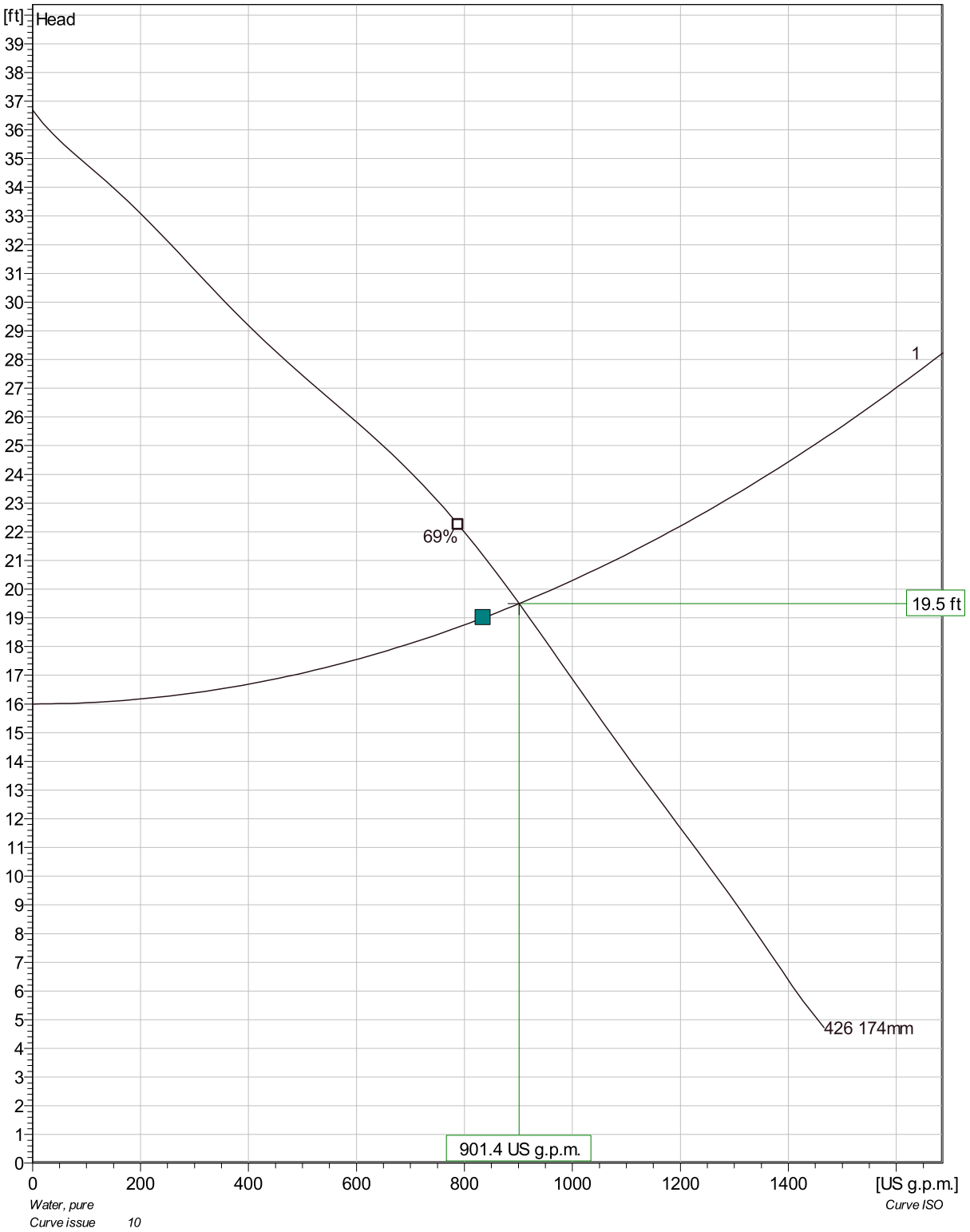



| Duty point | | Guarantee |
|---|---|---|
| **Flow** | **Head** | |
| 835 US g.p.m. | 19 ft | No |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | **6/23/2018** | |

# NP 3127 LT 3~ Adaptive 426

## Duty Analysis

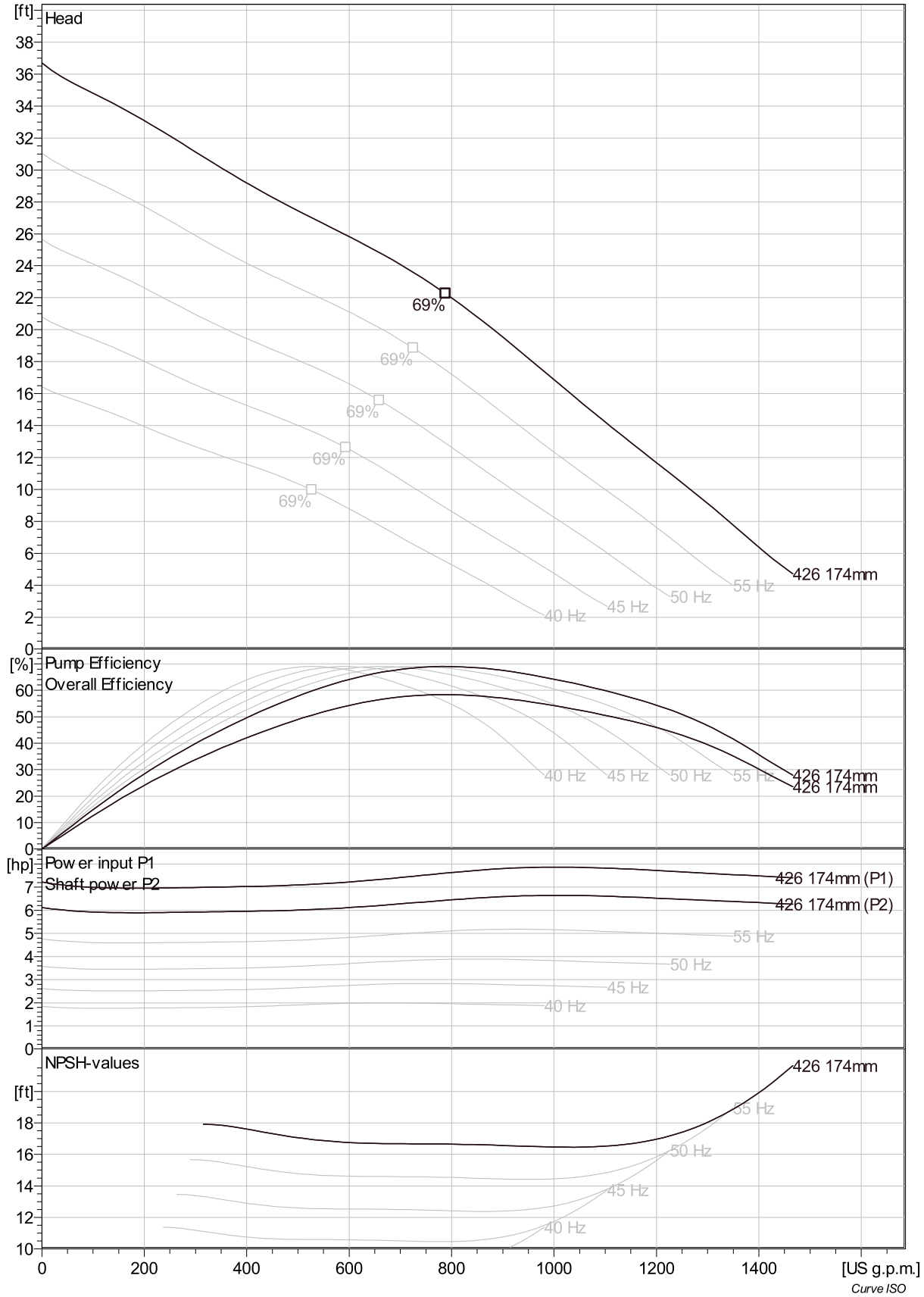



| Pumps running /System | Individual pump | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Flow | Head | Shaft power | Flow | Head | Shaft power | Pump eff. | Specific energy | NPSHre |
| 1 | 901 US g.p.m. | 19.5 ft | 6.59 hp | 901 US g.p.m. | 19.5 ft | 6.59 hp | 67.5 % | 108 kWh/US MG | 16.6 ft |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3127 LT 3~ Adaptive 426

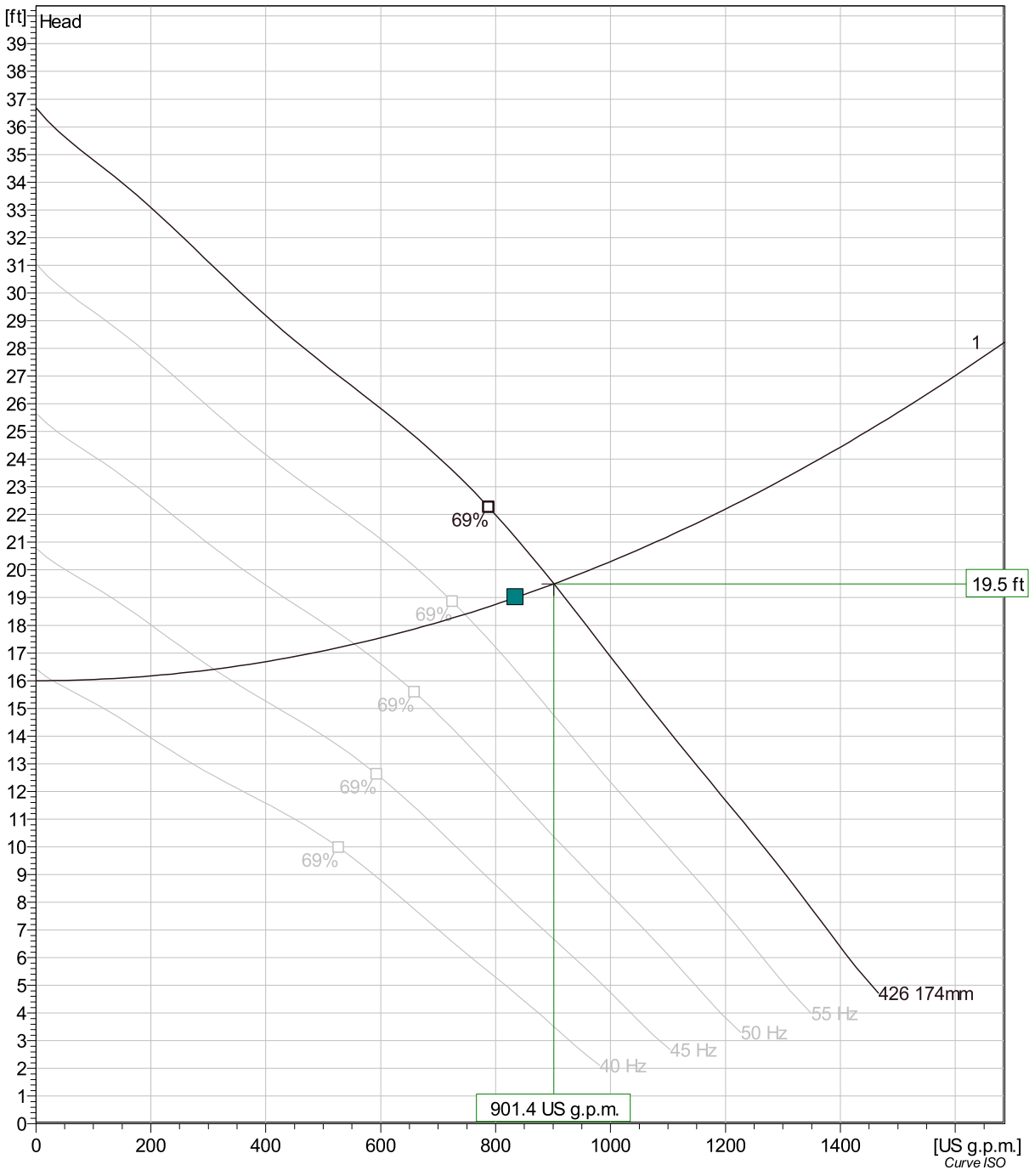
## VFD Curve




| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3127 LT 3~ Adaptive 426

## VFD Analysis

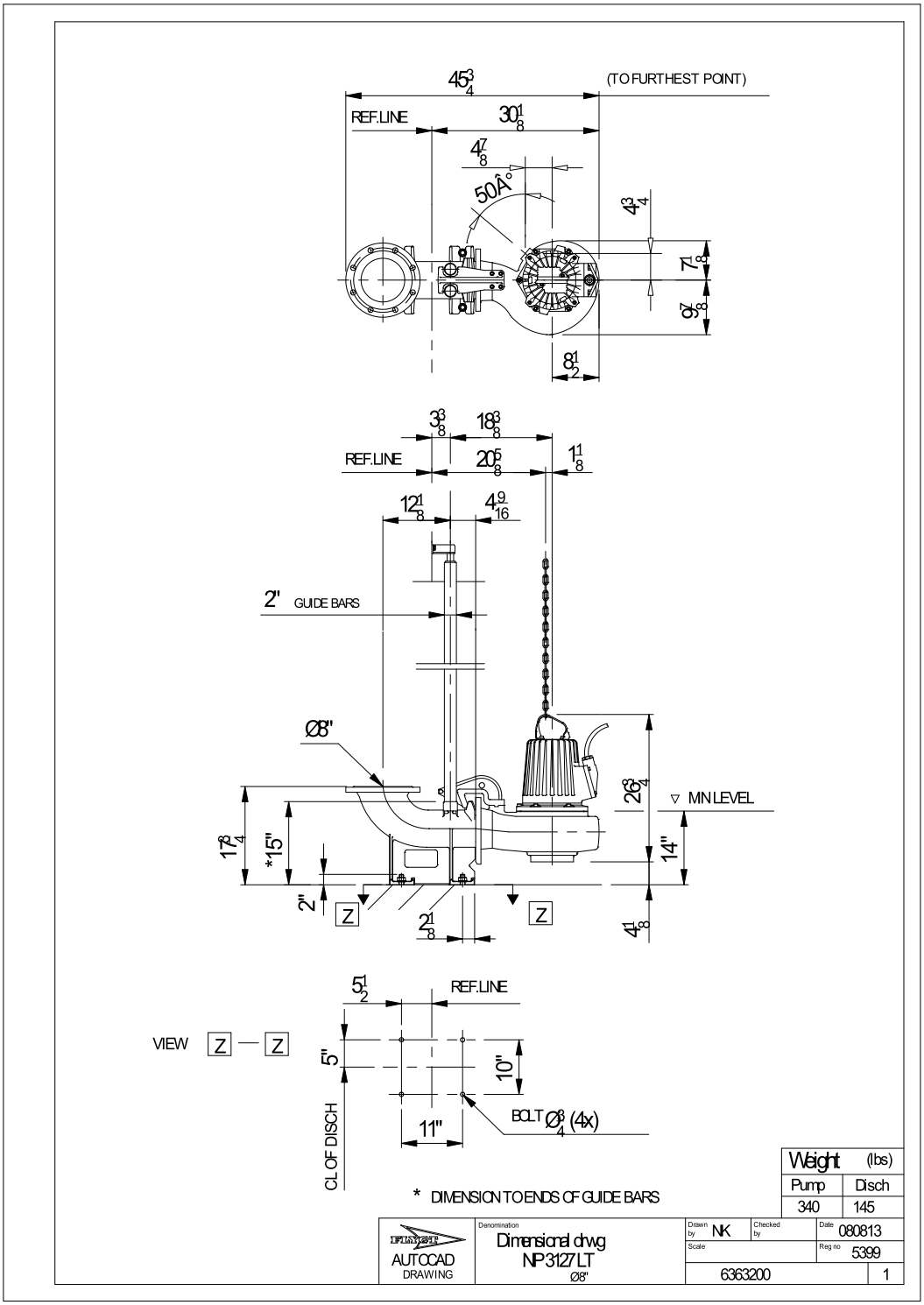



| Pumps running /System | Frequency | Flow | Head | Shaft power | Flow | Head | Shaft power | Hyd eff. | Specific energy | NPSHre |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 58.4 Hz | 901 US g.p.m. | 19.5 ft | 6.59 hp | 901 US g.p.m. | 19.5 ft | 6.59 hp | 67.5 % | 108 kWh/US MG | 16.6 ft |
| 1 | 55 Hz | 747 US g.p.m. | 18.4 ft | 5.04 hp | 747 US g.p.m. | 18.4 ft | 5.04 hp | 68.9 % | 99 kWh/US MG | 14.6 ft |
| 1 | 50 Hz | 554 US g.p.m. | 17.3 ft | 3.63 hp | 554 US g.p.m. | 17.3 ft | 3.63 hp | 66.8 % | 97.3 kWh/US MG | 12.5 ft |
| 1 | 45 Hz | 310 US g.p.m. | 16.4 ft | 2.54 hp | 310 US g.p.m. | 16.4 ft | 2.54 hp | 50.6 % | 126 kWh/US MG | 11.1 ft |
| 1 | 40 Hz | 28.9 US g.p.m. | 16 ft | 1.8 hp | 28.9 US g.p.m. | 16 ft | 1.8 hp | 6.46 % | 1000 kWh/US MG | |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3127 LT 3~ Adaptive 426

## Dimensional drawing



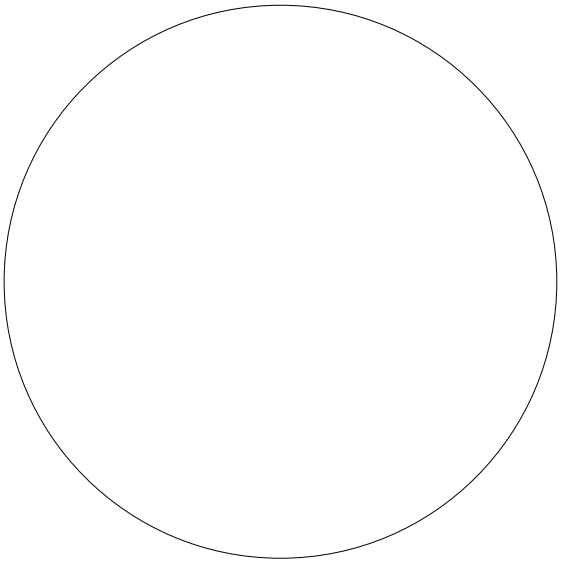

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3127 LT 3~ Adaptive 426

## Life cycle costs (LCC)

| | | | |
|---|---|---|---|
| Total lifetime | 15 | Inflation rate (rate of price increases) | 2 % |
| Annual operating time | 5600 | Interest rate (for investment) | 3 % |
| Energy cost per kWh | 0.00 USD | | |
| Power input P1 | | | |

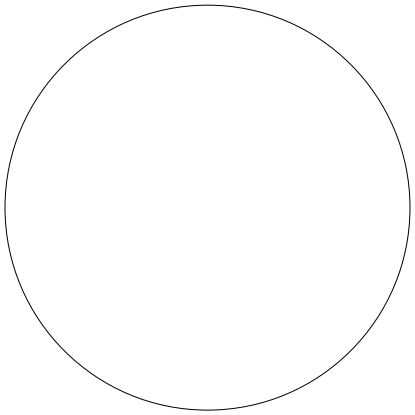
### Total costs



**0.00**
**USD**

| | | |
|---|---|---|
| 0% | **0.00 USD** | Energy |
| 0% | **0.00 USD** | Investment costs |
| 0% | **0.00 USD** | Installation & commissioning |
| 0% | **0.00 USD** | Operating cost |
| 0% | **0.00 USD** | Maintenance & repair |
| 0% | **0.00 USD** | Downtime |
| 0% | **0.00 USD** | Environmental |
| 0% | **0.00 USD** | Decommissioning |

### First year costs



**0.00**
**USD**

| | | |
|---|---|---|
| 0% | **0.00 USD** | Energy (1st year) |
| 0% | **0.00 USD** | Investment costs (1st year) |
| 0% | **0.00 USD** | Installation & commissioning (1st year) |
| 0% | **0.00 USD** | Operating cost (1st year) |
| 0% | **0.00 USD** | Maintenance & repair (1st year) |
| 0% | **0.00 USD** | Downtime (1st year) |
| 0% | **0.00 USD** | Environmental (1st year) |
| 0% | **0.00 USD** | Decommissioning (1st year) |

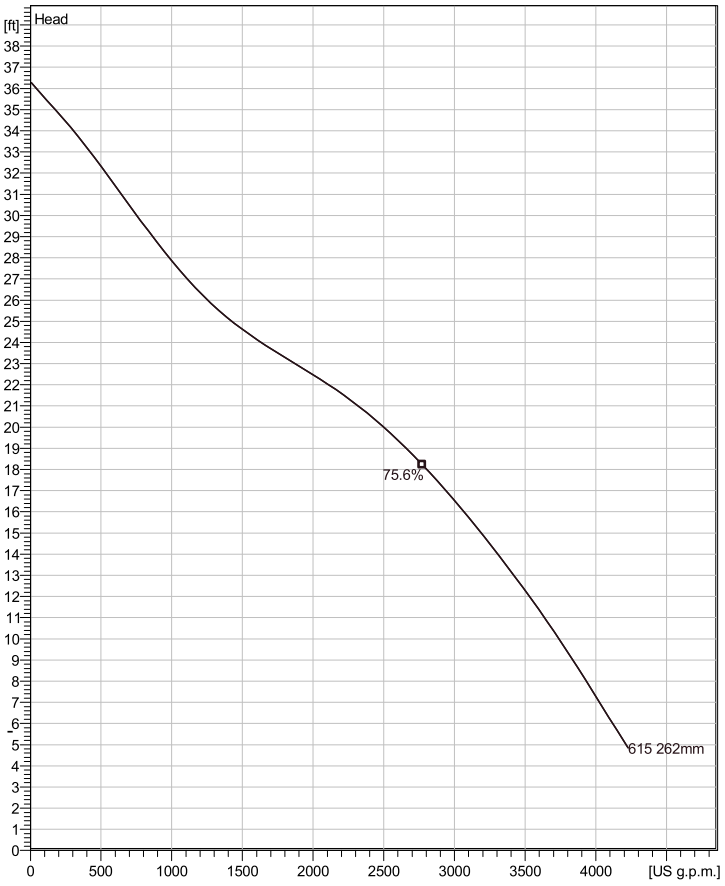
*Disclaimer: The calculations and the results are based on user input values and general assumptions and provide only estimated costs for the input data. Xylem inc can therefore not guarantee that the estimated savings will actually occur.*

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | **6/23/2018** | |

# FLYGT POND PUMP STATION QUOTE

# NP 3171 LT 3~ 615

## Technical specification




*Water, pure* *Curve ISO*



*Note: Picture might not correspond to the current configuration.*

### General

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.

### Impeller

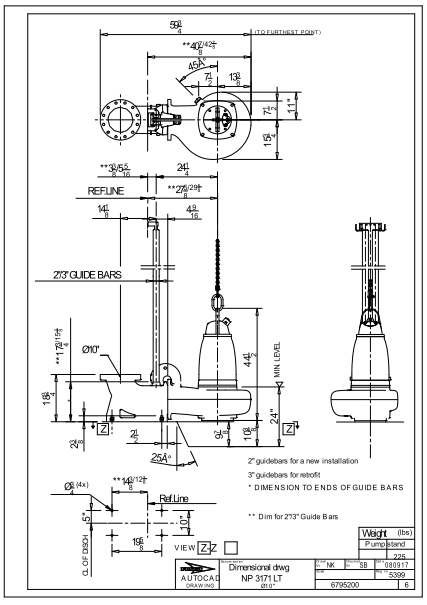
| | |
|---|---|
| Impeller material | Hard-Iron |
| Discharge Flange Diameter | 9 13/16 inch |
| Suction Flange Diameter | 9 13/16 inch |
| Impeller diameter | 262 mm |
| Number of blades | 2 |

### Motor

| | |
|---|---|
| Motor # | N3171.095 25-18-6BB-W 25hp FM |
| Stator variant | 7 |
| Frequency | 60 Hz |
| Rated voltage | 460 V |
| Number of poles | 6 |
| Phases | 3~ |
| Rated power | 25 hp |
| Rated current | 32 A |
| Starting current | 177 A |
| Rated speed | 1160 rpm |
| Power factor | |
| 1/1 Load | 0.85 |
| 3/4 Load | 0.80 |
| 1/2 Load | 0.70 |
| Motor efficiency | |
| 1/1 Load | 86.0 % |
| 3/4 Load | 87.5 % |
| 1/2 Load | 87.5 % |

### Configuration

**Installation: P - Semi permanent, Wet**




| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3171 LT 3~ 615

## Performance curve

### Pump

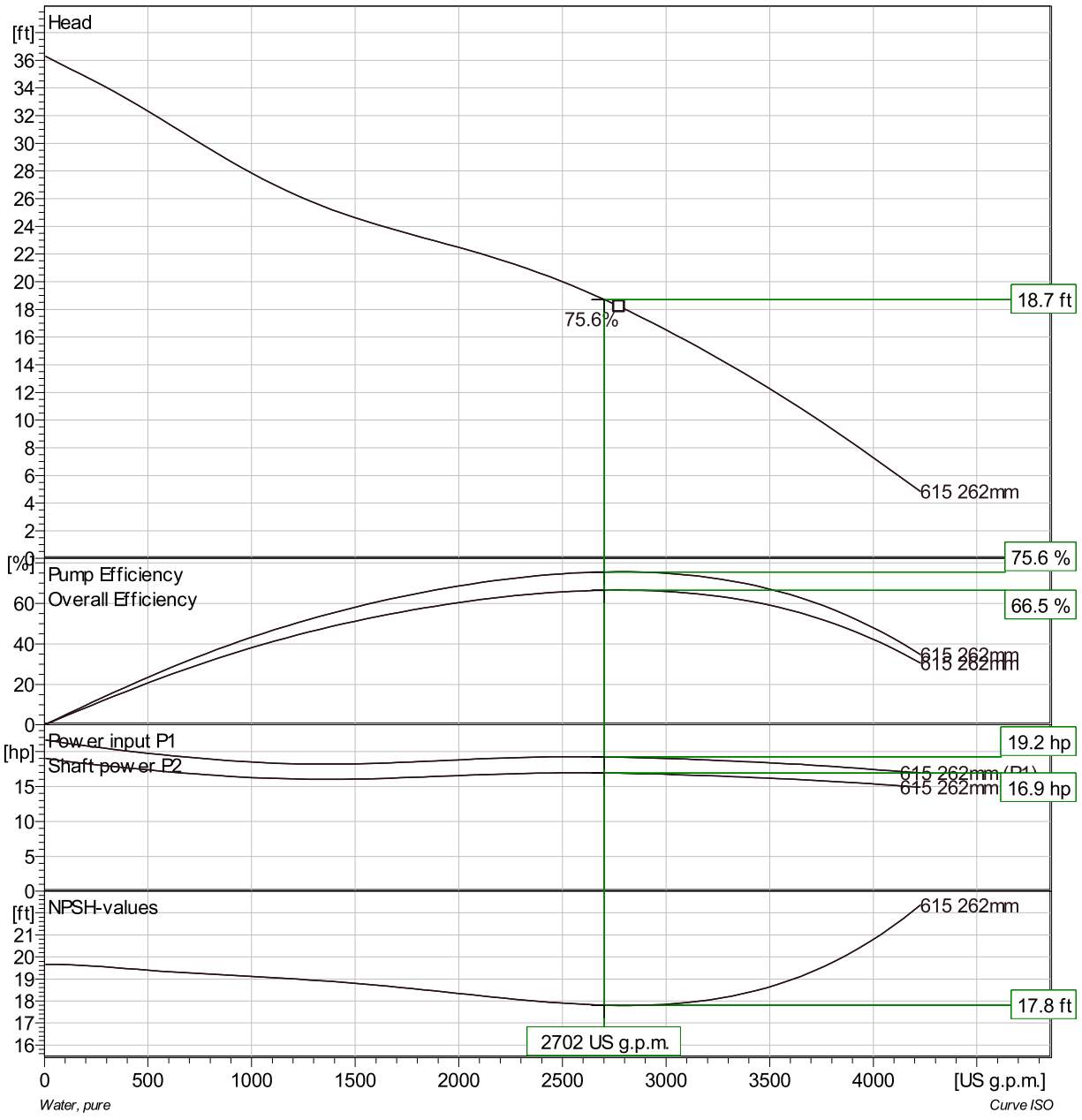
| | |
|---|---|
| Discharge Flange Diameter | 9 13/16 inch |
| Suction Flange Diameter | 250 mm |
| Impeller diameter | $10^{5}/_{16}$" |
| Number of blades | 2 |

### Motor

| | |
|---|---|
| Motor # | N3171.095 25-18-6BB-W 25hp |
| Stator variant | 7 |
| Frequency | 60 Hz |
| Rated voltage | 460 V |
| Number of poles | 6 |
| Phases | 3~ |
| Rated power | 25 hp |
| Rated current | 32 A |
| Starting current | 177 A |
| Rated speed | 1160 rpm |

| Power factor | |
|---|---|
| 1/1 Load | 0.85 |
| 3/4 Load | 0.80 |
| 1/2 Load | 0.70 |

| Motor efficiency | |
|---|---|
| 1/1 Load | 86.0 % |
| 3/4 Load | 87.5 % |
| 1/2 Load | 87.5 % |

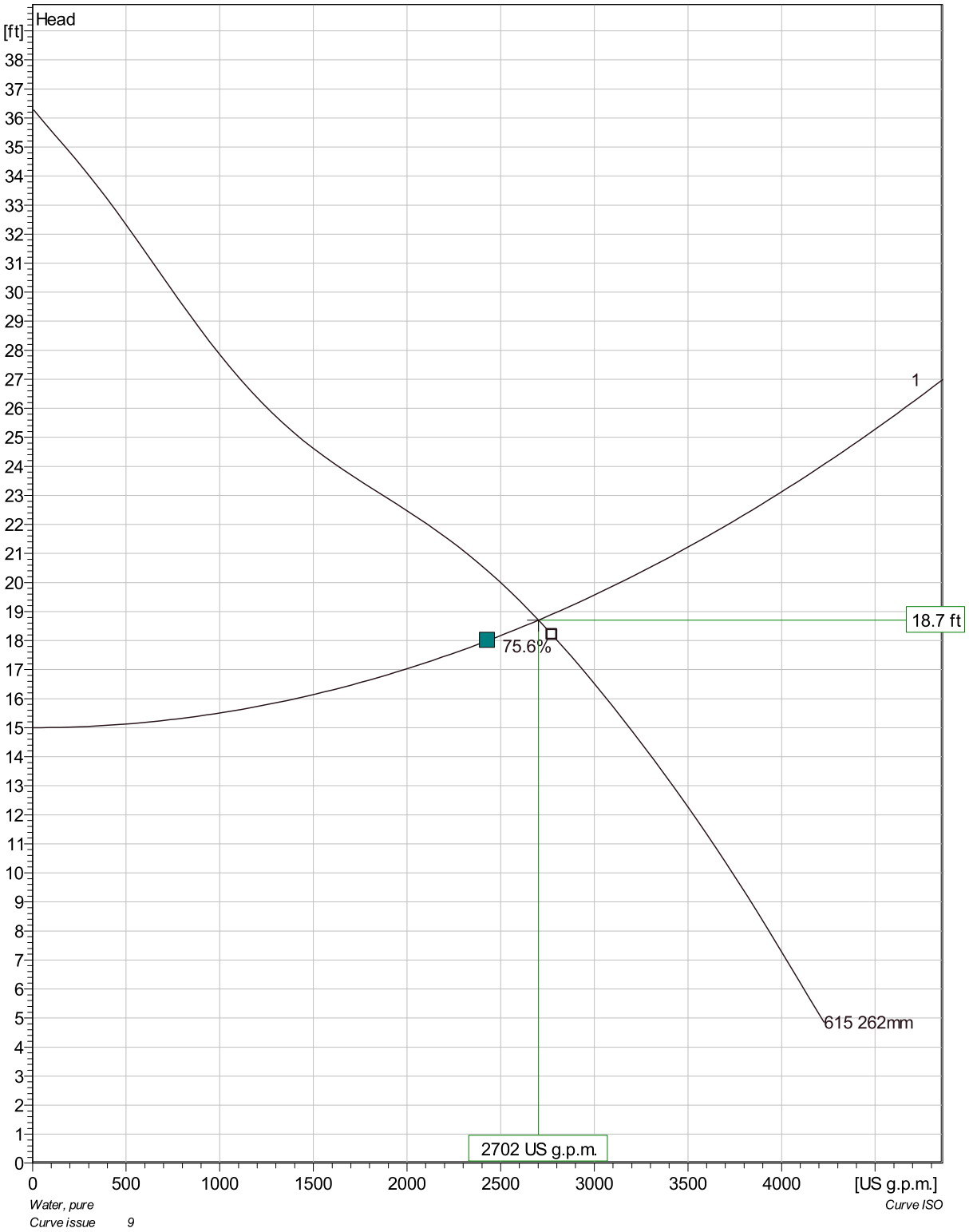



| Duty point | | Guarantee |
|---|---|---|
| Flow | Head | |
| 2430 US g.p.m. | 18 ft | No |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3171 LT 3~ 615

## Duty Analysis

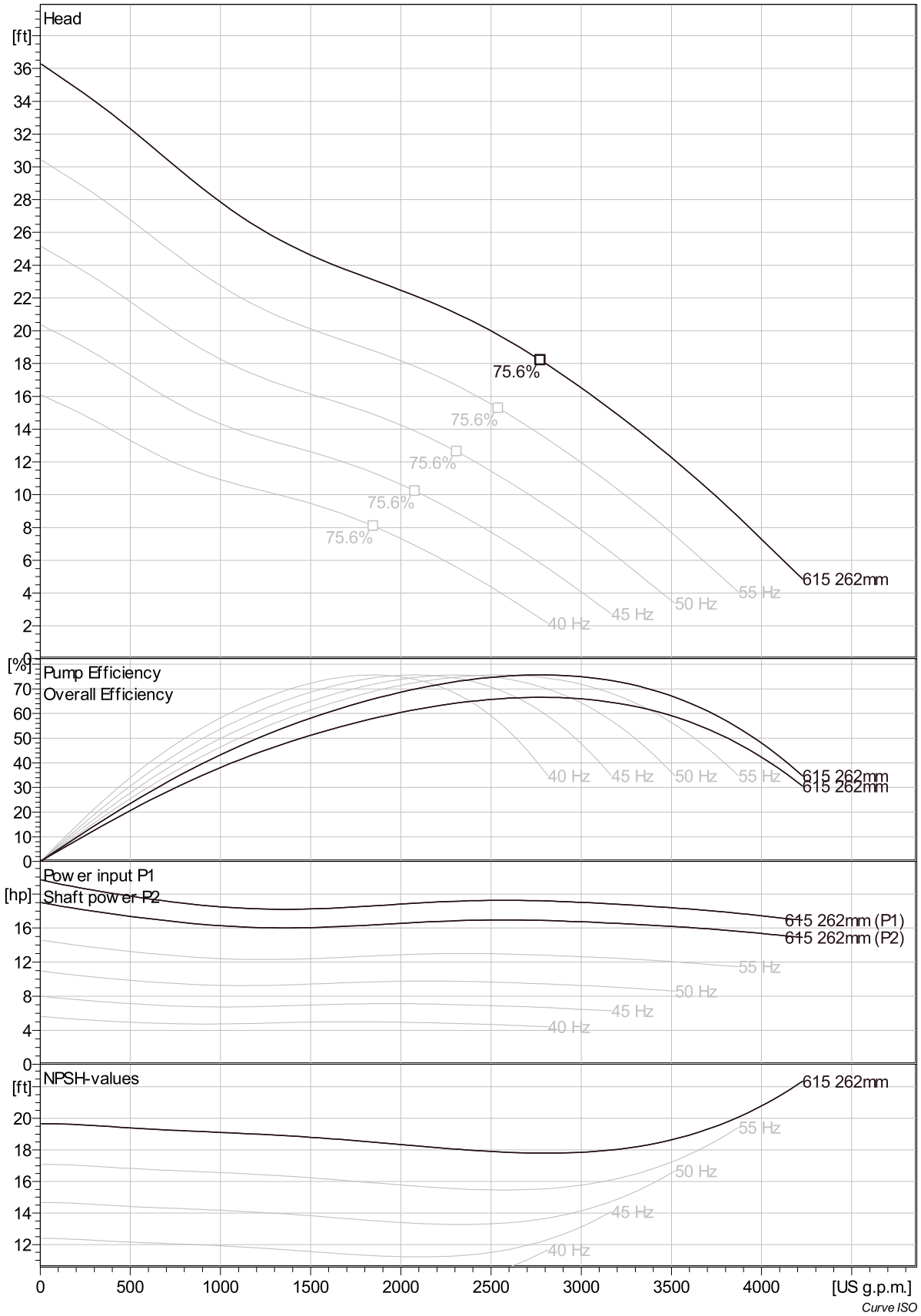



| Pumps running /System | Individual pump | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Flow | Head | Shaft power | Flow | Head | Shaft power | Pump eff. | Specific energy | NPSHre |
| 1 | 2700 US g.p.m. | 18.7 ft | 16.9 hp | 2700 US g.p.m. | 18.7 ft | 16.9 hp | 75.6 % | 88.5 kWh/US MG | 17.8 ft |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3171 LT 3~ 615

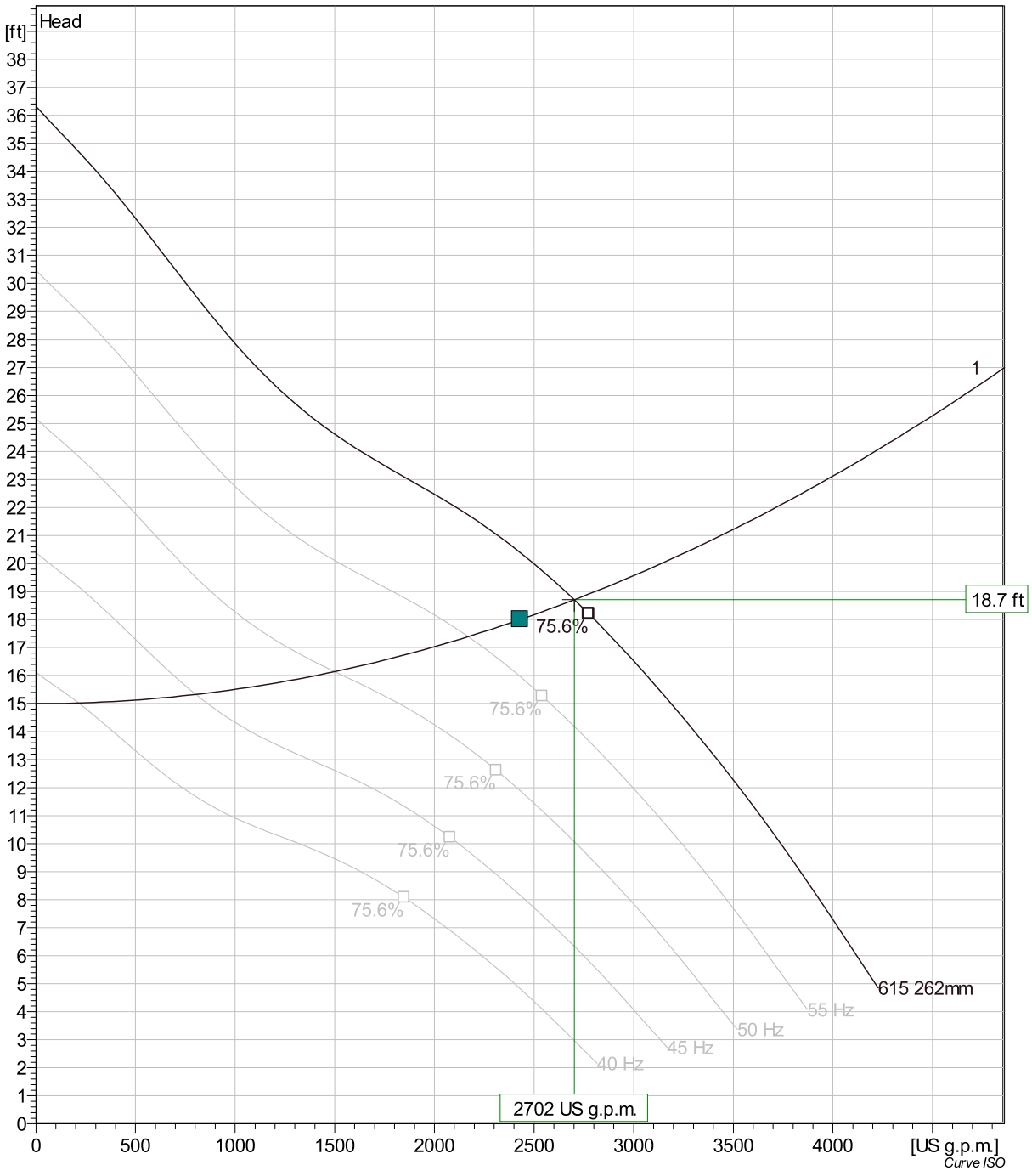
## VFD Curve




| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3171 LT 3~ 615

## VFD Analysis

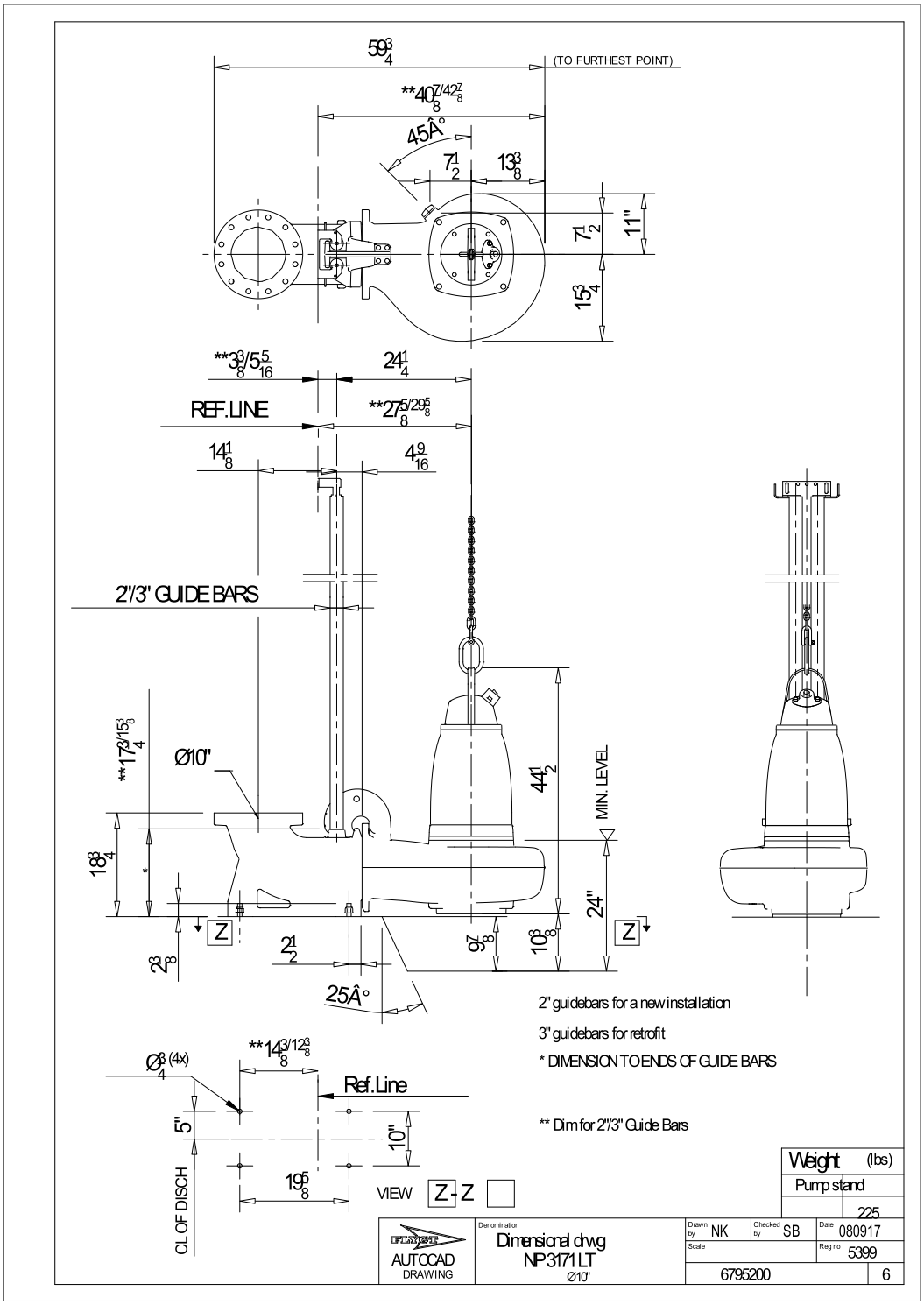



| Pumps running /System | Frequency | Flow | Head | Shaft power | Flow | Head | Shaft power | Hyd eff. | Specific energy | NPSHre |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 60 Hz | 2700 US g.p.m. | 18.7 ft | 16.9 hp | 2700 US g.p.m. | 18.7 ft | 16.9 hp | 75.6 % | 88.5 kWh/US MG | 17.8 ft |
| 1 | 55 Hz | 2170 US g.p.m. | 17.4 ft | 13 hp | 2170 US g.p.m. | 17.4 ft | 13 hp | 73.6 % | 84.6 kWh/US MG | 15.6 ft |
| 1 | 50 Hz | 1500 US g.p.m. | 16.1 ft | 9.42 hp | 1500 US g.p.m. | 16.1 ft | 9.42 hp | 65 % | 90.2 kWh/US MG | 13.8 ft |
| 1 | 45 Hz | 802 US g.p.m. | 15.3 ft | 6.81 hp | 802 US g.p.m. | 15.3 ft | 6.81 hp | 45.7 % | 126 kWh/US MG | 12 ft |
| 1 | 40 Hz | 213 US g.p.m. | 15 ft | 5.29 hp | 213 US g.p.m. | 15 ft | 5.29 hp | 15.4 % | 380 kWh/US MG | 10.2 ft |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3171 LT 3~ 615

## Dimensional drawing



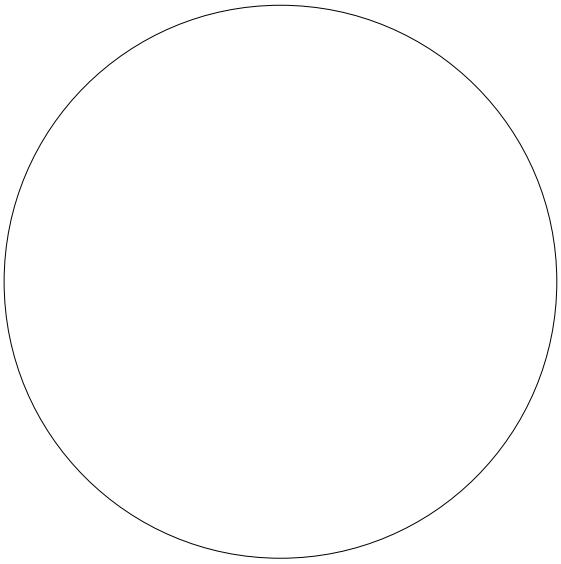

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3171 LT 3~ 615

## Life cycle costs (LCC)

| | | | |
|---|---|---|---|
| Total lifetime | 15 | Inflation rate (rate of price increases) | 2 % |
| Annual operating time | 5600 | Interest rate (for investment) | 3 % |
| Energy cost per kWh | 0.00 USD | | |
| Power input P1 | | | |

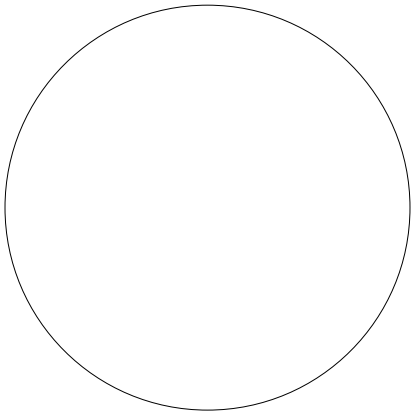
### Total costs



**0.00**
**USD**

| | | |
|---|---|---|
| 0% | **0.00 USD** | Energy |
| 0% | **0.00 USD** | Investment costs |
| 0% | **0.00 USD** | Installation & commissioning |
| 0% | **0.00 USD** | Operating cost |
| 0% | **0.00 USD** | Maintenance & repair |
| 0% | **0.00 USD** | Downtime |
| 0% | **0.00 USD** | Environmental |
| 0% | **0.00 USD** | Decommissioning |

### First year costs



**0.00**
**USD**

| | | |
|---|---|---|
| 0% | **0.00 USD** | Energy (1st year) |
| 0% | **0.00 USD** | Investment costs (1st year) |
| 0% | **0.00 USD** | Installation & commissioning (1st year) |
| 0% | **0.00 USD** | Operating cost (1st year) |
| 0% | **0.00 USD** | Maintenance & repair (1st year) |
| 0% | **0.00 USD** | Downtime (1st year) |
| 0% | **0.00 USD** | Environmental (1st year) |
| 0% | **0.00 USD** | Decommissioning (1st year) |

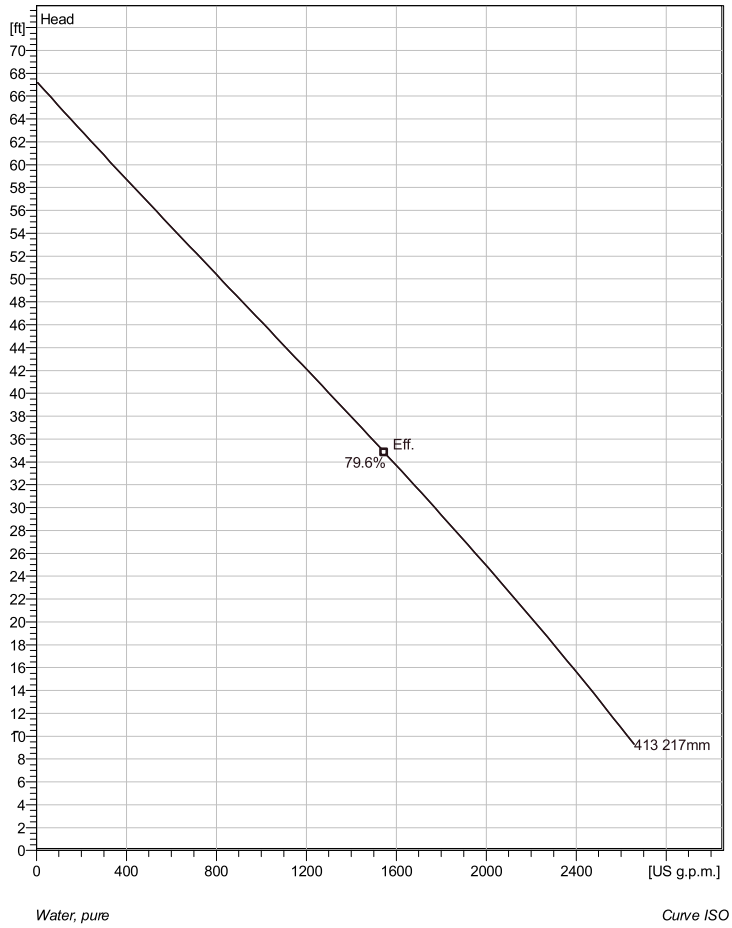
*Disclaimer: The calculations and the results are based on user input values and general assumptions and provide only estimated costs for the input data. Xylem inc can therefore not guarantee that the estimated savings will actually occur.*

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | **6/23/2018** | |

# FLYGT ENHANCEMENT WETLAND PUMP STATION QUOTE

# NP 3153 LT 3~ 413

## Technical specification




*Water, pure* *Curve ISO*



*Note: Picture might not correspond to the current configuration.*

### General

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.

### Impeller

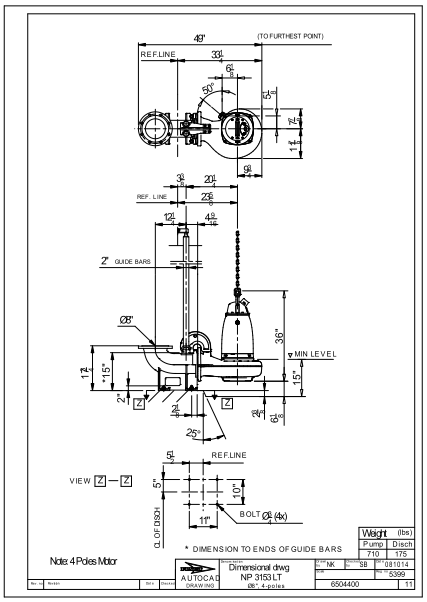
| | |
|---|---|
| Impeller material | Hard-Iron |
| Discharge Flange Diameter | 7 7/8 inch |
| Suction Flange Diameter | 7 7/8 inch |
| Impeller diameter | 217 mm |
| Number of blades | 2 |

### Motor

| | |
|---|---|
| Motor # | N3153.095 21-18-4AA-W 20hp FM |
| Stator variant | 5 |
| Frequency | 60 Hz |
| Rated voltage | 460 V |
| Number of poles | 4 |
| Phases | 3~ |
| Rated power | 20 hp |
| Rated current | 26 A |
| Starting current | 148 A |
| Rated speed | 1755 rpm |
| Power factor | |
| 1/1 Load | 0.83 |
| 3/4 Load | 0.77 |
| 1/2 Load | 0.66 |
| Motor efficiency | |
| 1/1 Load | 87.5 % |
| 3/4 Load | 89.0 % |
| 1/2 Load | 89.0 % |

### Configuration

**Installation: P - Semi permanent, Wet**




| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3153 LT 3~ 413

## Performance curve

### Pump

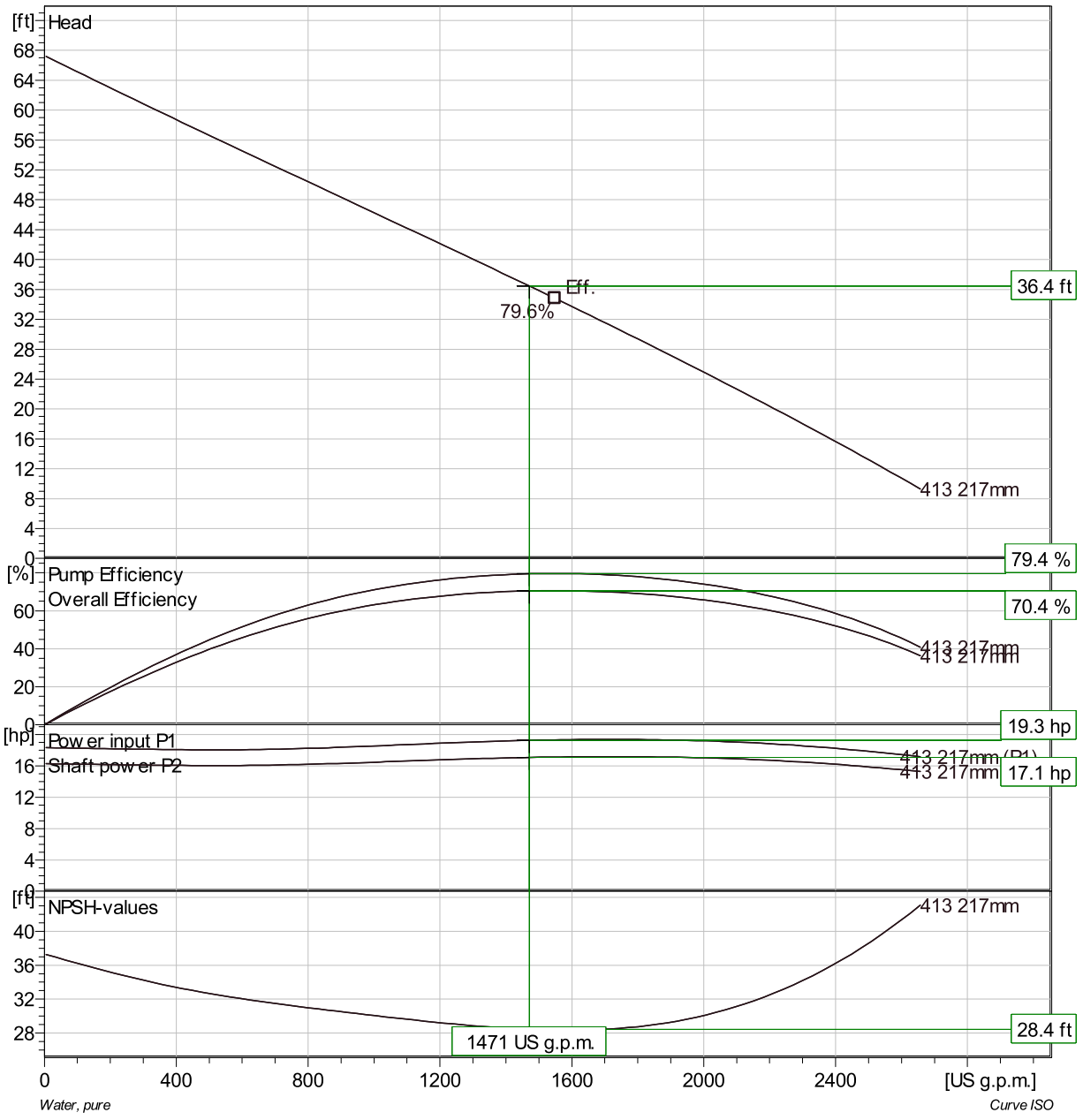
| | |
|---|---|
| Discharge Flange Diameter | 7 7/8 inch |
| Suction Flange Diameter | 200 mm |
| Impeller diameter | $8^{9}/_{16}$" |
| Number of blades | 2 |

### Motor

| | |
|---|---|
| Motor # | N3153.095 21-18-4AA-W 20hp |
| Stator variant | 5 |
| Frequency | 60 Hz |
| Rated voltage | 460 V |
| Number of poles | 4 |
| Phases | 3~ |
| Rated power | 20 hp |
| Rated current | 26 A |
| Starting current | 148 A |
| Rated speed | 1755 rpm |

| Power factor | |
|---|---|
| 1/1 Load | 0.83 |
| 3/4 Load | 0.77 |
| 1/2 Load | 0.66 |

| Motor efficiency | |
|---|---|
| 1/1 Load | 87.5 % |
| 3/4 Load | 89.0 % |
| 1/2 Load | 89.0 % |

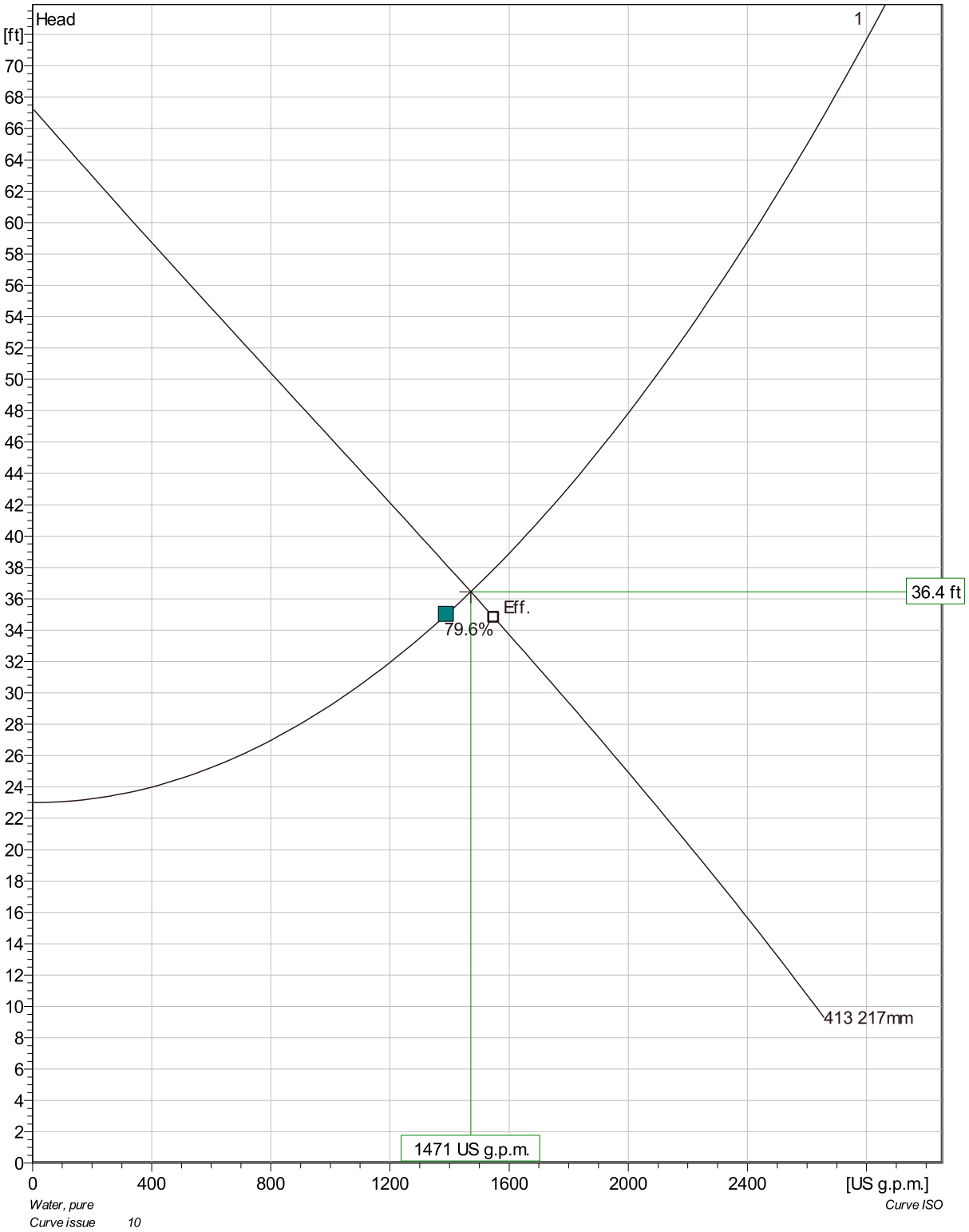



| Duty point | | Guarantee |
|---|---|---|
| Flow | Head | |
| 1390 US g.p.m. | 35 ft | No |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3153 LT 3~ 413

## Duty Analysis

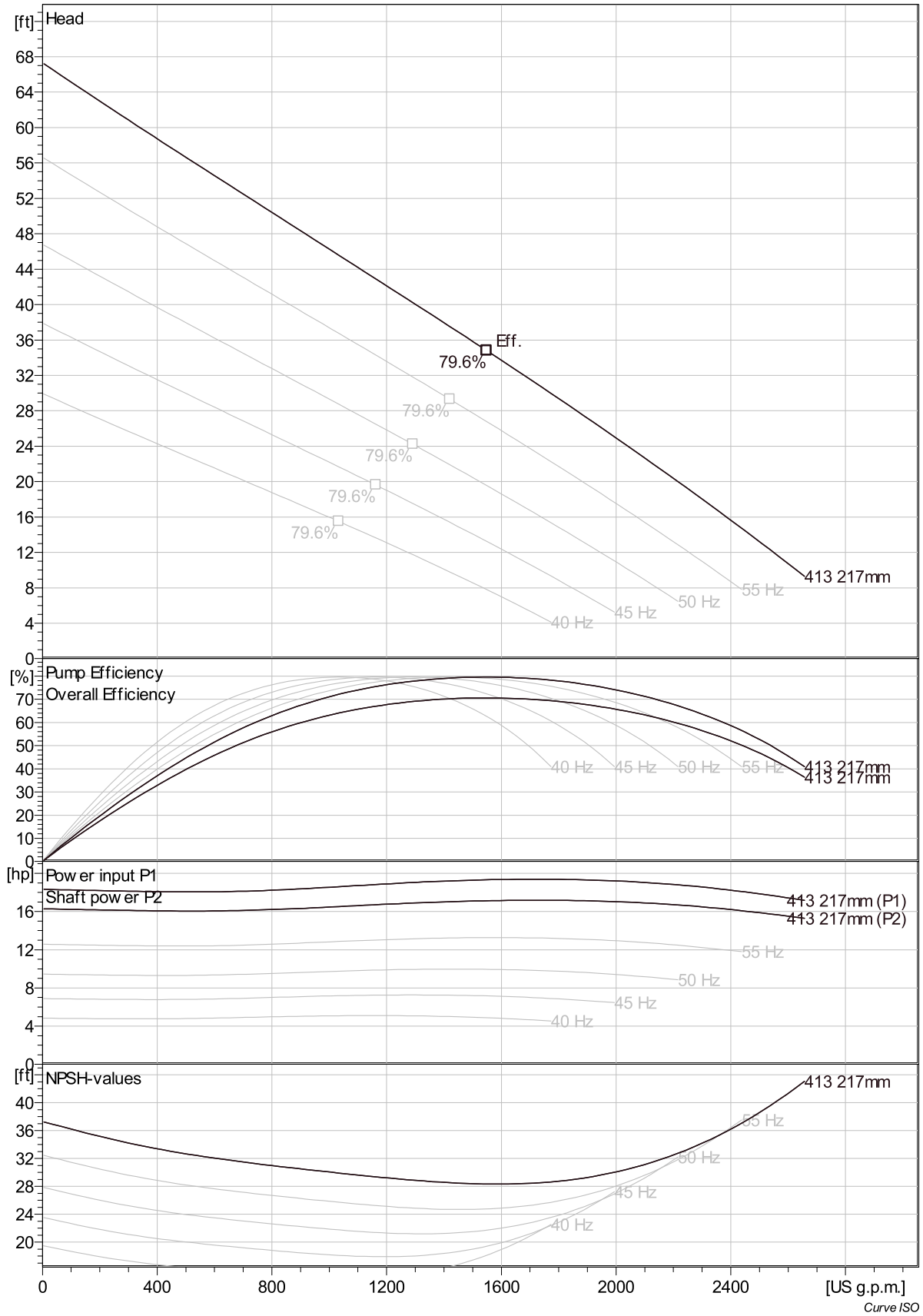



| Pumps running /System | Individual pump | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Flow | Head | Shaft power | Flow | Head | Shaft power | Pump eff. | Specific energy | NPSHre |
| 1 | 1470 US g.p.m. | 36.4 ft | 17.1 hp | 1470 US g.p.m. | 36.4 ft | 17.1 hp | 79.4 % | 163 kWh/US MG | 28.4 ft |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3153 LT 3~ 413

## VFD Curve

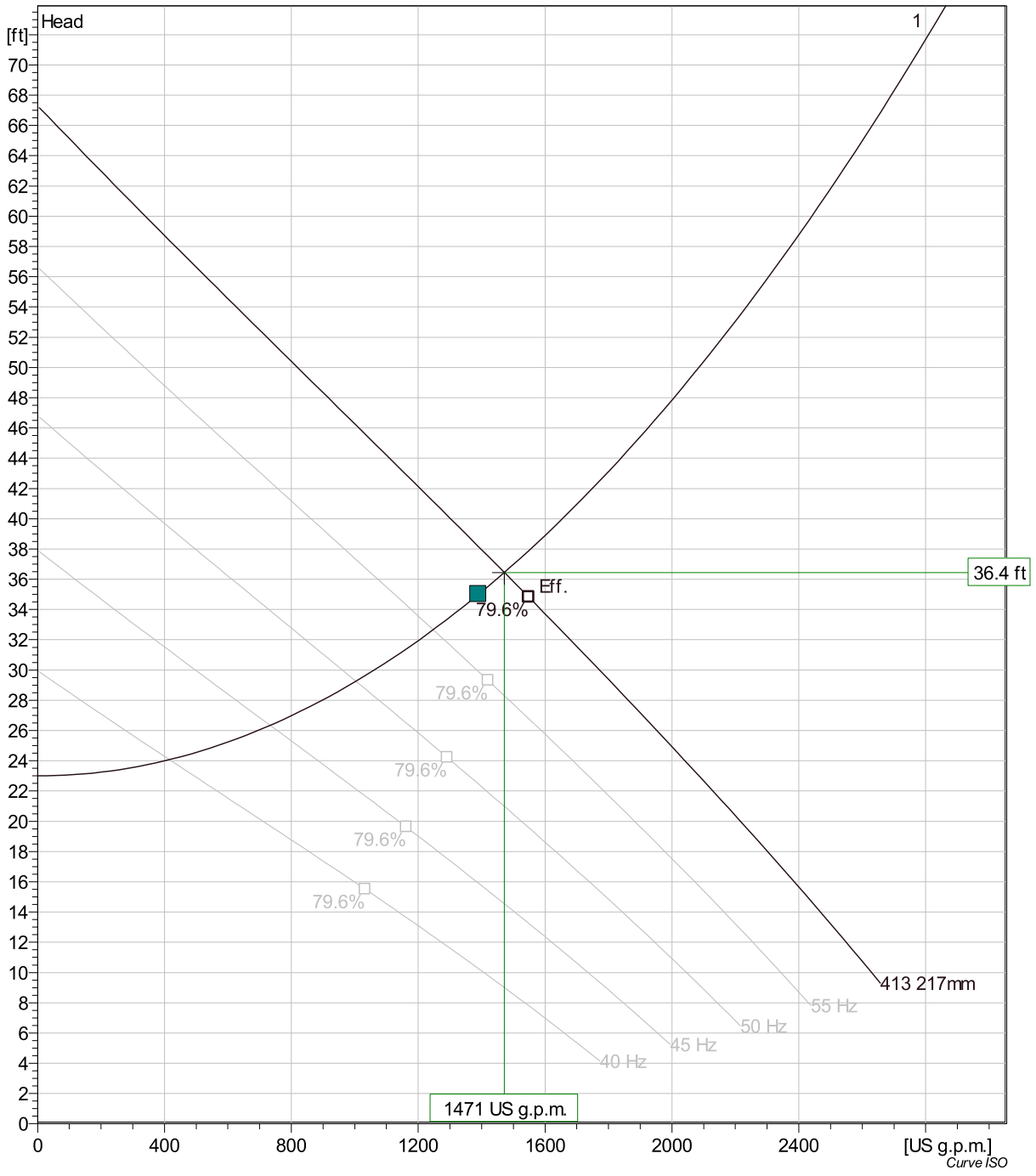



*Curve ISO*

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3153 LT 3~ 413

## VFD Analysis

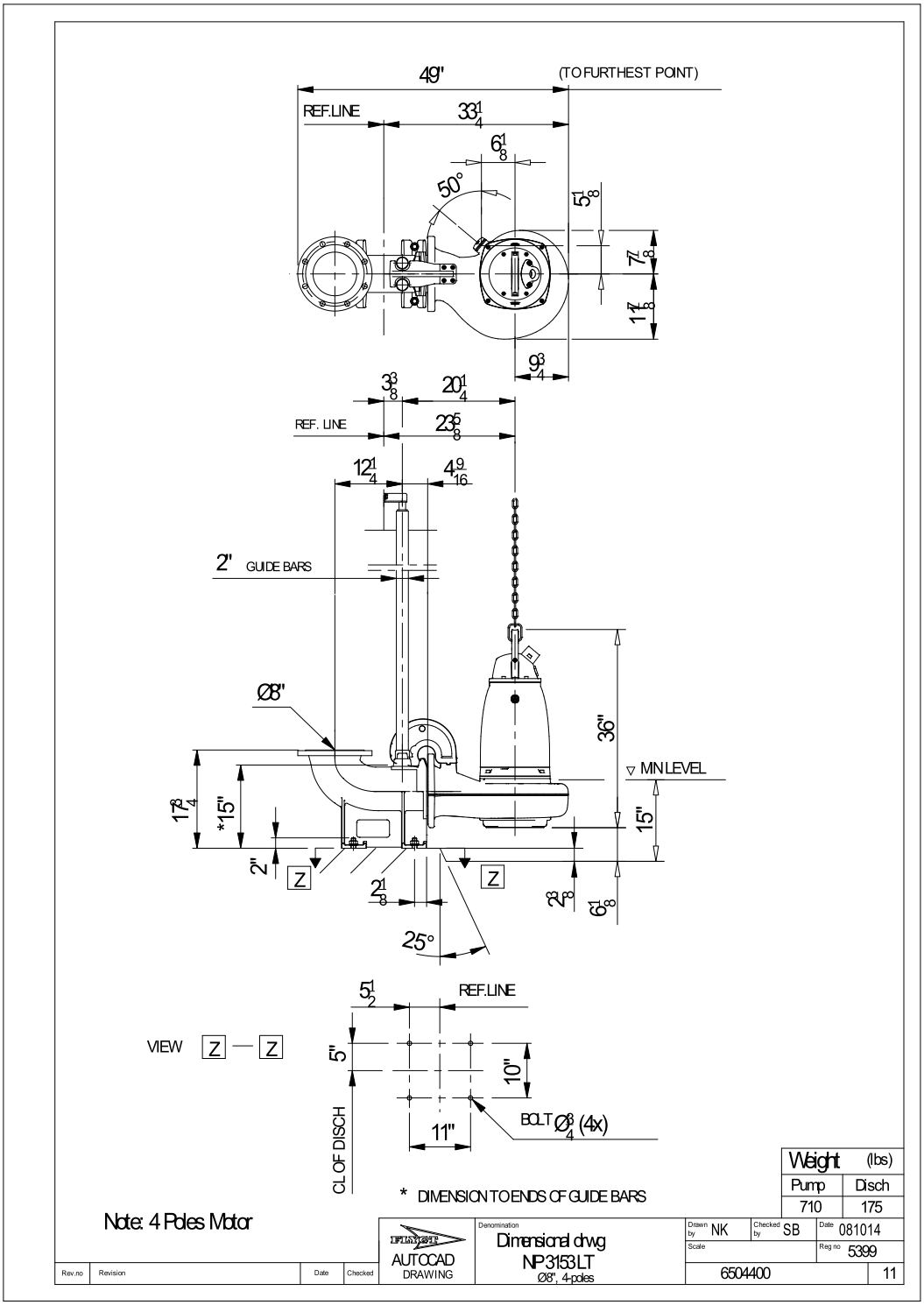



| Pumps running /System | Frequency | Flow | Head | Shaft power | Flow | Head | Shaft power | Hyd eff. | Specific energy | NPSHre |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 60 Hz | 1470 US g.p.m. | 36.4 ft | 17.1 hp | 1470 US g.p.m. | 36.4 ft | 17.1 hp | 79.4 % | 163 kWh/US MG | 28.4 ft |
| 1 | 55 Hz | 1250 US g.p.m. | 32.7 ft | 13.1 hp | 1250 US g.p.m. | 32.7 ft | 13.1 hp | 78.6 % | 146 kWh/US MG | 25 ft |
| 1 | 50 Hz | 1000 US g.p.m. | 29.3 ft | 9.73 hp | 1000 US g.p.m. | 29.3 ft | 9.73 hp | 76.3 % | 135 kWh/US MG | 21.9 ft |
| 1 | 45 Hz | 733 US g.p.m. | 26.3 ft | 6.95 hp | 733 US g.p.m. | 26.3 ft | 6.95 hp | 70.3 % | 134 kWh/US MG | 19.1 ft |
| 1 | 40 Hz | 416 US g.p.m. | 24.1 ft | 4.77 hp | 416 US g.p.m. | 24.1 ft | 4.77 hp | 53 % | 169 kWh/US MG | 16.7 ft |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3153 LT 3~ 413

## Dimensional drawing



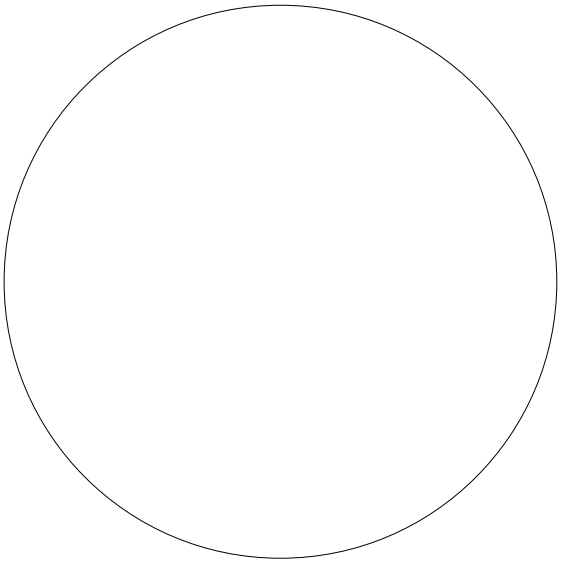

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3153 LT 3~ 413

## Life cycle costs (LCC)

| | | | |
|---|---|---|---|
| Total lifetime | 15 | Inflation rate (rate of price increases) | 2 % |
| Annual operating time | 5600 | Interest rate (for investment) | 3 % |
| Energy cost per kWh | 0.00 USD | | |
| Power input P1 | | | |

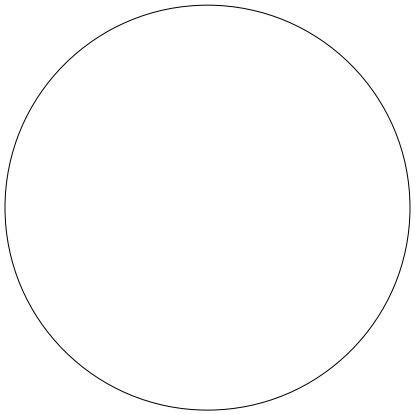
### Total costs



**0.00**
**USD**

| | | |
|---|---|---|
| 0% | **0.00 USD** | Energy |
| 0% | **0.00 USD** | Investment costs |
| 0% | **0.00 USD** | Installation & commissioning |
| 0% | **0.00 USD** | Operating cost |
| 0% | **0.00 USD** | Maintenance & repair |
| 0% | **0.00 USD** | Downtime |
| 0% | **0.00 USD** | Environmental |
| 0% | **0.00 USD** | Decommissioning |

### First year costs



**0.00**
**USD**

| | | |
|---|---|---|
| 0% | **0.00 USD** | Energy (1st year) |
| 0% | **0.00 USD** | Investment costs (1st year) |
| 0% | **0.00 USD** | Installation & commissioning (1st year) |
| 0% | **0.00 USD** | Operating cost (1st year) |
| 0% | **0.00 USD** | Maintenance & repair (1st year) |
| 0% | **0.00 USD** | Downtime (1st year) |
| 0% | **0.00 USD** | Environmental (1st year) |
| 0% | **0.00 USD** | Decommissioning (1st year) |

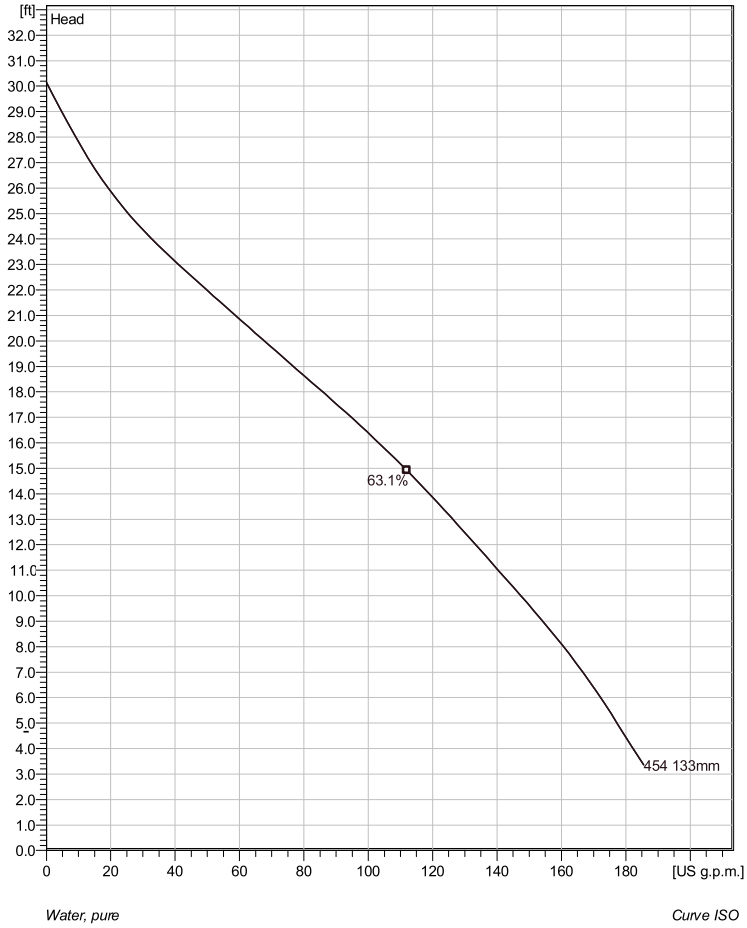
*Disclaimer: The calculations and the results are based on user input values and general assumptions and provide only estimated costs for the input data. Xyleminc can therefore not guarantee that the estimated savings will actually occur.*

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | **6/23/2018** | |

# FLYGT PRIMARY SCUM PUMP QUOTE

# NP 3085 SH 3~ Adaptive 454

## Technical specification




*Water, pure* *Curve ISO*



*Note: Picture might not correspond to the current configuration.*

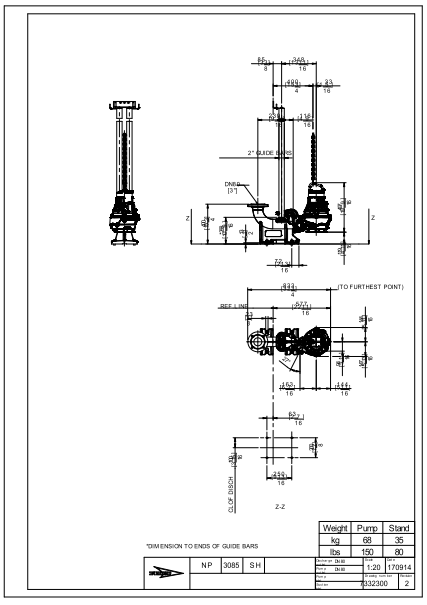
### General

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.

### Impeller

| | |
|---|---|
| Impeller material | Hard-Iron |
| Discharge Flange Diameter | 3 1/8 inch |
| Suction Flange Diameter | 3 1/8 inch |
| Impeller diameter | 133 mm |
| Number of blades | 2 |

**Installation: P - Semi permanent, Wet**




### Motor

| | |
|---|---|
| Motor # | N3085.070 15-10-4AL-W 2.2hp FM |
| Stator variant | 61 |
| Frequency | 60 Hz |
| Rated voltage | 460 V |
| Number of poles | 4 |
| Phases | 3~ |
| Rated power | 2.2 hp |
| Rated current | 3.6 A |
| Starting current | 25 A |
| Rated speed | 1735 rpm |
| Power factor | |
| 1/1 Load | 0.73 |
| 3/4 Load | 0.65 |
| 1/2 Load | 0.53 |
| Motor efficiency | |
| 1/1 Load | 78.4 % |
| 3/4 Load | 77.0 % |
| 1/2 Load | 72.5 % |

### Configuration

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3085 SH 3~ Adaptive 454

## Performance curve

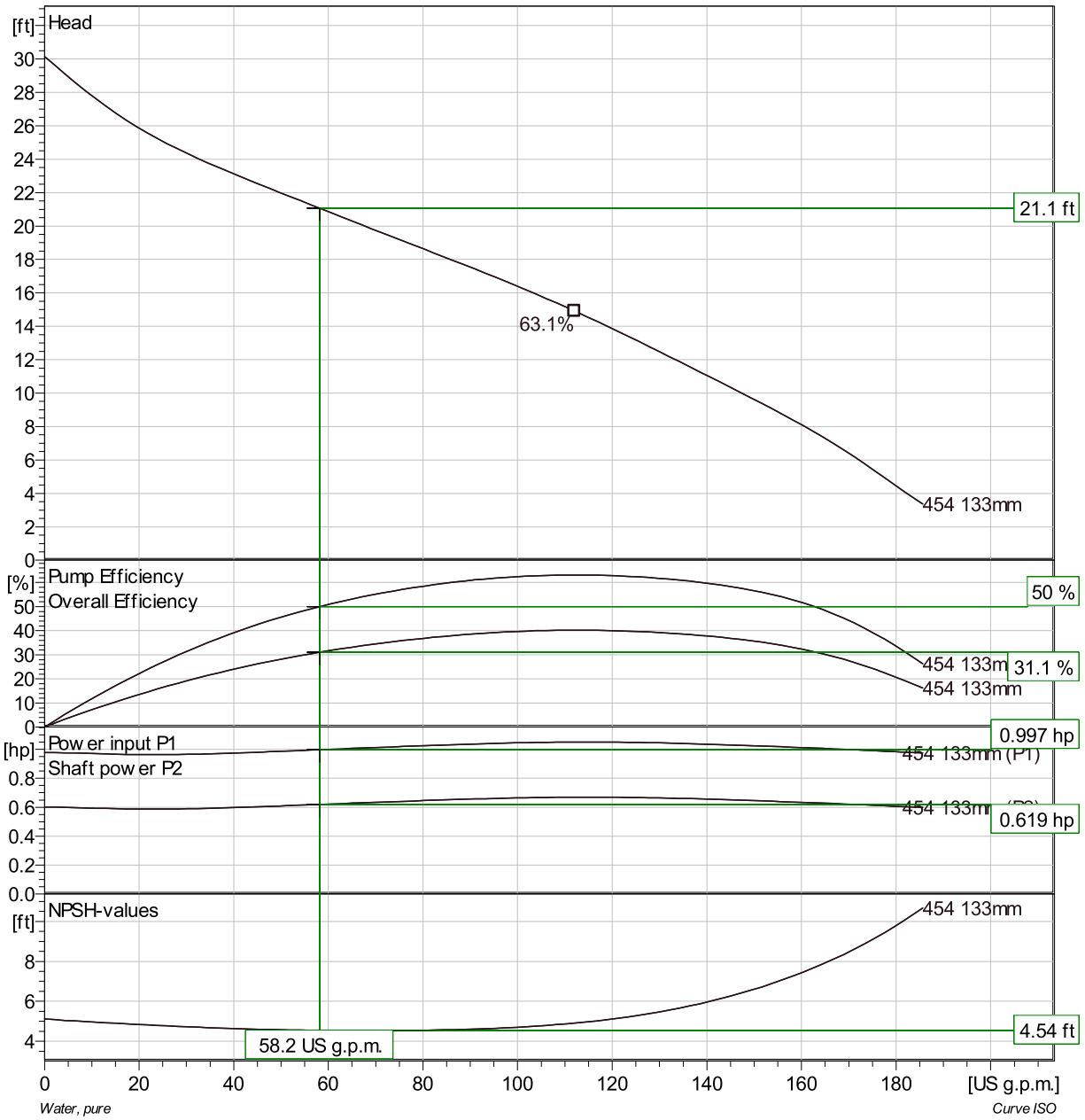
### Pump

| | |
|---|---|
| Discharge Flange Diameter | 3 1/8 inch |
| Suction Flange Diameter | 80 mm |
| Impeller diameter | 5 1/4" |
| Number of blades | 2 |

### Motor

| | |
|---|---|
| Motor # | N3085.070 15-10-4AL-W 2.2hp |
| Stator variant | 61 |
| Frequency | 60 Hz |
| Rated voltage | 460 V |
| Number of poles | 4 |
| Phases | 3~ |
| Rated power | 2.2 hp |
| Rated current | 3.6 A |
| Starting current | 25 A |
| Rated speed | 1735 rpm |

| | |
|---|---|
| Power factor | |
| 1/1 Load | 0.73 |
| 3/4 Load | 0.65 |
| 1/2 Load | 0.53 |
| Motor efficiency | |
| 1/1 Load | 78.4 % |
| 3/4 Load | 77.0 % |
| 1/2 Load | 72.5 % |

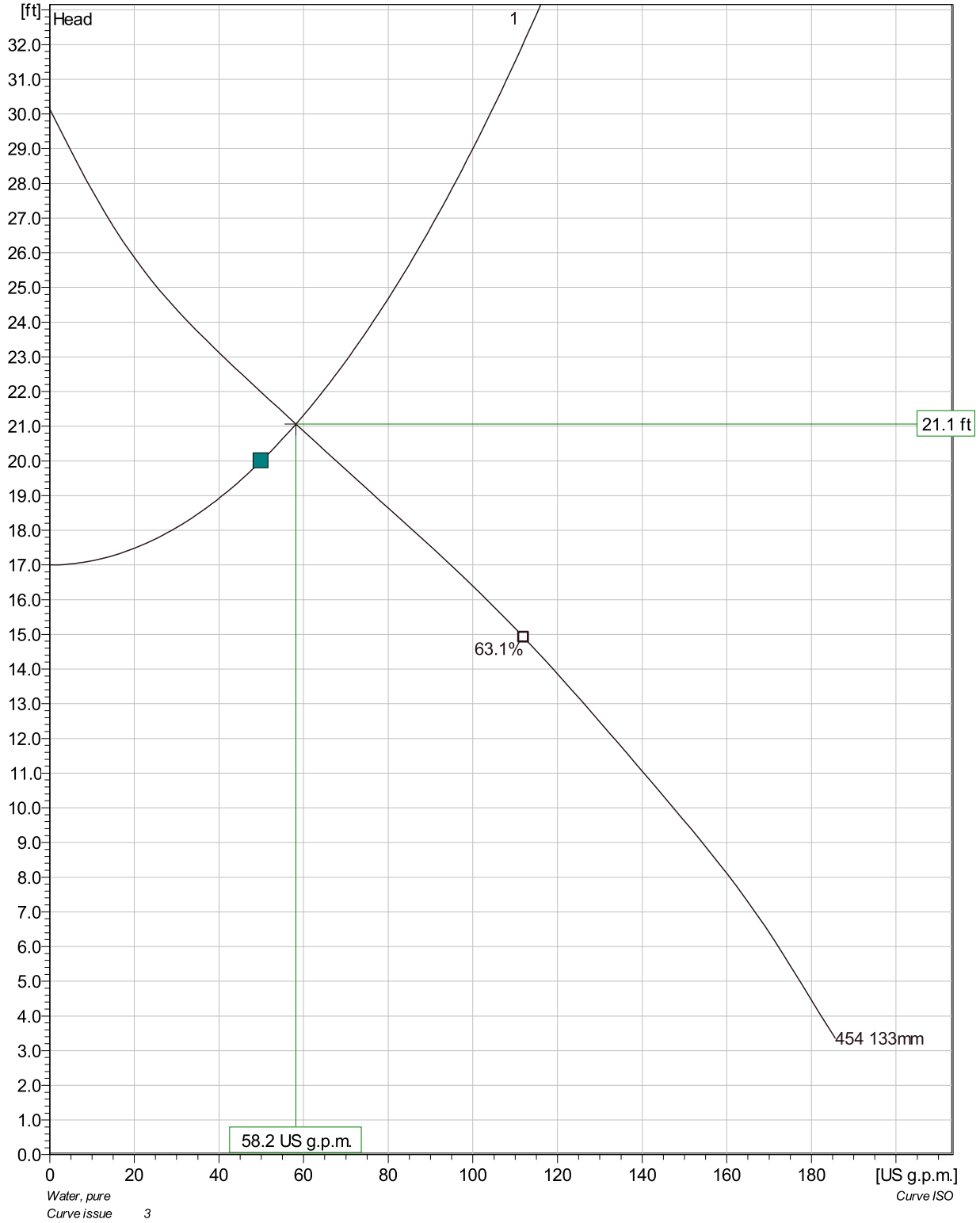



| Duty point | | Guarantee |
|---|---|---|
| Flow | Head | |
| 50 US g.p.m. | 20 ft | No |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3085 SH 3~ Adaptive 454

## Duty Analysis

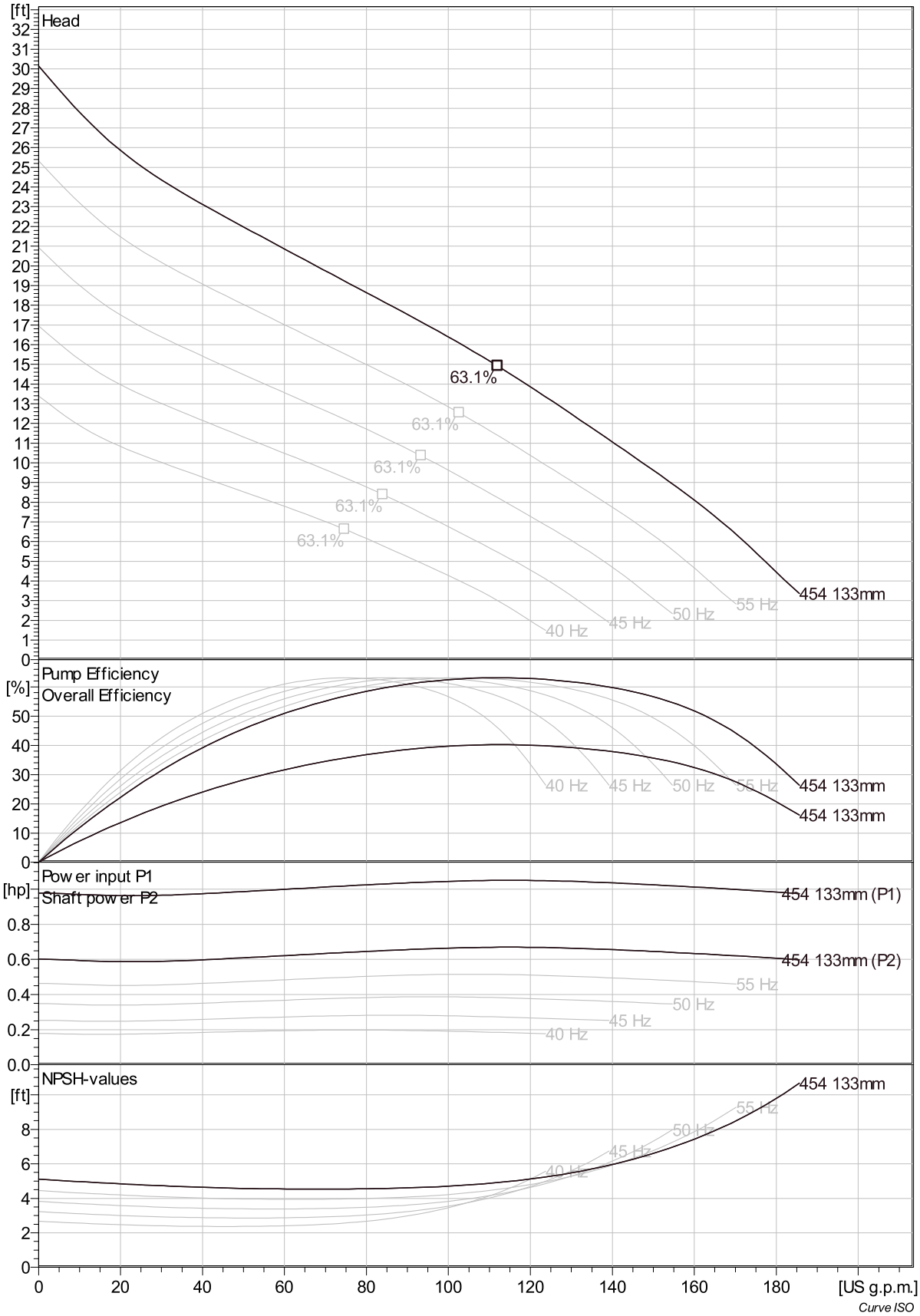



| Pumps running /System | Individual pump Flow | Head | Shaft power | Total Flow | Head | Shaft power | Pump eff. | Specific energy | NPSHre |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 58.2 US g.p.m. | 21.1 ft | 0.619 hp | 58.2 US g.p.m. | 21.1 ft | 0.619 hp | 50 % | 213 kWh/US MG | 4.54 ft |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3085 SH 3~ Adaptive 454

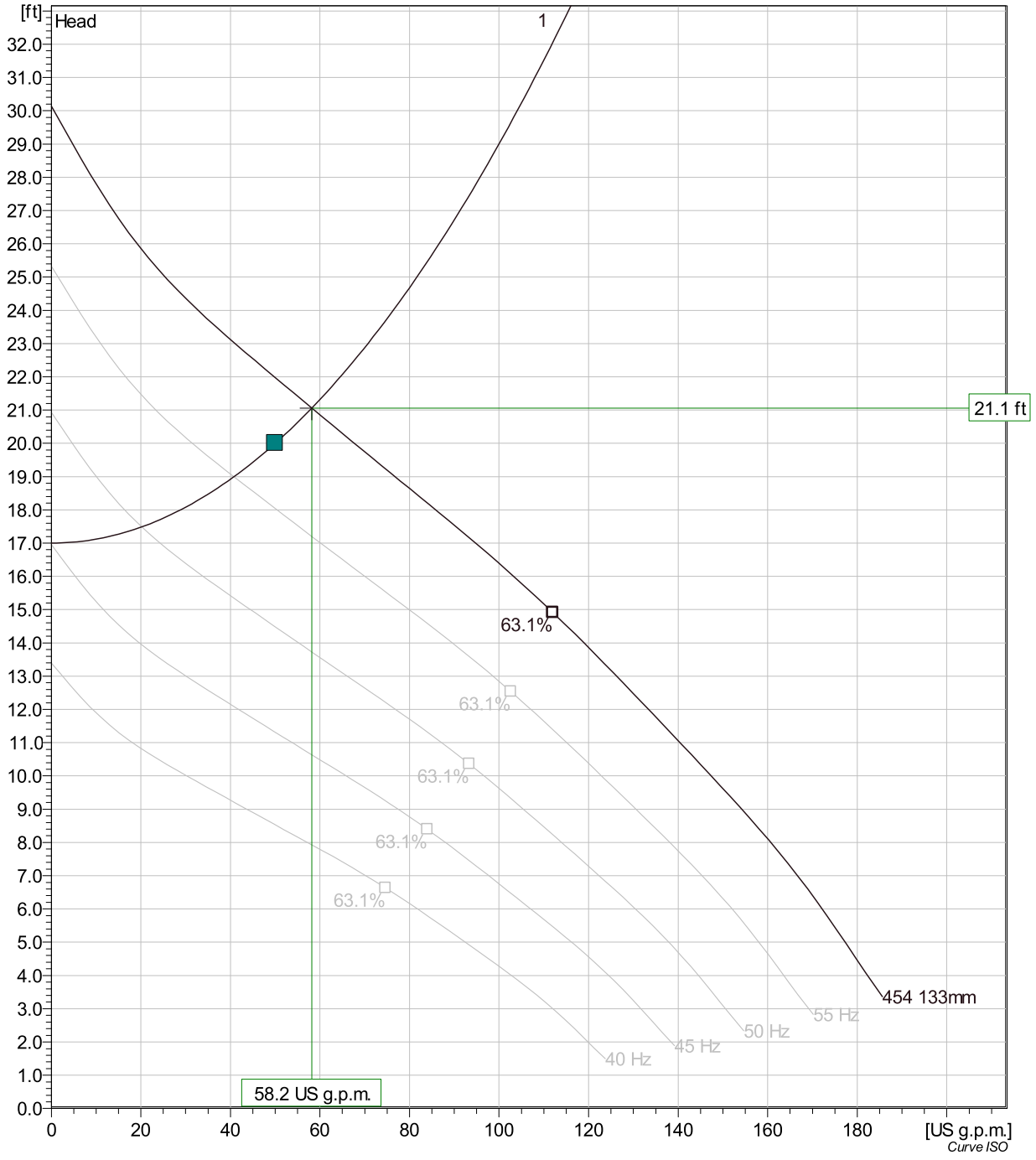
## VFD Curve




| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3085 SH 3~ Adaptive 454

## VFD Analysis

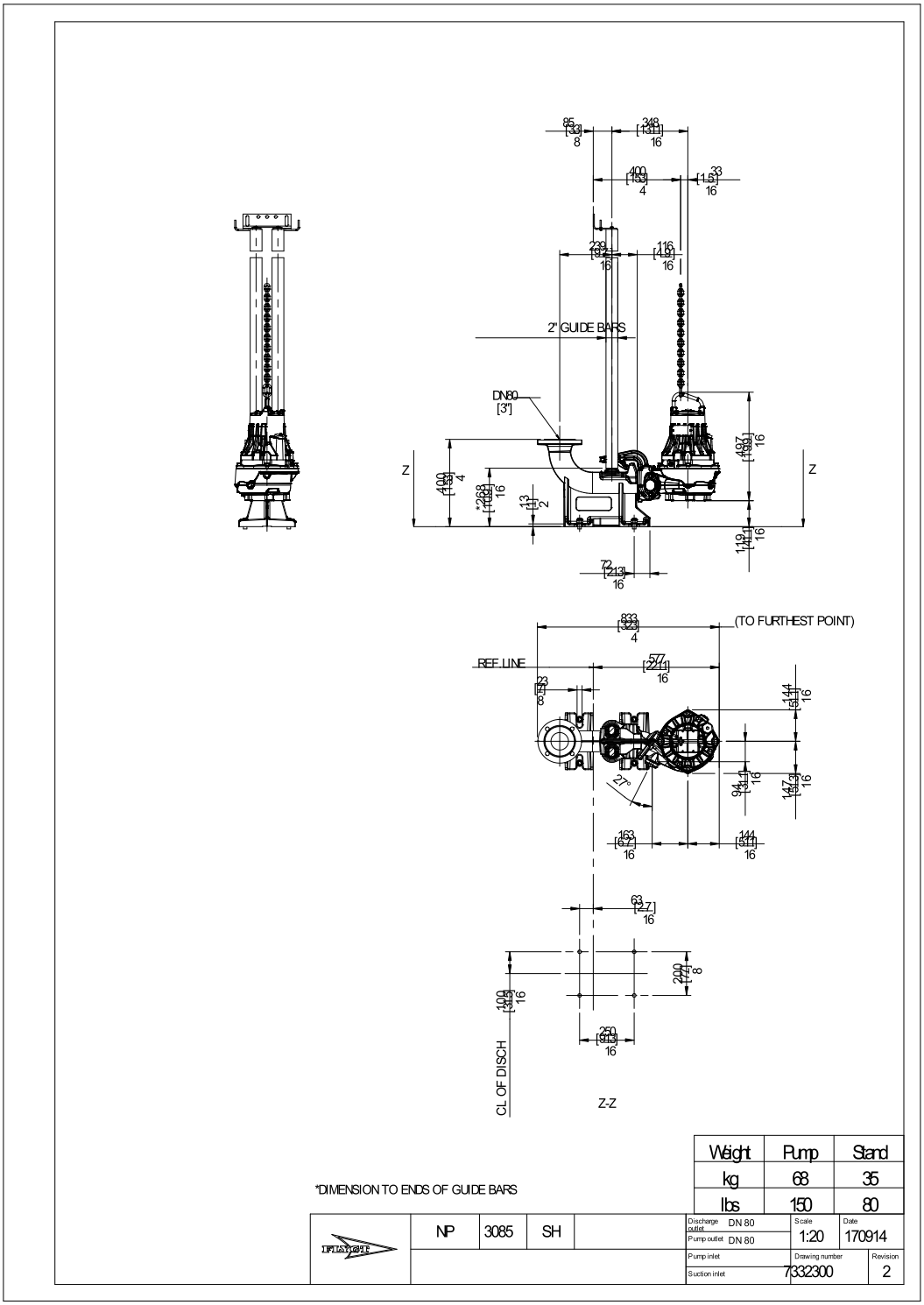



| Pumps running /System | Frequency | Flow | Head | Shaft power | Flow | Head | Shaft power | Hyd eff. | Specific energy | NPSHre |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 60 Hz | 58.2 US g.p.m. | 21.1 ft | 0.619 hp | 58.2 US g.p.m. | 21.1 ft | 0.619 hp | 50 % | 213 kWh/US MG | 4.54 ft |
| 1 | 55 Hz | 40.8 US g.p.m. | 19 ft | 0.464 hp | 40.8 US g.p.m. | 19 ft | 0.464 hp | 42.2 % | 254 kWh/US MG | 4.01 ft |
| 1 | 50 Hz | 20.2 US g.p.m. | 17.5 ft | 0.34 hp | 20.2 US g.p.m. | 17.5 ft | 0.34 hp | 26.3 % | 435 kWh/US MG | 3.58 ft |
| 1 | 45 Hz | | | | | | | | | |
| 1 | 40 Hz | | | | | | | | | |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3085 SH 3~ Adaptive 454

## Dimensional drawing



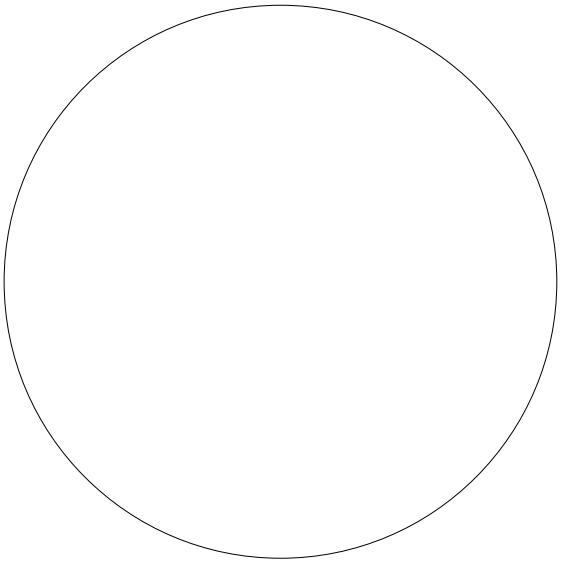

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/23/2018 | |

# NP 3085 SH 3~ Adaptive 454

## Life cycle costs (LCC)

| | | | |
|---|---|---|---|
| Total lifetime | 15 | Inflation rate (rate of price increases) | 2 % |
| Annual operating time | 5600 | Interest rate (for investment) | 3 % |
| Energy cost per kWh | 0.00 USD | | |
| Power input P1 | | | |

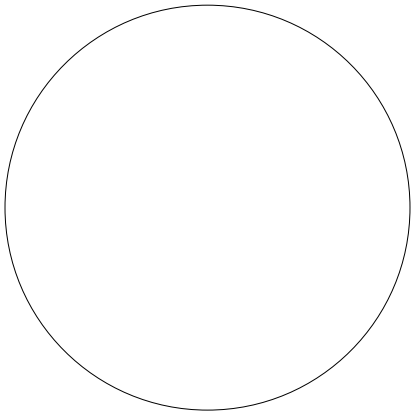
### Total costs



**0.00**
**USD**

| | | |
|---|---|---|
| 0% | **0.00 USD** | Energy |
| 0% | **0.00 USD** | Investment costs |
| 0% | **0.00 USD** | Installation & commissioning |
| 0% | **0.00 USD** | Operating cost |
| 0% | **0.00 USD** | Maintenance & repair |
| 0% | **0.00 USD** | Downtime |
| 0% | **0.00 USD** | Environmental |
| 0% | **0.00 USD** | Decommissioning |

### First year costs



**0.00**
**USD**

| | | |
|---|---|---|
| 0% | **0.00 USD** | Energy (1st year) |
| 0% | **0.00 USD** | Investment costs (1st year) |
| 0% | **0.00 USD** | Installation & commissioning (1st year) |
| 0% | **0.00 USD** | Operating cost (1st year) |
| 0% | **0.00 USD** | Maintenance & repair (1st year) |
| 0% | **0.00 USD** | Downtime (1st year) |
| 0% | **0.00 USD** | Environmental (1st year) |
| 0% | **0.00 USD** | Decommissioning (1st year) |

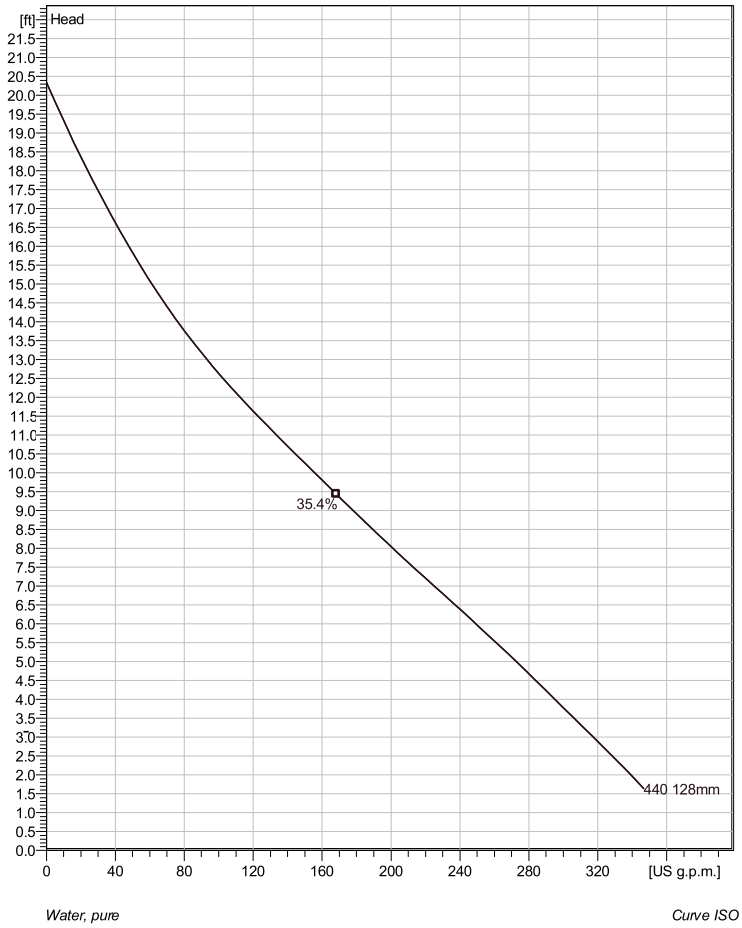
*Disclaimer: The calculations and the results are based on user input values and general assumptions and provide only estimated costs for the input data. Xylem inc can therefore not guarantee that the estimated savings will actually occur.*

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | **6/23/2018** | |

# FLYGT TREATMENT WETLAND 4 PUMP

# CP 3085 MT 3~ 440

## Technical specification

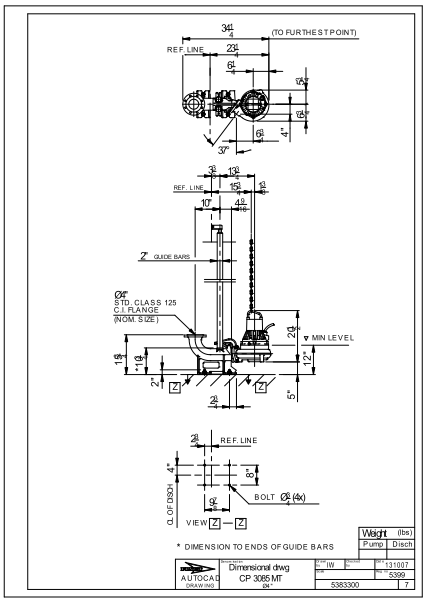



*Water, pure* *Curve ISO*



*Note: Picture might not correspond to the current configuration.*

**Installation: P - Semi permanent, Wet**




### General

Shrouded single or multi-channel impeller pumps with large throughlets and single volute pump casing for liquids containing solids and fibres. Cast iron design with double sealing technology. Some models available as stainless steel versions.

### Impeller

| | |
|---|---|
| Impeller material | Grey cast iron |
| Discharge Flange Diameter | 3 1/8 inch |
| Suction Flange Diameter | 3 1/8 inch |
| Impeller diameter | 128 mm |
| Number of blades | 1 |
| Throughlet diameter | 3 inch |

### Motor

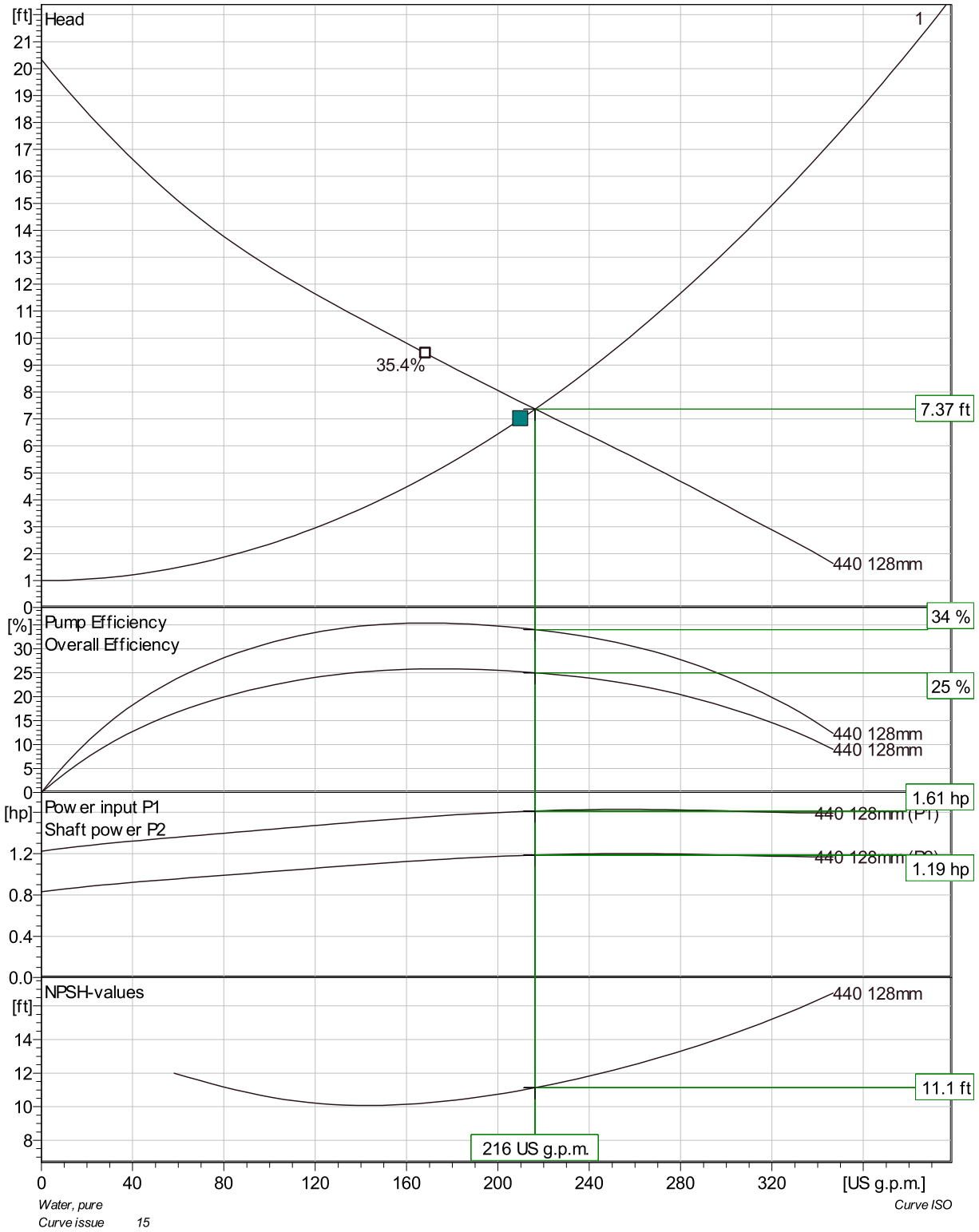
| | |
|---|---|
| Motor # | C3085.183 15-10-4AL-W 2.2hp Standard |
| Stator variant | 61 |
| Frequency | 60 Hz |
| Rated voltage | 460 V |
| Number of poles | 4 |
| Phases | 3~ |
| Rated power | 2.2 hp |
| Rated current | 3.6 A |
| Starting current | 25 A |
| Rated speed | 1735 rpm |
| Power factor | |
| 1/1 Load | 0.73 |
| 3/4 Load | 0.65 |
| 1/2 Load | 0.53 |
| Motor efficiency | |
| 1/1 Load | 78.0 % |
| 3/4 Load | 77.0 % |
| 1/2 Load | 72.5 % |

### Configuration

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/8/2018 | |

# CP 3085 MT 3~ 440

## Duty Analysis

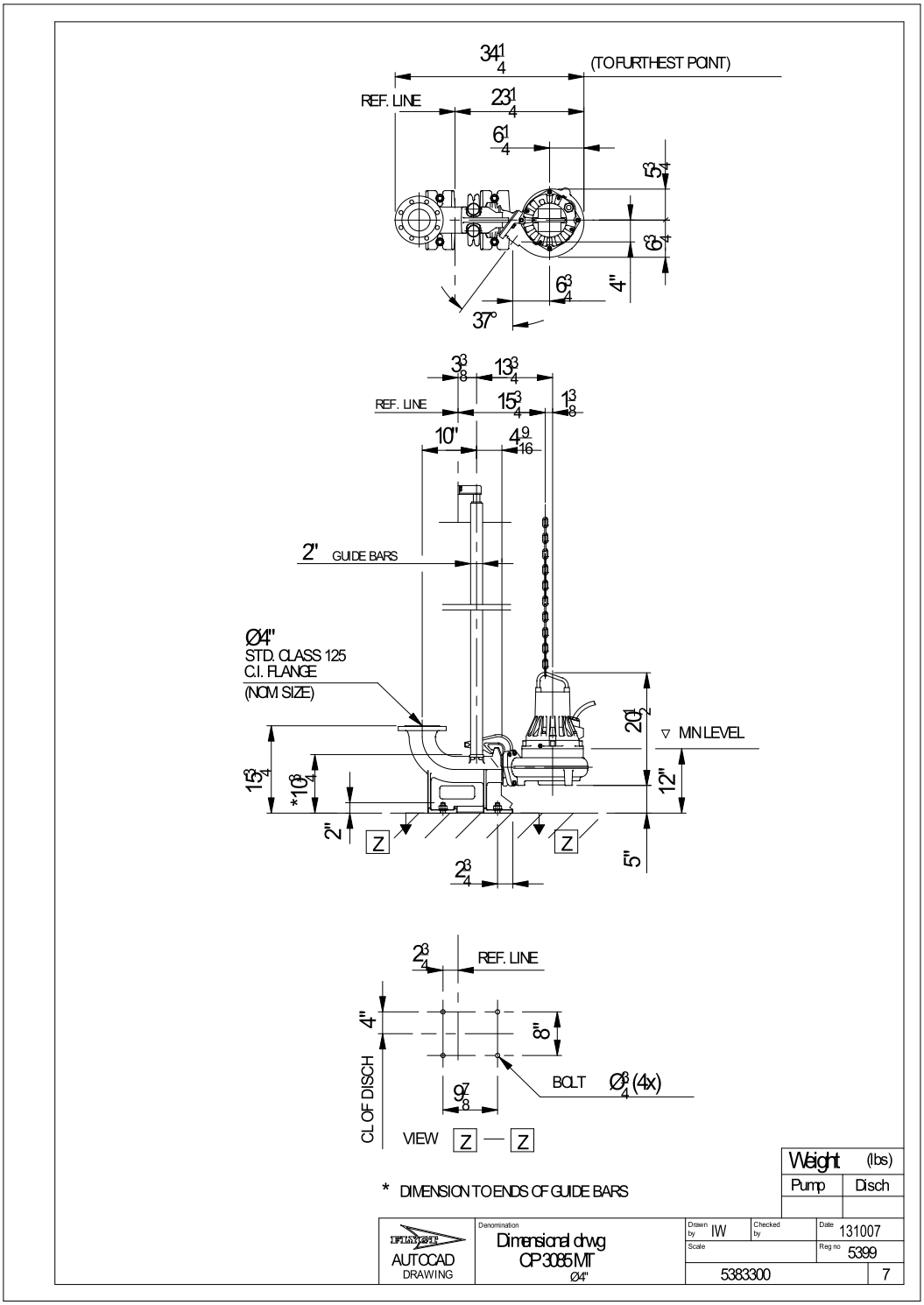



| Pumps running /System | Individual pump | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Flow | Head | Shaft power | Flow | Head | Shaft power | Pump eff. | Specific energy | NPSHre |
| 1 | 216 US g.p.m. | 7.37 ft | 1.19 hp | 216 US g.p.m. | 7.37 ft | 1.19 hp | 34 % | 92.6 kWh/US MG | 11.1 ft |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/8/2018 | |

# CP 3085 MT 3~ 440

## Dimensional drawing




| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| | | | 6/8/2018 | |

Appendix 5C

# ALKALINITY FEED SYSTEM

## 5C.1 Chemical Alternatives for Adding Alkalinity

There is a range of chemicals available for adding alkalinity to a wastewater treatment process. This analysis focuses on caustic soda (sodium hydroxide, NaOH), magnesium hydroxide (Mg(OH)2), and hydrated lime (calcium hydroxide, Ca(OH)2).

### 5C.1.1 Caustic Soda

Caustic soda is a common chemical used for alkalinity addition. It is delivered and stored as a slurry, typically at 25 percent. At this concentration it is considered hazardous. Caustic soda is generally more soluble and faster acting than magnesium hydroxide, but it provides less alkalinity per unit volume than both hydrated lime and magnesium hydroxide. Therefore, larger tanks and pumps, and more frequent chemical deliveries, would be required in comparison to magnesium hydroxide or hydrated lime.

### 5C.1.2 Magnesium Hydroxide

Magnesium hydroxide adds alkalinity and is non-hazardous, unlike caustic soda. It is relatively safe to handle and environmentally safe, in comparison to hydrated lime. It can be delivered and stored as a slurry if it is periodically mixed to keep it in suspension. Magnesium hydroxide is slower to react than the other chemicals, such as hydrated lime and caustic soda, so mixing and retention time must be accounted for in the design and control of the injection system.

Magnesium hydroxide has limited solubility and will only raise the pH to about pH 9.5, even if significantly over-dosed. Overdosing is less likely since the excess magnesium hydroxide in solution becomes available as needed, acting as a time-release alkalinity agent. In addition, since magnesium is a divalent cation, magnesium hydroxide aids floc formation. Magnesium hydroxide provides more alkalinity per volume than hydrated lime reducing the size of the tanks and pumps, and the number of chemical deliveries, in comparison to hydrated lime.

### 5C.1.3 Hydrated Lime

Like magnesium hydroxide, hydrated lime can be delivered as a slurry. It is simple to feed and is typically readily available and inexpensive compared to other chemicals. Hydrated lime is generally more soluble and faster acting than magnesium hydroxide, but it provides less alkalinity per unit volume than magnesium hydroxide. Therefore, larger tanks and pumps, and more frequent chemical deliveries, would be required in comparison to magnesium hydroxide.

Hydrated lime can cause scaling at feed facilities if they are not operated and maintained properly, which means there is a higher effort for equipment operation and maintenance. In addition, hydrated lime will buffer up to a pH of 12, which will negatively impact the secondary process if is overdosed, and it is corrosive so it must be handled properly to avoid skin contact.

## 5C.2 Facility sizing

The estimated facility size for caustic soda, magnesium hydroxide, and hydrated lime were developed to compare tank size and pumping requirements. This will affect the footprint of the facilities as well as the associated O&M. A comparison of the tank sizes and pump rates for the alkalinity facilities for various loading conditions are presented in Table 5C.1.

Table 5C.1 Facility Sizing Comparison

| Item | Current Conditions | | |
|---|---|---|---|
| | ADWF | MMF | PWWF |
| Additional Alkalinity Required, lbs/day as $CaCO_3$ | 2,400 | 5,400 | 3,900 |
| **Caustic Soda** (1) | | | |
| Alkalinity per Gallon, lbs $CaCO_3$ per gallon | 4.0 | 4.0 | 4.0 |
| Volume required, gal/day | 592 | 1,356 | 987 |
| Storage volume required for 14 days, gal | 8,300 | 19,000 | 13,800 |
| Feed pump rate, gal/hr | 24.7 | 56.5 | 41.1 |
| Number of Tanks | 2 | 2 | 2 |
| Tank Volume Required for 14 day Max Month Supply | | 10,000 | |
| **Magnesium Hydroxide Slurry** (2) | | | |
| Alkalinity per Gallon, lbs $CaCO_3$ per gallon | 12.5 | 12.5 | 12.5 |
| Volume required, gal/day | 189 | 434 | 316 |
| Storage volume required for 14 days, gal | 2,700 | 6,100 | 4,400 |
| Feed pump rate, gal/hr | 7.9 | 18.1 | 13.2 |
| Number of Tanks | 2 | 2 | 2 |
| Tank Volume Required for 14 day Max Month Supply | | 3,000 | |
| **Hydrated Lime** (3) | | | |
| Alkalinity per Gallon, lbs $CaCO_3$ per gallon | 6.8 | 6.8 | 6.8 |
| Volume required, gal/day | 346 | 794 | 578 |
| Storage volume required for 14 days, gal | 4,800 | 11,100 | 8,100 |
| Feed pump rate, gal/hr | 14.4 | 33.1 | 24.1 |
| Number of Tanks | 2 | 2 | 2 |
| Tank Volume Required for 14 day Max Month Supply | | 6,000 | |

Notes:
(1) Caustic soda is 25 percent solids.
(2) Magnesium hydroxide slurry is 60 percent solids.
(3) Hydrated lime is 45 percent solids.

Chemical bulk storage facility sizing is based on a conservative approach of chemical deliveries twice per month during maximum month conditions. The size of the chemical feed pumps is based upon the chemical flow rate required during peak loading. As shown in Table 5C.1, the smallest footprint would be needed if magnesium hydroxide slurry was used. With this chemical only two 3,000 gallon tanks would be required. However, if caustic soda was used, two 10,000 gallon tanks would be required. In between, hydrated lime would require two 6,000 gallon tanks.

For this predesign report, it was assumed that a hydrated lime slurry would be used. However, costs associated with this chemical will be evaluated during final design.

Appendix F

# TM 6 SOLIDS HANDLING AND DIGESTER IMPROVEMENTS



City of Arcata
Wastewater Treatment Facilities Improvements

# Technical Memorandum 6
# SOLIDS HANDLING AND DIGESTER IMPROVEMENTS

FINAL | April 2019

City of Arcata
Wastewater Treatment Facilities Improvements

# TECHNICAL MEMORANDUM 6

# SOLIDS HANDLING AND DIGESTER IMPROVEMENTS

FINAL | April 2019



# Contents

Technical Memorandum 6 - SOLIDS HANDLING AND DIGESTER IMPROVEMENTS 6-1

6.1 Purpose 6-1

6.2 Summary of Findings and Recommendations 6-1

6.3 Background 6-1

6.4 Overall System Configuration 6-2

6.5 Design Criteria 6-2

6.6 Solids-Thickening Prior to Digestion 6-4

6.6.1 Gravity Thickeners 6-5

6.6.2 Centrifuges 6-5

6.6.3 Gravity Belt Thickeners 6-5

6.6.4 Rotary Drum Thickeners 6-6

6.6.5 Recommendations 6-6

6.7 Digester Improvements 6-6

6.7.1 Digester Configuration and Operation 6-7

6.7.2 Digester Cleaning and Repairs 6-10

6.7.3 Digester Covers 6-10

6.7.4 Digester Mixing and Piping Improvements 6-10

6.7.5 Digester Boiler and Heat Exchanger 6-11

6.7.6 Digester Gas Flaring/Utilization 6-11

6.8 Sludge Dewatering and Utilization 6-12

6.8.1 Dewatering Through Drying Beds 6-12

6.8.2 Sludge Utilization 6-14

6.9 Construction Considerations 6-15

# Appendices

Appendix A Key Solids Criteria Associated with 1984 Project

Appendix B Design Criteria and Process Calculations – Proposed Upgrades

## Tables


| | | |
|---|---|---|
| Table 6.1 | Summary of Key Solids Handling Design Criteria | 6-2 |
| Table 6.2 | Solids Thickening Prior to Digestion | 6-4 |
| Table 6.3 | Digester Improvements | 6-8 |
| Table 6.4 | Sludge Dewatering and Utilization | 6-13 |


## Figures


| | | |
|---|---|---|
| Figure 6.1 | Solids Processing Schematic | 6-3 |

# Abbreviations

| | |
|---|---|
| AC | Acre |
| AFY | Acre-feet per year |
| ADD | Average Day Demand |
| BOD | Biochemical Oxygen Demand |
| btu | British Thermal Unit |
| Carollo | Carollo Engineers, Inc. |
| cf | cubic feet |
| cfs | cubic feet per second |
| CIP | Capital Improvement Program or cast iron pipe |
| F | Fahrenheit |
| $^{o}$F | Degrees Fahrenheit |
| ft | Feet |
| ft-msl | feet above mean sea level |
| GAC | Granular Activated Carbon |
| gpcd | gallons per capita day |
| gpd | gallons per day |
| HGL | Hydraulic Grade Line |
| kW | Kilo Watts |
| lb/d | pounds per day |
| µg/L | micrograms per liter |
| MDD | Max Day Demand |
| MG | million gallons |
| mgd | million gallons per day |
| mg/L | milligrams per liter |
| mgd | million gallons per day |
| MinDD | Minimum Day Demand |
| MinMD | Minimum Month Demand |
| MMD | Maximum Month Demand |
| msl | Mean sea level |
| PHD | peak hour demand |
| PS | Primary Solids |

| | |
|---|---|
| psi | pounds per square inch |
| RO | Reverse Osmosis |
| SCADA | Supervisory Control and Data Acquisition |
| SF | Square Feet |
| SWP | State Water Project |
| TSS | Total Suspended Solids |
| VSS | Volatile Suspended Solids |
| VSR | Volatile Solids Reduction |
| WAS | Waste Activated Solids |
| WRF | Water Reclamation Facility |
| WWTP | Wastewater treatment plant |

Technical Memorandum 6

# SOLIDS HANDLING AND DIGESTER IMPROVEMENTS

## 6.1 Purpose

The purpose of this Technical Memorandum (TM) is to identify, evaluate, select and size proposed solids handling and digester improvements for the City of Arcata Wastewater Treatment Plant (WWTP). The need for solids handling improvements was identified in the Facilities Plan and additional analysis and recommendations are presented in this TM. Refinements and final equipment selection would be completed during the final design process. As per the scope of services, the intent of the analysis in this TM is to refine the analysis of the Facilities Plan rather than to introduce a series of new concepts and alternatives.

The solids handling and digester improvements summarized in this TM are predicated upon other system improvements including headworks screening and grit removal as well as primary and secondary clarification and sludge pumping improvements. These related improvements are addressed in separate TM's and such work is not discussed further here. This TM focuses on thickening, digestion, and dewatering assuming the other improvements are also completed.

## 6.2 Summary of Findings and Recommendations

The key findings and recommendations of this TM are summarized below:

- Solids Thickening:
  - Provide a new rotary drum thickener for thickening secondary solids prior to digestion.
  - Provide piping to send primary sludge to thickener for co-thickening.
- Digester Improvements:
  - Clean both the primary and secondary digesters.
  - Replace primary digester floating cover with a fixed roof type cover
  - Replace the secondary digester floating roof with a new floating roof cover.
  - Replace the existing boiler / heat exchanger with a new unit.
  - Inspect the digester mixing and heating piping and replace existing plug valves that are inoperable and mixing nozzles if worn and deteriorated.
- Sludge Dewatering: Existing drying bed system will be used for sludge dewatering.

## 6.3 Background

The existing solids handling and treatment facilities include primary and secondary digesters, digester mixing and heating facilities for the primary digester, sludge drying beds, compost operation, and digester gas handling. The digesters were constructed as part of the original plant in the late 1950s. The primary digester was upgraded in the 1984 project, including increasing the overall height.

Floating gas holder roofs were added at that time as well. The external condition of the digesters was rated as Fair in the Facilities Plan given the overall age of the digesters and other information known about their condition. The digesters are reported to have been cleaned in 2002 and 2014 although there are no reports available on the internal condition. For the purposes of the Facilities Plan and this TM, the overall digester structures are assumed to be usable. However, the Facilities Plan recommended rehabilitation of the covers, which is discussed in more detail later in this TM.

## 6.4 Overall System Configuration

The overall solids handling process flow schematic for the proposed upgraded treatment plant is presented in Figure 6.1. Much of the existing digestion Infrastructure is planned to be reused so that capital improvements are focused on maintenance and upgrades to meet the solids handling requirements of the new mechanical treatment equipment. Pertinent support information regarding design criteria from 1984 is included in Appendix A and process calculations and criteria for proposed upgrades is included in Appendix B.

## 6.5 Design Criteria

The key solids handling design criteria used throughout this TM are summarized in Table 6.1.

Table 6.1 Summary of Key Solids Handling Design Criteria

| Criterion | Characteristic |
|---|---|
| Solids Thickening | |
| Solids Sources | Primary and Secondary Sludge |
| Solids Capture | 95% Capture at 5% TSS |
| Thickened Sludge Loading, Maximum | 16,000 gal/day |
| Digesters | |
| Primary Digester | |
| Type | Heated, mixed |
| Detention Time | 21 days |
| Boiler Heating Capacity | 1,000,000 but/hr |
| Secondary Digester | |
| Type | Unheated, Unmixed |
| Detention Time | Varies, depends on draw schedule & decanting |
| Supernatant Return | Decant and convey back to headworks |
| Overall` Volatile Solids Destruction | 50% |
| Sludge Dewatering | |
| Type | Covered Drying Beds, air dry, periodic mixing |
| Size | 30,000 sf, Two beds |
| Draw Frequency, Minimum | 2 -3 times per year |

See Appendix A for original 1984 system design criteria and Appendix B for more detailed design criteria and process calculations associated with recommended solids improvements.

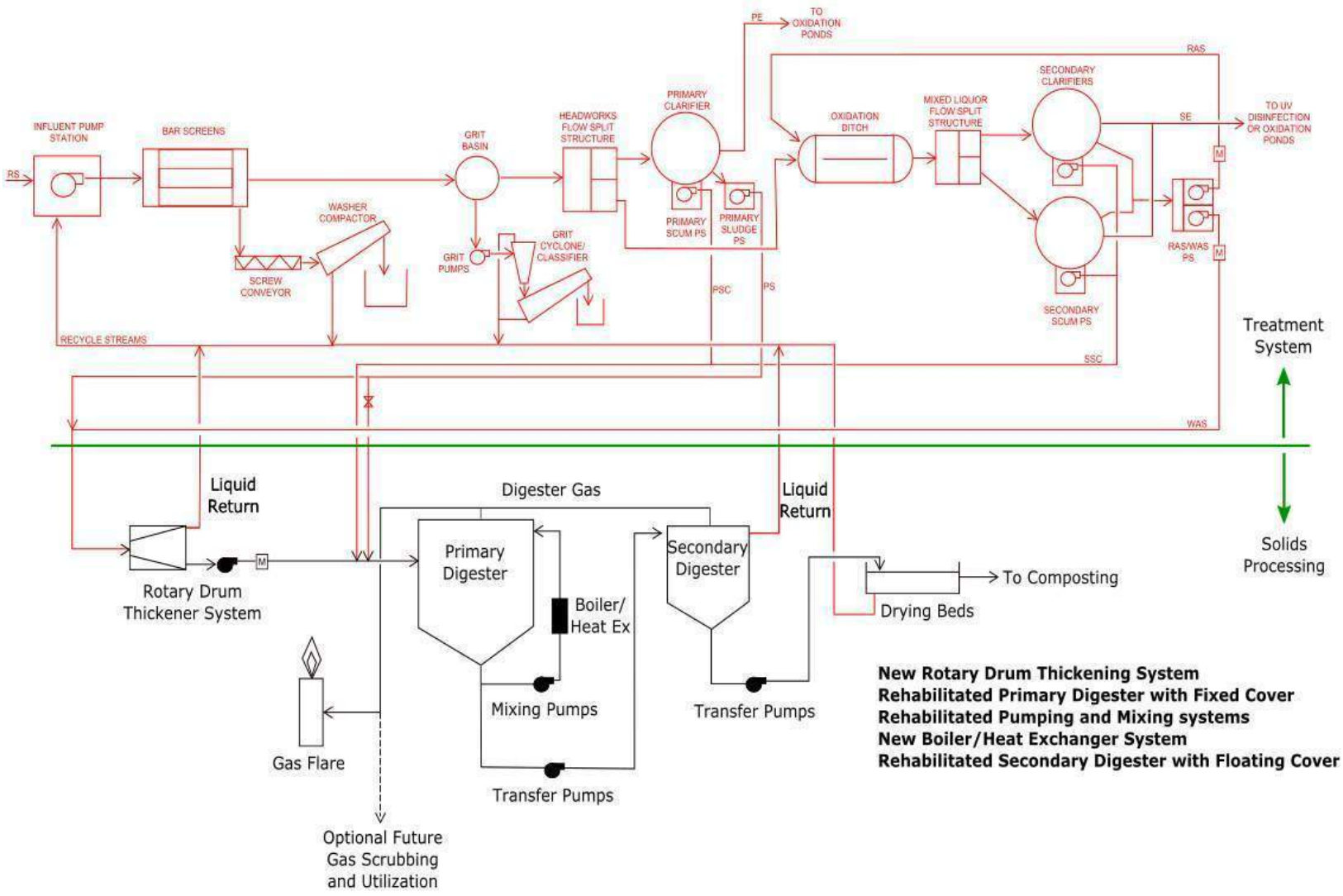



Figure 6.1 Solids Processing Schematic

## 6.6 Solids-Thickening Prior to Digestion

The existing solids processing system does not employ thickening prior to digestion. The existing system is based on collecting primary sludge only, which is highly digestible and tends to perform reasonably well in the digester without thickening. The digesters were originally sized to handle the additional water from unthickened primary sludge. However, the new system will have both primary and secondary sludge which introduces additional water and secondary sludge can be more difficult to digest without thickening. For the development of a new solids thickening system there are advantages to co-thickening primary and secondary sludge together such as improved thickening for secondary waste activated sludge (WAS), which is often difficult to thicken on its own, as well as reduced costs by utilizing a common process for both primary and secondary sludge.

The modified wastewater treatment process will produce mostly secondary waste activated sludge, with a small amount of primary sludge depending on how the primary clarifier is operated. The waste activated sludge is typically very dilute and it is best to thicken prior to digestion. Any primary sludge produced can be mixed with the waste activated sludge in a co-thickening process. A number of potential co-thickening technologies were considered and Rotary Drum Thickeners (RDT) were identified as the most appropriate approach. The system configuration should allow for pumping primary solids directly to digesters and thickening secondary solids in an RDT prior to pumping to digesters, or Co-thicken primary and secondary solids in an RDT prior to pumping to digesters.

How the primary and secondary solids are produced and may be mixed and thickened should be refined based on operational experience and preference. In addition, the proposed treatment upgrades and solids management strategy has a number of overall solids handling implications, including treating wastewater in the oxidation ditch with a long retention time to significantly reduce the volatile solids and hence reduce the biological load on the digesters. The implications are further discussed under the digestion and dewatering sections of this summary.

A summary of the proposed thickening process is summarized in Table 6.2.

Table 6. 2 Solids Thickening Prior to Digestion

| Near Term Strategy/Improvements | Longer Term Adaptive Management/Improvements |
|---|---|
| • New RDTs.<br>• Co-Thicken primary and secondary Solids in RDTs<br>• Allow for pumping primary solids directly to digesters.<br>• Always thicken secondary solids in an RDT prior to digestions. | • Treat the wastewater in the oxidation ditch with a long retention time to significantly reduce the volatile solids and the biological load on the digesters. |

A cothickening process could produce 5 percent solids feed to the digesters which is important for achieving acceptable hydraulic retention time in the digesters. A new thickening system could be located in the vicinity of the existing small primary clarifier adjacent to the existing digesters. The small clarifier will no longer be needed with the treatment plant upgrades and is planned to be demolished and so thickening facilities and piping could be located in this area.

To achieve the co-thickening objective, the following five thickening technologies were evaluated:

1. Gravity Thickener.
2. Dissolved Air Flotation Thickener (DAFT).
3. Centrifuge.
4. Gravity Belt Thickener (GBT).
5. RDTs.

Each of these is briefly discussed below.

### 6.6.1 Gravity Thickeners

**Gravity Thickeners** are similar to a primary clarifier and were in common use in the past, but problems including poor settling performance, gas forming from anaerobic conditions, odors, and difficulties with control of the process has led to better options. Gravity thickening will not be considered further.

#### 6.6.1.1 Dissolved Air Flotation Thickeners

DAFTs have been used for many years to thicken secondary WAS, which can otherwise be difficult to separate with gravity. This is accomplished by using small air bubbles to separate these solids from the liquid stream and float them to the top of the liquid surface for skimming off. While DAFT is typically an effective technology for secondary WAS, it is less than optimal performance with Primary Solids or mixed WAS/PS. For a co-thickening operation, this is not considered the best technology and will not be considered further.

### 6.6.2 Centrifuges

Centrifuge thickening has proven itself to be a very efficient and effective method for separating solids, either primary solids, WAS or a combination of the two. The centrifuge process is enclosed and contains odors and moisture. It is also capable of producing high concentrations of solids in the thickening process, beyond the 5 percent that is needed for digestion. Also, centrifuges are quite sophisticated and require significant operational skill as well as significant repair, maintenance and upkeep. Centrifuges also require more electrical energy than all of the thickening technologies under consideration. Centrifuges may at some point be appropriate for dewatering digested sludge, but this technology will not be considered further for thickening.

### 6.6.3 Gravity Belt Thickeners

GBTs utilize traveling belt filters to continuously allow water in sludge to pass through the traveling belt leaving thickened solids on the belt surface for removal. This technology can work well with both primary sludge and waste activated secondary sludge. Although waste activated sludge can be more difficult to thicken, combining it with primary sludge can enhance thickening performance and hence the strategy of co-thickening. GBTs are very energy efficient compared to centrifuges, but the units tend to be quite large. GBTs require wash water to clean the belt after the removal of thickened solids. This washing process tends to make for humid conditions that can result in odors. The GBTs can be contained in rooms or enclosures to contain the water/odors coupled with ducting to remove them from the unit and the room.

### 6.6.4 Rotary Drum Thickeners

RDTs utilize a rotating drum screen where sludge conditioned with polymer is introduced to the inside of the rotating drum screen. Free water drains by gravity through the screen openings and collects in a trough underdrain. Thickened sludge is conveyed through the rotatory drum and out the discharge end via continuous internal screw or angled flights. Some equipment manufacturers use a slight incline to aid with separation. Water spray/drainage is contained within the RDTs similar to GBTs but much water is needed. Power usage is one of the lowest of all choices. There are a number of experienced manufacturers of providing such equipment to the wastewater industry.

### 6.6.5 Recommendations

The 2017 Facility Plan identified RDTs for costing purposes and our analysis here concurs with this approach for co-thickening sludge prior to digestion for Arcata.

Based upon the anticipated flows and loads developed previously for the project and listed in the enclosed process calculations, 60 gpm of combined PS/WAS (6,361 lb/d TSS) can be processed by one RDT with 100 gpm capacity at 24/7 operation. A second RDT should be provided for standby redundancy and for processing higher flows. Production of 5 percent TSS should be the goal with 95 percent capture.

Facilities needed to support the RDTs include raw sludge blend tanks (2), thickened sludge hoppers (2), thickened sludge pumps (2), and an emulsion polymer system (sized to feed about 10 lb/dry ton) plus feed pumps (1 per RDT), duplicate mix/aging tanks, and a designated area for tote storage of emulsion polymer.

The overall thickening system described herein should be housed in a structure dedicated to the RDT process.

In addition to thickening, improvements to the digesters are recommended as further discussed below.

## 6.7 Digester Improvements

The primary and secondary digester structures have been in service for decades. During the upgrade of the primary digester during the 1984 project, the overall height was increased and floating gas holder roofs were added to both digesters at that time as well. Based on the Facilities Plan and confirmation through this preliminary design process, the overall condition is fair and the concrete structures appear serviceable for a number of years into the future. The covers, piping, mixing, heating, and other systems tend to require more maintenance due to corrosion and mechanical wear. The digesters need to be periodically cleaned of indigestible solids and caked on material. Also, the interior of the concrete may warrant maintenance, although the interior will not be visible for inspection until they digesters are cleaned. For the purposes of the Facilities Plan and this TM, the overall digester structures are assumed to be usable. Improvements are recommended for other solids management process as discussed below.

Historically, both digesters were operated with floating covers. It is proposed that the primary heated and mixed digester be operated with a fixed cover and that the secondary digester be operated with a floating cover. The primary digester provides the majority of the sludge

treatment while the secondary digester is essentially for storage between draws to the drying beds.

As is the current practice, supernatant will need be regularly removed from the secondary digester and conveyed back to the headworks as thickened sludge is pumped to the primary digester to provide solids storage volume.

Strategies for adaptive management for digester operation relate mostly to the heating and mixing of the primary digester and the frequency of draws from the secondary digester to the drying beds. These operational parameters can be modified based on actual flow and solids characteristics and operating practices.

Following thickening, the solids are processed in the digesters and the proposed improvements are summarized in Table 6.3.

Each of these improvement areas is further discussed below.

### 6.7.1 Digester Configuration and Operation

The overall purpose of making improvements to the existing solids handling and digestion system is to provide maintenance and improvements to existing components and to provide additional systems for handling additional primary and secondary solids to be produced through the planned treatment plant upgrades. Additional potential enhancements to digested solids dewatering as well as digester gas scrubbing and use are also briefly considered.

Solids handling and digester Improvements begin with the gathering of Primary Solids (PS) from primary clarifiers as has been done historically and combining with secondary WAS from proposed new oxidation ditch. Given the proposed strategy to bypass the existing primary treatment system and treat influent wastewater under normal flows in the oxidation ditch, primary solids would only be produced during higher flows that are then conveyed to the treatment ponds. Therefore, the solids will predominately be secondary WAS with primary solids being created during higher flows.

The overall digester configuration and operation is based on the anticipated solids streams from the upgraded system. The configuration discussed in this section is based on the continued strategy of a primary heated and mixed digester followed by a secondary unheated and unmixed digester in which supernatant is regularly decanted and sludge is drawn down several times a year and dewatered.

Given the anticipated flows, configuration, and solids production, it has been estimated the sludge pumped from clarifiers to the primary digester will have a hydraulic retention time of approximately 23 days, which is well above a typical minimum guideline of 15 days. The volatile solids loading rate is also within typical process guidelines. Given an adequately heated and mixed digester under these loading conditions, it is estimated that 50 percent volatile solids reduction can occur through the entire digestion process. Depending on actual flows and operating conditions over time, the City should expect similar future finished sludge characteristics in terms of frequency of draws and dewatering characteristics, although draws may become more frequent. This will require optimizing primary and secondary clarification processes to maximize initial solids content and optimizing cothickening operations to maximize solids to the primary digester. A key goal is to minimize water that enters the digesters.

Table 6.3 Digester Improvements

| Near Term Strategy/Improvements | Longer Term Adaptive Management/Improvements |
|---|---|
| **Configuration and Operation** | |
| • Replace the primary digester floating cover with a fixed cover.<br>• The secondary digester will remain a floating cover. | • The operational parameters for heating and mixing of the primary digester and the frequency of draws from the secondary digester should be modified based on actual flow and solids characteristics and operating practices. |
| **Digester Cleaning and Repairs** | |
| • It is recommended, that as part of the overall digester modification process, that the digesters be sequentially cleaned and the interior inspected and repaired as needed. | • It is recommended the performance of the digesters continue to be evaluated over time and that they are periodically taken off line for cleaning and maintenance.<br>• Detailed cleaning and maintenance reports should be maintained to provide a long term record of performance and to help guide operational practices and long term maintenance, improvement, or replacement planning. |
| **Digester Covers** | |
| • The primary digester cover should be replaced with a fixed cover.<br>• The secondary digester cover should be replaced with a floating cover. | • Regular inspection and maintenance of the covers should take place during periodic digester cleaning and inspections. |
| **Digester Mixing and Piping Improvements** | |
| • Include an allowance for valve and piping replacement in the construction documents. A number of valves are frozen, pumps, and pump bases are corroded, and some piping needs replacement to maintain the overall heating and mixing loops. | • The mixing and piping system will require regular inspection and maintenance.<br>• Piping and nozzles on the digester interior should be inspected and replaced during periodic digester cleaning.<br>• The new mixing pumps should be equipped with VFDs to allow operators to adjust mixing characteristics ,which will provide options for addressing potential foaming issues that are more common with digestion of WAS. |
| **Digester Boiler and Heat Exchanger** | |
| • Replace boiler with new unit with 1,000,000 btu/hr capacity. The existing boiler and heat exchanger system is at the end of a typical service life and replacement as part of the overall treatment plant upgrades will help maintain a reliable, maintainable system. | • The heat exchanger may require periodic cleaning to maintain heat transfer efficiency.<br>• Temperatures should be monitored and recorded over time to track possible issues and the need for cleaning. |

Table 6.3 Digester Improvements (Continued)

| Near Term Strategy/Improvements | Longer Term Adaptive Management/Improvements |
|---|---|
| **Digester Gas Flaring/Utilization** | |
| • Digester gas is a potential fuel source, but it is currently flared due to a number of factors including the variability in production and the high cost of scrubbing water, hydrogen sulfide, and siloxane from the gas.<br>• Unscrubbed gas has low heating value and leaves deposits in boilers and engines. Using the gas for fuel for an engine for combined heat and power would require extensive scrubbing to increase the fuel value and clean the gas to protect the engine.<br>• Extensive scrubbing for cogeneration adds significant capital and operations cost and is not typically done for small plants like Arcata. Such effort is not currently warranted given the relatively low cost of natural gas.<br>• A somewhat more viable option is to consider modest condensate removal and blending with natural gas for fueling the boiler for heating the digester. However, this is not typically done for plants the size of Arcata's given the low cost of natural gas and due to a variety of operational issues including siloxane deposits in the boiler. Gas utilization could be considered further during final design.<br>• With or without gas utilization, the flare will need to be utilized for periods when digester gas is not fully utilized. The existing flare has reached the end of its useful life and should be replaced as well. | • Gas utilization may at some point make economic sense for cogeneration if natural gas and electricity prices increase sufficiently.<br>• The City should track actual gas production and quality after the solids improvements are made to document the available digester gas resource while monitoring natural gas and electricity pricing.<br>• The City could in the future develop a cogeneration project when cost effective or offer the digester gas resource to a private firm to design, build, and operate a digester gas utilization system for cogeneration. |

As thickened sludge is pumped into the primary digester, it will push sludge from the mixed and heated primary digester to the unheated and unmixed secondary digester. As is the practice now, an equal volume of supernatant will need to be drawn from the secondary digester as thickened sludge pumped into the primary digester. The supernatant flows through several pipes tapped into the secondary digester and is conveyed back to the headworks. Regular decanting of supernatant is necessary to separate water from solids and provide sufficient working volume in the secondary digester for stocking solids between draws.

Depending on flows, performance of the new mechanical equipment, and operational practices it will likely be necessary for the City to draw sludge from the secondary digester to the drying beds more frequently. It has been estimated the City may need to draw a minimum of three times per year rather than the current practice of two times per year. Operational characteristics

should be monitored and adjusted based on adaptive management strategies as further discussed in the TM.

### 6.7.2 Digester Cleaning and Repairs

The digesters are reported to have been cleaned in 2002 and 2014. Although the recent cleaning is only four years ago, the proposed upgrades of the digesters will require them to be taken off line one at a time and they should be cleaned of grit and accumulated solids at that time. In addition, they should be thoroughly inspected and needed repairs made. It is anticipated as discussed below, that mixing nozzles and other internal piping is likely to need repairs during the cleaning process.

### 6.7.3 Digester Covers

Based on the evaluation in the Facilities Plan and as confirmed through further analysis in this preliminary design phase, the existing floating digester covers should be replaced. They have served their useful life and in fact the truss frame design of the covers makes them prone to internal corrosion that is difficult to visibly evaluate. Also, there are performance reasons to consider alternative cover approaches.

There are two strategies for replacing the digester covers. One is to provide both digesters with improved floating covers and a second strategy is to provide the Primary Digester with a fixed cover and the Secondary Digester with a floating cover.

A fixed cover typically used when the sludge level in the digester doesn't vary significantly. A fixed cover is also $50,000 to $100,000 less expensive than a floating cover and avoids the mechanical challenges associated with a floating cover. Floating covers are typically used where sludge level is variable and there isn't the need for gas storage under the digester cover.

Because the City operates one digester as a primary and a second digester as a secondary, there is no need for the primary digester to have a floating cover. The practical way to utilize a primary digester in this situation is to operate it with a fixed cover and provide an overflow pipe so that sludge pumped into the primary digester pushes digested sludge out through the overflow pipe and into the secondary digester with a floating cover. There are several advantages to this arrangement, the first being that there is a fixed volume for digestion in the primary digester. Second, the chance for short circuiting of flows through the digester can be minimized and hence overall digester performance can be improved.

Based on all of these factors, it is recommended that a fixed steel cover be used for the primary digester.

The secondary digester will need a floating cover because the volume in the digester varies throughout the year as it is being filled from the primary digester, as supernatant is being decanted, and during the periodic draws of solids for dewatering. The preferred floating cover today uses arched metal plates with a ballasted side skirt. This simple design has proven itself to be superior to the old truss style and is in fact approximately $50,000 less expensive than the old truss style.

### 6.7.4 Digester Mixing and Piping Improvements

The heating and mixing system for Digester No. 1 was upgraded in 2002 (Rotamix nozzles) and in 2013 (new mixing nozzles and mixing / recirculation pumps). The condition of this equipment as reported in the Facilities Plan appears to be good to fair. According to staff, many of the

valves in the sludge conveyance and pumping system, much of which dates back to the original construction, are frozen and inoperable. Grit has eroded and clogged portions of the digester mixing system, nozzles, piping, etc. The pumps have been in service for a number of years and are in need of significant maintenance or replacement. The current condition will need to be assessed when the digesters have been taken out of service for upgrades, however it is recommended the pumps be replaced and an allowance be provided for other mixing and piping improvements identified when the digesters are taken off line for cleaning and other major improvements.

The planned headworks upgrades are expected to significantly reduce grit issues which should help extend the useful life of the mixing and piping systems.

### 6.7.5 Digester Boiler and Heat Exchanger

The existing primary digester at the plant is heated by a Walker Process Boiler from the 1994 project coupled with a tube-in-tube heat exchanger (HEX) also provided in the 1994 project. These facilities are now over 20 years old and approaching the end of their useful life. Based on making some substantial capital improvements to the digestion facilities, it is critical that the digestion process can be properly heated to accomplish the required decomposition (digestion) required by regulation.

Like the mixing piping, the heat exchanger has been subject to the erosive forces of the grit in the sludge and is anticipated to be in need of replacement.

Fortunately there are current manufacturers that can provide the size and style of boiler/heat exchanger combinations needed to fit within the existing building and still provide the expanded capacity needed for this project. Based upon the preliminary calculations developed for this TM, Heat Exchangers of up to 1,000,000 BTU/hr can provide the heating needed for this project. Boilers should be similarly matched to these capacities as minimums. By providing boiler/heat exchanger arrangements similar to the existing, modifications to the existing piping will be minimized, saving costs and time to accomplish the work. Also, a similarly sized boiler/heat exchanger will fit within the existing building.

### 6.7.6 Digester Gas Flaring/Utilization

The digestion process produces gas that not only contains combustible methane, but also contains significant concentrations of hydrogen sulfide, moisture and siloxane. These other constituents cause problems utilizing the digester gas for firing boilers, or fueling engine generators, and can even cause problems with flaring. The digester gas is also corrosive to gas piping, valves and instruments.

The methane in digester gas is potentially useful. The City expends approximately $20,000 per year currently on natural gas for digester heating. However, digester gas needs to be scrubbed of water and impurities to optimize its value and protect the equipment that is burning it. It is only economical to scrub and utilize digester gas if it is less costly than natural gas and currently natural gas prices are very low.

The degree of scrubbing depends on the intended use. Scrubbing for use in an internal combustion engine to generate power and heat requires extensive equipment to remove water and impurities to improve the fuel value and protect the engine and reduce emissions. The equipment for significant scrubbing is complex, and requires additional space and operations

and maintenance attention and could top $200,000 alone and it is not currently economical nor practical to scrub the gas for an internal combustion engine.

The City could consider a lower level of condensate removal to fire a boiler. A simple condensate removal system is on the order of $50,000. Such gas could theoretically fire a boiler alone or be mixed with natural gas. However, the lower and variable fuel value of digester gas make it difficult to control the heating of a boiler and the remaining impurities in the gas deposit inside the boiler causing additional maintenance. It is recommended the City keep this option open and consider it further during final design process. If the City wanted to demonstrate reuse of the digester gas resource, the option could be provided and the degree to which it was used could be determined based on actual operational performance and natural gas prices over time.

The City could also consider making the digester gas available to a third party who may wish to develop a digester gas utilization project at some point in the future when technology and economics warrant it.

Even with digester gas utilization, there will be times when digester gas will continue to need to be flared if there is excess gas production or when equipment maintenance is required and so the flare should remain in operation. The existing flare has been in service for several decades and City staff report increased maintenance requirements and operational difficulties. The flare system has reached the end of its useful life and it should be replaced.

Following digestion process and gas utilization and flaring, the digested sludge is further processed through dewatering and it utilized.

## 6.8 Sludge Dewatering and Utilization

The City has been using covered drying beds for dewatering solids from the secondary digester. Staff report drawing sludge into the beds approximately twice a year and periodically mixing the solids to enhance drying and then loading and trucking them to the City's composting operation. The finished composted material is used on City land.

The proposed sludge dewatering and utilization improvements are summarized in Table 6.4.

These dewatering and utilization elements are discussed further below.

### 6.8.1 Dewatering Through Drying Beds

The condition assessment for the 2017 Facility Plan indicated the covered drying beds warranted maintenance and the City has undertaken projects to extend their useful life. The City is also considering the roof structure for holding solar panels for power generation.

Table 6.4 Sludge Dewatering and Utilization

| Near Term Strategy/Improvements | Longer Term Adaptive Management/Improvements |
|---|---|
| **Dewatering Through Drying Beds** | |
| • It may be necessary to load the drying beds more frequently than currently practiced.<br>• Current practice is to draw sludge from the digesters approximately twice a year. However, potential changes in primary and secondary solids capture and characteristics and digestion could result in an increase in the quantity of digested sludge depending on flow and operational characteristics.<br>• The characteristics of the sludge may differ than current conditions due to the solids treatment in the oxidation ditch. | • There are a number of adaptive management strategies that could be adopted over time to accommodate the changes in the solids handling system.<br>• Increased frequency of sludge draw from the digesters is the primary approach, which requires sufficient dewatering between draws.<br>• Longer term strategies could include adding polymer to enhance dewatering characteristics, increasing sludge drying bed area or changing dewatering strategies such as the use of mechanical dewatering equipment such as centrifuges or belt presses.<br>• Introduction of additional mechanical dewatering systems should be carefully considered based on actual operating experience because of the potential high capital and operational costs and added operational complexities.<br>• There may be value in consider contracted operation of mechanical dewatering systems brought to the plant on trailers two or three times a year as needed rather than purchasing the dewatering systems. |
| **Sludge Utilization** | |
| • The City currently composts dewatered sludge along with green waste to produce Class B material that is used on City properties. It is anticipated the City will continue this process, which may need to be adapted to accommodate a potential increase in dewatered sludge production. | • It may be necessary for the City to adapt the ratio of green waste to digested sludge or consider covered composting areas to achieve the desired composting results.<br>• In addition, sludge management is an issue faced by all local treatment plants and there may be long term benefit to considering a regional sludge treatment/reuse facility. |

As discussed previously in this TM, it is anticipated the current drying bed method can reasonably continue into the future although actual conditions based on the sludge generated through mechanical treatment system upgrades may warrant more frequent sludge draws into the beds. In the future the City could consider an alternative dewatering approach to adapt to

future conditions. Centrifuges, belt presses, and screw presses, which are commonly used dewater technologies employed at larger plants. These technologies are briefly discussed here to present context for future dewatering consideration.

Centrifuges rely on centrifugal force (≈3,000 g) to separate polymer conditioned sludge solids particles from liquid. For the Arcata plant, there are several centrifuge companies with models that operate at 35-50 gpm that would be appropriate for the Arcata plant. If two units were provided, one could be the duty unit and the other for standby or peak conditions. Because centrifuges are enclosed, odor control is greatly enhanced. Dewatered cake of 25 percent solids is possible and it is typically the highest of all common technologies. This would greatly reduce the need for onsite storage of dewatered solids and direct hauling to beneficial uses offsite or composting would be possible. Centrifuges have a high energy requirement, have high chemical use, and operate at high speed. They tend to have high operations and maintenance requirements as well.

Belt presses uses serpentine belts and rollers to squeeze water out of polymer conditioned solids. Chemical addition is needed to enhance dewatering. The equipment is not enclosed and so typically needs a building with good ventilation and potentially odor scrubbing. Belt pressed have low speed operation and so not as much bearing wear as centrifuges.

Screw presses are another option where a large slow moving screw compresses polymer conditioned sludge against metal screens to squeeze out water. A screw press operates as slow speed, but with high contact pressure. The equipment can be enclosed which leads to better odor and humidity control. Screw presses have relatively low energy use and relatively low operational requirements.

These types of mechanical sludge dewatering techniques are often used at plants that continuously produce sludge. They are impractical at this time for Arcata as the City uses a periodic draw operation and startup and shut down of such mechanical equipment would be cumbersome. Also, mechanical equipment has a high capital cost and most of the time the investment would remain idle. Private contractors install such dewatering equipment on mobile trailers and if desired the City could periodically hire a private contractor to bring equipment on site and dewater sludge as needed. Contract periodic dewatering is a good option for the City to consider in the future when additional dewatering capacity may be needed, because the City could avoid taking of very limited site space with equipment that is only occasionally requirement and the City could avoid significant capital outlay as well as associated operational costs and challenges. Therefore, it is recommended the City continue to use the drying bed method for sludge dewatering and adapt in the future as necessary.

### 6.8.2 Sludge Utilization

Sludge dewatered through the covered drying beds is currently mixed with green waste using a front end loader and composted in large windrow piles prior to being hauled to nearby beneficial uses on City property. The City can continue this process into the future as long as regulations allow this type of reuse and the City has area to process compost and sites to apply the compost. As a longer term adaptive management strategy the City could consider working with other Humboldt Bay area WWTP's that produce sludge and consider a regional approach to sludge management. This could be coupled with strategies to address the regional need for septage management.

## 6.9 Construction Considerations

The wastewater treatment plant including the solids processing facilities need to remain operational during the planned treatment plant upgrades. Digesters will need to be taken out of service for cleaning and rehabilitation and replacement of covers. The digesters have been taken out of service periodically for cleaning in the past. The rehabilitation and roof replacement is likely to take longer than a typically cleaning and so consideration needs to be given to sequencing of activities and timing as well as staging of associated construction. For example, it is desirable to have adequate space adjacent to the digesters for construction of a new roof structure at ground level and then crane it into place. Also, the timing of digester work should consider the ability to take one digester out of service while a second has sufficient capacity to allow for normal sludge flows during rehabilitation of the out of service digester. It may be necessary for the contractor to provide mobile dewatering equipment to augment the capacity of the existing drying beds. The consideration of the digester work should be included in the overall site planning, staging, and sequencing of the overall treatment plant improvements.

Appendix A

# KEY SOLIDS CRITERIA ASSOCIATED WITH 1984 PROJECT

**ARCATA WWTP**

Source: CH2M Hill Design 1984

| **Design Year** | | | |
|---|---|---|---|
| **Design Year** | | 1992 | |
| **Design Population** | | 19,056 | |
| **Wastewater Flow** | | | |
| | Avg. | 2.3 | mgd |
| | Max. thru Primary | 5 | mgd |
| | Max. Month | 5.9 | mgd |
| | Peak | 16.5 | mgd |
| **Wastewater Characteristics** | | | |
| | BOD | 4,100 | lb/d |
| | TSS | 3,400 | lb/d |

| **Primary Clarification** | | | |
|---|---|---|---|
| **BOD Loading** | | | |
| | Avg | 4145 | lb/d |
| | Max. Mo. | 4535 | lb/d |
| **TSS Loading** | | | |
| | Avg | 3660 | lb/d |
| | Max. Mo. | 4145 | lb/d |
| **Number** | | 2 | No. |
| **Diameter** | | | |
| | Small | 26 | ft |
| | Large | 60 | ft |
| **Side Water Depth** | | | |
| | Small | 9 | ft |
| | Large | 12 | ft |
| Volume | | cf | gal |
| | Small | 4,776 | 35,724 |
| | Large | 33,912 | 253,662 |
| | Volume, total | | 289,386 |
| **Overflow** | | | |
| | Avg | 810 | gpd/sf |
| | Max. Mo. | 1,490 | gpd/sf |
| **Detention** | | | |
| | Avg | 2.6 | hr |
| | Max. Mo. | 1.4 | hr |
| **Primary Sludge-TSS removal** | | | |
| | Avg. | 60 | % |
| | Max.Mo. | 50 | % |
| | TSS conc - min | 2.5 | % |
| | Underflow solids Avg | 7.3 | gpm |
| | Underflow solids MaxMo | 6.9 | gpm |

| **Sludge Stabilization** | | | |
|---|---|---|---|
| **Primary Sludge Quantities** | | | |
| | Dry Solids | | |
| | Avg | 2,200 | lb/d |
| | Max Mo | 2,075 | lb/d |
| | Solids | 2.5 | % |
| | Flow | | |
| | Avg | 10,550 | gpd |
| | Max Mo | 9,950 | gpd |
| | VSS | 75 | % |
| **Digesters** | | | |
| | No. | 2 | |
| | Diameter | | |
| | Primary | 45 | ft |
| | Secondary | 26 | ft |
| | Depth | 28 | ft |
| | Volume | 44,500 | cu ft |
| | | 14,900 | cu ft |
| | Detention | 31.6 | days |
| | | 33.5 | days |
| | Loading | | |
| | Avg | 0.037 | lb vss/cf/d |
| | Max Mo | 0.035 | lb vss/cf/d |
| **Digester mixing** | | | |
| | Gas reculation | | |
| | Compressors | 2 | No. |
| | Power | 10 | HP |
| **Drying Beds** | | | |
| | Solids-Avg | 1,115 | lb/d |
| | Area | 15,000 | sf |
| | Annual Loading | 27 | lb/yr/sf |
| **DiGas Generator** | | | |
| | No. | 1 | |
| | Capacity | 35 | kW |
| **Standby Generator** | | | |
| | No. | 1 | |
| | Capacity | 150 | kW |

Appendix B

# DESIGN CRITERIA AND PROCESS CALCULATIONS – PROPOSED UPGRADES

**Design Influent Flow and Loads - Facility Plan**

| | Design Criteria-Full Primary Treatment | | | Alternative Criteria-No Primary Treatment | |
|---|---|---|---|---|---|
| **Flow** | | | | | |
| Design | 2.3 | MGD | Dry Weather Flow( Maximum Month Flow) | 2.3 | MGD |
| Peak | 5.9 | MGD | Peak Wet-Weather Flow | 5.9 | MGD |
| Instantaneous Peak | 16.5 | MGD | Instaneous Peak Flow | 16.5 | MGD |
| **Loads** | | | | | |
| | | | 90th percentile load per city data 2003 to 2015 plus | | |
| **BOD** | 4,800 | lb/d | 20% growth | 4,800 | lb/d |
| **TSS** | 6,910 | lb/d | | 6,910 | lb/d |
| **NH3** | 1,060 | lb/d | | 1,060 | lb/d |
| **Concentrations** | | | | | |
| **BOD** - Design | 250 | mg/l | | 250 | mg/l |
| Peak | 98 | | | 98 | |
| Instantaneous Peak | 35 | | | 35 | |
| **TSS** - Design | 360 | mg/l | | 360 | mg/l |
| Peak | 140 | | | 140 | |
| Instantaneous Peak | 50 | | | 50 | |
| **Primary Sedimentation** | | | | | |
| **BOD** | 4,800 | lb/d | 90th percentile load per city data 2003 to 2015 plus | 4,800 | lb/d |
| BOD Removal % | 40% | | | 0% | |
| BOD lb/d | 1,920 | lb/d | | - | lb/d |
| **TSS** | 6,910 | lb/d | | 6,910 | lb/d |
| TSS Removal % | 60% | | | 0% | |
| lb/d | 4,146 | lb/d | | - | lb/d |
| Concentration % | 2.5 | | Historical values | 2.5 | |
| Underflow gpm avg | 13.81 | | | - | |
| Concentration % | 2.5 | | Concentration Chosen for Technical Memo | 2.5 | |
| Underflow gpm avg | 13.8 | | | - | |
| **Secondary Treatment** | | | | | |
| **Flow-Design** | 2.3 | MGD | Dry Weather Flow( Maximum Month Flow) | 2.3 | MGD |
| Peak | 5.9 | MGD | Peak Wet-Weather Flow | 5.9 | MGD |
| Instantaneous Peak | 16.5 | MGD | | 16.5 | MGD |
| **Loads-Design** | | | Not Captured by primary and thus into OxDitch | | |
| **BOD** | 2,880 | lb/d | 60% | 4,800 | lb/d 100% |
| **TSS** | 2,764 | lb/d | 40% | 6,910 | lb/d 100% |
| **WAS** - generation ratio from BOD | 0.6 | lb VSS/lb BOD | | 0.6 | lb VSS/lb BOD |
| **WAS VSS** | 1,728 | lb vss | | 2,880 | lb vss |
| VSS/TSS | 0.78 | vss/tss | | 0.78 | vss/tss |
| **WAS TSS** | 2,215 | lb TSS/d | | 3,692 | lb TSS/d |
| **Carry Through of NVSS in TSS** | | | | | |
| **NVSS fraction** | 0.22 | nvss/tss | | 0.22 | nvss/tss |
| **NVTSS** | 608 | lb/d | | 1,520 | lb/d |
| **WAS TSS + NVTSS through Ox Ditch** | 2,823 | lb/d | | 5,213 | lb/d |
| Concentration | 0.5 | %TSS | | 0.5 | %TSS |
| volume | 47.0 | gpm | | 86.8 | gpm |
| **Biosolids to Thickening** | | | | | |
| Primary Solids | 4146 | lb/d | vs 2,200 lb/d 1984 design | 0 | lb/d |
| WAS + NVTSS from OxDitch | 2,823 | lb/d | vs zero 1984 design | 5,213 | lb/d |
| Total Solids to Co-Thickening | 6,969 | lb/d | vs 2,200 lb/d 1984 design ... 2.9 times more solids | 5,213 | lb/d |
| Ratio VSS/TSS | 0.78 | | | 0.78 | |
| Total Volatile Solids to Co-Thickening | 5,436 | lb/d | | 4,066 | lb/d |
| Primary Solids %TSS | 2.5 | | | 2.5 | |
| PS flow | 13.8 | gpm | | - | gpm |
| WAS %TSS | 0.5 | | | 0.5 | |
| WAS Flow | 47.0 | gpm | | 86.8 | gpm |
| Total Flow | 60.8 | gpm | | 86.8 | gpm |
| | 87,594 | gal/day | | 125,000 | gal/day |
| RDTs Capacity | 100 | gpm | Parkson | 100 | gpm |
| No. | 2 | 1+1 | | 2 | 1+1 |
| **Biosolids Thickening** - Capture | 95% SS capture | | | 95% SS capture | |
| Combined solids Thickened | 6,621 | lb/d | | 4,952 | lb/d |
| 0.78 | 5,164.37 | lb VSS/d | | 3,862 | lb VSS/d |
| % TSS | 5.0 | | | 5.0 | |
| Flow to digestion | 15,878 | gal/day | | 11,875 | gal/day |
| Recycle back to Treatment Plant | 71,716 | gal/day | | 113,125 | gal/day |
| **Digestion** | | | | | |
| **Primary Digester** - Diameter | 45 | ft | | 45 | ft |
| SWD | 28 | ft | | 28 | ft |
| Volume | 44,500 | CF | | 44,500 | CF |
| | 332,860 | Gal | | 332,860 | Gal |
| Detention Time | 21.0 | Days | | 28.0 | Days |
| VSS Loading Rate | 0.12 | lb VSS/CF/Day | | 0.09 | lb VSS/CF/Day |
| Mixing-Vaughn jet Mix | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Volatile Solids Reduction-VSR | 50% | | | | 50% | | |
| VSR | 2,582 | lb/d | destroyed | | 1,931 | lb/d | destroyed |
| Volatile Solids Remaining | 2,582 | lb/d | remaining | | 1,931 | lb/d | remaining |
| Total Solids Remaining | 4,039 | lb/d | 24/7 | | 3,021 | lb/d | |
| Flow | 15,878 | gal/day | 24/7 | | 11,875 | gal/day | |
| Concentration | 3.05 | %TSS | | | 3.05 | %TSS | |
| Digestion | | | | | | | |
| Heating needs | See Calculations below | | | | See Calculations below | | |
| Boiler(s) | for heating incoming | | | | for heating incoming | | |
| Heat Exchanger | Biosolids & Heat losses | | | | Biosolids & Heat losses | | |
| **Covered Biosolids Drying Beds (2)** | 15,000 | sf | Total paved area with central drains | | 15,000 | sf | |
| Hours of operation/week | 168 | hr | 24/7-Assumed for calculations. Actual ops 1/2 secor | | 168 | hr | |
| Ratio to 24/7 flows/operation | 1 | ratio | | | 1 | ratio | |
| Adjusted Flow | 15,878 | gal/day | 24/7 | | Proposed conditions | | 1984 Conditions |
| **Performance** - Capture % | 95% | | | | 95% | | 0.95 day/yr |
| Production rate 24/7 | 3,837 | lb/d | | | 2,870 | lb/d | 1115 lb/day |
| % solids | 25.0 | TSS | | | 25.0 | TSS | 1059.25 lb/yr |
| Dewatered Biosolids | 1,840 | gal/day | 24/7 | | 1,376 | gal/day | 1,376 sf |
| | 68 | lb/cf | | | 68 | lb/cf | 0.770 lb/yr/sf Original Loadin |
| | 7.48 | gal/cf | | Solids up by 3x | 7.48 | gal/cf | |
| | 246 | cf/d | | Density Double 5% feed vs 2.5% feed to digestion | 184 | cf/d | |
| | 9 | cy/d | | Net Volume diff. | 7 | cy/d | |
| | **This will require the covered sludge beds be expanded by 50% or loadings to be 3 times/yr vs 2 times/yr** | | | | **This will require the covered sludge beds be expanded by 50% or loadings be 3 times/yr vs 2 times/yr** | | |
| **Digester Gas production** | of 2016 plant data indicates | | | | of 2016 plant data indicates | | |
| Volatile Solids Reduction-VSR | 50% | | | | 50% | | |
| VSR | 2,582 | lb/d | destroyed | 24/7 | 1,931 | lb/d | destroyed 24/7 |
| DiGas per lb VSR | 16 | cu ft/lb VSR | | | 16 | cu ft/lb VSR | |
| | 41,315 | cf/d | 13,200 cf/d 1984 design due to only PS digestion | | 30,900 | cf/d | |
| | 28.7 | cfm | | | 21.5 | cfm | |
| | 600.0 | BTU/cf | | | 600.0 | BTU/cf | |
| | 17,215 | BTU/min | | | 12,875 | BTU/min | |
| | **1,032,875** | **BTU/hr** | Compare to Digester heating requirements. | | **772,494** | **BTU/hr** | |
| | | 53% | This could be close to adequate gas quantity if energy conversion effeciency at max conditions. | | | 64% | |
| DiGas Cleaning | | 49% | energy conversion at 55% VSR | | | 58% | |
| $H_2S$ Removal | None now | TBD | Typical high efficiency boilers at 85% | | None now | TBD | |
| Moisture | Some existing | TBD | There are some condensate traps now | | Some existing | TBD | |
| Siloxane Removal | None now | TBD | | | None now | TBD | |
| DiGas Generator | 35 | kW | Previous unit | | 35 | kW | |
| **Primary Digester Heating** | | | | | | | |
| Diameter | 45 | ft | | | 45 | ft | |
| Radius | 22.5 | ft | | | 22.5 | ft | |
| Side Depth | 28 | ft | | | 28 | ft | |
| Center Depth | 34 | ft | | | 34 | ft | |
| Center Drop | 6 | ft | | | 6 | ft | |
| Volume | 44,500 | cf | | | 44,500 | cf | |
| Sludge Feed - Solids | 6,621 | lb/d | | | 4,952 | lb/d | |
| Concentration | 5.0 | %TSS | | | 5.0 | %TSS | |
| Flow | 15,878 | gpd | | | 11,875 | gpd | |
| weight of flow | 132,420 | lb/d | | | 99,038 | lb/d | |
| **Heat Transferr Coefficients** | | | | | | | |
| Walls 12" thick conctete w/o insultation | 0.85 | (Btu/sf) $^{o}$F H | | | 0.85 | (Btu/sf) $^{o}$F H | |
| Floor in groundwater | 0.15 | (Btu/sf) $^{o}$F H | | | 0.15 | (Btu/sf) $^{o}$F H | |
| Roof exposed to air | 0.2 | (Btu/sf) $^{o}$F H | | | 0.2 | (Btu/sf) $^{o}$F H | |
| Temperatures | | | | | | | |
| Air | 40 | $^{o}$F | Minimum | | 40 | $^{o}$F | |
| Feed Sludge | 55 | $^{o}$F | Minimum | | 55 | $^{o}$F | |
| Earth below floor | 45 | $^{o}$F | Minimum | | 45 | $^{o}$F | |
| Digester contents | 95 | $^{o}$F | Minimum | | 95 | $^{o}$F | |
| Specific Heat of Sludge | 1.0 | Btu/lb $^{o}$F | | | 1.0 | Btu/lb $^{o}$F | |
| Incoming Sludge Heating | 5,296,793 | Btu/d | 120,866 lb/d x (95$^{o}$F-55$^{o}$F)x 1.0 Btu/lb$^{o}$F | | 3,961,506 | Btu/d | |
| | 220,700 | Btu/hr | | | 165,063 | Btu/hr | |
| Area of Digester surfaces | | | | | | | |
| wall area | 3,956 | SF | 3.14 x Dia x Ht | | 3,956 | SF | |
| Floor area | 1,645 | SF | 3.14 x Rad x (Rad$^{2}$ + Center Drop$^{2}$)$^{1/2}$ | | 1,645 | SF | |
| Roof area | 1,590 | SF | 3.14 x Rad$^{2}$ | | 1,590 | SF | |
| Heat loss from Digester Surfaces | | | | | | | |
| Walls | 184,962 | Btu/hr | 0.85 x 3,956 sf x (95-35$^{o}$F) | | 184,962 | Btu/hr | |
| Floor | 12,339 | Btu/hr | 0.15 x 1,645 sf x (95-45$^{o}$F) | | 12,339 | Btu/hr | |
| Roof | 17,486 | Btu/hr | 0.2 x 1,590 sf x (95-35$^{o}$F) | | 17,486 | Btu/hr | |
| Total heat loss from digester | 214,786 | Btu/hr | | | 214,786 | Btu/hr | |
| Total sludge heating & losses | 435,486 | Btu/hr | Primary Digester | | 379,849 | Btu/hr | |
| **Secondary Digester Heating** | | | | | | | |
| Diameter | 26 | ft | | | 26 | ft | |
| Radius | 13 | ft | | | 13 | ft | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Flow | 15,878 | gpd | | 11,875 | gpd | |
| weight of flow | 132,420 | lb/d | | 99,038 | lb/d | |
| **Heat Transferr Coefficients** | | | | | | |
| Walls 12" thick conctete w/o insultation | 0.85 | (Btu/sf) $^{o}$F H | | 0.85 | (Btu/sf) $^{o}$F H | |
| Floor in groundwater | 0.15 | (Btu/sf) $^{o}$F H | | 0.15 | (Btu/sf) $^{o}$F H | |
| Roof exposed to air | 0.2 | (Btu/sf) $^{o}$F H | | 0.2 | (Btu/sf) $^{o}$F H | |
| Temperatures | | | | | | |
| Air | 40 | $^{o}$F | Minimum | 40 | $^{o}$F | |
| Feed Sludge | 95 | $^{o}$F | Minimum | 95 | $^{o}$F | |
| Earth below floor | 45 | $^{o}$F | Minimum | 45 | $^{o}$F | |
| Digester contents | 95 | $^{o}$F | Minimum | 95 | $^{o}$F | |
| Specific Heat of Sludge | 1.0 | Btu/lb $^{o}$F | | 1.0 | Btu/lb $^{o}$F | |
| Incoming Sludge Heating | - | Btu/d | 120,866 lb/d x (95$^{o}$F-95$^{o}$F)x 1.0 Btu/lb$^{o}$F | - | Btu/d | |
| | - | Btu/hr | | - | Btu/hr | |
| Area of Digester surfaces | | | | | | |
| wall area | 2,286 | SF | 3.14 x Dia x Ht | 2,286 | SF | |
| Floor area | 537 | SF | 3.14 x Rad x (Rad$^{2}$ + Center Drop$^{2}$)$^{1/2}$ | 537 | SF | |
| Roof area | 531 | SF | 3.14 x Rad$^{2}$ | 531 | SF | |
| Heat loss from Digester Surfaces | | | | | | |
| Walls | 106,867 | Btu/hr | 0.85 x 3,956 sf x (95-35$^{o}$F) | 106,867 | Btu/hr | |
| Floor | 4,027 | Btu/hr | 0.15 x 1,645 sf x (95-45$^{o}$F) | 4,027 | Btu/hr | |
| Roof | 5,837 | Btu/hr | 0.2 x 1,590 sf x (95-35$^{o}$F) | 5,837 | Btu/hr | |
| Total heat loss from digester | 116,731 | Btu/hr | | 116,731 | Btu/hr | |
| Total sludge heating & losses | 116,731 | Btu/hr | Secondary Digester | 116,731 | Btu/hr | |
| **Combined Heating & Losses-both Digesters** | **552,217** | **Btu/hr** | **Capacity of heat exchanger required - Minimum** | **496,580** | **Btu/hr** | |

Pick a boiler and heat exchanger with more than 0.5 M Btu/hr capacity and heat exchanger with

Appendix G

# TM 7 DISINFECTION SYSTEM



City of Arcata
Wastewater Treatment Facilities Improvements

# Technical Memorandum 7
# DISINFECTION SYSTEM PRELIMINARY DESIGN

FINAL | April 2019

City of Arcata
Wastewater Treatment Facilities Improvements

# Technical Memorandum 7

# DISINFECTION SYSTEM PRELIMINARY DESIGN

FINAL | April 2019



# Contents

Technical Memorandum 7 - DISINFECTION SYSTEM PRELIMINARY DESIGN 7-1

7.1 Purpose 7-1

7.2 Summary of Findings and Recommendations 7-1

7.3 Background 7-1

7.4 Design Criteria 7-2

7.5 Existing Disinfection System 7-2

7.5.1 Chlorine Contact Basin 7-3

7.5.2 Chlorine and Sulfur Dioxide Use and Impact 7-3

7.6 Ultraviolet Light Disinfection Preliminary Design 7-5

7.6.1 UV System Sizing Criteria 7-5

7.6.2 Initial UV Equipment Selection 7-9

7.6.3 UV Flow Configuration and Layout 7-11

7.6.4 UV System Costs 7-16

7.6.5 UV System Procurement 7-23

7.6.6 UV System Pretreatment 7-24

7.7 Existing Chlorine and Sulfur Dioxide System 7-25

7.8 Summary of Next Steps 7-29

7.9 References 7-29

# Appendices

Appendix A Plant Schematic

Appendix B Chlorine Use

Appendix C UVT Data

Appendix D UV Pilot Study

Appendix E Trojan UV3000Plus Equipment Proposals and Drawings

Appendix F Trojan UVSigna 2Row Proposal and Drawings

## Tables


| | | |
|---|---|---|
| Table 7.1 | Effluent Disinfection System Design Criteria | 7-2 |
| Table 7.2 | UV System Sizing Design Criteria | 7-5 |
| Table 7.3 | Trojan UV3000Plus System Equipment Configurations [(1)] | 7-10 |
| Table 7.4 | Trojan UVSigna 2-Row Equipment Configuration [(1)] | 7-10 |
| Table 7.5 | Trojan UV3000 Plus Equipment and Construction Cost Comparison | 7-16 |
| Table 7.6 | Trojan UVSigna 2-Row Equipment and Construction Cost Comparison | 7-16 |
| Table 7.7 | Trojan UV3000 Plus Annual O&M Cost Basis and Estimate | 7-21 |
| Table 7.8 | Trojan UV3000 Plus System Net Present Worth Summary | 7-21 |
| Table 7.9 | Trojan UVSigna 2-Row Annual O&M Cost Basis and Estimate | 7-22 |
| Table 7.10 | Trojan UVSigna 2-Row System Net Present Worth Summary | 7-23 |


## Figures


| | | |
|---|---|---|
| Figure 7.1 | Chlorine Contact Basin Operational Modes | 7-4 |
| Figure 7.2 | UVT Data | 7-7 |
| Figure 7.3 | MS2/T1 Dose Ratio for UV Systems | 7-8 |
| Figure 7.4 | UV Disinfection System Plan (35% UVT) for Trojan UV3000Plus | 7-12 |
| Figure 7.5 | UV Disinfection System Section (35% UVT) for Trojan UV3000Plus | 7-13 |
| Figure 7.6 | Typical Canopy Roof over UV Channels (Windsor, California) | 7-14 |
| Figure 7.7 | UV Disinfection System Plan (35% UVT) for Trojan UV3000 Plus | 7-15 |
| Figure 7.8 | UV Facility Plan for Trojan UVSigna 2-Row | 7-17 |
| Figure 7.9 | UV Facility Section for Trojan UVSigna 2-Row | 7-19 |
| Figure 7.10 | Chlorine and Sulfur Dioxide System Retrofit | 7-27 |

# Abbreviations

| | |
|---|---|
| AMRI | Arcata Marsh Research Institute |
| AWTF | Arcata Wastewater Treatment Facility |
| BFE | base flood elevation |
| Carollo | Carollo Engineers, Inc. |
| CCB | chlorine contact basin |
| $Cl_2$ | chlorine |
| FP | AWTF July 2017 Facility Plan |
| ft | feet |
| ft/s | feet per second |
| in | inches |
| kW | kilowatts |
| MAMW | mean annual maximum water |
| mgd | million gallons per day |
| MHW | mean high water |
| MHHW | mean higher high water |
| $mJ/cm^2$ | millijoules per centimeter squared |
| mL | milliliters |
| MLW | mean low water |
| MLLW | mean lower low water |
| MMMW | mean monthly maximum water |
| MPN | most probable number |
| MSL | mean sea level |
| NFPA | National Fire Protection Association |
| NPDES | National Pollutant Discharge Elimination System |
| NWRI | National Water Research Institute |
| PPD | pounds per day |
| PS | pump station |
| RMPP | Risk Management Prevention Plan |
| RWQCB | Regional Water Quality Control Board |
| SLR | sea level rise |
| $SO_2$ | sulfur dioxide |
| TM | technical memorandum |
| UV | ultraviolet |
| UVT | UV transmittance |
| WWTP | wastewater treatment plant |

Technical Memorandum 7

# DISINFECTION SYSTEM PRELIMINARY DESIGN

## 7.1 Purpose

The purpose of this Technical Memorandum (TM) is to provide a preliminary design for ultraviolet (UV) light effluent disinfection systems including evaluation and design criteria for the two treatment system with sizing, equipment selection, layout, construction, and operation costs, and a proposed implementation plan for the City of Arcata (City) Wastewater Treatment Facility (AWTF). The existing chlorine and sulfur dioxide disinfection/dechlorination facilities are also described, summarizing the general function and configuration, and the impact on effluent treatment is outlined. The alternative disinfection projects were originally included in the AWTF July 2017 Facility Plan (FP) and the FP capital improvements program.

## 7.2 Summary of Findings and Recommendations

The key findings and recommendations of this TM are summarized below:

- Ultraviolet light disinfection is recommended for flows up to the plant design flow of 5.9 million gallons per day (mgd).
- Design UVT shall be 35 percent based on wetland effluent and 55 percent based on a blended wetland and secondary effluent.
- Proposed design dose is 50 milliJoules per centimeter squared ($mJ/cm^2$) to provide bacterial disinfection and virus reduction.
- Design should be based on the most recent offering of the equipment that was pilot tested. The mechanical and chemical cleaning system provided sufficient cleaning and achieved required disinfection.
- Existing gaseous chlorine and sulfur dioxide system should be retrofitted with a liquid chemical system for disinfection of wet weather flows.

The overall proposed plant flow diagram is included in Appendix A.

## 7.3 Background

The City of Arcata operates the AWTF, which consists of headworks with screening and grit removal, primary clarification, oxidation ponds and treatment wetlands secondary treatment and polishing enhancement wetlands. Discharges from the AWTF are currently regulated by the National Pollutant Discharge Elimination System (NPDES) Order No. R1-2012-0031, which became effective on August 1, 2012, and expired on July 31, 2017. The City submitted a Report of Waste Discharge in January 2017, as required for the permit renewal. The new permit is pending and is under review by the North Coast Regional Water Quality Control Board (RWQCB).

The beneficial uses of the receiving bay include habitat for shorebirds, waterfowl, raptors, and migratory birds, oyster farming, and recreational use. The complete list of beneficial uses is included in the NPDES Permit.

The existing secondary effluent is first disinfected and then discharged to the enhancement wetlands, then returned to the plant for a second disinfection step before discharge to Humboldt Bay (Outfall 001). The discharge permit outlines a disinfection and flow configuration upgrade that is based on a once-through flow system, with UV disinfection following the enhancement wetlands, and then discharge to a new discharge point at the brackish marsh (Outfall 003).

## 7.4 Design Criteria

The effluent disinfection system design criteria based on the current NPDES permit are listed In Table 7.1. The effluent limitations for fecal coliform bacteria at new Outfall 003 to Humboldt Bay were retained from the previous permit. These limitations, which are described below, reflect water quality objectives for bacteria established by the Basin Plan for protection of shellfish harvesting areas. The Basin Plan criteria are based on recommendations of the National Shellfish Sanitation Program for shellfish growing areas that are affected by point source discharges.

The NPDES permit requires that treated wastewater discharged to Humboldt Bay meet the following fecal coliform bacteria criteria:

- The median fecal coliform concentration shall not exceed a Most Probable Number (MPN) of 14 organisms per 100 mL in a calendar month.
- Not more than 10 percent of samples collected in a 30-day period shall exceed an MPN of 43 organisms per 100 mL.
- The dose for a future UV system is not specified in the permit, although it is implied to be 50 mJ/cm$^2$, based on the reporting requirements.

Table 7.1 Effluent Disinfection System Design Criteria

| | Unit | Value |
|---|---|---|
| **Indicator Organism** | | |
| Fecal coliform | MPN/100 mL | 14 (1), 43 (2) |
| **Flow** | | |
| Average Dry Weather Flow | mgd | 1.1 |
| Maximum Month Flow (3) | mgd | 3.6 |
| Peak Wet Weather Flow (4) | mgd | 5.9 |
| Peak Instantaneous Flow (4) | mgd | 16.5 |

Notes:
(1) Monthly Median.
(2) Not more than 10% of samples collected in a 30-day period shall exceed 43 MPN/100mL.
(3) UV effluent disinfection system capacity limit.
(4) Overall facility capacity limit including storage, UV disinfection, and wet weather discharge system.

## 7.5 Existing Disinfection System

Treatment equivalent to secondary treatment is accomplished using two oxidation ponds followed by six treatment wetlands. Detention time in the AWTF, prior to Allen, Gearheart and Hauser enhancement wetland, is approximately 40 days during average dry weather design flow periods when the system is well-maintained. Currently, effluent is disinfected with chlorine and dechlorinated with sulfur dioxide prior to discharge. Under the existing AWTF configuration, treated effluent from the AWTF can be combined with effluent from the AMWS, disinfected, and split, flowing by gravity either to Humboldt Bay or again through the AMWS. The result is

disinfected secondary effluent, but not all effluent receives the benefit of enhanced wetland treatment through the AMWS before discharge to Humboldt Bay. In this mode of disinfection, effluent may actually be chlorinated multiple times, increasing the opportunity to form disinfection byproducts at levels above water quality objectives.

The existing disinfection system, including chlorine ($Cl_2$) gas disinfection followed by sulfur dioxide ($SO_2$) gas dechlorination, was constructed in 1984. Two banks of three one-ton $Cl_2$ gas cylinders are connected in parallel to provide a duty and standby supply of $Cl_2$ gas for disinfection. The chlorine gas feeders receive both a flow and residual signal for gas pacing and control. Gas induction units installed at the chlorine contact basin provide vacuum to transfer gas to the wastewater flow while providing mixing.

The 2003 plant evaluation (SHN, 2003) noted that the system was near its maximum capacity to handle peak wet weather flows. At that time, measures were recommended to reduce chlorine use. It was noted that any capacity increases or upgrades of the existing gas systems would trigger the need to comply with current National Fire Protection Association (NFPA) standards.

### 7.5.1 Chlorine Contact Basin

The existing disinfection system includes a chlorine contact basin (CCB) constructed in 1984. The basin can operate as one or two tanks, labelled the east and west basins in the plant O&M manual. The approximate volume for each basin is 185,400 gallons. The detention time at 2.3 mgd is listed as 58 minutes, while the detention time at 5.9 mgd is listed as 30 minutes.

The plant operates the basin in two modes: Split or Combined Mode, which is shown schematically in Figure 7.1.

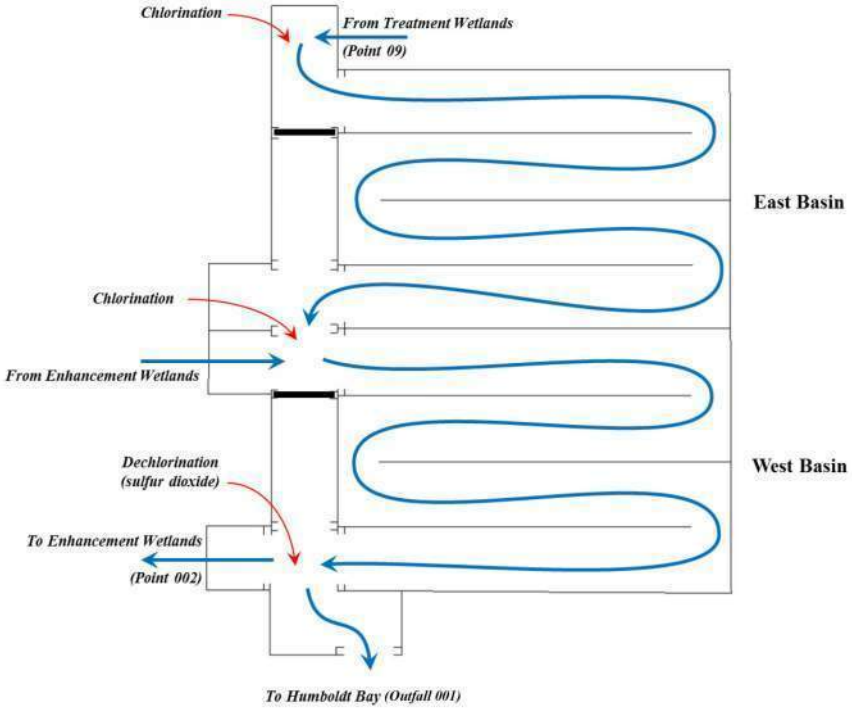
In the combined mode, flow from the treatment wetlands enter the east side, and is dosed with chlorine at the entrance to this first section. The flow then joins with the flow returned from the enhancement wetlands, mixed, and dosed a second time with chlorine. The combined flow is dechlorinated, then is split to return a portion of the flow to the enhancement wetlands, with the rest of the flow going to discharge through Outfall 001.

In split mode, flow from the treatment wetlands enters the east side, is not dosed with chlorine, and then goes to the enhancement wetlands. The return flow from the enhancement wetlands is dosed with chlorine for a first time as it enters the west basin section, then goes through the basin, is dechlorinated, and discharged to Outfall 001.

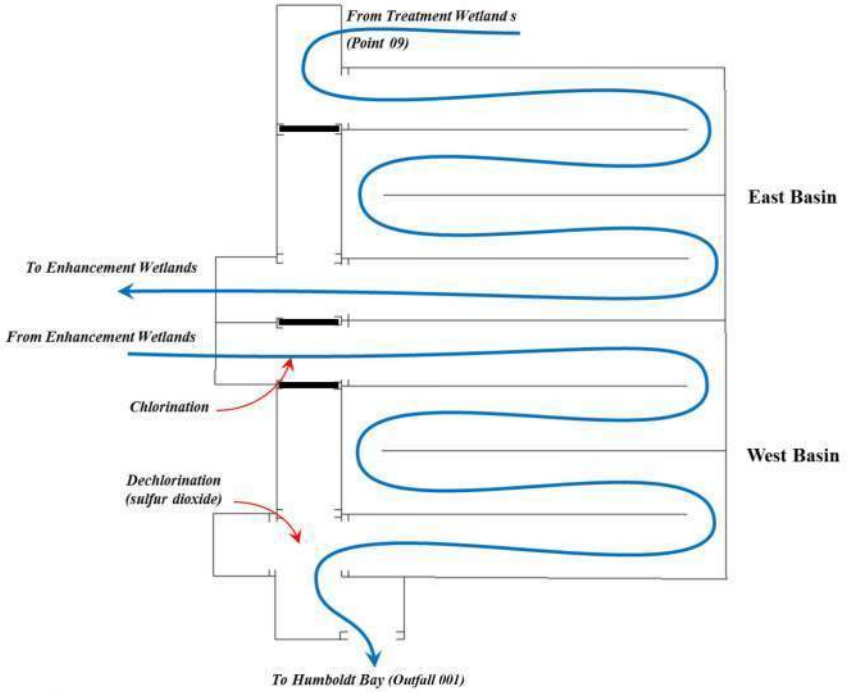
The combined mode is the normal operating mode, especially when flows exceed the capacity of the enhancement wetlands effluent pump station. This mode is especially important during wet weather flows. The split mode is used during low flows, or dry weather. It has the advantage of reducing the chlorine usage to the amount needed to disinfect the flow at Outfall 001 and reducing the potential formation of disinfection by-products.

### 7.5.2 Chlorine and Sulfur Dioxide Use and Impact

The AWTF currently uses approximately 225 pounds per day (ppd) of chlorine and 160 ppd of sulfur dioxide for disinfection and dechlorination, based on 2014 data. The daily average chemical use by month for the last 5 years is included in Appendix B. Chlorination also appears to impact water quality by reducing effluent BOD and suspended solids. Information from the City and Arcata Marsh Research Institute (AMRI) indicate that at times the BOD reduction can range from 700 to 1400 ppd.




COMBINED MODE




SPLIT MODE

# CHLORINE CONTACT BASIN OPERATIONAL MODES

FIGURE 7.1

CITY OF ARCATA
*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

carollo

arc0915f6-9913.ai

## 7.6 Ultraviolet Light Disinfection Preliminary Design

UV light disinfection has been proposed for the AWTF discharge based on a series of pilot tests conducted by the City and the AMRI. The current Waste Discharge and NPDES permit provides general requirements for replacing the existing chlorination disinfection system with a UV system. The proposed UV system design requirements for the recommended project alternatives are outlined in this TM.

### 7.6.1 UV System Sizing Criteria

The UV system sizing criteria is listed in Table 7.2. Two alternative dose levels are outlined below, depending on the type of effluent and the final permit requirements. The basis for the dose is outlined below.

Table 7.2 UV System Sizing Design Criteria

| Indicator Organism | Unit | Value |
|---|---|---|
| Fecal coliform (1) | MPN/100 mL | 14 (2), 43 (3) |
| **Flow** | | |
| Annual average | mgd | 2.3 |
| Maximum month (4) | mgd | 5.9 |
| **UV Transmittance (UVT)** | | |
| Pond/treatment wetland effluent | % | 35 |
| Oxidation Ditch and wetland blended effluent | % | 55 |
| **Dose (5)** | | |
| Alternative Dose 1 – Wetlands Effluent | $mJ/cm^2$ | Minimum T1 dose: 17 $mJ/cm^2$<br>Minimum MS2 dose: 35 $mJ/cm^2$ (6) |
| Alternative Dose 2 – Blended Effluent | $mJ/cm^2$ | Minimum T1 dose: N/A<br>Minimum MS2 dose: 50 $mJ/cm^2$ (6) |

Notes:
(1) Shellfish Harvesting Waters, EPA Quality Criteria for Water, 1986.
(2) Monthly Median.
(3) Not more than 10% of samples collected in a 30-day period shall exceed the listed value.
(4) UV facility capacity.
(5) The typical recommended test organism used for validating UV systems is MS2 coliphage (MS2) to mimic polio virus; however, using MS2 validation data for disinfection of bacteria results in potential under dosing since bacteria (coliforms) react differently to UV disinfection than MS2. Some UV manufacturers have performed validation work using proven bacteria surrogates such as T1 coliphage (T1).
(6) Additional analysis required to confirm that dose meets virus reduction concerns of RWQCB.

#### 7.6.1.1 Design UV Transmittance

A design UVT of 35 percent was originally recommended for the UV system sizing based on a review of the available data collected to date. The original pilot UVT data is summarized in the project memorandum included in Appendix C. The UVT may seem low compared to filtered secondary effluent, but is consistent with effluent expected from other wetlands or natural systems.

Plant staff purchased a UVT meter in April 2015 and started to collect UVT data across the plant including the treatment and enhancement wetlands effluents. It was recommended that UVT sampling be continued to establish a long term history of UVT. This is especially important because it was projected that the UVT would vary seasonally. Based on the longer detention

times during summer dry weather flows, it was thought that the effluent would have lower UVT levels as more organic materials decay in the wetlands and release humic type compounds. In the winter it was thought that the organic material would be diluted with rain water that falls on the system. The lower detention times due to the higher wet weather flows may also reduce the concentration of material. The data collected to date is shown in Figure 7.2. In general, the pond/wetland system UVT is fairly low, around 30 to 35 percent in the dry months, and around 45 to 55 percent in the wet months. The higher UVT may possibly be due to dilution of the soluble humic material which would raise the UVT in the wet months.

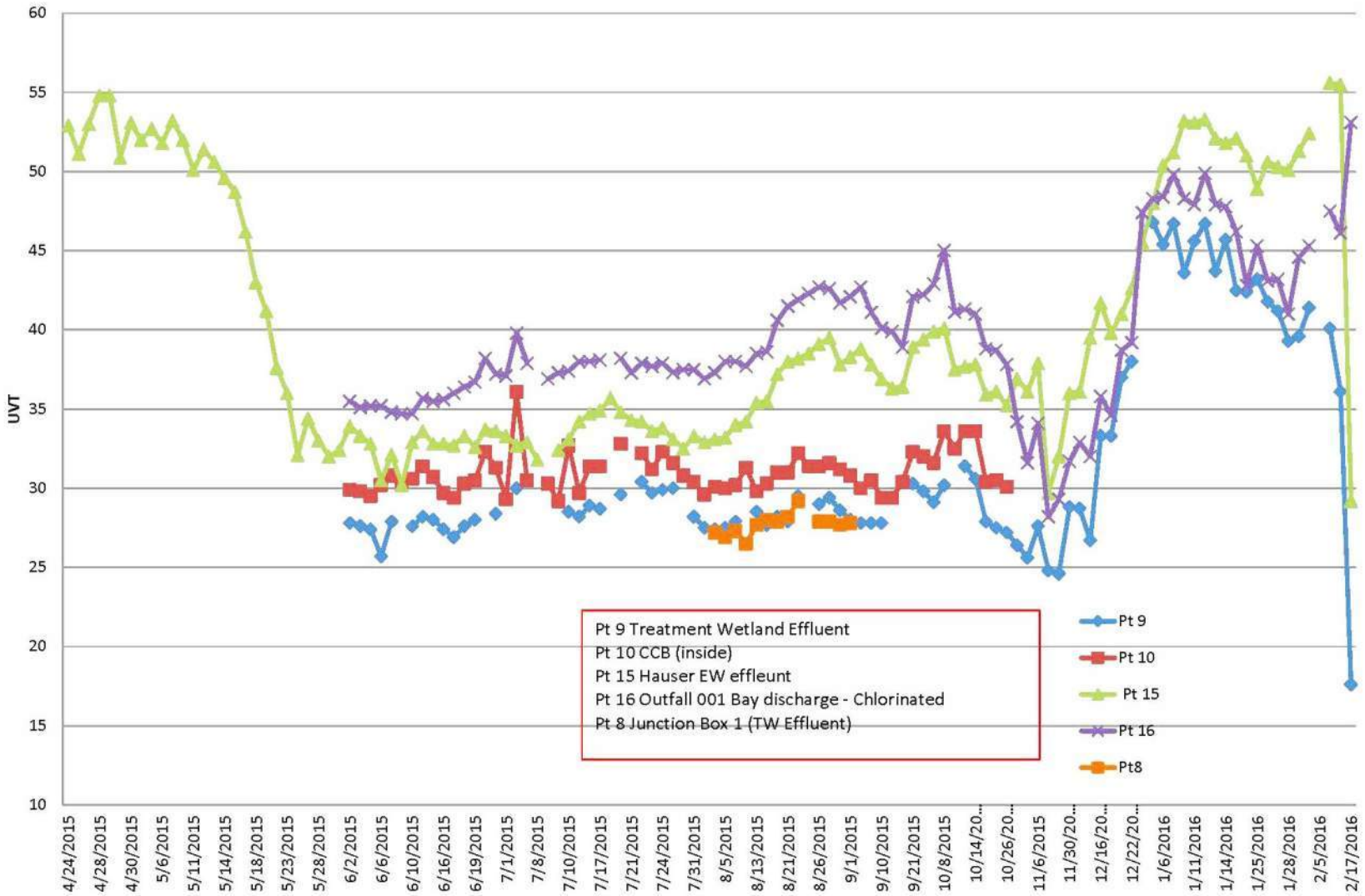
An alternative UV system design has been proposed for a blended effluent concept, where the lower wetland effluent (UVT 35 percent) would be blended with the higher oxidation ditch secondary treatment process effluent (estimated UVT of 65 percent). The blending is envisioned during the dry weather, lower flow periods of the year. The resulting blended effluent UVT is estimated at a minimum of 55 percent. The other design criteria including the peak flow of 5.9 million gallons per day (mgd), a dose of 35 millijoules per square centimeter ($mJ/cm^2$), with 50 percent redundancy, remain the same. The higher UVT results in a reduction in lamps from 528 to 336 and a corresponding reduction in power demand from 136 to 84 kilowatts (kW).

As noted in FP, at the June 27, 2016 meeting with the RWQCB, UV disinfection design criteria was proposed to be based on a minimum UVT of 35 percent regardless of the alternative.

#### 7.6.1.2 Design Dose

The selection of the design UV dose is outlined below. The current permit implies the required minimum dose as 50 $mJ/cm^2$ which may have been based on protection of the bay oyster farming operation. The dose requirement is currently under review by the RWQCB as part of the NPDES permit update. Therefore the dose will need to be confirmed as part of the permit process for final design.

The first criterion for a design dose is that the discharge must provide bacteria reduction, specifically to meet the fecal coliform level required in the discharge permit. In an initial meeting with the RWQCB, Arcata City staff, LACO and Carollo (June 23, 2015), RWQCB staff indicated a specific concern about virus kill. The discussion focused on the disinfection of coliphage, but without any specific effluent target. In the meeting with the RWQCB on June 27, 2016, there was discussion about a future virus reduction requirement. Virus reduction would require a higher design UV dose than for bacteria reduction alone. The City will need additional input from the State (RWQCB and Division of Drinking Water) on the design dose and disinfection objectives during final design. The design dose discussion that follows is based on the current permit requirement for bacteria (fecal coliform) reduction. Design dose will need to be revised during final design when additional information is provided by the State.




# UVT DATA

FIGURE 7.2

CITY OF ARCATA

*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

carollo

arc0516rf19-9913.ai

To properly size a UV system, the dose must be determined for each target organism (bacteria and/or virus, in this case). Different organisms (e.g., bacteria, virus, and protozoa) have measurably different sensitivities to UV disinfection. For example, viruses tend to be more resistant to UV disinfection than bacteria. Much of the UV system validation work that has been completed to date has been for water reuse applications in California, where virus inactivation is the primary goal. For these applications, the ideal and recommended test organism is MS2 coliphage (MS2); however, using MS2 validation data for disinfection of bacteria results in potential under dosing since bacteria (coliforms) react differently to UV disinfection than MS2. All of the latest equipment offerings by UV manufacturers (Trojan, Calgon Carbon, Ozonia and Wedeco) considered for this project have performed validation work using T1 coliphage (T1) which is a proven bacteria surrogate. For older equipment offerings where manufacturers have not validated their system based on T1, MS2 validations can be allowed with some degree of conservatism. To account for the difference between the dose-response curves of the organisms, higher dose levels will be specified for systems validated with MS2. Based on systems that have been validated by Carollo using both MS2 and T1, the ratio between the two varies depending on the UVT and the reactor efficiency.

Figure 7.3 below shows the MS2/T1 dose ratio for two different UV reactors that range between 1.63 and 2.06 at this project's design UVT of 35 percent. For the higher MS2/T1 ratio of 2.06, a T1 dose of 1.0 mJ/cm$^2$ is equivalent to an MS2 dose of 2.06 mJ/cm$^2$.

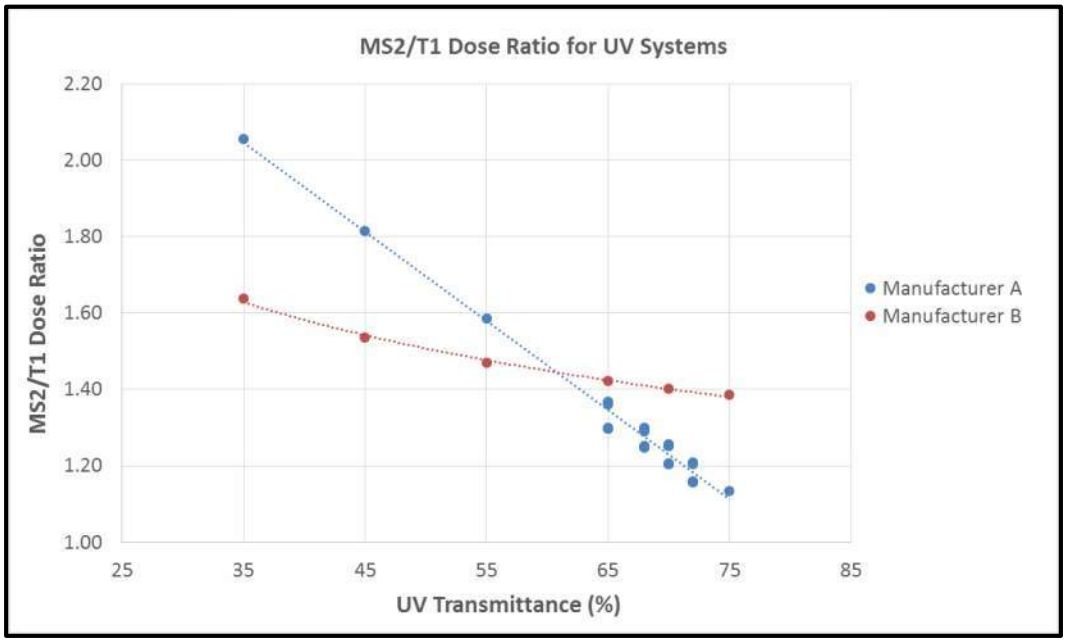



Figure 7.3 MS2/T1 Dose Ratio for UV Systems

In establishing dose criteria, the first step is to address the permit limits. The permit requirement for this project is a median fecal coliform concentration that should not exceed 14 MPN per 100 mL on a monthly basis and a daily limit that should not exceed more than 10 percent of samples exceeding 43 MPN per 100 mL. Previous UV studies by Arcata Marsh Research Institute have indicated the maximum wetland effluent fecal coliform concentration is in the 10,000 MPN per 100 mL range. Therefore, the UV system is required to provide a minimum 2.85 log reduction of fecal coliform to meet the permit limit of 14 to treat effluent from the natural system.

Typically, Carollo's recommended sizing approach is to design a UV system to disinfect fecal coliform to approximately one log below the permit limit; however, due to this project's already low permit limit, a half log will be added as a safety factor. This level of conservatism has worked well for our clients and provides plant staff greater flexibility when operating the UV system.

Using T1 as a surrogate for fecal coliform, and knowing that T1 has a similar UV sensitivity as fecal coliform, the proper dose for 2.85 log reduction of coliform can be determined. T1 has a UV sensitivity of 5 mJ/cm$^2$/log inactivation; a fecal coliform log inactivation of 3.35 (2.85 + 0.50 safety factor) thus represents a T1 dose of 16.75 mJ/cm$^2$. Converting this T1 dose to a MS2 dose using the MS2/T1 ratio of 2.06 from above, the validated MS2 dose will be 34.5 mJ/cm$^2$. Therefore, the specified MS2 dose for an equivalent log inactivation of fecal coliform is 35 mJ/cm$^2$.

For blended effluents from the natural system and the oxidation ditch/secondary clarifier treatment train, we need to look at the pathogen concentrations from each source of water. The fecal coliform concentration from the oxidation ditch/secondary clarifier effluent may be as high as 2,000,000 MPN per 100 mL range. Depending on the blending ratio, a typical fecal concentration from the blended effluents might be 1,000,000 MPN per 100 mL with a UVT of 50 to 55%. The dose analysis for this scenario results in a fecal coliform log inactivation of 5.35 (4.85 plus 0.50 safety factor) for a T1 design dose of 27.11 mJ/cm$^2$. However, T1 validation is generally limited to 5 log inactivation as anything above this is not reliable. Hence, for blended effluents an equivalent MS2 design dose of 50 mJ/cm$^2$ is specified.

The second step of the dose analysis is to address the RWQCB concerns regarding virus kill. As part of final design, the dose necessary to reduce indigenous virus (measured as coliphage) in the UV effluent should be determined. This would be done with a collimated beam test on the Arcata treatment wetland effluent, at dose values dependent on the desired test organism. There are two types of native coliphage in effluent, F-specific and somatic). F-specific (F+) coliphage has a similar UV sensitivity to MS2; therefore, recommended dose levels are 0, 5, 10, 15, 20, 30, and 50 mJ/cm$^2$. Somatic coliphage has a similar UV sensitivity to T1; therefore, recommended dose levels are 0, 2.5, 5, 7.5, 10, 15, and 20 mJ/cm$^2$.

#### 7.6.1.3 Equipment Reliability

Equipment reliability must also be considered when designing a UV system since the regulatory standards for shellfish harvesting waters are stringent. The industry standard reference for UV is the National Water Research Institute (NWRI) Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (UV Guidelines), Third Edition. This document recommends a standby bank per channel or standby channel be installed to ensure that the specified UV dose is provided under worst-case conditions with one bank of lamps out of service. For this project we recommend one standby bank for the single channel design.

### 7.6.2 Initial UV Equipment Selection

Several UV manufacturers have had their equipment validated to UVT levels down to 35 percent and lower and can be used for this application. The equipment originally selected for evaluation in the design was the Trojan UV3000Plus system.

The UV3000Plus equipment was selected based successful testing in 2011 during a pilot study conducted by Trojan, AMRI, and plant staff. The Pilot Study Report is included in Appendix D, and indicated that the fecal coliform requirement could be meet with a dose as low as 20 mJ/cm$^2$. The method used to calculate the dose during the pilot study is proprietary and is

based on a March 2012 Validation report for low UVT applications. The validation report was reviewed as part of this study.

The recommended equipment was revisited with the preferred supplier, and they now recommend that the Trojan UVSigna 2-Row model be considered. The UVSigna system utilizes higher powered UV lamps thereby requiring less lamps and a smaller footprint. In addition, the mechanical/chemical cleaning system is the same as the system that was previously pilot tested.

Equipment proposals, and details of the UV3000Plus and UVSigna 2 Row system are included in Appendix E and F, respectively.

A number of dose levels were reviewed to determine the recommended equipment configuration for this Facility Plan. A summary of the configuration is included in Table 7.3 and Table 7.4, for the two proposed systems, for dose levels of 35 mJ/cm$^2$ and 50 mJ/cm$^2$, at 35 percent and 55 percent UVT.

Table 7.3 Trojan UV3000Plus System Equipment Configurations (1)

| | Design Parameters | | | |
|---|---|---|---|---|
| Minimum UV Transmittance | 35% | 55% | 35% | 55% |
| Minimum MS2 Dose (mJ/cm$^2$) | 35 | 35 | 50 | 50 |
| **Configuration** | | | | |
| Number of Channels | 1 | 2 | 1 | 2 |
| Number of Duty Banks/Channel | 2 | 2 | 3 | 3 |
| Number of Standby Banks/Channel | 1 | 1 | 1 | 1 |
| Number of UV Modules/Bank | 22 | 7 | 20 | 7 |
| Number of Lamps/UV Module | 8 | 8 | 8 | 8 |
| **Total Number of Lamps** | **528** | **336** | **640** | **448** |
| **Total Power Consumption (kW)** | **136** | **87** | **165** | **116** |

Notes:
(1) Design assumes an End of Lamp Life Factor of 0.86 and a Fouling Factor of 0.94.

Table 7.4 Trojan UVSigna 2-Row Equipment Configuration (1)

| | Design Parameters | | | |
|---|---|---|---|---|
| Minimum UV Transmittance | 35% | 55% | 35% | 55% |
| Minimum MS2 Dose (mJ/cm$^2$) | 35 | 35 | 50 | 50 |
| **Configuration** | | | | |
| Number of Channels | 1 | 1 | 1 | 1 |
| Number of Duty Banks/Channel | 5 | 3 | 6 | 4 |
| Number of Standby Banks/Channel | 1 | 1 | 1 | 1 |
| Number of Banks/Channel | 6 | 4 | 7 | 5 |
| Number of Lamps/UV Module | 10 | 8 | 12 | 10 |
| **Total Number of Lamps** | **60** | **32** | **84** | **50** |
| **Total Power Consumption (kW)** | **63.5** | **33.9** | **88.9** | **52.9** |

Notes:
(1) Design assumes an End of Lamp Life Factor of 0.86 and a Fouling Factor of 0.94.

The main feature illustrated on the two configuration tables is the reduction in the number of lamps for the UVSigna 2-Row system. In addition, the total power consumption is also significantly reduced.

One other alternative was considered at the request of the City consultant from AMRI. The Enaqua UV system was recently validated and approved for use on wastewater disinfection. Preliminary sizing indicated that the Enaqua system would require eight times the number of lamps and approximately 15 percent more power consumption. Due to the higher lamp count, the Enaqua system was not included as part of this evaluation.

### 7.6.3 UV Flow Configuration and Layout

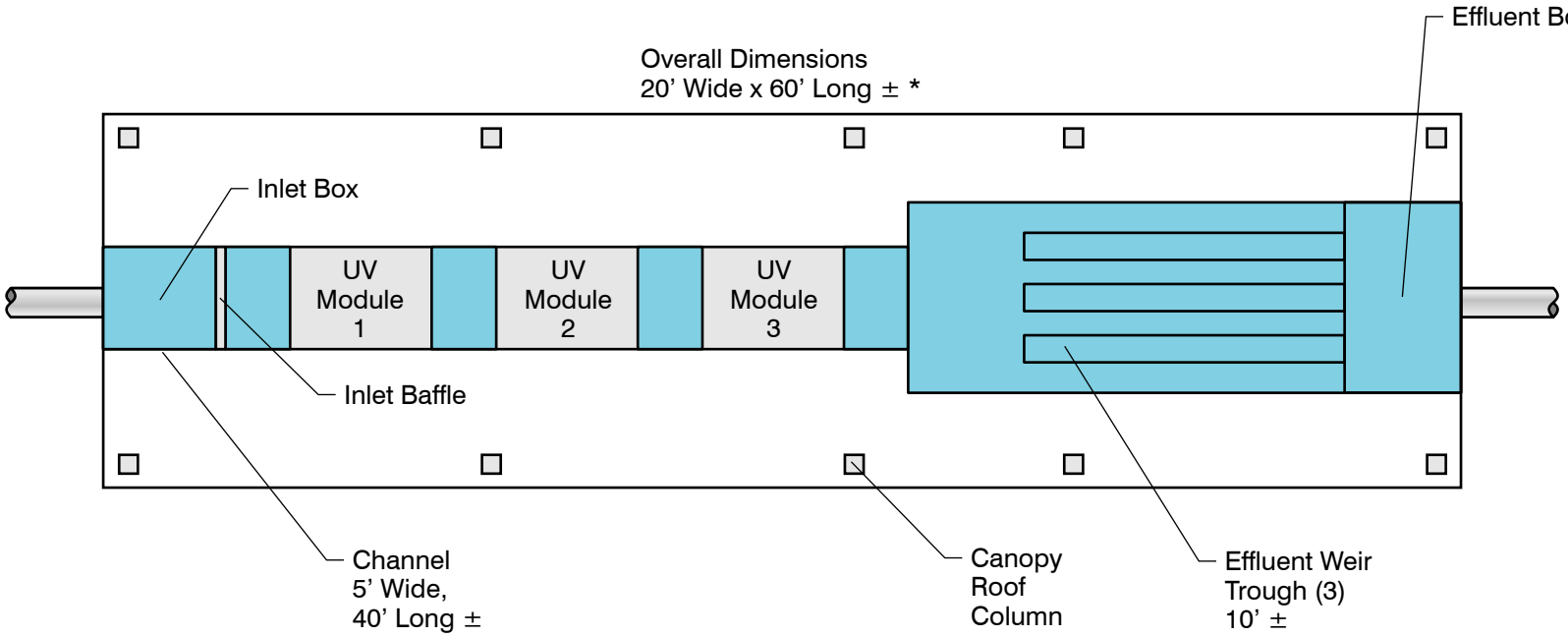
The concept envisioned by the City during the pilot testing and outlined in the NPDES permit was to disinfect the Hauser Marsh (enhancement wetland) effluent using UV disinfection, prior to discharge to the new outfall 003 at the brackish marsh. It was originally proposed that the system would be located at the outlet of the Hauser enhancement wetland. Based on the review of this location it was decided that the new UV system would be located on the plant site adjacent to the CCB. This will allow mixing of treatment wetland effluent with oxidation ditch effluent. In addition, the system can match the industrial look of the existing facilities and will provide additional security for disinfection process.

#### 7.6.3.1 Layout for 35 Percent UVT with Trojan UV3000Plus System

The plan and section for the 35 percent UVT alternative is shown on Figures 7.4 and 7.5 to illustrate the UV system design. The plan is based on the Trojan proposal for 35 mJ/cm$^2$ dose with redundancy. A Trojan UV3000Plus plan and section drawing is provided in Appendix E that provides the basis for the footprint shown in these figures. If a dose of 50 mJ/cm$^2$ is required the facility then it will require an additional UV equipment bank, a longer overall channel, and a larger footprint.

The concept shows a single 5 feet wide channel with three banks (2 duty and 1 standby) system. The influent flow would be pumped into the channel in an inlet box, and should include a flow distribution baffle (not shown). The flow will pass the three reactor banks and flow over the effluent finger weirs. A total weir length of approximately 60 to 70 feet will be required to minimize the water surface fluctuation (1-inch maximum) during average to peak flows. The preliminary overall dimensions are shown on the plan. On each side of the channel, a walkway will be provided for access and maintenance. The Section, Figure 7.5, illustrates one concept for the protection of the facility with a sloped canopy type roof for sun and rain protection over the walkways and channel. The entire area could be enclosed with a guard rail type barrier, which would allow worker protection at a lower cost. It could also be fully enclosed in a structure at additional cost. A photograph of a similar UV system in an operating plant shows the canopy roof over UV channels on Figure 7.6. The architecture and alternatives for enclosure will be reviewed during final design.

The UV equipment maintenance would be completed using a rolling gantry type crane to lift the modules or banks from the channels. The specific Trojan reactor has an effective sleeve cleaning system, but additional cleaning of the modules and the channel is needed. Modules would be removed for cleaning on a monthly to quarterly (or longer) frequency, depending upon site-specific conditions. The major equipment maintenance, including bulb replacement, would be completed on an annual basis. Channel cleaning requires high pressure washing to remove algae and debris. Therefore, open access to the channel will be required with the equipment removed and storage adjacent to the channel.




NOTE:

* Small electrical enclosure will also be required (6' x 6' ±).

# UV DISINFECTION SYSTEM CONCEPTUAL PLAN (35% UVT)

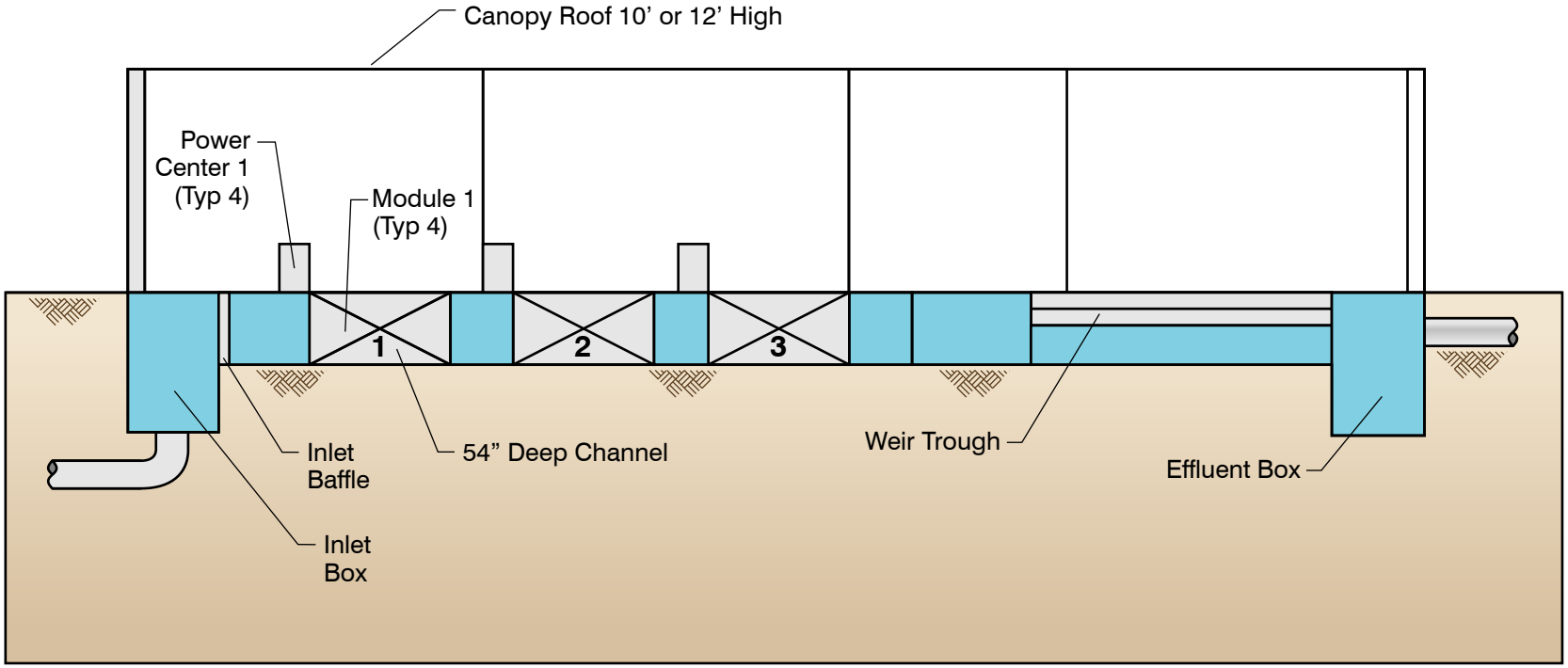
FIGURE 7.4

CITY OF ARCATA

*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

carollo

arc0516rf15-9913.ai




# UV DISINFECTION SYSTEM
# CONCEPTUAL SECTION

FIGURE 7.5

CITY OF ARCATA
*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

carollo

arc0516rf16-9913.ai



Figure 7.6 Typical Canopy Roof over UV Channels (Windsor, California)

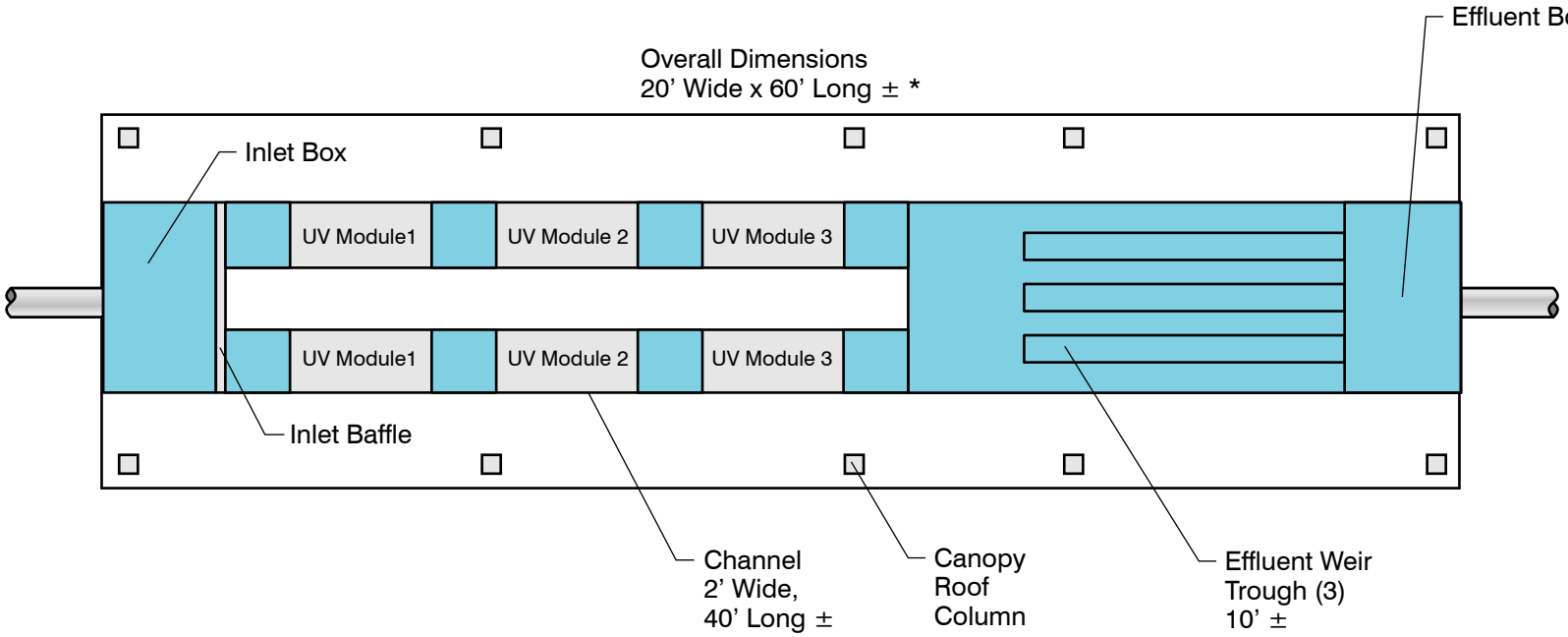
A small electrical and control building would also be required. The size for electrical enclosure might be in the range of 6 feet square. If a 150 to 180 kW standby generator is required, the size might double. The electrical and standby requirements will be finalized in final design.

#### 7.6.3.2 Layout for 55 Percent UVT with the Trojan UV3000Plus System

The UV facility layout was updated for the projected 55 percent UVT, and will be smaller than for 35 percent due to the decrease in the number of lamps. The updated design is based on a 2 channel system. Each channel will have a capacity of up to 2.95 mgd. Therefore during most of the year, only one channel will be in service at a time. A two channel design will allow for channel and equipment maintenance. An updated layout for 55 percent UVT is shown on Figure 7.7.

#### 7.6.3.3 Layout for 35 Percent UVT with the Trojan UVSigna 2-Row System

The Trojan UVSigna system uses a 1000 watt TrojanUV Solo Lamp™. These lamps are staggered at a 45 degree inclination that makes lamp replacement relatively easy while the UV system remains in operation. The Solo Lamp Driver enables lamp dimming from 100 to 30 percent power and can be located up to 80 feet away from the UV Modules. Additionally, the Trojan UVSigna 2-Row system can be operated based on sensor output, which means that it adjusts the power input to account for real time lamp aging and sleeve fouling. Systems that do not have the same capability continuously operate based on the assumption that the lamps are at the end of their useful life and that the sleeves are at the most fouled condition. Therefore, there can be significant savings from an O&M perspective by using a UV sensor-based control system.




NOTE:

* Small electrical enclosure will also be required (6' x 6' ±).

# UV DISINFECTION SYSTEM CONCEPTUAL PLAN (55% UVT)

FIGURE 7.7

CITY OF ARCATA

*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

carollo

arc0516rf17-9913.ai

The system is equipped with the same patented automated chemical/mechanical cleaning system as the Trojan UV3000Plus system.

The UV facility layout was updated for the Trojan UVSigna 2-Row system and the plan and section views are shown in Figures 7.8 and 7.9, respectively.

### 7.6.4 UV System Costs

The UV equipment cost to meet the 35 or 50 mJ/cm$^2$ dose at 35 or 55 percent UVT, with redundancy, is outlined in Table 7.5. The cost is based on budget proposals from Trojan for the UV3000Plus system. These costs illustrate the increasing cost with redundancy and with higher dose. The estimated construction cost is based on recent experience for standalone system projects where the costs range from 3 to 5 times the equipment cost.

Table 7.5 Trojan UV3000 Plus Equipment and Construction Cost Comparison

| Item | 35 mJ/cm$^2$ Dose With Redundancy | 50 mJ/cm$^2$ Dose With Redundancy | 35 mJ/cm$^2$ Dose With Redundancy | 50 mJ/cm$^2$ Dose With Redundancy |
|---|---|---|---|---|
| UVT, percent | 35 | 35 | 55 | 55 |
| UV Disinfection Equipment Cost | $1,090,000 | $1,310,000 | $786,000 | $923,000 |
| **Total Construction Costs** | | | | |
| Average range (4 times equipment) | $4,360,000 | $5,240,000 | $3,140,000 | $3,690,000 |

Notes:
(1) Equipment sizing is based on an End of Lamp Life Factor of 0.90 and a Fouling Factor of 0.95.

For reference, the equipment cost for a 100 mJ/cm$^2$ dose is approximately 2.5 times the cost for a 50 mJ/cm$^2$ system with redundancy. This higher dose is normally only required for a tertiary recycled water application with high incidence of public contact.

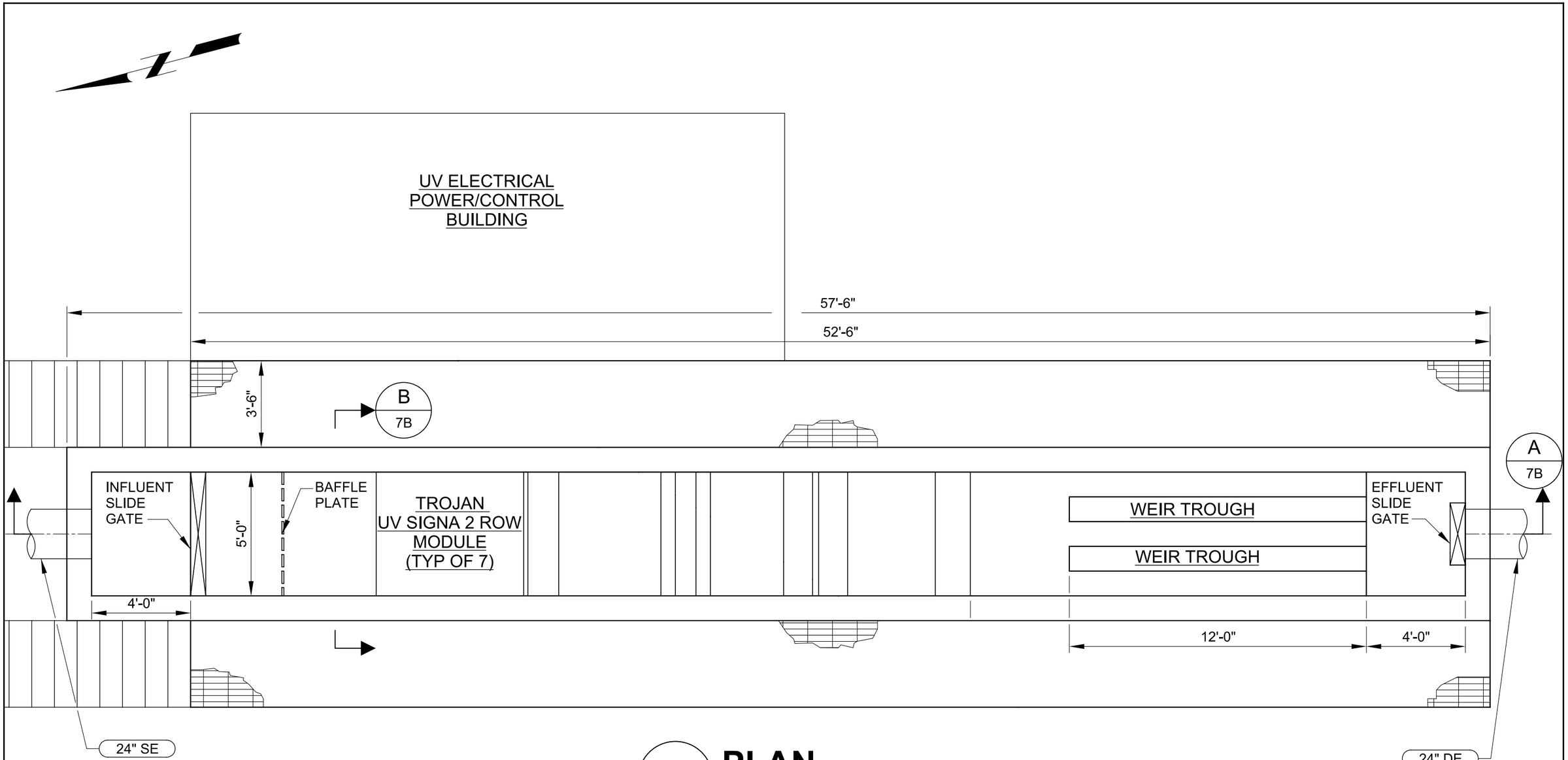
The updated Trojan proposal lists the equipment cost for a UVT of 55 percent at $785,500 with redundancy. The estimated construction cost will be 3 to 5 times the equipment cost, and range from $2,360,000 to $3,930,000 using the same installation cost factors. This reduces the cost by $910,000 to $1,520,000 for the higher UVT.

Proposals were also received from Trojan for the UVSigna 2-Row for the same conditions. Equipment and construction costs are shown in Table 7.6.

Table 7.6 Trojan UVSigna 2-Row Equipment and Construction Cost Comparison

| Item | 35 mJ/cm$^2$ Dose With Redundancy | 50 mJ/cm$^2$ Dose With Redundancy | 35 mJ/cm$^2$ Dose With Redundancy | 50 mJ/cm$^2$ Dose With Redundancy |
|---|---|---|---|---|
| UVT, percent | 35 | 35 | 55 | 55 |
| UV Disinfection Equipment Cost (1) | $510,000 | $640,000 | $355,000 | $460,000 |
| **Total Construction Costs** | | | | |
| Low range (4 times equipment) | $2,040,000 | $2,460,000 | $1,420,000 | $1,840,000 |

Notes:
(1) Equipment sizing is based on an End of Lamp Life Factor of 0.5.

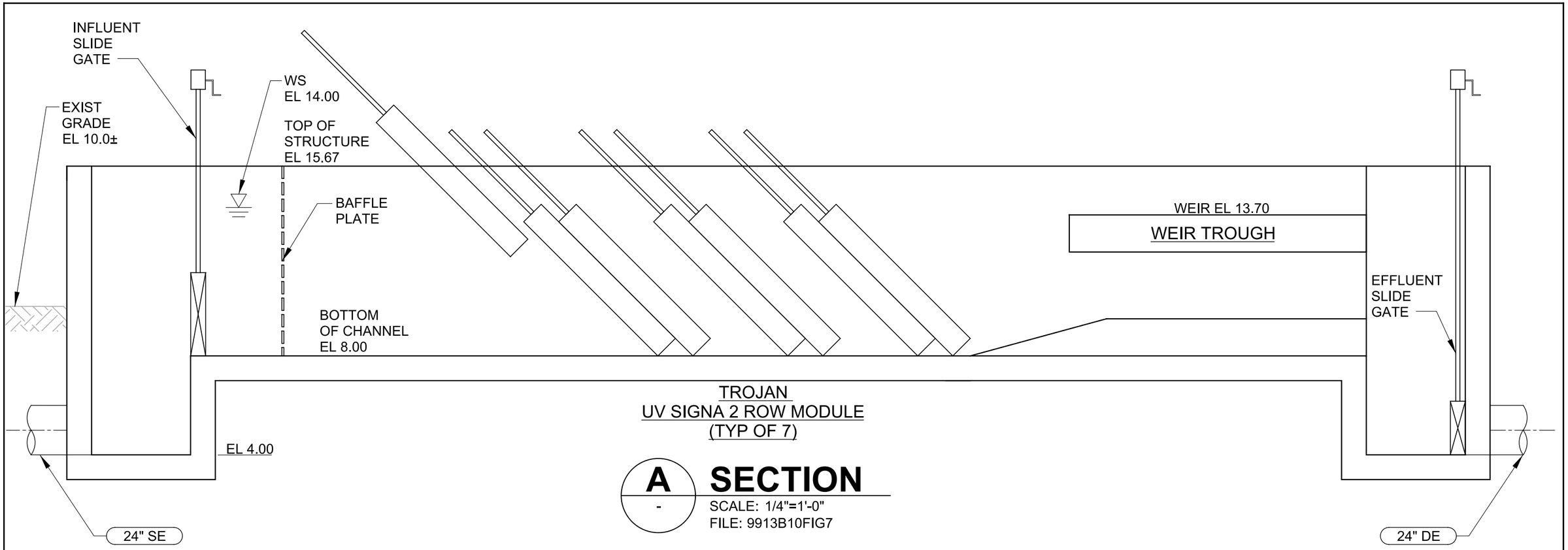



A **PLAN**
SCALE: 1/4"=1'-0"
FILE: 9913B10FIG7

**Figure No.** 7.8
**UV FACILITY PLAN**
CITY OF ARCATA

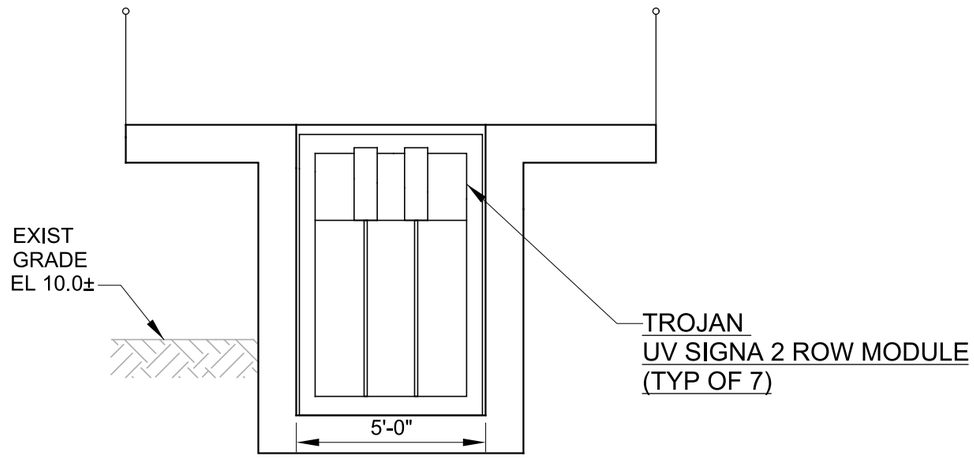
carollo

File: IP_PWP:d0794338\9913B10FIG7A.dgn
Plot Date: 13-JUN-2018 9:31:59 AM
User: gleal




**A** - **SECTION**

SCALE: 1/4"=1'-0"
FILE: 9913B10FIG7




**B** - **SECTION**

SCALE: 1/4"=1'-0"
FILE: 9913B10FIG7

**Figure No.** 7.9
**UV FACILITY SECTION**
CITY OF ARCATA

carollo

File: IP_PWP:d0794338\9913B10FIG7B.dgn
Plot Date: 13-JUN-2018 9:30:54 AM
User: gleal

Preliminary estimates of operating costs for the Trojan UV3000Plus were prepared for the 35 and 50 mJ/cm$^2$ dose levels with redundancy, and are outlined in Table 7.7. The assumptions for the costs are included in the table and are based on our analysis of the system and input from Trojan.

Table 7.7 Trojan UV3000 Plus Annual O&M Cost Basis and Estimate

| Description | 35 mJ/cm$^2$ Dose at 35% UVT | 50 mJ/cm$^2$ Dose at 35% UVT | 35 mJ/cm$^2$ Dose at 55% UVT | 50 mJ/cm$^2$ Dose at 55% UVT |
|---|---|---|---|---|
| UVT, percent | 35 | 35 | 55 | 55 |
| Lamp Replacement | $250 | $250 | $250 | $250 |
| Ballast Replacement | $400 | $400 | $400 | $400 |
| Wiper Replacement | $15 | $15 | $15 | $15 |
| Quartz Sleeve Replacement | $80 | $80 | $80 | $80 |
| Chemical Usage | $300 | $300 | $300 | $300 |
| UV Sensor Replacement | $1,000 | $1,000 | $1,000 | $1,000 |
| Interest Rate | | | 6.00% | |
| Project Life, years | | | 15 | |
| Electricity Rate (kWh) | | | $0.10 | |
| Labor Rate (per hour) | | | $50.00 | |
| Annual Parts and Replacement Cost | $112,000 | $141,000 | $47,300 | $66,600 |
| Annual Labor Cost | $29,600 | $31,000 | $25,300 | $34,100 |
| Annual Energy Cost | $50,000 | $66,400 | $26,000 | $33,000 |
| **Total Annual Cost** | **$191,600** | **$238,400** | **$98,600** | **$133,700** |

Notes:
(1) All costs are based on redundant equipment.

The difference in annual O&M cost between the lower and higher dose values of 35 and 50 mJ/cm$^2$ is $46,800, and is predominately due to the higher energy use at the 50 mJ/cm$^2$ dose and the lamp count. The higher dose system has 112 more UV lamps (21 percent) compared to the 35 mJ/cm$^2$ system. Using the O&M cost basis in Table 7.7, the life cycle costs were calculated for both UV transmittances. The operating cost of the system at 55 percent UVT is substantially less than at 35 percent UVT, by over $104,000 per year. A comparison of the life cycle cost at the different UVTs is shown on Table 7.8. The higher UVT has a lower life cycle cost by over $2,000,000.

Table 7.8 Trojan UV3000 Plus System Net Present Worth Summary

| Equipment | Equipment Cost (1) | Estimated Construction Cost (2) | Annual O&M Cost | Present Worth Life Cycle Cost (3) |
|---|---|---|---|---|
| 35 mJ/cm$^2$ Dose @ 35% UVT | $1,090,000 | $4,360,000 | $191209,000 | $6,390,000 |
| 35 mJ/cm$^2$ Dose @ 55% UVT | $785,000 | $3,140,000 | $102,200 | $4.130,000 |
| Difference | $305,000 | $1,220,000 | $107,800 | $2,270,000 |
| 50 mJ/cm$^2$ Dose @ 35% UVT | $1,310,000 | $5,240,000 | $239,000 | $7,560,000 |
| 35 mJ/cm$^2$ Dose @ 35% UVT | $1,090,000 | $4,36,000 | $133,700 | $4,991,000 |
| Difference | $387,000 | $1,548,000 | $104,700 | $2,564,000 |

Notes:
(1) Based on redundant equipment and facilities.
(2) Based on 4 times the equipment cost.
(3) Life cycle based on 15 years and 6 percent interest.

The same preliminary estimates of annual operating costs for the Trojan UVSigna 2-Row were prepared for the 35 and 50 mJ/cm$^2$ dose levels with redundancy, and are outlined in Table 7.9. The assumptions for the costs are included in the table and are based on our analysis of the system and input from Trojan.

Table 7.9 Trojan UVSigna 2-Row Annual O&M Cost Basis and Estimate

| Description | 35 mJ/cm$^2$ Dose at 35% UVT | 50 mJ/cm$^2$ Dose at 35% UVT | 35 mJ/cm$^2$ Dose at 55% UVT | 50 mJ/cm$^2$ Dose at 55% UVT |
|---|---|---|---|---|
| UVT, percent | 35 | 35 | 55 | 55 |
| Lamp Replacement | $485 | $485 | $485 | $485 |
| Ballast Replacement | $862 | $862 | $862 | $862 |
| Wiper Replacement | $20 | $20 | $20 | $20 |
| Quartz Sleeve Replacement | $162 | $162 | $162 | $162 |
| Chemical Usage | $300 | $300 | $300 | $300 |
| UV Sensor Replacement | $862 | $862 | $862 | $862 |
| Interest Rate | 6.00% | | | |
| Project Life, years | 15 | | | |
| Electricity Rate (kWh) | $0.10 | | | |
| Labor Rate (per hour) | $50.00 | | | |
| Annual Parts and Replacement Cost | $18,000 | $22,600 | $10,200 | $13,600 |
| Annual Labor Cost | $7,600 | $9,900 | $4,600 | $6,400 |
| Annual Energy Cost | $19,300 | $32,900 | $9,900 | $16,900 |
| **Total Annual Cost** | **$44,900** | **$65,400** | **$24,700** | **$36,900** |

Notes:
(1) All costs are based on redundant equipment.

The difference in annual O&M cost between the lower and higher dose values of 35 and 50 mJ/cm$^2$ is $20,500, and is predominately due to the higher energy use at the 50 mJ/cm$^2$ dose. The higher dose system has 24 more UV lamps (40 percent) compared to the 35 mJ/cm$^2$ system. Using the O&M cost basis in Table 7.9, the life cycle costs were calculated for both UV transmittances. The operating cost of the system at 55 percent UVT is less than at 35 percent UVT, by over $28,000 per year. A comparison of the life cycle cost at the different UVTs is shown on Table 7.10. The higher UVT has a lower life cycle cost by over $800,000.

The Trojan UVSigna 2-Row system offers significant annual operation and maintenance as well as present worth life cycle cost savings. For all of the scenarios, the annual O&M cost savings are greater than 70 percent compared to the UV3000Plus system. The life cycle cost savings are greater than 55 percent compared to the Trojan UV3000Plus system. The Trojan UVSigna 2Row system is the recommended disinfection system for the City of Arcata.

Table 7.10 Trojan UVSigna 2-Row System Net Present Worth Summary

| Equipment | Equipment Cost (1) | Estimated Construction Cost (2) | Annual O&M Cost | Present Worth Life Cycle Cost (3) |
|---|---|---|---|---|
| 35 mJ/cm$^2$ Dose @ 35% UVT | $510,000 | $2,040,000 | $44,900 | $2,476,000 |
| 35 mJ/cm$^2$ Dose @ 55% UVT | $355,000 | $1,420,000 | $24,700 | $1,660,000 |
| Difference | $155,000 | $620,000 | $20,200 | $816,000 |
| 50 mJ/cm$^2$ Dose @ 35% UVT | $640,000 | $2,460,000 | $65,400 | $3,195,000 |
| 50 mJ/cm$^2$ Dose @ 55% UVT | $460,000 | $1,840,000 | $36,900 | $2,198,000 |
| Difference | $180,000 | $720,000 | $28,500 | $997,000 |

Notes:
(1) Based on redundant equipment and facilities.
(2) Based on 4 times the equipment cost.
(3) Life cycle based on 15 years and 6 percent interest.

### 7.6.5 UV System Procurement

The UV system will be included in the final design for the flow reconfiguration / disinfection improvements portion of the Plant project. UV system equipment procurement can be implemented in a number of ways. The options are reviewed below at a high level for consideration by the City. The method of UV system procurement will be reviewed with the City and selected during preliminary design.

#### 7.6.5.1 Sole Source Design and Bid

In this option, a single design is prepared and bid based on a single manufacture/supplier's product. In some cases, owners and designers have selected one supplier to provide an equipment supply bid without a competitive process. This has been done in limited cases where the supplier's equipment provides some unique feature that is critical to the project. This might include, matching existing equipment, or some patented feature that is important to the success of the project, such as the method of sleeve cleaning, or pilot results that provide critical benefits. Based on the characteristics of the Trojan equipment, with patented cleaning system, and successful pilot testing results, this could be considered by the City. Depending of the City's plan for funding, this would still need to be approved by the funding source, such as State Revolving Loan Fund (SRF).

#### 7.6.5.2 Traditional Design and Bid

The traditional design and bid format is complicated when bidding UV disinfection equipment due to the different configurations offered by different UV equipment supplier or manufacturers. When UV equipment designs were first being considered, this was the preferred method of procurement. The designer would design the facility around one supplier, including structural, mechanical, and electrical designs. In general the UV disinfection equipment was specified based on a performance specification allowing competitive bidding. The issue with this approach was that the equipment supplied sometimes required very different structural, mechanical, and electrical designs. Even when the contractor was required to take the differences into consideration in the bid, items were sometimes missed or left out for alternative UV systems. In some cases this has resulted in disputes and change orders.

To avoid this issue, designers have prepared multiple designs around two or three suppliers, providing in some cases, two or three complete UV system designs. This was costly to the owner, since the designer had three times the effort, especially for structural, and electrical design components. In most cases the General Contractor selected the equipment based on cost alone, and the owner had no say in equipment selection.

One variation on this approach is to base bid the one manufacture that is used in the development of the bid documents. The general contractor provides a cost for installing one base bid with the pre-selected supplier's equipment, and provides the added or deductive cost for supplying other equipment. This provides the Owner with the differences in the cost of construction for different alternative suppliers. This can help to cut down on changes, but forces the contractor to determine all the extra costs for the alternative equipment, including design revisions.

#### 7.6.5.3 Evaluated Bid for UV Equipment

One solution that designers and owners follow to avoid the issues with the traditional design and bid approach, is an evaluated bid for UV equipment. The designer and owner first issue a Request for Proposal package for bidding the UV disinfection equipment. It is based on approximately a 30 percent design, and a performance based specification. The proposal forms require not only the capital cost bid, but guaranteed power cost, lamp replacement costs, and chemical cost (if required). The proposals are used to complete a present worth analysis for each proposer. The proposer with the lowest present worth (or best overall value) would be selected. The owner would then contract with the supplier for the UV equipment supply based on this selection. In most cases the selected supply also includes an allowance for working with the owner and designer to complete the design. Then the installation could be bid to a general contractor based on the selected equipment supplier and design requirements. The equipment cost proposal is then included in the general contractors bid, and is assigned to the General Contractor by the Owner once a General Contractor is selected. Carollo has used this approach on a number of UV installations, and generally has had good experience with the overall approach. In most cases it has resulted in a good installation bid, and allows the UV supplier to be part of the design team. This approach also helps to ensure that no details are missed in the design. In addition, it provides a system that has the best value to the Owner.

In an evaluated bid format, other factors can also be used in ranking a suppliers bid. These could be addressed in a weighting process and could include the following:

- Suppliers warranty and warranty terms.
- Proximity to factory authorized service center.
- Number of installation of the type proposed for owner.
- Recent installation issues or claims against the supplier.
- Validation experience.
- Regulatory acceptance of the technology if new or improved.

### 7.6.6 UV System Pretreatment

The treatment wetland will require pretreatment including coarse screening and medium fine screening prior to the UV process.

The Pump Station No 1 (PS1) modifications will include a coarse screen at the inlet structure to remove larger debris and vegetation prior to pumping. This will protect both the pumps and the UV system. The type of screen and details will be reviewed during PS1 final design.

The pump station modifications should also include some type of protection for downstream UV system such as an effluent strainer to remove material especially stringy algae and other organic material. The strainer will be sized to provide 200 to 500 micron strainer with automatic cleaning. The type of strainer best suited for wetland effluent including algae and vegetation solids will be reviewed during final design.

## 7.7 Existing Chlorine and Sulfur Dioxide System

The City of Arcata will phase out the existing chlorine and sulfur dioxide gas system as the primary disinfection process after the implementation of the new UV system. The existing system could still remain as a backup to the UV and for peak wet weather flow disinfection. This will require that the plant maintain the system and store chlorine and sulfur dioxide ton cylinders on site, especially during wet weather. It has been reported in the City's 2011 Risk Management Prevention Plan (RMPP), that the AWTF has been handling chlorine for over 25 years and has never experienced a release. As noted in the plan, the plant, on average, has fifteen (1 ton) chlorine cylinders on site. Typically six cylinders are on-line and nine are in storage. In addition, there are also six sulfur dioxide containing cylinders on-site, with two cylinders on-line and four in storage. As part of the RMPP evaluation, plant staff determined that due to an annual average chlorine consumption of 1.5 - 2.0 tons per week, chemical supplier location (500 miles away), delivery delays due to road conditions and effluent disinfection requirements, that the amount of on-site chemical was necessary. While the amount of chemical stored on-site in this scenario can be reduced once the UV system is online, chlorine and sulfur dioxide will still need to be stored on-site, and ready for use during wet weather.

The system can be retrofit to a liquid chemical system for use during wet weather or as a redundant system to the new UV system. Note that this system would only be used for disinfection for the existing Outfall 001.

The reason to retrofit the system is to reduce the overall potential risk from the ton chlorine cylinder system. Commonly sodium hypochlorite and sodium bisulfite are used to retrofit gas systems. The benefit of using the liquid chemical is lower potential for release of hazardous gas, and a fairly simple chemical dosing system. The downside is that these chemicals are less stable, and degrade over time. Typically the hypochlorite is supplied as 15 to 25 percent and bisulfite as 15 to 45 percent. These can degrade over time to less than 10 percent strength in a matter of weeks. For example, depending on the temperature a 15 percent hypochlorite solution can degrade in half in 60 to 100 days.

The chemicals would be stored in high density polyethylene tanks. The tanks could be located in the existing chlorine gas storage area, with slight modifications to provide containment. Chemical metering pumps could be installed adjacent to the tanks, and used to pump chemical solution directly to the existing CCB. The existing chemical induction units could be reused for this application. The cost of the retrofit is estimated at $350,000 to $500,000. A preliminary layout is shown on Figure 7.10.

KEY NOTES:

1. BISULFITE TANK, 8'-6" Ø (1).
2. 10'-0" Ø TANK PAD.
3. BISULFITE PUMPS (2).
4. HYPOCHLORITE TANK, 8'-6" Ø (2).
5. HYPOCHLORITE PUMPS (3).
6. UV EQUIPMENT STORAGE.
7. NEW CURB.
8. DEMOLISH AND REMOVE EXISTING CHLORINE EQUIPMENT.

EXISTING CHLORINE BUILDING

STORAGE

ANALYZER ROOM

STORAGE AREA

A PLAN
SCALE: 3/8" = 1'-0"

**Figure No. 7.10**
**WET WEATHER CHLORINE DISINFECTION SYSTEM**
CITY OF ARCATA

carollo

File: IP_PWP:d0794338\09913B10FIG7.10.dgn
Plot Date: 24-AUG-2018 7:39:05 AM
User: DFassbinder

## 7.8 Summary of Next Steps

The following items need to be reviewed or finalized during final design based on the final effluent permit requirements:

- Final system sizing based on the expected design UVT: 35 percent.
- Final design dose of 50 mJ/cm$^2$, to be confirmed by collimated beam test on the Arcata enhancement marsh effluent and based on feedback from State on requirements to be protective of shellfish.
- UV system facility design requirements including the need for an enclosure or other type of weather protection and architectural treatment.
- Power supply and back-up power requirements.
- Procurement method based on evaluated bid or sole source procurement.
- Chlorine system retrofit design, including demolition of existing chlorine and sulfur dioxide gas system and replacement with liquid chemical system.

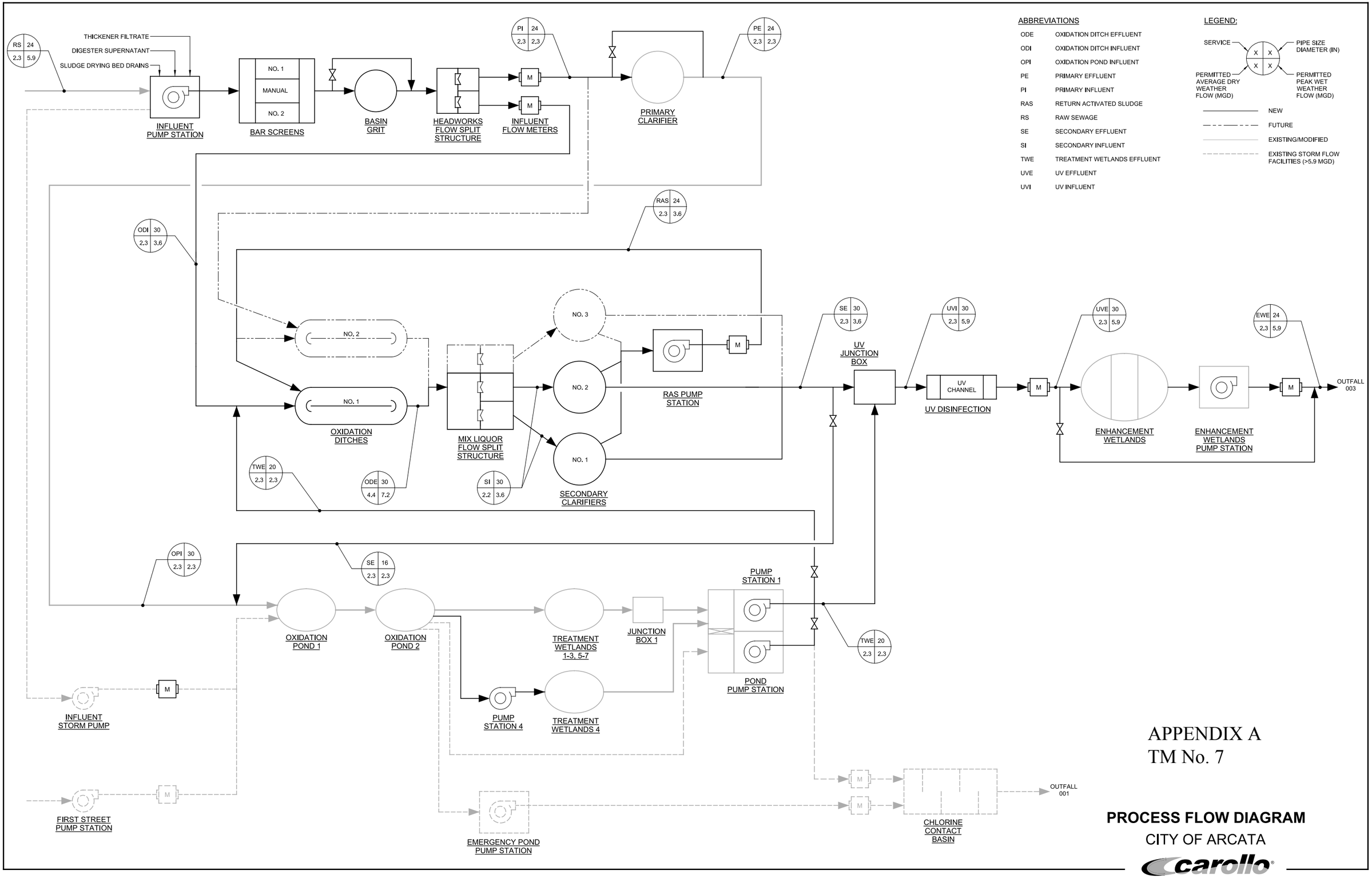
## 7.9 References

SHN 2003 - 2000/2002 Wastewater Treatment Plant Evaluation, February 2003, SHN Consulting Engineers & Geologists Inc.

Appendix A

# PLANT SCHEMATIC

File: E:\ICSforPDFWorking\170431794338_8\9913B10FIG2.3.dgn
Plot Date: 01-JUN-2018 8:52:12 AM
User: svcPW




APPENDIX A
TM No. 7

**PROCESS FLOW DIAGRAM**
CITY OF ARCATA

carollo

Appendix B

# CHLORINE USE

| Month/Year | Monthly Ave Flow (MGD) | Average $SO_2$ Use (lbs/day) | Average $SO_2$ Dose (mg/L) | $SO_2$ Peak Daily Use (lbs) | Average $CL_2$ Use (lbs/day) | Average $CL_2$ Dose (mg/L) | $CL_2$ Peak Daily Use (lbs) |
|---|---|---|---|---|---|---|---|
| Jun-10 | 2.17 | 186 | 10.28 | 370 | 220 | 12.16 | 520 |
| Jul-10 | 1.32 | 143 | 12.99 | 210 | 176 | 15.99 | 270 |
| Aug-10 | 1.28 | 160 | 14.99 | 220 | 230 | 21.55 | 360 |
| Sep-10 | 1.37 | 145 | 12.69 | 200 | 341 | 29.84 | 530 |
| Oct-10 | 1.48 | 221 | 17.90 | 400 | 347 | 28.11 | 470 |
| Nov-10 | 2.47 | 233 | 11.31 | 390 | 263 | 12.77 | 470 |
| Dec-10 | 3.52 | 270 | 9.20 | 420 | 275 | 9.37 | 500 |
| AVERAGE | | 194 | | 316 | 265 | | 446 |
| Jan-11 | 2.75 | 205 | 8.94 | 350 | 197 | 8.59 | 340 |
| Feb-11 | 2.51 | 203 | 9.70 | 320 | 189 | 9.03 | 300 |
| Mar-11 | 3.26 | 307 | 11.29 | 510 | 373 | 13.72 | 560 |
| Apr-11 | 2.54 | 220 | 10.39 | 420 | 227 | 10.72 | 420 |
| May-11 | 1.70 | 139 | 9.80 | 170 | 202 | 14.25 | 340 |
| Jun-11 | 1.48 | 118 | 9.56 | 180 | 178 | 14.42 | 250 |
| Jul-11 | 1.18 | 92 | 9.35 | 140 | 190 | 19.31 | 380 |
| Aug-11 | 1.25 | 132 | 12.66 | 180 | 412 | 39.52 | 286 |
| Sep-11 | 1.33 | 143 | 12.89 | 180 | 347 | 31.28 | 540 |
| Oct-11 | 2.00 | 217 | 13.01 | 300 | 362 | 21.70 | 560 |
| Nov-11 | 1.59 | 201 | 15.16 | 290 | 234 | 17.65 | 320 |
| Dec-11 | 1.42 | 145 | 12.24 | 200 | 218 | 18.41 | 380 |
| AVERAGE | . | 177 | | 270 | 261 | | 390 |
| Jan-12 | 2.79 | 213 | 9.15 | 315 | 271 | 11.65 | 360 |
| Feb-12 | 2.03 | 187 | 11.05 | 290 | 252 | 14.88 | 380 |
| Mar-12 | 2.74 | 241 | 10.55 | 340 | 256 | 11.20 | 420 |
| Apr-12 | 3.16 | 231 | 8.77 | 400 | 317 | 12.03 | 580 |
| May-12 | 1.67 | 151 | 10.84 | 220 | 237 | 17.02 | 320 |
| Jun-12 | 1.38 | 132 | 11.47 | 180 | 163 | 14.16 | 380 |
| Jul-12 | 1.19 | 145 | 14.61 | 200 | 137 | 13.80 | 200 |
| Aug-12 | 1.21 | 134 | 13.28 | 190 | 225 | 22.30 | 310 |
| Sep-12 | 1.31 | 145 | 13.27 | 190 | 232 | 21.23 | 320 |
| Oct-12 | 1.37 | 154 | 13.48 | 200 | 199 | 17.42 | 270 |
| Nov-12 | 1.72 | 198 | 13.80 | 310 | 198 | 13.80 | 420 |
| Dec-12 | 3.28 | 238 | 8.70 | 510 | 282 | 10.31 | 830 |
| AVERAGE | | 181 | | 279 | 231 | | 399 |

| Month/Year | Monthly Ave Flow (MGD) | Average $SO_2$ Use (lbs/day) | Average $SO_2$ Dose (mg/L) | $SO_2$ Peak Daily Use (lbs) | Average $CL_2$ Use (lbs/day) | Average $CL_2$ Dose (mg/L) | $CL_2$ Peak Daily Use (lbs) |
|---|---|---|---|---|---|---|---|
| Jan-13 | 2.00 | 179 | 10.73 | 230 | 166 | 9.95 | 240 |
| Feb-13 | 1.86 | 212 | 13.67 | 270 | 217 | 13.99 | 290 |
| Mar-13 | 2.40 | 175 | 8.74 | 230 | 181 | 9.04 | 290 |
| Apr-13 | 1.72 | 150 | 10.46 | 210 | 195 | 13.59 | 290 |
| May-13 | 1.40 | 139 | 11.90 | 210 | 153 | 13.10 | 240 |
| Jun-13 | 1.24 | 166 | 16.05 | 210 | 235 | 22.72 | 390 |
| Jul-13 | 1.10 | 149 | 16.24 | 200 | 287 | 31.28 | 440 |
| Aug-13 | 1.19 | 105 | 10.58 | 280 | 236 | 23.78 | 380 |
| Sep-13 | 1.32 | 96 | 8.72 | 260 | 198 | 17.99 | 670 |
| Oct-13 | 1.37 | 156 | 13.65 | 250 | 237 | 20.74 | 440 |
| Nov-13 | 1.30 | 142 | 13.10 | 210 | 347 | 32.01 | 530 |
| Dec-13 | 1.19 | 120 | 12.09 | 160 | 174 | 17.53 | 320 |
| AVERAGE | | 149 | | 227 | 219 | | 377 |
| Jan-14 | 1.32 | 129 | 11.72 | 180 | 170 | 15.44 | 240 |
| Feb-14 | 2.16 | 213 | 11.82 | 360 | 266 | 14.77 | 490 |
| Mar-14 | 2.28 | 213 | 11.20 | 380 | 266 | 13.99 | 520 |
| Apr-14 | 1.73 | 194 | 13.45 | 260 | 167 | 11.57 | 240 |
| May-14 | 1.41 | 156 | 13.27 | 200 | 170 | 14.46 | 220 |
| Jun-14 | 1.16 | 136 | 14.06 | 190 | 227 | 23.46 | 500 |
| Jul-14 | 1.07 | 75 | 8.40 | 180 | 187 | 20.96 | 470 |
| Aug-14 | 1.18 | 59 | 6.00 | 90 | 158 | 16.05 | 200 |
| Sep-14 | 1.85 | 94 | 6.09 | 160 | 190 | 12.31 | 480 |
| Oct-14 | 1.57 | 142 | 10.84 | 300 | 263 | 20.09 | 770 |
| Nov-14 | 1.67 | 211.3 | 15.17 | 240 | 318.3 | 22.85 | 460 |
| Dec-14 | 3.19 | 284 | 10.67 | 420 | 302 | 11.35 | 460 |
| AVERAGE | | 159 | | 247 | 224 | | 421 |
| Jan-15 | 1.55 | 180 | 13.92 | 320 | 193 | 14.93 | 360 |
| Feb-15 | 1.93 | 203 | 12.61 | 320 | 233 | 14.48 | 410 |
| Mar-15 | 1.77 | 194 | 13.14 | 260 | 191 | 12.94 | 320 |
| Apr-15 | 1.84 | 211 | 13.75 | 280 | 202 | 13.16 | 260 |
| May-15 | 1.29 | 90 | 8.37 | 180 | 87 | 8.09 | 240 |
| AVERAGE | | 176 | | 272 | 181 | | 318 |

Appendix C

# UVT DATA

# PROJECT MEMORANDUM

| | | | |
|---|---|---|---|
| **Project Name:** | WWTP Improvements Project | **Date:** | June 4, 2015 |
| **Client:** | City of Arcata (LACO) | **Project Number:** | 9913A10 |
| **Prepared By:** | Andrew Salveson | | |
| **Reviewed By:** | Doug Wing | | |
| **Subject:** | Technical Brief - UVT Data Summary and Implications | | |
| **Distribution:** | LACO, City, File | | |

This technical brief reviews several UV transmittance (UVT) data sets, provides a graphical comparison of those data sets, and evaluates the potential implications. Recommendations for additional sampling are also provided.

## 1.0 UVT DATA

The Carollo team was provided with several UVT data sets:

- Sample Dates: 2008, 2011, and 2015 (current).
- Sample Locations: 8, 8-3, 9, and 15.

The sample locations are shown in Figure 1. Point 15 is the Hauser effluent, whereas Points 8, 8-3, and 9, as we interpret the locations, all represent essentially the same location in the treatment process, which is after the treatment wetlands but before the enhancement marshes. The UVT data is presented in Figures 2 to 5.

## 2.0 DATA ANALYSIS

Our review of this data set results in both questions and answers, and more data is needed. We propose the following items for discussion with the City:

- Points 8, 8-3, and 9 have consistently had a low UVT in the ~20% range (Figure 2 and Figure 3). The higher UVT using one UVT meter in 2011 may be the result of a calibration issue.
- Point 15 has had a UVT of ~40% to ~55%, with consistent data in 2011, but a concerning downward trend in 2015. Something has changed within the process treatment train which is driving the UVT down as part of the latest testing. It may be that flows to the enhancement marshes were chlorinated, which may have reduced increased UVT by oxidizing soluble organic matter. We are in need of feedback from the City.
- The UV system is currently considered for implementation after Point 15, and thus the UVT data from Point 15 is most relevant. If the current downward UVT trend at Point 15 continues, then the new UV system will be quite expensive to implement. Further, the UVT at Point 15 is currently well below the UVT value in the new permit.

- The increase in UVT from Points 8, 8-3, and 9 to Point 15 is substantial and must be better understood. Is the UVT increase purely a function of biological activity and filtration through the Hauser Marsh? Was there (or is there) any other type of treatment that occurs after Points 8, 8-3, and 9 but before the end of the enhancement marshes?

## 3.0 RECOMMENDATIONS

It is recommended that the UVT sampling at location 15 be expanded to include testing after the treatment wetlands, at either points 8 or 9, prior to the chlorine contact basin. Further, we suggest testing of UVT as it enters the Hauser Marsh.




**Figure III- 2. Locations and labels for sampling points through the AWTF.**

**Figure 1 – Sample Locations**

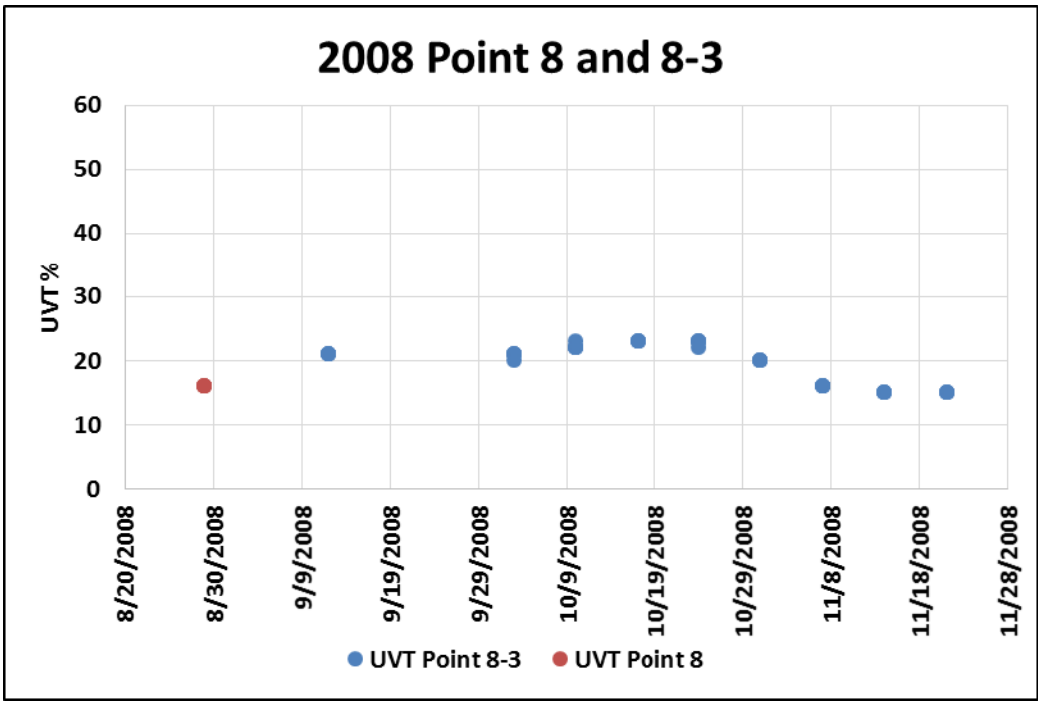



**Figure 2 – 2008 Data, Points 8 and 8-3**

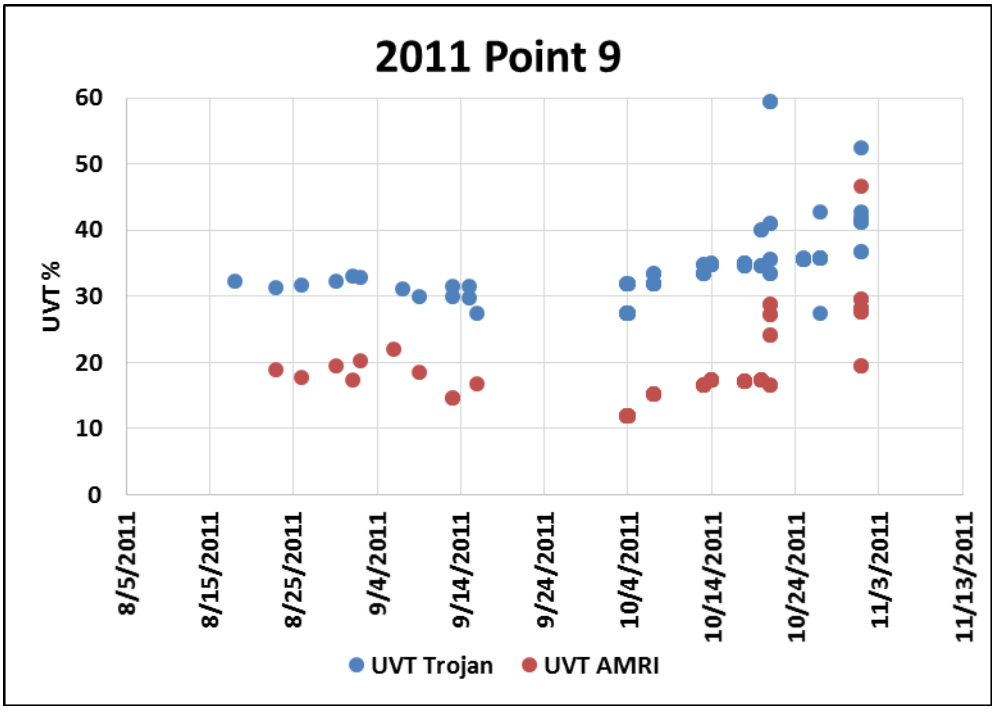



**Figure 3 – 2011 Data, Point 9**

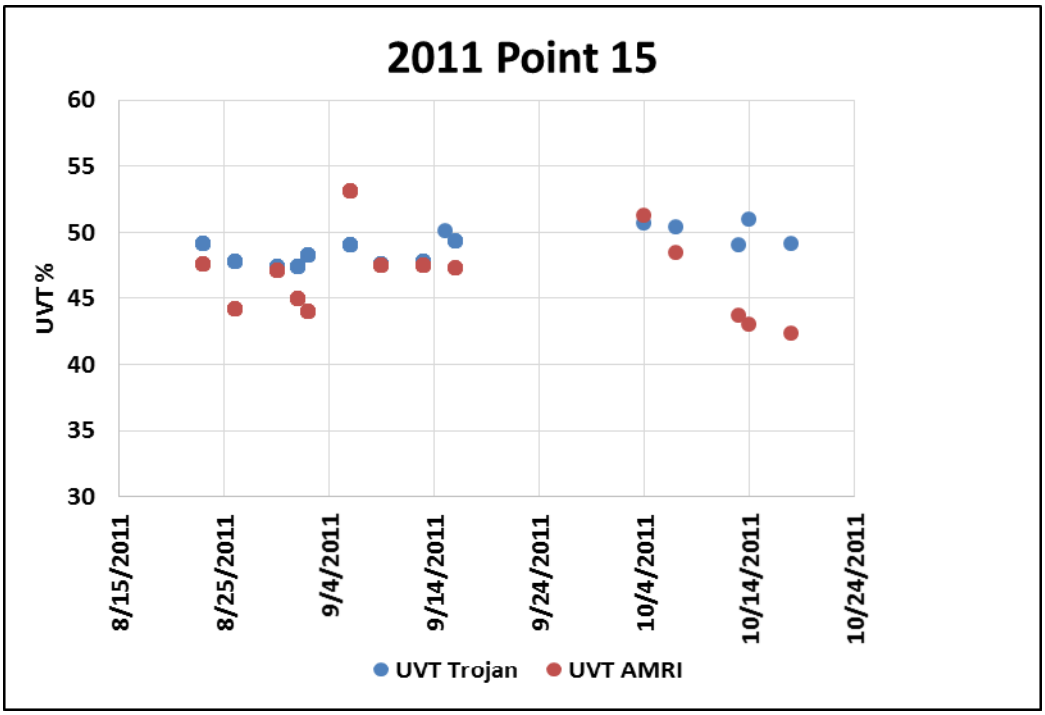



**Figure 4 – 2011, Point 15**

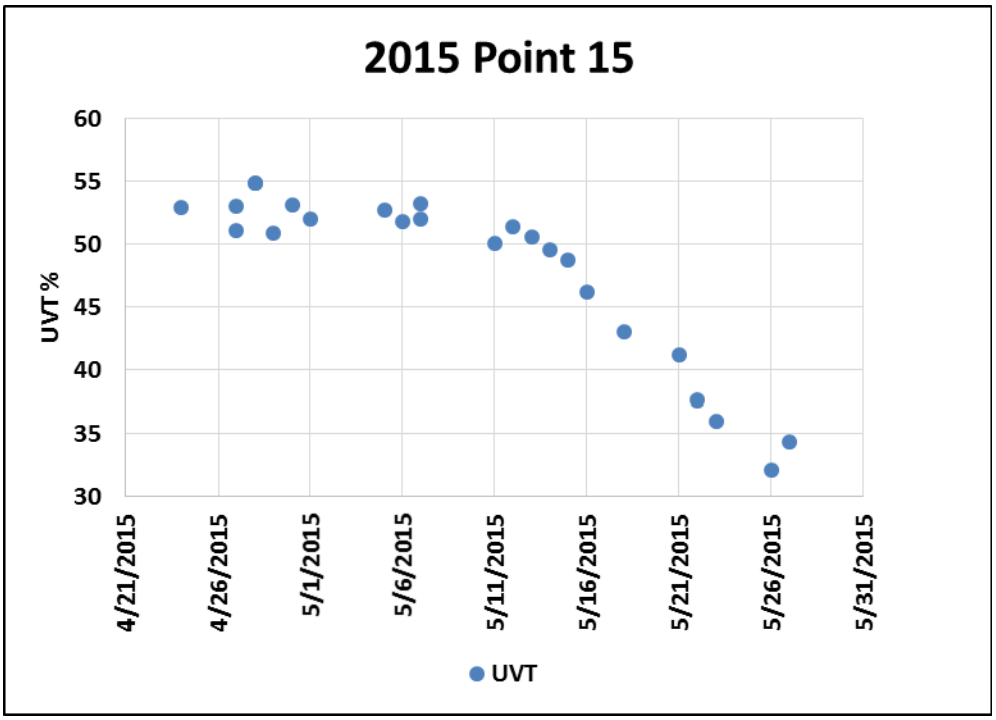


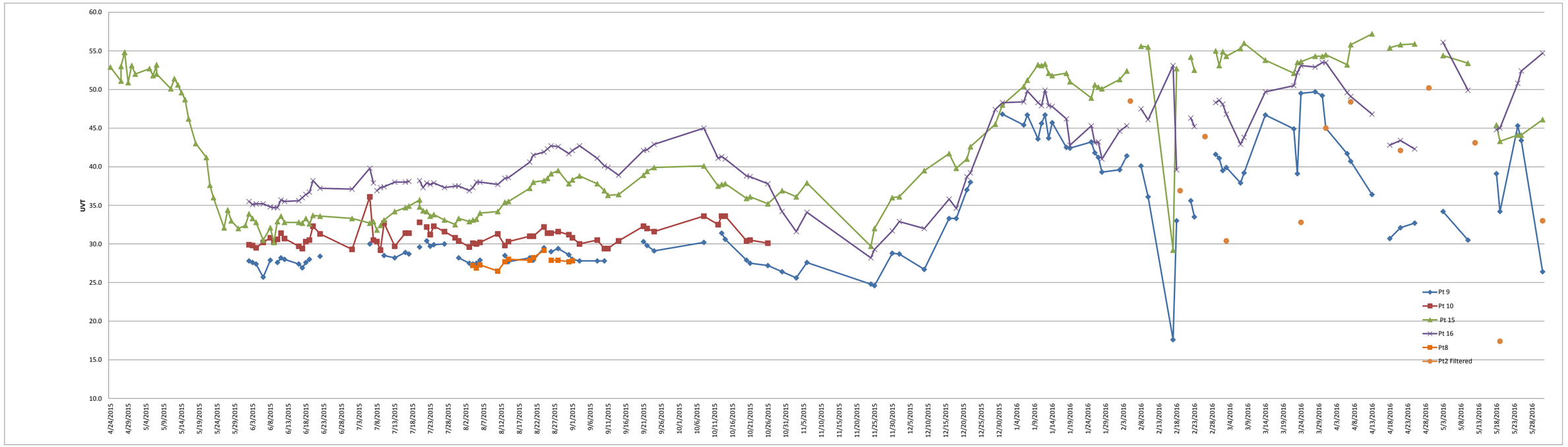

**Figure 5 – 2015, Point 15**

**Prepared By:**

Andrew Salveson

This is where the engineer digital seal will be placed.

Appendix M, UVT Data
City of Arcata
Wastewater Treatment Facility Improvements Project



Appendix D

# UV PILOT STUDY

# MEMO

From: Arcata Marsh Research Institute

Date: November 2, 2011

---

# UV Disinfection of the City of Arcata's treated wastewater

## *Purpose*

Presently, UV disinfection is being considered to replace chlorine disinfection. Alternative sites for UV disinfection are being considered depending upon permitting requirements. The purpose of studying UV disinfection at multiple locations is to provide information that can be used to prove effectiveness and to design a full-system UV disinfection process. Continuing to disinfect with a chlorine-based system will produce disinfection byproducts that are not removed in the dechlorination process and are known human and ecological toxins. These disinfection byproducts have been identified in Arcata's effluent. The following list states the multipurpose goals of this UV pilot system.

- City of Arcata treats their wastewater with the lowest impact possible to meet all existing permit requirements (for disinfection permit limits see Table 1).
- Eliminating the chlorination disinfection system eliminates toxic byproducts and human hazards associated with chlorine usage.
- Options for disinfection are Point 9, a mixture of Point 9 and Point 15, and Point 15.
- Installation of UV disinfection at Point 001 is redundant when disinfection has been achieved at Point 002. Therefore, disinfection should be focused at Point 002. Additional water quality limits (BOD, TSS, Ammonia, metals etc) should be argued for and implemented at a final discharge point (Pt 001, or Pt 003 – to McDaniels Slough).
- Installation of UV disinfection at Point 001 while chlorinating at Point 002 does not eliminate the delivery of toxic byproducts to the Tertiary Constructed Wetlands (TCW). If the TCW are decided to be Waters of the State then fresh water toxicity limits from chlorination will be a difficult permit limit to meet.

**Table 1: City of Arcata coliform permit limits at Outfall 001 and 002.**

| Permit location | Permit limit | Units | Monthly Average | Daily Maximum |
|---|---|---|---|---|
| Outfall 001 | Fecal Coliform | MPN/100mL | 14 | 43 |
| Outfall 002 | Total Coliform | MPN/100mL | 23 | 230 |

**Water Quality Objectives**

The North Coast Water Quality Control Board defines water quality objectives for (1) shellfish growing areas and (2) watersheds in the ***North Coast Basin Plan*** (Plan)**.** Objectives for shellfish growing waters (applied within the Bay waters) state "*the geometric mean for fecal coliform shall not exceed 14 MPN per 100 ml and that the 90th percentile value for fecal coliform shall not exceed 43 MPN per 100 ml*." This Study applied the 90th percentile value of 43 MPN in the interpretation analyses of bay water samples.

## *Ultraviolet Disinfection – Background Information*

The use of ultraviolet disinfection is an environmentally responsible, convenient, safe, and cost-effective way to disinfect municipal wastewater discharge. UV disinfection performance is equal to chlorine. The effluent easily meets NPDES permit requirements and is a more effective viralcide than chlorine. As a result, adequate disinfection is provided, permit requirements are met, and local aquatic life is protected. By reducing reliance on chlorine, the potential for accidental worker and/or citizen exposure is reduced.

## Advantages

**Safety:** UV disinfection is safer than wastewater treatment systems that rely on chlorine gas. By eliminating transport and handling of large quantities of a hazardous chemical, the UV system reduces potential liability for worker/community exposure. Studies also suggest that UV disinfection controls viruses and many disease-causing bacteria better than chlorination/dechlorination.

**Simplified Compliance:** UV disinfection can help ease compliance with NPDES permit requirements and Fire Code regulations. Continued use of chlorine would require Arcata to build a new disinfection area incorporating secondary containment and a scrubbing/neutralization system.

**Reduced Effluent Toxicity:** Even at low concentrations, chlorine is toxic to aquatic organisms. Dechlorination only removes chlorine in the free residual form leaving combined forms. Aqueous chlorination practices also generate halogenated organic compounds, which may also be toxic. UV disinfection protects the aquatic habitat of the receiving waters. (Literature citation)

**Operation, Maintenance and Cleaning:** The operation and maintenance of UV disinfection systems is simpler than chlorination/dechlorination systems. UV process monitoring and controls relies on instrumentation that maintains optimum irradiation levels for disinfection. Automatic shutoff values exist to stop flow when conditions for target disinfections are compromised. (Literature citation)

**Chemical of concern:** UV has been demonstrated to reduce and remove a wide range of personal products and pharmaceutical found in domestic wastewater. There is a large body of literature showing the effectiveness of UV light on complex organic compounds in wastewater including endocrine disrupters. UV disinfection system can serve as an effective process to deal with the next group of potential NPDES parameters. (Literature citation)

**Energy Consumption:** The total energy requirement for UV is less than chlorination mostly due to the transportation and handling energy cost. UV has the potential to use the electricity generated from anaerobic digesters on-site. Presently Arcata does not use biogas for electrical power production.

# UV Disinfection Studies

Currently, an open channel Trojan UV3000 system is being used to test disinfection of the City of Arcata's reclaimed wastewater. Previous studies (Wilson 1996, Ly 2008, Finney et al. 2009, and Garrison 2010) indicate UV disinfection is successful at both current chlorine disinfection locations (Pt 9 and Pt 15). The UV3000 model open-channel configuration believed to be the best model yet tested to handle the typical water quality seen at Pt 9 and Pt 15. Typical design range for industry norms is 20-140 $mJ/cm^2$.

## Past UV Studies

The City of Arcata has invested in 2 previous pilot scale studies (Finney et al. 2009, and Garrison 2010), and 2 bench scale studies (Wilson 1996, and Ly 2008) to determine the efficacy of UV disinfection as a replacement for the use of chlorine.

**Table 2: Summary of previous UV studies at the Arcata Marsh.**

| **Study** | **UV system (Q)** | **Study period;**<br><br>**[# of runs]** | **Point of disinfection; Water quality** |
|---|---|---|---|
| Wilson (1996) | Lifeguard Aquatics, QL-40 (40 Watt bulb); closed vessel, (.96-5 GPM) | Oct. 1994 – Apr. 1995 | Hauser effluent: Turbidity (0.9-6.1 NTU), TSS (0.3-8.2 mg/L), Transmittance (43-58%) |
| UV effectively disinfected all samples at all ranges below permit requirements. Dose ranged 48.4-283.63 $mJ/cm^2$. Note 19% of untreated samples complied with permit requirements. | | | |
| Ly (2007) | Bench-scale Double Helix UV sterilizer, closed vessel; (10 gallon samples) | Aug. – Dec. 2007<br><br>[n=15] | TM 4: TSS (17-35 mg/l), Transmittance (44.8 – 54.7%) |
| Influent FC ranged from 600-11,200 CFU/100ml all UV radiated samples achieved total FC kill and resulted in clean plates. UV dose is estimated to have ranged from 96-153 $mW/cm^2$. | | | |

| | | | |
|---|---|---|---|
| Finney et al. (2009) | Aquionics Inline 40+, closed vessel<br><br>(5-75 gal/min) | Aug. 2010<br><br>[n=5] | Pt 8: Turbidity (38-41 NTU), TSS (27-31 mg/l), Transmittance (16%). Water quality considered too low to achieve disinfection. |
| | | Sept. – Nov. 2010<br><br>[n=45] | TM 3: Turbidity (20-40 NTU), TSS (9-35 mg/l), Transmittance (25%). |
| | | Dec. 2010<br>[n=9] | Hauser: Turbidity (6 NTU), TSS (3 mg/l), Transmittance (49%). |
| Increased TSS correlated with higher turbidity and lower transmittance. FC fairly easy to inactivate, TC harder, TM 3 effluent needed a dose over 200 mJ/cm$^2$. Hauser effluent achieved disinfection at a dose of 100 mJ/cm$^2$. | | | |
| Garrison (2010) | Trojan Fit, model 18AL40 closed vessel<br><br>(0.11 – 1 MGD) | Sept. 2010 – Jan. 2011<br><br>[n = 107] | Pt 8: TSS (15-76 mg/L), Turbidity (10-75NTU), Transmittance @254 nm (22.5-56.3%) |
| The study shows disinfection is achieved at all tested levels of TSS and UVT with varying dosages. Consistent and sufficient disinfection was achieved at 100 mJ/cm$^2$. There was no clear relationship between TSS and effectiveness nor between UVT and effectiveness although both TSS and UVT are considered the main parameters that affect effectiveness. Trojan was unable to provide the dosage equation that may better describe these relationships. | | | |

## Findings:

Garrison (2010) found effective disinfection even though the closed-chamber Trojan Fit met unpredicted issues with solids build-up and flow regulation.

- Accumulated algal solids, unexpected cattail fragments, frogs, snails, and sticks.
- The UV lamps accumulated an opaque film that was described as excessive by the Trojan representative.
- The flow rate used to achieve UV disinfection was often below the designed operating parameters for the unit resulting in laminar flow rather than turbulent flow.

## Recommendations

- Routine maintenance and screening at the influent pump station would reduce the amount of detrital solids entering the disinfection systems.
- Find appropriate cleaning solution for opaque film if it occurs again.
- Closed chamber UV disinfection is not appropriate

# The 2011 UV Project – Testing Point 15 (Hauser) and Point 9 effluent

## *Pilot Study Design*

A Trojan UV3000 pilot-scale UV unit for ultra-violet disinfection is being tested for effectiveness on Arcata Marsh secondary treated effluent. UV disinfection effectiveness is being determined by both the ease of operations and the ability to disinfect total and fecal coliform (TC & FC). The disinfection efficacy at different doses and ease of operations are used as design criteria and in developing operational strategies. The UV unit is located on the berm next to the chlorine contact basin to allow for multiple influent sources (Figure 1).

In order to test the disinfection effectiveness, the UV dose can be altered by changing the flow rate and therefore the residence time. The second way to change the UV dose is to alter the level of power delivered to the water.

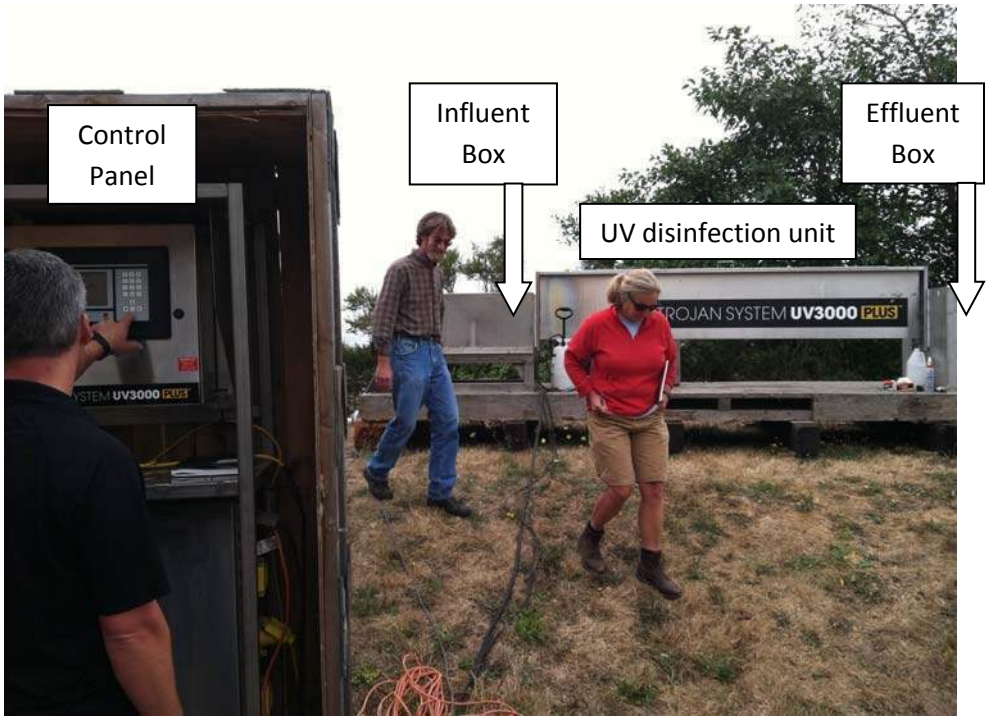



**Figure 1: Trojan UV3000 control panel and disinfection unit.**

The first source of water to be tested is from Hauser Wetland (Point 15). Additional sources of water to be tested are from Point 9 and a mixture from Point 9 and Hauser Wetland. The City of Arcata discharge permit has fecal coliform (FC) and total coliform (TC) limits for Outfall 001/Point 15 and Outfall 002/Point 9 (Table 3).

**Table 3: City of Arcata discharge permit limits for total and fecal coliform.**

| Permit location | Permit limit | Units | Monthly Average | Daily Maximum |
|---|---|---|---|---|
| Outfall 001 | Fecal Coliform | MPN/100mL | 14 | 43 |
| Outfall 002 | Total Coliform | MPN/100mL | 23 | 230 |

The different sources of water have different constituents that affect the ultra-violet transmittance (UVT). UVT is a measure of how well UV wavelengths can penetrate the source water and is effected by the turbidity, suspended and dissolved solids of the sample water. The assessment of each sampling location includes measuring UVT, turbidity, and TSS (Table 4). The Hauser Wetland effluent is typically described with a high UVT, low turbidity and TSS. Point 9 effluent is described with a lower UVT, and greater turbidity and TSS. The testing season, late summer, represents "worst-case" conditions for UVT due to high algal TSS, high turbidity, and increased humic acids (dissolved solids) from plant decomposition. Effective UV disinfection at this time of year provides design parameters that would cover poor water quality conditions.

**Table 4: Water quality parameters for the influent sources to the UV system.**

| Source of UV influent | Dates of operation | UVT range | TSS (mg/L) | Turbidity (NTU) |
|---|---|---|---|---|
| Point 9 | Aug 23 – Sept 16 | 27.5 – 34.9 | 54 – 77* | 40 - 59 |
| Mixture of Pt 9 and Hauser Wetland | | | | |
| Hauser Wetland | Oct 4 - 13 & Oct 25 - 28 | 47.4 – 49.4 | 3 - 6 | 4 - 18 |

On October 7$^{th}$ – 10$^{th}$ or something – there were three days in a row of heavy rainfall. The high value for TSS reflects a spike in solids during this rainfall event.

## *Methods*

Ease of operations is a function of how much time and effort is required by the treatment plant operators to maintain the UV unit as well as how much pre-treatment is necessary to deliver a quality of water that can be effectively disinfected.

Disinfection of coliform is being determined by the effect of UV dose on colony formation (reported in CFU/100mL) in accordance with Standard Methods for the Examination of Water and Wastewater. An alternative method for measuring coliform is the Most Probable Number (MPN) test that yields results in brackets of probable coliform abundance. The MPN test is the reporting standard for the discharge requirement.

The dose of UV light delivered to the water is described by a proprietary equation using flow rate and ultra-violet transmittance (UVT) (Figure 2). At this time of year, the effluent from Hauser Wetland is consistently about 50% UVT and Point 9 is about 30% UVT.

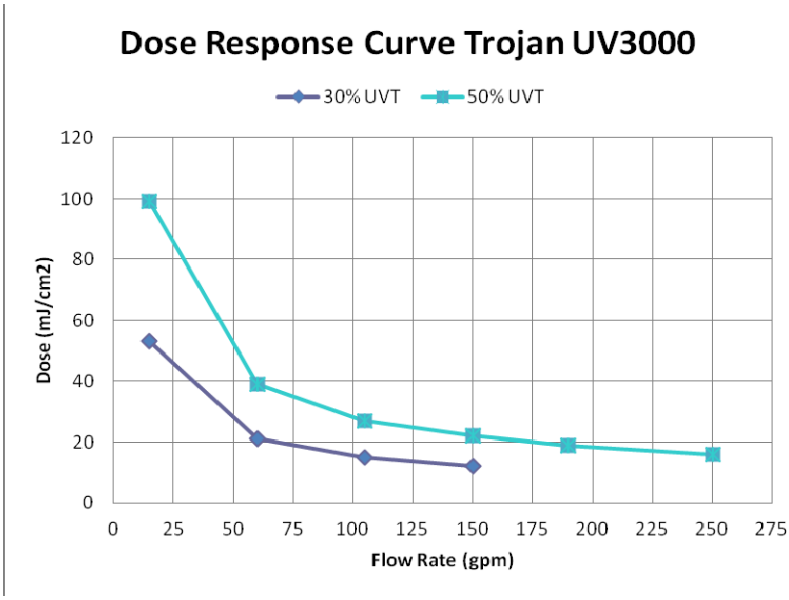



**Figure 2: Dose response curve for Trojan UV3000.**

## *Results and Discussion*

### Maintenance

Weekly visual inspections conducted by AMRI staff and City of Arcata wastewater treatment operators have demonstrated clean bulbs and some accumulation of solids. The clean bulbs were contrasted with the areas of grayish build-up on the bulbs that do not function as a part of the disinfection process and are not reached by the automatic cleaning mechanism (Figure 3). The accumulated solids were comprised of stringy material that may originate in the pipe between Hauser and the UV unit or may

originate in Hauser Wetland itself (Figure 4). Once the influent source changed to Point 9, the influent settling basin showed pebbles and debris collecting. A simple screen was placed in front of the UV chamber to reduce the amount of large particles moving through the disinfection process. Throughout the study, the bulbs remained clean and clear of any noticeable film or build-up.

Operators have indicated that the maintenance time requirements of the UV unit are acceptable. Daily tasks are checking the UV control panel for alarms, checking the flow rate and the level of water in the unit. Additionally, when the unit is being run with Hauser influent, the operators turn off the unit and travel to the Hauser pump station to clean the effluent screen. If the screen is not cleaned daily, or if it accumulates a lot of solids there is a corresponding drop in the flow rate to the UV unit. The weekly visual inspections are demonstrating success and providing confidence in the ability of the UV unit to continue operations without a lot of maintenance.

The accumulation of stringy solids and large solids is potentially problematic, as solids can provide shielding for coliform as they move through the system. The result would be viable coliform on the effluent end of the UV unit. The solution would be a mechanical self-cleaning screen on the influent to the UV disinfection system.



**Figure 3: Visual inspection demonstrating build-up of greyish coating on area of bulbs where the wiper does not reach.**

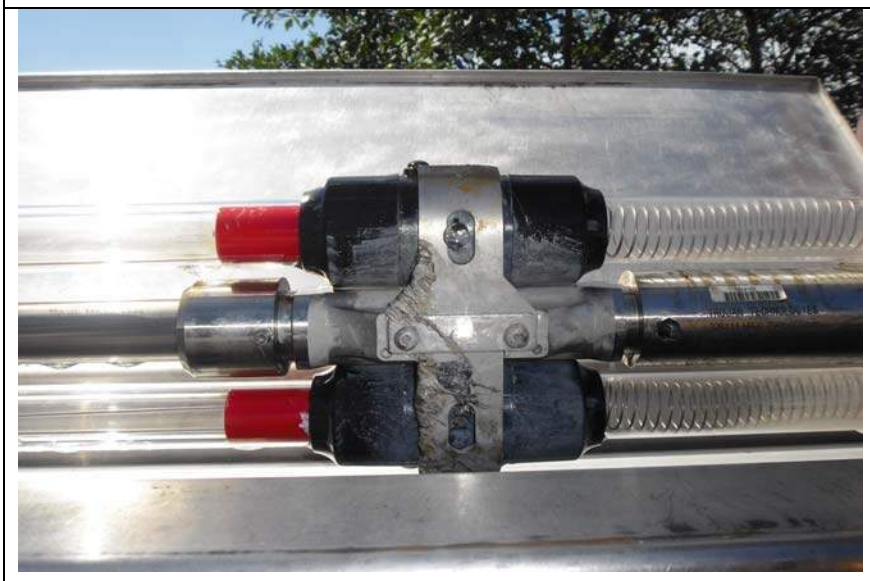


**Figure 4: Visual inspection demonstrating the accumulation of stringy solids on bulb apparatus and very clean bulbs.**

## UV Disinfection Effectiveness receiving Hauser Effluent

Doses were tested ranging from 11-44 mJ/cm$^2$, at flows from 48.8 to 192 gpm, and with UVT of 47-50%. Doses were reported from Trojan after supplying the conditions for flow rate and UVT. Ten sampling events were run from August 23 – September 16, 2011 to assess the disinfection of Hauser Wetland effluent. Samples were not taken at flows lower than about 50 gpm due to difficulties in setting the effluent weir in the UV unit. Each dose was analyzed for Total and Fecal Coliform (TC and FC respectively), TSS, turbidity, temperature, and UVT.

The results for TC were determined to be unreliable because of competition with muccoid colonies causing interference with the growth of TC colonies and a lack of agreement with North Coast Laboratory samples run using the MPN test. The results for FC have been verified by North Coast Laboratory samples run using the MPN test (Figure 5).

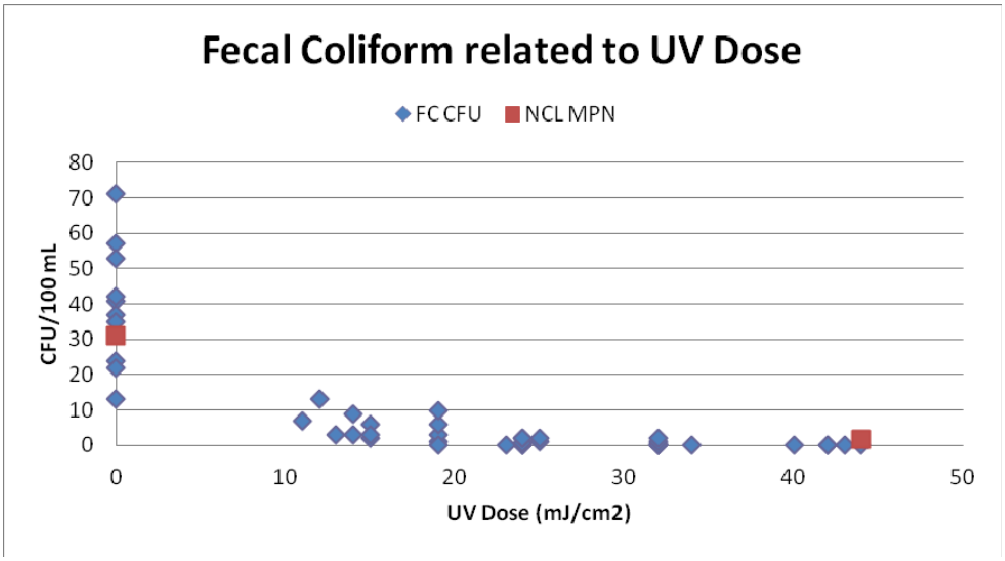



**Figure 5: Fecal coliform colonies in CFU/100mL as related to applying different doses.**

The lowest dose necessary to achieve permit levels for a daily maximum of 43 MPN/100mL was often achieved before disinfection, and was demonstrated by the coliform results at a dose of 0 mJ/cm$^2$ (Figure 5). All FC results were below 20 CFU/100mL. Results below 10 CFU/100mL were seen at doses greater than 20 mJ/cm$^2$.

The Trojan proprietary equation describing UV dose uses UVT and flow rate data. UVT is likely influenced by turbidity, TSS, and dissolved organics. The relationship between UVT, Turbidity, and TSS during the pilot study on Point 9 water is seen in **Error! Reference source not found.**. The distribution of turbidity data across the spectrum of UVT in Figure 6 shows a stronger correlation than that of TSS. As the turbidity of the water decreases the UVT increases.

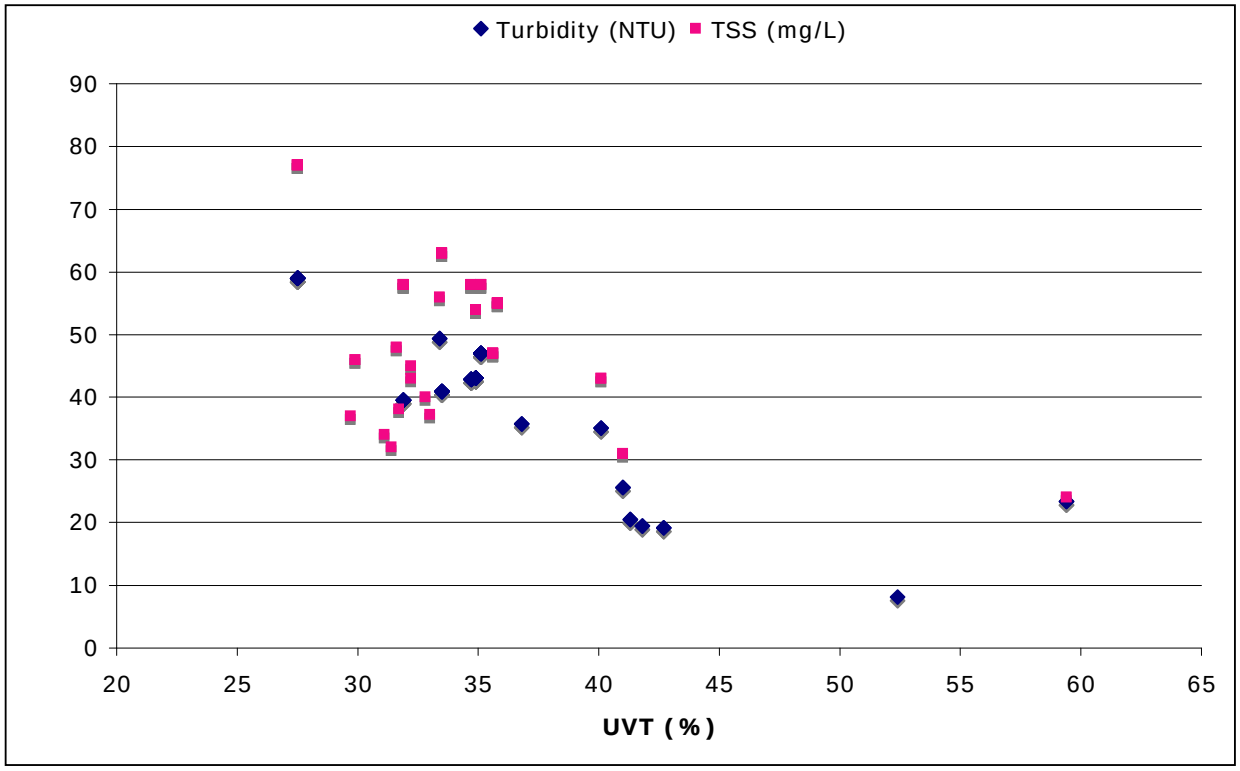



**Figure 6: Ultra-violet transmittance as it relates to TSS and turbidity using Point 9 influent.**

## UV Disinfection Effectiveness receiving Point 9 Effluent

Doses were tested ranging from 20-42.6 mJ/cm$^2$, at flows from 21-132 gpm, and with UVT 27.5-59%. Doses were reported from Trojan after supplying the conditions for flow rate and UVT. Ten sampling events were run from October 4 – November 1, 2011 to assess the disinfection of Point 9 effluent. Samples were not taken at flows lower than 20.8 gpm as this is the low flow rate limit for the machine. Each dose was analyzed for Total and Fecal Coliform (TC and FC respectively), TSS, turbidity, and UVT.

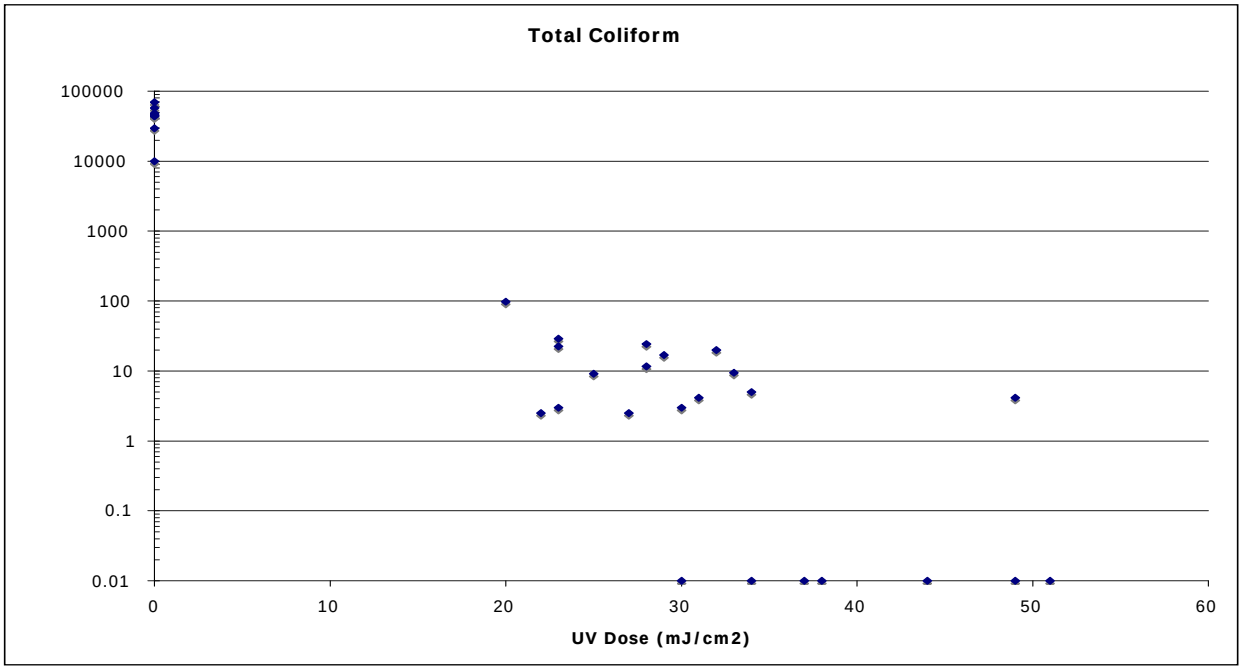



**Figure 7: Total coliform in response to increasing UV dose applied to Point 9 influent. Value of 0.01 coliform is substituted for 0 coliform to use a logarithmic scale.**

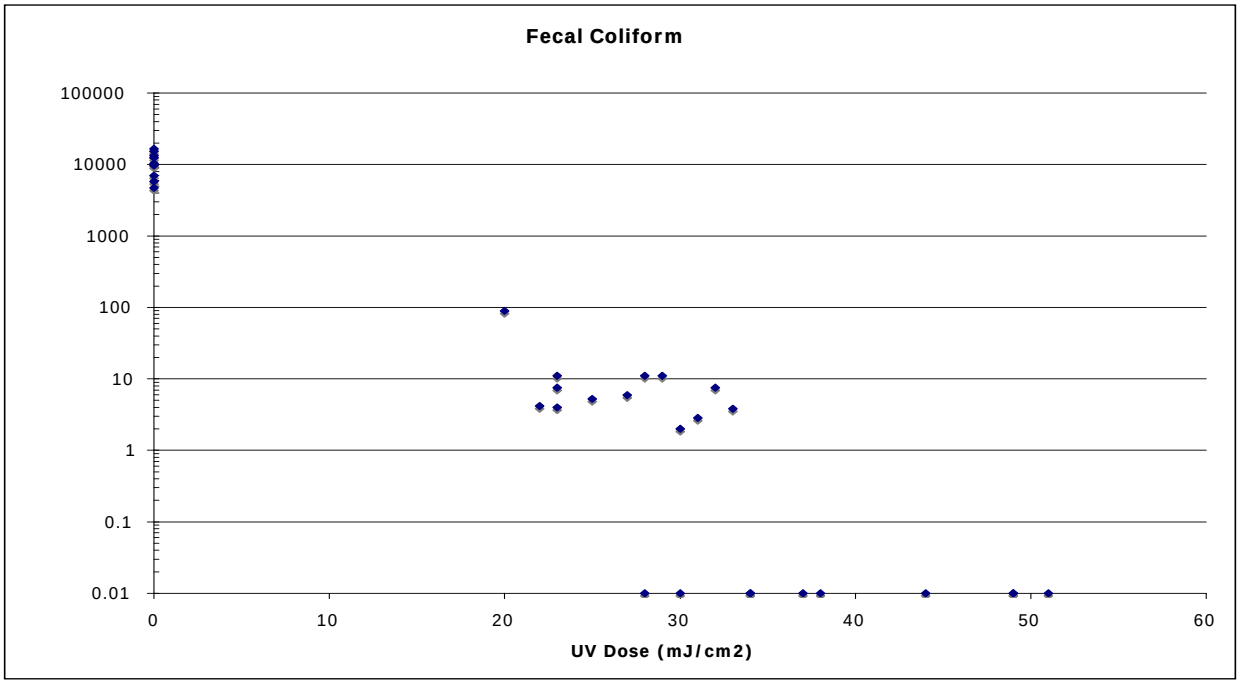



**Figure 8: Fecal coliform in response to increasing UV dose applied to Point 9 influent. Value of 0.01 coliform is substituted for 0 coliform to use a logarithmic scale.**

Total and fecal coliform colonies are reduced to less than 10 CFU/100mL at doses above 35 mJ/cm$^2$. All but one value for CFUs above 35 mJ/cm$^2$ are zero and are reported on the logarithmic scale as 0.01 CFU/100mL.

## *Conclusions*

The open-channel Trojan UV3000 unit was shown to function well given the water quality and conditions of Hauser Wetland effluent (Point 15) and Treatment Marsh effluent (Point 9). Weekly visual inspections demonstrated the functionality of the wiper mechanism in keeping the bulbs clean of any build-up that could obscure the UV bulb.

The observation of stringy solids from Hauser Wetland on the UV bulb apparatus, large suspended solids from Point 9, and noticeable attached growth on the influent box for the UV unit indicates a potential problem for UV disinfection. If such large solids are allowed to pass through the unit, they may shield coliform from UV radiation and therefore not achieve disinfection. The recommendation for solving this issue is to install a mechanical self-cleaning screen to reduce influent solids and adopt a strict cleaning routine to eliminate attached growth.

Fecal coliform levels in Hauser Wetland effluent often meet permit limits without disinfection. UV disinfection of Hauser Wetland effluent at current conditions described by UVT at ~50%, TSS at 3-6 mg/L, and turbidity at 3-4 NTUs, achieves levels below 10 CFU/100mL at doses above 20 mJ/cm$^2$. This low dose is considered the low end of the industry standard for UV disinfection and indicates the effectiveness of UV disinfection of Hauser Wetland effluent.

Total and fecal coliform levels in Point 9 effluent are numerous, around $10^4$. UV disinfection of Point 9 effluent at current conditions described by UVT at ~34%, TSS at ~57 mg/L, and turbidity at 44 NTUs, achieves levels below 10 CFU/100mL at doses above 35 mJ/cm$^2$. This dose is at the low end of the industry standard for UV disinfection and indicates the effectiveness of UV disinfection of Point 9 effluent.

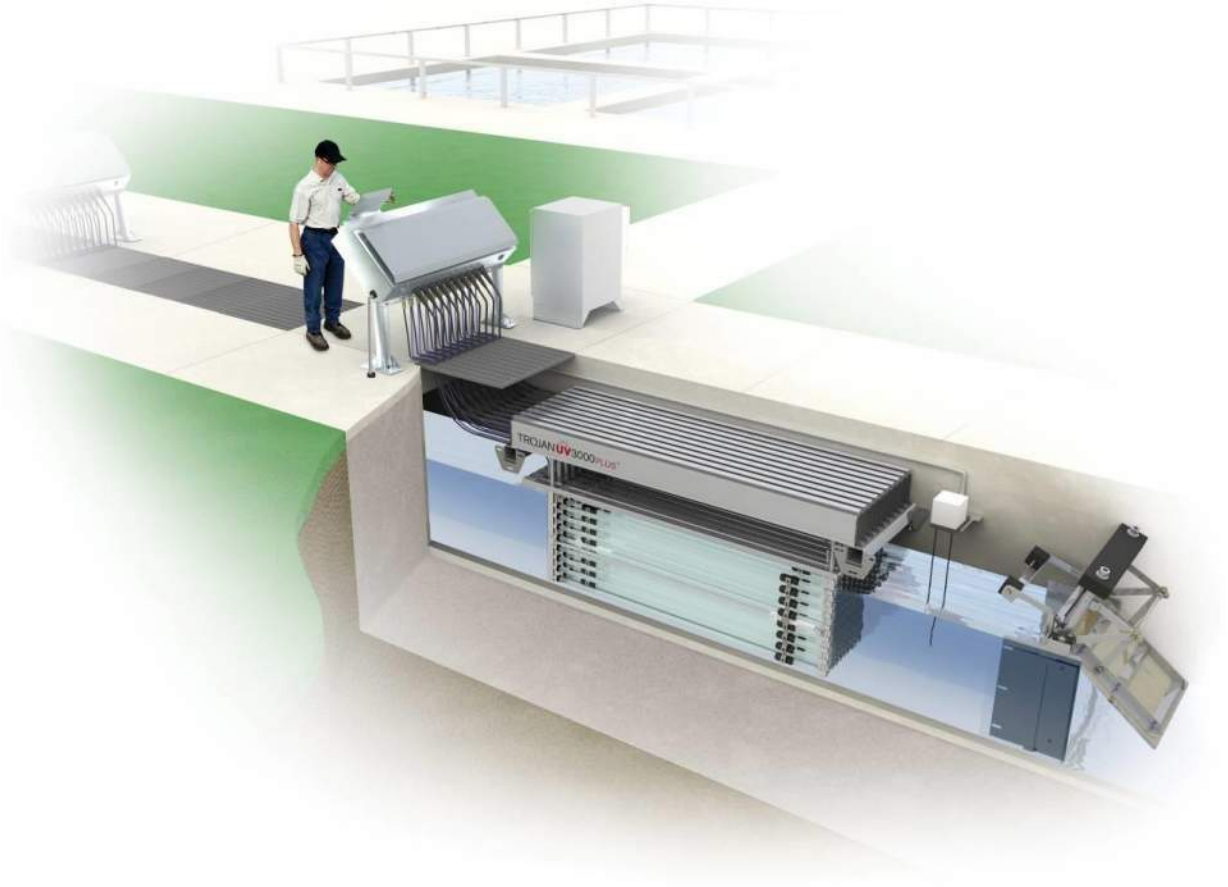
Appendix E

# TROJAN UV3000PLUS EQUIPMENT PROPOSALS AND DRAWINGS

TROJAN UV3000 PLUS™

# PROPOSAL FOR THE CITY OF ARCATA, CA

QUOTE: LJKR1061E
6/16/2015



The TrojanUV3000Plus™ is operating in **over 1300** municipal wastewater plants around the world. Disinfecting **over 17 billion** gallons a day, the TrojanUV3000Plus™ has become the reference standard in the industry.

June 16, 2015

In response to your request, we are pleased to provide the following TrojanUV3000Plus™ proposal for the **Arcata** project.

The TrojanUV3000Plus™ has been shown in over 1300 installations to provide dependable performance, simplified maintenance, and superior electrical efficiency. As explained in this proposal, the system incorporates innovative features to reduce O&M costs, including variable output electronic ballasts to provide dimming capability and Trojan's revolutionary ActiClean-WW™ system – the industry's only online chemical and mechanical quartz sleeve cleaning system. All Trojan installations are supported by a global network of certified Service Representatives providing local service and support.

Please do not hesitate to call us if you have any questions regarding this proposal. Thank you for the opportunity to quote the TrojanUV3000Plus™ and we look forward to working with you on this project.

With best regards,

Jordan Fournier
3020 Gore Road
London, Ontario N5V 4T7
Canada
(519) 457 – 3400 ext. 2193
jfournier@trojanuv.com

**Local Representative:**
David Frost
The Coombs-Hopkins Company
2855 Mitchell Drive
Suite 215, Walnut Creek, CA 94598-1609
USA
(925) 947-6733

# DESIGN CRITERIA

**ARCATA**

| | |
|---|---|
| Peak Design Flow: | **5.9 MGD** |
| UV Transmittance: | **35%** (minimum) |
| Total Suspended Solids: | **50 mg/l** (30 Day Average, grab sample) |
| Disinfection Limit: | **43 fecal coliform per 100 ml**, based on a 1 day Maximum (90%ile) of consecutive daily grab samples |
| Design Dose: | **35,000 µWs/cm$^2$**, bioassay validated |
| Validation Factors: | **0.90** end of lamp life factor (Low-Pressure Amalgam Lamps)<br>**0.95** fouling factor (ActiClean-WW™ Chemical / Mechanical Cleaning System) |

# DESIGN SUMMARY

**QUOTE: LJKR1061E**

Based on the above design criteria, the TrojanUV3000Plus™ proposed consists of:

| | |
|---|---|
| **CHANNEL** (Please reference Trojan layout drawings for details.) | |
| Number of Channels: | **1** |
| Approximate Channel Length Required: | **30 ft** |
| Channel Width Based on Number of UV Modules: | **66 in** |
| Channel Depth Recommended for UV Module Access: | **54 in** |
| **UV MODULES** | |
| Total Number of Banks: | **2** |
| Number of Modules per Bank: | **22** |
| Number of Lamps per Module: | **8** |
| Total Number of UV Lamps: | **352** |
| Maximum Power Draw: | **88 kW** |
| **UV PANELS** | |
| Power Distribution Center Quantity: | **2** |
| System Control Center Quantity: | **1** |
| **MISCELLANEOUS EQUIPMENT** | |
| Level Controller Quantity: | **1** |
| Type of Level Controller: | **Weighted Gate (ALC)** |
| Automatic Chemical / Mechanical Cleaning: | **Trojan ActiClean-WW™** |
| UV Module Lifting Device: | **Davit Crane** |
| On-line UVT Monitor: | **Hach UVAS sc Sensor** |
| Standard Spare Parts / Safety Equipment: | **Included** |
| Other Equipment: | |
| **ELECTRICAL REQUIREMENTS** | |

**1.** Each Power Distribution Center requires an electrical supply of one (1) 480 Volts, 3 phase, 4 wire (plus ground), 44.9 kVA.
**2.** The Hydraulic System Center requires an electrical supply of one (1) 480 Volts, 3 phase, 3 wire (plus ground), 2 kVA.
**3.** The System Control Center requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 15 Amps.
**4.** The Online UVT Monitor requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 1 Amp.
**5.** Electrical disconnects required per local code are not included in this proposal.

# COMMERCIAL INFORMATION

**Total Capital Cost: $750,000 (US$)**

This price excludes any taxes that may be applicable and is valid for 90 days from the date of this letter.

# OPERATING COST ESTIMATE

## Operating Conditions

Average Flow: **2.0 MGD**
Yearly Usage: **8760 hours**
UV Transmittance: **35%**

| Power Requirements | | Lamp Replacement | |
|---|---|---|---|
| Average Power Draw: | **44 kW** | Number lamps per year: | **129** |
| Cost per kW hour: | **$0.10** | Price per lamp: | **$250** |
| **Annual Power Cost:** | **$38,544** | **Annual Lamp Replacement Cost:** | **$32,250** |
| **Total Annual O&M Cost: $70,794** | | | |

This cost estimate is based on the average flow and UV transmittance listed above. Actual operating costs may be lower due to the TrojanUV3000Plus™ automatic dose pacing control system. As UV demand decreases, by a change in operating conditions, the power level of the lamps decreases accordingly. The dose pacing system minimizes equipment power levels while the target UV dose is maintained to ensure disinfection at all times.

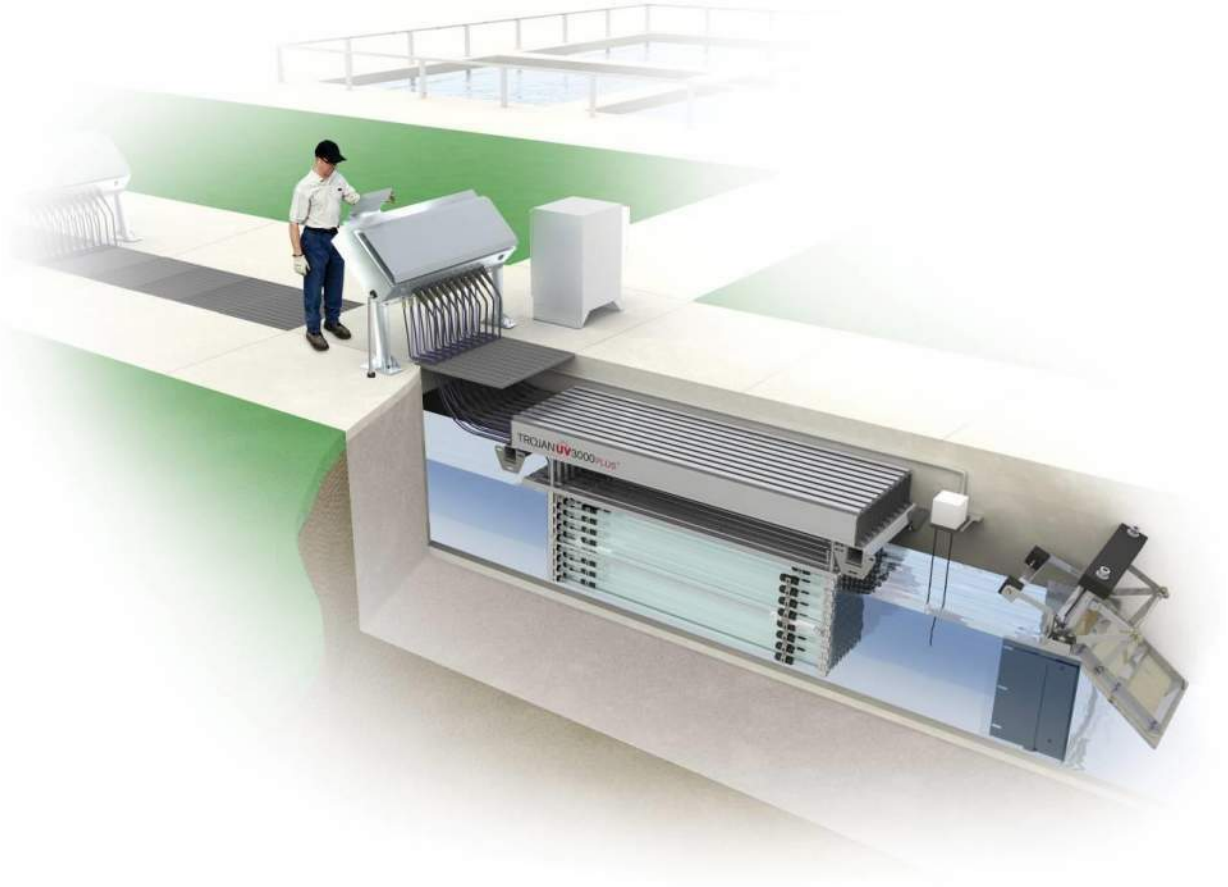
# EQUIPMENT WARRANTEES

1. Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, which ever comes first.
2. UV lamps purchased are warranted for 12,000 hours of operation or 3 years from shipment, whichever comes first. The warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge.
3. Electronic ballasts are warranted for 5 years, pro-rated after 1 year.

TROJAN UV3000 PLUS™

# PROPOSAL FOR THE CITY OF ARCATA, CA

QUOTE: LJKR1061G
6/16/2015



The TrojanUV3000Plus™ is operating in **over 1300** municipal wastewater plants around the world. Disinfecting **over 17 billion** gallons a day, the TrojanUV3000Plus™ has become the reference standard in the industry.

June 16, 2015

In response to your request, we are pleased to provide the following TrojanUV3000Plus™ proposal for the **Arcata** project.

The TrojanUV3000Plus™ has been shown in over 1300 installations to provide dependable performance, simplified maintenance, and superior electrical efficiency. As explained in this proposal, the system incorporates innovative features to reduce O&M costs, including variable output electronic ballasts to provide dimming capability and Trojan's revolutionary ActiClean-WW™ system – the industry's only online chemical and mechanical quartz sleeve cleaning system. All Trojan installations are supported by a global network of certified Service Representatives providing local service and support.

Please do not hesitate to call us if you have any questions regarding this proposal. Thank you for the opportunity to quote the TrojanUV3000Plus™ and we look forward to working with you on this project.

With best regards,


Jordan Fournier
3020 Gore Road
London, Ontario N5V 4T7
Canada
(519) 457 – 3400 ext. 2193
jfournier@trojanuv.com

**Local Representative:**
David Frost
The Coombs-Hopkins Company
2855 Mitchell Drive
Suite 215, Walnut Creek, CA 94598-1609
USA
(925) 947-6733


# DESIGN CRITERIA

**ARCATA**

| | |
|---|---|
| Peak Design Flow: | **5.9 MGD** |
| UV Transmittance: | **35%** (minimum) |
| Total Suspended Solids: | **50 mg/l** (30 Day Average, grab sample) |
| Disinfection Limit: | **43 fecal coliform per 100 ml**, based on a 1 day Maximum (90%ile) of consecutive daily grab samples |
| Design Dose: | **35,000 µWs/cm$^2$**, bioassay validated |
| Validation Factors: | **0.90** end of lamp life factor (Low-Pressure Amalgam Lamps)<br>**0.95** fouling factor (ActiClean-WW™ Chemical / Mechanical Cleaning System) |
| Redundancy: | **50%** |

# DESIGN SUMMARY

**QUOTE: LJKR1061G**

Based on the above design criteria, the TrojanUV3000Plus™ proposed consists of:

| | |
|---|---|
| **CHANNEL** (Please reference Trojan layout drawings for details.) | |
| Number of Channels: | **1** |
| Approximate Channel Length Required: | **42 ft** |
| Channel Width Based on Number of UV Modules: | **66 in** |
| Channel Depth Recommended for UV Module Access: | **54 in** |
| **UV MODULES** | |
| Total Number of Banks: | **3 (2 duty, 1 redundant)** |
| Number of Modules per Bank: | **22** |
| Number of Lamps per Module: | **8** |
| Total Number of UV Lamps: | **528** |
| Maximum Power Draw: | **132 kW** |
| **UV PANELS** | |
| Power Distribution Center Quantity: | **3** |
| System Control Center Quantity: | **1** |
| **MISCELLANEOUS EQUIPMENT** | |
| Level Controller Quantity: | **1** |
| Type of Level Controller: | **Weighted Gate (ALC)** |
| Automatic Chemical / Mechanical Cleaning: | **Trojan ActiClean-WW™** |
| UV Module Lifting Device: | **Davit Crane** |
| On-line UVT Monitor: | **Hach UVAS sc Sensor** |
| Standard Spare Parts / Safety Equipment: | **Included** |
| Other Equipment: | |

**ELECTRICAL REQUIREMENTS**

1. Each Power Distribution Center requires an electrical supply of one (1) 480 Volts, 3 phase, 4 wire (plus ground), 44.9 kVA.
2. The Hydraulic System Center requires an electrical supply of one (1) 480 Volts, 3 phase, 3 wire (plus ground), 2 kVA.
3. The System Control Center requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 15 Amps.
4. The Online UVT Monitor requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 1 Amp.
5. Electrical disconnects required per local code are not included in this proposal.

# COMMERCIAL INFORMATION

**Total Capital Cost: $1,090,000 (US$)**

This price excludes any taxes that may be applicable and is valid for 90 days from the date of this letter.

# OPERATING COST ESTIMATE

## Operating Conditions

Average Flow: **2 MGD**
Yearly Usage: **8760 hours**
UV Transmittance: **35%**

| Power Requirements | | Lamp Replacement | |
|---|---|---|---|
| Average Power Draw: | **44 kW** | Number lamps per year: | **129** |
| Cost per kW hour: | **$0.10** | Price per lamp: | **$250** |
| **Annual Power Cost:** | **$38,544** | **Annual Lamp Replacement Cost:** | **$32,250** |
| **Total Annual O&M Cost: $70,794** | | | |

This cost estimate is based on the average flow and UV transmittance listed above. Actual operating costs may be lower due to the TrojanUV3000Plus™ automatic dose pacing control system. As UV demand decreases, by a change in operating conditions, the power level of the lamps decreases accordingly. The dose pacing system minimizes equipment power levels while the target UV dose is maintained to ensure disinfection at all times.

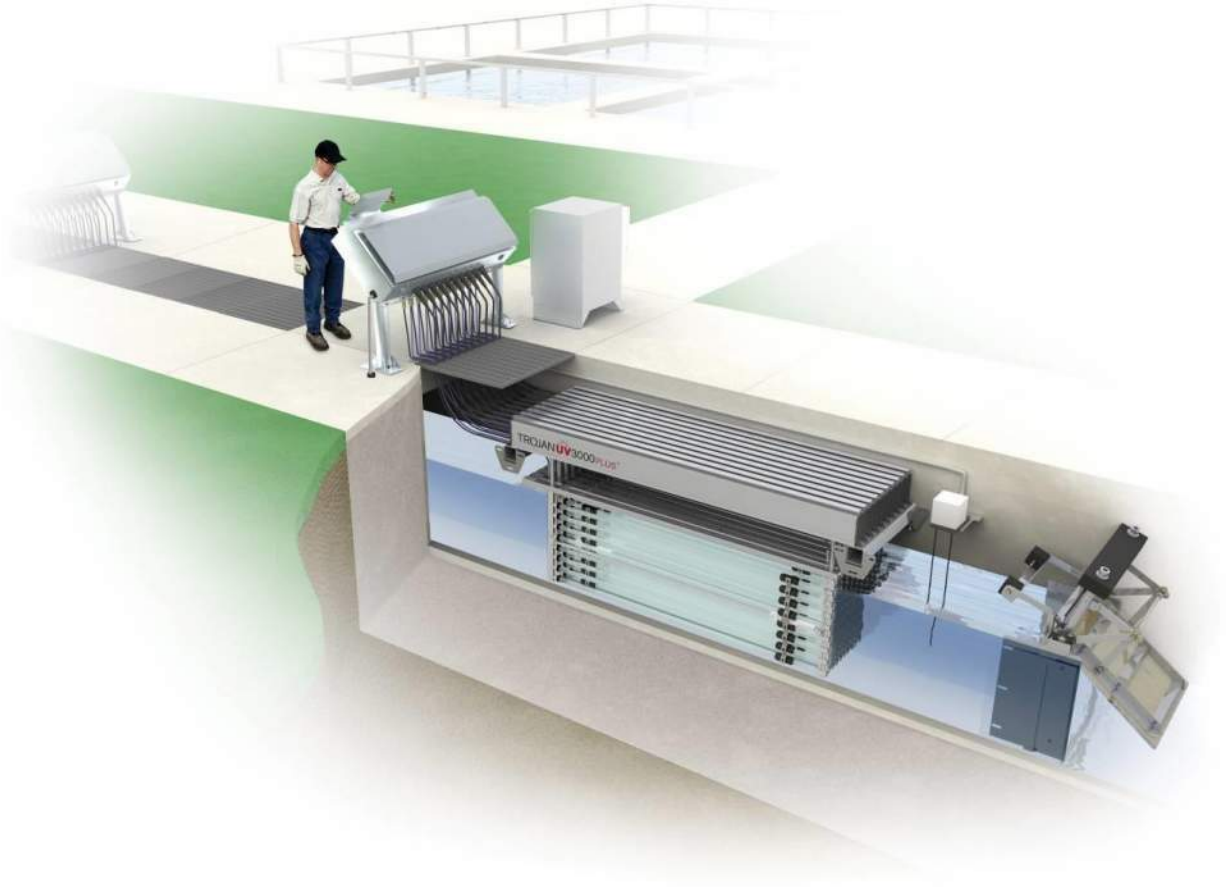
# EQUIPMENT WARRANTEES

1. Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, which ever comes first.
2. UV lamps purchased are warranted for 12,000 hours of operation or 3 years from shipment, whichever comes first. The warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge.
3. Electronic ballasts are warranted for 5 years, pro-rated after 1 year.

TROJAN UV3000 PLUS™

# PROPOSAL FOR THE CITY OF ARCATA, CA

QUOTE: LJKR1061D
6/16/2015



The TrojanUV3000Plus™ is operating in **over 1300** municipal wastewater plants around the world. Disinfecting **over 17 billion** gallons a day, the TrojanUV3000Plus™ has become the reference standard in the industry.

June 16, 2015

In response to your request, we are pleased to provide the following TrojanUV3000Plus™ proposal for the **Arcata** project.

The TrojanUV3000Plus™ has been shown in over 1300 installations to provide dependable performance, simplified maintenance, and superior electrical efficiency. As explained in this proposal, the system incorporates innovative features to reduce O&M costs, including variable output electronic ballasts to provide dimming capability and Trojan's revolutionary ActiClean-WW™ system – the industry's only online chemical and mechanical quartz sleeve cleaning system. All Trojan installations are supported by a global network of certified Service Representatives providing local service and support.

Please do not hesitate to call us if you have any questions regarding this proposal. Thank you for the opportunity to quote the TrojanUV3000Plus™ and we look forward to working with you on this project.

With best regards,

Jordan Fournier
3020 Gore Road
London, Ontario N5V 4T7
Canada
(519) 457 – 3400 ext. 2193
jfournier@trojanuv.com

**Local Representative:**
David Frost
The Coombs-Hopkins Company
2855 Mitchell Drive
Suite 215, Walnut Creek, CA 94598-1609
USA
(925) 947-6733

# DESIGN CRITERIA

**ARCATA**

| | |
|---|---|
| Peak Design Flow: | **5.9 MGD** |
| UV Transmittance: | **35%** (minimum) |
| Total Suspended Solids: | **50 mg/l** (30 Day Average, grab sample) |
| Disinfection Limit: | **43 fecal coliform per 100 ml**, based on a 1 day Maximum (90%ile) of consecutive daily grab samples |
| Design Dose: | **50,000 µWs/cm$^2$**, bioassay validated |
| Validation Factors: | **0.90** end of lamp life factor (Low-Pressure Amalgam Lamps)<br>**0.95** fouling factor (ActiClean-WW™ Chemical / Mechanical Cleaning System) |

# DESIGN SUMMARY

**QUOTE: LJKR1061D**

Based on the above design criteria, the TrojanUV3000Plus™ proposed consists of:

| | |
|---|---|
| **CHANNEL** (Please reference Trojan layout drawings for details.) | |
| Number of Channels: | **1** |
| Approximate Channel Length Required: | **42 ft** |
| Channel Width Based on Number of UV Modules: | **60 in** |
| Channel Depth Recommended for UV Module Access: | **54 in** |
| **UV MODULES** | |
| Total Number of Banks: | **3** |
| Number of Modules per Bank: | **20** |
| Number of Lamps per Module: | **8** |
| Total Number of UV Lamps: | **480** |
| Maximum Power Draw: | **120 kW** |
| **UV PANELS** | |
| Power Distribution Center Quantity: | **3** |
| System Control Center Quantity: | **1** |
| **MISCELLANEOUS EQUIPMENT** | |
| Level Controller Quantity: | **1** |
| Type of Level Controller: | **Weighted Gate (ALC)** |
| Automatic Chemical / Mechanical Cleaning: | **Trojan ActiClean-WW™** |
| UV Module Lifting Device: | **Davit Crane** |
| On-line UVT Monitor: | **Hach UVAS sc Sensor** |
| Standard Spare Parts / Safety Equipment: | **Included** |
| Other Equipment: | |
| **ELECTRICAL REQUIREMENTS** | |

1. Each Power Distribution Center requires an electrical supply of one (1) 480 Volts, 3 phase, 4 wire (plus ground), 40.8 kVA.
2. The Hydraulic System Center requires an electrical power supply that is powered from the Power Distribution Center.
3. The System Control Center requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 15 Amps.
4. The Online UVT Monitor requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 1 Amp.
5. Electrical disconnects required per local code are not included in this proposal.

# COMMERCIAL INFORMATION

**Total Capital Cost: $999,000 (US$)**

This price excludes any taxes that may be applicable and is valid for 90 days from the date of this letter.

# OPERATING COST ESTIMATE

## Operating Conditions

Average Flow: **2 MGD**
Yearly Usage: **8760 hours**
UV Transmittance: **35%**

| Power Requirements | | Lamp Replacement | |
|---|---|---|---|
| Average Power Draw: | **60.8 kW** | Number lamps per year: | **234** |
| Cost per kW hour: | **$0.10** | Price per lamp: | **$250** |
| **Annual Power Cost:** | **$53,261** | **Annual Lamp Replacement Cost:** | **$58,500** |
| **Total Annual O&M Cost: $111,761** | | | |

This cost estimate is based on the average flow and UV transmittance listed above. Actual operating costs may be lower due to the TrojanUV3000Plus™ automatic dose pacing control system. As UV demand decreases, by a change in operating conditions, the power level of the lamps decreases accordingly. The dose pacing system minimizes equipment power levels while the target UV dose is maintained to ensure disinfection at all times.

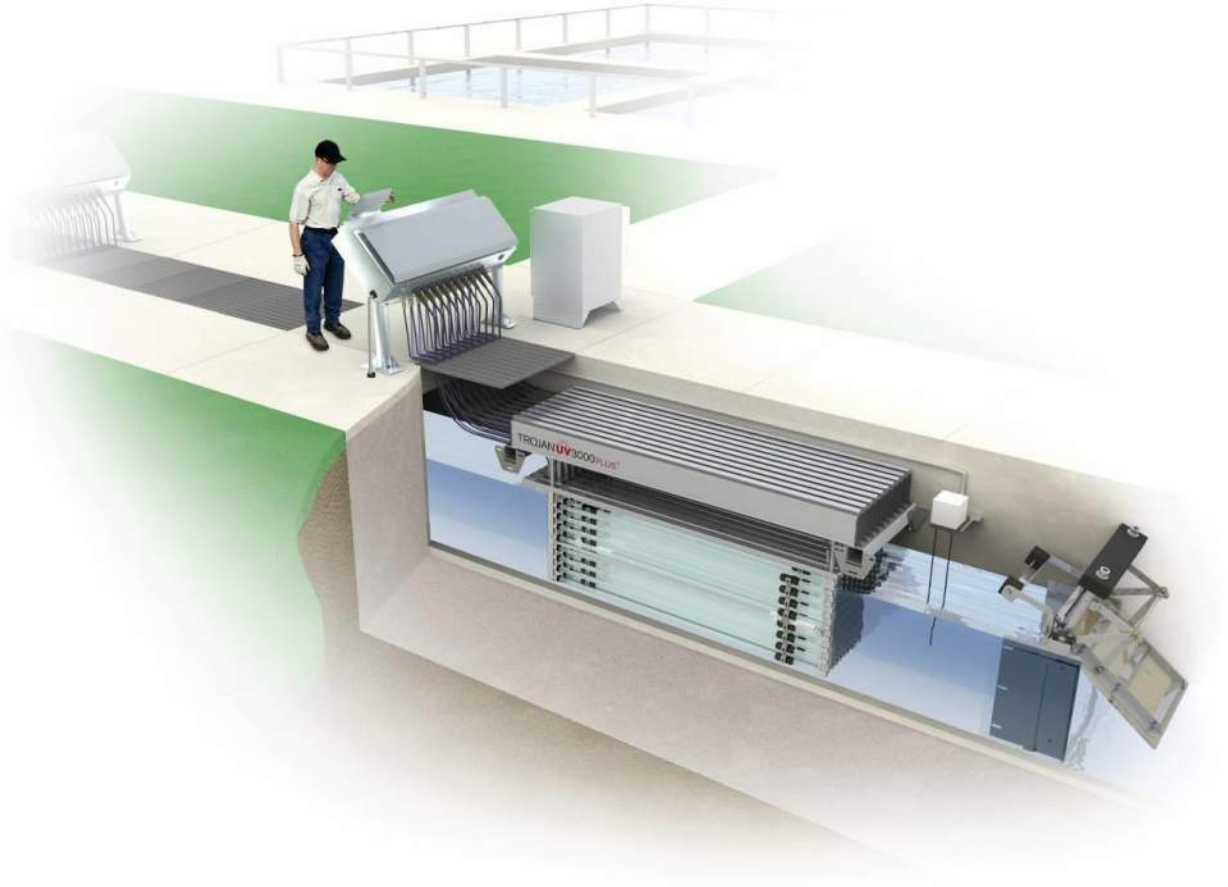
# EQUIPMENT WARRANTEES

1. Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, which ever comes first.
2. UV lamps purchased are warranted for 12,000 hours of operation or 3 years from shipment, whichever comes first. The warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge.
3. Electronic ballasts are warranted for 5 years, pro-rated after 1 year.

TROJAN UV3000 PLUS™

# PROPOSAL FOR THE CITY OF ARCATA, CA

QUOTE: LJKR1061F
6/16/2015



The TrojanUV3000Plus™ is operating in **over 1300** municipal wastewater plants around the world. Disinfecting **over 17 billion** gallons a day, the TrojanUV3000Plus™ has become the reference standard in the industry.

June 16, 2015

In response to your request, we are pleased to provide the following TrojanUV3000Plus™ proposal for the **Arcata** project.

The TrojanUV3000Plus™ has been shown in over 1300 installations to provide dependable performance, simplified maintenance, and superior electrical efficiency. As explained in this proposal, the system incorporates innovative features to reduce O&M costs, including variable output electronic ballasts to provide dimming capability and Trojan's revolutionary ActiClean-WW™ system – the industry's only online chemical and mechanical quartz sleeve cleaning system. All Trojan installations are supported by a global network of certified Service Representatives providing local service and support.

Please do not hesitate to call us if you have any questions regarding this proposal. Thank you for the opportunity to quote the TrojanUV3000Plus™ and we look forward to working with you on this project.

With best regards,

Jordan Fournier
3020 Gore Road
London, Ontario N5V 4T7
Canada
(519) 457 – 3400 ext. 2193
jfournier@trojanuv.com

**Local Representative:**
David Frost
The Coombs-Hopkins Company
2855 Mitchell Drive
Suite 215, Walnut Creek, CA 94598-1609
USA
(925) 947-6733

# DESIGN CRITERIA

**ARCATA**

| | |
|---|---|
| Peak Design Flow: | **5.9 MGD** |
| UV Transmittance: | **35%** (minimum) |
| Total Suspended Solids: | **50 mg/l** (30 Day Average, grab sample) |
| Disinfection Limit: | **43 fecal coliform per 100 ml**, based on a 1 day Maximum (90%ile) of consecutive daily grab samples |
| Design Dose: | **50,000 µWs/cm$^2$**, bioassay validated |
| Validation Factors: | **0.90** end of lamp life factor (Low-Pressure Amalgam Lamps)<br>**0.95** fouling factor (ActiClean-WW™ Chemical / Mechanical Cleaning System) |
| Redundancy: | **33%** |

# DESIGN SUMMARY

**QUOTE: LJKR1061F**

Based on the above design criteria, the TrojanUV3000Plus™ proposed consists of:

| | |
|---|---|
| **CHANNEL** (Please reference Trojan layout drawings for details.) | |
| Number of Channels: | **1** |
| Approximate Channel Length Required: | **54 ft** |
| Channel Width Based on Number of UV Modules: | **60 in** |
| Channel Depth Recommended for UV Module Access: | **54 in** |
| **UV MODULES** | |
| Total Number of Banks: | **4 (3 duty, 1 redundant)** |
| Number of Modules per Bank: | **20** |
| Number of Lamps per Module: | **8** |
| Total Number of UV Lamps: | **640** |
| Maximum Power Draw: | **160 kW** |
| **UV PANELS** | |
| Power Distribution Center Quantity: | **4** |
| System Control Center Quantity: | **1** |
| **MISCELLANEOUS EQUIPMENT** | |
| Level Controller Quantity: | **1** |
| Type of Level Controller: | **Weighted Gate (ALC)** |
| Automatic Chemical / Mechanical Cleaning: | **Trojan ActiClean-WW™** |
| UV Module Lifting Device: | **Davit Crane** |
| On-line UVT Monitor: | **Hach UVAS sc Sensor** |
| Standard Spare Parts / Safety Equipment: | **Included** |
| Other Equipment: | |
| **ELECTRICAL REQUIREMENTS** | |

1. Each Power Distribution Center requires an electrical supply of one (1) 480 Volts, 3 phase, 4 wire (plus ground), 40.8 kVA.
2. The Hydraulic System Center requires an electrical supply of one (1) 480 Volts, 3 phase, 3 wire (plus ground), 2 kVA.
3. The System Control Center requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 15 Amps.
4. The Online UVT Monitor requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 1 Amp.
5. Electrical disconnects required per local code are not included in this proposal.

# COMMERCIAL INFORMATION

**Total Capital Cost: $1,310,000 (US$)**

This price excludes any taxes that may be applicable and is valid for 90 days from the date of this letter.

# OPERATING COST ESTIMATE

## Operating Conditions

Average Flow: **2.0 MGD**
Yearly Usage: **8760 hours**
UV Transmittance: **35%**

| Power Requirements | | Lamp Replacement | |
|---|---|---|---|
| Average Power Draw: | **60.8 kW** | Number lamps per year: | **234** |
| Cost per kW hour: | **$0.10** | Price per lamp: | **$250** |
| **Annual Power Cost:** | **$53,261** | **Annual Lamp Replacement Cost:** | **$58,500** |
| **Total Annual O&M Cost: $111,761** | | | |

This cost estimate is based on the average flow and UV transmittance listed above. Actual operating costs may be lower due to the TrojanUV3000Plus™ automatic dose pacing control system. As UV demand decreases, by a change in operating conditions, the power level of the lamps decreases accordingly. The dose pacing system minimizes equipment power levels while the target UV dose is maintained to ensure disinfection at all times.

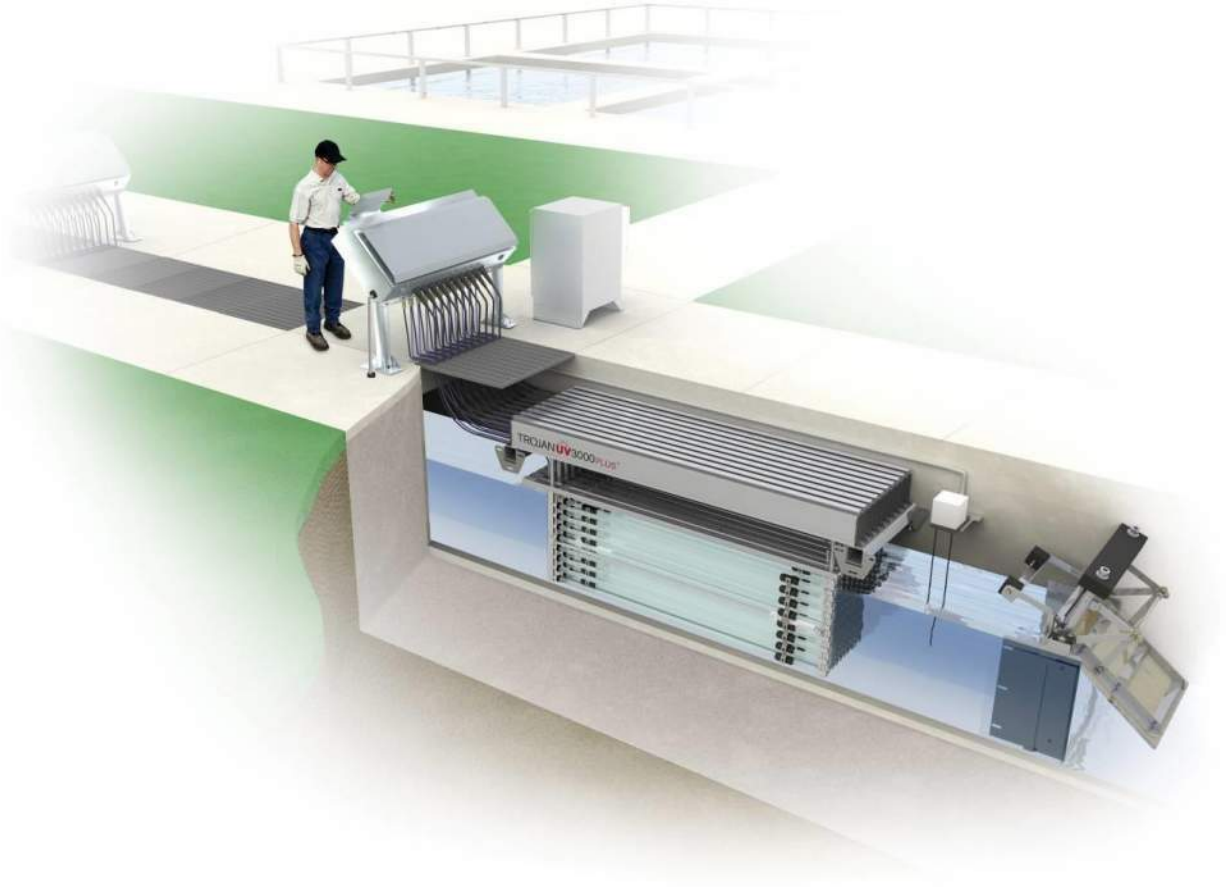
# EQUIPMENT WARRANTEES

1. Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, which ever comes first.
2. UV lamps purchased are warranted for 12,000 hours of operation or 3 years from shipment, whichever comes first. The warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge.
3. Electronic ballasts are warranted for 5 years, pro-rated after 1 year.

TROJANUV3000PLUS™

# PROPOSAL FOR THE CITY OF ARCATA, CA

QUOTE: LJKR1061H
6/19/2015



The TrojanUV3000Plus™ is operating in **over 1300** municipal wastewater plants around the world. Disinfecting **over 17 billion** gallons a day, the TrojanUV3000Plus™ has become the reference standard in the industry.

June 19, 2015

In response to your request, we are pleased to provide the following TrojanUV3000Plus™ proposal for the **Arcata** project.

The TrojanUV3000Plus™ has been shown in over 1300 installations to provide dependable performance, simplified maintenance, and superior electrical efficiency. As explained in this proposal, the system incorporates innovative features to reduce O&M costs, including variable output electronic ballasts to provide dimming capability and Trojan's revolutionary ActiClean-WW™ system – the industry's only online chemical and mechanical quartz sleeve cleaning system. All Trojan installations are supported by a global network of certified Service Representatives providing local service and support.

Please do not hesitate to call us if you have any questions regarding this proposal. Thank you for the opportunity to quote the TrojanUV3000Plus™ and we look forward to working with you on this project.

With best regards,

Jordan Fournier
3020 Gore Road
London, Ontario N5V 4T7
Canada
(519) 457 – 3400 ext. 2193
jfournier@trojanuv.com

**Local Representative:**
David Frost
The Coombs-Hopkins Company
2855 Mitchell Drive
Suite 215, Walnut Creek, CA 94598-1609
USA
(925) 947-6733

# DESIGN CRITERIA

**ARCATA**

| | |
|---|---|
| Peak Design Flow: | **5.9 MGD** |
| UV Transmittance: | **35%** (minimum) |
| Total Suspended Solids: | **50 mg/l** (30 Day Average, grab sample) |
| Disinfection Limit: | **43 fecal coliform per 100 ml**, based on a 1 day Maximum (90%ile) of consecutive daily grab samples |
| Design Dose: | **100,000 µWs/cm$^2$**, bioassay validated |
| Validation Factors: | **0.90** end of lamp life factor (Low-Pressure Amalgam Lamps)<br>**0.95** fouling factor (ActiClean-WW™ Chemical / Mechanical Cleaning System) |

# DESIGN SUMMARY

**QUOTE: LJKR1061H**

Based on the above design criteria, the TrojanUV3000Plus™ proposed consists of:

| **CHANNEL** (Please reference Trojan layout drawings for details.) | |
|---|---|
| Number of Channels: | **2** |
| Approximate Channel Length Required: | **54 ft** |
| Channel Width Based on Number of UV Modules: | **78 in** |
| Channel Depth Recommended for UV Module Access: | **54 in** |
| **UV MODULES** | |
| Total Number of Banks: | **8** |
| Number of Modules per Bank: | **26** |
| Number of Lamps per Module: | **8** |
| Total Number of UV Lamps: | **1664** |
| Maximum Power Draw: | **416 kW** |
| **UV PANELS** | |
| Power Distribution Center Quantity: | **8** |
| System Control Center Quantity: | **1** |
| **MISCELLANEOUS EQUIPMENT** | |
| Level Controller Quantity: | **2** |
| Type of Level Controller: | **Weighted Gate (ALC)** |
| Automatic Chemical / Mechanical Cleaning: | **Trojan ActiClean-WW™** |
| UV Module Lifting Device: | **Davit Crane** |
| On-line UVT Monitor: | **Hach UVAS sc Sensor** |
| Standard Spare Parts / Safety Equipment: | **Included** |
| Other Equipment: | |

**ELECTRICAL REQUIREMENTS**

1. Each Power Distribution Center requires an electrical supply of one (1) 480 Volts, 3 phase, 4 wire (plus ground), 53.1 kVA.
2. The Hydraulic System Center requires an electrical power supply that is powered from the Power Distribution Center.
3. The System Control Center requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 15 Amps.
4. The Online UVT Monitor requires an electrical supply of one (1) 120 Volts, 1 phase, 2 wire (plus ground), 1 Amp.
5. Electrical disconnects required per local code are not included in this proposal.

# COMMERCIAL INFORMATION

**Total Capital Cost: $3,240,000 (US$)**

This price excludes any taxes that may be applicable and is valid for 90 days from the date of this letter.

# OPERATING COST ESTIMATE

## Operating Conditions

Average Flow: **2 MGD**
Yearly Usage: **8760 hours**
UV Transmittance: **35%**

| Power Requirements | | Lamp Replacement | |
|---|---|---|---|
| Average Power Draw: | **125 kW** | Number lamps per year: | **456** |
| Cost per kW hour: | **$0.10** | Price per lamp: | **$250** |
| **Annual Power Cost:** | **$109,500** | **Annual Lamp Replacement Cost:** | **$114,000** |
| **Total Annual O&M Cost: $223,500** | | | |

This cost estimate is based on the average flow and UV transmittance listed above. Actual operating costs may be lower due to the TrojanUV3000Plus™ automatic dose pacing control system. As UV demand decreases, by a change in operating conditions, the power level of the lamps decreases accordingly. The dose pacing system minimizes equipment power levels while the target UV dose is maintained to ensure disinfection at all times.

# EQUIPMENT WARRANTEES

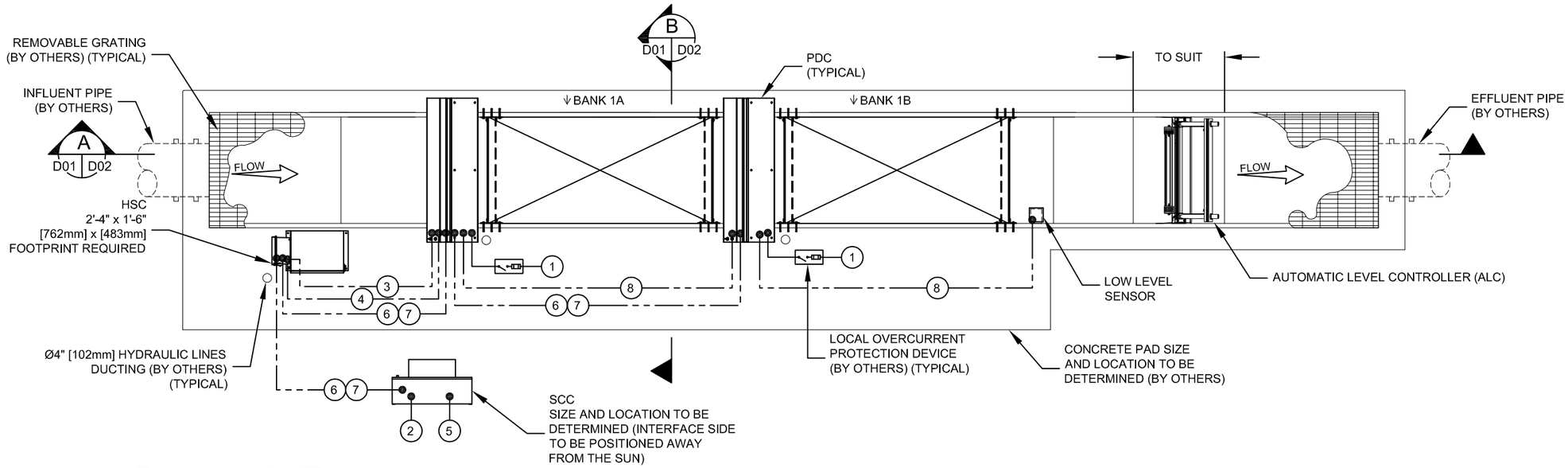
1. Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, which ever comes first.
2. UV lamps purchased are warranted for 12,000 hours of operation or 3 years from shipment, whichever comes first. The warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge.
3. Electronic ballasts are warranted for 5 years, pro-rated after 1 year.

# TROJAN UV3000 PLUS™

## EQUIPMENT INTERCONNECTIONS

| No. | DESCRIPTION | FROM | TO |
|---|---|---|---|
| 1 | POWER DISTRIBUTION CENTER (PDC)<br>POWER SUPPLY<br>480Y/277V, 3 PHASE, 4 WIRE + GROUND | DISTRIBUTION PANEL<br>(DP) (BY OTHERS)<br>(NOT SHOWN) | PDC |
| 2 | SYSTEM CONTROL CENTER (SCC)<br>POWER SUPPLY<br>120V, 1 PHASE, 2 WIRE + GROUND, XX AMPS | DISTRIBUTION PANEL<br>(DP) (BY OTHERS)<br>(NOT SHOWN) | SCC |
| 3 | HYDRAULIC SYSTEMS CENTER COMPACT<br>(HSC COMPACT)<br>POWER SUPPLY<br>480V, 3 PHASE, 3 WIRE + GROUND | PDC | HSC COMPACT |
| 4 | HYDRAULIC SYSTEMS CENTER COMPACT<br>(HSC COMPACT)<br>24 VDC | PDC | HSC COMPACT |

| No. | DESCRIPTION | FROM | TO |
|---|---|---|---|
| 5 | FLOW METER<br>4-20 mA, DC ANALOG INPUT<br>(BY OTHERS) | FLOW METER PANEL<br>(NOT SHOWN)<br>(BY OTHERS) | SCC |
| 6 | GROUND LINK<br>14 AWG TYPE TWH STRANDED | SCC | HSC COMPACT AND<br>PDC(s) (DAISY CHAINED) |
| 7 | MODBUS<br>1 SHIELDED TWISTED PAIR | SCC | HSC COMPACT THRU PDC(s)<br>(DAISY CHAINED) |
| 8 | LOW LEVEL SENSOR<br>12 VDC | LOW LEVEL SENSOR | PDC(s) (DAISY CHAINED) |




PLAN VIEW

SCALE: NOT TO SCALE

## NOTES:

: DO NOT SLOPE CHANNEL FLOOR.
: CHANNEL WIDTH & DEPTH MUST BE KEPT WITHIN A TOLERANCE OF + OR - ¼" [6mm].
: ANCHOR BOLTS ARE NOT SUPPLIED BY TROJAN TECHNOLOGIES.
: SYSTEM CONDUIT, WIRING, DISTRIBUTION PANELS & INTERCONNECTIONS BY OTHERS.
: ELECTRICAL REQUIREMENTS SHOWN ARE TO SUPPLY TROJAN UV EQUIPMENT ONLY. ELECTRICAL INRUSH FACTOR TO BE ADDED AS PER LOCAL CODE.

: HSC COMPACT IS SUPPLIED WITH A STANDARD 25' [7.6m] HOSE KIT.
: CHANNEL COVERING ABOVE THE MODULES MUST BE OPEN (E.G. PERFORATED GRATING). REMOVABLE GRATING SECTIONS SHALL BE EASILY REMOVED BY ONE PERSON. MAXIMUM WEIGHT OF THE SECTIONS SHALL BE IN ACCORDANCE WITH REQUIREMENTS OF THE APPLICABLE JURISDICTION.
: THE APPLICABLE INTERCONNECT IS TO BE DAISY-CHAINED BETWEEN PANELS. CONTRACTOR CAN CHOOSE THE ORDER OF CONNECTIONS THAT IS MOST APPROPRIATE.

: EFFLUENT LEVELS SHOWN REFLECT TROJAN EQUIPMENT ONLY. EFFLUENT LEVELS MAY CHANGE DUE TO CHANNEL DEBRIS OR GEOMETRY
:TOLERANCE AT ALC IS CHANNEL WIDTH +1" [25mm].

| DESIGN CRITERIA | | |
|---|---|---|
| PEAK FLOW | | MGD / m³ / DAY |
| U.V TRANSMITTANCE AT 253.7 nm | % | |
| SUSPENDED SOLIDS | mg / l | |
| DISINFECTION STANDARD | FC / 100ml | |

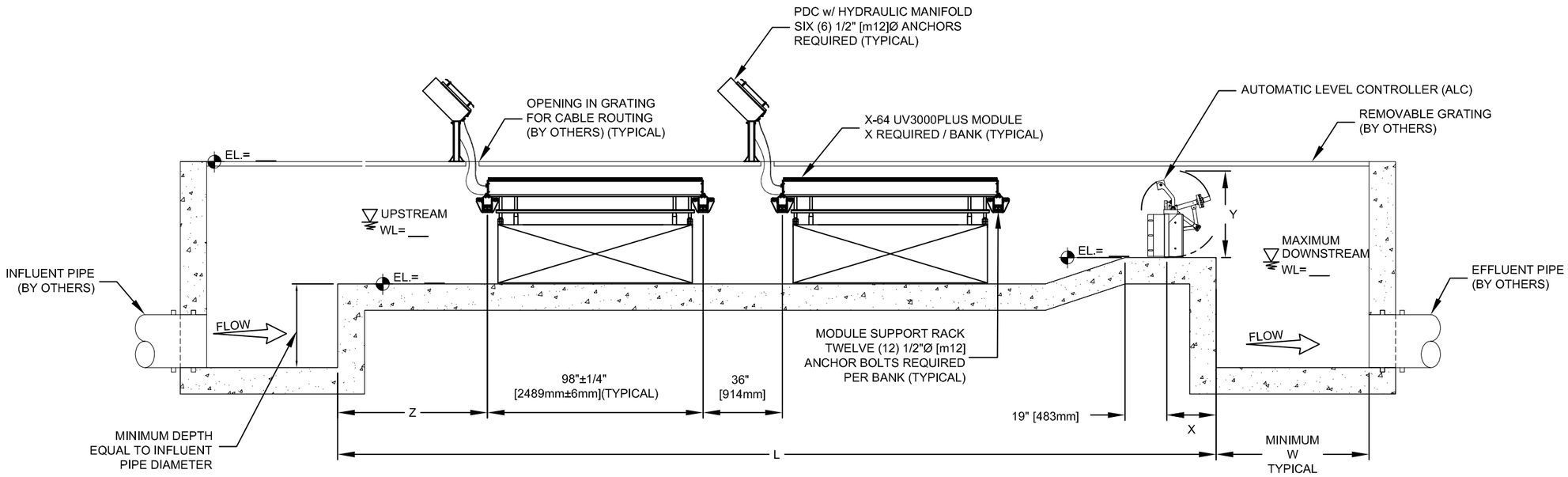
TROJANUV

CONFIDENTIALITY NOTICE
Copyright©2009 by Trojan Technologies. All rights reserved. No part of this document may be reproduced, stored in a retrieval system, or transmitted in any form, without the written permission of Trojan Technologies.

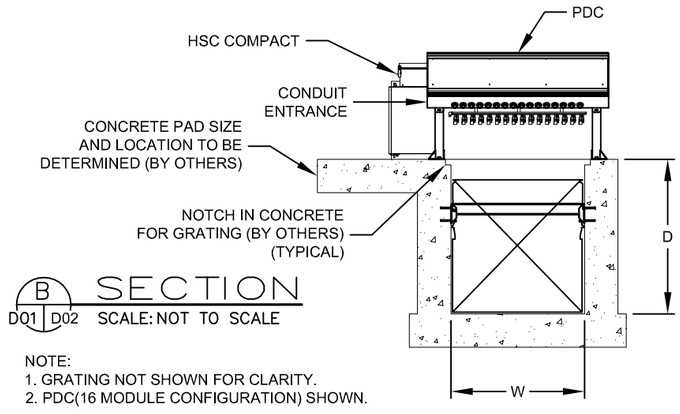
DESCRIPTION:
LAYOUT, UV3000PLUS 1 CHANNEL 2 BANK ALC WITH CLEANING (PLC)

| | | | |
|---|---|---|---|
| DRAWN BY : | RLM | DATE : | 09DE14 |
| CHECKED BY : | SAH | DATE : | 09DE16 |
| APPROVED BY : | LQ | DATE : | 09DE16 |
| SCALE : | NOT TO SCALE | LOG NUMBER : | N/A |

| | |
|---|---|
| QUOTE NO. | 3M0670 |
| PROJECT NO. | N/A |
| DWG NO. | D01 |
| REV. | A |




A SECTION
D01 | D02 SCALE: NOT TO SCALE




B SECTION
D01 | D02 SCALE: NOT TO SCALE

NOTE:
1. GRATING NOT SHOWN FOR CLARITY.
2. PDC(16 MODULE CONFIGURATION) SHOWN.

## NOTES:

: DO NOT SLOPE CHANNEL FLOOR.
: CHANNEL WIDTH & DEPTH MUST BE KEPT WITHIN A TOLERANCE OF + OR - ¼" [6mm].
: ANCHOR BOLTS ARE NOT SUPPLIED BY TROJAN TECHNOLOGIES.
: SYSTEM CONDUIT, WIRING, DISTRIBUTION PANELS & INTERCONNECTIONS BY OTHERS.
: ELECTRICAL REQUIREMENTS SHOWN ARE TO SUPPLY TROJAN UV EQUIPMENT ONLY. ELECTRICAL INRUSH FACTOR TO BE ADDED AS PER LOCAL CODE.
: HSC COMPACT IS SUPPLIED WITH A STANDARD 25' [7.6m] HOSE KIT.
: CHANNEL COVERING ABOVE THE MODULES MUST BE OPEN (E.G. PERFORATED GRATING). REMOVABLE GRATING SECTIONS SHALL BE EASILY REMOVED BY ONE PERSON. MAXIMUM WEIGHT OF THE SECTIONS SHALL BE IN ACCORDANCE WITH REQUIREMENTS OF THE APPLICABLE JURISDICTION.
: THE APPLICABLE INTERCONNECT IS TO BE DAISY-CHAINED BETWEEN PANELS. CONTRACTOR CAN CHOOSE THE ORDER OF CONNECTIONS THAT IS MOST APPROPRIATE.
: EFFLUENT LEVELS SHOWN REFLECT TROJAN EQUIPMENT ONLY. EFFLUENT LEVELS MAY CHANGE DUE TO CHANNEL DEBRIS OR GEOMETRY
:TOLERANCE AT ALC IS CHANNEL WIDTH +1" [25mm].

TROJANUV

CONFIDENTIALITY NOTICE
Copyright©2009 by Trojan Technologies. All rights reserved. No part of this document may be reproduced, stored in a retrieval system, or transmitted in any form, without the written permission of Trojan Technologies.

DESCRIPTION:
LAYOUT, UV3000PLUS 1 CHANNEL 2 BANK ALC WITH CLEANING (PLC)

| | | | |
|---|---|---|---|
| DRAWN BY : | RLM | DATE : | 09DE14 |
| CHECKED BY : | SAH | DATE : | 09DE16 |
| APPROVED BY : | LQ | DATE : | 09DE16 |
| SCALE : | NOT TO SCALE | LOG NUMBER : | N/A |

QUOTE NO. 3M0670
PROJECT NO. N/A
DWG NO. D02
REV. A

Appendix F

# TROJAN UVSIGNA 2ROW PROPOSAL AND DRAWINGS

TROJAN UV SIGNA™

PROPOSAL FOR ARCATA, CALIFORNIA
QUOTE: 216662
05/23/2018



TrojanUVSigna™ incorporates revolutionary innovations, including TrojanUV Solo Lamp™ technology, to reduce the total cost of ownership and drastically simplify operation and maintenance. It is the ideal solution for facilities wanting to upgrade their disinfection system easily and cost-effectively.

We are pleased to provide the enclosed TrojanUVSigna proposal. Please do not hesitate to contact us if you have any questions regarding this proposal. We look forward to working with you.

---

With best regards,

Jordan Fournier
Regional Manager
Trojan Technologies
(519) 457 – 3400 ext. 2193
jfournier@trojanuv.com

# DESIGN CRITERIA

| | |
|---|---|
| Peak Design Flow: | **5.9 MGD** |
| UV Transmittance: | **35%** (minimum) |
| Total Suspended Solids: | **30 mg/l (30 Day Average,** grab sample) |
| Disinfection Limit: | **43 fecal coliform per 100 ml**, based on a 1 day Maximum (90%ile) of consecutive daily grab samples |
| Design Dose: | **50 mJ/cm$^2$** |

# DESIGN SUMMARY

| | |
|---|---|
| **CHANNEL** (Refer to Trojan layout drawing for complete details) | |
| Number of Channels: | **1** |
| Minimum Channel Length Required: | **30'** |
| Channel Width at UV Banks: | **3.3'** |
| Channel Depth Recommended: | **7.8'** |
| **UV BANKS** | |
| Number of Banks per Channel: | **7 (6 duty, 1 redundant)** |
| Number of Lamps per Bank: | **12** |
| Total Number of UV Lamps: | **84 (Including 12 Redundant Lamps)** |
| Maximum Duty Power Draw: | **75.8 kW** |
| **UV PANELS** | |
| Power Distribution Center Quantity: | **2** |
| Hydraulic System Center Quantity: | **2** |
| System Control Center Quantity: | **1** |
| **ANCILLARY EQUIPMENT** | |
| Level Controller Quantity and Type: | **1 Fixed Weir** |
| Integral Bank Walls: | **Included** |
| On-line UVT Monitoring: | **Hach UVAS sc Sensor** |
| Other Equipment: | |
| **ELECTRICAL REQUIREMENTS** | |
| **1.** Each Power Distribution Center requires an electrical supply of one (1) 480V, 3 phase, 4 wire + GND, 50/60 Hz, 82.1 kVA<br>**2.** Electrical supply for Hydraulic System Center will be (1) 480V, 3 phase, 3 wire + GND, 60 Hz, 2.5 kVA<br>**3.** Electrical supply for System Control Center will be (1) 120V, 1 phase, 2 wire + GND, 60 Hz, 1.8 kVA<br>**4.** The On-line UVT monitor requires (1) 120 Volts, 1 phase, 2 wire + ground, 1A<br>**5.** Electrical disconnects are not included in this proposal. Refer to local electrical codes | |

# COMMERCIAL INFORMATION

| **Total Capital Cost: $ 640,000 (USD)** |
|---|

This price excludes any taxes or duties that may be applicable.
Standard equipment warrantees and start up by Trojan-certified technicians are included.

## Operating Conditions

| | |
|---|---|
| Average Flow: | **2.3 MGD** |
| UV Transmittance: | **35%** |
| Annual Operating Hours: | **8,760 hours** |
| Average Number of Lamps Online: | **36** |

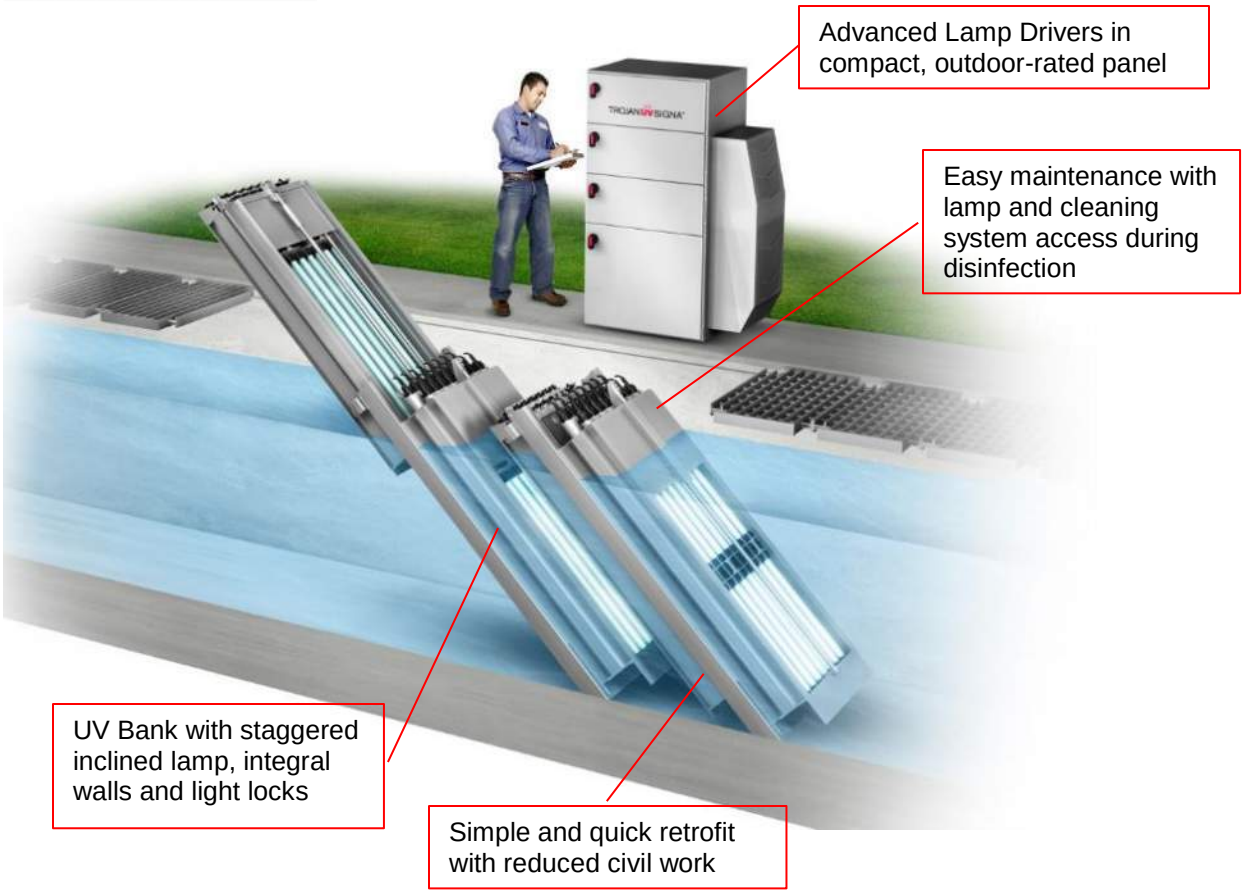
| **Power Requirements** | | **Lamp Replacement** | |
|---|---|---|---|
| Average Power Draw: | **31.7 kW** | Lamps Replaced per Year: | **21** |
| Cost per kW Hour: | **$0.10** | Price per Lamp: | **$650** |
| **Annual Power Cost:** | **$27,769** | **Annual Lamp Replacement Cost:** | **$13,650** |
| **Total Annual Operating Cost Estimate: $41,419** | | | |

This cost estimate is based on the average flow and UV transmittance listed above. Actual operating costs may be lower with the TrojanUVSigna automatic dose pacing control system. As UV demand decreases by a change in operating conditions, the number of lamps online and power level of the lamps decreases accordingly. The dose pacing system minimizes equipment power levels while ensuring the target UV dose is maintained at all times.

## Easy and Cost-Effective Maintenance

- The 1000 watt TrojanUV Solo Lamp combines the benefits of both low pressure and medium pressure lamps
- Fewer lamps, long lamp life and easy change-outs save time and money
- Lamp change-outs and cleaning solution replacement are done while the UV system is in the channel – minimizing downtime and simplifying maintenance
- Routine maintenance can be performed while banks are in the channel, but an Automatic Raising Mechanism (ARM) makes other tasks, such as winterization, simple, safe and easy
- Lamp plugs with LED status indicators and integral safety interlock prevent an operator from accidentally removing an energized lamp
- ActiClean WW™ chemical/mechanical cleaning system to keep sleeves clean during operation

# SYSTEM OVERVIEW




## Simple to Design and Install

- Light locks on the UV banks control water level within the channel, reducing dependence on downstream weirs and preventing short-circuiting above the lamp arc
- UV Banks include integral reactor walls to make installation easy and prevent short circuiting at the channel walls
- Stringent tolerances on concrete channel walls are not required – making retrofits simple and cost-effective

## Supported by Trojan Technologies

- Trojan Technologies warrants all components of the system (excluding UV lamps) against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, whichever comes first.
- UV lamps are warranted for 15,000 hours of operation or 3 years from shipment, whichever comes first. Lamp warranty is pro-rated after 9,000 hours of operation. This means that if a lamp fails prior to 9,000 hours of use, a new lamp is provided at no charge.
- Trojan offers an unparalleled Lifetime Performance Guarantee. The spirit of this guarantee is simple: the Trojan equipment, as sized for the project, will meet the disinfection requirements for the life of the system.

Appendix H

# TM 8 SITE IMPROVEMENTS



City of Arcata
Wastewater Treatment Facilities Improvements

# Technical Memorandum 8
# SITE IMPROVEMENTS

FINAL | April 2019

City of Arcata
Wastewater Treatment Facilities Improvements

# Technical Memorandum 8
# SITE IMPROVEMENTS

DRAFT | April 2019



# Contents

Technical Memorandum 8 - SITE IMPROVEMENTS 8-1

8.1 Purpose 8-1

8.2 Summary of Findings and Recommendations 8-1

8.3 Background 8-2

8.4 Site Master Plan 8-2

8.4.1 Proposed Site Layout 8-2

8.4.2 Anticipated Phased Expansion 8-11

8.4.3 Perimeter Security 8-11

8.4.4 Site Access 8-11

8.4.5 Relocated Facilities 8-12

8.5 Construction Staging and Phasing 8-12

8.6 Geotechnical Issues 8-13

8.7 Site Utilities 8-13

8.7.1 Potable Water 8-13

8.7.2 Utility Water 8-13

8.7.3 Fire Protection 8-13

8.7.4 Stormwater Management 8-14

8.7.5 Tank Drain System 8-14

8.8 Civil Design Criteria 8-14

8.9 Sea Level Rise 8-14

# Tables

Table 8.1 Potential for Existing Structure Flooding with SLR 8-15

# Figures

Figure 8.1 Treatment Wetlands Site Plan 8-3

Figure 8.2 Enhancement Wetlands Site Plan 8-5

Figure 8.3 Central Site Plan 8-7

Figure 8.4 Central Site Plan Alternative 8-9

# Abbreviations

| | |
|---|---|
| 1W | potable water |
| 2W | non-potable water |
| AWTF | Arcata Wastewater Treatment Facility |
| BFE | base flood elevation |
| Carollo | Carollo Engineers, Inc. |
| CEQA | California Environmental Quality Act |
| EPPS | emergency pond pump station |
| kV | kilovolt |
| MAW | mean annual maximum water elevation |
| NAVD 88 | North American Vertical Datum of 1988 |
| SLR | sea level rise |
| TM | technical memorandum |
| UV | ultraviolet |

Technical Memorandum 8

# SITE IMPROVEMENTS

## 8.1 Purpose

The purpose of this Technical Memorandum (TM) is to present the overall site planning findings and recommendations for the City of Arcata (City) Wastewater Treatment Facility (AWTF). This includes planning for current and future projects, site access, construction staging and access, stormwater runoff collection, and site security options. This TM will also review, at a conceptual level, the impact of sea level rise (SLR) and the requirements for plant facilities transition with SLR. A preliminary site plan is presented for use in California Environmental Quality Act (CEQA) permitting and for preliminary discussion with resource agencies regarding project permitting.

## 8.2 Summary of Findings and Recommendations

The key findings and recommendations of this TM are summarized below:

- Site Plan: The central site plan for the new treatment facilities was developed to avoid as many existing corporation yard facilities as possible. However, the bus barn and maintenance shop, and biosolids composting facility will need to be relocated.
- Phased Expansion: Some new facilities will be phased in, with additional secondary treatment facilities coming on line as sea level rise impacts the natural treatment systems such that they are no longer available for use as treatment facilities.
- Site Security: Existing fencing will not be updated with this project.
- Site Access: No changes will be made to the existing plant site access.
- Facility Relocation: The existing bus barn, maintenance shop, dirt and rock storage bins, and biosolids composting facilities will need to be relocated. The bus barn, maintenance shop, and dirt and rock storage bins will be relocated just north of Treatment Wetland No. 3 while the biosolids composting facilities will be located to the west of Treatment Wetland No. 3.
- Construction Staging: Space is available for construction staging to the north and west of Treatment Wetland No. 3. There is also City owned property on South I Street that could be used for construction staging. However, these areas are limited and land nearby may need to be leased for construction staging.
- Geotechnical Considerations: A geotechnical investigation has been completed and a two part report will be issued in 2018. The report recommendations will be incorporated into final design.
- Site Utilities: The non-potable water system and stormwater drainage systems will be expanded with this project. Based on Fire Marshal input, additional fire protection facilities may also be needed, which will be determined during final design.

- Civil Design Criteria: General civil design criteria are presented in this TM for final design. In addition, the City's standard plans will also be incorporated into final design.
- Sea Level Rise: All new structures will be built at an elevation of at least 11.5 (NAVD 88), to prevent flooding during a 100-year storm with SLR and to provide an additional safety factor for process and electrical equipment. Additionally, it is recommended that all existing structures be reviewed and modified as needed to provide an elevation of at least 10.4 (NAVD 88), to prevent annual flooding at high tide with SLR.

## 8.3 Background

The AWTF consists of headworks with screening and grit removal, primary clarification, oxidation ponds and treatment wetlands secondary treatment, and polishing enhancement wetlands. Solids processing consists of digestion and drying in sludge drying beds. Except for the oxidation ponds and wetlands, all AWTF facilities are located on an 8.4 acre parcel off of South G Street. In addition to treatment plant facilities, this area also houses the Streets Department, corporation yard, police evidence storage facilities, as well as biosolids composing operations.

While space is limited at the AWTF, additional facilities are needed for adequate treatment of current and projected AWTF wastewater flows and future SLR.

## 8.4 Site Master Plan

This section describes the proposed site layout and identifies the site planning constraints including site access, site security, facility relocation, and master planning for future capacity expansion.

### 8.4.1 Proposed Site Layout

The facilities shown in the proposed site layouts are sized based on the discussions in process TM's developed for this project.

The proposed site layout for the oxidation ponds and treatment wetlands is shown in Figure 8.1 and the proposed site layout for the enhancement wetlands is shown in Figure 8.2.

Figure 8.3 shows the initial layout proposed for the central plant facilities. However, based on conversations with AWTF staff, it was determined that construction around the Sign Building should be kept to a minimum, as contaminated soil reportedly may be present in that area. Additionally, city staff want to keep as much of the corporation yard intact as possible. Thus, the central plant facility layout was revised, and the alternate central site plan is shown in Figure 8.4. While this alternative keeps much of the corporation yard intact, it does require the re-location of the bus barn structure and biosolids composting operation. Design will move forward with the alternate central site plan.




**Figure No. 8.1**

**TREATMENT WETLANDS SITE PLAN**

CITY OF ARCATA

carollo

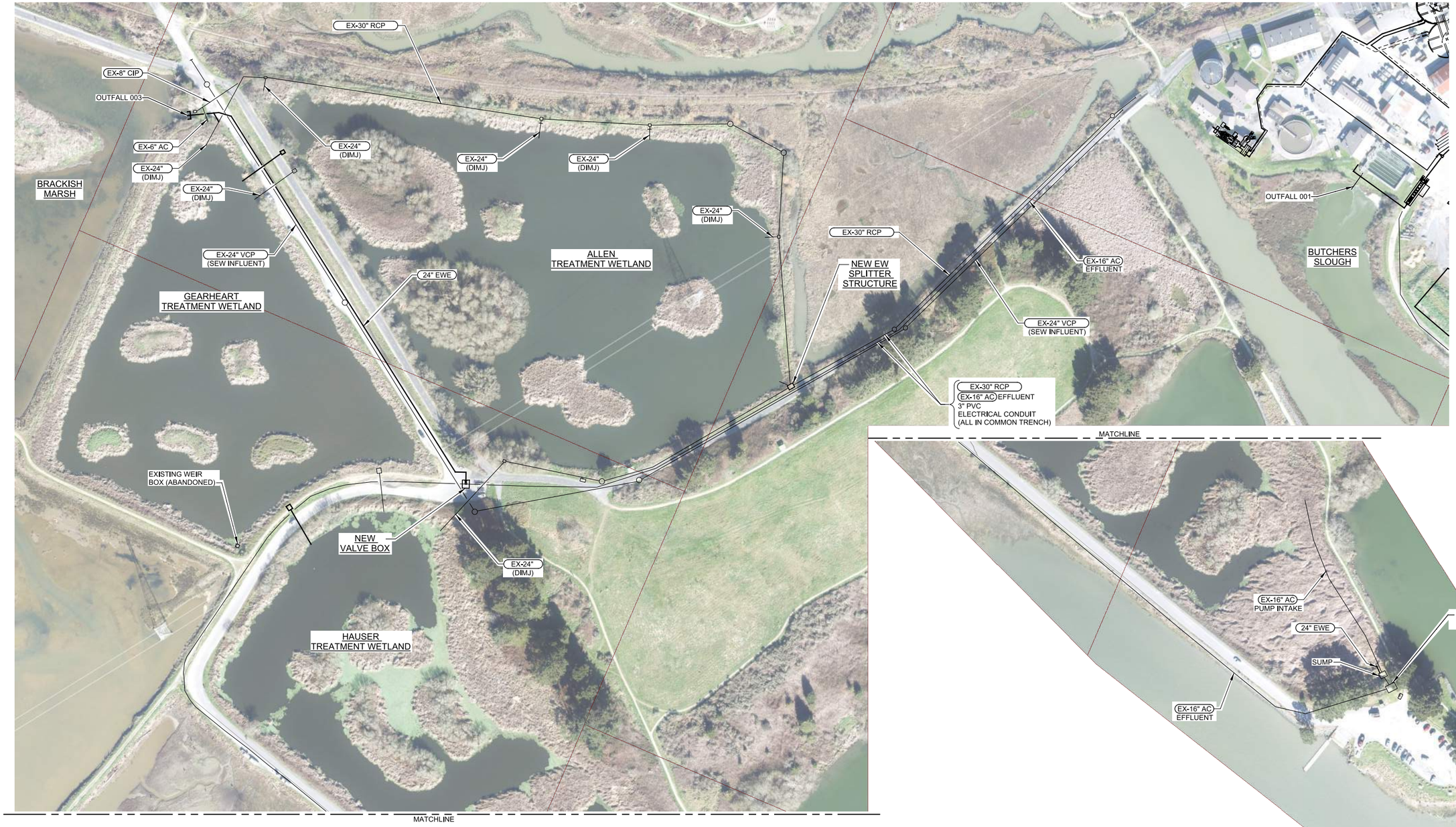
File: E:\ICSforPDFWorking\32157\794338_20\9913B10FIG8.1.dgn

Plot Date: 05-SEP-2018 9:36:57 AM

User: svcPW

File: E:\ICSforPDFWorking\321551794338_3T9913B10FIG8.2.dgn
Plot Date: 05-SEP-2018 9:33:59 AM
User: svcPW

0 50' 100' 200'




LEGEND:

EXISTING

NEW

FUTURE

**Figure No. 8.2**

**ENHANCEMENT WETLANDS SITE PLAN**

CITY OF ARCATA

carollo




**Figure No. 8.3**
**CENTRAL SITE PLAN**
CITY OF ARCATA

carollo

File: E:\ICSforPDFWorking\32160\794338_2219913B10FIG8.3.dgn
Plot Date: 05-SEP-2018 9:41:30 AM
User: svcPW




File: E:\ICSforPDFWorking\32162\794338_2319913B10FIG8.4.dgn
Plot Date: 05-SEP-2018 9:45:22 AM
User: svcPW

**Figure No. 8.4**
**CENTRAL SITE PLAN ALTERNATIVE**
CITY OF ARCATA
carollo

### 8.4.2 Anticipated Phased Expansion

The site layout presented is based on master planning the site to accommodate 20 percent growth. In addition, with anticipated SLR, the site layout is based on the future loss of the existing natural treatment system for treatment. Therefore, the site plans include a preliminary layout that shows future treatment units needed when the existing natural treatment system is no longer functional. These future units are not required under the current project but are shown to address the potential for future SLR. For example, the secondary process includes one oxidation ditch and two secondary clarifiers, with a second oxidation ditch and third secondary clarifier required for future expansion.

### 8.4.3 Perimeter Security

A chain link fence, that provides limited perimeter security, is currently installed along South G Street. The fence is continuous from the bridge north of the plant to the north eastern edge of Oxidation Pond 2. A gate is currently installed at the plant entrance off of South G Street. In discussions with AWTF staff, a new fence along the Arcata Bay side of the plant is not anticipated at this time nor is the replacement of the existing fence and gate, as they are in acceptable condition. AWTF staff have considered installing a second gate to the facility. Two potential gate locations were identified:

- The south end of the proposed oxidation ditch by the new bike trail.
- Between the proposed electrical building and oxidation ditch.

A second plant entrance was discussed for future plant improvements and was not included in the current project.

### 8.4.4 Site Access

As described above, there is currently one gated entrance into the AWTF. This entrance is used not only for AWTF staff access, but for police and city staff access, chemical deliveries, and sludge/screening and grit hauling. Currently, chemical deliveries arrive on a flatbed truck and loop around the street department facilities, stopping at the chlorine building. Additionally, sludge/screening and grit hauling trucks pull up to the headworks, use a front loading truck to load material for removal, and have to back out of the headworks area. These truck routes will continue with the proposed new facilities.

In addition to existing chlorine deliveries, it is anticipated that additional chemical deliveries to the new alkalinity feed system will also be needed. As shown on the site plan, this facility will be located adjacent to the relocated bus barn. Truck routing for these chemical deliveries are anticipated to be similar to current truck routing for chemical deliveries, with trucks looping around the existing street department facilities. At the south end of the street department facilities, alkalinity delivery trucks may need to back down the road leading to the oxidation ponds up to 100 feet to reach the new alkalinity feed system before continuing on their loop around the existing street department facilities.

On-site biosolids and compost hauling will also be impacted by the proposed facility changes. As described above, the alternative central site plan requires the relocation of the biosolids composting facilities offsite. Thus trucks that haul biosolids from the existing sludge drying beds to the existing composing facilities will need to drive to the new offsite location to reach the composting facilities.

### 8.4.5 Relocated Facilities

The following facilities will need to be relocated with the proposed new facilities:

- Bus barn used for vehicle and other material storage
- Maintenance shop
- Dirt and rock storage bins
- Biosolids composting

As shown in Figure 8.4, the bus barn will be re-located to the area just north of Treatment Wetland No. 3 and will be included with this project.

There are several potential locations for the relocated maintenance shop including incorporation into the new bus barn, at the existing chlorine facilities site (depending on the modifications to the chlorine system), or elsewhere on site as seen fit by the City. For predesign planning purposes, it is assumed that the maintenance shop will be incorporated into the bus barn. The final location of the maintenance shop will be coordinated during final design.

The dirt and rock storage bins may also be able to be relocated to this area. However, the final location of the dirt and rock storage bins is City preference and the relocation of these facilities is not included in this project.

Additionally, the biosolids composting facilities will need to be relocated. It is anticipated that these facilities can be relocated to the west of Treatment Wetland No. 3 as shown in Figure 8.4. Currently the area dedicated to biosolids composting is approximately 100 feet by 200 feet. This space allows for ten 100 foot by 20 foot non-aerated composting bays. According to AWTF staff, this area is sized sufficiently. These composting bays will be re-located with the project.

Furthermore, the road southeast of the chlorine contact basin will need to be re-routed around the proposed ultraviolet (UV) Disinfection facility. The piping from the emergency pond pump station (EPPS) and 12 kilovolt (kV) electrical feed that run along this road will also likely need to be re-routed.

In general, storage at the AWTF is quite limited and is only going to become more limited with the proposed new facilities. For this reason, expanded storage space will be accommodated with a larger bus barn. In an effort to address limited storage space, AWTF staff are currently clearing out the area around the proposed location for the relocated bus barn.

## 8.5 Construction Staging and Phasing

The AWTF is limited in available space so areas for construction staging onsite are minimal. Construction staging includes space for contractor parking, material and equipment storage, construction trailer, restrooms, etc. Possible construction staging locations onsite are as follows:

- Area just north of Treatment Wetland No. 3 (proposed location of relocated bus barn).
- Area just west of Treatment Wetland No. 3 (poor drainage in the winter; proposed location of the relocated biosolids composting).
- City-owned property on south I street (far from central plant).

Because the relocated bus barn and biosolids composting will be relocated to the area onsite proposed for construction staging, construction phasing is an important component of design that is discussed in TM 11 - Implementation and Schedule. If additional construction staging

space is needed, the City should consider renting space along South G Street for the duration of construction.

## 8.6 Geotechnical Issues

A geotechnical report is currently being prepared for the project to address these issues. It will be completed in 2018 and its recommendations will be incorporated into final design. Boring locations around the central site used for the geotechnical evaluation are shown in geotechnical report.

## 8.7 Site Utilities

This section describes the existing and new site utilities.

### 8.7.1 Potable Water

Potable water (1W) is used for drinking, sanitary facilities, wash rooms, emergency shower and eyewash basins, seals for grit and sludge pumps, and chemical dilution water. Presently, potable water is split into two services outside of the AWTF gate. One service is for the corporation yard facilities on the southern end of the plant and the other service is for the plant processes on the northern half of the plant. On the plant processes side, 1W is supplied to the control building, storage building, and chlorine building from a tie in to the City's system on South G Street. On the corporation yard side, 1W is supplied to three restrooms and a car wash station. Additional 1W needs and supply upgrades are not anticipated with this project.

### 8.7.2 Utility Water

Non-potable water (2W) is used throughout the plant for utility station wash-down water and water supply to spray and flush lines. Presently, 2W is supplied to the generator building, headworks, control building, primary clarifiers, digesters, and chlorine building. The 2W is supplied from a tie in with a reduced pressure principle device to the City's potable system on South G Street. Initially an air gap tank was installed; however the valve in the air gap tank aged and caused a water hammer effect, so the air gap tank was replaced with a reduced pressure principal device.

It is anticipated that with the proposed facilities, the 2W system will need to be expanded. 2W would be supplied to the new oxidation ditches and secondary clarifiers for wash-down water. Additionally, a separate 2W feed from the plant's disinfected effluent could be used for spray water at the new facilities and the existing primary clarifiers. The need for this separate spray water system will be defined during final design. Alternatively a portion of the process water needs could be supplied with chlorinated plant effluent.

The distribution system would be designed to provide the supply necessary to accommodate recommended improvements. The system will be looped for reliability and have isolation capability.

### 8.7.3 Fire Protection

There are currently no fire hydrants on site. The closest fire hydrant is just outside the AWTF entrance gate on South G Street. According to AWTF staff, there are also no sprinkler systems in any of the buildings.

The City contacted the Fire Marshal and he had no issues with the predesign. As the design process progresses, the Fire Marshal will be updated and additional fire safety measures may be recommended, such as additional fire hydrants or sprinkler systems. A fire hydrant could be added adjacent to the new electrical building. These recommendations will be included in final design.

### 8.7.4 Stormwater Management

The existing on-site stormwater drainage system is designed to drain to either the headworks/influent sewer or the oxidation ponds. Currently, the northern portion of the AWTF drains by gravity to the headworks or influent sewer. The Streets Department offices, Chlorine Contact Basin, and corporation yard areas drain to the southern edge of the Chlorine Contact Basin where two 5 horsepower Gorman-Rupp pumps pump the stormwater drainage to the oxidation ponds. AWTF staff have observed that during heavy storms the corporation yard has experienced flooding, indicating that this system may be undersized.

It is anticipated that with the proposed facilities, the storm drainage facilities will need to be expanded. Stormwater drainage would be provided for the process facilities. These new drainage facilities would be designed to capture a 100-year 2-hour storm and drain to new pumps at the Chlorine Contact Basin that would pump the stormwater to the oxidation ponds.

### 8.7.5 Tank Drain System

Tank drain pump stations with portable submersible pumps will be considered for each major tank or process added. The pump stations could be designed to return the tank's contents to an operating tank of similar process. Quick disconnects and permanent piping would be provided at each pumping location. The need for tank drainage would be reviewed during final design, then the location and sizing of the pumps would be completed.

## 8.8 Civil Design Criteria

The site improvements will be designed based on the following civil design criteria:

- All new process pipelines will have a minimum depth of 4 feet below the finished subgrade.
- All new gravity pipelines will have a depth between 4 and 10 feet below the finished subgrade.
- If existing process pipe is less than 4 feet below the finished subgrade it may need to be encased or capped with concrete.
- Paving will be 4 inch AC pavement over 12 inch of ABC.
- New piping between wetland cells will have cutoff walls to prevent "piping" of water along the pipelines in berms and levees.
- Roadways will be a minimum of 24 feet wide with shoulders on each side that are a minimum of 2 foot wide.
- New duct banks will be designed for a minimum of 2 feet of cover.

In addition, the City's standard plans shall be used where applicable.

## 8.9 Sea Level Rise

As discussed in TM 2, Flow Reconfiguration, SLR is expected to impact plant operations in the near future by raising the water level in Humboldt Bay and thus the hydraulic grade line

throughout the plant. Additionally, SLR has the potential to cause flooding of the plant site itself. This potential of plant flooding is discussed in this section.

By 2050 it is projected that sea level will rise by 1.1 feet (Humboldt Bay Sea Level Rise Adaptation Planning Project: Phase 2 Report, February 2015). The potential for flooding, given this projected SLR, was evaluated for two scenarios: (1) during a 100-year flood, and (2) during mean annual maximum tide.

Currently the Base Flood Elevation (BFE) is 10.05 feet (NAVD 88). With SLR the BFE will increase to 11.05 (NAVD 88). Thus all new structures will be built at an elevation of at least 11.5 feet, to prevent flooding during a 100-year storm with SLR and to provide an additional safety factor for process and electrical equipment.

Currently the mean annual maximum water elevation (MAMW) is 8.78 feet (NAVD 88). With SLR the MAMW will increase to 9.8. It is recommended that all existing structures have an elevation of at least 10.4 feet, to prevent annual flooding with the MAMW. Table 8.1 shows the elevation of existing structures at the AWTF that will remain with this project. As shown in the table, no structures except for the EWPS Intake Structure will flood annually during MAMW with SLR. However, a number of structures will flood during a 100-year flood with SLR. Table 8.1 does not include the elevations of the ponds and wetlands.

Table 8.1 Potential for Existing Structure Flooding with SLR

| Existing Structure | Elevation (NAVD 88) (1) | Structure Will Flood during MAMW with SLR | Structure Will Flood during BFE with SLR |
|---|---|---|---|
| Chlorine Building | 10.4 | - | Yes |
| Control Building | 10.4 | - | Yes |
| Generator Building | 10.4 | - | Yes |
| First Street PS | 10.4 | - | Yes |
| Influent PS Wet Well | 10.4 | - | Yes |
| Primary Clarifier | 15.6 | - | - |
| Chlorine Contact Basin | 14.9 | - | - |
| Chlorine Contact Sump Pump | 13.1 | - | - |
| Primary Digester (top) | 36.1 | - | - |
| Secondary Digester (top) | 36.1 | - | - |
| Sludge Drying Beds | 10.4 (2) | - | Yes |
| PS 1 / PPS | 10.9 | - | - |
| EWPS | 10.4 | - | Yes |
| EWPS Intake Structure | 7.4 | Yes | Yes |

Notes:
(1) Elevations are based on the 1984 drawings provided by the AWTF. The conversion from NAVD 29, provided on the drawings, to NAVD 88, shown here is: NAVD 29 + 3.35 = NAVD 88.
(2) Sludge drying bed elevation was assumed, and will be confirmed in final design.

Appendix I

# TM 9 ENERGY EFFICIENCY, ELECTRICAL, AND CONTROL SYSTEM



City of Arcata
Wastewater Treatment Facility Improvements

# Technical Memorandum 9
# ENERGY EFFICIENCY, ELECTRICAL, AND CONTROL SYSTEM

FINAL | April 2019

City of Arcata
Wastewater Treatment Facility Improvements

# TECHNICAL MEMORANDUM 9
# ENERGY EFFICIENCY, ELECTRICAL, AND CONTROL SYSTEM

FINAL | April 2019



# Contents

Technical Memorandum 9 9-1

Energy Efficiency, Electrical and Control System 9-1

9.1 Purpose 9-1

9.2 Summary of Findings and Recommendations 9-1

9.3 Background 9-2

9.3.1 Existing 12 kV Service and 12 kV Distribution System 9-2

9.3.2 Existing MCCs Serving the Emergency Pump Station and the Oxidation Ponds 9-7

9.3.3 Existing Power Distribution Panel at Enhancement Wetlands Pump Station 9-7

9.3.4 Existing Equipment at the Central Garage and the Corporation Yard 9-7

9.3.5 Existing Equipment at the AMRI Field Office 9-8

9.4 New 12 kV System 9-8

9.4.1 New Electrical Service and Electrical Building 9-8

9.4.2 New 12 kV Cable System 9-8

9.4.3 New Electrical Building and 480 Volt Loads at the Treatment Wetlands & Oxidation Pond No. 2 9-12

9.4.4 Existing Electrical Building 9-12

9.4.5 Emergency Pond Pump Station and Oxidation Pond Building 9-13

9.4.6 Enhancement Wetlands Pump Station 9-13

9.4.7 Equipment at the Central Garage, Corporation Yard, and AMRI 9-14

9.5 SCADA Network and Distributed PLCs 9-14

9.5.1 Existing SCADA Network 9-14

9.5.2 SCADA Network Improvements and Additions 9-15

9.5.3 SCADA Server Room Requirements 9-15

9.6 Energy Efficiency 9-15

9.6.1 New Energy Efficiency Equipment and Existing Motors 9-15

9.6.2 LED Lighting Efficiency 9-15

9.6.3 Improving Efficiency through Data 9-16

9.6.4 Solar Photovoltaic Project 9-16

## Appendices

Appendix A Equipment List Report
Appendix B Load Study Report

## Tables

Table 9.1 New Electrical Building Process Load Summary 9-12
Table 9.2 Existing Electrical Building Process Load Summary 9-13
Table 9.3 Emergency Pond Pump Station and Oxidation Ponds Process Load Summary 9-14
Table 9.4 Enhancement Wetlands Process Load Summary 9-14

## Figures

Figure 9.1 Existing 12 kV Electrical Site Plan 9-3
Figure 9.2 Existing Overall One-Line Existing Electrical Building, MCC-A, and Standby Generators 9-5
Figure 9.3 Modified 12 kV Electrical Site Plan 9-9
Figure 9.4 Modified Overall One-Line Electrical Power System Requirements 9-11
Figure 9.5 Existing AWTF Wastewater Network Block Diagram 9-17
Figure 9.6 Modified AWTF Wastewater Network Block Diagram 9-19

# Abbreviations

| | |
|---|---|
| A | amperes |
| AMRI | Arcata Marsh Research Institute |
| ATS | aerobic treatment system |
| AWTF | Arcata Wastewater Treatment Facility |
| Carollo | Carollo Engineers, Inc. |
| City | City of Arcata |
| CT | current transformer |
| EPPS | Emergency Pond Pump Station |
| EWPS | Enhancement Wetlands Pump Station |
| kV | kilovolt |
| kVA | kilovolt amperes |
| kW | kilowatt |
| LED | light emitting diode |
| MCC | motor control center |
| NEMA | National Electrical Manufacturer Association |
| PLC | programmable logic controller |
| PT | potential transformer |
| SCADA | supervisory control and data acquisition |
| TM | Technical Memorandum |
| UV | ultraviolet |
| V | volt |

Technical Memorandum 9

# ENERGY EFFICIENCY, ELECTRICAL AND CONTROL SYSTEM

## 9.1 Purpose

The purpose of this Technical Memorandum (TM) is to establish preliminary design criteria, identify main components, develop conceptual layouts, and recommend energy efficiency improvements for a rehabilitated and expanded power distribution system and supervisory control and data acquisition (SCADA) network at the City of Arcata (City) Wastewater Treatment Facility (AWTF).

This TM proposes modifications to the existing 12 kilovolt (kV) service to feed a new 12 kV service entrance rated switchgear, new 12 kV cable distribution throughout the facilities, new pad-mount transformers, and new 480 volt (V) motor control center (MCC) distribution equipment for new facilities and to replace the existing electrical distribution equipment. The new service and equipment would be sized to provide power to the existing AWTF facilities and the increased demand of the new process facilities. This TM also outlines the proposed improvements for networked monitoring and controls of the new and replaced equipment motor loads.

## 9.2 Summary of Findings and Recommendations

The key findings and recommendations of this TM are summarized below:

- A modified 12-kV service including a new protective device at the existing utility service pole is needed.
- New service-entrance rated switchgear will replace the existing 12 kV switch cabinet. New service cables will be installed from the existing service pole to the new switchgear.
- The new switchgear and new 480 V MCC will be housed in a new Electrical Building.
- The new switchgear will power the existing MCC at the existing Electrical Building and the new 480 V equipment at the new Electrical Building. The existing 12 kV switch cabinet and stepdown transformer at the existing Electrical Building will be demolished.
- New 12 kV distribution cable from new 12 kV service-entrance rated switchgear will feed new main plant pad-mount stepdown transformers and intercept exiting 12 kV cable to feed pad-mount stepdown transformers along the Treatment Wetlands and ponds.
- The Enhancement Wetlands Pumps Station (EWPS) will be fed by the new plant 12 kV cable to accommodate the new larger pumps. A new pad-mount stepdown transformer would be installed at the EWPS. Alternatively, the EWPS could be fed at 480 V from MCC-17A or with a new utility service.
- New and replaced process loads in the area of the existing Electrical Building will be fed by new MCC-17A located in the existing Electrical Building. Carollo recommends that existing loads fed by MCC-A be refed by MCC-17A. Alternatively, existing MCC-A could be maintained to power process loads that do not need modifications in the area of the existing Electrical Building.

- The existing pad-mount stepdown transformer and MCC south of Oxidation Pond No. 1 will be reused to accommodate the temporary aerators in Oxidation Pond No. 1.
- The existing pad-mount stepdown transformers at the existing Electrical Building, the Central Garage, the Emergency Pond Pump Station (EPPS), and the Arcata Marsh Research Institute (AMRI) field office, will be replaced.
- Carollo recommends the existing 250 kilowatt (kW) standby generator at the existing Electrical Building be maintained. A new standby generator will be located at the new Electrical Building to increase overall standby capacity. The new standby generator will be sized to backup critical equipment at the new facilities.
- Carollo recommends that existing lighting fixtures be replaced with light emitting diode (LED) fixtures and existing motors be surveyed for efficiency to determine if replacement could realize energy and cost savings.
- New programmable logic controllers (PLCs) will be added to the SCADA system to centralize and track equipment status information and allow quicker, more informed AWTF operation. More energy usage information will help operations make decisions to improve AWTF energy efficiency.

## 9.3 Background

This section includes a brief summary of the existing 12 kV service, 12 kV distribution system, and AWTF load centers.

### 9.3.1 Existing 12 kV Service and 12 kV Distribution System

The AWTF and the Corporation Yard receive power from the existing overhead 12 kV service located near the existing Electrical Building. Incoming overhead service cables deliver power from an offsite existing utility pole to an on-site pole owned by the AWTF. The existing utility meter potential transformer (PT) and current transformers (CTs) are located high up on the onsite pole and the meter is in a standalone enclosure at grade. 12 kV cables run down the onsite pole to an existing pad-mount switch cabinet which feeds the AWTF with two 12 kV circuits. One 12 kV circuit is stepped down to 480 V by a 225 kilovolt amperes (kVA) pad-mount stepdown transformer just north of the existing Electrical Building. This circuit powers the majority of AWTF equipment via MCC-A in the existing Electrical Building. The other 12 kV circuit powers the rest of the AWTF and Corporation Yard facilities through four pad-mount stepdown transformers distributed throughout the facility, which step down to 208 V. These transformers include a 75 kVA transformer at the Central Garage, a 75 kVA transformer at the AMRI field office, a 75 kVA transformer at the EPPS, and a 150 kVA transformer on the south side of Oxidation Pond No. 1. The 12 kV cable feeding these transformers runs down the west side of the treatment wetlands and oxidation ponds. This routing and other existing electrical facilities are shown in Figure 9.1.

The existing switch cabinet, 12 kV cable, and stepdown transformers were constructed by the Wastewater Treatment Plant Modifications project (CH2M HILL, 1984). Most of the equipment installed by that project have exceeded their useful life and should be replaced. The condition assessment of the transformers performed by Transformer Testing & Repairs, Inc. in 2009 showed that the transformers at the existing Electrical Building, the Central Garage, and Oxidation Pond No. 1 were failing and in need of replacement. AWTF staff has indicated that the transformers at the AMRI staff office and the EPPS are also in need of replacement. Carollo recommends that these transformers be replaced, with the exception of the Oxidation Pond No. 1 transformer which will not be needed beyond temporary aeration of Oxidation Pond No. 1. An overview of the existing electrical system and demolition is shown in Figure 9.2.

File: IP_PWP:d0794338\9913B10FIG9.1.dgn
Plot Date: 13-AUG-2018 11:47:24 AM
User: jgilkey

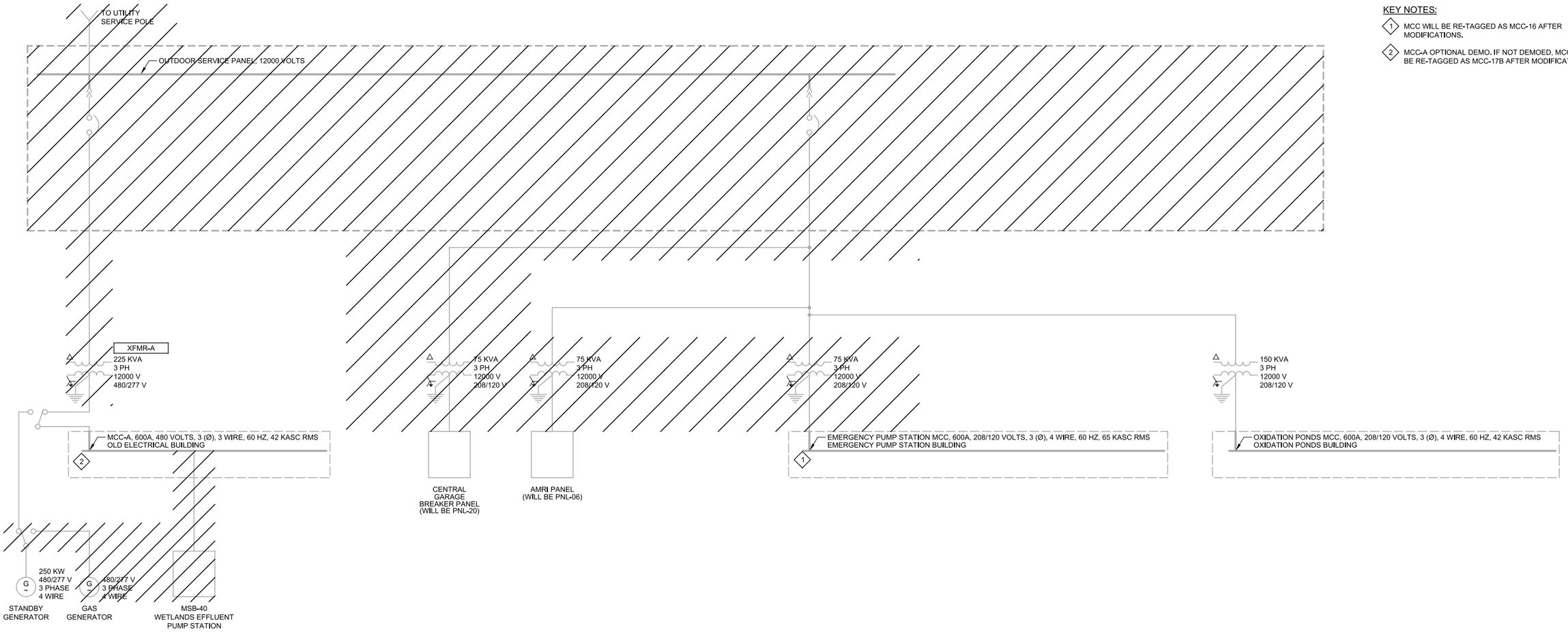
KEY NOTES:

1. EXISTING 12KV PULL BOX.
2. APPROXIMATE ROUTE OF EXISTING 12KV CONDUIT.
3. TWO EXISTING 4" PVC CONDUIT ENCASED IN CONCRETE.
4. EXISTING PADMOUNT TRANSFORMER IDENTIFIED FOR REPLACEMENT IN 2009.
5. EXISTING 12KV PULL BOX WITH 3-WAY CONNECTIONS.

0 50' 100' 200'

EXISTING UTILITY-OWNED 12KV SERVICE POLE
EXISTING PLANT OWNED 12KV POLE
EXISTING 12KV SWITCH CABINET
EXISTING 225KVA TRANSFORMER
EXISTING OLD ELECTRICAL BUILDING
EXISTING MCC-A
CENTRAL GARAGE
EXISTING 75KVA TRANSFORMER
P1
P2
P3
OXIDATION POND BUILDING
OXIDATION PONDS MCC
EXISTING 150KVA TRANSFORMER
EXISTING 75KVA TRANSFORMER
EMERGENCY POND PUMP STATION
EMERGENCY PUMP STATION MCC
EXISTING 75KVA TRANSFORMER

**Figure No. 9.1**
**EXISTING 12KV ELECTRICAL SITE PLAN**
CITY OF ARCATA
carollo




KEY NOTES:

1. MCC WILL BE RE-TAGGED AS MCC-16 AFTER MODIFICATIONS.
2. MCC-A OPTIONAL DEMO. IF NOT DEMOED, MCC-A WILL BE RE-TAGGED AS MCC-17B AFTER MODIFICATIONS.

File: IP_PWP:d0794338\9913B10FIG9.2.dgn
Plot Date: 14-AUG-2018 10:49:41 AM
User: jgilkey

**Figure No. 9.2**
**EXISTING OVERALL ONE-LINE**
CITY OF ARCATA

carollo

Most existing AWTF process loads are powered out of the existing 600 amperes (A) rated MCC-A located in the existing electrical building. MCC-A was manufactured by Klockner-Moeller, which has since merged with Eaton. Eaton no longer supports Klockner-Moeller MCCs so it will be increasingly difficult get replacement parts. Due to this and to the fact that the MCC is over 30 years old, Carollo recommends replacing MCC-A.

The existing electrical building also houses an existing 250-kW standby generator connected to MCC-A by an automatic transfer switch and an existing 150-kW natural gas generator connected upstream of the aerobic treatment system (ATS). The standby generator was replaced by the AWTF in 2008 and is in good condition. Carollo recommends that the existing standby generator be maintained to back up loads fed by MCCs at the existing electrical building. The AWTF staff has expressed that the digester gas generator is not needed and does not need to be maintained. Thus, it will be demolished to make room for other equipment.

### 9.3.2 Existing MCCs Serving the Emergency Pump Station and the Oxidation Ponds

An existing 600 A, 208/120 V MCC is located at the EPPS building and at the oxidation pond building. Fed through pad-mount stepdown transformers on the 12-kV system, each of these MCCs are located away from the main plant to serve remote processes. The MCC at the EPPS building is about 20 years old and has useful life remaining. The MCC at the oxidation pond building is beyond its useful life. Figure 9.2 shows the demolition of the EPPS building transformer, which will be replaced. The MCC at the EPPS building will be maintained for 208 V loads at and around Oxidation Pond No. 2; however, it will not be suitable for 480 V loads. The oxidation pond building transformer and MCC will not be demolished because they have sufficient capacity to power temporary aerators planned for installation in Oxidization Pond No. 1. The oxidation pond building transformer and MCC will be abandoned or demolished after the temporary aerators are removed.

### 9.3.3 Existing Power Distribution Panel at Enhancement Wetlands Pump Station

An existing 480 V feeder from MCC-A provides power to the EWPS panel. In the EWPS panel, this feeder is tapped for each pump starter and for the local power center that provides power to minor loads. The existing panel and most of the distribution equipment was installed in 1984 and is at the end of its useful life. Additionally, the existing 480 V feeder and distribution equipment is undersized for the planned new loads. Carollo recommends that the EWPS panel and the panel distribution equipment and starters be replaced together.

### 9.3.4 Existing Equipment at the Central Garage and the Corporation Yard

Equipment at the central garage and the Corporation Yard are fed through a pad-mount stepdown transformer on the 12 kV system. The central garage transformer was identified as failing by the 2009 transformer assessment and will be replaced. The central garage and the Corporation Yard equipment is old and may need to be replaced; however, since the only process load (Treatment Wetlands No. 4 Pump) fed by this system will be demolished by this project, Carollo recommends that replacement of any central garage and the Corporation Yard equipment be left to City discretion. At a minimum, Carollo recommends replacing any equipment identified by the AWTF to be exhibiting problematic tripping or other functional issues.

### 9.3.5 Existing Equipment at the AMRI Field Office

Equipment at the AMRI field office panel is fed through a pad-mount stepdown transformer on the 12 kV system. The AMRI transformer is severely corroded was identified by AWTF staff for replacement. The only process loads (Pump Station No. 2 Pond 3 Storm Pumps) fed by this system will be demolished by this project. Abandoned generator and generator transfer switch in the AMRI field office will also be demolished as instructed by AWTF staff. The rest of the equipment at the AMRI field office will be maintained.

## 9.4 New 12 kV System

This section summarizes the basis of design for modifications to the existing 12-kV service, provision of new 12 kV switchgear, and modifications to the existing 12 kV-distribution system.

### 9.4.1 New Electrical Service and Electrical Building

New 12 kV service cables will be installed from the existing utility service pole to the new service-entrance rated 12 kV switchgear at the new electrical building. This installation will be in parallel with the existing service and will allow construction of the new electrical system without significant system downtimes. The new electrical building will be located near the new process equipment loads. Figure 9.3 shows the new electrical building with the new service entrance-rated switchgear location alongside the new oxidation ditch and secondary clarifiers. A one-line diagram for the new system is shown in Figure 9.4. A new outdoor weather wrapped standby generator will be provided at the new electrical building to power critical loads during utility power outages. The new standby generator will be sized for critical equipment at the new processes, and a PLC controlled load shedding program will disable non-critical equipment when the generator is starting.

### 9.4.2 New 12 kV Cable System

New 12-kV duct bank will be installed to protect new 12-kV cable from the new 12-kV switchgear to the existing electrical building transformer, the central garage transformer, and to the south edge of the main plant where the new cable will intercept existing 12-kV cable in a new manhole. Existing 12-kV cable will be maintained from the south edge of the main plant to the AMRI transformer, the EPPS transformer, and the south oxidation building transformer. Keynote 4 on Figure 9.3 shows the new 12 kV duct bank routing and the proposed existing interception point of existing cables. The existing cabling will not be affected by construction and is maintained to reduce duct bank and 12 kV cable costs. New 12-kV duct bank will also be installed to the EWPS from a 12-kV manhole near the existing electrical building connection. This existing 480 V feed will be replaced with 12 kV cable to reduce cable size and cost. New pad-mount transformers will step the 12 kV down to 480 V at the new electrical building and the EWPS. Additionally, new pad-mount transformers will step the 12 kV down to 208 V/120 V at the central garage and AMRI field office.




KEY NOTES:

1. EXISTING MCC-A RETAGGED AS MCC-17B. KEEPING MCC IS OPTIONAL FOR COST SAVINGS. RECOMMEND MCC-A BE REPLACED IN FULL BY NEW MCC-17A TO PROVIDE NEW MOTOR CONTROLS FOR NEW EQUIPMENT IN AREA OF OLD ELECTRICAL BUILDING.
2. RECOMMENDED REPLACEMENT OF EXISTING TRANSFORMER.
3. SPLICE LOCATION OF NEW 12KV DUCT BANK TO NEW PADMOUNT TRANSFORMER AT ENHANCEMENT WETLANDS.
4. AT NEW MANHOLE, NEW 12KV DUCT BANK IS SPLICED TO EXISTING 12KV CABLE TO AMRI, EMERGENCY PUMP STATION, AND OXIDATION PONDS FACILITIES.
5. EXISTING EQUIPMENT TO BE MAINTAINED TO FEED OXIDATION POND 1 TEMPORARY AERATORS.
6. EXISTING 12KV PULL BOX.
7. APPROXIMATE ROUTE OF EXISTING 12KV CONDUIT.
8. EXISTING 12KV PULL BOX WITH 3-WAY CONNECTIONS

**Figure No. 9.3**

**MODIFIED 12KV ELECTRICAL SITE PLAN**

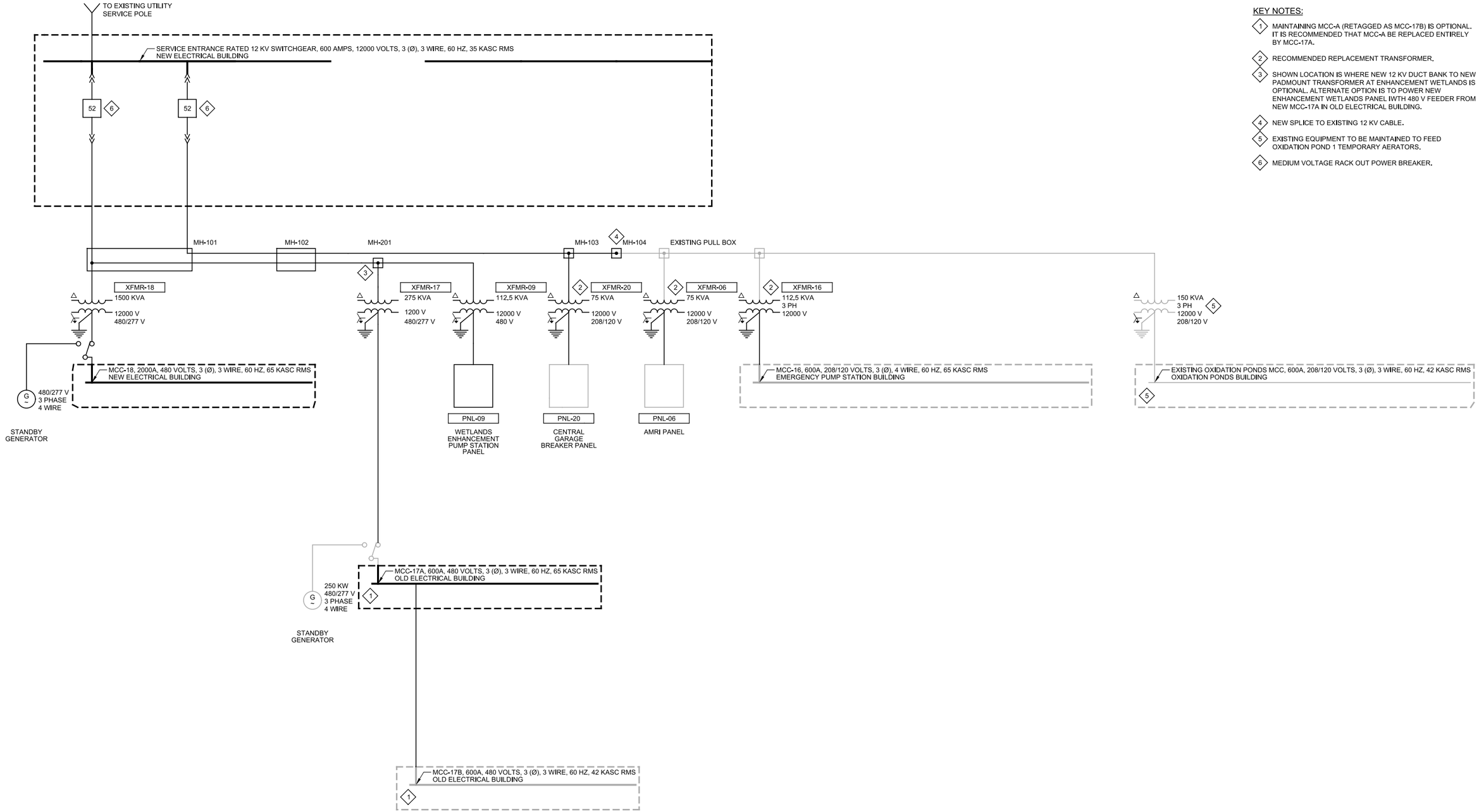
CITY OF ARCATA

carollo

File: IP_PWP:d0794338\9913B10FIG9.3.dgn

Plot Date: 14-AUG-2018 8:53:12 AM

User: jgilkey




KEY NOTES:

1. MAINTAINING MCC-A (RETAGGED AS MCC-17B) IS OPTIONAL. IT IS RECOMMENDED THAT MCC-A BE REPLACED ENTIRELY BY MCC-17A.
2. RECOMMENDED REPLACEMENT TRANSFORMER.
3. SHOWN LOCATION IS WHERE NEW 12 KV DUCT BANK TO NEW PADMOUNT TRANSFORMER AT ENHANCEMENT WETLANDS IS OPTIONAL. ALTERNATE OPTION IS TO POWER NEW ENHANCEMENT WETLANDS PANEL IWTH 480 V FEEDER FROM NEW MCC-17A IN OLD ELECTRICAL BUILDING.
4. NEW SPLICE TO EXISTING 12 KV CABLE.
5. EXISTING EQUIPMENT TO BE MAINTAINED TO FEED OXIDATION POND 1 TEMPORARY AERATORS.
6. MEDIUM VOLTAGE RACK OUT POWER BREAKER.

**Figure No. 9.4**
**MODIFIED OVERALL ONE-LINE**
CITY OF ARCATA

File: IP_PWP:d0794338\9913B10FIG9.4.dgn
Plot Date: 14-AUG-2018 10:59:28 AM
User: jgilkey

This section summarizes the basis of design for the low voltage distribution equipment based on the existing and modified facility power requirements.

### 9.4.3 New Electrical Building and 480 Volt Loads at the Treatment Wetlands & Oxidation Pond No. 2

A new 1,500 kVA pad-mount transformer will serve a new 2,000 A MCC at 480 V at the new Electrical Building as shown in Figure 9.4. The new Electrical Building MCC-18 will feed new process equipment at the south end of the AWTF, MCC at the existing electrical building, new process equipment throughout the treatment wetlands, and new 480 V process equipment at Oxidation Pond No. 2. A summary of process loads fed by the new Electrical Building is shown in Table 9.1. The total operating load for all buildout loads to be powered by the new Electrical Building transformer and MCC is 1,144 kVA or 1,376 A. The transformer and MCC are sized based on the next sizes up from the minimum allowed by NEC 215, as shown in the Load Study Report in Appendix B.

Table 9.1 New Electrical Building Process Load Summary

| | Existing AWTF Load(1) (kVA) | Modified AWTF Load(1) (kVA) | Buildout AWTF Load(1) (kVA) | New Power Source |
|---|---|---|---|---|
| Oxidation Ditches | - | 260 | 520 | MCC-18 (2) |
| Secondary Clarifiers | - | 11 | 17 | MCC-18 (2) |
| UV Disinfection | - | 38 | 38 | MCC-18 (2) |
| RAS Pump Station | - | 6 | 6 | MCC-18 (2) |
| WAS Pump Station | - | 1 | 1 | MCC-18 (2) |
| Thickening | - | 18 | 18 | MCC-18 (2) |
| Alkalinity Feed System | - | 20 | 20 | MCC-18 (2) |
| AWTF Water System | - | 18 | 18 | MCC-18 (2) |
| Treatment Wetlands Pump No. 4 | 9 (3) | 6 | 6 | MCC-18 (2) |
| Pump Station No. 1 | - | 23 | 23 | MCC-18 (2) |
| Pond Pump Station | 18(4) | 57 | 57 | MCC-18 (2) |
| Oxidation Pond No. 2 Aerators | - | 420 | 420 | MCC-18 (2) |
| **Total** | **27** | **878** | **1144** | |

Notes:
(1) Duty loads only.
(2) MCC-18 is a new MCC located at the new electrical building.
(3) Previously fed by central garage panel.
(4) Previously fed by MCC-A.
See Appendix A for a full list of process equipment.

### 9.4.4 Existing Electrical Building

A new 275 kVA pad-mount transformer will serve a new 600 A MCC at 480 V at the existing Electrical Building as shown in Figure 9.4. Carollo recommends that the existing MCC-A be demolished and all existing MCC-A loads be re-fed from MCC-17A. Alternatively, existing MCC-A could be subfed from MCC-17A and retagged as MCC-17B. New and existing process loads in the north end of the AWTF will be fed by existing Electrical Building MCC(s). A summary of process loads to be fed by the existing Electrical Building is shown in Table 9.2. The total operating load

for all buildout loads to be powered by the existing Electrical Building transformer and MCC is 205 kVA, or 247 A. The transformer and new MCC are sized based on the next sizes up from the minimum allowed by NEC 215, as shown in the Load Study Report in Appendix B.

Table 9.2 Existing Electrical Building Process Load Summary

| | Existing AWTF Load[1] (kVA) | Modified AWTF Load[1] (kVA) | Buildout AWTF Load[1] (kVA) | New Power Source |
|---|---|---|---|---|
| Headworks | 65 [4] | 110 | 110 | MCC-17A [2] |
| Primary Clarifier | 11 [4] | 9 | 9 | MCC-17A/B [2] [3] |
| Chlorine Contact Basin | 34 [4] | 34 | 34 | MCC-17B [3] |
| Digesters | 52 [4] | 52 | 52 | MCC-17B [3] |
| Marsh Effluent Pumps | 13 [4] | - | - | - |
| Pump Station No. 2 Pond No. 3 Storm Pumps | 18 [5] | - | - | - |
| **Total** | **193** | **205** | **205** | |

Notes:
(1) Duty loads only.
(2) MCC-17A is a new MCC located at the existing Electrical Building.
(3) MCC-17B is retagged MCC-A located at the existing Electrical Building.
(4) Previously fed by MCC-A.
(5) Previously fed by the AMRI field office panel.
See Appendix A for a full list of process equipment.

### 9.4.5 Emergency Pond Pump Station and Oxidation Pond Building

A new 112.5 kVA pad-mount transformer will serve the existing 600 A MCC at 208 V/120 V at the EPPS as shown in Figure 9.4. The existing EPPS MCC will be tagged as MCC-05. At the oxidation pond building, the existing 75 kVA and existing 600 A MCC at 208 V/120 V will be maintained to provide power for the temporary Oxidation Pond No. 1 aerators. The existing oxidation pond building facilities will be abandoned or demolished once these temporary aerators are removed. A summary of EPPS and oxidation pond loads is shown in Table 9.3. The total operating load for all loads on the EPPS transformer and MCC will be approximately 80 kVA, or 222 A. The transformer is sized to power these loads and other minor loads as the pump station. The equipment sizing is shown in the Load Study Report in Appendix B. The total temporary aerator operating load will be 140 kVA, or 389 A. MCC-05 and possibly MCC-18 will also need to be sourced to provide additional power to temporary aerators, as required.

### 9.4.6 Enhancement Wetlands Pump Station

A new 12-kV feed will be stepped down to 480 V by a new 112.5 kVA pad-mount transformer at the EWPS. This transformer will serve a new 125 A control panel at 480 V at the EWPS as shown in Figure 9.4. The new control panel will separately house both 480 V distribution equipment and 120 V controls and communication equipment for the new upsized EWPS pumps. The control panel will be mounted either behind the existing kiosk or in an electrical room in the new restroom facility. This new control panel will completely replace the control panel and distribution equipment mounted in the existing kiosk. EWPS process loads are shown in Table 9.4.

Table 9.3 Emergency Pond Pump Station and Oxidation Ponds Process Load Summary

| | Existing AWTF Load[1] (kVA) | Modified AWTF Load[1] (kVA) | Buildout AWTF Load[1] (kVA) | New Power Source |
|---|---|---|---|---|
| Oxidation Pond No. 1 Temporary Aerators | - | ~140 | ~140 | MCC-05 [2]<br>MCC-16 [3]<br>MCC-18 [5] |
| Pond No. 1 Effluent Weirs | - | 3 | 3 | MCC-16 [3] |
| Pond No. 2 Effluent Weirs | 3 [4] | 13 | 14 | MCC-16 [3] |
| Emergency Pond Pump Station (EPPS) | 63 [4] | 63 | 63 | MCC-16 [3] |
| **Total** | **66** | **219** | **219** | |

Notes:
(1) Duty loads only.
(2) MCC-05 is the existing MCC located at the oxidation pond building.
(3) MCC-16 is the existing MCC located at the EPPS.
(4) Previously fed by existing MCC located at the EPPS.
(5) MCC-18 is a new MCC located at the new electrical building.
See Appendix A for a full list of process equipment.

Table 9.4 Enhancement Wetlands Process Load Summary

| | Existing AWTF Load[1] (kVA) | Modified AWTF Load[1] (kVA) | Buildout AWTF Load[1] (kVA) | New Power Source |
|---|---|---|---|---|
| Enhancement Wetlands Pump Station (EWPS) | 23 [3] | 57 | 57 | PNL09 [2] |
| **Total** | **23** | **57** | **57** | |

Notes:
(1) Duty loads only.
(2) PNL-09 is a new panel at the EWPS.
(3) Previously fed by MCC-A.
See Appendix A for a full list of process equipment.

### 9.4.7 Equipment at the Central Garage, Corporation Yard, and AMRI

New 75 kVA pad-mount transformers will replace the existing transformers at the central garage and AMRI field office. These transformers will step the 12 kV down to 208 V/120 V for the existing central garage and AMRI facilities. No other new equipment is planned for these facilities.

## 9.5 SCADA Network and Distributed PLCs

This section provides a brief overview of the existing AWTF SCADA system and their proposed modifications.

### 9.5.1 Existing SCADA Network

The exiting SCADA network block diagram is shown in Figure 9.5. Operators interface with SCADA at a workstation running a Wonderware Intouch application. The workstation

communicates with a Dell Server running Wonderware Historian Server and a Wonderware remote log in software. The server communicates with two existing Siemens S7 PLCs over wireless Ethernet bridges. These PLCs and the wireless connections were installed by the AWTF SCADA technician. The PLCs are located in the Analyzer Room and the EPPS Building.

### 9.5.2 SCADA Network Improvements and Additions

Four additional Siemens S7 PLCs will be added to the SCADA network to increase the monitoring and remote control capabilities of AWTF staff. A preliminary network diagram of the upgraded SCADA Network is shown on Figure 9.6. A PLC will be added at the new Electrical Building, the existing Electrical Building, the EWPS control panel, and the ultraviolet (UV) facility. AWTF staff has expressed interest in replacing the existing wireless communications and new communications with fiber, but are also concerned that installing fiber to all of the remote pump stations might be too costly. A cost savings alternative would be to install additional wireless communications to match existing Ethernet bridges. Another alternative would be a hybrid system, where fiber is installed to link relatively near AWTF-located facilities and use wireless Ethernet bridges where distances to wetlands areas are relatively great. Carollo recommends that a further cost and benefit analysis be done to determine which of these approaches is best for the modified facility.

### 9.5.3 SCADA Server Room Requirements

A new SCADA server room is recommended for the facility. The location will be determined based on the system, although it should be centrally located. The City has requested that he room be climate controlled and have fire suppression.

## 9.6 Energy Efficiency

This section provides a brief overview of some options to make the existing and new AWTF processes more energy efficient.

### 9.6.1 New Energy Efficiency Equipment and Existing Motors

New equipment installed for new areas and processes will be energy efficient. New energy efficient equipment includes National Electrical Manufacturer Association (NEMA) premium efficiency motors and energy efficient transformers. The overall increase in motor efficiency is approximately 5 percent with premium efficiency motors. Additionally, Carollo recommends that the large existing motors to be maintained be surveyed first for efficiency to determine if replacement could realize energy and cost savings.

### 9.6.2 LED Lighting Efficiency

New energy efficient equipment includes LED lighting as required by the DOE and Title 24. According to a 2018 assessment completed by San Francisco State University, the AWTF has existing luminaires with high pressure sodium bulbs, incandescent bulbs, linear fluorescent tubes, compact fluorescent light bulbs, and metal halide bulbs. On a recent site visit, Carollo learned that replacement of the existing site light fixtures was completed. Carollo recommends that the existing fixtures for the rest of the facilities be replaced with LED fixtures to further improve energy savings and reduce maintenance costs.

### 9.6.3 Improving Efficiency through Data

Energy can be the greatest controllable cost of operating a wastewater plant if energy consumption data is available to show how and when a plant is using energy. Carollo recommends the plant introduce a procedure for periodically collecting average motor operating current and operating hours per year for all energy-intensive electrical equipment. With more detailed input, AWTF staff can create a more detailed view of energy usage and performance at the AWTF. Gathering energy consumption data by process could be automated by incorporating meter data from each MCC in to the SCADA system and displaying it on the system workstations. To accomplish this energy tracking, Smart MCCs could be installed. These Smart MCCs are able to measure the current drawn by each load supplied from the MCC. This would enable AWTF staff to monitor how much energy is used by each process as well as how much energy is used by parallel process trains.

### 9.6.4 Solar Photovoltaic Project

The 2018 San Francisco State University assessment recommended that a solar photovoltaic system could be installed on existing building roofs to offset utility power usage by the AWTF. It is understood that the City is currently pursuing such a system under a separate project. The size of the system will be determined by the available footprint. The preliminary size estimate is approximately 60 kW.

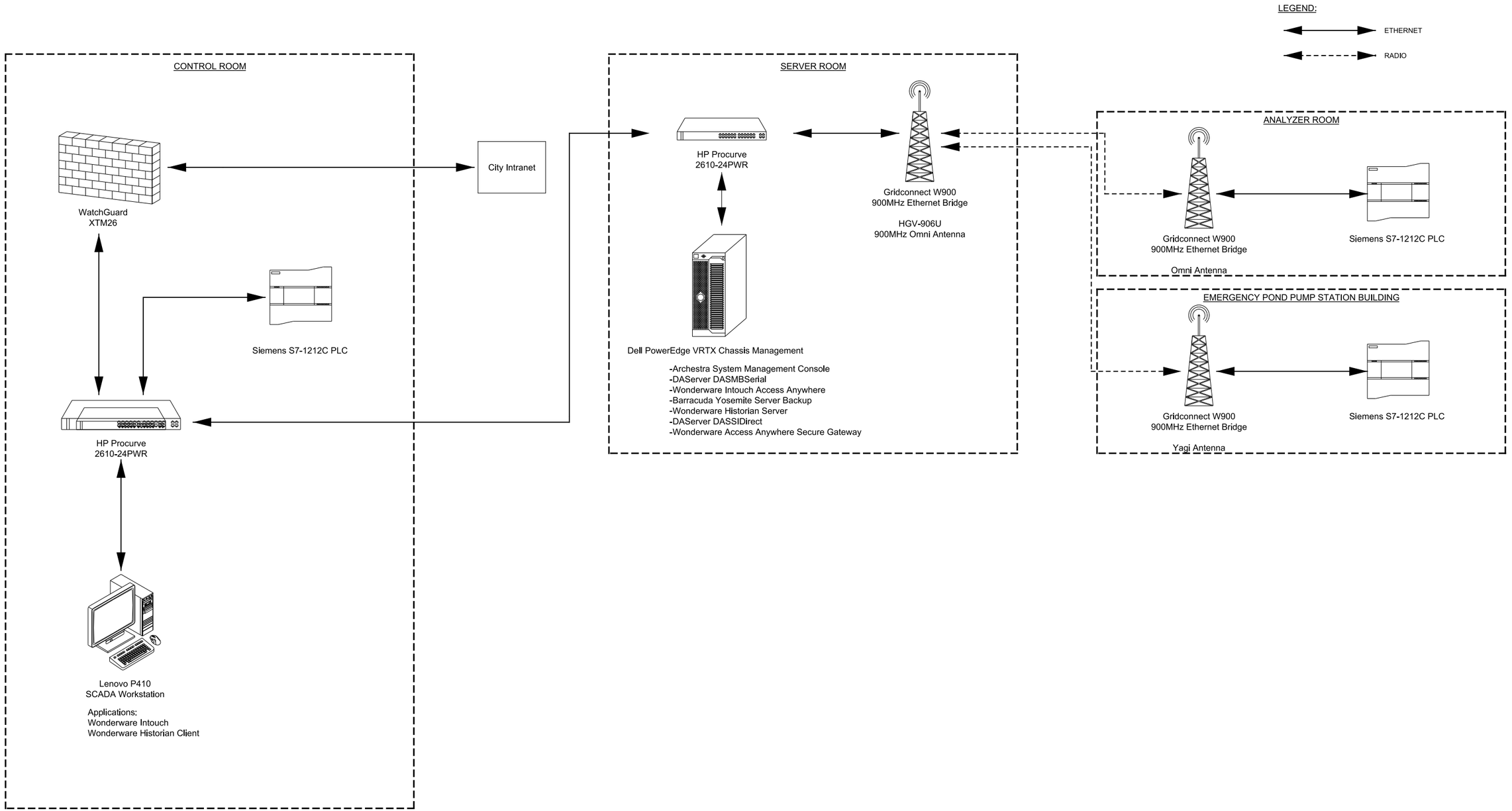



**Figure No. 9.5**

**EXISTING WASTE WATER TREATMENT PLANT NETWORK DIAGRAM**

CITY OF ARCATA

carollo

File: IP_PWP:d0794338\9913B10FIG9.5.dgn

Plot Date: 13-AUG-2018 1:10:29 PM

User: cyoung

File: IP_PWP:d0794338\9913B10FIG9.6.dgn
Plot Date: 13-AUG-2018 1:10:50 PM
User: cyoung

LEGEND:

ETHERNET

RADIO (ALTERNATIVE TO RADIO IS FIBER)

CONTROL ROOM

WatchGuard
XTM26

City Intranet

Siemens S7-1212C PLC

HP Procurve
2610-24PWR

Lenovo P410
SCADA Workstation

Applications:
Wonderware Intouch
Wonderware Historian Client

SERVER ROOM

HP Procurve
2610-24PWR

Gridconnect W900
900MHz Ethernet Bridge

HGV-906U
900MHz Omni Antenna

Dell PowerEdge VRTX Chassis Management

-Archestra System Management Console
-DAServer DASMBSerial
-Wonderware Intouch Access Anywhere
-Barracuda Yosemite Server Backup
-Wonderware Historian Server
-DAServer DASSIDirect
-Wonderware Access Anywhere Secure Gateway

ANALYZER ROOM

Gridconnect W900
900MHz Ethernet Bridge

Siemens S7-1212C PLC

Omni Antenna

EMERGENCY POND PUMP STATION BUILDING

Gridconnect W900
900MHz Ethernet Bridge

Siemens S7-1212C PLC

Yagi Antenna

ENHANCEMENT WETLANDS PUMP STATION

Siemens S7-1212C PLC

Gridconnect W900
900MHz Ethernet Bridge

Yagi Antenna

NEW ELECTRICAL BUILDING

Gridconnect W900
900MHz Ethernet Bridge

Siemens S7-1212C PLC

Yagi Antenna

UV FACILITY

Siemens S7-1212C PLC

Gridconnect W900
900MHz Ethernet Bridge

Yagi Antenna

EXISTING ELECTRICAL BUILDING

Gridconnect W900
900MHz Ethernet Bridge

Siemens S7-1212C PLC

Yagi Antenna

**Figure No. 9.6**

**MODIFIED WASTE WATER TREATMENT PLANT NETWORK DIAGRAM**

CITY OF ARCATA

carollo

Appendix A

# EQUIPMENT LIST REPORT

# EQUIPMENT LIST REPORT

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS<br>PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:19 PM |

## 00 | OPERATIONS BUILDING & LAB

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [None] | [None] | | | | | | | | | | | |

## 01 | HEADWORKS

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | COMPACTOR | | DEMO | DUTY | CONSTANT SPEED | 2.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| 01-AGI-301 | GRIT WASHER AGITATOR | | NEW | DUTY | CONSTANT SPEED | 1.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 01-BAR-201 | SCREEN DRIVE NO. 1 | | NEW | DUTY | CONSTANT SPEED | 1.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 01-BAR-202 | SCREEN DRIVE NO. 2 | | NEW | DUTY | CONSTANT SPEED | 1.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 01-BSR-201 | SCREEN RAKE NO. 1 | | NEW | DUTY | CONSTANT SPEED | 2.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 01-BSR-202 | SCREEN RAKE NO. 2 | | NEW | DUTY | CONSTANT SPEED | 2.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 01-CLA-301 | GRIT CLASSIFIER | | NEW | DUTY | CONSTANT SPEED | 1.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 01-COL-301 | GRIT COLLECTOR | | NEW | DUTY | CONSTANT SPEED | 1.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 01-CON-201 | SCREW CONVEYOR | | NEW | DUTY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 01-PMP-101 | INFLUENT PUMP NO. 1 | | NEW | DUTY | VARIABLE SPEED | 25.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 01-PMP-102 | INFLUENT PUMP NO. 2 | | NEW | DUTY | VARIABLE SPEED | 25.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 01-PMP-103 | INFLUENT PUMP NO. 3 | | NEW | STANDBY | VARIABLE SPEED | 25.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 01-PMP-104 | INFLUENT PUMP NO. 4 | | NEW | DUTY | VARIABLE SPEED | 10.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 01-PMP-301 | GRIT PUMP NO. 1 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 01-PMP-302 | GRIT PUMP NO. 2 | | NEW | STANDBY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 01-WCO-201 | SCREENINGS WASHER/COMPACTOR NO. 1 | | NEW | DUTY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 01-WCO-202 | SCREENINGS WASHER/COMPACTOR NO. 2 | | NEW | STANDBY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 01-WSH-301 | GRIT WASHER DRIVE | | NEW | DUTY | CONSTANT SPEED | 1.5 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| M-B-13-1 | GRIT CHAMBER RAKE | | DEMO | DUTY | CONSTANT SPEED | 0.5 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| M-B-4-1 | EAST SCREW PUMP | | DEMO | DUTY | VARIABLE SPEED | 15.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| M-B-4-2 | WEST SCREW PUMP | | DEMO | DUTY | VARIABLE SPEED | 15.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| M-B-7-1 | EAST BAR SCREEN | | DEMO | DUTY | CONSTANT SPEED | 0.8 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| M-B-7-2 | WEST BAR SCREEN | | DEMO | DUTY | CONSTANT SPEED | 0.8 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| M-B-8-1 | SCREENING CONVEYOR | | DEMO | DUTY | CONSTANT SPEED | 1.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| M-B-9-1 | GRIT CYCLONE | | DEMO | DUTY | CONSTANT SPEED | 0.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| M-B-9-2 | GRIT CLASSIFIER | | DEMO | DUTY | CONSTANT SPEED | 1.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| M-P-5-1 | EAST GREASE PUMP | | DEMO | DUTY | CONSTANT SPEED | 0.3 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| M-P-5-2 | WEST GREASE PUMP | | DEMO | DUTY | CONSTANT SPEED | 0.3 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| P-B-11-1 | GRIT PUMP #1 - NORTH | | DEMO | DUTY | CONSTANT SPEED | 7.5 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| P-B-11-2 | GRIT PUMP #2 - SOUTH | | DEMO | DUTY | CONSTANT SPEED | 7.5 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS<br>PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:19 PM |

## 02 | PRIMARY CLARIFIER

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02-PMP-201 | PRIMARY SLUDGE PUMP NO. 1 | | NEW | DUTY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 02-PMP-202 | PRIMARY SLUDGE PUMP NO. 2 | | NEW | STANDBY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 02-PMP-301 | PRIMARY SCUM PUMP NO. 1 | | NEW | DUTY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| 02-PMP-302 | PRIMARY SCUM PUMP NO. 2 | | NEW | STANDBY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-17A | N | Outdoor |
| M-C-1 | 26' PRIMARY CLARIFIER MECHANISM | | DEMO | DUTY | CONSTANT SPEED | 0.8 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| M-C-2 | 60' PRIMARY CLARIFIER MECHANISM | | EXISTING | DUTY | CONSTANT SPEED | 0.8 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| P-C-3-1 | PRIMARY SLUDGE PUMP #1 | | DEMO | DUTY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| P-C-3-2 | PRIMARY SLUDGE PUMP #2 | | DEMO | DUTY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| P-C-3-3 | PRIMARY SLUDGE PUMP #3 | | DEMO | STANDBY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |

## 03 | OXIDATION DITCHES

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 03-AER-101 | AERATOR NO. 1 | | NEW | DUTY | VARIABLE SPEED | 125.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 03-AER-102 | AERATOR NO. 2 | | NEW | DUTY | VARIABLE SPEED | 125.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 03-AER-103 | AERATOR NO. 3 | | FUTURE | DUTY | VARIABLE SPEED | 125.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 03-AER-104 | AERATOR NO. 4 | | FUTURE | DUTY | VARIABLE SPEED | 125.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |

## 04 | SECONDARY CLARIFIER

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 04-CLR-101 | SECONDARY CLARIFIER DRIVE NO. 1 | | NEW | DUTY | CONSTANT SPEED | 1.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 04-CLR-102 | SECONDARY CLARIFIER DRIVE NO. 2 | | NEW | DUTY | CONSTANT SPEED | 1.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 04-CLR-103 | SECONDARY CLARIFIER DRIVE NO. 3 | | FUTURE | DUTY | CONSTANT SPEED | 1.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 04-PMP-201 | SECONDARY SCUM PUMP NO. 1 | | NEW | DUTY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 04-PMP-202 | SECONDARY SCUM PUMP NO. 2 | | NEW | STANDBY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 04-PMP-203 | SECONDARY SCUM PUMP NO. 3 | | NEW | DUTY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 04-PMP-204 | SECONDARY SCUM PUMP NO. 4 | | NEW | STANDBY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 04-PMP-205 | SECONDARY SCUM PUMP NO. 5 | | FUTURE | DUTY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 04-PMP-206 | SECONDARY SCUM PUMP NO. 6 | | FUTURE | STANDBY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |

## 05 | OXIDATION PONDS

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05-AER-101 | AERATOR NO. 1 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-102 | AERATOR NO. 2 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-103 | AERATOR NO. 3 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |

## PROJECT INFORMATION

**PROJECT** ARCATA WWTF IMPROVEMENTS
PRELIMINARY DESIGN
**CLIENT** CITY OF ARCATA
**PROJECT NUMBER** 9913B10
**REPORT BY** ERIK BAHNEMAN
**REPORT DATE** 8/14/2018 4:19 PM

## 05 | OXIDATION PONDS

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05-AER-104 | AERATOR NO. 4 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-105 | AERATOR NO. 5 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-106 | AERATOR NO. 6 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-107 | AERATOR NO. 7 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-108 | AERATOR NO. 8 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-109 | AERATOR NO. 9 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-110 | AERATOR NO. 10 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-111 | AERATOR NO. 11 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-112 | AERATOR NO. 12 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-113 | AERATOR NO. 13 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-114 | AERATOR NO. 14 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-115 | AERATOR NO. 15 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-116 | AERATOR NO. 16 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-117 | AERATOR NO. 17 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-118 | AERATOR NO. 18 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-119 | AERATOR NO. 19 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-120 | AERATOR NO. 20 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-121 | AERATOR NO. 21 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-122 | AERATOR NO. 22 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-123 | AERATOR NO. 23 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-AER-124 | AERATOR NO. 24 | | NEW | DUTY | CONSTANT SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-GAT-401 | POND 2 EFFLUENT WEIR GATE NO. 1 | | EXISTING | DUTY | CONSTANT SPEED | 1.0 | HP | 208 | 3 | MCC-16 | N | Outdoor |
| 05-GAT-402 | POND 2 EFFLUENT WEIR GATE NO. 2 | | EXISTING | DUTY | CONSTANT SPEED | 1.0 | HP | 208 | 3 | MCC-16 | N | Outdoor |
| 05-GAT-403 | POND 2 EFFLUENT WEIR GATE NO. 3 | | NEW | DUTY | CONSTANT SPEED | 1.0 | HP | 208 | 3 | MCC-16 | N | Outdoor |
| 05-GAT-404 | POND 2 EFFLUENT WEIR GATE NO. 4 | | NEW | DUTY | CONSTANT SPEED | 1.0 | HP | 208 | 3 | MCC-16 | N | Outdoor |
| 05-GAT-405 | POND 2 EFFLUENT WEIR GATE NO. 5 | | NEW | DUTY | CONSTANT SPEED | 1.0 | HP | 208 | 3 | MCC-16 | N | Outdoor |
| 05-GAT-406 | POND 2 EFFLUENT WEIR GATE NO. 6 | | NEW | DUTY | CONSTANT SPEED | 1.0 | HP | 208 | 3 | MCC-16 | N | Outdoor |
| 05-GAT-407 | POND 2 EFFLUENT WEIR GATE NO. 7 | | NEW | DUTY | CONSTANT SPEED | 1.0 | HP | 208 | 3 | MCC-16 | N | Outdoor |
| 05-GAT-408 | POND 2 EFFLUENT WEIR GATE NO. 8 | | NEW | DUTY | CONSTANT SPEED | 1.0 | HP | 208 | 3 | MCC-16 | N | Outdoor |
| 05-GAT-409 | POND 1 EFFLUENT WEIR GATE NO. 1 | | NEW | DUTY | CONSTANT SPEED | 1.0 | HP | 208 | 3 | MCC-16 | N | Outdoor |
| 05-GAT-410 | POND 1 EFFLUENT WEIR GATE NO. 2 | | NEW | DUTY | CONSTANT SPEED | 1.0 | HP | 208 | 3 | MCC-16 | N | Outdoor |
| 05-PMP-201 | POND PUMP STATION PUMP NO. 1 | | NEW | DUTY | VARIABLE SPEED | 25.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-PMP-202 | POND PUMP STATION PUMP NO. 2 | | NEW | DUTY | VARIABLE SPEED | 25.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 05-PMP-203 | POND PUMP STATION PUMP NO. 3 | | NEW | STANDBY | VARIABLE SPEED | 25.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| P-E-9-1 | POND PUMP STATION PUMP #1 | | DEMO | DUTY | CONSTANT SPEED | 7.5 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |

# EQUIPMENT LIST REPORT

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS<br>PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:19 PM |

## 05 | OXIDATION PONDS

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P-E-9-2 | POND PUMP STATION PUMP #2 | | DEMO | DUTY | CONSTANT SPEED | 7.5 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| P-E-9-3 | POND PUMP STATION PUMP #3 | | DEMO | STANDBY | CONSTANT SPEED | 7.5 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |

## 06 | TREATMENT WETLANDS

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TREATMENT WETLANDS 4 PUMP | | DEMO | DUTY | CONSTANT SPEED | 7.5 | HP | 208 | 3 | PNL-20 | N | Outdoor |
| 06-PMP-101 | PUMP STATION 1 PUMP NO. 1 | | NEW | DUTY | VARIABLE SPEED | 10.0 | HP | 480 | 3 | MCC-18 | N | |
| 06-PMP-102 | PUMP STATION 1 PUMP NO. 2 | | NEW | DUTY | VARIABLE SPEED | 10.0 | HP | 480 | 3 | MCC-18 | N | |
| 06-PMP-103 | PUMP STATION 1 PUMP NO. 3 | | NEW | STANDBY | VARIABLE SPEED | 10.0 | HP | 480 | 3 | MCC-18 | N | |
| 06-PMP-201 | TREATMENT WETLANDS 4 PUMP NO. 1 | | NEW | DUTY | CONSTANT SPEED | 5.0 | HP | 480 | 3 | MCC-18 | N | |
| P-E-8-1 | MARSH EFFLUENT PUMP #1 | | DEMO | DUTY | CONSTANT SPEED | 5.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| P-E-8-2 | MARSH EFFLUENT PUMP #2 | | DEMO | DUTY | CONSTANT SPEED | 5.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| P-E-8-3 | MARSH EFFLUENT PUMP #3 | | DEMO | STANDBY | CONSTANT SPEED | 5.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |

## 07 | UV DISINFECTION

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 07-UVB-101 | UV BANK NO. 1 | | NEW | DUTY | | 12.7 | KW | 480 | 3 | MCC-18 | N | Outdoor |
| 07-UVB-102 | UV BANK NO. 2 | | NEW | DUTY | | 12.7 | KW | 480 | 3 | MCC-18 | N | Outdoor |
| 07-UVB-103 | UV BANK NO. 3 | | NEW | DUTY | | 12.7 | KW | 480 | 3 | MCC-18 | N | Outdoor |
| 07-UVB-104 | UV BANK NO. 4 | | NEW | STANDBY | | 12.7 | KW | 480 | 3 | MCC-18 | N | Outdoor |

## 08 | CHLORINE CONTACT BASIN

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WATER CHAMP #1 - EAST CL2 | | EXISTING | DUTY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| | WATER CHAMP #2 - MIDDLE CL2 | | EXISTING | DUTY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| | WATER CHAMP #3 - WEST SO2 | | EXISTING | DUTY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| | CHLORINE CONTACT BASIN SUMP PUMP #1 - WEST | | EXISTING | DUTY | CONSTANT SPEED | 5.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| | CHLORINE CONTACT BASIN SUMP PUMP #2 - EAST | | EXISTING | DUTY | CONSTANT SPEED | 5.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | Outdoor |
| P-E-1-1 | SAMPLE PUMP NO. 1 | | EXISTING | DUTY | CONSTANT SPEED | 0.8 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | |
| P-E-1-2 | SAMPLE PUMP NO. 2 | | EXISTING | DUTY | CONSTANT SPEED | 0.8 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | |
| P-E-1-3 | SAMPLE PUMP NO. 3 | | EXISTING | DUTY | CONSTANT SPEED | 0.8 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | |
| P-E-1-4 | SAMPLE PUMP NO. 4 | | EXISTING | DUTY | CONSTANT SPEED | 0.8 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | |
| P-E-1-5 | SAMPLE PUMP NO. 5 | | EXISTING | DUTY | CONSTANT SPEED | 0.8 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | |

# EQUIPMENT LIST REPORT

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS<br>PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:19 PM |

## 09 | ENHANCEMENT WETLANDS

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 09-PMP-101 | ENHANCEMENT WETLANDS PUMP NO. 1 | | NEW | DUTY | VARIABLE SPEED | 25.0 | HP | 480 | 3 | PNL-09 (OLD MSP-40) | N | Indoor |
| 09-PMP-102 | ENHANCEMENT WETLANDS PUMP NO. 2 | | NEW | DUTY | VARIABLE SPEED | 25.0 | HP | 480 | 3 | PNL-09 (OLD MSP-40) | N | Indoor |
| 09-PMP-103 | ENHANCEMENT WETLANDS PUMP NO. 3 | | NEW | STANDBY | VARIABLE SPEED | 25.0 | HP | 480 | 3 | PNL-09 (OLD MSP-40) | N | Indoor |
| P-E-40-1 | WETLANDS PUMP #1 | | DEMO | DUTY | CONSTANT SPEED | 10.0 | HP | 480 | 3 | PNL-09 (OLD MSP-40) | N | Indoor |
| P-E-40-2 | WETLANDS PUMP #2 | | DEMO | DUTY | CONSTANT SPEED | 10.0 | HP | 480 | 3 | PNL-09 (OLD MSP-40) | N | Indoor |
| P-E-40-3 | WETLANDS PUMP #3 | | DEMO | STANDBY | CONSTANT SPEED | 10.0 | HP | 480 | 3 | PNL-09 (OLD MSP-40) | N | Indoor |

## 10 | RAS PUMP STATION

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10-PMP-101 | RAS PUMP NO. 1 | | NEW | DUTY | VARIABLE SPEED | 5.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 10-PMP-102 | RAS PUMP NO. 2 | | NEW | STANDBY | VARIABLE SPEED | 5.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |

## 11 | WAS PUMP STATION

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11-PMP-101 | WAS PUMP NO. 1 | | NEW | DUTY | VARIABLE SPEED | 0.5 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 11-PMP-102 | WAS PUMP NO. 2 | | NEW | STANDBY | VARIABLE SPEED | 0.5 | HP | 480 | 3 | MCC-18 | N | Outdoor |

## 12 | THICKENING

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12-PMP-201 | TWAS PUMP NO. 1 | | NEW | DUTY | VARIABLE SPEED | 10.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 12-PMP-202 | TWAS PUMP NO. 2 | | NEW | STANDBY | VARIABLE SPEED | 10.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 12-THI-101 | THICKENER NO. 1 | | NEW | DUTY | CONSTANT SPEED | 5.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 12-THI-102 | THICKENER NO. 2 | | NEW | STANDBY | CONSTANT SPEED | 5.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |

## 13 | DIGESTERS

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M-F-10 | DIGESTER GAS BOOSTER | | EXISTING | DUTY | CONSTANT SPEED | 3.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | |
| M-F-6 | RADIATOR FAN | | EXISTING | DUTY | CONSTANT SPEED | 2.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | |
| P-F-1-1 | 4" CHOPPER SLUDGE RECIRCULATION PUMP | | EXISTING | DUTY | CONSTANT SPEED | 5.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | |
| P-F-2 | SLUDGE TRANSFER PUMP | | EXISTING | DUTY | CONSTANT SPEED | 7.5 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | |
| P-F-2-2 | 6" CHOPPER SLUDGE RECIRCULATION PUMP | | EXISTING | DUTY | CONSTANT SPEED | 25.0 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | |
| P-F-3-2 | WATER CIRCULATION PUMP | | EXISTING | DUTY | CONSTANT SPEED | 0.8 | HP | 480 | 3 | MCC-17B (OLD MCC-A) | N | |

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS<br>PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:19 PM |

## 14 | ALKALINITY FEED SYSTEM

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14-MIX-301 | ALKALINITY TANK MIXER NO. 1 | | NEW | DUTY | CONSTANT SPEED | 1.5 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 14-MIX-302 | ALKALINITY TANK MIXER NO. 2 | | NEW | DUTY | CONSTANT SPEED | 1.5 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 14-PMP-101 | ALKALINITY FEED PUMP NO. 1 | | NEW | DUTY | VARIABLE SPEED | 1.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 14-PMP-102 | ALKALINITY FEED PUMP NO. 2 | | NEW | STANDBY | VARIABLE SPEED | 1.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 14-PMP-201 | ALKALINITY SYSTEM TRANSFER PUMP | | NEW | DUTY | CONSTANT SPEED | 10.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 14-PMP-401 | SUMP PUMP | | NEW | DUTY | CONSTANT SPEED | 0.8 | HP | 480 | 3 | MCC-18 | N | Outdoor |

## 15 | PLANT WATER SYSTEM

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15-PMP-301 | 3W PUMP NO. 1 | | NEW | DUTY | VARIABLE SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |
| 15-PMP-302 | 3W PUMP NO. 2 | | NEW | STANDBY | VARIABLE SPEED | 15.0 | HP | 480 | 3 | MCC-18 | N | Outdoor |

## 16 | STORMWATER SYSTEM

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PUMP STATION 2 POND 3 STORM PUMP #1 | | DEMO | DUTY | CONSTANT SPEED | 7.5 | HP | 208 | 3 | PNL-06 | N | Indoor |
| | PUMP STATION 2 POND 3 STORM PUMP #2 | | DEMO | DUTY | CONSTANT SPEED | 7.5 | HP | 208 | 3 | PNL-06 | N | Indoor |
| 05-PMP-301 | EMERGENCY POND PUMP STATION PUMP NO. 1 | | EXISTING | DUTY | CONSTANT SPEED | 30.0 | HP | 208 | 3 | MCC-16 | N | Indoor |
| 05-PMP-302 | EMERGENCY POND PUMP STATION PUMP NO. 2 | | EXISTING | DUTY | CONSTANT SPEED | 30.0 | HP | 208 | 3 | MCC-16 | N | Indoor |

## 18 | NEW ELECTRICAL BUILDING

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [None] | [None] | | | | | | | | | | | |

## 20 | AUTO SHOP

| TAG | DESCRIPTION | SPEC SECTION | STATUS | SERVICE | LOAD TYPE | LOAD VALUE | LOAD UNITS | VOLTS | PHASE | POWER SOURCE | GEN POWER | ENVIRONMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [None] | [None] | | | | | | | | | | | |

*Date/Time displayed in this report reflect time in PST*

Appendix B

# LOAD STUDY REPORT

# LOAD STUDY REPORT

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:18 PM |

## EQUIPMENT INFORMATION

| | | | |
|---|---|---|---|
| **TAG** | SWGR-18 | | |
| **DESCRIPTION** | NEW ELECTRICAL BUILDING SWITHGEAR | **PHASE, WIRE, KASC** | 3PH, 3W, 35 KAIC KASC |
| **LOCATION** | NEW ELECTRICAL BUILDING | **LARGEST MOTOR** | 125HP |
| **VOLTAGE** | 12470 | **COMMENTS** | |
| **BUS AMPS** | 600 | | |

## LOAD TOTALS

| OPERATING KVA | OPERATING AMPS |
|---|---|
| 1481.1 | 68.6 |

## NEC 215 EQUIPMENT SIZING

| EQUIPMENT KVA | EQUIPMENT AMPS |
|---|---|
| 1851.3 | 85.7 |

## NEC 430 EQUIPMENT SIZING

| EQUIPMENT KVA | EQUIPMENT AMPS |
|---|---|
| 1523.0 | 70.5 |

**DEFINITIONS**

OPERATING = CONTINUOUS + INTERMITTENT

NEC 215 EQUIPMENT SIZING = 1.25 x CONTINUOUS + 1.0 x INTERMITTENT (BASED ON NEC ARTICLE 215)

NEC 430 EQUIPMENT SIZING = 1.25 x LARGEST MOTOR + 1.0 x ALL OTHER MOTORS + 1.25 x CONTINUOUS NON-MOTOR + 1.0 x INTERMITTENT NON-MOTOR (BASED ON NEC ARTICLE 430)

EQUIPMENT SIZING IS BASED ON THE LARGER OF NEC 215 AND NEC 430 CALCULATIONS (LARGER IS HIGHLIGHTED WHEN APPLICABLE)

*Note: For 3-phase busses that feed single -phase loads, the amp summation under loads will not match the bus amps due to the difference in voltage.*

*Note: The values in this report are rounded from higher precision numbers. Manually summing the values shown may yield slightly varied results due to rounding error.*

## SUBFED EQUIPMENT

| TAG | DESCRIPTION | EQUIPMENT SIZE | EQUIPMENT UNITS | STATUS | OPERATING KVA | OPERATING AMPS | BUS COMMENTS |
|---|---|---|---|---|---|---|---|
| XFMR-05 | OXIDATION PONDS TRANSFORMER | 150.0 | KVA | EXISTING | 0.0 | 0.0 | |
| XFMR-06 | AMRI FIELD OFFICE TRANSFORMER | 75.0 | KVA | NEW | 0.0 | 0.0 | |
| XFMR-09 | EWPS TRANSFORMER | 112.5 | KVA | NEW | 56.5 | 2.6 | |
| XFMR-16 | EMERGENCY PUMP STATION TRANSFORMER | 112.5 | KVA | NEW | 80.0 | 3.7 | |
| XFMR-17 | EXISTING ELECTRICAL BUILDING NEW TRANSFORMER | 275.0 | KVA | NEW | 202.9 | 9.4 | |
| XFMR-18 | NEW ELECTRICAL BUILDING TRANSFORMER | 1,500.0 | KVA | NEW | 1141.6 | 52.9 | |
| XFMR-20 | CENTRAL GARAGE TRANSFORMER | 75.0 | KVA | NEW | 0.0 | 0.0 | |
| | | | | OPERATING LOAD SUBFED SUBTOTAL | 1481.1 | 68.6 | |

*Date/Time displayed in this report reflect time in PST*

# LOAD STUDY REPORT

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:18 PM |

## EQUIPMENT INFORMATION

| | | | |
|---|---|---|---|
| **TAG** | MCC-05 | | |
| **DESCRIPTION** | OXIDATION PONDS MCC | **PHASE, WIRE, KASC** | 3PH, 4W, 42 KAIC KASC |
| **LOCATION** | OXIDATION PONDS | **LARGEST MOTOR** | 0HP |
| **VOLTAGE** | 208 | **COMMENTS** | |
| **BUS AMPS** | 600 | | |

## LOAD TOTALS

| OPERATING KVA | OPERATING AMPS |
|---|---|
| 0.0 | 0.0 |

## NEC 215 EQUIPMENT SIZING

| EQUIPMENT KVA | EQUIPMENT AMPS |
|---|---|
| 0.0 | 0.0 |

## NEC 430 EQUIPMENT SIZING

| EQUIPMENT KVA | EQUIPMENT AMPS |
|---|---|
| 0.0 | 0.0 |

**DEFINITIONS**

OPERATING = CONTINUOUS + INTERMITTENT

NEC 215 EQUIPMENT SIZING = 1.25 x CONTINUOUS + 1.0 x INTERMITTENT (BASED ON NEC ARTICLE 215)

NEC 430 EQUIPMENT SIZING = 1.25 x LARGEST MOTOR + 1.0 x ALL OTHER MOTORS + 1.25 x CONTINUOUS NON-MOTOR + 1.0 x INTERMITTENT NON-MOTOR (BASED ON NEC ARTICLE 430)

EQUIPMENT SIZING IS BASED ON THE LARGER OF NEC 215 AND NEC 430 CALCULATIONS (LARGER IS HIGHLIGHTED WHEN APPLICABLE)

*Note: For 3-phase busses that feed single -phase loads, the amp summation under loads will not match the bus amps due to the difference in voltage.*

*Note: The values in this report are rounded from higher precision numbers. Manually summing the values shown may yield slightly varied results due to rounding error.*

## SUBFED EQUIPMENT

| TAG | DESCRIPTION | EQUIPMENT SIZE | EQUIPMENT UNITS | STATUS | OPERATING KVA | OPERATING AMPS | BUS COMMENTS |
|---|---|---|---|---|---|---|---|
| PANEL "P" | LIGHTING PANEL | 100.0 | AMPS | EXISTING | 0.0 | 0.0 | |
| | | | | OPERATING LOAD SUBFED SUBTOTAL | 0.0 | 0.0 | |

*Date/Time displayed in this report reflect time in PST*

# LOAD STUDY REPORT

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:18 PM |

## EQUIPMENT INFORMATION

| | | | |
|---|---|---|---|
| **TAG** | PNL-06 | | |
| **DESCRIPTION** | AMRI FIELD OFFICE PANEL | **PHASE, WIRE, KASC** | 3PH, 4W, 65 KAIC KASC |
| **LOCATION** | TREATMENT WETLANDS | **LARGEST MOTOR** | 0HP |
| **VOLTAGE** | 208 | **COMMENTS** | |
| **BUS AMPS** | 100 | | |

## LOAD TOTALS

| OPERATING KVA | OPERATING AMPS |
|---|---|
| 0.0 | 0.0 |

## NEC 215 EQUIPMENT SIZING

| EQUIPMENT KVA | EQUIPMENT AMPS |
|---|---|
| 0.0 | 0.0 |

## NEC 430 EQUIPMENT SIZING

| EQUIPMENT KVA | EQUIPMENT AMPS |
|---|---|
| 0.0 | 0.0 |

**DEFINITIONS**

OPERATING = CONTINUOUS + INTERMITTENT

NEC 215 EQUIPMENT SIZING = 1.25 x CONTINUOUS + 1.0 x INTERMITTENT (BASED ON NEC ARTICLE 215)

NEC 430 EQUIPMENT SIZING = 1.25 x LARGEST MOTOR + 1.0 x ALL OTHER MOTORS + 1.25 x CONTINUOUS NON-MOTOR + 1.0 x INTERMITTENT NON-MOTOR (BASED ON NEC ARTICLE 430)

EQUIPMENT SIZING IS BASED ON THE LARGER OF NEC 215 AND NEC 430 CALCULATIONS (LARGER IS HIGHLIGHTED WHEN APPLICABLE)

*Note: For 3-phase busses that feed single -phase loads, the amp summation under loads will not match the bus amps due to the difference in voltage.*

*Note: The values in this report are rounded from higher precision numbers. Manually summing the values shown may yield slightly varied results due to rounding error.*

## LOADS

| TAG | DESCRIPTION | LOAD VALUE | LOAD UNITS | STARTING METHOD | LOAD DESIGNATION | LOAD STATUS | OPERATING KVA | OPERATING AMPS | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|
| | PUMP STATION 2 POND 3 STORM PUMP #1 | 7.50 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 0.0 | |
| | PUMP STATION 2 POND 3 STORM PUMP #2 | 7.50 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 0.0 | |
| | | | | | | OPERATING LOAD SUBTOTAL | 0.0 | 0.0 | |

*Date/Time displayed in this report reflect time in PST*

# LOAD STUDY REPORT

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:18 PM |

## EQUIPMENT INFORMATION

| | | | |
|---|---|---|---|
| **TAG** | PNL-09 (OLD MSP-40) | | |
| **DESCRIPTION** | WETLANDS EFFLUENT DISTRIBUTION PANEL | **PHASE, WIRE, KASC** | 3PH, 3W, 42 KAIC KASC |
| **LOCATION** | ENHANCEMENT WETLANDS | **LARGEST MOTOR** | 25HP |
| **VOLTAGE** | 480 | **COMMENTS** | |
| **BUS AMPS** | 100 | | |

## LOAD TOTALS

| OPERATING KVA | OPERATING AMPS |
|---|---|
| 56.5 | 68.0 |

## NEC 215 EQUIPMENT SIZING

| EQUIPMENT KVA | EQUIPMENT AMPS |
|---|---|
| 70.7 | 85.0 |

## NEC 430 EQUIPMENT SIZING

| EQUIPMENT KVA | EQUIPMENT AMPS |
|---|---|
| 63.6 | 76.5 |

**DEFINITIONS**

OPERATING = CONTINUOUS + INTERMITTENT

NEC 215 EQUIPMENT SIZING = 1.25 x CONTINUOUS + 1.0 x INTERMITTENT (BASED ON NEC ARTICLE 215)

NEC 430 EQUIPMENT SIZING = 1.25 x LARGEST MOTOR + 1.0 x ALL OTHER MOTORS + 1.25 x CONTINUOUS NON-MOTOR + 1.0 x INTERMITTENT NON-MOTOR (BASED ON NEC ARTICLE 430)

EQUIPMENT SIZING IS BASED ON THE LARGER OF NEC 215 AND NEC 430 CALCULATIONS (LARGER IS HIGHLIGHTED WHEN APPLICABLE)

*Note: For 3-phase busses that feed single -phase loads, the amp summation under loads will not match the bus amps due to the difference in voltage.*

*Note: The values in this report are rounded from higher precision numbers. Manually summing the values shown may yield slightly varied results due to rounding error.*

## SUBFED EQUIPMENT

| TAG | DESCRIPTION | EQUIPMENT SIZE | EQUIPMENT UNITS | STATUS | OPERATING KVA | OPERATING AMPS | BUS COMMENTS |
|---|---|---|---|---|---|---|---|
| MPC-XFMR-09 | WETLANDS EFFLUENT MINI POWER CENTER XFMR | 0.0 | KVA | EXISTING | 0.0 | 0.0 | |
| | | | | OPERATING LOAD SUBFED SUBTOTAL | 0.0 | 0.0 | |

## LOADS

| TAG | DESCRIPTION | LOAD VALUE | LOAD UNITS | STARTING METHOD | LOAD DESIGNATION | LOAD STATUS | OPERATING KVA | OPERATING AMPS | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|
| 09-PMP-101 | ENHANCEMENT WETLANDS PUMP NO. 1 | 25 | HP | VFD-6 | DUTY / CONTINUOUS | NEW | 28.3 | 34.0 | |
| 09-PMP-102 | ENHANCEMENT WETLANDS PUMP NO. 2 | 25 | HP | VFD-6 | DUTY / CONTINUOUS | NEW | 28.3 | 34.0 | |
| 09-PMP-103 | ENHANCEMENT WETLANDS PUMP NO. 3 | 25 | HP | VFD-6 | STANDBY | NEW | 28.3 | 34.0 | |
| P-E-40-1 | WETLANDS PUMP #1 | 10 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 14.0 | |
| P-E-40-2 | WETLANDS PUMP #2 | 10 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 14.0 | |
| P-E-40-3 | WETLANDS PUMP #3 | 10 | HP | FVNR | STANDBY | DEMO | | 14.0 | |
| | | | | | | OPERATING LOAD SUBTOTAL | 84.8 | 144.0 | |

*Date/Time displayed in this report reflect time in PST*

# LOAD STUDY REPORT

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:18 PM |

## EQUIPMENT INFORMATION

| | | | |
|---|---|---|---|
| **TAG** | MCC-16 | | |
| **DESCRIPTION** | EMERGENCY PUMP STATION MCC | **PHASE, WIRE, KASC** | 3PH, 4W, 65 KAIC KASC |
| **LOCATION** | STORMWATER SYSTEM | **LARGEST MOTOR** | 30HP |
| **VOLTAGE** | 208 | **COMMENTS** | |
| **BUS AMPS** | 600 | | |

## LOAD TOTALS

| OPERATING KVA | OPERATING AMPS |
|---|---|
| 80.0 | 222.0 |

## NEC 215 EQUIPMENT SIZING

| EQUIPMENT KVA | EQUIPMENT AMPS |
|---|---|
| 100.0 | 277.5 |

## NEC 430 EQUIPMENT SIZING

| EQUIPMENT KVA | EQUIPMENT AMPS |
|---|---|
| 87.9 | 244.0 |

**DEFINITIONS**

OPERATING = CONTINUOUS + INTERMITTENT

NEC 215 EQUIPMENT SIZING = 1.25 x CONTINUOUS + 1.0 x INTERMITTENT (BASED ON NEC ARTICLE 215)

NEC 430 EQUIPMENT SIZING = 1.25 x LARGEST MOTOR + 1.0 x ALL OTHER MOTORS + 1.25 x CONTINUOUS NON-MOTOR + 1.0 x INTERMITTENT NON-MOTOR (BASED ON NEC ARTICLE 430)

EQUIPMENT SIZING IS BASED ON THE LARGER OF NEC 215 AND NEC 430 CALCULATIONS (LARGER IS HIGHLIGHTED WHEN APPLICABLE)

*Note: For 3-phase busses that feed single -phase loads, the amp summation under loads will not match the bus amps due to the difference in voltage.*

*Note: The values in this report are rounded from higher precision numbers. Manually summing the values shown may yield slightly varied results due to rounding error.*

## LOADS

| TAG | DESCRIPTION | LOAD VALUE | LOAD UNITS | STARTING METHOD | LOAD DESIGNATION | LOAD STATUS | OPERATING KVA | OPERATING AMPS | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|
| 05-GAT-401 | POND 2 EFFLUENT WEIR GATE NO. 1 | 1 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 1.7 | 4.6 | |
| 05-GAT-402 | POND 2 EFFLUENT WEIR GATE NO. 2 | 1 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 1.7 | 4.6 | |
| 05-GAT-403 | POND 2 EFFLUENT WEIR GATE NO. 3 | 1 | HP | FVNR | DUTY / CONTINUOUS | NEW | 1.7 | 4.6 | |
| 05-GAT-404 | POND 2 EFFLUENT WEIR GATE NO. 4 | 1 | HP | FVNR | DUTY / CONTINUOUS | NEW | 1.7 | 4.6 | |
| 05-GAT-405 | POND 2 EFFLUENT WEIR GATE NO. 5 | 1 | HP | FVNR | DUTY / CONTINUOUS | NEW | 1.7 | 4.6 | |
| 05-GAT-406 | POND 2 EFFLUENT WEIR GATE NO. 6 | 1 | HP | FVNR | DUTY / CONTINUOUS | NEW | 1.7 | 4.6 | |
| 05-GAT-407 | POND 2 EFFLUENT WEIR GATE NO. 7 | 1 | HP | FVNR | DUTY / CONTINUOUS | NEW | 1.7 | 4.6 | |
| 05-GAT-408 | POND 2 EFFLUENT WEIR GATE NO. 8 | 1 | HP | FVNR | DUTY / CONTINUOUS | NEW | 1.7 | 4.6 | |
| 05-GAT-409 | POND 1 EFFLUENT WEIR GATE NO. 1 | 1 | HP | FVNR | DUTY / CONTINUOUS | NEW | 1.7 | 4.6 | |
| 05-GAT-410 | POND 1 EFFLUENT WEIR GATE NO. 2 | 1 | HP | FVNR | DUTY / CONTINUOUS | NEW | 1.7 | 4.6 | |
| 05-PMP-301 | EMERGENCY POND PUMP STATION PUMP NO. 1 | 30 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 31.7 | 88.0 | |
| 05-PMP-302 | EMERGENCY POND PUMP STATION PUMP NO. 2 | 30 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 31.7 | 88.0 | |
| | | | | | | OPERATING LOAD SUBTOTAL | 80.0 | 222.0 | |

*Date/Time displayed in this report reflect time in PST*

# LOAD STUDY REPORT

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:18 PM |

## EQUIPMENT INFORMATION

| | | | |
|---|---|---|---|
| **TAG** | MCC-17A | | |
| **DESCRIPTION** | NEW MCC IN EXISTING ELECTRICAL BUILDING | **PHASE, WIRE, KASC** | 3PH, 3W, 65 KAIC KASC |
| **LOCATION** | EXISTING ELECTRICAL BUILDING | **LARGEST MOTOR** | 25HP |
| **VOLTAGE** | 480 | **COMMENTS** | |
| **BUS AMPS** | 600 | | |

## LOAD TOTALS

| OPERATING KVA | OPERATING AMPS |
|---|---|
| 202.9 | 244.1 |

## NEC 215 EQUIPMENT SIZING

| EQUIPMENT KVA | EQUIPMENT AMPS |
|---|---|
| 253.7 | 305.1 |

## NEC 430 EQUIPMENT SIZING

| EQUIPMENT KVA | EQUIPMENT AMPS |
|---|---|
| 210.0 | 252.6 |

**DEFINITIONS**

OPERATING = CONTINUOUS + INTERMITTENT

NEC 215 EQUIPMENT SIZING = 1.25 x CONTINUOUS + 1.0 x INTERMITTENT (BASED ON NEC ARTICLE 215)

NEC 430 EQUIPMENT SIZING = 1.25 x LARGEST MOTOR + 1.0 x ALL OTHER MOTORS + 1.25 x CONTINUOUS NON-MOTOR + 1.0 x INTERMITTENT NON-MOTOR (BASED ON NEC ARTICLE 430)

EQUIPMENT SIZING IS BASED ON THE LARGER OF NEC 215 AND NEC 430 CALCULATIONS (LARGER IS HIGHLIGHTED WHEN APPLICABLE)

*Note: For 3-phase busses that feed single -phase loads, the amp summation under loads will not match the bus amps due to the difference in voltage.*

*Note: The values in this report are rounded from higher precision numbers. Manually summing the values shown may yield slightly varied results due to rounding error.*

## SUBFED EQUIPMENT

| TAG | DESCRIPTION | EQUIPMENT SIZE | EQUIPMENT UNITS | STATUS | OPERATING KVA | OPERATING AMPS | BUS COMMENTS |
|---|---|---|---|---|---|---|---|
| MCC-17B (OLD MCC-A) | GENERATOR BUILDING OLD MCC | 600.0 | AMPS | EXISTING | 84.5 | 101.6 | |
| | | | | OPERATING LOAD SUBFED SUBTOTAL | 84.5 | 101.6 | |

## LOADS

| TAG | DESCRIPTION | LOAD VALUE | LOAD UNITS | STARTING METHOD | LOAD DESIGNATION | LOAD STATUS | OPERATING KVA | OPERATING AMPS | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|
| 01-AGI-301 | GRIT WASHER AGITATOR | 1 | HP | FVNR | DUTY / CONTINUOUS | NEW | 1.7 | 2.1 | |
| 01-BAR-201 | SCREEN DRIVE NO. 1 | 1 | HP | FVNR | DUTY / CONTINUOUS | NEW | 1.7 | 2.1 | |
| 01-BAR-202 | SCREEN DRIVE NO. 2 | 1 | HP | FVNR | DUTY / CONTINUOUS | NEW | 1.7 | 2.1 | |
| 01-BSR-201 | SCREEN RAKE NO. 1 | 2 | HP | FVNR | DUTY / CONTINUOUS | NEW | 2.8 | 3.4 | |
| 01-BSR-202 | SCREEN RAKE NO. 2 | 2 | HP | FVNR | DUTY / CONTINUOUS | NEW | 2.8 | 3.4 | |
| 01-CLA-301 | GRIT CLASSIFIER | 1 | HP | FVNR | DUTY / CONTINUOUS | NEW | 1.7 | 2.1 | |
| 01-COL-301 | GRIT COLLECTOR | 1 | HP | FVNR | DUTY / CONTINUOUS | NEW | 1.7 | 2.1 | |
| 01-CON-201 | SCREW CONVEYOR | 3 | HP | FVNR | DUTY / CONTINUOUS | NEW | 4.0 | 4.8 | |
| 01-PMP-101 | INFLUENT PUMP NO. 1 | 25 | HP | VFD-6 | DUTY / CONTINUOUS | NEW | 28.3 | 34.0 | |
| 01-PMP-102 | INFLUENT PUMP NO. 2 | 25 | HP | VFD-6 | DUTY / CONTINUOUS | NEW | 28.3 | 34.0 | |
| 01-PMP-103 | INFLUENT PUMP NO. 3 | 25 | HP | VFD-6 | STANDBY | NEW | 28.3 | 34.0 | |
| 01-PMP-104 | INFLUENT PUMP NO. 4 | 10 | HP | VFD-6 | DUTY / CONTINUOUS | NEW | 11.6 | 14.0 | |

# LOAD STUDY REPORT

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:18 PM |

## EQUIPMENT INFORMATION

| | | | |
|---|---|---|---|
| **TAG** | MCC-17A | | |
| **DESCRIPTION** | NEW MCC IN EXISTING ELECTRICAL BUILDING | **PHASE, WIRE, KASC** | 3PH, 3W, 65 KAIC KASC |
| **LOCATION** | EXISTING ELECTRICAL BUILDING | **LARGEST MOTOR** | 25HP |
| **VOLTAGE** | 480 | **COMMENTS** | |
| **BUS AMPS** | 600 | | |

## LOADS

| TAG | DESCRIPTION | LOAD VALUE | LOAD UNITS | STARTING METHOD | LOAD DESIGNATION | LOAD STATUS | OPERATING KVA | OPERATING AMPS | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|
| 01-PMP-301 | GRIT PUMP NO. 1 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 01-PMP-302 | GRIT PUMP NO. 2 | 15 | HP | FVNR | STANDBY | NEW | 17.5 | 21.0 | |
| 01-WCO-201 | SCREENINGS WASHER/COMPACTOR NO. 1 | 3 | HP | FVNR | DUTY / CONTINUOUS | NEW | 4.0 | 4.8 | |
| 01-WCO-202 | SCREENINGS WASHER/COMPACTOR NO. 2 | 3 | HP | FVNR | STANDBY | NEW | 4.0 | 4.8 | |
| 01-WSH-301 | GRIT WASHER DRIVE | 1.50 | HP | FVNR | DUTY / CONTINUOUS | NEW | 2.5 | 3.0 | |
| 02-PMP-201 | PRIMARY SLUDGE PUMP NO. 1 | 3 | HP | FVNR | DUTY / CONTINUOUS | NEW | 4.0 | 4.8 | |
| 02-PMP-202 | PRIMARY SLUDGE PUMP NO. 2 | 3 | HP | FVNR | STANDBY | NEW | 4.0 | 4.8 | |
| 02-PMP-301 | PRIMARY SCUM PUMP NO. 1 | 3 | HP | FVNR | DUTY / CONTINUOUS | NEW | 4.0 | 4.8 | |
| 02-PMP-302 | PRIMARY SCUM PUMP NO. 2 | 3 | HP | FVNR | STANDBY | NEW | 4.0 | 4.8 | |
| | OPERATING LOAD SUBTOTAL | 176.2 | | | | | | 211.9 | |

*Date/Time displayed in this report reflect time in PST*

# LOAD STUDY REPORT

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:18 PM |

## EQUIPMENT INFORMATION

| | | | |
|---|---|---|---|
| **TAG** | MCC-17B (OLD MCC-A) | | |
| **DESCRIPTION** | GENERATOR BUILDING OLD MCC | **PHASE, WIRE, KASC** | 3PH, 3W, 42 KAIC KASC |
| **LOCATION** | EXISTING ELECTRICAL BUILDING | **LARGEST MOTOR** | 25HP |
| **VOLTAGE** | 480 | **COMMENTS** | |
| **BUS AMPS** | 600 | | |

## LOAD TOTALS

| OPERATING KVA | OPERATING AMPS |
|---|---|
| 84.5 | 101.6 |

## NEC 215 EQUIPMENT SIZING

| EQUIPMENT KVA | EQUIPMENT AMPS |
|---|---|
| 105.6 | 127.0 |

## NEC 430 EQUIPMENT SIZING

| EQUIPMENT KVA | EQUIPMENT AMPS |
|---|---|
| 91.5 | 110.1 |

**DEFINITIONS**

OPERATING = CONTINUOUS + INTERMITTENT

NEC 215 EQUIPMENT SIZING = 1.25 x CONTINUOUS + 1.0 x INTERMITTENT (BASED ON NEC ARTICLE 215)

NEC 430 EQUIPMENT SIZING = 1.25 x LARGEST MOTOR + 1.0 x ALL OTHER MOTORS + 1.25 x CONTINUOUS NON-MOTOR + 1.0 x INTERMITTENT NON-MOTOR (BASED ON NEC ARTICLE 430)

EQUIPMENT SIZING IS BASED ON THE LARGER OF NEC 215 AND NEC 430 CALCULATIONS (LARGER IS HIGHLIGHTED WHEN APPLICABLE)

*Note: For 3-phase busses that feed single -phase loads, the amp summation under loads will not match the bus amps due to the difference in voltage.*

*Note: The values in this report are rounded from higher precision numbers. Manually summing the values shown may yield slightly varied results due to rounding error.*

## SUBFED EQUIPMENT

| TAG | DESCRIPTION | EQUIPMENT SIZE | EQUIPMENT UNITS | STATUS | OPERATING KVA | OPERATING AMPS | BUS COMMENTS |
|---|---|---|---|---|---|---|---|
| T-20 | CHLORINE BUILDING TRANSFORMER | 15.0 | KVA | EXISTING | 0.0 | 0.0 | |
| T-26-1 | CONTROL BUILDING TRANSFORMER | 37.5 | KVA | EXISTING | 0.0 | 0.0 | |
| T-29 | GENERATOR BUILDING TRANSFORMER | 15.0 | KVA | EXISTING | 0.0 | 0.0 | |
| | | | | OPERATING LOAD SUBFED SUBTOTAL | 0.0 | 0.0 | |

## LOADS

| TAG | DESCRIPTION | LOAD VALUE | LOAD UNITS | STARTING METHOD | LOAD DESIGNATION | LOAD STATUS | OPERATING KVA | OPERATING AMPS | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|
| | COMPACTOR | 2 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 0.0 | |
| M-B-13-1 | GRIT CHAMBER RAKE | 1/2 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 0.0 | |
| M-B-4-1 | EAST SCREW PUMP | 15 | HP | VFD-6 | DUTY / CONTINUOUS | DEMO | | 0.0 | |
| M-B-4-2 | WEST SCREW PUMP | 15 | HP | VFD-6 | DUTY / CONTINUOUS | DEMO | | 0.0 | |
| M-B-7-1 | EAST BAR SCREEN | 3/4 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 0.0 | |
| M-B-7-2 | WEST BAR SCREEN | 3/4 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 0.0 | |
| M-B-8-1 | SCREENING CONVEYOR | 1 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 0.0 | |
| M-B-9-1 | GRIT CYCLONE | 0 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 0.0 | |
| M-B-9-2 | GRIT CLASSIFIER | 1 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 0.0 | |
| M-P-5-1 | EAST GREASE PUMP | 33333333 3/100000 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 0.0 | |

*Date/Time displayed in this report reflect time in PST*

# LOAD STUDY REPORT

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:18 PM |

## EQUIPMENT INFORMATION

| | | | |
|---|---|---|---|
| **TAG** | MCC-17B (OLD MCC-A) | | |
| **DESCRIPTION** | GENERATOR BUILDING OLD MCC | **PHASE, WIRE, KASC** | 3PH, 3W, 42 KAIC KASC |
| **LOCATION** | EXISTING ELECTRICAL BUILDING | **LARGEST MOTOR** | 25HP |
| **VOLTAGE** | 480 | **COMMENTS** | |
| **BUS AMPS** | 600 | | |

## LOADS

| TAG | DESCRIPTION | LOAD VALUE | LOAD UNITS | STARTING METHOD | LOAD DESIGNATION | LOAD STATUS | OPERATING KVA | OPERATING AMPS | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|
| M-P-5-2 | WEST GREASE PUMP | 0000 33333333 3/100000 0000 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 0.0 | |
| P-B-11-1 | GRIT PUMP #1 - NORTH | 7.50 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 0.0 | |
| P-B-11-2 | GRIT PUMP #2 - SOUTH | 7.50 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 0.0 | |
| M-C-1 | 26' PRIMARY CLARIFIER MECHANISM | 3/4 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 0.0 | |
| M-C-2 | 60' PRIMARY CLARIFIER MECHANISM | 3/4 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 1.3 | 1.6 | |
| P-C-3-1 | PRIMARY SLUDGE PUMP #1 | 3 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 4.8 | |
| P-C-3-2 | PRIMARY SLUDGE PUMP #2 | 3 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 4.8 | |
| P-C-3-3 | PRIMARY SLUDGE PUMP #3 | 3 | HP | FVNR | STANDBY | DEMO | | 4.8 | |
| P-E-9-1 | POND PUMP STATION PUMP #1 | 7.50 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 0.0 | |
| P-E-9-2 | POND PUMP STATION PUMP #2 | 7.50 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 11.0 | |
| P-E-9-3 | POND PUMP STATION PUMP #3 | 7.50 | HP | FVNR | STANDBY | DEMO | | 0.0 | |
| P-E-8-1 | MARSH EFFLUENT PUMP #1 | 5 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 7.6 | |
| P-E-8-2 | MARSH EFFLUENT PUMP #2 | 5 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 7.6 | |
| P-E-8-3 | MARSH EFFLUENT PUMP #3 | 5 | HP | FVNR | STANDBY | DEMO | | 7.6 | |
| | WATER CHAMP #1 - EAST CL2 | 3 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 4.0 | 4.8 | |
| | WATER CHAMP #2 - MIDDLE CL2 | 3 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 4.0 | 4.8 | |
| | WATER CHAMP #3 - WEST SO2 | 3 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 4.0 | 4.8 | |
| | CHLORINE CONTACT BASIN SUMP PUMP #1 - WEST | 5 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 6.3 | 7.6 | |
| | CHLORINE CONTACT BASIN SUMP PUMP #2 - EAST | 5 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 6.3 | 7.6 | |
| P-E-1-1 | SAMPLE PUMP NO. 1 | 3/4 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 1.3 | 1.6 | |
| P-E-1-2 | SAMPLE PUMP NO. 2 | 3/4 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 1.3 | 1.6 | |
| P-E-1-3 | SAMPLE PUMP NO. 3 | 3/4 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 1.3 | 1.6 | |
| P-E-1-4 | SAMPLE PUMP NO. 4 | 3/4 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 1.3 | 1.6 | |
| P-E-1-5 | SAMPLE PUMP NO. 5 | 3/4 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 1.3 | 1.6 | |
| M-F-10 | DIGESTER GAS BOOSTER | 3 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 4.0 | 4.8 | |
| M-F-6 | RADIATOR FAN | 2 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 2.8 | 3.4 | |
| P-F-1-1 | 4" CHOPPER SLUDGE RECIRCULATION PUMP | 5 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 6.3 | 7.6 | |
| P-F-2 | SLUDGE TRANSFER PUMP | 7.50 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 9.1 | 11.0 | |
| P-F-2-2 | 6" CHOPPER SLUDGE RECIRCULATION PUMP | 25 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 28.3 | 34.0 | |

# LOAD STUDY REPORT

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:18 PM |

## EQUIPMENT INFORMATION

| | | | |
|---|---|---|---|
| **TAG** | MCC-17B (OLD MCC-A) | | |
| **DESCRIPTION** | GENERATOR BUILDING OLD MCC | **PHASE, WIRE, KASC** | 3PH, 3W, 42 KAIC KASC |
| **LOCATION** | EXISTING ELECTRICAL BUILDING | **LARGEST MOTOR** | 25HP |
| **VOLTAGE** | 480 | **COMMENTS** | |
| **BUS AMPS** | 600 | | |

## LOADS

| TAG | DESCRIPTION | LOAD VALUE | LOAD UNITS | STARTING METHOD | LOAD DESIGNATION | LOAD STATUS | OPERATING KVA | OPERATING AMPS | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|
| P-F-3-2 | WATER CIRCULATION PUMP | 3/4 | HP | FVNR | DUTY / CONTINUOUS | EXISTING | 1.3 | 1.6 | |
| | | | | | | OPERATING LOAD SUBTOTAL | 84.5 | 149.8 | |

*Date/Time displayed in this report reflect time in PST*

# LOAD STUDY REPORT

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:18 PM |

## EQUIPMENT INFORMATION

| | | | |
|---|---|---|---|
| **TAG** | MCC-18 | | |
| **DESCRIPTION** | NEW ELECTRICAL BUILDING MCC | **PHASE, WIRE, KASC** | 3PH, 3W, 65 KAIC KASC |
| **LOCATION** | NEW ELECTRICAL BUILDING | **LARGEST MOTOR** | 125HP |
| **VOLTAGE** | 480 | **COMMENTS** | |
| **BUS AMPS** | 2000 | | |

## LOAD TOTALS

| OPERATING KVA | OPERATING AMPS |
|---|---|
| 1141.6 | 1373.1 |

## NEC 215 EQUIPMENT SIZING

| EQUIPMENT KVA | EQUIPMENT AMPS |
|---|---|
| 1427.0 | 1716.4 |

## NEC 430 EQUIPMENT SIZING

| EQUIPMENT KVA | EQUIPMENT AMPS |
|---|---|
| 1183.5 | 1423.6 |

**DEFINITIONS**

OPERATING = CONTINUOUS + INTERMITTENT

NEC 215 EQUIPMENT SIZING = 1.25 x CONTINUOUS + 1.0 x INTERMITTENT (BASED ON NEC ARTICLE 215)

NEC 430 EQUIPMENT SIZING = 1.25 x LARGEST MOTOR + 1.0 x ALL OTHER MOTORS + 1.25 x CONTINUOUS NON-MOTOR + 1.0 x INTERMITTENT NON-MOTOR (BASED ON NEC ARTICLE 430)

EQUIPMENT SIZING IS BASED ON THE LARGER OF NEC 215 AND NEC 430 CALCULATIONS (LARGER IS HIGHLIGHTED WHEN APPLICABLE)

*Note: For 3-phase busses that feed single -phase loads, the amp summation under loads will not match the bus amps due to the difference in voltage.*

*Note: The values in this report are rounded from higher precision numbers. Manually summing the values shown may yield slightly varied results due to rounding error.*

## LOADS

| TAG | DESCRIPTION | LOAD VALUE | LOAD UNITS | STARTING METHOD | LOAD DESIGNATION | LOAD STATUS | OPERATING KVA | OPERATING AMPS | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|
| 03-AER-101 | AERATOR NO. 1 | 125 | HP | VFD-18 | DUTY / CONTINUOUS | NEW | 129.7 | 156.0 | |
| 03-AER-102 | AERATOR NO. 2 | 125 | HP | VFD-18 | DUTY / CONTINUOUS | NEW | 129.7 | 156.0 | |
| 03-AER-103 | AERATOR NO. 3 | 125 | HP | VFD-18 | DUTY / CONTINUOUS | FUTURE | 129.7 | 156.0 | |
| 03-AER-104 | AERATOR NO. 4 | 125 | HP | VFD-18 | DUTY / CONTINUOUS | FUTURE | 129.7 | 156.0 | |
| 04-CLR-101 | SECONDARY CLARIFIER DRIVE NO. 1 | 1 | HP | FVNR | DUTY / CONTINUOUS | NEW | 1.7 | 2.1 | |
| 04-CLR-102 | SECONDARY CLARIFIER DRIVE NO. 2 | 1 | HP | FVNR | DUTY / CONTINUOUS | NEW | 1.7 | 2.1 | |
| 04-CLR-103 | SECONDARY CLARIFIER DRIVE NO. 3 | 1 | HP | FVNR | DUTY / CONTINUOUS | FUTURE | 1.7 | 2.1 | |
| 04-PMP-201 | SECONDARY SCUM PUMP NO. 1 | 3 | HP | FVNR | DUTY / CONTINUOUS | NEW | 4.0 | 4.8 | |
| 04-PMP-202 | SECONDARY SCUM PUMP NO. 2 | 3 | HP | FVNR | STANDBY | NEW | 4.0 | 4.8 | |
| 04-PMP-203 | SECONDARY SCUM PUMP NO. 3 | 3 | HP | FVNR | DUTY / CONTINUOUS | NEW | 4.0 | 4.8 | |
| 04-PMP-204 | SECONDARY SCUM PUMP NO. 4 | 3 | HP | FVNR | STANDBY | NEW | 4.0 | 4.8 | |
| 04-PMP-205 | SECONDARY SCUM PUMP NO. 5 | 3 | HP | FVNR | DUTY / CONTINUOUS | FUTURE | 4.0 | 4.8 | |
| 04-PMP-206 | SECONDARY SCUM PUMP NO. 6 | 3 | HP | FVNR | STANDBY | FUTURE | 4.0 | 4.8 | |
| 05-AER-101 | AERATOR NO. 1 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-102 | AERATOR NO. 2 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-103 | AERATOR NO. 3 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-104 | AERATOR NO. 4 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-105 | AERATOR NO. 5 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |

# LOAD STUDY REPORT

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS<br>PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:18 PM |

## EQUIPMENT INFORMATION

| | | | |
|---|---|---|---|
| **TAG** | MCC-18 | | |
| **DESCRIPTION** | NEW ELECTRICAL BUILDING MCC | **PHASE, WIRE, KASC** | 3PH, 3W, 65 KAIC KASC |
| **LOCATION** | NEW ELECTRICAL BUILDING | **LARGEST MOTOR** | 125HP |
| **VOLTAGE** | 480 | **COMMENTS** | |
| **BUS AMPS** | 2000 | | |

## LOADS

| TAG | DESCRIPTION | LOAD VALUE | LOAD UNITS | STARTING METHOD | LOAD DESIGNATION | LOAD STATUS | OPERATING KVA | OPERATING AMPS | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|
| 05-AER-106 | AERATOR NO. 6 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-107 | AERATOR NO. 7 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-108 | AERATOR NO. 8 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-109 | AERATOR NO. 9 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-110 | AERATOR NO. 10 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-111 | AERATOR NO. 11 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-112 | AERATOR NO. 12 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-113 | AERATOR NO. 13 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-114 | AERATOR NO. 14 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-115 | AERATOR NO. 15 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-116 | AERATOR NO. 16 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-117 | AERATOR NO. 17 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-118 | AERATOR NO. 18 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-119 | AERATOR NO. 19 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-120 | AERATOR NO. 20 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-121 | AERATOR NO. 21 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-122 | AERATOR NO. 22 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-123 | AERATOR NO. 23 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-AER-124 | AERATOR NO. 24 | 15 | HP | FVNR | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 05-PMP-201 | POND PUMP STATION PUMP NO. 1 | 25 | HP | VFD-6 | DUTY / CONTINUOUS | NEW | 28.3 | 34.0 | |
| 05-PMP-202 | POND PUMP STATION PUMP NO. 2 | 25 | HP | VFD-6 | DUTY / CONTINUOUS | NEW | 28.3 | 34.0 | |
| 05-PMP-203 | POND PUMP STATION PUMP NO. 3 | 25 | HP | VFD-6 | STANDBY | NEW | 28.3 | 34.0 | |
| 06-PMP-101 | PUMP STATION 1 PUMP NO. 1 | 10 | HP | VFD-6 | DUTY / CONTINUOUS | NEW | 11.6 | 14.0 | |
| 06-PMP-102 | PUMP STATION 1 PUMP NO. 2 | 10 | HP | VFD-6 | DUTY / CONTINUOUS | NEW | 11.6 | 14.0 | |
| 06-PMP-103 | PUMP STATION 1 PUMP NO. 3 | 10 | HP | VFD-6 | STANDBY | NEW | 11.6 | 14.0 | |
| 06-PMP-201 | TREATMENT WETLANDS 4 PUMP NO. 1 | 5 | HP | FVNR | DUTY / CONTINUOUS | NEW | 6.3 | 7.6 | |
| 07-UVB-101 | UV BANK NO. 1 | 12.70 | KW | | DUTY / CONTINUOUS | NEW | 12.7 | 15.3 | |
| 07-UVB-102 | UV BANK NO. 2 | 12.70 | KW | | DUTY / CONTINUOUS | NEW | 12.7 | 15.3 | |
| 07-UVB-103 | UV BANK NO. 3 | 12.70 | KW | | DUTY / CONTINUOUS | NEW | 12.7 | 15.3 | |
| 07-UVB-104 | UV BANK NO. 4 | 12.70 | KW | | STANDBY | NEW | 12.7 | 15.3 | |
| 10-PMP-101 | RAS PUMP NO. 1 | 5 | HP | VFD-6 | DUTY / CONTINUOUS | NEW | 6.3 | 7.6 | |
| 10-PMP-102 | RAS PUMP NO. 2 | 5 | HP | VFD-6 | STANDBY | NEW | 6.3 | 7.6 | |

*Date/Time displayed in this report reflect time in PST*

# LOAD STUDY REPORT

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS<br>PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:18 PM |

## EQUIPMENT INFORMATION

| | | | |
|---|---|---|---|
| **TAG** | MCC-18 | | |
| **DESCRIPTION** | NEW ELECTRICAL BUILDING MCC | **PHASE, WIRE, KASC** | 3PH, 3W, 65 KAIC KASC |
| **LOCATION** | NEW ELECTRICAL BUILDING | **LARGEST MOTOR** | 125HP |
| **VOLTAGE** | 480 | **COMMENTS** | |
| **BUS AMPS** | 2000 | | |

## LOADS

| TAG | DESCRIPTION | LOAD VALUE | LOAD UNITS | STARTING METHOD | LOAD DESIGNATION | LOAD STATUS | OPERATING KVA | OPERATING AMPS | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|
| 11-PMP-101 | WAS PUMP NO. 1 | 1/2 | HP | VFD-6 | DUTY / CONTINUOUS | NEW | 0.9 | 1.1 | |
| 11-PMP-102 | WAS PUMP NO. 2 | 1/2 | HP | VFD-6 | STANDBY | NEW | 0.9 | 1.1 | |
| 12-PMP-201 | TWAS PUMP NO. 1 | 10 | HP | VFD-6 | DUTY / CONTINUOUS | NEW | 11.6 | 14.0 | |
| 12-PMP-202 | TWAS PUMP NO. 2 | 10 | HP | VFD-6 | STANDBY | NEW | 11.6 | 14.0 | |
| 12-THI-101 | THICKENER NO. 1 | 5 | HP | FVNR | DUTY / CONTINUOUS | NEW | 6.3 | 7.6 | |
| 12-THI-102 | THICKENER NO. 2 | 5 | HP | FVNR | STANDBY | NEW | 6.3 | 7.6 | |
| 14-MIX-301 | ALKALINITY TANK MIXER NO. 1 | 1.50 | HP | FVNR | DUTY / CONTINUOUS | NEW | 2.5 | 3.0 | |
| 14-MIX-302 | ALKALINITY TANK MIXER NO. 2 | 1.50 | HP | FVNR | DUTY / CONTINUOUS | NEW | 2.5 | 3.0 | |
| 14-PMP-101 | ALKALINITY FEED PUMP NO. 1 | 1 | HP | VFD-6 | DUTY / CONTINUOUS | NEW | 1.7 | 2.1 | |
| 14-PMP-102 | ALKALINITY FEED PUMP NO. 2 | 1 | HP | VFD-6 | STANDBY | NEW | 1.7 | 2.1 | |
| 14-PMP-201 | ALKALINITY SYSTEM TRANSFER PUMP | 10 | HP | FVNR | DUTY / CONTINUOUS | NEW | 11.6 | 14.0 | |
| 14-PMP-401 | SUMP PUMP | 3/4 | HP | FVNR | DUTY / CONTINUOUS | NEW | 1.3 | 1.6 | |
| 15-PMP-301 | 3W PUMP NO. 1 | 15 | HP | VFD-6 | DUTY / CONTINUOUS | NEW | 17.5 | 21.0 | |
| 15-PMP-302 | 3W PUMP NO. 2 | 15 | HP | VFD-6 | STANDBY | NEW | 17.5 | 21.0 | |
| | | | | | | OPERATING LOAD SUBTOTAL | 1250.6 | 1504.2 | |

*Date/Time displayed in this report reflect time in PST*

# LOAD STUDY REPORT

## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT** | ARCATA WWTF IMPROVEMENTS PRELIMINARY DESIGN |
| **CLIENT** | CITY OF ARCATA |
| **PROJECT NUMBER** | 9913B10 |
| **REPORT BY** | ERIK BAHNEMAN |
| **REPORT DATE** | 8/14/2018 4:18 PM |

## EQUIPMENT INFORMATION

| | | | |
|---|---|---|---|
| **TAG** | PNL-20 | | |
| **DESCRIPTION** | CENTRAL GARAGE BREAKER | **PHASE, WIRE, KASC** | 3PH, 4W, 65 KAIC KASC |
| **LOCATION** | AUTO SHOP | **LARGEST MOTOR** | 0HP |
| **VOLTAGE** | 208 | **COMMENTS** | |
| **BUS AMPS** | 100 | | |

## LOAD TOTALS

| OPERATING KVA | OPERATING AMPS |
|---|---|
| 0.0 | 0.0 |

## NEC 215 EQUIPMENT SIZING

| EQUIPMENT KVA | EQUIPMENT AMPS |
|---|---|
| 0.0 | 0.0 |

## NEC 430 EQUIPMENT SIZING

| EQUIPMENT KVA | EQUIPMENT AMPS |
|---|---|
| 0.0 | 0.0 |

**DEFINITIONS**

OPERATING = CONTINUOUS + INTERMITTENT

NEC 215 EQUIPMENT SIZING = 1.25 x CONTINUOUS + 1.0 x INTERMITTENT (BASED ON NEC ARTICLE 215)

NEC 430 EQUIPMENT SIZING = 1.25 x LARGEST MOTOR + 1.0 x ALL OTHER MOTORS + 1.25 x CONTINUOUS NON-MOTOR + 1.0 x INTERMITTENT NON-MOTOR (BASED ON NEC ARTICLE 430)

EQUIPMENT SIZING IS BASED ON THE LARGER OF NEC 215 AND NEC 430 CALCULATIONS (LARGER IS HIGHLIGHTED WHEN APPLICABLE)

*Note: For 3-phase busses that feed single -phase loads, the amp summation under loads will not match the bus amps due to the difference in voltage.*

*Note: The values in this report are rounded from higher precision numbers. Manually summing the values shown may yield slightly varied results due to rounding error.*

## LOADS

| TAG | DESCRIPTION | LOAD VALUE | LOAD UNITS | STARTING METHOD | LOAD DESIGNATION | LOAD STATUS | OPERATING KVA | OPERATING AMPS | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|
| | TREATMENT WETLANDS 4 PUMP | 7.50 | HP | FVNR | DUTY / CONTINUOUS | DEMO | | 24.2 | |
| | | | | | | OPERATING LOAD SUBTOTAL | 0.0 | 24.2 | |

*Date/Time displayed in this report reflect time in PST*

Appendix J

# TM 10 COST ESTIMATE



City of Arcata
Wastewater Treatment Facilities Improvements

# Technical Memorandum 10
# COST ESTIMATE

FINAL | April 2019

City of Arcata
Wastewater Treatment Facilities Improvements

# TECHNICAL MEMORANDUM 10

# COST ESTIMATE

FINAL | April 2019



# Contents

Technical Memorandum 10 - COST ESTIMATE 10-1

10.1 Purpose 10-1

10.2 Summary of Findings and Recommendations 10-1

10.3 Basis for Estimate 10-1

10.3.1 ENR Benchmark 10-1

10.3.2 Unit Costs 10-1

10.3.3 Contingencies 10-2

10.4 Cost Estimate 10-2

10.4.1 Cost Estimate Breakdown 10-2

10.4.2 Cost Estimate Comparison to Facility Planning 10-5

10.4.3 Cost Estimate Inflation Factors 10-5

# Tables

Table 10.1 Cost Estimate 10-3

Table 10.2 Cost Estimate Breakdown by Need 10-5

# Abbreviations

| | |
|---|---|
| Carollo | Carollo Engineers, Inc. |
| CCI | Construction Cost Indices |
| ENR | Engineering News Record |
| NPDES | National Pollutant Discharge Elimination System |
| SRF | State Revolving Fund |
| TM | Technical Memorandum |

Technical Memorandum 10

# COST ESTIMATE

## 10.1 Purpose

The purpose of this Technical Memorandum (TM) is to update the project cost estimate based on the predesign evaluations, additional input from City staff, further assessment of existing system conditions, updated cost for materials, and vendor quotes for equipment for the City of Arcata (City) Wastewater Treatment Facility (AWTF) Improvements Project. The cost presented in the memorandum should provide the application basis for the State Revolving Loan Fund (SRF) loan and grant application.

## 10.2 Summary of Findings and Recommendations

The key findings of this TM are summarized below:

- The estimated construction cost is $44,020,000 in current dollars, escalated to the midpoint of construction.
- The construction cost is higher than the facility plan construction cost estimate of $32,200,000.

## 10.3 Basis for Estimate

The project is currently in the preliminary design phase and the design has not been developed in detail. The construction cost estimates are consistent with an AACE International Class 4 budget estimate with an accuracy range of plus 50 percent to minus 30 percent of the actual project cost.

### 10.3.1 ENR Benchmark

Providing a cost benchmark for construction estimates is useful in documenting the time of estimate preparation and in allowing for projections and escalations to later dates using the equivalent index value.

This preliminary design cost estimate is benchmarked to the Construction Cost Indices (CCI) published by the Engineering News Record (ENR) for May 2018, which is the most current ENR. We recommend using the 20 City Average ENR, which was 11,013 for May 2018.

### 10.3.2 Unit Costs

Unit costs have been researched and used for the major components of the project. These major components include site work, piping, pumps, valving, structures, and appurtenances. Unit costs have also been developed using preliminary quotations received from equipment and material manufacturers supplemented with installation costs based on past experience with similar projects, available recent bid data, or cost estimating guidelines derived from estimating guides such as the 2018 RS Means Heavy Construction Data publication, the most current publication to date.

### 10.3.3 Contingencies

Contingencies are typically applied to a construction estimate at the design development phase to account for construction items not yet identified, and construction design unknowns. As the design is refined and finalized, the contingency, typically expressed as a percent of the raw construction cost, will trend downward. At the completion of the design, the contingency should represent only a reasonable construction change order allowance. Agencies typically retain contingency within their project budgets, even when construction contract award values are known, to cover the cost or deal with unforeseen conditions.

A 25 percent contingency, calculated based on the raw construction cost, has been included in the cost estimate. This is in alignment with the recommendations for a project at an AACE Class 4 level of development.

## 10.4 Cost Estimate

The total construction cost is estimated at $40,500,000 based on today's costs. This cost estimate includes a plus 50 to minus 30 percent accuracy. The estimate was escalated by 8.1 percent to $44,020,000 to match the proposed construction schedule, an annual rate of approximately 3.5 percent per year. The City's overall cost including the construction, design, construction services, permitting, administration, and start up is estimated at $59,400,000 based on adding 35 percent to the escalated construction cost.

### 10.4.1 Cost Estimate Breakdown

Table 10.1 summarizes the construction cost by process area and compares the updated cost estimate to the original Facility Plan cost estimate (LACO, Carollo, July 2017). While, the project components included in this preliminary design are not exactly comparable to the Facility Plan components, the comparison provided helps identify changes to required project components included in this preliminary design. A summary of the major improvements by process area as well as changes in scope since the Facility Plan is provided in the sections that follow.

#### 10.4.1.1 Headworks

The influent pumping and headworks will be replaced with this project, and the costs for this facility went down from the initial Facility Plan estimates. Costs were lowered by reducing the size of the proposed headworks to match the existing footprint, while keeping the existing influent junction box. Planned screening, grit removal, and flow metering facilities are similar to existing facilities but upgraded versions will be provided.

#### 10.4.1.2 Primary Clarifier

The primary clarifier will be rehabilitated instead of replaced. This lowered the cost of the recommended facilities.

#### 10.4.1.3 Oxidation Ditch and Secondary Clarifiers

One new oxidation ditch and two new secondary clarifiers will be provided with this project. The cost of this secondary treatment system increased from the Facility Plan estimate to meet the projected ammonia limits. The volume of the ditch is larger than anticipated in the facility plan, and a second clarifier was needed for peak flows. In the future only one more oxidation ditch and a third secondary clarifier will be required to treat the full plant flow (5.9 million gallons per day

[mgd]). An alkalinity addition system was also added because additional alkalinity is needed for complete ammonia removal.

Table 10.1 Cost Estimate

| Description | Construction Cost [(1)] | Facility Plan Cost |
|---|---|---|
| Headworks | $4,990,000 | $6,600,000 |
| Primary Clarifier Rehabilitation | $1,510,000 | $2,050,000 |
| Oxidation Ditch (1) | $6,980,000 | $7,380,000 |
| Secondary Clarifiers (2) | $2,800,000 | Included |
| Oxidation Ponds (includes Pond PS and EPPS) | $3,480,000 | $4,180,000 |
| Treatment Wetlands - PS and Wetlands ( No. 7 not included) | $1,060,000 | $1,100,000 |
| UV Disinfection | $2,460,000 | $4,360,000 |
| Chlorine Disinfection (DRAFT ESTIMATE) | $380,000 | $150,000 |
| Enhancement Wetlands (includes Hauser PS) | $1,830,000 | $1,970,000 |
| RAS Pump Station | $2,090,000 | Included |
| WAS Pump Station | $280,000 | Included |
| Thickeners | $980,000 | $1,410,000 |
| Digesters | $2,200,000 | $1,200,000 |
| Alkalinity Feed System | $650,000 | New |
| Plant Water Systems (placeholder) | $160,000 | New |
| Stormwater System (placeholder) | $160,000 | New |
| Existing Electrical Building/SCADA and Controls | $1,370,000 | Included |
| New Electrical Building/SCADA and Controls | $2,390,000 | $300,000 |
| Yard Piping & Site Improvements | $5,540,000 | $1,900,000 |
| **TOTAL AWTF IMPROVEMENTS CONSTRUCTION COSTS** | **$41,310,000** | **$32,100,000** |
| Corporation Yard Relocation | $1,550,000 | $100,000 |
| Biosolids Composting Relocation | $1,160,000 | New |
| **TOTAL CONSTRUCTION COSTS** | **$44,020,000** | **$32,200,000** |
| Project Cost (35% added for administration, design, construction management, legal and other costs) | **$59,400,000** | |

Notes:
(1) Includes 3.5 percent annual escalation to midpoint of construction.

#### 10.4.1.4 Oxidation Ponds

Pond piping and pump station upgrades are included in the project to address wet weather flows and equipment rehabilitation. Aerators are also proposed for the ponds, although the extent of the benefit of aeration is still difficult to quantify. With just these improvements, the oxidation pond costs have gone down slightly since the Facility Plan because the accumulated solids will be left in the ponds. Deletions of the dredging and dewatering saved a significant cost that may have limited benefits.

#### 10.4.1.5 Treatment Wetlands

The treatment wetland costs have gone up since the Facility Plan based on the addition of flow baffling, vegetation management, and treatment wetland 4 reconstruction. The included cost for the wetland pump station upgrade is similar to the Facility Plan costs.

#### 10.4.1.6 Enhancement Wetlands

The enhancement wetland costs have gone up based on the addition of flow baffling, vegetation management, and flow conveyance between the wetland cells. The cost of the Hauser, enhancement wetland pump station upgrade is similar to the Facility Plan costs.

#### 10.4.1.7 Disinfection

A new UV disinfection facility will be included with this project. The latest UV disinfection technology, with higher efficiency lamps, will be used. This lowers the cost of the UV disinfection system since the high efficiency lamps reduce both the capital and operating cost of the UV disinfection system. Additionally, the cost to update the existing chlorination system is included in the project. To maintain the existing system, we propose replacing the gaseous chlorine and sulfur dioxide system with a liquid bleach system that has lower risks and will meet current health and safety codes.

#### 10.4.1.8 Digesters and Solids Thickening

A new solids thickener will be included with the project and the existing digesters will be rehabilitated. The cost of the digester rehabilitation and thickening has increased since the Facility Plan due to additional costs for the digested sludge heating and mixing system rehabilitation. A new boiler is required to replace the original unit, which is 30 years old, and was not identified in the Facility Plan. Furthermore, additional piping and valve replacement was identified during a recent assessment of the digesters.

#### 10.4.1.9 Electrical, SCADA, Control and Utilities

The extent of the overall electrical facility rehabilitation and expansion is significantly greater than originally envisioned. The existing system was assessed during the recent site visit and is not expandable to meet the needs of the new facilities, so new facilities are proposed.

A new SCADA and control system is proposed to provide additional control and monitoring, and to modernize the existing plant controls. The system will allow for central operation, and remote operation and alarm monitoring during periods when the plant is not staffed. This will save time and operation expenses by reducing the time required if staff have to come to the plant during off times at premium labor costs.

The original Facility Plan cost estimate included electrical improvements within the cost for each area. This underestimated the full electrical investment needed for the required electrical expansion.

Plant water and drainage facilities cost have also increased to meet the needs of the new plant facilities.

#### 10.4.1.10 Relocation of Facilities

A number of corporation yard facilities will need to be relocated with the proposed project. The cost to relocate the portion of the corporation yard impacted by the new plant construction has increased since these facilities need to be maintained onsite while also accommodating the

needs of the City. Relocation of the Bus Barn, Maintenance Shop, and biosolids composting operation was not originally included in the relocation costs.

### 10.4.2 Cost Estimate Comparison to Facility Planning

The project components included in this preliminary design are each required to address different priorities. Some project components are needed to repair or replace aging equipment, while other project components are needed to meet permit limits. Still other projects are necessary facility relocations. Table 10.2 breaks the construction cost down by project need and compares these costs to the Facility Plan costs estimate. The projects included in this preliminary design, while more expensive than originally identified in the Facility Plan, will help ensure that the Arcata Facility will continue to be a community asset for the next 30 years and longer.

Table 10.2 Cost Estimate Breakdown by Need

| Description | Construction Cost Estimate | Facility Plan Cost Estimate | Project Need |
|---|---|---|---|
| Flow Reconfiguration | $5,540,000 | $3,220,000 | Permit Requirements |
| Headworks / Primary Clarifier Rehabilitation | $6,500,000 | $8,650,000 | Rehabilitation |
| Ponds and Wetland | $6,370,000 | $5,860,000 | Rehabilitation |
| Secondary Treatment | $12,800,000 | $7,380,000 | Permit Requirements |
| Disinfection – UV and Wet weather system | $2,840,000 | $4,510,000 | Permit Requirements |
| Digesters/Solids | $3,180,000 | $2,140,000 | Rehabilitation |
| Corporation Yard Relocation | $2,710,000 | $400,000 | Relocation |
| Electrical, Controls, SCADA and Utilities | $4,080,000 | Included in above costs | Permit Requirements |
| **TOTAL CONSTRUCTION COSTS** | **$44,020,000** | **$32,200,000** | |
| **TOTAL PROJECT COSTS (35%)** | **$59,430,000** | | |

### 10.4.3 Cost Estimate Inflation Factors

When construction is very active, total construction costs typically increase more rapidly than the net cost of labor and materials. In active markets overhead and profit margins also increase in response to increased demand. These factors tend to increase the actual overall inflation factor compared to the factor used in developing a cost estimate. The current estimate is based on an annual inflation factor of 3.5 percent. A review of recent construction cost inflation factors show that this may be slightly low for future estimates due to three factors:

- The general California construction market is very robust, and the backlog of construction work is higher than normal. This will put pressure to drive up costs, and may require a higher inflation factor. In addition, labor costs have been rising, especially in specialty trades such as electrical. To account for this factor, some engineers have added a flat 10 percent factor to construction cost estimates to account for the bid market climate.

- The impact of the federal tariffs is currently unknown on the public works construction, especially tariffs on steel, and stainless steel. The impact of tariffs will be to drive costs up as well.
- The overall San Francisco Engineering News construction cost index is also currently trending higher at approximately a 3.5 percent annual change, higher than the 2.5 percent factor used in the previous estimate. This index may not represent the construction market in Northern California, especially the North Coast area where Arcata is located. Therefore local construction costs need to be reviewed to see what the actual inflation rate may be.

Therefore the City should consider these factors when finalizing the construction cost estimate and the City project cost estimate used in budgeting for the project. The escalated construction cost estimate should be reviewed based on local experience and adjusted if needed to account for the current bid climate and construction cost inflation.

Appendix K

# TM 11 IMPLEMENTATION PLAN



City of Arcata
Wastewater Treatment Facilities Improvements

# Technical Memorandum 11
# IMPLEMENTATION PLAN

FINAL | April 2019

City of Arcata
Wastewater Treatment Facilities Improvements

# TECHNICAL MEMORANDUM 11

# IMPLEMENTATION PLAN

FINAL | April 2019



# Contents

Technical Memorandum 11 - Implementation PLAN 11-1

11.1 Purpose 11-1

11.2 Summary of Findings and Recommendations 11-1

11.3 Schedule Review 11-1

11.4 Implementation Options and Constraints 11-3

11.4.1 Implementation Options 11-3

11.4.2 Implementation Sequence Constraints 11-5

# Tables

Table 11.1 Construction Implementation Constraints 11-5

# Figures

Figure 11.1 Overall Schedule 11-2

# Abbreviations

| | |
|---|---|
| AWTF | City of Arcata Wastewater Treatment Facilities |
| Carollo | Carollo Engineers, Inc. |
| CEQA | California Environmental Quality Act |
| NPDES | National Pollutant Discharge Elimination System |
| NTP | Notice to proceed |
| RWQCB | Regional Water Quality Control Board |
| SRF | State Revolving Fund |
| TM | Technical Memorandum |
| UV | Ultraviolet |

Technical Memorandum 11

# IMPLEMENTATION PLAN

## 11.1 Purpose

The purpose of this Technical Memorandum (TM) is to outline implementation strategies for the City of Arcata (City) Wastewater Treatment Facilities (AWTF) project. The current project schedule will be reviewed to provide a basis for the implementation plan. The different implementation strategies and constraints will then be reviewed to see which strategy or strategies have the highest probability to meet the schedule with the least disruption to the on-going operation of the existing treatment plant and corporation yard facilities.

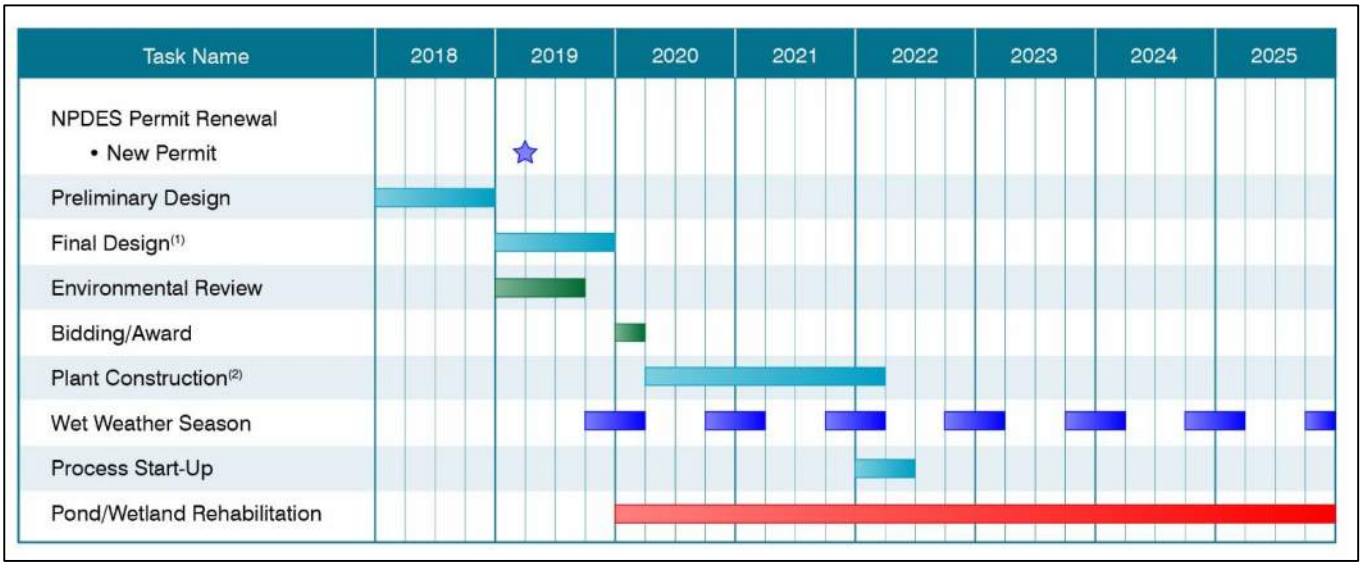
## 11.2 Summary of Findings and Recommendations

The key findings and recommendations of this TM are summarized below:

- The City will continue to pursue an overall project schedule based on:
  - Final design in 2019
  - Construction in 2020 and 2021
  - Startup in 2022
- Items that potentially impact schedule include:
  - National Pollutant Discharge Elimination System (NPDES) permit renewal, including new discharge limits and time schedule requirements
  - SRF funding approval and rate study
  - Environmental impact assessment, including California Environmental Quality Act (CEQA)
- A single construction project is recommended in order to capitalize on low interest loan financing and minimize administrative costs.
- Construction sequencing constraints due to limited space on site will require planning in final design and working with the contractor during construction to complete the new facilities within two years.
- City will complete rehabilitation and upgrades to treatment wetlands separately as maintenance projects.

## 11.3 Schedule Review

The project is currently in the preliminary design phase and final design has not started. The current schedule is shown on Figure 11.1.




Notes:
(1) To be finalized after completion of the Preliminary Design.
(2) Construction schedule is preliminary, constraints to be determined in Final Design.

Figure 11.1 Overall Schedule

The schedule is based on completion and approval of the Preliminary Design Report by September 2018 and acceptance by City Council in November 2018. Final design will start in 2019 with completion of the Final Design Bid Documents by December 2019. The project could then be bid for construction in the spring of 2020, with bids due early in 2020. A Notice to Proceed for a construction contract would be issued in early 2020, depending on the status of the funding, permitting, and other constraints. It is still envisioned that the construction would take place in 2020 and 2021 in order to make use of 2 dry weather construction seasons. Finally, process startup of the new secondary and disinfection facilities would take place through the middle of 2022.

The City has proposed completion of the wetlands improvements themselves as maintenance projects, separate from the contract for new facility construction. It is envisioned that startup of the natural system mechanical components would be completed in the same time period as the new facilities. The startup of the natural wetland components including revegetated wetlands will take longer, and may require several years to reach optimum performance.

The project timeline has been evolving since the last (NPDES) discharge permit was issued in 2012. That permit included a timeline for improvements to address several long standing issues including:

- Flow reconfiguration to a single pass flow to eliminate recirculation of wetland effluent.
- New outfall to brackish marsh identified as Outfall 003.
- Installation and startup of a new ultraviolet (UV) disinfection system.

Completion of these improvements was required by December 2016 in the 2012 permit. Due to the complexity of the overall wastewater treatment facility project, this time line was not achieved.

The City proposed an updated schedule for compliance in the Report of Waste Discharge submitted in January 2017. The proposed schedule was similar to the schedule outlined above. This project schedule was proposed to the Regional Water Quality Control Board (RWQCB) as the basis for a potential Time Schedule Order, if one was issued with the NPDES permit renewal. The City is currently working with RWQCB staff on a final project implementation schedule.

## 11.4 Implementation Options and Constraints

The implementation of the project will be dependent on coordination of several different activities including:

- NPDES permit renewal, especially any new discharge limits and anticipated time schedule requirements.
- Funding approval since SRF funds and grants are anticipated as the means to finance the project. Currently the City has indicated it will pursue the SRF funding once the Predesign Report is completed. The report will provide the technical basis and budget cost for the SRF loan and grant application. A new rate study and finance plan will need to be developed to demonstrate the City's ability to finance the project. These will be completed in parallel with the initial steps of final design.
- The rate study and financial plan will need to be approved by the City council for SRF funding.
- Environmental impact assessment and review including an initial study, and CEQA determination. In addition, SRF requires a CEQA Plus review that incorporates additional areas for review including cultural resources. This CEQA documentation will be provided to SRF for loan funding.
- Consultation on permitting (other than discharge permit), especially with natural resource agencies, to confirm jurisdiction and requirements for project approval.

The discharge permit is probably the most critical element affecting the project timing and configuration, since it will impact the direction the project may take based on the potential requirement for a new ammonia limit. If the limit is lower than the limit anticipated from the recent Eureka permit, the City may need to rethink the overall approach to the project, especially the upgrades to the ponds and wetlands. Early indications from the RWQCB suggest that lower ammonia limits will be required, at least on a seasonal basis, based on the receiving water data collected at the proposed Outfall 003 location.

### 11.4.1 Implementation Options

Implementation options considered for the predesign evaluation of project implementation include the following:

- Single large project
- Multiple smaller projects defined by work area
- Multiple smaller projects to provide early deliverables.
- Breakout of smaller pond and wetland projects.
- Phased implementation.

#### 11.4.1.1 Single Project

The City has indicated that they prefer a single project. A large single project can potentially be financed with low interest SRF loan and grant, reducing the overall implementation costs. A

single project will also reduce the city administration costs. These features provide advantages to the City from a cost and overall management perspective. The main issue with a single large project is that if any one constraint noted above is delayed it may tie up the project until each constraint is resolved.

A single project can be organized with add and deduct items that allow the City to select critical components to stay within the project budget at bid time.

#### 11.4.1.2 Multiple Projects by Work Area

The construction could be divided up by the work area. One example is that it might work to complete the pond and wetland projects separate from the central area treatment plant work. Since the pond and wetland work is specialized, it might make sense to have a separate contractor to complete that work. In the same way, the treatment wetland work could be completed by the City (or City contractor). The main plant construction could be completed by a general contractor that regularly does treatment plant work. A treatment plant Contractor could be the most efficient with plant construction, and might be slowed down if they had to coordinate with a wetlands contractor. The disadvantage to this approach would be that the City would have to manage multiple contracts for construction.

Another option is to complete some of the repair and rehabilitation projects first, since they are not dependent upon the NPDES permit requirements.

#### 11.4.1.3 Multiple Projects to Provide an Early Deliverable

This option could be used if the City wanted to complete items separately, especially to meet a permit requirement sooner than later. An early deliverable could be targeted for completion in the initial construction season (summer 2020). The main example is if the City wanted to complete the flow routing construction to allow the use of Outfall 003 before the remainder of the plant was constructed or on-line. Since this work is included in the current permit that will be renewed, it could be addressed before other work is started. The same thing could be done for the pond 1 and 2 flow equalization improvements. These could be implemented early to reduce the peak flows the plant might experience during subsequent construction.

#### 11.4.1.4 Breakout of Smaller Pond and Wetland Projects

These pond and wetlands projects could be completed as either traditional design-bid-build or design-build projects. The goal of a design-build project would be to reduce to reduce the overall cost and schedule for implementation. A secondary goal might be to create work for local contractors that have worked for the City and might be able to mobilize and complete work quickly. Alternatively these projects could be completed by the City as maintenance projects. The City has indicated that they will take on some of these projects as maintenance projects.

#### 11.4.1.5 Phased Implementation

The concept of phased implementation was discussed several times during the Facility Plan development. It had been suggested that the pond and wetlands work might be completed first, then tested to see if the secondary treatment additions were needed. In fact the opposite might make sense, to complete the secondary treatment system and see if the pond process upgrades are required to meet permit. The deferral or elimination of pond and wetland process upgrades might save money and reduce the improvements that might be lost to sea level rise.

#### 11.4.1.6 Recommended Implementation Strategy

It is recommended that the City continue to pursue implementation of a single project.

Based on initial discussion with City staff, the City may also pursue a temporary implementation of the new discharge location, and single pass operation for dry weather flows. This may provide additional information on receiving water quality, and partially meet the current permit discharge requirements. The City has indicated that they will take on some of the wetlands rehabilitation projects as maintenance projects.

### 11.4.2 Implementation Sequence Constraints

A list of preliminary implementation constraints for a single project are outlined below and on Table 11.1. During final design, these constraints and the construction sequence will be further developed.

Table 11.1 Construction Implementation Constraints

| Description | Predecessor | Year |
|---|---|---|
| Corporation Yard Relocation | | |
| Biosolids Composting Relocation | NTP | 2020 |
| New Bus Barn | NTP | 2020 |
| Headworks | Primary Clarifier No. 2 Rehabilitation | 2021 |
| Primary Clarifier Rehabilitation | NTP | 2020 |
| Oxidation Ditch[(1)] | Corp Yard Relocation | 2020 |
| Alkalinity Addition Facilities | NTP | 2020 |
| Secondary Clarifiers (2) | Corp Yard Relocation | 2020 |
| RAS/WAS Pump Station | NTP | 2020 |
| ML Flow Split Structure | Corp Yard Relocation | 2020 |
| New Electrical Building | NTP | 2020 |
| Existing Electrical Building | New Electrical Building | 2012 |
| UV Disinfection | NTP | 2020 |
| Chlorine system improvements | UV disinfection | 2021 |
| Solids | | |
| Digester No 1 cleaning/cover | NTP | 2020 |
| Digester No. 2 cleaning/cover | Digester No. 1 Rehabilitation | 2021 |
| Thickener | NTP/ Primary Clarifier No. 1 demolition | 2020 |
| Digester Heating, Boiler, and gas system | NTP | 2021 |
| Oxidation Ponds (includes Pond PS & EPPS) | | |
| Pond Pump Station | NTP | 2020 |
| Pond Piping Improvements | NTP | 2020 |

Table 11.1 Construction Implementation Constraints (Continued)

| Description | Predecessor | Year |
|---|---|---|
| Pond Aerators | New Electrical Building | TBD |
| Treatment Wetlands - PS and Wetlands | | |
| Pump Station 1 and yard Piping | NTP | 2020 |
| TW 1, 2 and 3 | TW 4 | TBD |
| TW 4 including PS | NTP | TBD |
| Enhancement Wetlands (includes Hauser PS) | | |
| Hauser PS | Outfall 003 | 2021 |
| Transfer Structures | NTP | 2020 |
| Vegetation Management | NTP | 2020 |
| Baffles and hydraulic improvements | NTP | 2020 |
| Outfall 003 | NTP | 202 |
| Plant Water Systems | | Ongoing |
| Stormwater System | | Ongoing |
| Yard Piping & Site Improvements | | Ongoing |

Appendix L

# ORIGINAL EXECUTIVE SUMMARY



City of Arcata
Wastewater Treatment Facilities Improvements

# Executive Summary
# PREDESIGN REPORT

DRAFT | November 2018

City of Arcata

Wastewater Treatment Facilities Improvements

# EXECUTIVE SUMMARY

# PREDESIGN REPORT

DRAFT | November 2018

Doug Wing, November 2018,
State of California, Civil,
38950

# Contents

Executive Summary - PREDESIGN REPORT 1

1.1 Purpose 1

1.2 Background 1

1.3 Project Goals 1

1.4 Anticipated Improvements 2

1.5 Improvement Siting and Site Constraints 3

1.6 Construction and Project Costs Estimate 3

1.7 Implementation Plan and Schedule 11

1.8 Conclusion 12

# Tables

Table ES-1 Cost Estimate Breakdown by Need 11

# Figures

Figure ES-1 Treatment Wetlands Site Plan 5

Figure ES-2 Enhancement Wetland Site Plan 7

Figure ES-3 Central Site Plan 9

Figure ES-4 Overall Schedule 12

# Appendices

Appendix A TM 1 Basis of Design

Appendix B TM 2 Flow Reconfiguration

Appendix C TM 3 Headworks and Primary Clarifier Replacement

Appendix D TM 4 Ponds and Wetlands Improvements

Appendix E TM 5 Secondary Treatment and Associated Facilities

Appendix F TM 6 Solids Handling and Digester Improvements

Appendix G TM 7 Disinfection System

Appendix H TM 8 Site Improvements

Appendix I TM 9 Energy Efficiency, Electrical, and Control System

Appendix J TM 10 Cost Estimate

Appendix K TM 11 Implementation Plan

# Abbreviations

| | |
|---|---|
| AMWS | Arcata marsh wildlife sanctuary |
| AWTF | Arcata wastewater treatment facility |
| BOD | biological oxygen demand |
| Carollo | Carollo Engineers, Inc. |
| City | City of Arcata |
| NPDES | National Pollutant Discharge Elimination System |
| RWQCB | Regional Water Quality Control Board |
| TM | Technical Memorandum |

Executive Summary

# PREDESIGN REPORT

## 1.1 Purpose

The purpose of this Executive Summary is to outline the recommended improvements, new site plan and site constraints, and construction cost estimate for the improvement project. The improvement project elements are detailed in a series of Technical Memorandums (TMs), briefly described below, and included as appendices in this Predesign Report.

## 1.2 Background

The City of Arcata (City) Wastewater Treatment Facility (AWTF) currently discharges treated wastewater to Humboldt Bay in conjunction with enhanced treatment occurring in the Arcata Marsh Wildlife Sanctuary (AMWS). Discharges are regulated by the North Coast Regional Water Quality Control Board (RWQCB) through application of the National Pollutant Discharge Elimination System (NPDES) permit.

The AWTF operates under an NPDES permit issued in 2012 and updated in 2014, which includes requirements for disinfection, treatment processes, and outfalls. Due to compliance problems, the permit required that changes be made to improve wastewater treatment, protect beneficial uses, and reduce chemical usage. A new permit was due in 2017 and is currently expected to be issued in early 2019. It is anticipated that the new permit will introduce new lower limits for effluent ammonia. The permit will also include an updated compliance schedule, and revised requirements for the new ultraviolet light disinfection system.

## 1.3 Project Goals

The AWTF will be sized to meet the community needs now and for growth envisioned by the City General Plan 2020. The facility design criteria are reviewed in TM No. 1. The City currently has under taken a separate program to reduce the peak wet weather flows and volumes that must be treated at the AWTF.

The overall project goal is to improve the AWTF infrastructure with the addition of a new secondary treatment system while preserving the natural treatment system of ponds and wetlands. The objective is to optimize the existing oxidation ponds, treatment wetlands, and enhancement wetlands in conjunction with a parallel secondary treatment system to meet the anticipated treatment requirements. This project will replace, repair, or rehabilitate aging AWTF facilities to meet the community's current and future needs.

The project environmental goal is to improve water management by addressing existing and proposed NPDES requirements for wastewater treatment and by providing reliable hydraulic capacity and treatment capacity for wet weather flows.

The project will also prepare the AWTF for future infrastructure needs and will provide a resilient system that will address future concerns such as sea level rise. New facilities will be elevated

above the projected flood and sea level elevations, and the project will be coordinate with the anticipated City project to raise the plant levees.

## 1.4 Anticipated Improvements

The project includes the anticipated improvements listed below.

1. Flow reconfiguration to single pass system, to meet permit objectives is described in TM No. 2 and includes:
    - New outfall (Outfall 003) into brackish marsh.
    - Treatment Wetlands (TW) Pump Station rehabilitation.
    - Enhancement Wetlands (EW) Pump Station replacement.
    - Piping modifications required for the flow reconfiguration.
2. Headworks replacement and Primary Clarifier No. 2 rehabilitation to replace aging facilities and provide additional treatment capacity are described in TM No. 3 and include:
    - New Influent Pump Station.
    - New bar screens and screenings treatment
    - New grit removal system and grit handling system.
    - New influent flow meters.
    - Rehabilitate Primary Clarifier No. 2, including a new mechanism.
    - Demolish Primary Clarifier No. 1.
    - New primary sludge and scum pumping system.
3. Pond and treatment wetland improvements to provide increased treatment and hydraulic capacity are discussed in TM No. 4, and also addresses wet weather flows management. The improvements include:
    - Oxidation Pond No. 1 transfer piping modification to allow for peak wet weather flow storage and attenuation.
    - Oxidation Pond No. 2 transfer structure improvements.
    - Oxidation Pond No. 2 aeration system.
    - Oxidation Pond No. 2 baffle wall.
    - Treatment Wetlands Nos. 1 to 4 regrading and revegetation. (Separate City projects)
    - Treatment Wetlands No. 7 construction. (Separate City project)
    - New Treatment Wetland No. 4 pump station. (Separate City Project)
    - Enhancement Wetlands vegetation management and excavation (Separate City Project)
    - Pump Station No. 1 and Pond Pump Station rehabilitation.
    - Emergency Pond Pump Station improvements.
4. New parallel/series secondary treatment to provide additional treatment capacity, to improve water quality and meet anticipated new permit requirements is described in TM No. 5. The proposed facilities include:
    - New oxidation ditch (design for one new and one future).
    - New secondary clarifiers (design for two new and one future).
    - RAS and WAS pumping facility.
    - Alkalinity addition facility to meet permit requirements for ammonia removal (if required).

5. Disinfection system improvements to improve water quality and meet anticipated permit requirements are described in TM No 7, and include:
    - New effluent UV disinfection facility.
    - Liquid chlorine system upgrade for peak wet weather flows.
    - New UV and EW effluent flow meters.
6. Solids handling and treatment upgrades to replace aging facilities, provide additional treatment capacity is described in TM No. 6, and includes:
    - Thickener addition for waste primary and secondary sludge.
    - Digester rehabilitation and improvements.
7. Miscellaneous site improvements to address aging infrastructure, to add all the ancillary and support facilities required for a complete treatment plant, and to accommodate corporation yard facilities impacted by new treatment plant facilities is described in TMs No. 8 and 9, and includes:
    - Bus Barn, maintenance shop, and biosolids composting relocation.
    - Electrical and instrumentation improvements.
    - Plant water system modifications.
    - Relocation and reuse of facilities for plant maintenance and parts storage facilities.

## 1.5 Improvement Siting and Site Constraints

The new treatment processes will be constructed within the existing plant site while maintaining operation of existing wastewater treatment processes. New facility layouts are shown in TM No. 8 Site Improvements. It is assumed that the new influent pump station and headworks will be sited in the same location as the existing influent pump station and headworks.

The City will also maintain the City Corporation Yard in conjunction with the AWTF, at the treatment plant site. As noted, the corporation yard will need to be consolidated and several areas relocated to accommodate the new plant facilities. The overall site plan with the proposed location of the new facilities is presented in Figures ES-1, ES-2, and ES-3.

## 1.6 Construction and Project Costs Estimate

The estimated construction cost of the recommended improvements is $40.7 M in current costs, and $44.0 M when escalated to the mid-point of construction of January 2021. A breakdown of the construction costs for the AWTF improvements is outlined in TM No. 10. The costs to meet the main project objectives are presented in Table ES-1.

File: E:\ICSforPDFWorking\321461794338_4\19913B10FIGES-1.dgn
Plot Date: 05-SEP-2018 9:14:33 AM
User: svcPW




**Figure No. ES-1**

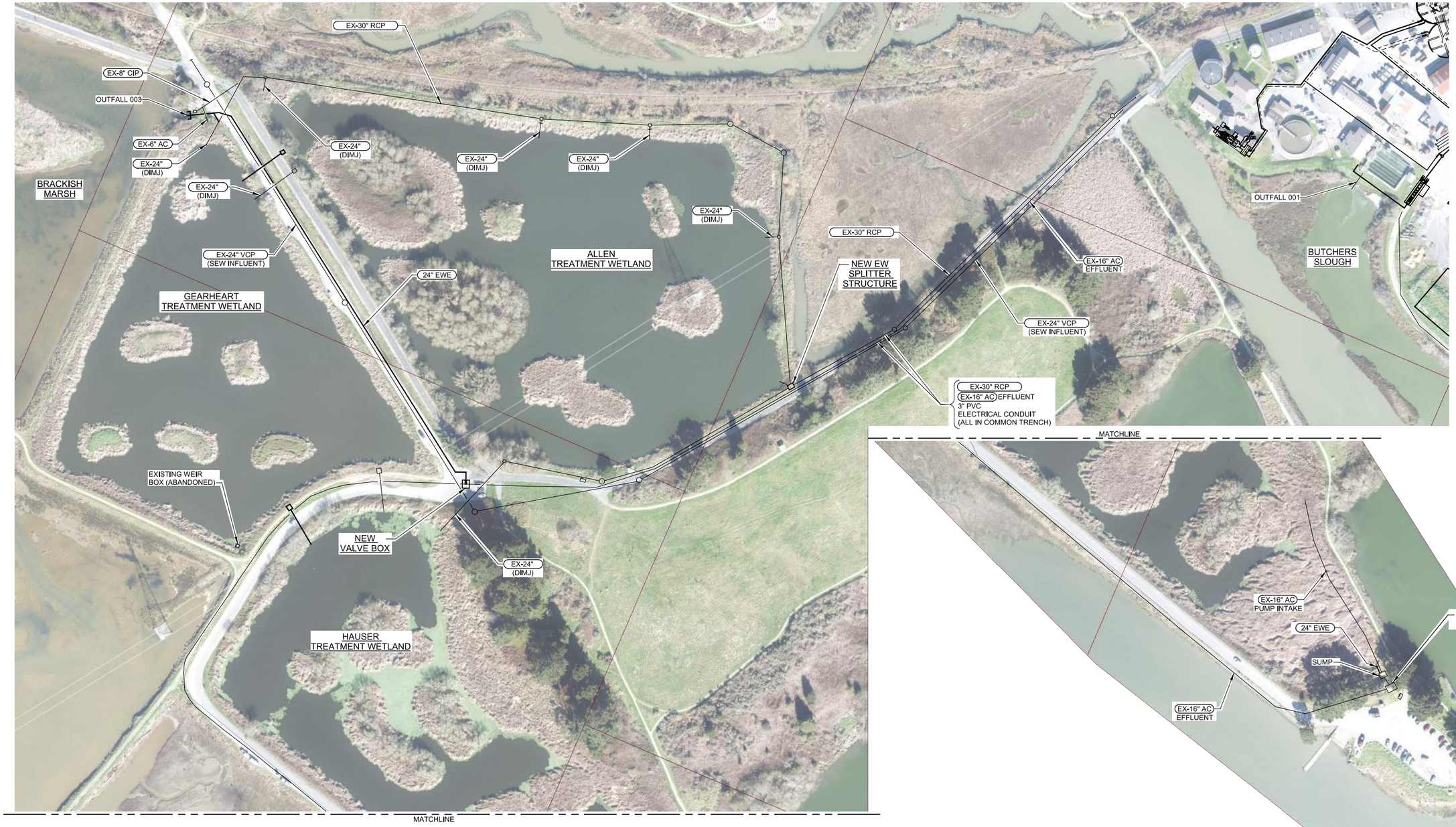
**TREATMENT WETLANDS SITE PLAN**

CITY OF ARCATA

carollo

File: E:\ICSforPDFWorking\321331794338_4919913B10FIGES-2.dgn
Plot Date: 05-SEP-2018 8:47:43 AM
User: svcPW

0 50' 100' 200'




LEGEND:

EXISTING

NEW

FUTURE

**Figure No. ES-2**

**ENHANCEMENT WETLANDS SITE PLAN**

CITY OF ARCATA

carollo




**Figure No. ES-3**
**CENTRAL SITE PLAN**
CITY OF ARCATA

carollo

File: E:\ICSforPDFWorking\32147\794338_4B9913B10FIGES-3.dgn
Plot Date: 05-SEP-2018 9:17:34 AM
User: svcPW

Table ES-1 Cost Estimate Breakdown by Need

| Description | Construction Cost Estimate |
|---|---|
| Flow Reconfiguration improvements | $5,540,000 |
| Headworks / Primary Clarifier replacement and rehabilitation | $6,500,000 |
| Ponds and Wetland improvements | $6,370,000 |
| Secondary Treatment addition | $12,800,000 |
| Disinfection system: UV and Wet weather system upgrades | $2,840,000 |
| Digesters/Solids improvements repair and rehabilitation | $3,180,000 |
| Corporation Yard relocation | $2,710,000 |
| Electrical, Controls, SCADA and Utilities additions | $4,080,000 |
| **TOTAL CONSTRUCTION COSTS (3.5% escalation)** | **$44,020,000** |
| **TOTAL PROJECT COSTS (35%)** | **$59,430,000** |

When construction is very active, total construction costs typically increase more rapidly than the net cost of labor and materials. In active markets overhead and profit margins also increase in response to increased demand. These factors tend to increase the actual overall inflation factor compared to the factor used in developing a cost estimate. The current estimate is based on an annual inflation factor of 3.5 percent. A review of recent construction cost inflation factors show that this may be slightly low for future estimates due to three factors:

- The general California construction market is very robust, and the backlog of construction work is higher than normal. This will put pressure to drive up costs, and may require a higher inflation factor. In addition, labor costs have been rising, especially in specialty trades such as electrical. To account for this factor, some engineers have added a flat 10 percent factor to construction cost estimates to account for the bid market climate.
- The impact of the federal tariffs is currently unknown on the public works construction, especially tariffs on steel, and stainless steel. The impact of tariffs will be to drive costs up as well.
- The overall San Francisco Engineering News construction cost index is also currently trending higher at approximately a 3.5 percent annual change, higher than the 2.5 percent factor used in the previous estimate. This index may not represent the construction market in Northern California, especially the North Coast area where Arcata is located. Therefore local construction costs need to be reviewed to see what the actual inflation rate may be.

Therefore the City should consider these factors when finalizing the construction cost estimate and the City project cost estimate used in budgeting for the project. The escalated construction cost estimate should be reviewed based on local experience and adjusted if needed to account for the current bid climate and construction cost inflation.

## 1.7 Implementation Plan and Schedule

The implementation schedule is outlined below in Figure ES-4. The plan is to continue with the engineering design required to develop documents to obtain construction bids. In parallel with

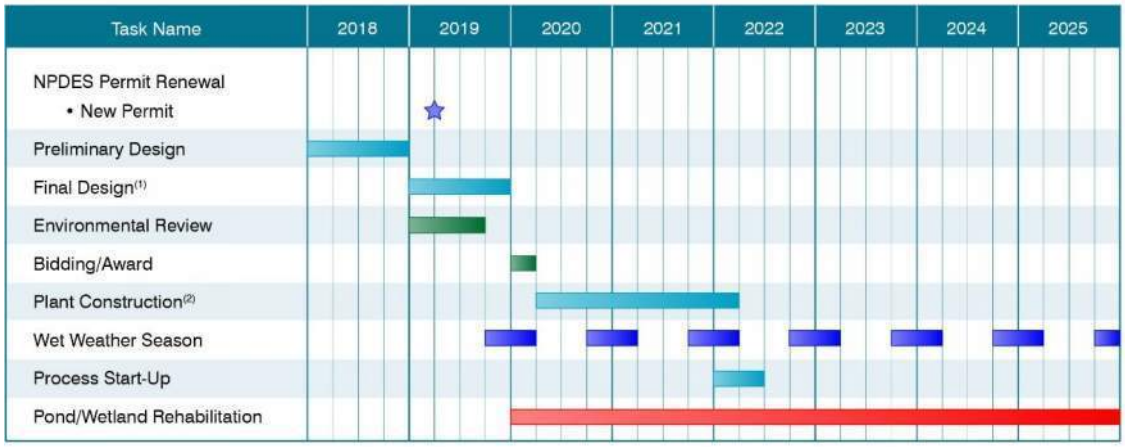
the design activity, environmental review for CEQA compliance will be completed, and any required permits will be identified. Then the permits will be obtained for the improvements project. A financing plan including a rate study will also be developed parallel to the design activities to ensure the City can fund the project.

It is anticipated that construction documents could be prepared in about 12 months, and a project could then be bid and awarded in three or more months. The construction, shown in 2020 and 2021, would be 24 months, or longer and cover two dry weather construction seasons. The startup would be two or three months for the mechanical portion of the plant. The startup for wetlands that might be revegetated could take up to 12 to 18 months. In addition, it is anticipated that ongoing pond and wetland rehabilitation will continue into the future, on a regular schedule.

The City has indicated that several recommended elements of the AWTF improvements would be completed by the City as separate projects. These include:

- TW 7 construction
- TW 4 construction including regrading, vegetation planting, and inlet pump station
- TW 1 and 2 vegetation management and grading/excavation
- Enhancement wetlands vegetation management and excavation

These projects can be completed as maintenance projects and do not require the same level of permit review, design and construction support as the other elements.




Notes:
(1) To be finalized after completion of the Preliminary Design.
(2) Construction schedule is preliminary, constraints to be determined in Final Design.

Figure ES-4 Overall Schedule

## 1.8 Conclusion

In conclusion, it is anticipated that a combination of new plant facilities and plant rehabilitation improvements can be completed within the next five year NPDES permit cycle. The new permit, which is likely to be issued in early 2019, will set new discharge criteria, and will have a compliance schedule included for meeting water quality improvements. This preliminary design report outlines the facilities needed to comply with the anticipated new standards as well as lays

out an implementation schedule that is achievable within the anticipated time schedule requirements of a five year permit window.

Appendix M

# HEADWORKS UPDATE

# ARCATA WASTEWATER TREATMENT FACILITIES – IMPROVEMENTS PROJECT

## Headworks & Screw Pump Option

February 21, 2019

Updated April 2019

WATER
OUR FOCUS
OUR BUSINESS
OUR PASSION

Engineers...Working Wonders With Water®

# Headworks Screw Pump Alternatives

| Configuration | Screw Pumps | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Torque Tube Diameter | Screw Diameter | Number of Flights | Motor Size, hp | Firm Capacity[1] mgd | Total Capacity[2] mgd | Cost | Comments |
| **Retrofit Existing Structure with Added Lift Pumps and Submersible Pump** | | | | | | | | |
| 2 Screw Pumps + 1 Submersible Pump @ 2.5 mgd each | 20″ | 36″ | 3 | 15 | 5.0 | 7.5 | $ | Able to reuse existing wet well but not designed for submersible pump, lowest capacity |
| **New Structure with New Screw Pumps** | | | | | | | | |
| 1+1 @ 6.0 mgd each | 24″ | 54″ | 2 | 40 | 6.0 | 12.0 | $$ | Highest total capacity |
| 2+1 @ 3.0 mgd each | 24″ | 54″ | 1 | 20 | 6.0 | 9.0 | $$$ | Better energy efficiency versus 6.0 mgd screw pumps since only one 3.0 mgd is required most of the time |

All screw pumps listed are external lift pumps with 38° inclination.

**Notes:**
1. Capacity with one of the largest units out of service.
2. Capacity with all units in service.

# New Headworks Pump Station Alternatives

| Configuration | Speed | Firm Capacity[1] mgd | Total Capacity[2] mgd | Minimum Capacity[3] mgd | Cost | Comments |
|---|---|---|---|---|---|---|
| **Submersible Pumps** | | | | | | |
| 2+1 @ 2.0 mgd each | Variable | 4.0 | 6.0 | 1.0 | $ | Lowest cost, but firm capacity less than design capacity |
| 2+1 @ 3.0 mgd each | Variable | 6.0 | 9.0 | 1.5 | $$ | Low cost, but not capable of low flow pumping |
| 2+1 @ 2.5 mgd , 1 @ 1.0 mgd | Variable | 6.0 | 8.5 | 0.5 | $$$ | Good balance of capacity range and cost |
| 1+1 @ 4.0 mgd , 2 @ 1.0 mgd | Variable | 6.0 | 10.0 | 0.5 | $$$$ | Highest total capacity and highest cost for submersible pumps |
| **Screw Pumps** | | | | | | |
| 1+1 @ 6.0 mgd each | Constant | 6.0 | 12.0 | 0.0 | $$$$$ | Highest total capacity, able to pump at lowest flows |
| 2+1 @ 3.0 mgd each | Constant | 6.0 | 9.0 | 0.0 | $$$$$$ | Better energy efficiency versus 6.0 mgd screw pumps since only one 3.0 mgd is required most of the time |

**Notes:**
1. Capacity with one of the largest units out of service.
2. Capacity with all units in service.
3. 50 percent capacity of smallest unit.

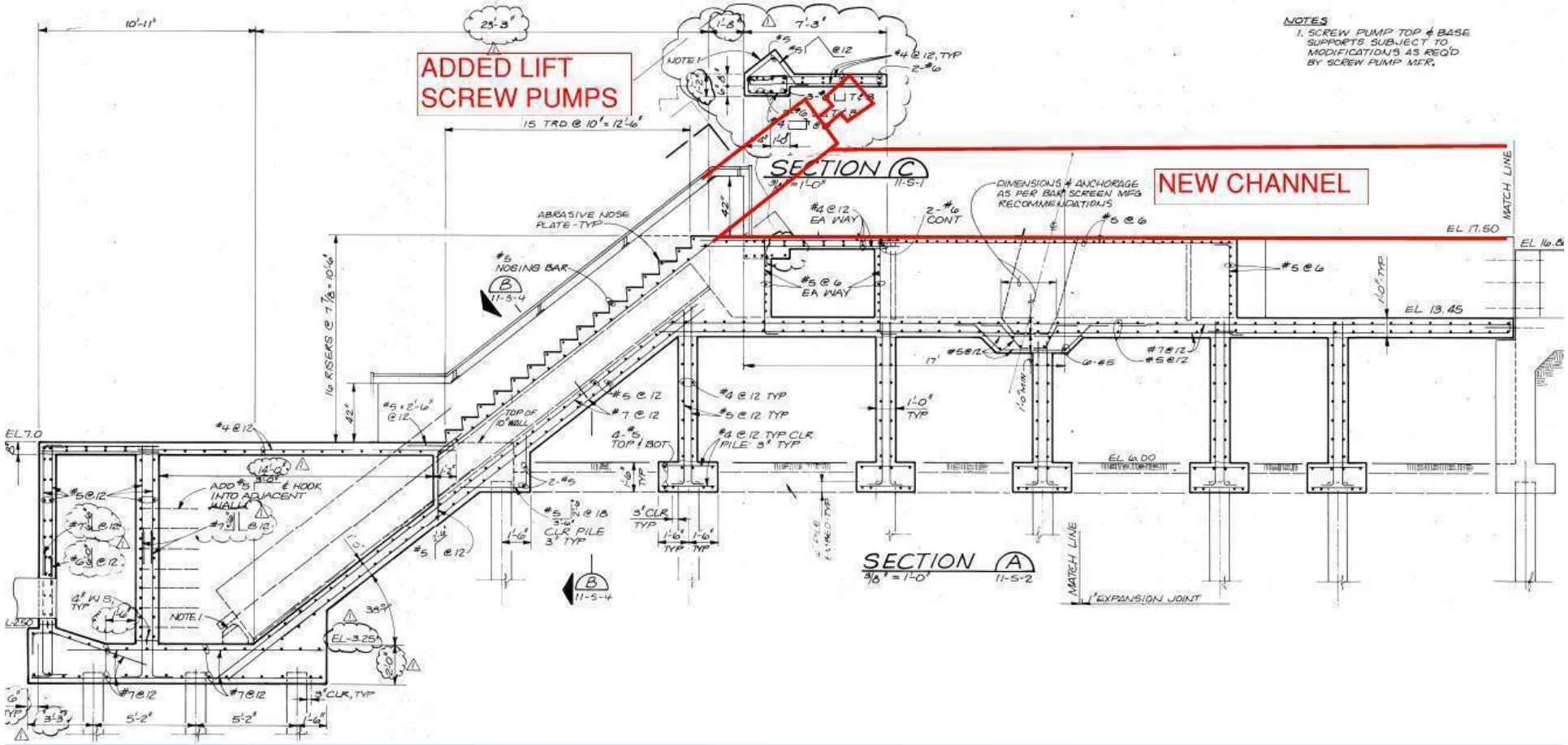
# Screw Pumps

- Similar to existing influent pumps
- Reliable and relatively simple to maintain
- Able to move larger solids than other types of pumps
- Can utilize a smaller wet well
- Will continue to operate regardless of the water level or flow conditions in the wet well
- Require a large footprint due to the size of the torque tube and flights and the support structure

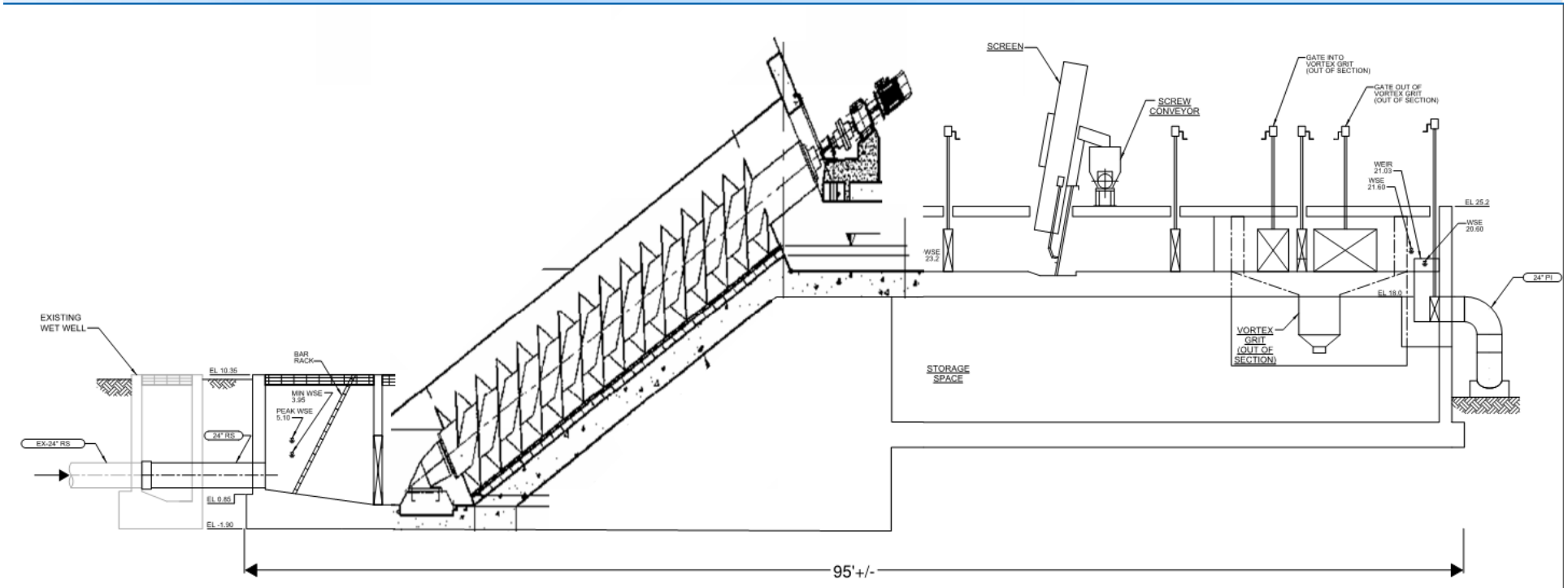
# Submersible Pumps

- Smaller footprint and lower capital costs than screw pumps
- Size allows for multiple configurations of pump sizes and wet well layouts
- Require a minimum submergence that is deeper than screw pumps
- Require wet well flow conditioning to reduce turbulence into the pumps
- Require a lift or crane to pull the pump out of the wet well

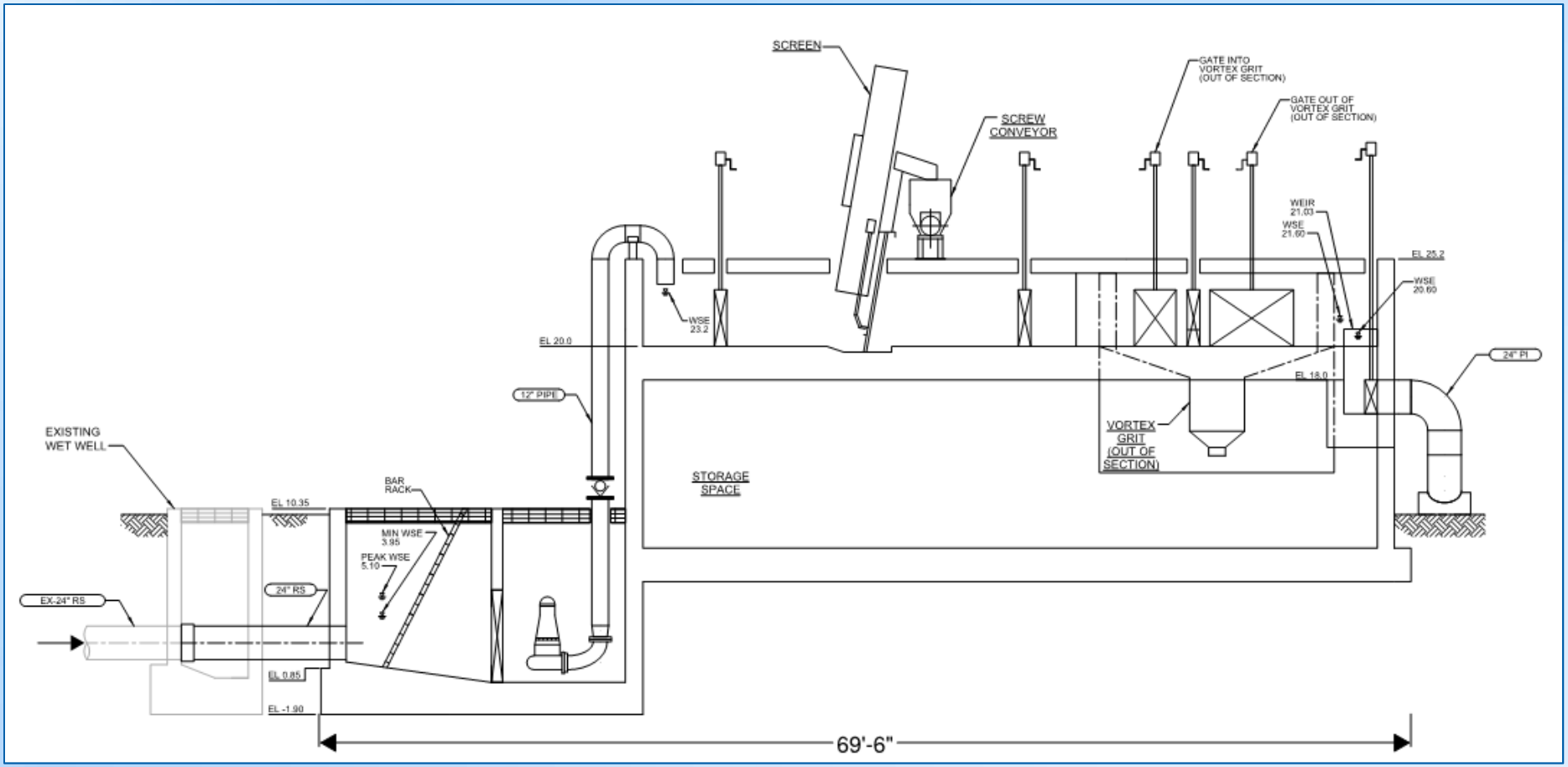
# Retrofit Headworks Screw Pump Section



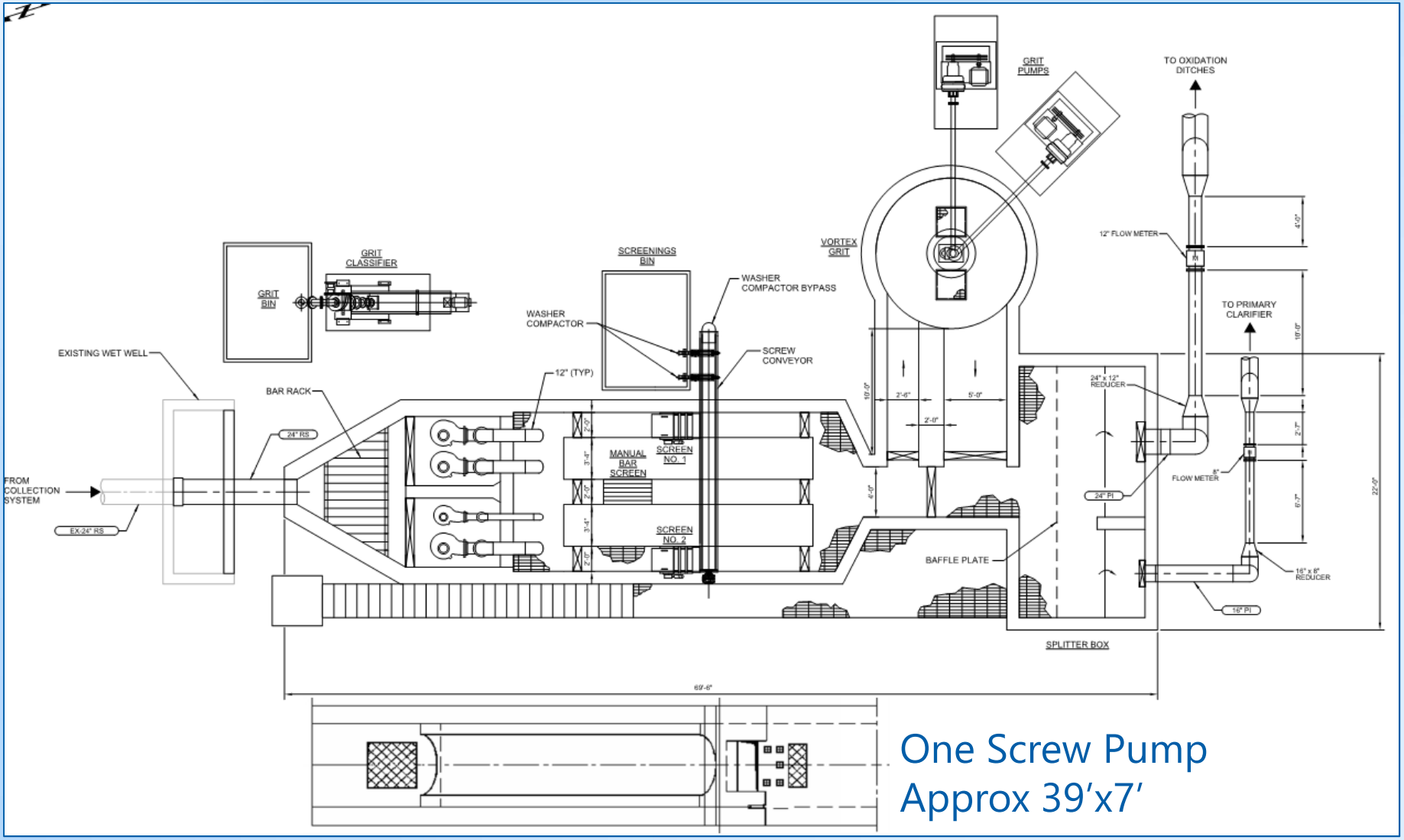
# New Headworks Screw Pump Section



# New Headworks Submersible Pump Section



# Screw Pump Footprint Comparison




One Screw Pump
Approx 39'x7'

# Additional Construction Costs for Screw Pumps

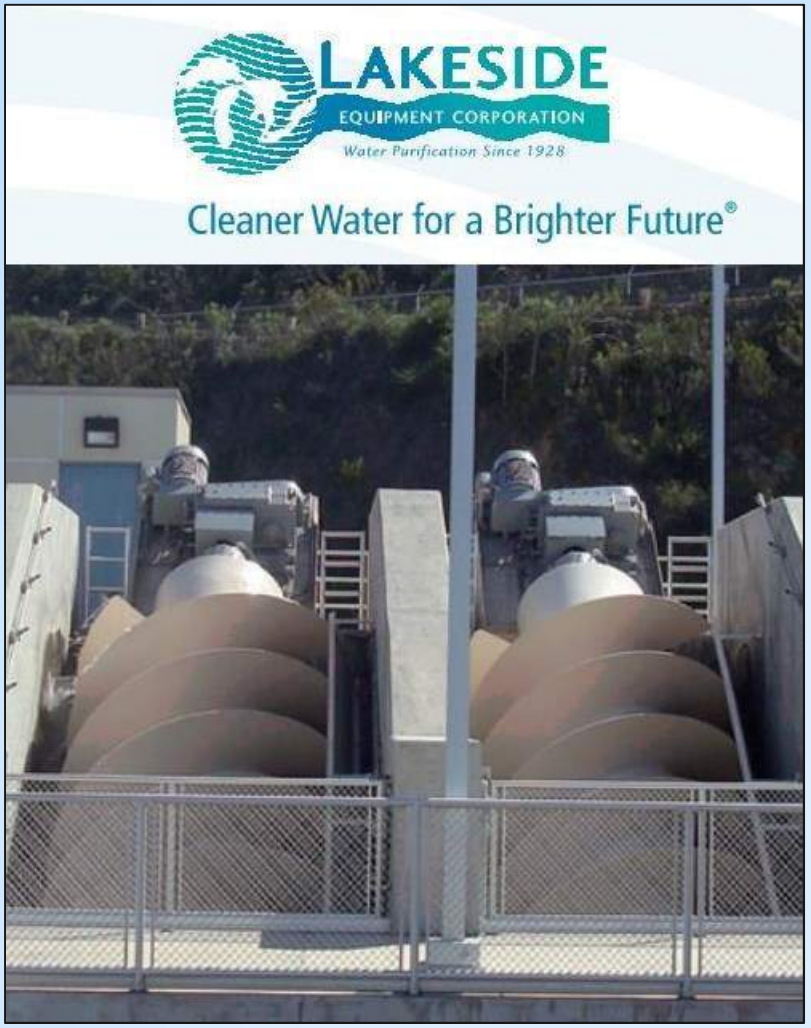
- Pump station equipment costs $400,000 to $830,000 more than submersible pump type station
- Installed costs with additional structure and piles adds $1.3 to $1.8 M to Headworks construction costs

# City Review and Selection (Feb 21 Call)

- City recommended a revised influent pump option using screw pumps
  - Install 2 screw pumps with same diameter as existing, extended for the additional lift.
  - Screw Pump Capacity – 2.5 mgd each
  - Additional submersible or other auxiliary pump with 2.5 mgd capacity.
  - Firm PS capacity – 5.0 mgd (2 + 1 pumps)
  - Total capacity – 7.5 mgd

# City Review and Selection (Feb 21 Call)

- City asked to retain a portion of the existing structure if possible. Carollo to review and estimate any cost savings in final design
- Carollo to prepare an updated cost estimate to confirm cost of screw pump selection in final design.



# ARCATA WASTEWATER TREATMENT FACILITIES – IMPROVEMENTS PROJECT

## Headworks – Screw Pump Option

January 7, 2019

Updated April 2019

WATER
OUR FOCUS
OUR BUSINESS
OUR PASSION

carollo
Engineers...Working Wonders With Water®

Appendix N

# DISINFECTION UPDATE

# ARCATA WASTEWATER TREATMENT FACILITIES – IMPROVEMENTS PROJECT

## UV Disinfection – Wet Weather Options

January 7, 2019

Updated April 2019

City of ARCATA

WATER
OUR FOCUS
OUR BUSINESS
OUR PASSION

carollo
Engineers...Working Wonders With Water®

# Purpose

- Eliminate chlorine disinfection for peak wet weather flows
- Upsize UV disinfection to account for flows greater than 5.9 MGD

# Influent Flow Data

| Influent Flow Condition | Probability | Influent Flow Value, MGD |
|---|---|---|
| Average dry weather flow | | 1.1 MGD |
| Average annual flow | | 1.7 |
| Maximum month flow | 91.7% (1 month in 12 months) | 3.0 |
| Peak daily average flow | 99.7% (1 day in 365 days) | 5.7 |
| Maximum day flow | 99.9 (1 day in 4 years) | 9.1 |

Note: Based on 2013 to 2017 data

# UV Configuration Options

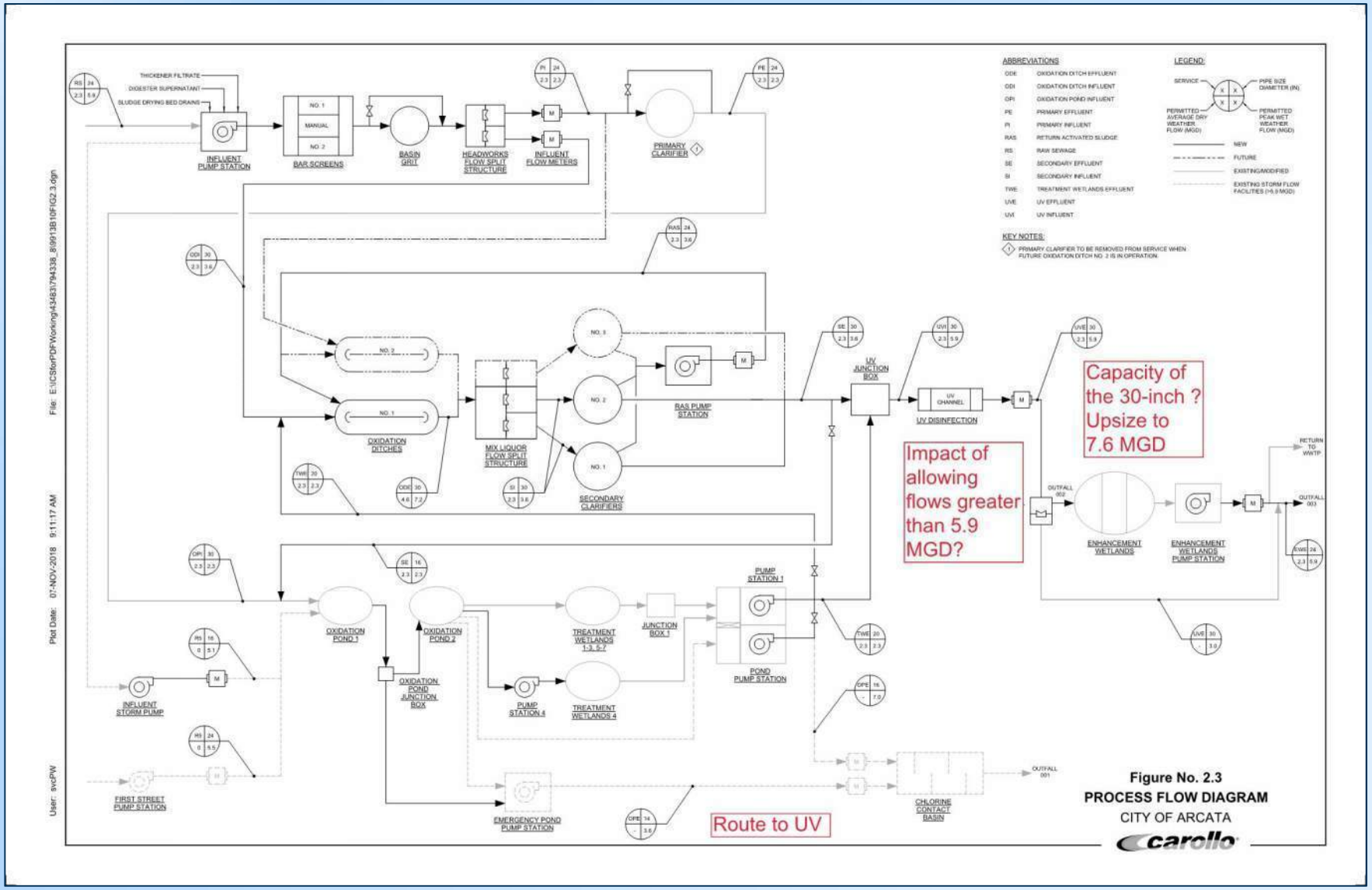
| Parameters | Option 1<br>Trojan<br>UVSigna 2-Row | Option 2<br>Trojan<br>UVSigna 2-Row | Option 3<br>Trojan<br>UVSigna 2-Row | Original<br>Trojan<br>UVSigna 2-Row |
|---|---|---|---|---|
| | | | | |
| Peak Flow Rate (MGD) | 5.9 | 7.6 | 9.8 | 5.9 |
| Minimum UV Transmittance (%) | 35 | 35 | 35 | 35 |
| Design MS2 RED (mJ/cm2) | 50.0 | 50.0 | 50.0 | 50.0 |
| | | | | |
| Configuration: | | | | |
| Number of Channels | 2 | 2 | 2 | 1 |
| Number of Duty Banks/Channel | 4 | 5 | 6 | 5 |
| Total Number of Lamps | 100 | 120 | 140 | 96 |
| | | | | |
| Total Power Consumption (kW) | 105.8 | 127.0 | 148.1 | 101.6 |
| | | | | |
| Headloss Across UV Banks (inches) | 0.8 | 1.4 | 2.3 | 1.3 |
| | | | | |
| Total Equipment Price | $825,000 | $935,000 | $1,090,000 | $640,000 |
| | | | | |
| Estimated Construction Cost | $3,176,000 | $3,600,000 | $4,197,000 | $2,464,000 |
| | | | | |

# Wet Weather UV Options

- Existing single channel system will handle flow 99% of the time.
- Higher flows will require a 2 channel system to address headloss.
- A 5.9 MGD 2 channel system increases equipment cost by $185,000 and construction cost by $710,000 +/-.
- Recommended option 2 channel system sized for a minimum of 7.6 MGD with 5.9 MGD equipment installed. Will increases equipment cost by $185,000 and construction cost by $1,000,000 +/-.

Note – see alternative sizing handout for additional details.

# Impact on effluent conveyance. Capacity may need to be increased!



# Updated UVT Data - Lower UVT during lower flows

| | PT 9 Treatment Wetland (TW) | PT 10 TW in CCB | PT 15 Enhancement Wetland | PT 16 Existing Discharge |
|---|---|---|---|---|
| Average | 35.2 | 31.9 | 44.1 | 43.5 |
| Min | 17.6 | 29.2 | 29.2 | 28.2 |
| Max | 51.4 | 43.0 | 60.8 | 56.8 |
| Median | 33.9 | 30.9 | 42.7 | 43.2 |
| Lower 10th percentile | 27.5 | 29.7 | 33.0 | 35.2 |

Note: Based on data from 12/17/18 email

# City Review and Selection Update (March 7 email)

- City selected the 9.8 mgd option to address wet weather flows in conjunction with pond system improvements to equalize peak flowrates.
- Will eliminate the need to rehabilitate existing chlorine system. Chlorine building can be repurposed for storage and maintenance. The CCB can be demolished and free up space for other uses.
- Will eliminate the issues with intermittent operation of the chlorine system. This will eliminate the potential of chlorine violations and disinfection byproduct issues.

# City Review and Selection Update (March 7 email)

- Final design
  - Will confirm 2 channel design at higher flow
  - Proposed dose design criteria – 50 mJ/cm2
  - Confirmed UVT design criteria - 35% UVT
  - Will review impact of higher flow to EW (002) / Brackish marsh outfall (003) on effluent piping sizing/headloss
- Block grant will require open bid for equipment.

# ARCATA WASTEWATER TREATMENT FACILITIES – IMPROVEMENTS PROJECT

## UV Disinfection – Wet Weather Options

January 7, 2019

Updated April 2019

City of ARCATA

WATER
OUR FOCUS
OUR BUSINESS
OUR PASSION

carollo
Engineers...Working Wonders With Water®

Appendix O

# COST UPDATE BY PHASES

| | | | | |
|---|---|---|---|---|
| **Project:** | **Wastewater Treatment Facility Improvements** | | | |
| **Client:** | **City of Arcata** | **Location Factor:** | **1.071** | **REVISED** |
| **Location:** | **Arcata, CA** | **Estimated Midpoint of Construction:** | **April 1, 2021** | **April 7, 2019** |
| **Zip Code:** | **95521** | **Cost Estimate Preparation Date:** | **November 1, 2018** | **REV 4** |
| **Carollo Job #** | **9913B.10** | **By:** | **RRH/EAC** | |
| | | **Reviewed:** | **DW** | |
| | | Rate of Annual Inflation: | 3.5% | Trending up |
| | | Estimating Contingency: | 25.0% | |
| | | Sales Tax: | 8.5% | |
| | | General Conditions: | 10.0% | Trending up |
| | | Contractor Overhead and Profit: | 10.0% | |
| | | Bid Market Allowance: | 0.0% | 5% to 10% |

| NO. | DESCRIPTION | Original Construction Cost | Phase 1 Construction Cost | Phase 2 Construction Cost |
|---|---|---|---|---|
| 01 | Headworks **(Placeholder)** | $5,020,000 | $5,020,000 | $0 |
| 02 | Primary Clarifier Rehabilitation | $1,520,000 | $1,520,000 | $0 |
| 03 | Oxidation Ditch (1) | $7,020,000 | $0 | $7,020,000 |
| 04 | Secondary Clarifiers (2) | $2,820,000 | $0 | $2,820,000 |
| 05 | Oxidation Ponds (includes Pond PS & EPPS)) | $3,480,000 | $3,480,000 | $0 |
| 06 | Treatment Wetlands - PS and Wetlands | $1,240,000 | $1,240,000 | $0 |
| 07 | UV Disinfection **(9.8 MGD Wet Weather)** | $2,474,000 | $4,200,000 | $0 |
| 08 | Chlorine Disinfection **(Deleted)** | $380,000 | $0 | $0 |
| 09 | Enhancement Wetlands (includes Hauser PS) | $1,830,000 | $1,830,000 | $0 |
| 10 | RAS Pump Station | $2,100,000 | $0 | $2,100,000 |
| 11 | WAS Pump Station | $280,000 | $0 | $280,000 |
| 12 | Thickeners | $980,000 | $0 | $980,000 |
| 13 | Digesters | $2,210,000 | $0 | $2,210,000 |
| 14 | Alkalinity Feed System | $660,000 | $0 | $660,000 |
| 15 | Plant Water Systems | $160,000 | $0 | $160,000 |
| 16 | Stormwater System | $160,000 | $0 | $160,000 |
| 17 | Existing Electrical Building **(100% split)** | $1,380,000 | $1,380,000 | $0 |
| 18 | New Electrical Building (does not includes PV) **(75%/25% split)** | $2,410,000 | $1,808,000 | $602,000 |
| 19 | Yard Piping & Site Improvements **(50% split assumption)** | $5,570,000 | $2,785,000 | $2,785,000 |
| | **TOTAL WWTF IMPROVEMENTS CONSTRUCTION COSTS** | **$41,690,000** | **$23,263,000** | **$19,777,000** |
| 20 | Corporation Yard relocation | $1,560,000 | $0 | $1,560,000 |
| 21 | Biosolids Composting relocation | $1,170,000 | $0 | $1,170,000 |
| | **TOTAL CONSTRUCTION COSTS (Includes Phase 1 Escalation)** | **$44,420,000** | **$23,263,000** | **$22,507,000** |
| | **Phase 2 Escalation Beyond Phase 1** | | | **$1,958,000** |
| | **TOTAL PHASE 2 CONSTRUCTION COSTS** | | | **$24,465,000** |
| | **Project Cost 35%** | **$60,000,000** | **$31,400,000** | **$33,000,000** |

Notes

*The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of accurate costs at this time and is subject to change as the project design matures. Carollo Engineers have no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. Carollo Engineers cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.*

# ATTACHMENT 25

City of Arcata. 2020. *Early Notice and Public Review of Proposed Activities in 100-Year Floodplain and Mapped Wetland Area.* Published 07/08/2020.

# Early Notice and Public Review of Proposed Activities in 100-Year Floodplain and Mapped Wetland Area

To: All interested Agencies, Groups, and Individuals:

This is to give notice that the City of Arcata, under Part 58 of Title 24 Code of Federal Regulation, has determined that the following proposed action under the Community Development Block Grant Program and contract number 17-CDBG-12017 is located in the 100-year floodplain and may permanently impact an identified freshwater emergent wetland. The City of Arcata is required to identify and evaluate practicable alternatives to locating the action in the 100-year floodplain and wetland, and the potential impacts on the floodplain and wetland from the proposed action, as required by Executive Orders 11988 and 11990, in accordance with HUD regulations at 24 CFR 55.20 Subpart C Procedures for Making Determinations on Floodplain Management and Protection of Wetlands.

The proposed project will upgrade elements of the existing Arcata Wastewater Treatment Facility located at 601 G Street in Arcata, Humboldt County. Arcata's Wastewater Treatment Facility (Facility) is located within the Arcata Marsh and Wildlife Sanctuary, and utilizes innovative treatment methods using treatment ponds within the marsh area. The City of Arcata is proposing to replace a portion of existing Facility infrastructure and upgrade several components as part of the Arcata Wastewater Treatment Facility Improvement Project. The work will include installation of buried pipe for the flow reconfiguration of disinfected enhancement wetlands effluent, installing a discharge pipe into a constructed brackish marsh at the north end of the Arcata Bay section of Humboldt Bay (future outfall discharge point), relocation of the electrical equipment building in the Facility to allow for improved road access for fire and emergency services (requiring installation of a new utility service line), and constructing a mitigation wetland area.

A major project objective is to minimize disinfection byproducts associated with the use of chlorine and health hazards associated with the use and storage of large chlorine cylinders onsite. The City of Arcata has received a Community Development Block Grant (CDBG) to purchase Ultraviolet (UV) equipment to treat wastewater in place of chlorine in order to comply with the National Pollution Discharge Elimination System (NPDES) requirements for treated effluent. This funding has triggered the examination of alternatives.

The Facility is located in the "AE" zone, which has an annual 1% probability of flooding. The project scope includes the installation of a new discharge pipe for treated effluent into an existing brackish marsh created for the purposes of treating wastewater. The perimeter of the brackish marsh has been identified as containing 0.1 acres of freshwater emergent wetland which may be permanently impacted by the project (Stillwater Sciences, 2020). This wetland area is subject to Section 404 of the Clean Water Act and thus under USACE-jurisdiction as well as State- and LCP-jurisdiction.

The entire Facility is currently protected by a newly repaired (2009 FEMA funded) rock armored levee (approx. 1.0 mile) constructed of native derived soils of elevation range 10.5' to 14' NGVD borrowed immediately from the bay side of the ringed facility. The existing armored western facing dike adjacent to any VE zone will be raised to 14' min. on top of the dike at a 1.5 to 1 max slope with an armored engineered fill soil prism to protect the dike and inner Facility from erosive storm driven wave action (4500LF ) and also an interior non armored crown dike encircling the Facility core area (1775LF). The

remaining portions of dike (2200LF) will be raised to 12' min. for remaining dike areas along southeast and east sides of the Facility on the dike to meet the zone AE (BFE 10' NGVD 88) requirements plus 2' Safety factor.

The core Facility (6.5 acres) is equipped with a stormwater collection and pumping system. The system will be sized to accommodate the 100-year return event within the core Facility and will be pumped into the to the City's Facility for treatment prior to discharge with the plant effluent.

There are three primary purposes for this notice. First, people who may be affected by activities in floodplains and wetlands and those who have an interest in the protection of the natural environment should be given an opportunity to express their concerns and provide information about these areas. Commenters are encouraged to offer alternative sites outside of the floodplain or wetland, alternative methods to serve the same project purpose, and methods to minimize and mitigate impacts. Second, an adequate public notice program can be an important public educational tool. The dissemination of information and requests for public comment about floodplains and wetlands can facilitate and enhance Federal efforts to reduce the risks and impacts associated with the occupancy and modification of these special areas. Third, as a matter of fairness, when the Federal government determines it will participate in actions taking place in floodplains and wetlands, it must inform those who may be put at greater or continued risk.

Comments must be received by the City of Arcata, either in writing or by email, at the following address on or before Friday July 24, 2020: 736 "F" Street, Arcata CA 95521, phone number (707) 822-5955, Attention: David Loya, Community Development Director. Comments may also be submitted via email at comdev@cityofarcata.org. More information on the project may also be reviewed at https://www.cityofarcata.org/856/Wastewater-Treatment-Facilities-Improvem.

# ATTACHMENT 26

North Coast Regional Water Quality Control Board. 2019. *North Coast Regional Water Quality Control Board. 2019. Order No. R1-2019-0006. Waste Discharge Requirements for the City of Arcata Wastewater Treatment Facility, Humboldt County.* Signed 11/06/2019.

**ORDER NO. R1-2019-0006**
**NPDES NO. CA0022713**
**WDID NO. 1B82114OHUM**

**WASTE DISCHARGE REQUIREMENTS**

**FOR THE**

**CITY OF ARCATA**
**WASTEWATER TREATMENT FACILITY**
**HUMBOLDT COUNTY**

The following Permittee is subject to waste discharge requirements (WDRs) set forth in this Order:

**Table 1. Permittee Information**

| | |
|---|---|
| **Permittee** | City of Arcata |
| **Name of Facility** | Wastewater Treatment Facility |
| **Facility Address** | 600 South G Street |
| | Arcata, CA 95521 |
| | Humboldt County |
| **Type of Facility** | Publicly Owned Treatment Works (POTW) |
| **Facility Design Flow** | 2.3 million gallons per day (mgd) (average dry weather design flow)<br>5.0 mgd (average wet weather design flow)<br>5.9 mgd (peak wet weather design flow)<br>16.5 mgd (wet weather $Q_{max}$) |

**Table 2. Discharge Locations**

| Discharge Point | Effluent Description | Discharge Point Latitude (North) | Discharge Point Longitude (West) | Receiving Water |
|---|---|---|---|---|
| 001 | Equivalent to secondary treated wastewater | 40° 51' 18" | 124° 5' 26" | Humboldt Bay |
| 002 | Secondary treated wastewater | 40° 51' 29" | 124° 5' 31" | Arcata Marsh Wildlife Sanctuary |
| 003 | Secondary treated wastewater | 40° 51' 40" | 124° 5' 37" | Brackish Marsh, Humboldt Bay |

**Table 3. Administrative Information**

| | |
|---|---|
| This Order was adopted on: | **October 17, 2019** |
| This Order shall become effective on: | **December 1, 2019** |
| This Order shall expire on: | **November 30, 2024** |
| The Permittee shall file a Report of Waste Discharge as an application for reissuance of WDRs in accordance with title 23, California Code of Regulations, (CCR) and an application for reissuance of a National Pollutant Discharge Elimination System (NPDES) permit no later than: | **December 1, 2023** |
| The U.S. Environmental Protection Agency (U.S. EPA) and the California Regional Water Quality Control Board, North Coast Region have classified this discharge as follows: | Major |

IT IS HEREBY ORDERED, that Waste Discharge Requirements (WDR) Order No. R1-2012-0031 and Monitoring and Reporting Program (MRP) No. R1-2012-0031, are rescinded upon the effective date of this Order except for enforcement purposes, and in order to meet the provisions contained in division 7 of the California Water Code (Water Code) (commencing with section 13000) and regulations and guidelines adopted thereunder, and the provisions of the federal Clean Water Act (CWA) and regulations and guidelines adopted thereunder, the Permittee shall comply with the requirements of this Order. This action in no way prevents the North Coast Regional Water Quality Control Board (Regional Water Board) from taking enforcement action for past violations of the previous permit.

I, Matthias St. John, Executive Officer, do hereby certify that this Order with all attachments is a full, true, and correct copy of the Order adopted by the California Regional Water Quality Control Board, North Coast Region, on **October 17, 2019.**

Matt St. John

Digitally signed by Matt St. John
Date: 2019.11.06 15:53:12 -08'00'

Water Boards

Matthias St. John, Executive Officer

19_0006_Arcata_NPDES

## Contents

I. Facility Information ..... 4
II. Findings ..... 4
III. Discharge Prohibitions ..... 5
IV. Effluent Limitations and Discharge Specifications ..... 6
V. Receiving Water Limitations ..... 14
A. Surface Water Limitations ..... 14
B. Groundwater Limitations ..... 16
VI. Provisions ..... 17
A. Standard Provisions ..... 17
B. Monitoring and Reporting Program (MRP) Requirements ..... 18
C. Special Provisions ..... 18
VII. Compliance Determination ..... 28

## Tables

Table 1. Permittee Information ..... 1
Table 2. Discharge Locations ..... 1
Table 3. Administrative Information ..... 2
Table 4. Effluent Limitations – Discharge Point 001 ..... 6
Table 5. Effluent Limitations – Discharge Point 001 ..... 7
Table 6. Effluent Limitations – Discharge Point 003 ..... 9
Table 7. Effluent Limitations – Discharge Point 002 ..... 10
Table 8. Effluent Limitations – Discharge Point 003 ..... 11
Table 9. Discharge Specifications – Discharge Point 002 ..... 12

## Attachments

Attachment A – Definitions ..... A-1
Attachment B – Location Map ..... B-1
Attachment C – Flow Schematic ..... C-1
Attachment D – Standard Provisions ..... D-1
Attachment E – Monitoring and Reporting Program (MRP) ..... E-1
Attachment F – Fact Sheet ..... F-1
Attachment G - AMEL and MDEL Ammonia Standards based on the 1989 Saltwater acute criteria ..... G-1
Attachment H – PDF Example of the AIR Calculator ..... H-1

## I. FACILITY INFORMATION

Information describing the City of Arcata (Permittee) Wastewater Treatment Facility (Facility) is summarized in Table 1 and in sections I and II of the Fact Sheet (Attachment F). Section I of the Fact Sheet also includes information regarding the Facility's permit application.

## II. FINDINGS

The California Regional Water Quality Control Board, North Coast Region (Regional Water Board), finds:

**A. Legal Authorities.** This Order serves as Waste Discharge Requirements (WDRs) pursuant to article 4, chapter 4, division 7 of the Water Code (commencing with section 13260). This Order is also issued pursuant to section 402 of the federal Clean Water Act (CWA) and implementing regulations adopted by the U.S. Environmental Protection Agency (U.S. EPA) and chapter 5.5, division 7 of the Water Code (commencing with section 13370). It shall serve as a National Pollutant Discharge Elimination System (NPDES) permit authorizing the Permittee to discharge into waters of the United States at the discharge locations described in Table 2 subject to WDRs in this Order.

**B. Basis and Rationale for Requirements.** The Regional Water Board developed the requirements in this Order based on information submitted as part of the Permittee's application, monitoring and reporting programs, and other available information. The Fact Sheet (Attachment F), which contains background information and rationale for the requirements in this Order, is hereby incorporated into this Order, and constitutes Findings for this Order. Attachments A through E, G and H are also incorporated into this Order.

**C. Provisions and Requirements Implementing State Law.** The provisions/requirements in subsections III.E, III.F, IV.B, IV.C, IV.D, V.B, VI.C.5.a, VI.C.5.c.ix and x, and VI.C.5.d of this Order and section X.E of the Monitoring and Reporting Program (MRP) are included to implement state law only. These provisions/requirements are not required or authorized under the federal CWA; consequently, violations of these provisions/requirements are not subject to the enforcement remedies that are available for NPDES violations.

**D. Notification of Interested Parties.** The Regional Water Board has notified the Permittee and interested agencies and persons of its intent to prescribe WDRs for the discharge and has provided them with an opportunity to submit their written comments and recommendations. Details of the notification are provided in the Fact Sheet.

**E. Consideration of Public Comment.** The Regional Water Board, in a public meeting, heard and considered all comments pertaining to the discharge. Details of the Public Hearing are provided in the Fact Sheet.

## III. DISCHARGE PROHIBITIONS

**A.** The discharge of waste to Humboldt Bay is prohibited unless the discharge is consistent with State Water Resources Control Board (State Water Board) Order No. 79-20 and Regional Water Board Resolution No. 83-9.

**B.** The discharge of any waste not disclosed by the Permittee or not within the reasonable contemplation of the Regional Water Board is prohibited.

**C.** Creation of pollution, contamination, or nuisance, as defined by section 13050 of the Water Code is prohibited.

**D.** The discharge of sludge or digester supernatant is prohibited, except as authorized under section VI.C.5.c of this Order (Sludge Disposal and Handling Requirements).

**E.** The discharge of untreated or partially treated waste (receiving a lower level of treatment than described in section II.B of the Fact Sheet) from anywhere within the collection, treatment, or disposal systems is prohibited, except as provided for in Attachment D, Standard Provisions G (Bypass) and H (Upset).

**F.** Any sanitary sewer overflow (SSO) that results in a discharge of untreated or partially treated wastewater to (a) waters of the state or (b) land and creates pollution, contamination, or nuisance, as defined in Water Code section 13050(m) is prohibited.

**G.** The discharge of waste at any point not described in Finding II.B of the Fact Sheet or authorized by a permit issued by the State Water Board or another Regional Water Board is prohibited.

**H.** The average dry weather flow of waste through the Facility shall not exceed 2.3 million gallons per day (mgd), measured daily and averaged over a calendar month. Compliance with this prohibition shall be determined as defined in sections VII.K of this Order.

**I.** The discharge of treated effluent at Discharge Point 001 is prohibited[1], other than that portion of the flow exceeding peak flows of 5.9 mgd that cannot be stored on-site.

**J.** The discharge of any radiological, chemical, or biological warfare agent into waters of the state is prohibited under Water Code section 13375.

**K.** The acceptance of septage is prohibited unless the Permittee has a septage receiving station approved by the Executive Officer of the Regional Water Board.

[1] Discharge Prohibition III.I shall take effect upon completion of Phase I of the Proposed Upgrade Project which includes construction of Discharge Point 003 to the Brackish Marsh.

## IV. EFFLUENT LIMITATIONS AND DISCHARGE SPECIFICATIONS

### A. Effluent Limitations – Discharge Point 001 (Prior to completion of Phase One and Phase Two of the Upgrade Project)

#### 1. Final Effluent Limitations – Discharge Point 001

**a.** The discharge of treated wastewater shall maintain compliance with the following effluent limitations at Discharge Point 001, with compliance measured at Monitoring Location EFF-001, as described in the MRP (Attachment E). These limitations apply until Phase One of the Upgrade Project is complete. Time Schedule Order No R1-2019-0011 has a compliance date for Phase One of June 30, 2022.

**Table 4. Effluent Limitations – Discharge Point 001 (Prior to completion of Phase One and Phase Two of the Upgrade Project)**

| Parameter | Units | Effluent Limitations[1] | | | | |
|---|---|---|---|---|---|---|
| | | Average Monthly | Average Weekly | Maximum Daily | Instantaneous Minimum | Instantaneous Maximum |
| pH | standard units | -- | -- | -- | 6.0 | 8.5 |
| Cyanide, Total (as CN) | µg/L | 0.43 | -- | 1.0 | -- | -- |
| TCDD-Equivalents | µg/L | $1.4 \times 10^{-8}$ | -- | $3.3 \times 10^{-8}$ | -- | -- |
| Chlorine, Total Residual | mg/L | 0.01 | -- | 0.02 | -- | -- |
| Settleable Solids | ml/L | 0.1 | -- | 0.2 | -- | -- |

Table Notes:
1. See Definitions in Attachment A and Compliance Determination discussion in section VII of this Order.

**b.** **Percent Removal.** The average monthly percent removal of $BOD_5$ and TSS shall not be less than 85 percent. Percent removal shall be determined from the monthly average value of influent wastewater concentration in comparison to the monthly average value of effluent concentration for the same constituent over the same time period, as measured at Monitoring Locations INF-001 and EFF-001, respectively.

**c.** **Disinfection**. Disinfected effluent discharged from the Facility through Discharge Point 001 to Humboldt Bay shall not contain fecal coliform bacteria exceeding the following concentrations, as measured at Monitoring Location EFF-001:

**i.** The median concentration shall not exceed a Most Probable Number (MPN) of 14 per 100 milliliters (mL) using the bacteriological results of the last calendar month for which analyses have been completed[1]; and

**ii.** The number of fecal coliform bacteria shall not exceed an MPN of 43 per 100 mL in more than 10% of samples in any calendar month.

**d.** **Acute Toxicity.** There shall be no acute toxicity in treated wastewater discharged to Humboldt Bay. The Permittee will be considered in compliance with this limitation

[1] See section VII.H of this Order regarding compliance with bacteriological limitations.

when the survival of aquatic organisms in a 96-hour bioassay of undiluted effluent complies with the following:

**i.** Minimum for any one bioassay: 70 percent survival; and

**ii.** Median for any three or more consecutive bioassays: at least 90 percent survival.

Compliance with this effluent limitation shall be determined in accordance with section VII.I of this Order and section V.A of the MRP (Attachment E).

### B. Effluent Limitations – Discharge Points 001 and 003 (After Completion of Phase One of the Upgrade Project)

#### 1. Final Effluent Limitations – Discharge Point 001

**a.** The discharge of treated wastewater shall maintain compliance with the following effluent limitations at Discharge Point 001, with compliance measured at Monitoring Location EFF-001, as described in the MRP (Attachment E). These limitations apply only to flows permitted in accordance with Discharge Prohibition III.I

**Table 5. Effluent Limitations – Discharge Point 001 (After Completion of Phase One of the Upgrade Project)**

| Parameter | Units | Effluent Limitations[1] | | | | |
|---|---|---|---|---|---|---|
| | | Average Monthly | Average Weekly | Maximum Daily | Instantaneous Minimum | Instantaneous Maximum |
| Biochemical Oxygen Demand 5-day @ 20°C ($BOD_5$) | mg/L | 38 | 57 | -- | -- | -- |
| Total Suspended Solids (TSS) | mg/L | 32 | 48 | -- | -- | -- |
| pH | standard units | -- | -- | -- | 6.0 | 8.5 |
| Cyanide, Total (as CN) | µg/L | 0.43 | -- | 1.0 | -- | -- |
| TCDD-Equivalents | µg/L | $1.4 \times 10^{-8}$ | -- | $3.3 \times 10^{-8}$ | -- | -- |
| Ammonia Impact Ratio[3] | Ratio | 1.0[2] | -- | 1.0[2] | -- | -- |
| Settleable Solids | ml/L | 0.1 | -- | 0.2 | -- | -- |

Table Notes:

1. See Definitions in Attachment A and Compliance Determination discussion in section VII of this Order.
2. The Ammonia Impact Ratio (AIR) is calculated as the ratio of the ammonia concentration in the effluent and the applicable ammonia standard (AMEL and MDEL). Attachment H is a PDF example of the calculator that will be sent to the Permittee to determine compliance with the AMEL/MDEL AIR. For each of the applicable ammonia standards, Attachment G includes two tables that provide the variable AMEL and MDEL ammonia standards used in calculating the AIR. The AIR is the ammonia effluent limit and must be reported in the self-monitoring reports in addition to ammonia, pH, salinity and temperature values. Monitoring for ammonia, pH, salinity and temperature must be conducted concurrently in order for the AIR to be calculated properly. Compliance determination will be based on the receiving water data and ammonia effluent data taken on the same day.
3. See sections VII.L and VII.M of this Order regarding compliance with each AIR effluent limitation.

**b. Percent Removal.** The average monthly percent removal of $BOD_5$ and TSS shall not be less than 65 percent. Percent removal shall be determined from the monthly average value of influent wastewater concentration in comparison to the monthly average value of effluent concentration for the same constituent over the same time period, as measured at Monitoring Locations INF-001 and EFF-001, respectively.

**c. Disinfection**. Disinfected effluent discharged from the Facility through Discharge Point 001 to Humboldt Bay shall not contain fecal coliform bacteria exceeding the following concentrations, as measured at Monitoring Location EFF-001:

**i.** The median concentration shall not exceed a Most Probable Number (MPN) of 14 per 100 milliliters (mL) using the bacteriological results of the last calendar month for which analyses have been completed[1]; and

**ii.** The number of fecal coliform bacteria shall not exceed an MPN of 43 per 100 mL in more than 10% of samples in any calendar month.

**d. Acute Toxicity.** There shall be no acute toxicity in treated wastewater discharged to Humboldt Bay. The Permittee will be considered in compliance with this limitation when the survival of aquatic organisms in a 96-hour bioassay of undiluted effluent complies with the following:

**i.** Minimum for any one bioassay: 70 percent survival; and

**ii.** Median for any three or more consecutive bioassays: at least 90 percent survival.

Compliance with this effluent limitation shall be determined in accordance with section VII.I of this Order and section V.A of the MRP (Attachment E).

**2. Final Effluent Limitations – Discharge Point 003**

**a.** The discharge of treated wastewater shall maintain compliance with the following effluent limitations at Discharge Point 003, with compliance measured at Monitoring Location EFF-003 as described in the MRP (Attachment E). Time Schedule Order No R1-2019-0011 has a compliance date for Phase One of June 30, 2022.

[1] See section VII.H of this Order regarding compliance with bacteriological limitations.

**Table 6. Effluent Limitations – Discharge Point 003 (After Completion of Phase One of the Upgrade Project)**

| Parameter | Units | Effluent Limitations[1] | | | | |
|---|---|---|---|---|---|---|
| | | Average Monthly | Average Weekly | Maximum Daily | Instantaneous Minimum | Instantaneous Maximum |
| Biochemical Oxygen Demand 5-day @ 20°C ($BOD_5$) | mg/L | 30 | 45 | -- | -- | -- |
| Total Suspended Solids (TSS) | mg/L | 30 | 45 | -- | -- | -- |
| pH | standard units | -- | -- | -- | 6.0 | 8.5 |
| Copper, Total Recoverable | µg/L | 3.3 | -- | 5.3 | -- | -- |
| Cyanide, Total (as CN) | µg/L | 0.43 | -- | 1.0 | -- | -- |
| TCDD-Equivalents | µg/L | $1.4 \times 10^{-8}$ | -- | $3.3 \times 10^{-8}$ | -- | -- |
| Ammonia Impact Ratio[3] | Ratio | 1.0[2] | -- | 1.0[2] | -- | -- |
| Settleable Solids | ml/L | 0.1 | -- | 0.2 | -- | -- |

Table Notes:

1. See Definitions in Attachment A and Compliance Determination discussion in section VII of this Order.
2. The Ammonia Impact Ratio (AIR) is calculated as the ratio of the ammonia concentration in the effluent and the applicable ammonia standard (AMEL and MDEL). Attachment H is a PDF example of the calculator that will be sent to the Permittee to determine compliance with the AMEL/MDEL AIR. For each of the applicable ammonia standards, Attachment G includes two tables that provide the variable AMEL and MDEL ammonia standards used in calculating the AIR. The AIR is the ammonia effluent limit and must be reported in the self-monitoring reports in addition to ammonia, pH, salinity and temperature values. Monitoring for ammonia, pH, salinity and temperature must be conducted concurrently in order for the AIR to be calculated properly. Compliance determination will be based on the receiving water data and ammonia effluent data taken on the same day.
3. See sections VII.L and VII.M of this Order regarding compliance with each AIR effluent limitation.

**b.** **Percent Removal.** The average monthly percent removal of $BOD_5$ and TSS shall not be less than 85 percent. Percent removal shall be determined from the monthly average value of influent wastewater concentration in comparison to the monthly average value of effluent concentration for the same constituent over the same time period, as measured at Monitoring Locations INF-001 and EFF-003, respectively.

**c.** **Disinfection**. Disinfected effluent discharged from the Facility through Discharge Point 003 to the Brackish Marsh shall not contain fecal coliform bacteria exceeding the following concentrations, as measured at Monitoring Location INT-001:

**i.** The median concentration shall not exceed a Most Probable Number (MPN) of 14 per 100 milliliters (mL) using the bacteriological results of the last calendar month for which analyses have been completed[1]; and

[1] See section VII.H of this Order regarding compliance with bacteriological limitations.

**ii.** The number of fecal coliform bacteria shall not exceed an MPN of 43 per 100 mL in more than 10% of samples in any calendar month.

**d. Acute Toxicity.** There shall be no acute toxicity in treated wastewater discharged to Humboldt Bay. The Permittee will be considered in compliance with this limitation when the survival of aquatic organisms in a 96-hour bioassay of undiluted effluent complies with the following:

**i.** Minimum for any one bioassay: 70 percent survival; and

**ii.** Median for any three or more consecutive bioassays: at least 90 percent survival.

Compliance with this effluent limitation shall be determined in accordance with section VII.I of this Order and section V.A of the MRP (Attachment E).

**e. Chronic Toxicity.** As measured at Monitoring Location EFF-003, there shall be no chronic toxicity in the effluent when discharging to the brackish marsh. Compliance with this narrative effluent limitation shall be determined in accordance with section VII.J of this Order and sections V.B and V.C of the MRP (Attachment E).

### C. Effluent Limitations – Discharge Points 002 and 003 (After Completion of Phase Two of the Upgrade Project)

#### 1. Final Effluent Limitations – Discharge Point 002

**a.** The discharge of treated wastewater shall maintain compliance with the following effluent limitations at Discharge Point 002, with compliance measured at Monitoring Location EFF-002, unless otherwise noted, as described in the MRP (Attachment E). Final effluent limitations for Discharge Point 002 will take effect once activation of the oxidation ditch has been completed, or on June 30, 2024, whichever comes first. Time Schedule Order No R1-2019-0011 has a compliance date for Phase Two of the Upgrade Project of June 30, 2024.

**Table 7. Effluent Limitations – Discharge Point 002 (After Completion of Phase Two of the Upgrade Project)**

| Parameter | Units | Effluent Limitations[1] | | | | |
|---|---|---|---|---|---|---|
| | | Average Monthly | Average Weekly | Maximum Daily | Instantaneous Minimum | Instantaneous Maximum |
| Biochemical Oxygen Demand 5-day @ 20°C ($BOD_5$) | mg/L | 30 | 45 | -- | -- | -- |
| Total Suspended Solids (TSS) | mg/L | 30 | 45 | -- | -- | -- |
| pH | standard units | -- | -- | -- | 6.0 | 8.5 |

Table Notes:
1. See Definitions in Attachment A and Compliance Determination discussion in section VII of this Order.

**b. Percent Removal.** The average monthly percent removal of $BOD_5$ and TSS shall not be less than 85 percent. Percent removal shall be determined from the monthly average value of influent wastewater concentration in comparison to the monthly average value

of effluent concentration for the same constituent over the same time period as measured at Monitoring Locations INF-001 and EFF-002, respectively.

**c. Disinfection**. Disinfected effluent discharged from the Facility through Discharge Point 002 to the Arcata Marsh Wildlife Sanctuary (AMWS) shall not contain fecal coliform bacteria exceeding the following concentrations, as measured at Monitoring Location EFF-002:

**i.** The median concentration shall not exceed an MPN of 14 per 100 mL using the bacteriological results of the last calendar month for which analyses have been completed; and

**ii.** The number of fecal coliform bacteria shall not exceed an MPN of 43 per 100 mL in more than 10% of samples in any calendar month.

**2. Final Effluent Limitations – Discharge Point 003 (After Completion of Phase Two of the Upgrade Project)**

**a.** The discharge of treated wastewater shall maintain compliance with the following effluent limitations at Discharge Point 003, with compliance measured at Monitoring Location EFF-003 as described in the MRP (Attachment E). Time Schedule Order No R1-2019-0011 has a compliance date for Phase Two of the Upgrade Project of June 30, 2024.

**Table 8. Effluent Limitations – Discharge Point 003**

| Parameter | Units | Effluent Limitations[1] | | | | |
|---|---|---|---|---|---|---|
| | | Average Monthly | Average Weekly | Maximum Daily | Instantaneous Minimum | Instantaneous Maximum |
| Copper, Total Recoverable | µg/L | 3.3 | -- | 5.3 | -- | -- |
| Cyanide, Total (as CN) | µg/L | 0.43 | -- | 1.0 | -- | -- |
| TCDD-Equivalents | µg/L | $1.4 \times 10^{-8}$ | -- | $3.3 \times 10^{-8}$ | -- | -- |
| Ammonia Impact Ratio[3] | Ratio | 1.0[2] | -- | 1.0[2] | -- | -- |
| Settleable Solids | ml/L | 0.1 | -- | 0.2 | -- | -- |

Table Notes:

1. See Definitions in Attachment A and Compliance Determination discussion in section VII of this Order.
2. The Ammonia Impact Ratio (AIR) is calculated as the ratio of the ammonia concentration in the effluent and the applicable ammonia standard (AMEL and MDEL). Attachment H is a PDF example of the calculator that will be sent to the Permittee to determine compliance with the AMEL/MDEL AIR. For each of the applicable ammonia standards, Attachment G includes two tables that provide the variable AMEL and MDEL ammonia standards used in calculating the AIR. The AIR is the ammonia effluent limit and must be reported in the self-monitoring reports in addition to ammonia, pH and temperature values. Monitoring for ammonia, pH and temperature must be conducted concurrently in order for the AIR to be calculated properly. Compliance determination will be based on the receiving water data and ammonia effluent data taken on the day.
3. See sections VII.L and VII.M of this Order regarding compliance with each AIR effluent limitation.

**b. Percent Removal.** The average monthly percent removal of $BOD_5$ and TSS shall not be less than 85 percent. Percent removal shall be determined from the monthly average value of influent wastewater concentration in comparison to the monthly average value

of effluent concentration for the same constituent over the same time period, as measured at Monitoring Locations INF-001 and EFF-003, respectively.

**c. Acute Toxicity.** There shall be no acute toxicity in treated wastewater discharged to Humboldt Bay. The Permittee will be considered in compliance with this limitation when the survival of aquatic organisms in a 96-hour bioassay of undiluted effluent complies with the following:

**i.** Minimum for any one bioassay: 70 percent survival; and

**ii.** Median for any three or more consecutive bioassays: at least 90 percent survival.

Compliance with this effluent limitation shall be determined in accordance with section VII.I of this Order and section V.A of the MRP (Attachment E).

**d. Chronic Toxicity.** As measured at Monitoring Location EFF-003, there shall be no chronic toxicity in the effluent when discharging to the brackish marsh. Compliance with this narrative effluent limitation shall be determined in accordance with section VII.J of this Order and sections V.B and V.C of the MRP (Attachment E).

**3. Interim Effluent Limitations – Not Applicable**

This Order does not establish interim effluent limitations or schedules for compliance with final limitations.

## D. Discharge Specifications

### 1. Discharge Specifications – Discharge Point 002 (Prior to completion of Phase Two of the Upgrade Project)

**a.** The Discharge of treated wastewater shall maintain compliance with the following final discharge specifications at Discharge Point 002, with compliance measured and Monitoring Location EFF-002, as described in the MRP (Attachment E). Discharge Specifications for Discharge Point 002 are in effect until activation of the oxidation ditch in Phase Two of the Proposed Treatment Upgrade or until June 30, 2024, whichever comes first.

**Table 9. Discharge Specifications – Discharge Point 002 (Prior to completion of Phase Two of the Upgrade Project)**

| Parameter | Units | Effluent Limitations[1] | | | | |
|---|---|---|---|---|---|---|
| | | Average Monthly | Average Weekly | Maximum Daily | Instantaneous Minimum | Instantaneous Maximum |
| Biochemical Oxygen Demand 5-day @ 20°C ($BOD_5$) | mg/L | 38 | 57 | -- | -- | -- |
| Total Suspended Solids (TSS) | mg/L | 32 | 48 | -- | -- | -- |
| pH | standard units | -- | -- | -- | 6.0 | 8.5 |
| Chlorine, Total Residual[2] | mg/L | 0.01 | -- | 0.02 | -- | -- |
| Settleable Solids | ml/L | 0.1 | -- | 0.2 | -- | -- |

| Parameter | Units | Effluent Limitations[1] | | | | |
|---|---|---|---|---|---|---|
| | | Average Monthly | Average Weekly | Maximum Daily | Instantaneous Minimum | Instantaneous Maximum |

Table Notes:
1. See Definitions in Attachment A and Compliance Determination discussion in section VII of this Order.
2. Limitations for chlorine residual apply at all times. However, monitoring for chlorine residual may be discontinued as specified in Table E-4, Footnote 7 of the MRP (Attachment E).

### E. Land Discharge Specifications and Requirements – Not Applicable

This Order does not authorize discharges to land.

### F. Water Recycling Specifications and Requirements – Not Applicable

This Order does not authorize discharges of recycled water.

### G. Other Requirements

#### 1. Disinfection Process Requirements for Ultraviolet Light (UV) Disinfection System[1]

The Permittee shall operate the UV disinfection system to maintain compliance with disinfection effluent limitations specified in section IV.A.2.c of this Order. Specifically, the Permittee shall:

**a.** Prior to initial discharge at Discharge Point 003, the Permittee shall submit, for Executive Officer approval, a copy of a letter from the UV supplier showing written acceptance of the UV system design specifications and capacity for the Facility.

**b.** Prior to initial discharge at Discharge Point 003, the Permittee shall submit to the Executive Officer approval, an operations and maintenance plan detailing how compliance with the National Water Research Institute's guidelines or the U.S. EPA UV Disinfection Guidance Manual will be assured at all times.

**c.** Provide continuous, reliable monitoring of flow, UV transmittance (UVT), UV intensity, UV dose, and UV power at Monitoring Location INT-001. The Permittee must demonstrate compliance with the UV dose requirement.

**d.** Operate the UV disinfection system to provide a minimum UV dose of 50 millijoules per square centimeter ($mJ/cm^2$) at all times at Monitoring Location INT-001.

**e.** Ensure that the UVT (at least 254 nanometers) in the wastewater does not fall below 35 percent of maximum at any time.

**f.** Visually inspect the quartz sleeves and cleaning system components per the manufacturer's operation manual for physical wear (scoring, solarization, seal leaks, etc.) and check the efficacy of the cleaning system.

**g.** Wipe/clean the quartz sleeves at fixed intervals following the manufacturer's procedures to ensure the minimum required UV dose delivery is consistently achieved. Cleaning intervals shall be increased as necessary to ensure compliance with permit requirements, such as UV dose and fecal coliform organism requirements.

[1] These Disinfection Requirements will take effect upon activation of Phase One of the Proposed Treatment Upgrade.

**h.** Operate the UV disinfection system in accordance with an approved operations and maintenance plan, which clearly specifies the operational limits and responses required for critical alarms. The Permittee shall maintain a copy of the approved operations plan at the treatment plant and make the plan readily available to properly trained operations personnel and regulatory agencies. The Permittee shall post a quick reference plant operations data sheet at the treatment plant. The data sheet shall include the following information:

**i.** The alarm set points for high and low flow, UV dose and transmittance, UV lamp operation hours, and power.

**ii.** The values of high and low flow, UV dose and transmittance, UV lamp operation hours, and power when flow must be diverted to waste.

**iii.** The values of high daily and weekly median fecal coliform when an operational response must be taken.

**iv.** The required frequency of calibration for all meters measuring flow, UVT, and power.

**v.** The required frequency of mechanical cleaning/wiping and equipment inspection.

**i.** Replace lamps per the manufacturer's recommendation, or sooner, if there are indications the lamps are failing to provide adequate disinfection. The Permittee shall maintain lamp age and lamp replacement records for a time period consistent with the record retention requirements in the Standard Provisions (Attachment D, section IV).

**j.** Properly calibrate flow meters and UVT monitors to ensure proper disinfection.

**k.** Inspect the UVT meter and check against a reference bench-top unit weekly to document accuracy.

**l.** Recalibrate the on-line UVT analyzer by a procedure recommended by the manufacturer if the on-line analyzer UVT reading varies from the bench-top spectrophotometer UVT reading by 2 percent or more.

**m.** Operate the UV disinfection system with a built-in automatic reliability feature that must be triggered when the system is below the target UV dose. If the measured UV dose goes below the minimum UV dose, the UV reactor in question must alarm and startup the next available row of UV lamps or UV lamp bank.

**n.** Not allow equivalent or substitutions of equipment to occur without an adequate demonstration of equivalent disinfection performance to the satisfaction and approval of the Executive Officer.

**o.** Ensure that flow through the UV disinfection system not exceed the peak design flow of the system as a daily maximum.

## V. RECEIVING WATER LIMITATIONS

### A. Surface Water Limitations

Receiving water limitations are based on water quality objectives contained in the Basin Plan and are a required part of this Order. Receiving water conditions not in conformance with the

limitations are not necessarily a violation of this Order. Compliance with receiving water limitations shall be measured at monitoring locations described in the MRP (Attachment E). The Regional Water Board may require an investigation to determine cause and culpability prior to asserting that a violation has occurred.

Discharges from the Facility shall not cause the following in the receiving waters:

**1.** The discharge shall not cause the dissolved oxygen concentration of the receiving water to be depressed below 6.0 mg/L.

In those waterbodies for which the aquatic life-based DO requirements are unachievable due to natural conditions[1], site-specific background DO requirements can be applied[2] as water quality objectives by calculating the daily minimum DO necessary to maintain 85% DO saturation during the dry season and 90% DO saturation during the wet season under site salinity, site atmospheric pressure, and natural receiving water temperature[3]. In no event may controllable factors reduce the daily minimum DO below 6.0 mg/L.

For the protection of estuarine habitat (EST), the dissolved oxygen concentration of enclosed bays and estuaries shall not be depressed to levels adversely affecting beneficial uses as a result of controllable water quality factors.

**2.** The discharge shall not cause the pH of receiving waters to be depressed below natural background levels nor raised above 8.5. Within this range, the discharge shall not cause the pH of the receiving waters to be changed at any time more than 0.2 units from that which occurs naturally.

**3.** The discharge shall not cause the turbidity of receiving waters to be increased more than 20 percent above naturally occurring background levels.

**4.** The discharge shall not cause receiving waters to contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.

**5.** The discharge shall not cause receiving waters to contain floating materials, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses.

**6.** The discharge shall not cause receiving waters to contain taste- or odor-producing substances in concentrations that impart undesirable tastes or odors to fish flesh or other edible products of aquatic origin, that cause nuisance, or that adversely affect beneficial uses.

**7.** The discharge shall not cause coloration of receiving waters that causes nuisance or adversely affects beneficial uses.

[1] Natural conditions are conditions or circumstances affecting the physical, chemical, or biological integrity of water that are not influenced by past or present anthropogenic activities.
[2] Upon approval from the Regional Water Board Executive Officer.
[3] The method(s) used to estimate natural temperatures for a given waterbody or stream length must be approved by the Executive Officer and may include, as appropriate, comparison with reference streams, simple calculation, or computer models.

8. The discharge shall not contain substances in concentrations that result in deposition of material in receiving waters to the extent that such deposits cause nuisance or adversely affect beneficial uses.

9. The discharge shall not cause receiving waters to contain concentrations of biostimulatory substances that promote objectionable aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses.

10. The discharge shall not cause receiving waters to contain toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in humans, plants, animals, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration, or other appropriate methods, as specified by the Regional Water Board.

11. The discharge shall not cause a measurable temperature change in the receiving water at any time.

12. The discharge shall not cause an individual pesticide or combination of pesticides to be present in concentrations that adversely affect beneficial uses. The discharge shall not cause bioaccumulation of pesticide concentrations in bottom sediments or aquatic life.

13. The discharge shall not cause receiving waters to contain concentrations of pesticides in excess of Maximum Contaminant Levels (MCLs) established for these pollutants in title 22, division 4, chapter 15, articles 4 and 5.5 of the CCR.

14. The discharge shall not cause receiving waters to contain oils, greases, waxes, or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause nuisance, or that otherwise affect beneficial uses.

15. The discharge shall not cause a violation of any applicable water quality standard for receiving waters adopted by the Regional Water Board or the State Water Board, as required by the federal Clean Water Act and regulations adopted thereunder. If more stringent applicable water quality standards are promulgated or approved pursuant to section 303 of the Clean Water Act, or amendments thereto, the Regional Water Board will revise and modify this Order in accordance with such more stringent standards.

16. The discharge shall not cause concentrations of chemical constituents to occur in excess of MCLs and secondary MCLs (SMCLs) established for these pollutants in title 22, division 4, chapter 15, articles 4, section 64431, article 5.5, section 64444, and article 16, section 64449 of the CCR.

17. The discharge shall not cause receiving waters to contain radionuclides in concentrations which are deleterious to human, plant, animal or aquatic life, nor which result in the accumulation of radionuclides in the food web to an extent which presents a hazard to human, plant, animal or indigenous aquatic life, nor in excess of the MCLs and SMCLs established for these pollutants in title 22, division 4, chapter 15, article 5, sections 64442 and 64443 of the CCR.

**B. Groundwater Limitations**

1. The collection, treatment, storage, and disposal of wastewater shall not cause degradation of groundwater quality unless a technical evaluation is performed that demonstrates that any degradation that could reasonably be expected to occur, after implementation of all regulatory requirements (e.g., Basin Plan) and reasonable best management practices (BMPs), will not violate groundwater quality objectives or cause impacts to beneficial uses of groundwater.
2. The collection, treatment, storage, and disposal of wastewater shall not cause alterations of groundwater that contain chemical concentrations in excess of the MCLs and SMCLs established for these pollutants in title 22, division 4, chapter 15, article 4, sections 64435 (Tables 2 and 3) 64431, and article 5.5, section 64444, and article 16 section 64449 and the Basin Plan.
3. The collection, treatment, storage, and disposal of wastewater shall not cause groundwater to contain levels of radionuclides in concentrations that cause nuisance or adversely affect beneficial uses, nor in excess of the MCLs and SMCLs established in title 22, division 4, chapter 15, article 5, sections 64442 and 64443 of the CCR
4. The collection, treatment, storage, and disposal of wastewater shall not cause groundwater to contain taste- or odor-producing substances in concentrations that cause nuisance or adversely affect beneficial uses.
5. In groundwaters used for domestic or municipal supply (MUN), the collection, treatment, storage, and disposal of wastewater shall not cause the median of the most probable number of coliform organisms over any 7-day period to exceed 1.1 MPN/100 mL or 1 colony/100 mL.
6. Groundwaters shall not contain toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in humans, or that adversely affects beneficial uses. This limitation applies regardless of whether the toxicity is caused by a single substance or the synergistic effect of multiple substances.

## VI. PROVISIONS

### A. Standard Provisions

1. **Federal Standard Provisions.** The Permittee shall comply with all Standard Provisions included in Attachment D of this Order.
2. **Regional Water Board Standard Provisions.** The Permittee shall comply with the following Regional Water Board standard provisions. In the event that there is any conflict, duplication, or overlap between provisions specified by this Order, the more stringent provision shall apply:
   a. Failure to comply with provisions or requirements of this Order, or violation of other applicable laws or regulations governing discharges from this Facility, may subject the Permittee to administrative or civil liabilities, criminal penalties, and/or other enforcement remedies to ensure compliance. Additionally, certain violations may subject the Permittee to civil or criminal enforcement from appropriate local, state, or federal law enforcement entities.

**b.** In the event the Permittee does not comply or will be unable to comply for any reason, with any prohibition, final effluent limitation, other specification, receiving water limitation, or provision of this Order that may result in a significant threat to human health or the environment, such as inundation of treatment infrastructure, breach of pond containment, SSO, etc., that results in a discharge to a drainage channel or a surface water, the Permittee shall notify Regional Water Board staff within 24 hours of having knowledge of such noncompliance. Spill notification and reporting shall be conducted in accordance with section V.E of Attachment D and section X.E of the MRP.

## B. Monitoring and Reporting Program (MRP) Requirements

The Permittee shall comply with the MRP, included as Attachment E to this Order, and future revisions thereto.

## C. Special Provisions

### 1. Reopener Provisions

**a. Standard Revisions.** If applicable water quality standards are promulgated or approved pursuant to section 303 of the CWA, or amendments thereto, the Regional Water Board may reopen this Order and make modifications in accordance with such revised standards.

**b. Reasonable Potential.** This Order may be reopened for modification to include an effluent limitation if monitoring establishes that the discharge causes, or has the reasonable potential to cause or contribute to, an excursion above a water quality criterion or objective applicable to the receiving water.

**c. Whole Effluent Toxicity (WET).** As a result of a Toxicity Reduction Evaluation (TRE), this Order may be reopened to include a numeric chronic toxicity limitation, a new acute toxicity limitation, and/or a limitation for a specific toxicant identified in the TRE. Additionally, if a numeric chronic toxicity water quality objective is adopted by the State Water Board, this Order may be reopened to include a numeric chronic toxicity effluent limitation based on that objective.

**d. 303(d)-Listed Pollutants.** If an applicable total maximum daily load (TMDL) (see Fact Sheet, section III.D) program is adopted, this Order may be reopened and effluent limitations for the pollutant(s) that are the subject of the TMDL may be modified or imposed to conform this Order to the TMDL requirements.

**e. Water Effects Ratios (WERs) and Metal Translators.** A default WER of 1.0 has been used in this Order for calculating CTR criteria for applicable priority pollutant inorganic constituents, except for copper at Discharge Point 001. In addition, default dissolved-to-total metal translators have been used to convert water quality objectives from dissolved to total recoverable. If the Permittee performs studies to determine site-specific WERs and/or site-specific dissolved-to-total metal translators and submits a report that demonstrates that WER or translator studies were performed in accordance with U.S. EPA or other approved guidance, this Order may be reopened to modify the effluent limitations for the applicable constituents.

**f. Nutrients.** This Order contains effluent limitations for ammonia and effluent monitoring requirements for nutrients (ammonia, nitrate, and phosphorus). If new

water quality objectives for nutrients are established, if monitoring data indicate the need for new or revised effluent limitations for any of these parameters, or if new or revised methods for compliance with effluent limitations for any of these parameters are developed, this Order may be reopened and modified to include new or modified effluent limitations or other requirements, as necessary.

**g. Ultraviolet Light (UV) Disinfection Operating Specifications[1].** The UV operating specifications in this Order are based on the Permittee's proposed design specifications for the UV disinfection system, which identify site-specific UV operating specifications that will achieve virus inactivation necessary to protect oyster growing areas within Humboldt Bay. If the Permittee conducts additional site-specific UV engineering studies that identify necessary revisions to the site-specific UV operating specifications necessary achieve the desired virus inactivation, this Order may be reopened to modify the UV operating specifications.

**2. Special Studies, Technical Reports and Additional Monitoring Requirements**

**a. Arcata Marsh Wildlife Sanctuary (AMWS) Evaluation.** The Permittee shall continue to implement the approved work plan for the ongoing evaluation of the beneficial uses of the AMWS identified by the Regional Water Board under section III of the Fact Sheet.

The Permittee shall provide a summary of the findings from the evaluation with the Report of Waste Discharge (ROWD), due one year prior to the expiration date of this Order. The findings from the ongoing evaluation will be used for adaptive management to ensure the AMWS retains maximum treatment function while protecting beneficial uses.

**b. Disaster Preparedness Assessment Report and Action Plan.** Natural disasters, extreme weather events, sea level rise, and shifting precipitation patterns, some of which are projected to intensify due to climate change, have significant implications for wastewater treatment and operations. Some natural disasters are expected to become more frequent and extreme according to the current science on climate change. In order to ensure that Facility operations are not disrupted, compliance with conditions of this Order are achieved, and receiving waters are not adversely impacted by permitted and unpermitted discharges, the Permittee shall submit a Disaster Preparedness Assessment Report and Action Plan to the Regional Water Board by **June 1, 2022,** for Executive Officer review and approval.

The Permittee shall: (1) conduct an assessment of the wastewater treatment facility, operations, collection, and discharge systems to determine areas of short- and long-term vulnerabilities related to natural disasters and extreme weather, including sea level rise and other conditions projected by climate change science, if applicable; the assessment shall consider, as applicable, impacts to plant operations due to changing influent and receiving water quality, rising sea level, storm surges, fires, floods, earthquakes, tsunamis, back-to-back severe storms, and other extreme conditions that pose a risk to plant operations and water quality; (2) identify control measures needed to protect, improve, and maintain wastewater infrastructure, waste discharge compliance, and receiving water quality in the event of a natural disaster or, if

[1] These Disinfection Requirements will take effect upon activation of Phase I of the Proposed Treatment Upgrade.

applicable, under conditions resulting from climate change; (3) develop a schedule to implement necessary control measures. Control measures shall include, but are not limited to, emergency procedures, contingency plans, alarm/notification systems, training, backup power and equipment, and the need for planned mitigations to ameliorate potential risks associated with extreme weather events and changing conditions resulting from climate change; and (4) implement the necessary control measures per the approved schedule of implementation.

**c. Source Control and Pretreatment Studies.**

The Permittee shall review the existing sections in the pretreatment program and submit, for Executive Officer review and approval, a written description of the pretreatment program. The written description of the pretreatment program shall be submitted by December 31, 2023 and consist of the following sections:

**i. Organizational and Multi-jurisdiction Implementation**

This section shall describe the overall program structure as well as contain descriptions of the Facility, collection system and the service area including political boundaries.

**ii. Legal Authority**

This section shall contain a revised Sewer Use Ordinance (SUO) and all necessary multi-jurisdictional agreements to allow for the implementation of the pretreatment program. The SUO shall be submitted as a final draft ready for adoption and implementation pending approval of the local limits, described below, by the Regional Water Board Executive Officer.

**iii. Local Limits[1]**

This section shall describe the technical basis for the local limits and shall provide a work plan for conducting a Local Limits Study in accordance with U.S. EPA's July 2004 Local Limits Development Guidance (EPA 833-R-04-002A. and shall include a schedule for conducting the Local Limits Study and for public hearings and outreach.

The Permittee shall conduct a Local Limits Study to determine the pollutants of concern, collect and analyze data, calculate maximum allowable headworks loadings (MAHLs) for each pollutant of concern at the Facility and the maximum pollutant levels protective of the collection system, the method for allocating allowable loadings to users, and designate and implement technically-based local limits, where necessary, for industrial users discharging to the Permittee's collection system. The Local Limits can be numerical concentrations, loading limits, prohibitions or control strategies.

**iv. Identification of Non-domestic Users**

[1] A new Local Limits Study will be performed once Phase Two of the Proposed Upgrade Project is completed. The 2019 TSO establishes a compliance schedule for completion of the Phase Two of the Proposed Upgrade Project.

This section shall contain the procedures to be used in the initial Industrial Waste Survey (IWS) as well as the procedures to be used for on-going updates. This section shall also include the current inventory of industrial users, by non-domestic sewer connection, and of the zero-discharging categorical industrial users who comply with their Federal standards by not discharging process wastewater.

The inventory must indicate the following for each industrial user and zero-discharging categorical industrial users:

**(a)** Whether it qualifies as a significant industrial user;

**(b)** The average and peak flow rates;

**(c)** The SIC code;

**(d)** The pretreatment-in-place, and;

**(e)** The local permit status

**v. Permits and Fact Sheets**

This section shall describe the permitting procedures and include a fact sheet and final draft permit for each significant industrial user to be issued upon approval of the local limits and revised SUO by the Regional Water Board Executive Officer. The fact sheets must indicate the following for each significant industrial user and zero-discharging categorical industrial user:

**(a)** The industry name, owner or plant manager;

**(b)** The permit expiration date (not to exceed five years in duration);

**(c)** A description of the facility including the products made or services provided, building names, the process in each building and when current operations began;

**(d)** The identification of each sewer connection;

**(e)** A description of the contributing waste streams that comprise each identified non-domestic discharge to the sewers;

**(f)** The pretreatment-in-place for each identified non-domestic discharge to the sewers;

**(g)** The classification by Federal point source category and the reasons justifying classification;

**(h)** The applicable Federal categorical pretreatment standards, supporting production data (if necessary), and the compliance sampling point(s) where the standards apply;

**(i)** The pollutants of concern and the compliance sampling point(s) where the local limits apply;

**(j)** A site map indicating the locations of all compliance sampling point(s), sewer connections, and sewer laterals;

**(k)** The sampling frequency by regulated pollutant for each compliance sampling point, and the supporting statistical rationale, to ensure that the sampling is representative of the wastewater discharge variability over the reporting period;

**(l)** The sampling protocol by regulated pollutant for each compliance sampling point to ensure that the samples collected to determine compliance with Federal standards are representative of the sampling day's discharge.

**vi. Compliance Monitoring**

This section shall describe the industrial user self-monitoring program and the Permittees oversight monitoring program. The compliance monitoring program shall ensure that all sampling is representative over the reporting period and that each sample collected to determine compliance with Federal standards is representative of the sampling day's discharge. The compliance monitoring program must also set analytical detection limits to allow the determination of non-compliance.

**vii. Enforcement**

This section shall establish the enforcement response plan (ERP) to be used to address, at a minimum, each of the following types of violations:

**(a)** Isolated and chronic violations of permit effluent limitations;

**(b)** Violations of permit effluent limitations that result in any adverse impacts upon the Facility such as pass-through, interference, sludge contamination, sewer line degradation, explosive or inflammability risks, or worker health and safety risks;

**(c)** Failure to self-monitor or report;

**(d)** The bypassing of pretreatment necessary to comply with Federal categorical pretreatment standards;

**(e)** The bypassing of compliance sampling or the tampering with sampling equipment, and;

**(f)** Willful or negligent violations.

**viii. Resources**

This section shall demonstrate that adequate budget, staffing and equipment is allocated to provide for the needs of the pretreatment program to ensure effective implementation.

**ix. Public Participation and Confidentiality**

This section shall describe the administrative procedures required under 40 CFR 403.8(f)(1(vii) and 403.8(f)(2)(viii).

**3. Best Management Practices and Pollution Prevention**

**a. Pollutant Minimization Program (PMP)**

**i.** The Permittee shall, as required by the Executive Officer, develop and conduct a PMP as further described below when there is evidence (e.g., sample results from analytical methods more sensitive than those methods required by this Order, presence of WET, health advisories for fish consumption, results of benthic or aquatic organism tissue sampling) that a CTR priority pollutant is present in the effluent above an effluent limitation and either:

**(a)** The concentration of the pollutant is reported as "Detected, but Not Quantified" (DNQ) and the effluent limitation is less than the reporting limit (RL);

**(b)** A sample result is reported as non-detect (ND) and the effluent limitation is less than the method detection limit (MDL), using definitions described in Attachment A and reporting protocols described in MRP section X.B.5.

**ii.** The PMP shall include, but not be limited to, the following actions and submittals acceptable to the Regional Water Board:

**(a)** An annual review and semi-annual monitoring of potential sources of the reportable CTR priority pollutant(s), which may include fish tissue monitoring and other bio-uptake sampling;

**(b)** Quarterly monitoring for the reportable CTR priority pollutant(s) in the influent to the wastewater treatment system;

**(c)** Submittal of a control strategy designed to proceed toward the goal of maintaining concentrations of the reportable CTR priority pollutant(s) in the effluent at or below the effluent limitation;

**(d)** Implementation of appropriate cost-effective control measures for the reportable CTR priority pollutant(s), consistent with the control strategy; and

**(e)** An annual status report that shall be submitted as part of the Annual Facility Report due **March 1st** to the Regional Water Board and shall include:

**(1)** All PMP monitoring results for the previous year;

**(2)** A list of potential sources of the reportable pollutant(s);

**(3)** A summary of all actions undertaken pursuant to the control strategy; and

**(4)** A description of actions to be taken in the following year.

**4. Construction, Operation and Maintenance Specifications**

**a.** This Order (Attachment D, Standard Provision I.D) requires that the Permittee at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the Permittee to achieve

compliance with this Order. Proper operation and maintenance includes adequate laboratory quality control and appropriate quality assurance procedures.

**b.** The Permittee shall maintain an updated Operation and Maintenance (O&M) Manual for the operational components of the Facility. The Permittee shall update the O&M Manual, as necessary, to conform to changes in operation and maintenance of the Facility. The Permittee shall operate and maintain the Facility in accordance with the most recently updated O&M Manual. The O&M Manual shall be readily available to operating personnel on-site and for review by state or federal inspectors. The O&M Manual shall include the following.

**i.** Description of the Facility's organizational structure showing the number of employees, duties, and qualifications, and plant attendance schedules (daily, weekends and holidays, part-time, etc.). The description should include documentation that the personnel are knowledgeable and qualified to operate the Facility so as to achieve the required level of treatment at all times.

**ii.** Detailed description of safe and effective operation and maintenance of treatment processes, process control instrumentation and equipment.

**iii.** Description of laboratory and quality assurance procedures.

**iv.** Process and equipment inspection and maintenance schedules.

**v.** Description of safeguards to assure that, should there be reduction, loss, or failure of electric power, the Permittee will be able to comply with requirements of this Order.

**vi.** Description of preventive (fail-safe) and contingency (response and cleanup) plans for controlling accidental discharges, and for minimizing the effect of such events. These plans shall identify the possible sources (such as loading and storage areas, power outage, waste treatment unit failure, process equipment failure, tank and piping failure) of accidental discharges, untreated or partially treated waste bypass, and polluted drainage.

**5. Special Provisions for Municipal Facilities (POTWs Only)**

**a. Wastewater Collection Systems**

**i. Statewide General WDRs for Sanitary Sewer Systems**

The Permittee has coverage under, and is separately subject to, the requirements of State Water Board Order No. 2006-0003-DWQ, Statewide General WDRs for Sanitary Sewer Systems, as amended by Order No. WQ 2013-0058-EXEC. As such, the Permittee provides notification and reporting of SSOs in accordance with the requirements of Order Nos. 2006-0003-DWQ and WQ 2013-0058-EXEC and any revisions thereto for operation of its wastewater collection system.

**b. Pretreatment of Industrial Waste**

**i.** The Permittee shall be responsible for the performance of all pretreatment requirements contained in 40 C.F.R. part 403 and shall be subject to enforcement actions, penalties, fines, and other remedies by the U.S. EPA or other appropriate

parties as provided in the CWA, as amended (33 U.S.C. 1351 et seq.). The Permittee shall implement and enforce its approved Facility Pretreatment Program. The Permittee's approved Facility Pretreatment Program is hereby made an enforceable condition of this Order. U.S. EPA may initiate enforcement action against an industrial user for noncompliance with applicable standards and requirements as provided in the CWA.

**ii.** The Permittee shall enforce the requirements promulgated under section 307(b), 307(c), 307(d), and 402(d) of the CWA. The Permittee shall cause industrial users subject to Federal Categorical Standards to achieve compliance no later than the date specified in those requirements or, in the case of a new industrial user, upon commencement of the discharge.

**iii.** The Permittee shall perform the pretreatment functions as required in 40 C.F.R. part 403, including, but not limited to:

**(a)** Implement the necessary legal authorities as provided in 40 C.F.R. section 403.8(f)(1);

**(b)** Enforce the pretreatment requirements under 40 C.F.R. sections 403.5 and 403.6;

**(c)** Implement the programmatic functions as provided in 40 C.F.R. section 403.8(f)(2); and

**(d)** Provide the requisite funding and personnel to implement the pretreatment program as provided in 40 C.F.R. section 403.8(f)(3).

**iv.** The Permittee shall implement, as more completely set forth in 40 C.F.R. section 403.5, the necessary legal authorities, programs, and controls to ensure that the following incompatible wastes are not introduced to the treatment system:

**(a)** Wastes that create a fire or explosion hazard in the treatment works;

**(b)** Wastes that will cause corrosive structural damage to treatment works, but in no case wastes with a pH lower than 5.0, unless the works is specially designed to accommodate such wastes;

**(c)** Solid or viscous wastes in amounts that cause obstruction to flow in sewers, or that cause other interference with proper operation of treatment works;

**(d)** Any waste, including oxygen demanding pollutants ($BOD_5$, etc.), released in such volume or strength as to cause inhibition or disruption in the treatment works, and subsequent treatment process upset and loss of treatment efficiency;

**(e)** Heat in amounts that inhibit or disrupt biological activity in the treatment works, or that raise influent temperatures above 40°C (104°F);

**(f)** Petroleum oil, non-biodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through;

**(g)** Pollutants which result in the presence of toxic gases, vapors, or fumes within the treatment works in a quantity that may cause acute worker health and safety problems; and

**(h)** Any trucked or hauled pollutants, except at points predesignated by the Permittee, and consisting of waste that can be adequately treated at the Facility.

**v.** The Permittee shall implement, as more completely set forth in 40 C.F.R. section 403.5, the legal authorities, programs, and controls necessary to ensure that indirect discharges do not introduce pollutants into the sewerage system that, either alone or in conjunction with a discharge or discharges from other sources:

**(a)** Flow through the system to the receiving water in quantities or concentrations that cause a violation of this Order, or

**(b)** Inhibit or disrupt treatment processes, treatment system operations, or sludge processes, use, or disposal and either cause a violation of this Order or prevent sludge use or disposal in accordance with this Order.

**c. Sludge Disposal and Handling Requirements**

**i.** Sludge, as used in this Order, means the solid, semisolid, and liquid residues removed during primary, secondary, or advanced wastewater treatment processes. Solid waste refers to grit and screenings generated during preliminary treatment. Biosolids refers to sludge that has been treated, tested, and demonstrated to be capable of being beneficially and legally used pursuant to federal and state regulations as a soil amendment for agriculture, silviculture, horticulture, and land reclamation activities.

**ii.** All collected sludges and other solid waste removed from liquid wastes shall be removed from screens, sumps, ponds, and tanks as needed to ensure optimal plant operation and disposed of in accordance with applicable federal and state regulations.

**iii.** The use and disposal of biosolids shall comply with all of the land application and disposal requirements in 40 C.F.R. part 503, which are enforceable by the U.S. EPA, not the Regional Water Board. If during the life of this Order, the state accepts primacy for implementation of 40 C.F.R. part 503, the Regional Water Board may also initiate enforcement where appropriate.

**iv.** Sludge or biosolids that are disposed of in a municipal solid waste landfill or used as daily landfill cover shall meet the applicable requirements of 40 C.F.R. part 258. In the annual self-monitoring report, the Permittee shall report the amount of sludge placed in a landfill and the landfill(s) which received the sludge or biosolids.

**v.** The Permittee shall take all reasonable steps to prevent and minimize any sludge use or disposal in violation of this Order that may adversely affect human health or the environment.

**vi.** Solids and sludge treatment, storage, and disposal or reuse shall not create a nuisance, such as objectionable odors or flies, and shall not result in groundwater contamination.

**vii.** Solids and sludge treatment and storage sites shall have facilities adequate to divert surface water runoff from adjacent areas, to protect the boundaries of the site from erosion, and to prevent drainage from the treatment and storage site. Adequate protection is defined as protection from a design storm with a 100-year recurrence interval and 24-hour duration.

**viii.** The discharge of sewage sludge and solids shall not cause waste material to be in a position where it is, or can be, conveyed from the treatment and storage sites and deposited in the waters of the state.

**ix.** For the land application of biosolids as a soil amendment, the Permittee shall submit a ROWD or the Permittee may dispose of biosolids at another appropriately permitted facility.

**x.** New sludge treatment and storage facilities must comply with the requirements of the Water Code and title 27 of the CCR for the protection of water quality.

**d. Operator Certification**

Supervisors and operators of municipal wastewater treatment facilities shall possess a certificate of appropriate grade in accordance with title 23, CCR, section 3680. The State Water Board may accept experience in lieu of qualification training. In lieu of a properly certified wastewater treatment facility operator, the State Water Board may approve use of a water treatment facility operator of appropriate grade certified by DDW where water recycling is involved.

**e. Adequate Capacity**

If the Facility will reach capacity within 4 years, the Permittee shall notify the Regional Water Board. A copy of such notification shall be sent to appropriate local elected officials, local permitting agencies, and the press. Factors to be evaluated in assessing reserve capacity shall include, at a minimum, (1) comparison of the wet weather design flow with the highest daily flow, and (2) comparison of the average dry weather design flow with the lowest 30-day flow. The Permittee shall demonstrate that adequate steps are being taken to address the capacity problem. The Permittee shall submit a technical report to the Regional Water Board showing how flow volumes will be prevented from exceeding capacity, or how capacity will be increased, **within 120 days after providing notification to the Regional Water Board**, or within 120 days after receipt of Regional Water Board notification that the Facility will reach capacity within 4 years. The time for filing the required technical report may be extended by the Regional Water Board. An extension of 30 days may be granted by the Executive Officer, and longer extensions may be granted by the Regional Water Board itself. [CCR title 23, section 2232].

### 6. Other Special Provisions

#### a. Storm Water

BMPs to control the run-on of storm water to the Facility site shall be maintained and upgraded as necessary. The Permittee shall describe the effectiveness of these storm water BMPs, as well as activities to maintain and upgrade these BMPs during the previous year, in its annual report to the Regional Water Board.

### 7. Compliance Schedules – Not Applicable

This Order does not establish interim effluent limitations or schedules of compliance for final numeric effluent limitations.

## VII. COMPLIANCE DETERMINATION

Compliance with the prohibitions and effluent limitations contained in sections III and IV of this Order will be determined as specified below.

### A. General

Compliance with effluent limitations for CTR priority pollutants, when effluent limitations have been established, shall be determined using sample reporting protocols defined in the MRP and Attachment A of this Order. For purposes of reporting and administrative enforcement by the Regional and State Water Boards, the Permittee shall be deemed out of compliance with effluent limitations if the concentration of pollutant in the monitoring sample is greater than the effluent limitation and greater than or equal to the reported minimum level (ML).

### B. Multiple Sample Data

When determining compliance with an average monthly effluent limitation (AMEL) for CTR priority pollutants, and more than one sample result is available, the Permittee shall compute the arithmetic mean unless the data set contains one or more reported determinations of DNQ or ND. In those cases, the Permittee shall compute the median in place of the arithmetic mean in accordance with the following procedure.

1. The data set shall be ranked from low to high, ranking the reported ND determinations lowest, DNQ determinations next, followed by quantified values (if any). The order of the individual ND or DNQ determinations is unimportant.

2. The median value of the data set shall be determined. If the data set has an odd number of data points, then the median is the middle value. If the data set has an even number of data points, then the median is the average of the two middle values unless one or both of the points are ND or DNQ, in which case the median value shall be the lower of the two data points where DNQ is lower than a value and ND is lower than DNQ and a value of zero shall be used for the ND or DNQ value in the median calculation for compliance purposes only. Using a value of zero for DNQ or ND samples does not apply when performing reasonable potential or antidegradation analysis.

### C. Average Monthly Effluent Limitation (AMEL)

If the average (or when applicable, the median determined by subsection B, above, for multiple sample data) of daily discharges over a calendar month exceeds the AMEL for a given parameter, this will represent a single violation, though the Permittee will be considered out of compliance

for each day of that month for that parameter (e.g., resulting in 31 days of noncompliance in a 31-day month). If only a single sample is taken during the calendar month and the analytical result for that sample exceeds the AMEL, the Permittee will be considered out of compliance for that calendar month. The Permittee will only be considered out of compliance for days when the discharge occurs. If there are ND or DNQ results for a specific constituent in a calendar month, the Permittee shall calculate the median of all sample results within that month for compliance determination with the AMEL as described in section VII.B, above.

**D. Average Weekly Effluent Limitation (AWEL)**

If the average (or when applicable, the median determined by subsection B, above, for multiple sample data) of daily discharges over a calendar week exceeds the AWEL for a given parameter, this will represent a single violation, though the Permittee will be considered out of compliance for each day of that week for that parameter, resulting in 7 days of non-compliance. If only a single sample is taken during the calendar week and the analytical result for that sample exceeds the AWEL, the Permittee will be considered out of compliance for that calendar week. The Permittee will only be considered out of compliance for days when the discharge occurs. If there are ND or DNQ results for a specific constituent in a calendar week, the Permittee shall calculate the median of all sample results within that week for compliance determination with the AWEL as described in section VII.B, above.

**E. Maximum Daily Effluent Limitation (MDEL)**

If a daily discharge (or when applicable, the median determined by subsection B, above, for multiple sample data of a daily discharge) exceeds the MDEL for a given parameter, the Permittee will be considered out of compliance for that parameter for that 1 day only within the reporting period.

**F. Instantaneous Minimum Effluent Limitation**

If the analytical result of a single grab sample is lower than the instantaneous minimum effluent limitation for a parameter, the Permittee will be considered out of compliance for that parameter for that single sample. Noncompliance for each sample will be considered separately (e.g., the results of two grab samples taken within a calendar day that both are lower than the instantaneous minimum effluent limitation would result in two instances of noncompliance with the instantaneous minimum effluent limitation).

If the Permittee monitors pH continuously, pursuant to 40 C.F.R. section 401.17, the Permittee shall be in compliance with the pH limitation specified herein provided that both of the following conditions are satisfied: (1) the total sum of time during which the pH values are outside the required range of pH values shall not exceed 7 hours and 26 minutes in any calendar month; and (2) no individual excursion from the range of pH values shall exceed 60 minutes.

**G. Instantaneous Maximum Effluent Limitation**

If the analytical result of a single grab sample is higher than the instantaneous maximum effluent limitation for a parameter, the Permittee will be considered out of compliance for that parameter for that single sample. Noncompliance for each sample will be considered separately (e.g., the results of two grab samples taken within a calendar day that both exceed the instantaneous maximum effluent limitation would result in two instances of noncompliance with the instantaneous maximum effluent limitation).

If the Permittee monitors pH continuously, pursuant to 40 C.F.R. section 401.17, the Permittee shall be in compliance with the pH limitation specified herein provided that both of the following conditions are satisfied: (1) the total sum of time during which the pH values are outside the required range of pH values shall not exceed 7 hours and 26 minutes in any calendar month; and (2) no individual excursion from the range of pH values shall exceed 60 minutes.

**H. Bacteriological Limitations (Fecal Coliform)**

1. **Median.** The median is the central tendency concentration of the pollutant. The data set shall be ranked from low to high, ranking the ND concentrations lowest, followed by quantified values. The median value is determined based on the number of data points in the set. If the data set has an odd number of data points, then the median is the middle value. If the data set has an even number of data points, the median is the average of the two middle values, unless one or both points are ND or DNQ, in which case the median value shall be the lower of the two middle data points. DNQ is lower than a detected value, and ND is lower than DNQ.

**I. Acute Toxicity Limitations**

Compliance with the three-sample median acute toxicity effluent limitation shall be determined when there is a discharge, by calculating the median percent survival of the three most recent consecutive samples meeting all test acceptability criteria collected from Monitoring Location EFF-001 for discharges at Discharge Point 001 and Monitoring Location EFF-003 for discharges at Discharge Point 003.

Compliance with the accelerated monitoring and TRE provisions shall constitute compliance with the acute toxicity requirements, as specified in the MRP (Attachment E, sections V.A and V.C).

**J. Chronic Toxicity**

Compliance with the accelerated monitoring and TRE provisions specified in the MRP (Attachment E, sections V.B.8 and V.C) shall constitute compliance with the narrative chronic toxicity requirement specified as Effluent Limitation IV.A.3.c. The narrative chronic toxicity limitation is exceeded when a chronic toxicity test, analyzed using the TST approach, results in "Fail" and the "Percent Effect" is ≥0.50. The relative "Percent (%) Effect" at the discharge Instream Waste Concentration (IWC) is defined and reported as: ((Mean control response – Mean discharge IWC response) ÷ Mean control response) × 100. The chronic toxicity IWC for a chronic toxicity test is 100 percent effluent[1]. In addition, compliance with the accelerated monitoring and TRE provisions identified in the MRP (Attachment E, sections V.B and V.C) is further required.

**K. Average Dry Weather Flow**

Compliance with the average dry weather flow prohibition in section III.H of this Order will be determined once each calendar year by evaluating all flow data collected at Monitoring Location INF-001 in a calendar year. The flow through the Facility, measured daily and averaged monthly, must be 2.3 mgd or less for the month with the lowest average monthly flow.

[1] The chronic toxicity test shall be conducted using a series of five dilutions and a control. The series shall consist of the following dilutions: 12.5, 25, 50, 75, and 100 percent. Compliance determination will be based on the IWC (100 percent effluent) and a control as further described in section IV.C.5.c of the Fact Sheet (Attachment F).

**L. Ammonia Impact Ratio AMEL**

Compliance with the ammonia impact ratio average monthly effluent limitation in sections IV.A.1 and IV.A.3 of this Order will be determined based on the monthly average of the receiving water pH, temperature and salinity samples. If more than one monthly ammonia sample is taken in the month, the average of the ammonia samples will be used in conjunction with the average of the receiving water samples. If the AIR is greater than 1.0 then the Permittee is considered out of compliance with the AIR AMEL.

**M. Ammonia Impact Ratio MDEL**

Compliance with the ammonia impact ratio maximum daily effluent limitation in sections IV.A.1 and IV.A.3 of this Order will be determined based on the receiving water pH, temperature and salinity samples taken on the same day as the ammonia sample in the effluent. If the AIR is greater than 1.0 then the Permittee is considered out of compliance with the AIR MDEL.

## ATTACHMENT A – DEFINITIONS

**Arithmetic Mean (μ)**
Also called the average is the sum of measured values divided by the number of samples. For ambient water concentrations, the arithmetic mean is calculated as follows:

Arithmetic mean = $\mu = \Sigma x / n$ where: $\Sigma x$ is the sum of the measured ambient water concentrations, and n is the number of samples.

**Average Monthly Effluent Limitation (AMEL)**
The highest allowable average of daily discharges over a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month.

**Average Weekly Effluent Limitation (AWEL)**
The highest allowable average of daily discharges over a calendar week (Sunday through Saturday), calculated as the sum of all daily discharges measured during a calendar week divided by the number of daily discharges measured during that week.

**Bioaccumulative Pollutants**
Substances taken up by an organism from its surrounding medium through gill membranes, epithelial tissue, or from food and subsequently concentrated and retained in the body of the organism.

**Carcinogenic Pollutants**
Substances that are known to cause cancer in living organisms.

**Coefficient of Variation (CV)**
A measure of the data variability and is calculated as the estimated standard deviation divided by the arithmetic mean of the observed values.

**Daily Discharge**
Daily Discharge is defined as either: (1) the total mass of the constituent discharged over the calendar day (12:00 am through 11:59 pm) or any 24-hour period that reasonably represents a calendar day for purposes of sampling (as specified in the permit), for a constituent with limitations expressed in units of mass or; (2) the unweighted arithmetic mean measurement of the constituent over the day for a constituent with limitations expressed in other units of measurement (e.g., concentration).

The daily discharge may be determined by the analytical results of a composite sample taken over the course of one day (a calendar day or other 24-hour period defined as a day) or by the arithmetic mean of analytical results from one or more grab samples taken over the course of the day.

For composite sampling, if 1 day is defined as a 24-hour period other than a calendar day, the analytical result for the 24-hour period will be considered as the result for the calendar day in which the 24-hour period ends.

**Detected, but Not Quantified (DNQ)**
Sample results that are less than the reported Minimum Level, but greater than or equal to the laboratory's MDL. Sample results reported as DNQ are estimated concentrations.

**Dilution Credit**
The amount of dilution granted to a discharge in the calculation of a water quality-based effluent limitation, based on the allowance of a specified mixing zone. It is calculated from the dilution ratio or determined through conducting a mixing zone study or modeling of the discharge and receiving water.

**Effective Concentration (EC)**
A point estimate of the toxicant concentration that would cause an adverse effect on a quantal, "all or nothing," response (such as death, immobilization, or serious incapacitation) in a given percent of the test organisms. If the effect is death or immobility, the term lethal concentration (LC) may be used. EC values may be calculated using point estimation techniques such as probit, logit, and Spearman-Karber. EC25 is the concentration of toxicant (in percent effluent) that causes a response in 25 percent of the test organisms.

**Effluent Concentration Allowance (ECA)**
A value derived from the water quality criterion/objective, dilution credit, and ambient background concentration that is used, in conjunction with the coefficient of variation for the effluent monitoring data, to calculate a long-term average (LTA) discharge concentration. The ECA has the same meaning as wasteload allocation (WLA) as used in U.S. EPA guidance (Technical Support Document For Water Quality-based Toxics Control, March 1991, second printing, EPA/505/2-90-001).

**Enclosed Bays**
Indentations along the coast that enclose an area of oceanic water within distinct headlands or harbor works. Enclosed bays include all bays where the narrowest distance between headlands or outermost harbor works is less than 75 percent of the greatest dimension of the enclosed portion of the bay. This definition includes but is not limited to: Humboldt Bay, Bodega Harbor, Tomales Bay, Drakes Estero, San Francisco Bay, Morro Bay, Los Angeles Harbor, Upper and Lower Newport Bay, Mission Bay, and San Diego Bay.

**Estimated Chemical Concentrations**
The estimated chemical concentration that results from the confirmed detection of the substance by the analytical method below the ML value.

**Estuaries and Coastal Lagoons** are waters at the mouths of streams that serve as mixing zones for fresh and ocean waters during a major portion of the year. Mouths of streams that are temporarily separated from the ocean by sandbars shall be considered as estuaries. Estuarine waters will generally be considered to extend from a bay or the open ocean to the upstream limit of tidal action but may be considered to extend seaward if significant mixing of fresh and saltwater occurs in the open coastal waters. The waters described by this definition include but are not limited to the Sacramento-San Joaquin Delta as defined by section 12220 of the California Water Code, Suisun Bay, Carquinez Strait downstream to Carquinez Bridge, and appropriate areas of the Smith, Klamath, Mad, Eel, Noyo, Russian, San Diego, and Otay Rivers. Estuaries do not include inland surface waters or ocean waters.

**Field Measurement**

Water quality field measurements are determinations of physical or chemical properties that must be measured onsite, as close as possible in time and space to the medium being sampled. Onsite measurements are necessary to preserve sample integrity and ensure data accuracy.

**Inhibition Concentration**
The IC25 is typically calculated as a percentage of effluent. It is the level at which the organisms exhibit 25 percent reduction in biological measurement such as reproduction or growth. It is calculated statistically and used in chronic toxicity testing.

**Inland Surface Waters**
All surface waters of the State that do not include the ocean, enclosed bays, or estuaries.

**Instantaneous Maximum Effluent Limitation**
The highest allowable value for any single grab sample or aliquot (i.e., each grab sample or aliquot is independently compared to the instantaneous maximum limitation).

**Instantaneous Minimum Effluent Limitation**
The lowest allowable value for any single grab sample or aliquot (i.e., each grab sample or aliquot is independently compared to the instantaneous minimum limitation).

**Lowest Observed Effect Concentration (LOEC)**
The lowest concentration of an effluent or toxicant that results in adverse effects on the test organism (i.e., where the values for the observed endpoints are statistically different from the control).

**Maximum Daily Effluent Limitation (MDEL)**
The highest allowable daily discharge of a pollutant, over a calendar day (or 24-hour period). For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the daily discharge is calculated as the arithmetic mean measurement of the pollutant over the day.

**Median**
The middle measurement in a set of data. The median of a set of data is found by first arranging the measurements in order of magnitude (either increasing or decreasing order). If the number of measurements ($n$) is odd, then the median = $X_{(n+1)/2}$. If $n$ is even, then the median = $(X_{n/2} + X_{(n/2)+1})/2$ (i.e., the midpoint between the $n/2$ and $n/2+1$).

**Method Detection Limit (MDL)**
The minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is distinguishable from method blank results, as defined in 40 C.F.R. part 136, revised as of August 28, 2017.

**Minimum Level (ML)**
The concentration at which the entire analytical system must give a recognizable signal and acceptable calibration point. The ML is the concentration in a sample that is equivalent to the concentration of the lowest calibration standard analyzed by a specific analytical procedure, assuming that all the method specified sample weights, volumes, and processing steps have been followed.

**Mixing Zone**
A limited volume of receiving water that is allocated for mixing with a wastewater discharge where water quality criteria can be exceeded without causing adverse effects to the overall water body.

**Not Detected (ND)**
Those sample results less than the laboratory's MDL

**No Observed Effect Concentration (NOEC)**
The highest tested concentration of an effluent or a test sample at which the effect is no different from the control effect, according to the statistical test used (see LOEC). The NOEC is usually the highest tested concentration of an effluent or toxicant that causes no observable effects on the aquatic test organisms (i.e., the highest concentration of toxicity at which the values for the observed responses do not statistically differ from the controls). It is determined using hypothesis testing.

**Ocean Waters**
The territorial marine waters of the state as defined by California law to the extent these waters are outside of enclosed bays, estuaries, and coastal lagoons. If a discharge outside the territorial waters of the state could affect the quality of the waters of the state, the discharge may be regulated to assure no violation of the Ocean Plan will occur in ocean waters.

**Persistent Pollutants**
Substances for which degradation or decomposition in the environment is nonexistent or very slow.

**Pollutant Minimization Program (PMP)**
PMP means waste minimization and pollution prevention actions that include, but are not limited to, product substitution, waste stream recycling, alternative waste management methods, and education of the public and businesses. The goal of the PMP shall be to reduce all potential sources of a CTR priority pollutant(s) through pollutant minimization (control) strategies, including pollution prevention measures as appropriate, to maintain the effluent concentration at or below the water quality-based effluent limitation. Pollution prevention measures may be particularly appropriate for persistent bioaccumulative CTR priority pollutants where there is evidence that beneficial uses are being impacted. The Regional Water Board may consider cost effectiveness when establishing the requirements of a PMP. The completion and implementation of a Pollution Prevention Plan, if required pursuant to Water Code section 13263.3(d), shall be considered to fulfill the PMP requirements.

**Pollution Prevention**
Any action that causes a net reduction in the use or generation of a hazardous substance or other pollutant that is discharged into water and includes, but is not limited to, input change, operational improvement, production process change, and product reformulation (as defined in Water Code section 13263.3). Pollution prevention does not include actions that merely shift a pollutant in wastewater from one environmental medium to another environmental medium, unless clear environmental benefits of such an approach are identified to the satisfaction of the State or Regional Water Board.

**Publicly Owned Treatment Works (POTW)**
A treatment works as defined in section 212 of the Clean Water Act (CWA), which is owned by a State or municipality as defined by section 502(4) of the CWA. [Section 502(4) of the CWA defines a municipality as a city, town, borough, county, parish, district, association, or other public body created by or pursuant to State law and having jurisdiction over disposal of sewage, industrial wastes, or other wastes). This definition includes any devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of a liquid nature. It also includes sewers, pipes and other conveyances only if they convey wastewater to a POTW Treatment Plant. The term also means the municipality as defined in section 502(4) of the CWA, which has jurisdiction over the Indirect Discharges to and the discharges from such a treatment works.

**Reporting Level (RL)**
The RL is the ML (and its associated analytical method) chosen by the Permittee for reporting and compliance determination from the MLs included in this Order, including an additional factor if applicable as discussed herein. The MLs included in this Order correspond to approved analytical methods for

reporting a sample result that are selected by the Regional Water Board either from Appendix 4 of the SIP in accordance with section 2.4.2 of the SIP or established in accordance with section 2.4.3 of the SIP. The ML is based on the proper application of method-based analytical procedures for sample preparation and the absence of any matrix interferences. Other factors may be applied to the ML depending on the specific sample preparation steps employed. For example, the treatment typically applied in cases where there are matrix-effects is to dilute the sample or sample aliquot by a factor of ten. In such cases, this additional factor must be applied to the ML in the computation of the RL.

**Septage**
Defined as the liquid or solid material removed from a septic tank, cesspool, portable toilet, type III marine sanitation device, recreational vehicle's sanitation tank, or similar storage or treatment works that receives domestic waste.

**Shellfish**
Organisms identified by the California Department of Health Services as shellfish for public health purposes (i.e., mussels, clams, and oysters).

**Significant Difference**
Defined as a statistically significant difference in the means of two distributions of sampling results at the 95 percent confidence level.

**Source of Drinking Water**
Any water designated as municipal or domestic supply (MUN) in a Regional Water Board Basin Plan.

**Standard Deviation ($\sigma$)**
A measure of variability that is calculated as follows:

$$\sigma = (\sum[(x - \mu)^2]/(n - 1))^{0.5}$$

where:

x is the observed value;

$\mu$ is the arithmetic mean of the observed values; and

n is the number of samples.

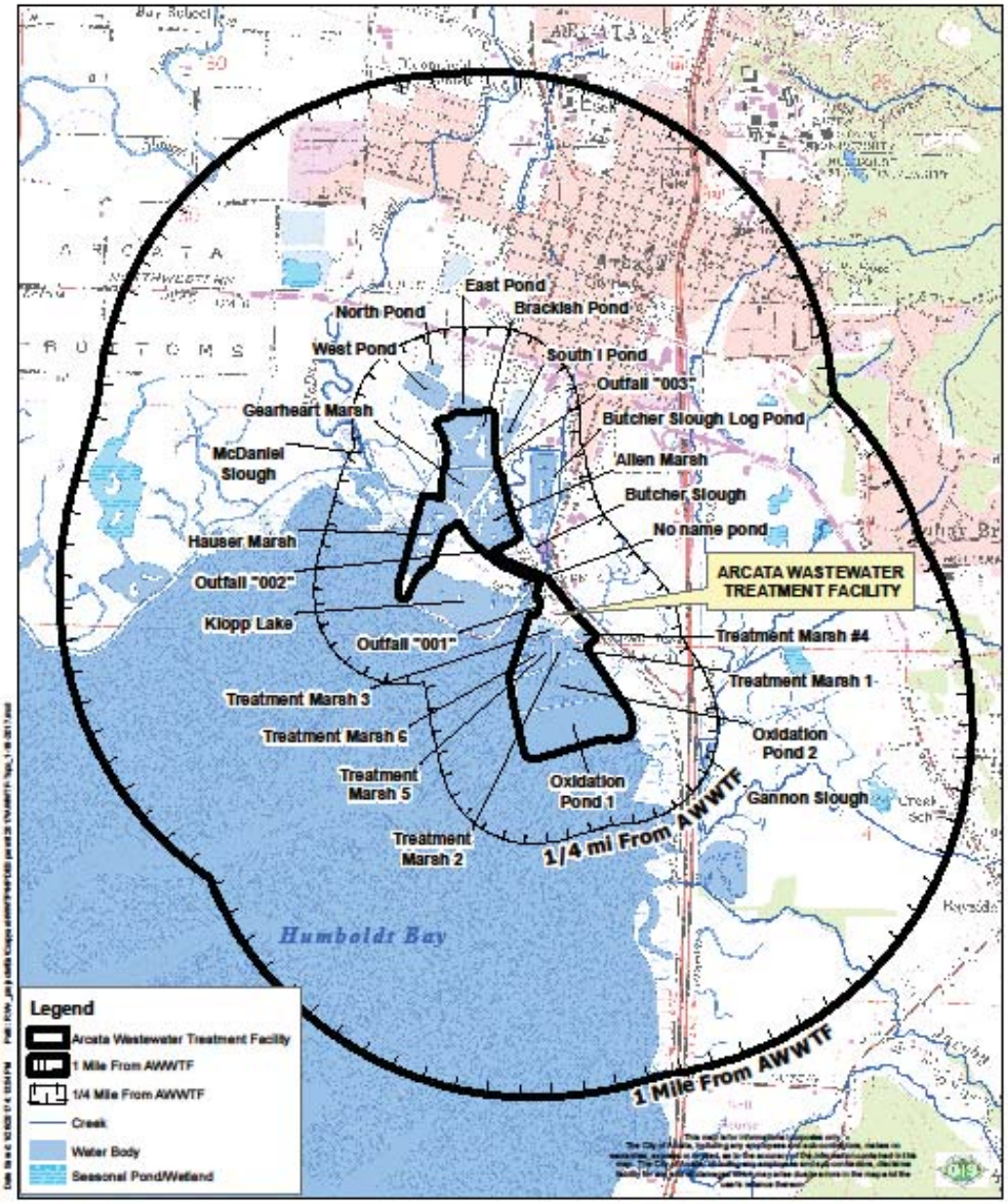
**TCDD Equivalents**
The sum of the concentrations of chlorinated dibenzodioxins (2,3,7,8-CDDs) and chlorinated dibenzofurans (2,3,7,8-CDFs) multiplied by their respective toxicity factors, as shown in the table below.

| Isomer Group | Toxicity Equivalence Factor |
|---|---|
| 2,3,7,8-tetra CDD | 1.0 |
| 2,3,7,8-penta CDD | 0.5 |
| 2,3,7,8-hexa CDDs | 0.1 |
| 2,3,7,8-hepta CDD | 0.01 |
| octa CDD | 0.001 |
| 2,3,7,8 tetra CDF | 0.1 |
| 1,2,3,7,8 penta CDF | 0.05 |
| 2,3,4,7,8 penta CDF | 0.5 |
| 2,3,7,8 hexa CDFs | 0.1 |
| 2,3,7,8 hepta CDFs | 0.01 |
| octa CDF | 0.001 |

**Toxicity Reduction Evaluation (TRE)**
A study conducted in a stepwise process designed to identify the causative agents of effluent or ambient toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in toxicity. The first steps of the TRE consist of the collection of data relevant to the toxicity, including additional toxicity testing, and an evaluation of facility operations and maintenance practices, and best management practices. A Toxicity Identification Evaluation (TIE) may be required as part of the TRE, if appropriate. (A TIE is a set of procedures to identify the specific chemical(s) responsible for toxicity. These procedures are performed in three phases (characterization, identification, and confirmation) using aquatic organism toxicity tests.)

**Test of Significant Toxicity (TST)**
The statistical approach described in National Pollutant Discharge Elimination System Test of Significant Toxicity Implementation Document (EPA 833-R10-003, 2010). TST was developed by the U.S. Environmental Protection Agency (EPA) for analyzing WET and ambient toxicity data. Using the TST approach, the sample is declared toxic if there is greater than or equal to a 25% effect in chronic tests, or if there is greater than or equal to a 20% effect in acute tests at the permitted instream waste concentration (IWC) (referred to as the toxic regulatory management decision (RMD)). The sample is declared non-toxic if there is less than or equal to a 10% effect at the IWC in acute or chronic tests (referred to as the non-toxic RMD).

**ATTACHMENT B – LOCATION MAP**

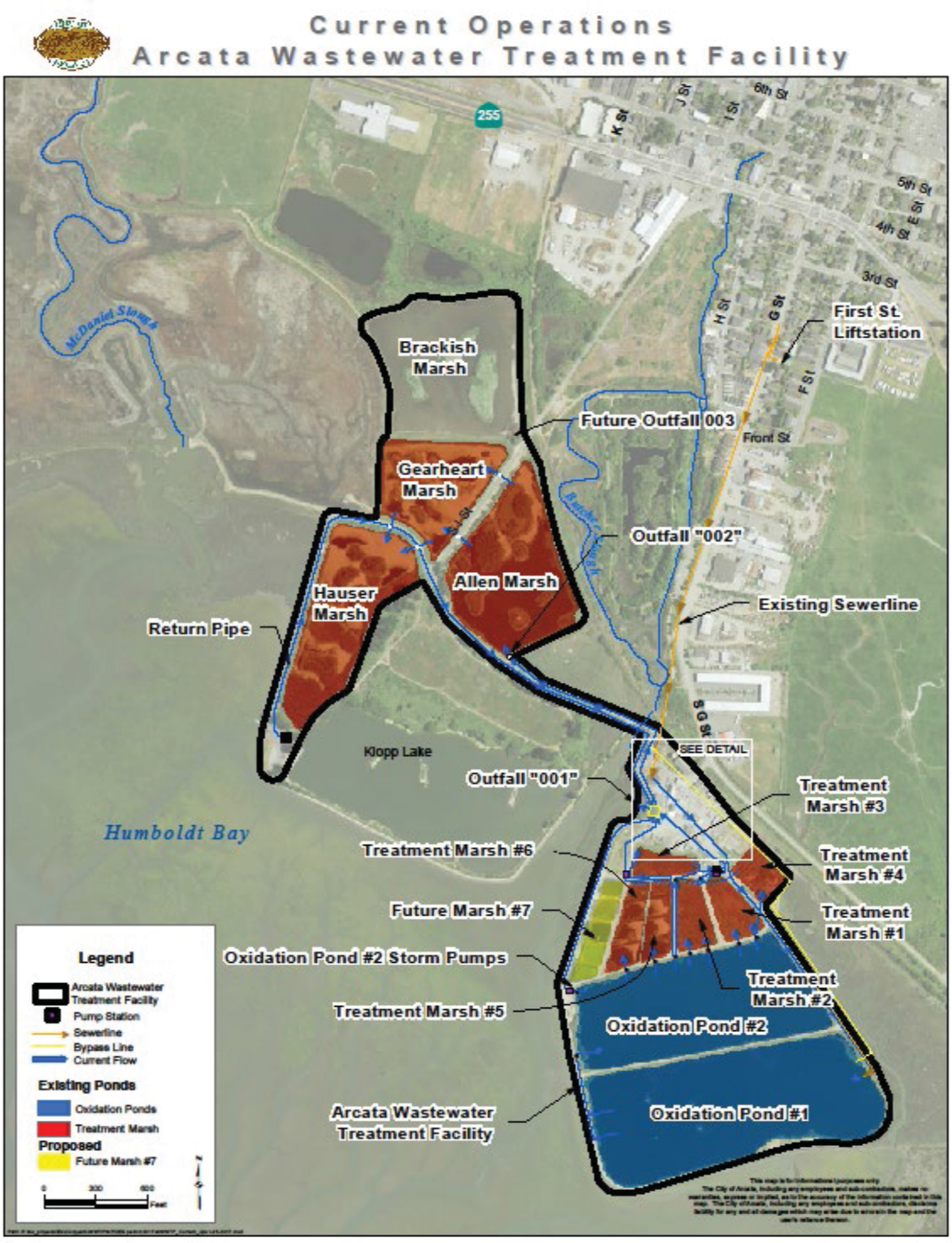



City of Arcata
*Environmental Services*

## Arcata Wastewater Treatment Facility Topographical Map

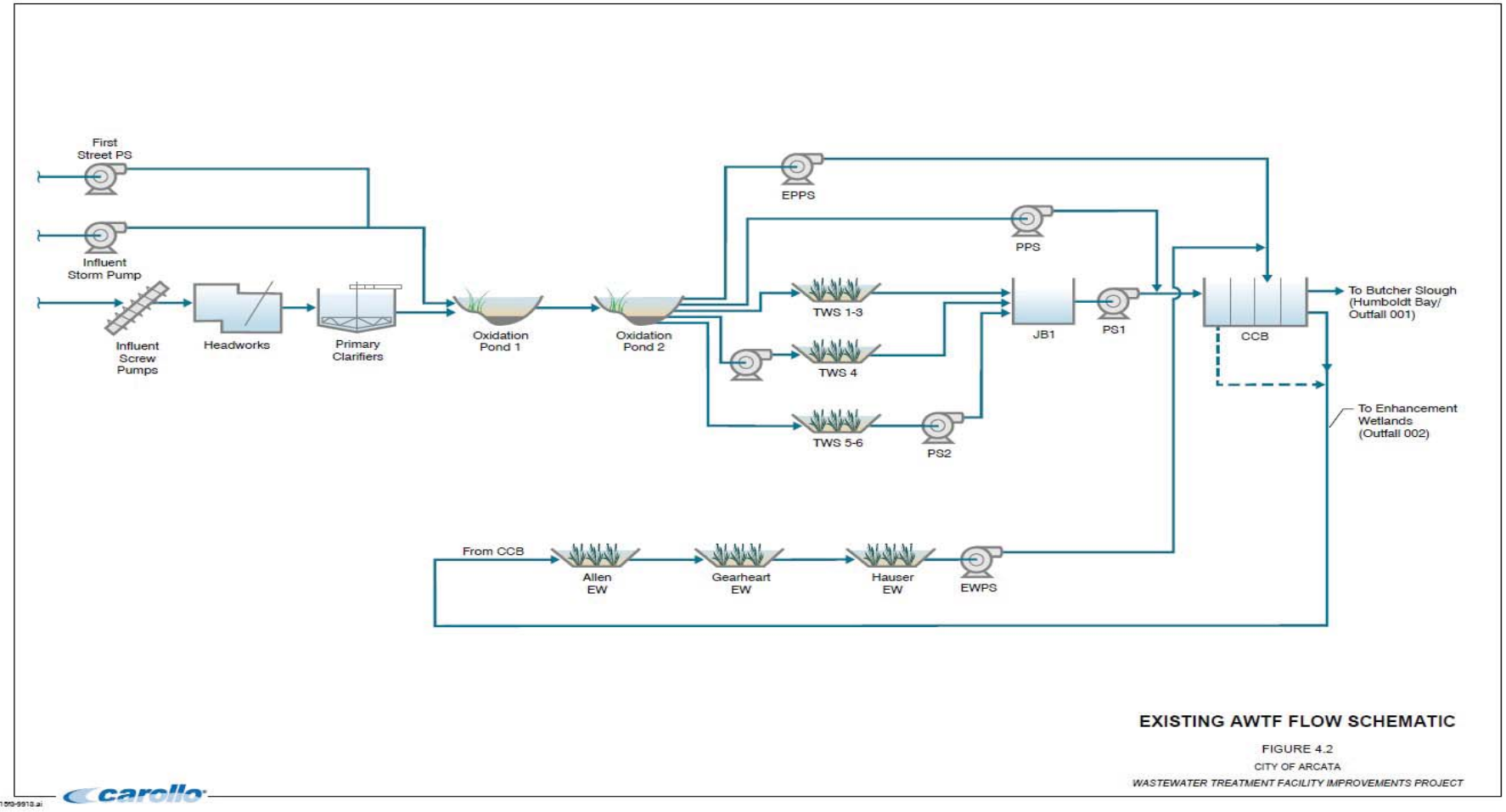
U.S.G.S. 7.5 Minute Topographic Map: Arcata South Quadrangle
Section 32 of T.6.N., R.1.E. of H.B. & M.

NORTH
0 1,000 Feet


Current Operations
Arcata Wastewater Treatment Facility
255
K St
J St
I St
6th St
5th St
4th St
3rd St
H St
G St
F St
Front St
First St. Liftstation
McDaniel Slough
Brackish Marsh
Future Outfall 003
Gearheart Marsh
I St
Outfall "002"
Allen Marsh
Hauser Marsh
Return Pipe
Existing Sewerline
Klopp Lake
SEE DETAIL
Outfall "001"
Treatment Marsh #3
Humboldt Bay
Treatment Marsh #6
Treatment Marsh #4
Future Marsh #7
Treatment Marsh #1
Oxidation Pond #2 Storm Pumps
Treatment Marsh #2
Treatment Marsh #5
Oxidation Pond #2
Arcata Wastewater Treatment Facility
Oxidation Pond #1
Legend
Arcata Wastewater Treatment Facility
Pump Station
Sewerline
Bypass Line
Current Flow
Existing Ponds
Oxidation Ponds
Treatment Marsh
Proposed
Future Marsh #7
0
300
600
Feet

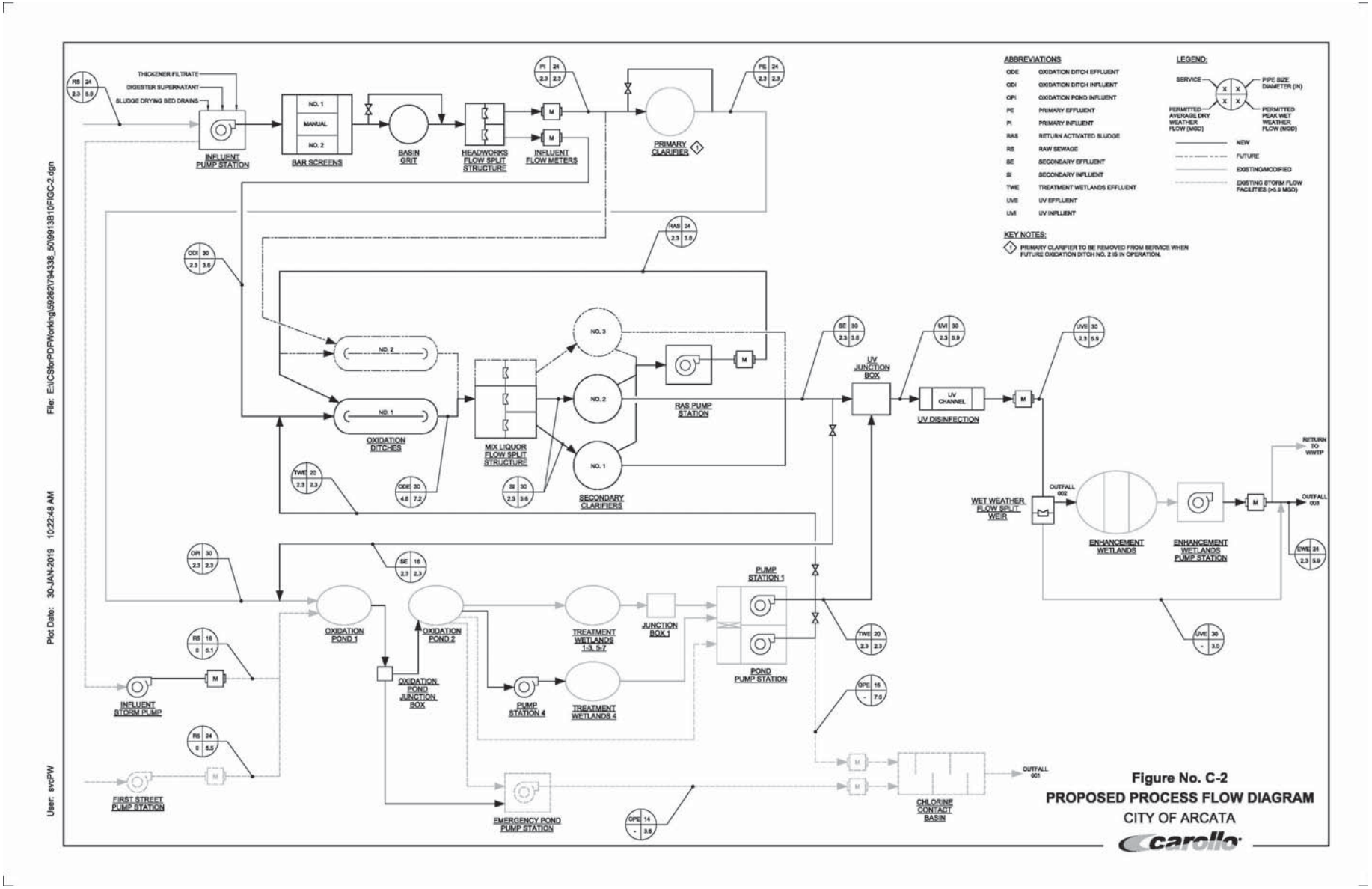
## ATTACHMENT C – FLOW SCHEMATIC

### Figure C-1. Existing Wastewater Flow[1] Schematic




[1] Under the existing flow configuration, a portion of the treated effluent is sent to the enhancement marshes for enhanced treatment while the remainder is discharged to Humboldt Bay via Outfall-001. Average flow through Allen, Gearheart and Hauser Enhancement Wetlands from August 2012 through September 2018 was 1.14 mgd.

**Figure C-2. Proposed Treatment Upgrade Flow Schematic**



# ATTACHMENT D – STANDARD PROVISIONS

## I. STANDARD PROVISIONS – PERMIT COMPLIANCE

### A. Duty to Comply

**1.** The Permittee must comply with all of the conditions of this Order. Any noncompliance constitutes a violation of the Clean Water Act (CWA) and the California Water Code and is grounds for enforcement action, for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application. (40 C.F.R. § 122.41(a); Wat. Code, §§ 13261, 13263, 13265, 13268, 13000, 130001, 13304, 13350, 13385)

**2.** The Permittee shall comply with effluent standards or prohibitions established under section 307(a) of the CWA for toxic pollutants and with standards for sewage sludge use or disposal established under section 405(d) of the CWA within the time provided in the regulations that establish these standards or prohibitions, even if this Order has not yet been modified to incorporate the requirement. (40 C.F.R. § 122.41(a)(1))

### B. Need to Halt or Reduce Activity Not a Defense

It shall not be a defense for a Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this Order. (40 C.F.R. § 122.41(c))

### C. Duty to Mitigate

The Permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this Order that has a reasonable likelihood of adversely affecting human health or the environment. (40 C.F.R. § 122.41(d))

### D. Proper Operation and Maintenance

The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the Permittee to achieve compliance with the conditions of this Order. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems that are installed by a Permittee only when necessary to achieve compliance with the conditions of this Order. (40 C.F.R. § 122.41(e))

### E. Property Rights

**1.** This Order does not convey any property rights of any sort or any exclusive privileges. (40 C.F.R. § 122.41(g))

**2.** The issuance of this Order does not authorize any injury to persons or property or invasion of other private rights, or any infringement of state or local law or regulations. (40 C.F.R. § 122.5(c))

### F. Inspection and Entry

The Permittee shall allow the Regional Water Board, State Water Board, U.S. EPA, and/or their authorized representatives (including an authorized contractor acting as their representative), upon the presentation of credentials and other documents, as may be required by law, to (33 U.S.C. § 1318(a)(4)(b); 40 C.F.R. § 122.41(i); Wat. Code, §§ 13267, 13383):

1. Enter upon the Permittee's premises where a regulated facility or activity is located or conducted, or where records are kept under the conditions of this Order (33 U.S.C. § 1318(a)(4)(b)(i); 40 C.F.R. § 122.41(i)(1); Wat. Code, §§ 13267, 13383);

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this Order (33 U.S.C. § 1318(a)(4)(b)(ii); 40 C.F.R. § 122.41(i)(2); Wat. Code, §§ 13267, 13383);

3. Inspect and photograph, at reasonable times, any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Order (33 U.S.C. § 1318(a)(4)(b)(ii); 40 C.F.R. § 122.41(i)(3); Wat. Code, §§ 13267, 13383); and

4. Sample or monitor, at reasonable times, for the purposes of assuring Order compliance or as otherwise authorized by the CWA or the Water Code, any substances or parameters at any location. (33 U.S.C. § 1318(a)(4)(b); 40 C.F.R. § 122.41(i)(4); Wat. Code, §§ 13267, 13383)

## G. Bypass

### 1. Definitions

a. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility. (40 C.F.R. § 122.41(m)(1)(i))

b. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities, which causes them to become inoperable, or substantial and permanent loss of natural resources that can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production. (40 C.F.R. § 122.41(m)(1)(ii))

2. **Bypass not exceeding limitations.** The Permittee may allow any bypass to occur which does not cause exceedances of effluent limitations, but only if it is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions listed in Standard Provisions – Permit Compliance I.G.3, I.G.4, and I.G.5 below. (40 C.F.R. § 122.41(m)(2).)

3. **Prohibition of bypass.** Bypass is prohibited, and the Regional Water Board may take enforcement action against a Permittee for bypass, unless (40 C.F.R. § 122.41(m)(4)(i)):

a. Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage (40 C.F.R. § 122.41(m)(4)(i)(A));

b. There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass that occurred during normal periods of equipment downtime or preventive maintenance (40 C.F.R. § 122.41(m)(4)(i)(B)); and

c. The Permittee submitted notice to the Regional Water Board as required under Standard Provisions – Permit Compliance I.G.5 below. (40 C.F.R. § 122.41(m)(4)(i)(C))

4. **Burden of Proof**. In any enforcement proceeding, the permittee seeking to establish the bypass defense has the burden of proof.

5. The Regional Water Board may approve an anticipated bypass, after considering its adverse effects, if the Regional Water Board determines that it will meet the three conditions listed in Standard Provisions – Permit Compliance I.G.3 above. (40 C.F.R. § 122.41(m)(4)(ii))

6. **Notice**

a. **Anticipated bypass.** If the Permittee knows in advance of the need for a bypass, it shall submit a prior notice, if possible, at least 10 days before the date of the bypass. (40 C.F.R. § 122.41(m)(3)(i))

b. **Unanticipated bypass.** The Permittee shall submit notice of an unanticipated bypass as required in Standard Provisions - Reporting V.E below (24-hour notice). (40 C.F.R. § 122.41(m)(3)(ii))

### H. Upset

Upset means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation. (40 C.F.R. § 122.41(n)(1))

1. **Effect of an upset.** An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of Standard Provisions – Permit Compliance I.H.2 below are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review. (40 C.F.R. § 122.41(n)(2))

2. **Conditions necessary for a demonstration of upset.** A Permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs or other relevant evidence that (40 C.F.R. § 122.41(n)(3)):

   a. An upset occurred and that the Permittee can identify the cause(s) of the upset (40 C.F.R. § 122.41(n)(3)(i));

   b. The Facility was, at the time, being properly operated (40 C.F.R. § 122.41(n)(3)(ii));

   c. The Permittee submitted notice of the upset as required in Standard Provisions – Reporting V.E.2.b below (24-hour notice) (40 C.F.R. § 122.41(n)(3)(iii)); and

   d. The Permittee complied with any remedial measures required under Standard Provisions – Permit Compliance I.C above. (40 C.F.R. § 122.41(n)(3)(iv))

3. **Burden of Proof**. In any enforcement proceeding, the Permittee seeking to establish the occurrence of an upset has the burden of proof. (40 C.F.R. § 122.41(n)(4))

## II. STANDARD PROVISIONS – PERMIT ACTION

### A. General

This Order may be modified, revoked and reissued, or terminated for cause. The filing of a request by the Permittee for modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any Order condition. (40 C.F.R. § 122.41(f))

### B. Duty to Reapply

If the Permittee wishes to continue an activity regulated by this Order after the expiration date of this Order, the Permittee must apply for and obtain a new permit. (40 C.F.R. § 122.41(b))

### C. Transfers

This Order is not transferable to any person except after notice to the Regional Water Board. The Regional Water Board may require modification or revocation and reissuance of the Order to

change the name of the Permittee and incorporate such other requirements as may be necessary under the CWA and the Water Code. (40 C.F.R. § 122.41(l)(3); § 122.61)

## III. STANDARD PROVISIONS – MONITORING

**A.** Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. (40 C.F.R. § 122.41(j)(1))

**B.** Monitoring must be conducted according to test procedures under 40 C.F.R. part 136 for the analyses of pollutants unless another method is required under 40 C.F.R. chapter 1, subchapters N or O. Monitoring must be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 C.F.R. part 136 for the analysis of pollutants or pollutant parameters or required under 40 C.F.R. chapter 1, subchapter N or O. For the purposes of this paragraph, a method is "sufficiently sensitive" when:

**1.** The method minimum level (ML) is at or below the level of the effluent limitation established in the permit for the measured pollutant or pollutant parameter, and, either the method ML is at or below the level of the applicable water quality criterion for the measured pollutant or pollutant parameter or the method ML is above the applicable water quality criterion, but the amount of the pollutant or pollutant parameter in a facility's discharge is high enough that the method detects and quantifies the level of the pollutant or pollutant parameter in the discharge; or

**2.** The method has the lowest ML of the analytical methods approved under 40 C.F.R. part 136 or required under 40 C.F.R. chapter 1, subchapter N or O for the measured pollutant or pollutant parameter.

In the case of pollutants for which there are no approved methods under 40 C.F.R. part 136 or otherwise required under 40 C.F.R. chapter 1, subchapters N or O, monitoring must be conducted according to a test procedure specified in this Order for such pollutants. (40 C.F.R. § 122.41(j)(4); § 122.44(i)(1)(iv))

In the case of sludge use or disposal approved under 40 C.F.R. part 136, monitoring must be conducted according to test procedures in part 503 unless otherwise specified in 40 C.F.R. or other test procedures have been specified in this Order.

## IV. STANDARD PROVISIONS – RECORDS

**A.** Except for records of monitoring information required by this Order related to the Permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by 40 C.F.R. part 503), the Permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this Order, and records of all data used to complete the application for this Order, for a period of at least three (3) years from the date of the sample, measurement, report, or application. This period may be extended by request of the Regional Water Board Executive Officer at any time. (40 C.F.R. § 122.41(j)(2))

**B. Records of monitoring information shall include:**

**1.** The date, exact place, and time of sampling or measurements (40 C.F.R. § 122.41(j)(3)(i));

**2.** The individual(s) who performed the sampling or measurements (40 C.F.R. § 122.41(j)(3)(ii));

**3.** The date(s) analyses were performed (40 C.F.R. § 122.41(j)(3)(iii));

**4.** The individual(s) who performed the analyses (40 C.F.R. § 122.41(j)(3)(iv));

5. The analytical techniques or methods used (40 C.F.R. § 122.41(j)(3)(v)); and

6. The results of such analyses. (40 C.F.R. § 122.41(j)(3)(vi))

**C. Claims of confidentiality for the following information will be denied (40 C.F.R. § 122.7(b)):**

1. The name and address of any permit applicant or Permittee (40 C.F.R. § 122.7(b)(1)); and

2. Permit applications and attachments, permits and effluent data. (40 C.F.R. § 122.7(b)(2))

## V. STANDARD PROVISIONS – REPORTING

### A. Duty to Provide Information

The Permittee shall furnish to the Regional Water Board, State Water Board, or U.S. EPA within a reasonable time, any information which the Regional Water Board, State Water Board, or U.S. EPA may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Order or to determine compliance with this Order. Upon request, the Permittee shall also furnish to the Regional Water Board, State Water Board, or U.S. EPA copies of records required to be kept by this Order. (40 C.F.R. § 122.41(h); Wat. Code, § 13267)

### B. Signatory and Certification Requirements

1. All applications, reports, or information submitted to the Regional Water Board, State Water Board, and/or U.S. EPA shall be signed and certified in accordance with Standard Provisions – Reporting V.B.2, V.B.3, V.B.4, and V.B.5 below. (40 C.F.R. § 122.41(k))

2. All permit applications shall be signed by either a principal executive officer or ranking elected official. For purposes of this provision, a principal executive officer of a federal agency includes: (i) the chief executive officer of the agency, or (ii) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of U.S. EPA). (40 C.F.R. § 122.22(a)(3))

3. All reports required by this Order and other information requested by the Regional Water Board, State Water Board, or U.S. EPA shall be signed by a person described in Standard Provisions – Reporting V.B.2 above, or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described in Standard Provisions – Reporting V.B.2 above (40 C.F.R. § 122.22(b)(1));

   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.) (40 C.F.R. § 122.22(b)(2)); and

   c. The written authorization is submitted to the Regional Water Board and State Water Board. (40 C.F.R. § 122.22(b)(3))

4. If an authorization under Standard Provisions – Reporting V.B.3 above is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Standard Provisions – Reporting V.B.3 above must be submitted to the Regional Water Board and State Water Board prior to or together with any reports, information, or applications, to be signed by an authorized representative. (40 C.F.R. § 122.22(c))

5. Any person signing a document under Standard Provisions – Reporting V.B.2 or V.B.3 above shall make the following certification:

   "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations." (40 C.F.R. § 122.22(d))

6. Any person providing the electronic signature for documents described in Standard Provisions – V.B.1, V.B.2, or V.B.3 that are submitted electronically shall meet all relevant requirements of Standard Provisions – Reporting V.B, and shall ensure that all relevant requirements of 40 C.F.R. part 3 (Cross-Media Electronic Reporting) and 40 C.F.R. part 127 (NPDES Electronic Reporting Requirements) are met for that submission. (40 C.F.R § 122.22(e))

## C. Monitoring Reports

1. Monitoring results shall be reported at the intervals specified in the MRP (Attachment E) in this Order. (40 C.F.R. § 122.41(l)(4))

2. Monitoring results must be reported on a Discharge Monitoring Report (DMR) form or forms provided or specified by the Regional Water Board or State Water Board for reporting results of monitoring, sludge use, or disposal practices. As of December 21, 2016, all reports and forms must be submitted electronically to the initial recipient defined in Standard Provisions – Reporting V.J and comply with 40 C.F.R. part 3, 40 C.F.R. section 122.22, and 40 C.F.R. part 127. (40 C.F.R. § 122.41(l)(4)(i))

3. If the Permittee monitors any pollutant more frequently than required by this Order using test procedures approved under 40 C.F.R. part 136, or another method required for an industry-specific waste stream under 40 C.F.R. chapter 1, subchapters N or O, the results of such monitoring shall be included in the calculation and reporting of the data submitted in the DMR or sludge reporting form specified by the Regional Water Board. (40 C.F.R. § 122.41(l)(4)(ii))

4. Calculations for all limitations, which require averaging of measurements, shall utilize an arithmetic mean unless otherwise specified in this Order. (40 C.F.R. § 122.41(l)(4)(iii))

## D. Compliance Schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this Order, shall be submitted no later than 14 days following each schedule date. (40 C.F.R. § 122.41(l)(5))

## E. Twenty-Four Hour Reporting

1. The Permittee shall report any noncompliance that may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the Permittee becomes aware of the circumstances. A written submission shall also be provided within five (5) days of the time the Permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to

reduce, eliminate, and prevent reoccurrence of the noncompliance.
(40 C.F.R. § 122.41(l)(6)(i))

For noncompliance events related to combined sewer overflows, sanitary sewer overflows, or bypass events, these reports must include the data described above (with the exception of time of discovery) as well as the type of event (i.e., combined sewer overflow, sanitary sewer overflow, or bypass event), type of overflow structure (e.g., manhole, combined sewer overflow outfall), discharge volume untreated by the treatment works treating domestic sewage, types of human health and environmental impacts of the event, and whether the noncompliance was related to wet weather.

As of December 21, 2020, all reports related to combined sewer overflows, sanitary sewer overflows, or bypass events must be submitted to the Regional Water Board and must be submitted electronically to the initial recipient defined in Standard Provisions – Reporting V.J. The reports shall comply with 40 C.F.R. part 3, 40 C.F.R. section 122.22, and 40 C.F.R. part 127. The Regional Water Board may also require the Permittee to electronically submit reports not related to combined sewer overflows, sanitary sewer overflows, or bypass events under this section. (40 C.F.R. § 122.41(l)(6)(i))

**2.** The following shall be included as information that must be reported within 24 hours under this paragraph (40 C.F.R. § 122.41(l)(6)(ii)):

**a.** Any unanticipated bypass that exceeds any effluent limitation in this Order. (40 C.F.R. § 122.41(l)(6)(ii)(A))

**b.** Any upset that exceeds any effluent limitation in this Order. (40 C.F.R. § 122.41(l)(6)(ii)(B))

**3.** The Regional Water Board may waive the above-required written report under this provision on a case-by-case basis if an oral report has been received within 24 hours. (40 C.F.R. § 122.41(l)(6)(iii))

## F. Planned Changes

The Permittee shall give notice to the Regional Water Board as soon as possible of any planned physical alterations or additions to the Facility. Notice is required under this provision only when (40 C.F.R. § 122.41(l)(1)):

**1.** The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in section 122.29(b) (40 C.F.R. § 122.41(l)(1)(i)); or

**2.** The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants that are not subject to effluent limitations in this Order. (40 C.F.R. § 122.41(l)(1)(ii))

**3.** The alteration or addition results in a significant change in the Permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan. (40 C.F.R. § 122.41(l)(1)(iii))

## G. Anticipated Noncompliance

The Permittee shall give advance notice to the Regional Water Board of any planned changes in the Facility or activity that may result in noncompliance with this Order's requirements. (40 C.F.R. § 122.41(l)(2))

### H. Other Noncompliance

The Permittee shall report all instances of noncompliance not reported under Standard Provisions – Reporting V.C, V.D, and V.E above at the time monitoring reports are submitted. The reports shall contain the information listed in Standard Provision – Reporting V.E above. For noncompliance events related to combined sewer overflows, sanitary sewer overflows, or bypass events, these reports shall contain the information described in Standard Provision – Reporting V.E and the applicable required data in appendix A to 40 C.F.R. part 127. The Regional Water Board may also require the Permittee to electronically submit reports not related to combined sewer overflows, sanitary sewer overflows, or bypass events under this section. (40 C.F.R. § 122.41(l)(7))

### I. Other Information

When the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Regional Water Board, State Water Board, or U.S. EPA, the Permittee shall promptly submit such facts or information. (40 C.F.R. § 122.41(l)(8))

### J. Initial Recipient for Electronic Reporting Data

The owner, operator, or the duly authorized representative is required to electronically submit NPDES information specified in appendix A to 40 C.F.R. part 127 to the initial recipient defined in 40 C.F.R. section 127.2(b). U.S. EPA will identify and publish the list of initial recipients on its website and in the Federal Register, by state and by NPDES data group [see 40 C.F.R. section 127.2(c)]. U.S. EPA will update and maintain this listing. (40 C.F.R. § 122.41(l)(9))

## VI. STANDARD PROVISIONS – ENFORCEMENT

The Regional Water Board is authorized to enforce the terms of this permit under several provisions of the Water Code, including, but not limited to, sections 13385, 13386, and 13387.

## VII. ADDITIONAL PROVISIONS – NOTIFICATION LEVELS

### A. Publicly-Owned Treatment Works (POTWs)

All POTWs shall provide adequate notice to the Regional Water Board of the following (40 C.F.R. § 122.42(b)):

1. Any new introduction of pollutants into the POTW from an indirect discharger that would be subject to sections 301 or 306 of the CWA if it were directly discharging those pollutants (40 C.F.R. § 122.42(b)(1)); and
2. Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of adoption of this Order (40 C.F.R. § 122.42(b)(2))
3. Adequate notice shall include information on the quality and quantity of effluent introduced into the POTW as well as any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW. (40 C.F.R. § 122.42(b)(3))

# ATTACHMENT E – MONITORING AND REPORTING PROGRAM (MRP)

## Contents


I. General Monitoring Provisions ..... E-2
II. Monitoring Locations ..... E-3
III. Influent Monitoring Requirements ..... E-3
  A. Monitoring Location INF-001 ..... E-3
IV. Effluent Monitoring Requirements ..... E-4
  A. Monitoring Location EFF-001 ..... E-4
  B. Monitoring Location EFF-002 ..... E-5
  C. Monitoring Location EFF-003 ..... E-6
V. Whole Effluent Toxicity (WET) Testing Requirements ..... E-7
  A. Acute Toxicity Testing ..... E-7
  B. Chronic Toxicity Testing ..... E-10
  C. Toxicity Reduction Evaluation (TRE) Process ..... E-13
VI. Land Discharge Monitoring Requirements – Not applicable ..... E-15
VII. Recycling Monitoring Requirements – Not Applicable ..... E-15
VIII. Receiving Water Monitoring Requirements – Surface Water ..... E-15
  A. Arcata Marsh Wildlife Sanctuary (AMWS) Monitoring Locations ..... E-15
  B. Monitoring Location RSW-001 ..... E-15
IX. Other Monitoring Requirements ..... E-16
  A. Disinfection Process Monitoring for Ultraviolet Light (UV) Disinfection System (Monitoring Location INT-001) ..... E-16
  B. Visual Monitoring (Monitoring Locations EFF-001, EFF-002, EFF-003, and RSW-001) ..... E-16
  C. Sludge Monitoring (Monitoring Location BIO-001) ..... E-16
X. Reporting Requirements ..... E-16
  A. General Monitoring and Reporting Requirements ..... E-16
  B. Self-Monitoring Reports (SMRs) ..... E-16
  C. Discharge Monitoring Reports (DMRs) ..... E-19
  D. Other Reports ..... E-19
  E. Spill Notification ..... E-22


## Tables


Table E-1. Monitoring Station Locations ..... E-3
Table E-2. Influent Monitoring – Monitoring Location INF-001 ..... E-3
Table E-3. Effluent Monitoring – Monitoring Locations EFF-001 ..... E-4
Table E-4. Effluent Monitoring – Monitoring Location EFF-002 ..... E-5
Table E-5. Effluent Monitoring – Monitoring Location EFF-003 ..... E-6
Table E-6. Receiving Water Monitoring – Monitoring Location RSW-001 ..... E-15
Table E-7. Monitoring Periods and Reporting Schedule ..... E-17
Table E-8. Reporting Requirements for Special Provisions Reports ..... E-19

## ATTACHMENT E – MONITORING AND REPORTING PROGRAM

The Code of Federal Regulations (40 C.F.R. § 122.48) requires that all NPDES permits specify monitoring and reporting requirements. California Water Code (Water Code) section 13383 also authorizes the Regional Water Board to require technical and monitoring reports. This MRP establishes monitoring and reporting requirements that implement federal and California regulations.

### I. GENERAL MONITORING PROVISIONS

**A. Wastewater Monitoring Provision**. Composite samples may be taken by a proportional sampling device approved by the Executive Officer or by grab samples composited in proportion to flow. In compositing grab samples, the sampling interval shall not exceed 1 hour.

**B. Supplemental Monitoring Provision**. If the Permittee monitors any pollutant more frequently than required by this Order, using test procedures approved by 40 C.F.R. part 136 or as specified in this Order, the results of such monitoring shall be included in the calculation and reporting of the data submitted in the quarterly and annual discharge monitoring reports.

**C. Data Quality Assurance Provision**. Laboratories analyzing monitoring samples shall be certified by the State Water Resources Control Board (State Water Board) in accordance with the provisions of Water Code section 13176 and must include quality assurance / quality control data with their analytical reports. The Permittee may analyze pollutants with short hold times (e.g., pH, chlorine residual, etc.) with field equipment or its on-site laboratory provided that the Permittee has standard operating procedures (SOPs) that identify quality assurance/quality control procedures to be followed to ensure accurate results.

The Permittee shall keep a manual onsite containing the SOPs followed in this program and must demonstrate sufficient capability to adequately perform these field tests (e.g., qualified and trained employees, properly calibrated and maintained field instruments). The program shall conform to U.S. EPA guidelines or other approved procedures.

**D. Instrumentation and Calibration Provision.** All monitoring instruments and devices used by the Permittee to fulfill the prescribed monitoring program shall be properly maintained and calibrated as necessary to ensure their continued accuracy. All flow measurement devices shall be calibrated no less than the manufacturer's recommended intervals or one-year intervals, (whichever comes first) to ensure continued accuracy of the devices.

**E. Minimum Levels (ML) and Reporting Levels (RL).** Unless otherwise specified by this MRP, all monitoring shall be conducted according to test procedures established at 40 C.F.R. part 136, *Guidelines Establishing Test Procedures for Analysis of Pollutants*. All analyses shall be conducted using the lowest practical quantitation limit achievable using U.S. EPA approved methods. For the purposes of the NPDES program, when more than one test procedure is approved under 40 C.F.R., part 136 for the analysis of a pollutant or pollutant parameter, the test procedure must be sufficiently sensitive as defined at 40 C.F.R. 122.21(e)(3) and 122.44(i)(1)(iv). Where effluent limitations are set below the lowest achievable quantitation limits, pollutants not detected at the lowest practical quantitation limits will be considered in compliance with effluent limitations. Analysis for toxics listed by the California Toxics Rule (CTR) shall also adhere to guidance and requirements contained in the *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California* (2005) (SIP). However, there may be situations when analytical methods are published with MLs that are more sensitive than the MLs for analytical methods listed in the SIP. For instance, U.S. EPA Method 1631E for mercury is not currently listed in SIP Appendix 4, but it is published with an ML of 0.5 ng/L that makes it a sufficiently sensitive analytical method. Similarly, U.S. EPA Method 245.7 for mercury is published with an ML of 5 ng/L.

**F. Discharge Monitoring Report Quality Assurance (DMR-QA) Study.** The Permittee shall ensure that the results of the DMR-QA Study or the most recent Water Pollution Performance Evaluation Study are submitted annually to the State Water Board at the following address:

State Water Resources Control Board
Quality Assurance Program Officer
Office of Information Management and Analysis
1001 I Street, Sacramento, CA 95814

## II. MONITORING LOCATIONS

The Permittee shall establish the following monitoring locations to demonstrate compliance with the effluent limitations, discharge specifications, and other requirements in this Order:

**Table E-1. Monitoring Station Locations**

| Discharge Point Name | Monitoring Location Name | Monitoring Location Description |
|---|---|---|
| -- | INF-001 | Untreated influent wastewater collected at the plant headworks at a representative point preceding primary treatment. |
| -- | INT-001 | Location for monitoring ultraviolet light (UV) radiation dose and UV transmittance of the UV disinfection system. |
| 001 | EFF-001 | Location where representative samples of treated wastewater, to be discharged to Humboldt Bay at Discharge Point 001, can be collected at a point following disinfection and prior to contact with Humboldt Bay. |
| 002 | EFF-002 | Location where representative samples of treated wastewater, to be discharged to the Arcata Marsh Wildlife Sanctuary (AMWS) at Discharge Point 002, can be collected at a point following the UV disinfection system and prior to contact with the AMWS. |
| -- | AMWS | Areas throughout the AMWS representative of various wetland conditions in accordance with the Special Study required under section VI.C.2.a of the Order. |
| 003 | EFF-003 | Location where representative samples of treated wastewater, to be discharged to the brackish marsh at Discharge Point 003, can be collected at a point prior to contact with the brackish marsh. |
| -- | RSW-001 | Receiving water monitoring location at the tide gate following the point at which the brackish marsh discharges into Humboldt Bay. |

## III. INFLUENT MONITORING REQUIREMENTS

### A. Monitoring Location INF-001

**1.** The Permittee shall monitor influent to the Facility at Monitoring Location INF-001 as follows:

**Table E-2. Influent Monitoring – Monitoring Location INF-001**

| Parameter | Units | Sample Type | Minimum Sampling Frequency | Required Analytical Test Method |
|---|---|---|---|---|
| Influent Flow[1] | Mgd | Meter | Continuous | -- |
| Biochemical Oxygen Demand 5-day @ 20°C ($BOD_5$) | mg/L | 24-hr Composite | Weekly | Part 136[2] |
| Total Suspended Solids (TSS) | mg/L | 24-hr Composite | Weekly | Part 136[2] |

| Parameter | Units | Sample Type | Minimum Sampling Frequency | Required Analytical Test Method |
|---|---|---|---|---|
| Table Notes:<br>1. Each quarter, the Permittee shall report the average daily and average monthly flow rates.<br>2. Pollutants shall be analyzed using the analytical methods described in 40 C.F.R. part 136 or by methods approved by the Regional Water Board or State Water Board. | | | | |

## IV. EFFLUENT MONITORING REQUIREMENTS

### A. Monitoring Location EFF-001

**1.** During periods of discharge at Discharge Point 001[1], the Permittee shall monitor treated wastewater to be discharged to Humboldt Bay at Monitoring Location EFF-001, as follows:

**Table E-3. Effluent Monitoring – Monitoring Location EFF-001**

| Parameter | Units | Sample Type | Minimum Sampling Frequency | Required Analytical Test Method |
|---|---|---|---|---|
| Flow[1] | Mgd | Meter | Continuous | -- |
| Biochemical Oxygen Demand 5-day @ 20°C ($BOD_5$) | mg/L | 24-hr Composite | Weekly[2] | Part 136[3] |
| Fecal Coliform Bacteria | MPN/100 mL | Grab | Weekly[2,4] | Part 136[3] |
| Enterococci Bacteria[12] | CFU/100 mL | Grab | Weekly[2,4] | Part 136[3] |
| pH | standard units | Grab | Daily[5,6] | Part 136[3] |
| Total Suspended Solids (TSS) | mg/L | 24-hr Composite | Weekly[2] | Part 136[3] |
| Cyanide, Total (as CN) | µg/L | Grab | Monthly[7,8] | Part 136[3] |
| TCDD Equivalents[9] | µg/L | Grab | Quarterly[7,8] | Part 136[3] |
| Ammonia Nitrogen, Total (as N) | mg/L | Grab | Monthly[7,8] | Part 136[3] |
| Ammonia Impact Ratio | Ratio | Calculation | Monthly[8] | |
| Chlorine, Total Residual[10] | mg/L | Meter | Continuous | Part 136[3] |
| Nitrate Nitrogen, Total (as N) | mg/L | Grab | Quarterly[8] | Part 136[3] |
| Phosphorus, Total (as P) | mg/L | Grab | Quarterly[8] | Part 136[3] |
| Settleable Solids | ml/L | Grab | Daily[6] | Part 136[3] |
| Temperature | °C | Grab | Daily | |
| Acute Toxicity[11] | % Survival, Pas or Fail, and % Effect | Grab | Annually[8] | See Section V Below |
| Chronic Toxicity[11] | Pass or Fail, and % Effect | Grab | Quarterly[8] | See Section V Below |

[1] The routine monitoring requirements are in effect until the Permittee begins discharging effluent to EFF-003. Once discharge begins at EFF-003, EFF-001 will be used for the discharge of emergency flows over 5.9 mgd. Monitoring at EFF-001 will then be required for each discharge event.

| Parameter | Units | Sample Type | Minimum Sampling Frequency | Required Analytical Test Method |
|---|---|---|---|---|

Table Notes:

1. For each month, the Permittee shall report the average daily and average monthly flow rates.
2. Accelerated monitoring (weekly monitoring frequency). If two consecutive weekly test results exceed an effluent limitation, the Permittee shall take two samples each of the 2 weeks following receipt of the second sample result. During the intervening period, the Permittee shall take steps to identify the cause of the exceedance and take steps needed to return to compliance.
3. Pollutants shall be analyzed using the analytical methods described in 40 C.F.R. part 136 or by methods approved by the Regional Water Board or State Water Board, such as with the current edition of *Standard Methods for Examination of Water and Wastewater* (American Public Health Administration).
4. Fecal and enterococci coliform bacteria samples may be collected at any point downstream of the disinfection process.
5. pH, salinity and temperature monitoring at RSW-001 shall be recorded at the time of ammonia sampling.
6. Accelerated Monitoring (daily monitoring frequency). If a test result exceeds an effluent limitation, the Permittee shall increase monitoring frequency to a minimum of twice a day for a week to evaluate whether an exceedance is persisting. If two or more samples in a week exceed an effluent limitation, the Permittee shall take steps to identify the cause of the exceedance and take steps needed to return to compliance.
7. Accelerated monitoring (monthly and annual monitoring frequency). If a test result exceeds an effluent limitation, the Permittee shall take two more samples, one within 7 days and one within 14 days following receipt of the initial sample result. During the intervening period, the Permittee shall take steps to identify the cause of the exceedance and take steps needed to return to compliance.
8. When Discharge Point 001 is used for emergency discharges of flows exceeding 5.9 mgd under the upgraded Facility configuration, effluent monitoring at Monitoring Location EFF-001 shall be conducted annually when discharge occurs during a calendar year. The Permittee shall cease sample collection after the discharge ends. If the duration of the discharge is less than 24 hours or the duration required for toxicity testing, the Permittee shall conduct the analyses using the available sample type/volume.
9. The sum of concentrations of chlorinated dibenzodioxins (2,3,7,8-CDDs) and chlorinated dibenzofurans (2,3,7,8-CDFs) multiplied by their respective toxicity factors, as identified in the *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California* (State Implementation Policy or SIP).
10. Chlorine residual monitoring at Monitoring Location EFF-001 shall demonstrate if the discharge complies with effluent limits in Table 4 and Table 5 during periods of discharge to Humboldt Bay. Samples collected to demonstrate complete dechlorination shall be collected at a point following disinfection and prior to discharge to Humboldt Bay. All chlorine residual measurements shall be reported as total chlorine residual. This monitoring requirement applies when chlorine is used as a disinfection system.
11. Whole effluent acute and chronic toxicity shall be monitored in accordance with the requirements in section V of this MRP.
12. The Permittee shall began monitoring for enterococci, from an ELAP accredited lab, by June 1, 2021.

### B. Monitoring Location EFF-002

**1.** The Permittee shall monitor secondary treated wastewater to be discharged to the AMWS at Monitoring Location EFF-002, as follows:

**Table E-4. Effluent Monitoring – Monitoring Location EFF-002**

| Parameter | Units | Sample Type | Minimum Sampling Frequency | Required Analytical Test Method |
|---|---|---|---|---|
| Flow[1] | mgd | Meter | Continuous | -- |
| Biochemical Oxygen Demand 5-day @ 20°C ($BOD_5$) | mg/L | 24-hr Composite | Weekly[2] | Part 136[3] |
| Enterococci Bacteria[8] | CFU/100 mL | Grab | Weekly[2,4] | Part 136[3] |
| Fecal Coliform Bacteria | MPN/100 mL | Grab | Weekly[2,4] | Part 136[3] |
| pH | standard units | Grab | Daily[5] | Part 136[3] |
| Total Suspended Solids (TSS) | mg/L | 24-hr Composite | Weekly[2] | Part 136[3] |
| Chlorine, Total Residual[6] | mg/L | Meter | Continuous[7] | Part 136[3] |
| Settleable Solids | ml/L | Grab | Daily[5] | Part 136[3] |

| Parameter | Units | Sample Type | Minimum Sampling Frequency | Required Analytical Test Method |
|---|---|---|---|---|

Table Notes:

1. For each month, the Permittee shall report the average daily and average monthly flow rates.
2. Accelerated monitoring (weekly monitoring frequency). If two consecutive weekly test results exceed an effluent limitation, the Permittee shall take two samples each of the 2 weeks following receipt of the second sample result. During the intervening period, the Permittee shall take steps to identify the cause of the exceedance and take steps needed to return to compliance.
3. Pollutants shall be analyzed using the analytical methods described in 40 C.F.R. part 136 or by methods approved by the Regional Water Board or State Water Board, such as with the current edition of *Standard Methods for Examination of Water and Wastewater* (American Public Health Administration).
4. Fecal coliform bacteria samples may be collected at any point downstream of the UV disinfection process.
5. Accelerated Monitoring (daily monitoring frequency). If a test result exceeds an effluent limitation, the Permittee shall increase monitoring frequency to a minimum of twice a day for a week to evaluate whether an exceedance is persisting. If two or more samples in a week exceed an effluent limitation, the Permittee shall take steps to identify the cause of the exceedance and take steps needed to return to compliance.
6. Chlorine residual monitoring at Monitoring Location EFF-002 shall demonstrate that chlorine residual complies with effluent limits in Table 4 during periods of discharge to the AMWS. Samples collected to demonstrate complete dechlorination shall be collected at a point following disinfection and prior to discharge to the AMWS. All chlorine residual measurements shall be reported as total chlorine residual.
7. Monitoring for total chlorine residual is required at Monitoring Location EFF-002 until the Permittee submits written certification that a chlorine-based disinfection system is no longer in use for discharges through Discharge Point 002, chlorine byproducts are no longer present, and chlorine-containing chemicals are not added to the treatment process for wastewater discharged through Discharge Point 002. The monitoring change may only be implemented after the Permittee receives written approval from the Executive Officer.
8. The Permittee shall began monitoring for enterococci, from an ELAP accredited lab, by June 1, 2021.

### C. Monitoring Location EFF-003

**1.** The Permittee shall monitor secondary treated wastewater to be discharged to the brackish marsh at Monitoring Location EFF-003[1], as follows:

**Table E-5. Effluent Monitoring – Monitoring Location EFF-003**

| Parameter | Units | Sample Type | Minimum Sampling Frequency | Required Analytical Test Method |
|---|---|---|---|---|
| Flow[1] | Mgd | Meter | Continuous | -- |
| pH | standard units | Grab | Daily[3,4] | Part 136[2] |
| Biochemical Oxygen Demand 5-day @ 20°C ($BOD_5$)[12] | mg/L | 24-hr Composite | Weekly[3] | Part 136[2] |
| Total Suspended Solids (TSS)[12] | mg/L | 24-hr Composite | Weekly[3] | Part 136[2] |
| Fecal Coliform Bacteria | MPN/100 mL | Grab | Weekly[3,13] | Part 136[2] |
| Copper, Total Recoverable | µg/L | Grab | Monthly[5,6] | Part 136[2] |
| Cyanide, Total (as CN) | µg/L | Grab | Monthly[5] | Part 136[2] |
| TCDD Equivalents[7] | µg/L | Grab | Quarterly | Part 136[2] |
| Ammonia Nitrogen, Total (as N) | mg/L | Grab | Monthly[4,5] | Part 136[2] |
| Hardness, Total (as $CaCO_3$) | mg/L | Grab | Monthly[6] | Part 136[2] |
| Nitrate Nitrogen, Total (as N) | mg/L | Grab | Quarterly | Part 136[2] |
| Phosphorus, Total (as P) | mg/L | Grab | Quarterly | Part 136[2] |
| Settleable Solids | ml/L | Grab | Daily[2] | Part 136[2] |

[1] The Permittee will start monitoring for constituents listed in Table E-5 once discharge from Discharge Point 003 commences.

| Parameter | Units | Sample Type | Minimum Sampling Frequency | Required Analytical Test Method |
|---|---|---|---|---|
| CTR Priority Pollutants[8] | µg/L | 24-hr Composite[9] | Twice per permit term[10] | Part 136[2] |
| Acute Toxicity[11] | % Survival, Pass or Fail, and % Effect | Grab | Annually | See Section V Below |
| Chronic Toxicity[11] | Pass or Fail, and % Effect | Grab | Quarterly | See Section V Below |

Table Notes:

1. For each month, the Permittee shall report the average daily and average monthly flow rates.
2. Pollutants shall be analyzed using the analytical methods described in 40 C.F.R. part 136 or by methods approved by the Regional Water Board or State Water Board, such as with the current edition of *Standard Methods for Examination of Water and Wastewater* (American Public Health Administration).
3. Accelerated Monitoring (daily monitoring frequency). If a test result exceeds an effluent limitation, the Permittee shall increase monitoring frequency to a minimum of twice a day for a week to evaluate whether an exceedance is persisting. If two or more samples in a week exceed an effluent limitation, the Permittee shall take steps to identify the cause of the exceedance and take steps needed to return to compliance.
4. pH, salinity and temperature monitoring at RSW-001 shall be recorded at the time of ammonia sampling.
5. Accelerated monitoring (monthly and quarterly monitoring frequency). If a test result exceeds an effluent limitation, the Permittee shall take two more samples, one within 7 days and one within 14 days following receipt of the initial sample result. During the intervening period, the Permittee shall take steps to identify the cause of the exceedance and take steps needed to return to compliance.
6. Monitoring for effluent and receiving water hardness shall be conducted concurrently with effluent sampling for copper.
7. The sum of concentrations of chlorinated dibenzodioxins (2,3,7,8-CDDs) and chlorinated dibenzofurans (2,3,7,8-CDFs) multiplied by their respective toxicity factors, as identified in the *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California* (State Implementation Policy or SIP).
8. Those pollutants identified by the California Toxics Rule at 40 C.F.R. section 131.38. Hardness shall be monitored concurrently with the CTR priority pollutant sample.
9. CTR priority pollutant samples shall be collected using 24-hour composite sampling, except for pollutants that are volatile. Samples for volatile pollutants may be collected as a grab sample.
10. CTR priority pollutant sampling shall be completed no later than **June 1, 2023** during a period of discharge to the brackish marsh. Effluent and receiving water monitoring shall occur concurrently.
11. Whole effluent acute and chronic toxicity shall be monitored in accordance with the requirements in section V of this MRP.
12. BOD and TSS shall be monitored at EFF-003 for compliance with Technology-Based Effluent Limitations after Phase One and before Phase Two of the Proposed Upgrade Project is complete. Once Phase Two of the Proposed Upgrade Project is completed, monitoring for BOD and TSS at EFF-003 can be discontinued as compliance with TBELs will be determined at EFF-002.
13. Fecal coliform bacteria samples may be collected at any point downstream of the disinfection process. Monitoring for fecal coliform shall start once Phase One of the Proposed Upgrade Project is completed. Monitoring for fecal coliform shall be discontinued at EFF-003 once Phase Two of the Proposed Upgrade Project has been completed.

## V. WHOLE EFFLUENT TOXICITY (WET) TESTING REQUIREMENTS

### A. Acute Toxicity Testing

The Permittee shall conduct acute WET testing in accordance with the following acute toxicity testing requirements.

**1. Test Frequency.** The Permittee shall conduct acute WET testing in accordance with the schedule established by this MRP while discharging at Discharge Points 001 and/or 003, as summarized in Tables E-3 and E-5, above.

**2. Discharge In-stream Waste Concentration (IWC) for Acute Toxicity.** The IWC for this discharge is 100 percent effluent.[1]

[1] The acute toxicity test shall be conducted using 100 percent effluent collected at Monitoring Locations EFF-001 and EFF-003.

3. **Sample Volume and Holding Time.** The total sample volume shall be determined by the specific toxicity test method used. Sufficient sample volume shall be collected to perform the required toxicity test. All toxicity tests shall be conducted as soon as possible following sample collection. No more than 36 hours (holding time) shall elapse before the conclusion of sample collection and test initiation.

4. **Test Species and Test Methods.** The Permittee shall conduct the following acute toxicity tests using an invertebrate and a vertebrate in accordance with the species and test methods in *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms* (U.S. EPA Report No. EPA-821-R-02-012, 5th edition or subsequent editions). In no case shall these species be substituted with another test species unless written authorization from the Executive Officer is received. Species and test methods shall be selected from the following:

   **a.** A 96-hour static renewal toxicity test with an invertebrate, the water flea, *Ceriodaphnia dubia* (Survival Test Method 2002.0).

   **b.** A 96-hour static renewal or 96-hour static non-renewal toxicity test with an invertebrate, the mysid shrimp, *Mysidopsis bahia* (Survival Test Method 2007.0).

   **c.** A 96-hour static renewal toxicity test with a vertebrate, the rainbow trout, *Oncorhynchus mykiss* (Survival Test Method 2019.0).

   **d.** A 96-hour static renewal or 96-hour static non-renewal toxicity test with a vertebrate, the sheepshead minnow, *Cyprinodon variegatus* (Survival Test Method 2004.0).

   **e.** A 96-hour static renewal or 96-hour static non-renewal toxicity test with a vertebrate, the fathead minnow, *Pimephales promelas* (Survival Test Method 2000.0).

5. **Species Sensitivity Screening.** Species sensitivity screening shall be conducted during this Order's first required sample collection. The Permittee shall collect a single effluent sample and concurrently conduct acute toxicity tests using an invertebrate and a fish species identified in section V.A.4, above. This sample shall also be analyzed for the parameters required for the discharge. The species that exhibits the highest[1] "Percent (%) Effect" at the discharge IWC during species sensitivity screening shall be used for routine acute toxicity monitoring during the permit term[2].

6. **Quality Assurance and Additional Requirements.** Quality assurance measures, instructions, and other recommendations and requirements are found in the test methods manual referenced in section V.A.4, above. Additional requirements are specified below.

   **a.** The discharge is subject to determination of "Pass" or "Fail" and "Percent (%) Effect" from acute toxicity tests using the Test of Significant Toxicity (TST) approach described in *National Pollutant Discharge Elimination System Test of Significant Toxicity Implementation Document* (EPA 833-R10-003, 2010), Appendix A, Figure A-1, and Table A-1. The null hypothesis ($H_o$) for the TST approach is: mean discharge IWC response ≤ 0.80 × mean control response. A test result that rejects this null hypothesis is reported as "Pass". A test result that does not reject this null hypothesis is reported as "Fail". The relative "Percent (%) Effect" at the discharge IWC is defined and reported as: ((mean control response – mean discharge IWC response) ÷ mean control response) × 100.

[1] If the Percent Effect is less than or equal to 0% for each species, the Permittee shall either perform the test procedures again or use the species that was most sensitive during the previous permit term.

[2] Once the Proposed Treatment Upgrade Project is complete, the Permittee shall perform Species Sensitivity Screening for the new process.

**b.** If the effluent toxicity test does not meet the minimum effluent test acceptability criteria (TAC) specified in the referenced test method, then the Permittee shall re-sample and re-test within 7 days.

**c.** Dilution water and control water shall be laboratory water prepared and used as specified in the test methods manual. If dilution water and control water is different from test organism culture water, then a second control using culture water shall also be used.

**d.** Test procedures related to pH control, sample filtration, aeration, temperature control and sample dechlorination shall be performed in accordance with the U.S. EPA method and fully explained and justified in each acute toxicity report submitted to the Regional Water Board. The control of pH in acute toxicity tests is allowed, provided the test pH is maintained at the effluent pH measured at the time of sample collection, and the control of pH is done in a manner that has the least influence on the test water chemistry and on the toxicity of other pH sensitive materials such as some heavy metals, sulfide and cyanide.

**e.** **Ammonia Toxicity.** The acute toxicity test shall be conducted without modifications to eliminate ammonia toxicity.

**7.** **Notification.** The Permittee shall notify the Regional Water Board verbally within 72 hours and in writing 14 days after receipt of test results exceeding the acute toxicity effluent limitation during regular or accelerated monitoring. The notification shall describe actions the Permittee has taken or will take to investigate and correct the cause(s) of toxicity. It may also include a status report on any actions required by this Order, with a schedule for actions not yet completed. If no actions have been taken, the reasons shall be given.

**8.** **Accelerated Monitoring Requirements.** If the result of any acute toxicity test fails to meet the single test minimum limitation (70 percent survival), and the testing meets all TAC, the Permittee shall take two more samples, one within 14 days and one within 21 days following receipt of the initial sample result. If any one of the additional samples do not comply with the three-sample median minimum limitation (90 percent survival), the Permittee shall initiate a Toxicity Reduction Evaluation (TRE) in accordance with section V.C of the MRP. If the two additional samples are in compliance with the acute toxicity requirement and testing meets all TAC, then a TRE will not be required. If the discharge stops before additional samples can be collected, the Permittee shall contact the Executive Officer within 21 days with a plan to demonstrate compliance with the effluent limitation.

**9.** **Reporting.** The Self-Monitoring Report (SMR) shall include a full laboratory report for each toxicity test (WET report). The WET report shall be prepared using the format and content of section 12 (Report Preparation) of *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms* (U.S. EPA Report No. EPA-821-R-02-012, 5th edition or subsequent editions), including:

**a.** The toxicity test results in percent (%) survival for the 100 percent effluent sample.

**b.** The toxicity test results for the TST approach, reported as "Pass" or "Fail" and "Percent (%) Effect" at the acute toxicity IWC for the discharge.

**c.** Water quality measurements for each toxicity test (e.g., pH, dissolved oxygen, temperature, conductivity, hardness, salinity, chlorine, ammonia).

**d.** TRE/Toxicity Identification Evaluation (TIE) results. The Executive Officer shall be notified no later than 30 days from completion of each aspect of TRE/TIE analyses.

**e.** Statistical program (e.g., TST calculator, CETIS, etc.) output results for each toxicity test.

**B. Chronic Toxicity Testing**

The Permittee shall conduct chronic toxicity testing in accordance with the following chronic toxicity testing requirements:

1. **Test Frequency.** The Permittee shall conduct chronic toxicity testing in accordance with the schedule established by this MRP while discharging at Discharge Point 001 and/or 003, as summarized in Tables E-3 and E-5, above.

2. **Discharge In-stream Waste Concentration (IWC) for Chronic Toxicity.** The chronic toxicity IWC for this discharge is 100 percent effluent.[1]

3. **Sample Volume and Holding Time.** The total sample volume shall be determined by the specific toxicity test method used. Sufficient sample volume shall be collected to perform the required toxicity test. All toxicity tests shall be conducted as soon as possible following sample collection. For toxicity tests requiring renewals, a minimum of three 24-hour composite samples shall be collected. The lapsed time (holding time) from sample collection to first use of each sample must not exceed 36 hours.

4. **Test Species and Test Methods.** The Permittee shall conduct chronic toxicity tests using a vertebrate, an invertebrate, and a plant, in accordance with species and test methods in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Water to Freshwater Organisms* (U.S. EPA Report No. EPA-821-R-02-013, or subsequent editions) and *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms* (EPA/600/R-95/136, 1995). Artificial sea salts or hypersaline brine prepared from natural seawater shall be used to increase sample salinity. In no case shall these species be substituted with another test species unless written authorization from the Executive Officer is received. Species and test methods shall be selected from the following:

   **a.** A 7-day static renewal toxicity test with a vertebrate, the fathead minnow, *Pimephales promelas* (Larval Survival and Growth Test Method 1000.0).

   **b.** A static renewal toxicity test with the topsmelt, *Atherinops affinis* (Larval Survival and Growth Test Method 1006.011).

   **c.** A static renewal toxicity test with an invertebrate, the water flea, *Ceriodaphnia dubia* (Survival and Reproduction Test Method 1002.0).

   **d.** A static non-renewal toxicity test with the purple sea urchin, *Strongyloncentrotus purpuratus*, and the sand dollar, *Dendraster excentricus* (Fertilization Test Method 1008.0), or a static non-renewal toxicity test with the red abalone, *Haliotis rufescens* (Larval Shell Development Test Method).

   **e.** A 96-hour static renewal toxicity test with a plant, the green algae, *Selenastrum capricornutum* (also named *Raphidocelis subcapitata)* (Growth Test Method 1003.0).

   **f.** A static non-renewal toxicity test with the giant kelp, *Macrocystis pyrifera* (Germination and Growth Test Method 1009.0).

5. **Species Sensitivity Screening.** Species sensitivity screening shall be conducted during this Order's first required sample collection. The Permittee shall collect a single effluent sample

[1] The chronic toxicity test shall be conducted using a series of five dilutions and a control. The series shall consist of the following dilutions: 12.5, 25, 50, 75, and 100 percent. Compliance determination will be based on the IWC (100 percent effluent) and a control as further described in Fact Sheet section IV.C.5.c.

and concurrently conduct three chronic toxicity tests using a fish, an invertebrate, and an algae species identified in section V.B.4, above. This sample shall also be analyzed for the parameters required for the discharge. The species that exhibits the highest "Percent (%) Effect" at the discharge IWC during species sensitivity screening shall be used for routine monitoring during the permit term[1].

6. **Quality Assurance and Additional Requirements.** Quality assurance measures, instructions, and other recommendations and requirements are found in the test methods manual previously referenced. Additional requirements are specified below.

   **a.** The discharge is subject to determination of "Pass" or "Fail" and "Percent (%) Effect" for chronic toxicity tests using the TST approach described in *National Pollutant Discharge Elimination System Test of Significant Toxicity Implementation Document* (EPA 833-R10-003, 2010), Appendix A, Figure A-1, and Table A-1. The null hypothesis ($H_o$) for the TST approach is mean discharge IWC response 0.75 × mean control response. A test result that rejects this null hypothesis is reported as "Pass". A test result that does not reject this null hypothesis is reported as "Fail". The relative "Percent (%) Effect" at the discharge IWC is defined and reported as: ((mean control response – mean discharge IWC response) ÷ mean control response) × 100. The IWC for the chronic toxicity test is 100 percent effluent.

   **b.** If the effluent toxicity test does not meet the minimum effluent or reference toxicant TAC specified in the referenced test method, then the Permittee shall re-sample and re-test within 14 days.

   **c.** Dilution water and control water shall be laboratory water prepared and used as specified in the test methods manual. If dilution water and control water are different from test organism culture water, then a second control using culture water shall also be used.

   **d.** Monthly reference toxicant testing is sufficient. All reference toxicant test results should be reviewed and reported.

   **e.** The Permittee shall perform toxicity tests on final effluent samples. Chlorine and ammonia shall not be removed from the effluent sample prior to toxicity testing, unless explicitly authorized under this section of the MRP and the rationale is explained in the Fact Sheet (Attachment F).

   **f.** **Ammonia Removal.** Except with prior approval from the Executive Officer of the Regional Water Board, ammonia shall not be removed from bioassay samples. The Permittee must demonstrate the effluent toxicity is caused by ammonia because of increasing test pH when conducting the toxicity test. It is important to distinguish the potential toxic effects of ammonia from other pH sensitive chemicals, such as certain heavy metals, sulfide, and cyanide. The following may be steps to demonstrate that the toxicity is caused by ammonia and not other toxicants before the Executive Officer would allow for control of pH in the test.

      **i.** There is consistent toxicity in the effluent and the maximum pH in the toxicity test is in the range to cause toxicity due to increased pH.

      **ii.** Chronic ammonia concentrations in the effluent are greater than 4 mg/L total ammonia.

[1] Once the Proposed Treatment Upgrade Project is complete, the Permittee shall perform Species Sensitivity Screening for the new process.

**iii.** Conduct graduated pH tests as specified in the TIE methods. For example, mortality should be higher at pH 8 and lower at pH 6.

**iv.** Treat the effluent with a zeolite column to remove ammonia. Mortality in the zeolite treated effluent should be lower than the non-zeolite treated effluent. Then add ammonia back to the zeolite-treated samples to confirm toxicity due to ammonia.

When it has been demonstrated that toxicity is due to ammonia because of increasing test pH, pH may be controlled using appropriate procedures, which do not significantly alter the nature of the effluent.

**7. Notification.** The Permittee shall notify the Regional Water Board verbally within 72 hours and in writing within 14 days after the receipt of a result of "Fail" during routine or accelerated monitoring.

**8. Accelerated Monitoring Requirements.** Accelerated monitoring for chronic toxicity is triggered when a chronic toxicity test, analyzed using the TST approach, results in "Fail" and the "Percent Effect" is ≥0.50. Within 24 hours of the time the Permittee becomes aware of a summary result of "Fail", the Permittee shall implement an accelerated monitoring schedule consisting of four toxicity tests—consisting of 5-effluent concentrations (including the discharge IWC) and a control—conducted at approximately 2-week intervals, over an 8 week period. If each of the accelerated toxicity tests results is "Pass," the Permittee shall return to routine monitoring for the next monitoring period. If one of the accelerated toxicity test results is "Fail", the Permittee shall immediately implement the TRE Process conditions set forth in section V.C, below. If the discharge will cease before the additional samples can be collected, the Permittee shall contact the Executive Officer within 21 days with a plan to address elevated levels of chronic toxicity in effluent and/or receiving waters.

**9. Reporting**

**a. Routine Reporting.** Chronic toxicity monitoring results shall be submitted with the quarterly SMR for the month that chronic toxicity monitoring was performed. Routine reporting shall include the following in order to demonstrate compliance with permit requirements:

**i.** WET reports shall include the contracting laboratory's complete report provided to the Permittee and shall be consistent with the appropriate "Report Preparation and Test Review" sections of the methods manual and this MRP. The WET test reports shall contain a narrative report that includes details about WET test procedures and results, including the following:

**(a)** Receipt and handling of the effluent sample that includes a tabular summary of initial water quality characteristics (e.g., pH, dissolved oxygen, temperature, conductivity, hardness, salinity, chlorine, ammonia);

**(b)** The source and make-up of the lab control/diluent water used for the test;

**(c)** Any manipulations done to lab control/diluent and effluent such as filtration, nutrient addition, etc.;

**(d)** Tabular summary of test results for control water and each effluent dilution and statistics summary to include calculation of the No Observed Effect Concentration (NOEC), TUc, and IC25;

**(e)** Identification of any anomalies or nuances in the test procedures or results;

**(f)** WET test results shall include, at a minimum, for each test:

**(1)** Sample date(s);

**(2)** Test initiation date;

**(3)** Test species;

**(4)** Determination of "Pass" or "Fail" and "Percent (%) Effect" following the TST hypothesis testing approach in *National Pollutant Discharge Elimination System Test of Significant Toxicity Implementation Document* (EPA 833-R-10-003, 2010). The "Percent (%) Effect" shall be calculated as follows:

"Percent (%) Effect" (or Effect, in %) = ((Control mean response – IWC mean response) ÷ Control mean response)) x 100

**(5)** Endpoint values for each dilution (e.g., number of young, growth rate, percent survival);

**(6)** NOEC value(s) in percent effluent;

**(7)** IC15, IC25, IC40, and IC50 values (or EC15, EC25…etc.) in percent effluent;

**(8)** TUc values (100/NOEC);

**(9)** Mean percent mortality (±s.d.) after 96 hours in 100 percent effluent (if applicable);

**(10)** NOEC and LOEC values for reference toxicant test(s);

**(11)** IC50 or EC50 value(s) for reference toxicant test(s);

**(12)** Available water quality measurements for each test (e.g., pH, dissolved oxygen, temperature, conductivity, hardness, salinity, ammonia);

**(13)** Statistical methods used to calculate endpoints;

**(14)** The statistical program (e.g., TST calculator, CETIS, etc.) output results, which includes the calculation of percent minimum significant difference (PMSD); and

**(15)** Results of applicable reference toxicant data with the statistical output page identifying the species, NOEC, LOEC, type of toxicant, dilution water used, concentrations used, PMSD and dates tested; the reference toxicant control charts for each endpoint, to include summaries of reference toxicant tests performed by the contracting laboratory; and any information on deviations from standard test procedures or problems encountered in completing the test and how the problems were resolved.

**b. TRE/TIE results.** The Executive Officer shall be notified no later than 30 days from completion of each aspect of TRE/TIE analyses. TRE/TIE results shall be submitted to the Regional Water Board within 60 days of completion.

**C. Toxicity Reduction Evaluation (TRE) Process**

**1. TRE Work Plan.** The Permittee submitted a revised TRE Work Plan to the Regional Water Board on **January 17, 2018**. The Permittee's TRE Work Plan shall be reviewed by the Permittee once every five years and updated as necessary in order to remain current and applicable to the discharge and discharge facilities.

The Permittee shall notify the Regional Water Board of this review and submit any revisions of the TRE Work Plan within 90 days of the notification, to be ready to respond to toxicity events. The TRE Work Plan shall describe the steps the Permittee intends to follow if toxicity is detected, and should include at least the following items:

**a.** A description of the investigation and evaluation techniques that would be used to identify potential causes and sources of toxicity, effluent variability, and treatment system efficiency.

**b.** A description of the Facility's methods of maximizing in-house treatment efficiency, good housekeeping practices, and a list of all chemicals used in the operation of this Facility.

**c.** If a TIE is necessary, an indication of the person who would conduct the TIEs (i.e., an in-house expert or an outside contractor).

**2. Preparation and Implementation of a Detailed TRE Work Plan.** If one of the accelerated toxicity tests described in section V.A.8 (above) does not comply with the three sample median minimum limitation (90 percent survival) or in section V.B.8 (above) results in "Fail", the Permittee shall immediately initiate a TRE using EPA manual *Generalized Methodology for Conducting Industrial Toxicity Reduction Evaluations* (EPA/600/2-88/070, 1989) and within 30 days of receipt submit the accelerated monitoring result to the Regional Water Board Executive Officer. The Permittee shall also submit a Detailed TRE Work Plan, which shall follow the generic TRE Work Plan revised as appropriate for the toxicity event described in section V.A.8 or V.B.8 of this MRP. The Detailed TRE Work Plan shall include the following information, and comply with additional conditions set by the Regional Water Board Executive Officer:

**a.** Further actions by the Permittee to investigate, identify, and correct causes of toxicity.

**b.** Actions the Permittee will take to mitigate effects of the discharge and prevent the recurrence of toxicity.

**c.** A schedule for these actions, progress reports, and the final report.

**3. TIE Implementation.** The Permittee may initiate a TIE as part of a TRE to identify the causes of toxicity using the same species and test methods and, as guidance, EPA manuals: *Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures* (EPA/600/6-91/003, 1991); *Methods for Aquatic Toxicity Identification Evaluations, Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity* (EPA/600/R-92/080, 1993); *Methods for Aquatic Toxicity Identification Evaluations, Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity* (EPA/600/R-92/081, 1993); and *Marine Toxicity Identification Evaluation (TIE): Phase I Guidance Document* (EPA/600/R-96- 054, 1996). The TIE should be conducted on the species demonstrating the most sensitive toxicity response.

**4.** Many recommended TRE elements parallel required or recommended efforts for source control, pollution prevention, and storm water control programs. TRE efforts should be coordinated with such efforts. As toxic substances are identified or characterized, the Permittee shall continue the TRE by determining the sources and evaluating alternative strategies for reducing or eliminating the substances from the discharge. All reasonable steps shall be taken to reduce toxicity to levels consistent with toxicity evaluation parameters.

5. The Permittee shall conduct routine effluent monitoring for the duration of the TRE process. Additional accelerated monitoring and TRE Work Plans are not required once a TRE has begun.

6. The Regional Water Board recognizes that toxicity may be episodic and identification of the causes and reduction of sources of toxicity may not be successful in all cases. The TRE may be ended at any stage, pending Regional Water Board Executive Officer approval, if monitoring finds there is no longer toxicity.

## VI. LAND DISCHARGE MONITORING REQUIREMENTS – NOT APPLICABLE

This Order does not authorize discharges to land.

## VII. RECYCLING MONITORING REQUIREMENTS – NOT APPLICABLE

This Order does not authorize discharges of recycled water.

## VIII. RECEIVING WATER MONITORING REQUIREMENTS – SURFACE WATER

### A. Arcata Marsh Wildlife Sanctuary (AMWS) Monitoring Locations

Monitoring of the AMWS shall be implemented in accordance with the work plan approved by the Executive Officer in accordance with section VI.C.2.a of the Order. Monitoring results required in accordance with the approved plan shall be submitted annually, by March 1 each year.

### B. Monitoring Location RSW-001

1. The Permittee shall monitor the receiving water at Monitoring Location RSW-001 during periods of discharge to the brackish marsh, as follows:

**Table E-6. Receiving Water Monitoring – Monitoring Location RSW-001**

| Parameter | Units | Sample Type | Minimum Sampling Frequency | Required Analytical Test Method |
|---|---|---|---|---|
| pH | standard units | Grab | Weekly[1] | Part 136[2] |
| Dissolved Oxygen | mg/L | Grab | Weekly | Part 136[2] |
| Floatables/Discoloration | -- | Visual | Monthly | -- |
| Hardness, Total (as $CaCO_3$) | mg/L | Grab | Monthly | Part 136[2] |
| Nitrate Nitrogen, Total (as N) | mg/L | Grab | Monthly | Part 136[2] |
| Salinity | Ppt | Grab | Weekly[1] | Part 136[2] |
| Specific Conductance | µmhos/cm | Grab | Weekly | Part 136[2] |
| Temperature | °C | Grab | Weekly [1] | Part 136[2] |
| Total Dissolved Solids | mg/L | Grab | Monthly | Part 136[2] |
| Turbidity | NTU | Grab | Monthly | Part 136[2] |
| CTR Priority Pollutants[3] | µg/L | Grab | Twice per permit term[4] | Part 136[2] |

Table Notes:

1. pH, salinity and temperature monitoring must coincide with monthly effluent monitoring for ammonia.
2. Pollutants shall be analyzed using the analytical methods described in 40 C.F.R. part 136 or by methods approved by the Regional Water Board or State Water Board, such as with the current edition of *Standard Methods for Examination of Water and Wastewater* (American Public Health Administration).
3. Those pollutants identified by the California Toxics Rule at 40 C.F.R. section 131.38. Hardness shall be monitored concurrently with the CTR priority pollutant sample.
4. CTR priority pollutant sampling shall be completed no later than **June 1, 2023** during a period of discharge to the brackish marsh. Effluent and receiving water monitoring shall occur concurrently.

## IX. OTHER MONITORING REQUIREMENTS

### A. Disinfection Process Monitoring for Ultraviolet Light (UV) Disinfection System (Monitoring Location INT-001)[1]

#### 1. Monitoring Location INT-001

**a. Monitoring.** The UV transmittance (UVT) of the effluent from the UV disinfection system shall be monitored continuously and recorded at Monitoring Location INT-001. The operational UV dose shall be calculated from UVT and flow.

**b. Reporting.** The Permittee shall report daily average and lowest daily UVT and operations UV dose on its monthly SMRs. The Permittee shall report daily average and maximum flow through the UV disinfection system. If the UVT falls below 35 percent or UV dose falls below 50 $mJ/cm^2$, the event shall be reported to the Regional Water Board by telephone within 24 hours.

### B. Visual Monitoring (Monitoring Locations EFF-001, EFF-003, and RSW-001)

**1.** Visual observations of the discharge and the receiving water shall be recorded monthly and on the first day of each intermittent discharge. Visual monitoring shall include, but not be limited to, observations for floating materials, coloration, objectionable aquatic growths, oil and grease films, and odors. Visual observations and immediate actions taken necessary to clean up shall be recorded and included in the Permittee's quarterly SMRs.

### C. Biosolids Monitoring

**1.** Biosolids monitoring shall be conducted as required by the *Biosolids General Order No. 2004-0012-DWQ.*

## X. REPORTING REQUIREMENTS

### A. General Monitoring and Reporting Requirements

**1.** The Permittee shall comply with all Standard Provisions (Attachment D) related to monitoring, reporting, and recordkeeping.

### B. Self-Monitoring Reports (SMRs)

**1.** The Permittee shall submit electronic Self-Monitoring Reports (eSMRs) using the State Water Board's California Integrated Water Quality System (CIWQS) Program Web site (http://www.waterboards.ca.gov/ciwqs/index.html). The CIWQS Web site will provide additional directions for SMR submittal in the event there will be service interruption for electronic submittal. The Permittee shall maintain sufficient staffing and resources to ensure it submits eSMRs that are complete and timely. This includes provision of training and supervision of individuals (e.g., Permittee personnel or consultant) on how to prepare and submit eSMRs.

**2.** The Permittee shall report in the SMR the results for all monitoring specified in this MRP under sections III through IX. The Permittee shall submit quarterly SMRs including the results of all required monitoring using U.S. EPA approved test methods or other test methods specified in this Order. SMRs are to include all new monitoring results obtained since the last SMR was submitted. If the Permittee monitors any pollutant more frequently than required by this Order, the results of this monitoring shall be included in the calculations and reporting of the data submitted in the SMR.

[1] These Disinfection Requirements will take effect upon activation of Phase Two of the Proposed Treatment Upgrade

3. All monitoring results reported shall be supported by the inclusion of the complete analytical report from the laboratory that conducted the analyses.

4. Monitoring periods and reporting for all required monitoring shall be completed according to the following schedule:

**Table E-7. Monitoring Periods and Reporting Schedule**

| Sampling Frequency | Monitoring Period Begins On… | Monitoring Period | SMR Due Date |
|---|---|---|---|
| Continuous | Permit effective date | (Midnight through 11:59 PM) or any 24-hour period that reasonably represents a calendar day for purposes of sampling. | First day of second calendar month following the end of each quarter[1] (February 1, May 1, August 1, November 1) |
| Daily | Permit effective date | (Midnight through 11:59 PM) or any 24-hour period that reasonably represents a calendar day for purposes of sampling | First day of second calendar month following the end of each quarter[1] (February 1, May 1, August 1, November 1) |
| Weekly | Sunday following permit effective date or on permit effective date if on a Sunday | Sunday through Saturday | First day of second calendar month following the end of each quarter[1] (February 1, May 1, August 1, November 1) |
| Monthly | First day of calendar month following permit effective date or on permit effective date if that date is first day of the month | First day of calendar month through last day of calendar month | First day of second calendar month following the end of each quarter[1] (February 1, May 1, August 1, November 1) |
| Quarterly | Closest of January 1, April 1, July 1, or October 1 following (or on) permit effective date | January through March<br>April through June<br>July through September<br>October through January | First day of second calendar month following the end of each quarter[1] (February 1, May 1, August 1, November 1) |
| Annually | January 1 following (or on) permit effective date | January 1 through December 31 | March 1, each year (with annual report) |
| Twice per permit term | Permit effective date | All | March 1 following the year that monitoring is completed (with annual report) and at least 180 days prior to permit expiration |

Table Notes:
1. Quarterly monitoring periods are as follows: January 1 through March 31; April 1 through June 30; July 1 through September 30; and October 1 through December 31.

5. **Reporting Protocols.** The Permittee shall report with each sample result the applicable ML, the RL, and the current Method Detection Limit (MDL), as determined by the procedure in 40 C.F.R. part 136.

   The Permittee shall report the results of analytical determinations for the presence of chemical constituents in a sample using the following reporting protocols:

**a.** Sample results greater than or equal to the reported ML shall be reported as measured by the laboratory (i.e., the measured chemical concentration in the sample).

**b.** Sample results less than the reported ML, but greater than or equal to the laboratory's MDL, shall be reported as "Detected, but Not Quantified," or DNQ. The estimated chemical concentration of the sample shall also be reported.

For the purposes of data collection, the laboratory shall write the estimated chemical concentration next to DNQ as well as the words "Estimated Concentration" (may be shortened to "Est. Conc."). The laboratory may, if such information is available, include numerical estimates of the data quality for the reported result. Numerical estimates of data quality may be percent accuracy (± a percentage of the reported value), numerical ranges (low to high), or any other means considered appropriate by the laboratory.

**c.** Sample results less than the laboratory's MDL shall be reported as "Not Detected," or ND.

**d.** The Permittee is to instruct laboratories to establish calibration standards so that the ML value (or its equivalent if there is differential treatment of samples relative to calibration standards) is the lowest calibration standard. At no time is the Permittee to use analytical data derived from extrapolation beyond the lowest point of the calibration curve.

**6.** The Permittee shall submit SMRs in accordance with the following requirements:

**a.** The Permittee shall arrange all reported data in a tabular format. The data shall be summarized to clearly illustrate whether the Facility is operating in compliance with interim and/or final effluent limitations. The reported data shall include calculation of all effluent limitations that require averaging, taking of a median, or other computation. The Permittee is not required to duplicate the submittal of data that is entered in a tabular format within CIWQS. When electronic submittal of data is required and CIWQS does not provide for entry into a tabular format within the system, the Permittee shall electronically submit the data in a tabular format as an attachment.

**b.** The Permittee shall attach a cover letter to the SMR. The information contained in the cover letter shall clearly identify:

**i.** Facility name and address;

**ii.** WDID number;

**iii.** Applicable period of monitoring and reporting;

**iv.** Violations of the WDRs (identified violations must include a description of the requirement that was violated and a description of the violation);

**v.** Corrective actions taken or planned; and

**vi.** The proposed time schedule for corrective actions.

**c.** SMRs must be submitted to the Regional Water Board, signed and certified as required by the Standard Provisions (Attachment D), to the CIWQS Program Web site (http://www.waterboards.ca.gov/ciwqs/index.html). In the event that an alternate method for submittal of SMRs is required, the Permittee shall submit the SMR electronically via e-mail to NorthCoast@waterboards.ca.gov or on disk (CD or DVD) in Portable Document Format (PDF) file in lieu of paper-sourced documents. The guidelines for electronic submittal of documents can be found on the Regional Water Board website at http://waterboards.ca.gov/northcoast.

## C. Discharge Monitoring Reports (DMRs)

**1.** DMRs are U.S. EPA reporting requirements. The Permittee shall electronically certify and submit DMRs together with SMRs using Electronic Self-Monitoring Reports module eSMR 2.5 or any upgraded version. DMRs shall be submitted quarterly on the first day of the second calendar month following the end of each quarter (February 1, May 1, August 1, and November 1). Electronic DMR submittal shall be in addition to electronic SMR submittal. Information regarding electronic DMR submittal is available at the DMR website at http://www.waterboards.ca.gov/water_issues/programs/discharge_monitoring/.

## D. Other Reports

**1. Special Study Reports and Progress Reports.** As specified in the Special Provisions contained in section VI of the Order, special study and progress reports shall be submitted in accordance with the following reporting requirements.

**Table E-8. Reporting Requirements for Special Provisions Reports**

| Order Section | Special Provision Requirement | Reporting Requirements |
|---|---|---|
| Special Provision VI.C.2.a | AMWS Evaluation Report | **Submit with Report of Waste Discharge** |
| Special Provision VI.C.2.b | Disaster Preparedness Assessment Report and Action Plan | **June 1, 2022** |
| Special Provision VI.C.2.c | Source Control and Pretreatment Studies | **December 31, 2023** |
| Special Provision VI.C.3.a.ii(e) | Pollutant Minimization Program, Annual Facility Report | **March 1**, annually, following development of Pollutant Minimization Program |
| Special Provision VI.C.5.f | Adequate Capacity, Technical Report | **Within 120 days** of notification that the Facility will reach capacity within 4 years |
| MRP General Monitoring Provision I.F | DMR-QA Study Report | **Annually,** per State Water Board instructions |
| MRP WET Testing Requirement V.B.9.b | Notification of TRE/TIE Results | **No later than 30 days** from the completion of each aspect of the TRE/TIE analyses. |
| MRP WET Testing Requirement V.B.9.b | TRE/TIE Results | **Within 60 days** of completion of TRE/TIE analyses |
| MRP WET Testing Requirement V.C.2 | Detailed TRE Work Plan | **Within 30 days** of an accelerated monitoring test that results in "Fail" |
| MRP Reporting Requirements X.D.2 | Annual Report | **March 1,** each year |
| MRP Reporting Requirements X.D.3 | Annual Pretreatment Report | **March 1,** each year |
| MPR Reporting Requirement X.E | Notification of spills and unauthorized discharges | Oral reporting **within 24 hours** and written report **within 5 days** |

**2. Annual Report.** The Permittee shall submit an annual report to the Regional Water Board for each calendar year through the CIWQS Program Web site (http://www.waterboards.ca.gov/ciwqs/index.html). In the event that an alternate method for submittal of the annual report is required, the Permittee shall submit the annual report electronically via the email address in section X.B.6.c., above. The report shall be submitted

by **March 1st** of the following year and certified as required by Standard Provisions (Attachment D) of this Order. The report shall, at a minimum, include the following:

**a.** Where appropriate, tabular and/or graphical summaries of the monitoring data and disposal records from the previous year. If the Permittee monitors any pollutant more frequently than required by this Order, using test procedures approved under 40 C.F.R. part 136 or as specified in this Order, the results of this monitoring shall be included in the calculation and report of the data submitted in the SMR.

**b.** A comprehensive discussion of the Facility's compliance (or lack thereof) with all effluent limitations and other WDRs, and the corrective actions taken or planned, which may be needed to bring the discharge into full compliance with the Order.

**c.** The titles and general responsibilities of all persons employed at the Facility;

**d.** The names and telephone numbers of persons to contact regarding the Facility for emergency and routine situations; and

**e.** A statement certifying when the flow meter(s) and other monitoring instruments and devices were last calibrated, including identification of who performed the calibration.

**f. Sludge Handling and Disposal Activity Reporting.** The Permittee shall submit, as part of its annual report to the Regional Water Board, the most recent annual report from *Biosolids General Order No. 2004-0012 DWQ.*

**g. Storm Water Reporting.** The Permittee shall submit, as part of its annual report to the Regional Water Board, an evaluation of the effectiveness of the Permittee's best management practices (BMPs) to control the run-on of storm water to the treatment facility site, as well as activities to maintain and upgrade these BMPs.

**3. Annual Pretreatment Reporting Requirements.** The Permittee shall submit annually a report to the Regional Water Board, with copies to U.S. EPA Region 9 and the State Water Board, describing the Permittee's pretreatment activities over the previous calendar year. In the event that the Permittee is not in compliance with any conditions or requirements of this Order, including noncompliance with pretreatment audit/compliance inspection requirements, then the Permittee shall also include the reasons for noncompliance and state how and when the Permittee shall comply with such conditions and requirements.

An annual report shall be submitted by March 1st of the following year, and include at least the following items:

**a.** A summary of analytical results from all influent, effluent, and sludge sampling conducted during the reporting period, as specified in sections III.A (Table E-2), IV.A (Table E-3), IV.B (Table E-4), IV.C (Table E-5), and IX.C of the MRP. The Permittee shall also report results of any influent, effluent, or sludge monitoring data for nonpriority pollutant that may be causing or contributing to interference, pass-through, or adversely impacting sludge quality.

**b.** A discussion of upset, interference, or pass-through incidents, if any, at the treatment plant, which the Permittee knows, or suspects were caused by industrial users of the POTW or receipt of septage or other incompatible wastes. The discussion shall include the reasons why the incidents occurred, the corrective actions taken and, if known, the name and address of, the industrial user(s) responsible. The discussion shall also include a review of the applicable pollutant limitations to determine whether any additional limitations, or changes to existing requirements, may be necessary to prevent pass-through, interference, or noncompliance with sludge disposal requirements.

**c.** The cumulative number of industrial users that the Permittee has notified regarding Baseline Monitoring Reports and the cumulative number of industrial user responses.

**d.** An updated list of the Permittee's industrial users including their names and addresses, or a list of deletions and additions keyed to a previously submitted list. The Permittee shall provide a brief explanation for each deletion. The list shall identify the industrial users subject to federal categorical standards by specifying which set(s) of standards are applicable. The list shall indicate which categorical industries, or specific pollutants from each industry, are subject to local limitations that are more stringent than the federal categorical standards. The Permittee shall also list the non-categorical industrial users that are subject only to local discharge limitations.

**e.** The Permittee shall characterize the compliance status through the year of record of each industrial user by employing the following descriptions:

**i.** Compiled with baseline monitoring report requirements (where applicable);

**ii.** Consistently achieved compliance;

**iii.** Inconsistently achieved compliance;

**iv.** Significantly violated applicable pretreatment requirements as defined by 40 C.F.R. section 403.8(f)(2)(vii);

**v.** Compiled with schedule to achieve compliance (include the date final compliance is required);

**vi.** Did not achieve compliance and not on a compliance schedule; and

**vii.** Compliance status unknown.

**f.** A summary of the inspection and sampling activities conducted by the Permittee during the past year to gather information and data regarding the industrial users. The summary shall include:

**i.** The names and addresses of the industrial users subjected to surveillance and an explanation of whether they were inspected, sampled, or both and the frequency of these activities at each user; and

**ii.** The conclusions or results from the inspection or sampling of each industrial user.

**g.** A summary of the compliance and enforcement activities during the past year. The summary shall include the names and addresses of the industrial users affected by the following actions:

**i.** Warning letters or notices of violation regarding the industrial users' apparent noncompliance with federal categorical standards or local discharge limitations. For each industrial user, identify whether the apparent violation concerned the federal categorical standards or local discharge limitations.

**ii.** Administrative orders regarding the industrial users' noncompliance with federal categorical standards or local discharge limitations. For each industrial user, identify whether the violation concerned the federal categorical standards or local discharge limitations.

**iii.** Civil actions regarding the industrial users' noncompliance with federal categorical standards or local discharge limitations. For each industrial user, identify whether the violation concerned the federal categorical standards or local discharge limitations.

**iv.** Criminal actions regarding the industrial users' noncompliance with federal categorical standards or local discharge limitations. For each industrial user, identify whether the violation concerned the federal categorical standards or local discharge limitations.

**v.** Assessment of monetary penalties. For each industrial user identify the amount of the penalties.

**vi.** Restriction of flow to the POTW.

**vii.** Disconnection from discharge to the POTW.

**h.** A description of any significant changes in operating the pretreatment program which differ from the information in the Permittee's approved Pretreatment Program including, but not limited to, changes concerning: the program's administrative structure, local industrial discharge limitations, monitoring program or monitoring frequencies, legal authority or enforcement policy, funding mechanisms, resource requirements, or staffing levels.

**i.** A summary of the annual pretreatment budget, including the cost of pretreatment program functions and equipment purchases.

**j.** A summary of public participation activities to involve and inform the public.

**k.** A brief description of any programs the POTW implements to reduce pollutants from nondomestic users that are not classified as significant industrial users (SIUs).

**l.** In the event that the Permittee is not in compliance with any conditions or requirements of this permit affected by the pretreatment program, including any noncompliance with pretreatment audit or compliance inspection requirements, then the Permittee shall also include the reasons for noncompliance and state how and when the Permittee will comply with such conditions and requirements.

Duplicate signed copies of these Pretreatment Program reports shall be submitted to the North Coast Regional Water Board at NorthCoast@waterboards.ca.gov, U.S. EPA Region 9 at R9Pretreatment@epa.gov, and the State Water Board at the appropriate address below:

| Standard Mail | FEDEX/UPS/Other Private Carriers |
|---|---|
| State Water Resources Control Board<br>Division of Water Quality<br>c/o discharge Monitoring Report Processing Center<br>Post Office Box 100<br>Sacramento, CA 95812-1000 | State Water Resources Control Board<br>Division of Water Quality<br>c/o DMR Processing Center<br>1001 I Street, 15th Floor<br>Sacramento, CA 95814 |

## E. Spill Notification

**1. Spills and Unauthorized Discharges.** Information regarding all spills and unauthorized discharges (except SSOs) that may endanger health or the environment shall be provided orally to the Regional Water Board[1] within 24 hours from the time the Permittee becomes aware of the circumstances and a written report shall also be provided within five (5) days of the time the Permittee becomes aware of the circumstances, in accordance with section V.E of Attachment D.

[1] The contact number of the Regional Water Board during normal business hours is (707) 576-2220. After normal business hours, spill reporting to the California Governor's Office of Emergency Services Warning Center (CalOES) will satisfy the 24 hour spill reporting requirement for the Regional Water Board. The contact number for spill reporting for the CalOES is (800) 852-7550.

Information to be provided verbally to the Regional Water Board includes:

**a.** Name and contact information of caller;

**b.** Date, time, and location of spill occurrence;

**c.** Estimates of spill volume, rate of flow, and spill duration, if available and reasonably accurate;

**d.** Surface water bodies impacted, if any;

**e.** Cause of spill, if known at the time of the notification;

**f.** Cleanup actions taken or repairs made at the time of the notification; and

**g.** Responding agencies.

**2. Sanitary Sewer Overflows (SSOs).** Notification and reporting of SSOs is conducted in accordance with the requirements of Order No. 2006-0003-DWQ (Statewide General WDRs for Sanitary Sewer Systems), which is not incorporated herein by reference, and any revisions thereto.

**ATTACHMENT F – FACT SHEET**

## Contents


I. Permit Information ..... F-3
II. Facility Description ..... F-4
A. Background ..... F-4
B. Description of Wastewater and Biosolids Treatment and Controls ..... F-5
C. Discharge Points and Receiving Waters ..... F-7
D. Summary of Existing Requirements and Self-Monitoring Report (SMR) Data ..... F-7
E. Compliance Summary ..... F-9
F. Planned Changes ..... F-10
III. Applicable Plans, Policies, and Regulations ..... F-10
A. Legal Authorities ..... F-10
B. California Environmental Quality Act (CEQA) ..... F-10
C. State and Federal Laws, Regulations, Policies, and Plans ..... F-10
D. Impaired Water Bodies on the CWA section 303(d) List ..... F-13
E. Other Plans, Policies and Regulations ..... F-14
IV. Rationale for Effluent Limitations and Discharge Specifications ..... F-14
A. Discharge Prohibitions ..... F-15
B. Technology-Based Effluent Limitations ..... F-17
C. Water Quality-Based Effluent Limitations (WQBELs) ..... F-21
D. Final Effluent Limitation Considerations ..... F-38
E. Interim Effluent Limitations – Not Applicable ..... F-41
F. Land Discharge Specifications and Requirements – Not Applicable ..... F-41
G. Water Recycling Specifications and Requirements – Not Applicable ..... F-41
H. Other Requirements ..... F-41
V. Rationale for Receiving Water Limitations ..... F-42
A. Surface Water ..... F-42
B. Groundwater ..... F-42
VI. Rationale for Provisions ..... F-42
A. Standard Provisions ..... F-42
B. Special Provisions ..... F-43
VII. Rationale for Monitoring and Reporting Requirements ..... F-46
A. Influent Monitoring ..... F-46
B. Effluent Monitoring ..... F-47
C. Whole Effluent Toxicity Testing Requirements ..... F-48
D. Receiving Water Monitoring ..... F-49
E. Other Monitoring Requirements ..... F-49
VIII. Public Participation ..... F-50
A. Notification of Interested Parties ..... F-50
B. Written Comments ..... F-50
C. Public Hearing ..... F-50
D. Waste Discharge Requirements Petitions ..... F-51
E. Information and Copying ..... F-51
F. Register of Interested Persons ..... F-51
G. Additional Information ..... F-51

## Tables

Table F-1. Facility Information ..... F-3
Table F-2. Historic Effluent Limitations and Monitoring Data – Discharge Point 001 ..... F-7
Table F-3. Historic Effluent Limitations and Monitoring Data – Discharge Point 002 ..... F-8
Table F-4. Historic Effluent Limitations and Monitoring Data – Discharge Point 003 ..... F-9
Table F-5. Basin Plan Beneficial Uses ..... F-11
Table F-6. Summary of Reasonable Potential Analysis Results ..... F-29
Table F-7. Determination of Long Term Averages ..... F-33
Table F-8. Determination of Final WQBELs Based on Aquatic Life Criteria ..... F-33
Table F-9. Determination of Final WQBELs Based on Human Health Criteria ..... F-34
Table F-10. Summary of Chronic Toxicity Results ..... F-35
Attachment F-1 – City of Arcata RPA Summary ..... F-52

## ATTACHMENT F – FACT SHEET

As described in section I, the Regional Water Board incorporates this Fact Sheet as findings of the Regional Water Board supporting the issuance of this Order. This Fact Sheet includes the legal requirements and technical rationale that serve as the basis for the requirements of this Order.

This Order has been prepared under a standardized format to accommodate a broad range of discharge requirements for dischargers in California. Only those sections or subsections of this Order that are specifically identified as "not applicable" have been determined not to apply to this Permittee. Sections or subsections of this Order not specifically identified as "not applicable" are fully applicable to this Permittee.

### I. PERMIT INFORMATION

The following table summarizes administrative information related to the facility.

**Table F-1. Facility Information**

| | |
|---|---|
| **WDID** | 1B82114OHUM |
| **Permittee** | City of Arcata |
| **Name of Facility** | Wastewater Treatment Facility |
| **Facility Address** | 600 South G Street<br>Arcata, CA 95521<br>Humboldt County |
| **Facility Contact, Title and Phone** | Karen Diemer, City Manager, (707) 822-5953 |
| **Authorized Person to Sign and Submit Reports** | Mark Andre, Director of Environmental Services, (707) 822-5953 |
| **Mailing Address** | 736 F Street, Arcata, CA 95521 |
| **Billing Address** | Same as Mailing Address |
| **Type of Facility** | Publicly Owned Treatment Works (POTW) |
| **Major or Minor Facility** | Major |
| **Threat to Water Quality** | 1 |
| **Complexity** | A |
| **Pretreatment Program** | Yes |
| **Recycling Requirements** | Not Applicable |
| **Facility Permitted Flow** | 2.3 million gallons per day (mgd) (average dry weather flow) |
| **Facility Design Flow** | 2.3 mgd (average dry weather design flow)<br>5.0 mgd (average wet weather design flow)<br>5.9 mgd (peak wet weather design flow)<br>16.5 mgd (wet weather $Q_{max}$) |
| **Watershed** | Eureka Plain Hydrologic Unit |
| **Receiving Water** | Humboldt Bay, Arcata Marsh Wildlife Sanctuary (AMWS), and a brackish marsh tributary to Humboldt Bay |
| **Receiving Water Type** | Estuarine and Freshwater Wetlands |

**A.** The City of Arcata (hereinafter Permittee) is the owner and operator of the Arcata Wastewater Treatment Facility (hereinafter Facility), a POTW.

For the purposes of this Order, references to the "discharger" or "permittee" in applicable federal and state laws, regulations, plans, or policy are held to be equivalent to references to the Permittee herein.

The Permittee is authorized to discharge subject to waste discharge requirements (WDRs) in this Order at the discharge locations described in Table 2 on the cover page of this Order. The Code of

Federal Regulations at 40 C.F.R. section 122.46 limits the duration of National Pollutant Discharge Elimination System (NPDES) permits to be effective for a fixed term not to exceed five years. Accordingly, Table 3 of this Order limits the effective period for the discharge authorized by this Order. Pursuant to California Code of Regulations (CCR), title 23, section 2235.4, the terms and conditions of an expired permit are automatically continued pending issuance of a new permit if all requirements of the federal NPDES regulations on continuation of expired permits are complied with.

**B.** The Facility discharges treated wastewater to Humboldt Bay, a water of the United States, in conjunction with enhanced treatment occurring in the AMWS constructed freshwater wetlands. The Permittee was previously regulated by Order No. R1-2012-0031 and NPDES Permit No. CA0022713 adopted on June 7, 2012 and expired on July 31, 2017. Attachment B provides a map of the area around the Facility. Attachment C provides a flow schematic of the Facility.

**C.** The Permittee filed a report of waste discharge (ROWD) and submitted an application for reissuance of its WDRs and NPDES permit on January 26, 2017. The application was deemed complete on **February 21, 2017.**

## II. FACILITY DESCRIPTION

The Permittee owns and operates a municipal wastewater treatment facility (WWTF) and associated collection system. The Facility serves the City of Arcata and the unincorporated community of Glendale. The Facility serves a population of approximately 18,695, including 18,169 within the City of Arcata and 526 within the community of Glendale.

### A. Background

Adopted on May 16, 1974, Resolution No. 74-43, known as the Bays and Estuaries Policy, prohibits the discharge of municipal wastewater and industrial process water to enclosed bays and estuaries "*unless the discharge enhances the quality of the receiving water above that which would occur in the absence of the discharge*."[1] The Enclosed Bays and Estuaries Policy enhancement criteria is defined as, "… (*1) Full uninterrupted protection of all beneficial uses which could be made of the receiving water body in the absence of all point source discharge(s) along with (2) a demonstration by the applicant that the discharge, through the creation of new beneficial uses or fuller realization, enhances water quality for those beneficial uses which could be made of the receiving water in the absence of all point source discharges…*"[2]

In the fall of 1974, the Permittee first began to pursue an exemption from the Enclosed Bays and Estuaries Policy, and in the spring of 1977, the Permittee brought forward a project consisting of a marsh treatment process with discharge to Humboldt Bay.[3]

In 1979, after holding a fact-finding hearing, the State Water Resources Control Board (State Water Board) issued Order No. 79-20, interpreting the provision of the Enclosed Bays and Estuaries Policy that provided for an exemption from the discharge of municipal wastewater into an enclosed bay, such as Humboldt Bay. In that decision, the State Water Board concluded that there was a reasonable probability that the discharge of secondary, disinfected and dechlorinated effluent into Humboldt Bay, together with a treatment process which either created new beneficial uses or resulted in a fuller realization of existing beneficial uses, such as the marsh treatment process proposed by the Permittee, could enhance the receiving water quality. The State Water Board further concluded that enhancement required: (1) full secondary treatment,

[1] State Water Resources Control Board, Water Quality Control Policy For The Enclosed Bays and Estuaries of California, May 1974

[2] State Water Resources Control Board, Bill Dendy Memorandum to Regional Water Board Executive Officer David Joseph, October 21, 1974

[3] City of Arcata, draft Wastewater Treatment, Water Reclamation, and Ocean Ranching, April 18, 1977

with disinfection and dechlorination, of sewage discharges; (2) compliance with any additional NPDES permit requirements issued by the Regional Water Board to protect beneficial uses; and (3) the fuller realization of existing beneficial uses or the creation of new beneficial uses either by or in conjunction with a wastewater treatment project. [1] A pilot project funded by the State Water Board in 1981 was designed and implemented by the Permittee to demonstrate the effectiveness of wetland treatment in meeting water quality treatment standards. The final report from this pilot was accepted by the Regional Water Board.[2][3]

In 1983, the Regional Water Board adopted Resolution No. 83-9, granting the Permittee a waiver, as defined in Chapter I, Paragraph A of the Enclosed Bays and Estuaries Policy, permitting continued Humboldt Bay discharge. Resolution No. 83-9 found that the marsh disposal alternative meets the definition of enhancement set forth in State Water Board Order No. 79-20 because the waste would achieve secondary treatment standards, create no adverse impacts to present beneficial uses and the discharge would create new beneficial uses and wildlife habitat. [4]

As constructed, the AMWS consists of three freshwater wetlands: Allen, Gearheart, and Hauser Marshes. These marshes currently receive equivalent to secondary treated wastewater, provide enhanced treatment for discharges to Humboldt Bay, and create new beneficial uses, which would not exist in the absence of the discharge. The AMWS provides enhanced water quality treatment, while hosting a variety of cold-water aquatic organisms and vegetation, creating an extraordinary habitat for shorebirds, waterfowl, raptors, and migratory birds. As a result, the AMWS is an integral part of the WWTF and a valued part of the Arcata community as it provides numerous non-contact recreation and educational opportunities.

## B. Description of Wastewater and Biosolids Treatment and Controls

**1. Existing Treatment Configuration.** Primary wastewater treatment consists of mechanical bar screens, grit removal, and two primary clarifiers. Primary solids are sent to two anaerobic digesters, sludge drying beds, and a sludge composting operation. Influent flows above 5.0 mgd are diverted around primary treatment directly to the oxidation ponds.

Secondary treatment is accomplished using two oxidation ponds 22.4 acres and 17.3 acres in size, respectively, and six treatment marshes. Detention time in the Facility, prior to enhanced treatment in the AMWS, is approximately 39 days during average dry weather design flow periods. Effluent is disinfected with chlorine and dechlorinated with sulfur dioxide prior to discharged. Treated effluent is continuously commingled with effluent from the AMWS, disinfected, and split, flowing by gravity either to Humboldt Bay or again through the AMWS. The result is disinfected secondary effluent, but not all effluent receives the benefit of enhanced treatment through the AMWS before discharge to Humboldt Bay and some effluent may be chlorinated multiple times, increasing the opportunity to form disinfection byproducts above water quality objectives. The average flow through the AMWS during the previous permit (August 2012 through April 2019) was 1.14 mgd with a maximum flow of 2.3 mgd.

**2. Upgraded Treatment Configuration.** The Permittee is planning to upgrade the Facility in two phases. Phase One of the Proposed Upgrade Project will consist of rehabilitation of the headworks and primary clarifier, new aerators in oxidation pond one, addition of a baffle

[1] State Water Board Order No. 79-20, May 17, 1979

[2] Gearhart, R.A., B. Finney, S. Wilbur, J. Williams, D. Hill, and S. Sundberg, City of Arcata Marsh Pilot Project, Effluent Quality Results System Design Management, Project No: C-06-2270, State of California Water Resources Control Board, Sacramento, CA, 1983.

[3] Gearhart, R.A., S. Wilbur, H. Holbrook, and M. Ives, City of Arcata Marsh and Pilot Project, Wetland Bacteria Speciation and Harvesting Effect on Water Quality, Project No: 3-154-500-0, State of California Water Resources Control Board, Sacramento, CA, 1983.

[4] Regional Water Board, Resolution No. 83-9, July 28, 1983

wall and aerators in oxidation pond two, improvements to multiple pump stations, construction of the UV disinfection system and the construction of piping for Discharge Point 003. Completion of this phase will allow for peak flows to be discharged to Discharge Point 003.

Phase Two of the project will include construction of the oxidation ditch, secondary clarifiers, return activated sludge pump station, an alkalinity feed station and rehabilitation of the anaerobic digester. The rehabilitation of the anaerobic digester will include digester cleaning, replacing digester covers, replacing the boiler/heat exchanger, replacing the mixing and heating piping in the primary digester as needed, adding a sludge thickening system and relocating composting facilities to a new area on site. Completion of this phase will allow the Permittee to comply with final effluent limitations for ammonia at Discharge Point 001 and Discharge Point 003 as well as more stringent BOD and TSS limitations at Discharge Point 002. Time Schedule Order No. R1-2019-0011 includes task and compliance dates for completion of Phase One and Phase Two of the Proposed Upgrade Project.

The wetland treatment system train and parallel oxidation ditch train will each treat a portion of the influent flow at variable percentages. The wetland treatment system will treat the majority of the influent flow up to 2.3 mgd. The parallel oxidation ditch treatment train will provide $BOD_5$ removal and year-round full nitrification treatment capacity to handle the remainder of the hydraulic capacity needs up to 5.9 mgd.

The Permittee is planning to replace the chlorine disinfection system with an ultraviolet light (UV) disinfection system, through which commingled effluent from the treatment wetlands and parallel oxidation ditch will flow prior to discharge to the AMWS at Discharge Point 002. The Permittee has evaluated the ability to disinfect all flow using UV and is currently planning to disinfect flows up to 7.6 mgd through the Facility with UV. Wastewater discharged at Discharge Point 002 will flow through the Allen, Gearheart, and Hauser marshes in succession. The Permittee will manage flows through Allen, Gearheart, and Hauser Marshes to preserve enhanced treatment and beneficial uses of the enhancement marshes. Flow rates determined to negatively impact the enhancement marshes and flow in excess of 5.9 mgd will be diverted around the enhancement marshes. Diverted flow will co-mingle with Hauser Marsh effluent prior to discharge to the Brackish Marsh at Discharge Point 003. At the design average dry weather flow, detention time in the AMWS is approximately 60 days and results in full secondary treated effluent. Effluent from the AMWS will be discharged to the brackish marsh at Discharge Point 003. Key components of enhanced treatment provided by the AMWS include settling and clarification. The Regional Water Board finds the proposed upgraded treatment configuration is consistent with Resolution Nos. 79-20 and 83-9.

The upgraded Facility configuration will provide overall improvements to effluent quality discharged to Humboldt Bay because all effluent up to 5.9 mgd may receive enhanced treatment through the AMWS. In addition, chlorination will no longer be the primary form of disinfection, so formation of disinfection byproducts will be greatly diminished. Treated effluent discharged at Discharge Point 003 will enter Humboldt Bay in a diffuse manner due to the tidal mixing within the brackish marsh and subsequent flow through tidal marshes. As a result, the upgraded Facility will provide for higher quality effluent entering Humboldt Bay.

Discharge Prohibition III.I prohibits the discharge of treated effluent at Discharge Point 001, other than the portion of flow exceeding 5.9 mgd. For emergency discharges of flows exceeding 5.9 mgd, the Permittee will utilize the chlorine disinfection system to meet disinfection requirements prior to discharge to Humboldt Bay at Discharge Point 001. The

Permittee has evaluated the ability to disinfect all flows using UV but would like to maintain the ability to use chlorine as an emergency disinfection process.

## C. Discharge Points and Receiving Waters

**1.** The Facility is located within the Eureka Plain Hydrologic Unit.

**2.** For routine discharges of flows prior to completion of Phase One of the Proposed Upgrade Project, effluent treated in accordance with permit requirements in section IV.A.1. of the Order may be discharged to Humboldt Bay. For emergency discharges of flows exceeding 5.9 mgd, after completion of Phase One of the Proposed Upgrade Project, effluent treated in accordance with permit requirements in section IV.B.1 of the Order may be discharged to Humboldt Bay, a water of the United States, from Discharge Point 001 at 40° 51' 18" N latitude and 124° 5' 26" W longitude. Humboldt Bay is an estuarine waterbody.

**3.** Effluent treated in accordance with permit requirements in section IV.D.1 (prior to completion of Phase Two) and IV.C.1. (after completion of Phase Two) of the Order may be discharged to the AWMS, a water of the state, from Discharge Point 002 at 40° 51' 29" N latitude and 124° 5' 31" W longitude. The AMWS is a freshwater marsh system.

**4.** Effluent treated in accordance with permit requirements in section IV.B.2. (after completion of Phase One) and IV.C.2. (after completion of Phase Two) of the Order may be discharged to the brackish marsh, a water of the United States, from Discharge Point 003 at 40° 51' 40" N latitude and 124° 5' 37" W longitude. The brackish marsh discharges into a slough within the north end of the Arcata Bay portion of Humboldt Bay.

## D. Summary of Existing Requirements and Self-Monitoring Report (SMR) Data

Effluent limitations contained in Order No. R1-2012-0031 for discharges from Discharge Points 001,002 and 003 are as follows. Tables F-2 and F-3 summarize representative monitoring data from the term of Order No. R1-2012-0031 at Monitoring Locations EFF-001 and EFF-002, respectively. The Permittee did not discharge at Discharge Point 003 during the term of Order No. R1-2012-0031; therefore, effluent monitoring data is not available.

**Table F-2. Historic Effluent Limitations and Monitoring Data – Discharge Point 001**

| Parameter | Units | Effluent Limitation | | | Monitoring Data (August 2012 – January 2017) | | |
|---|---|---|---|---|---|---|---|
| | | Average Monthly | Average Weekly | Maximum Daily | Highest Average Monthly Discharge | Highest Average Weekly Discharge | Highest Daily Discharge |
| Biochemical Oxygen Demand 5-day @ 20°C ($BOD_5$) | mg/L | 30[1] | 45[1] | -- | 32 | 47 | -- |
| | mg/L | 45[2] | 65[2] | -- | -- | -- | -- |
| | lbs/day | 575[1,3] | 863[1,3] | -- | 798 | 1,349 | -- |
| | lbs/day | 863[2,3] | 1,304[2,3] | -- | -- | -- | -- |
| | % Removal | 85[1] | -- | -- | 74[4] | -- | -- |
| | % Removal | 65[2] | -- | -- | -- | -- | -- |
| Fecal Coliform | MPN/100 mL | 14[5] | -- | 43[6] | -- | -- | 7.8 |

| Parameter | Units | Effluent Limitation | | | Monitoring Data (August 2012 – January 2017) | | |
|---|---|---|---|---|---|---|---|
| | | Average Monthly | Average Weekly | Maximum Daily | Highest Average Monthly Discharge | Highest Average Weekly Discharge | Highest Daily Discharge |
| pH | standard units | -- | -- | 6.0 – 9.0[7] | -- | -- | 5.9 – 7.3 |
| Total Suspended Solids (TSS) | mg/L | 30[1] | 45[1] | -- | 37.6 | 61 | -- |
| | mg/L | 66[2] | 95[2] | -- | -- | -- | -- |
| | lbs/day | 575[1,3] | 863[1,3] | | 1,211 | 2,200 | -- |
| | lbs/day | 1,266[2,3] | 1,822[2,3] | -- | -- | -- | -- |
| | % Removal | 85[1] | -- | -- | 75.2[4] | -- | -- |
| | % Removal | 65[2] | -- | -- | -- | -- | -- |
| Bis(2-Ethylhexyl)Phthalate | µg/L | 1.8 | -- | 3.6 | 2.8 | -- | 2.8 |
| Carbon Tetrachloride | µg/L | 0.25 | -- | 0.50 | 0.80 | -- | 0.80 |
| Cyanide, Total (as CN) | µg/L | 0.5 | -- | 1.0 | 7.0 | -- | 7.0 |
| Dichlorobromomethane | µg/L | 0.56 | -- | 1.12 | 5.7 | -- | 5.7 |
| TCDD-Equivalents | µg/L | $1.3 \times 10^{-8}$ | -- | $2.6 \times 10^{-8}$ | $2.9 \times 10^{-7}$ | -- | $2.9 \times 10^{-7}$ |
| Chlorine, Total Residual | mg/L | 0.01 | -- | 0.02 | 0.0761 | -- | 2.36 |
| Settleable Solids | ml/L | 0.1 | -- | 0.2 | 0.0193 | -- | 0.4 |
| Acute Toxicity | % Survival | -- | -- | 70[8]/90[9] | -- | -- | 70[10] |

Table Notes:

1. Interim effluent limitation effective until the activation of the upgraded Facility configuration.
2. Final effluent limitation effective upon activation of the upgraded Facility configuration.
3. Mass-based effluent limitations are based on the dry weather design flow of the Facility of 2.3 mgd. During wet weather periods, when influent flow exceeds the dry weather design flow rate, mass emission limitations shall be calculated using the concentration-based effluent limitations and the actual daily average effluent flow rate (not to exceed the average wet weather design flow rate of 5.0 mgd).
4. Represents the minimum observed percent removal.
5. The median concentration shall not exceed a Most Probable Number (MPN) of 14 organisms per 100 mL in a calendar month.
6. Not more than 10 percent of samples collected in a calendar month shall exceed 43 MPN/100 mL.
7. Applied as instantaneous minimum and instantaneous maximum effluent limitations.
8. Minimum for one bioassay.
9. Median for any three or more consecutive bioassays.
10. Represents the minimum observed percent survival.

**Table F-3. Historic Effluent Limitations and Monitoring Data – Discharge Point 002**

| Parameter | Units | Effluent Limitation | | | Monitoring Data (August 2012 – January 2017) | | |
|---|---|---|---|---|---|---|---|
| | | Average Monthly | Average Weekly | Maximum Daily | Highest Average Monthly Discharge | Highest Average Weekly Discharge | Highest Daily Discharge |
| Biochemical Oxygen Demand 5-day @ 20°C ($BOD_5$) | mg/L | 45 | 65 | -- | 88 | 140 | -- |
| pH | standard units | -- | -- | 6.0 – 9.0[1] | -- | -- | 6.1 – 7.3 |
| Total Suspended Solids (TSS) | mg/L | 66 | 95 | -- | 44 | 66 | -- |
| Chlorine, Total Residual | mg/L | 0.01 | -- | 0.02 | 0.0761 | -- | 2.36 |

| Parameter | Units | Effluent Limitation | | | Monitoring Data (August 2012 – January 2017) | | |
|---|---|---|---|---|---|---|---|
| | | Average Monthly | Average Weekly | Maximum Daily | Highest Average Monthly Discharge | Highest Average Weekly Discharge | Highest Daily Discharge |
| Settleable Solids | ml/L | 0.1 | -- | 0.2 | 0.0193 | -- | 0.40 |

Table Notes:
1. Applied as instantaneous minimum and instantaneous maximum effluent limitations.

**Table F-4. Historic Effluent Limitations and Monitoring Data – Discharge Point 003**

| Parameter | Units | Effluent Limitation | | |
|---|---|---|---|---|
| | | Average Monthly | Average Weekly | Maximum Daily |
| Biochemical Oxygen Demand 5-day @ 20°C ($BOD_5$) | mg/L | 30 | 45 | -- |
| | lbs/day | 575[1] | 863[1] | -- |
| | % Removal | 85 | -- | -- |
| Fecal Coliform | MPN/100 mL | 14[2] | -- | 43[3] |
| pH | standard units | -- | -- | 6.0 – 9.0[4] |
| Total Suspended Solids (TSS) | mg/L | 30 | 45 | -- |
| | lbs/day | 575[1] | 863[1] | |
| | % Removal | 85 | -- | -- |
| Bis(2-Ethylhexyl)Phthalate | µg/L | 1.8 | -- | 3.6 |
| Carbon Tetrachloride | µg/L | 0.25 | -- | 0.50 |
| Copper, Total Recoverable | µg/L | 2.9 | -- | 5.8 |
| Cyanide, Total (as CN) | µg/L | 0.5 | -- | 1.0 |
| TCDD-Equivalents | µg/L | $1.3 \times 10^{-8}$ | -- | $2.6 \times 10^{-8}$ |
| Settleable Solids | ml/L | 0.1 | -- | 0.2 |
| Acute Toxicity | % Survival | -- | -- | 70[5]/90[6] |

Table Notes:
1. Mass-based effluent limitations are based on the dry weather design flow of the Facility of 2.3 mgd. During wet weather periods, when influent flow exceeds the dry weather design flow rate, mass emission limitations shall be calculated using the concentration-based effluent limitations and the actual daily average effluent flow rate (not to exceed the average wet weather design flow rate of 5.0 mgd).
2. The median concentration shall not exceed a Most Probable Number (MPN) of 14 organisms per 100 mL in a calendar month.
3. Not more than 10 percent of samples collected in a calendar month shall exceed 43 MPN/100 mL.
4. Applied as instantaneous minimum and instantaneous maximum effluent limitations.
5. Minimum for one bioassay.
6. Median for any three or more consecutive bioassays.

## E. Compliance Summary

On May 24, 2013, the Executive Officer issued Administrative Civil Liability (ACL) Complaint No. R1-2013-0034 for two violations, including failing to submit a ROWD or apply for a 401 Water Quality Certification for a maintenance project in violation of Water Code section 13376 and engaging in project activities that resulted in sediment discharges to Janes Creek, a tributary to Humboldt Bay, from October 2-3, 2012 in violation of Water Code section 13243 and prohibitions and criteria contained in the Basin Plan. The ACL Complaint assessed a penalty of $10,880 for these violations, including $1,200 for staff costs. The Permittee agreed to pay the assessed penalty of $10,880.

From August 1, 2012, through September 30, 2018 the Permittee had 115 effluent limitation violations for the following parameters: dichlorobromomethane (39), pH (3), carbon tetrachloride (2), settleable solids (1), 2,3,7,8-TCDD (2), total cyanide (6), total copper (25), total suspended solids (TSS) concentration (10), TSS mass loading (10), biochemical oxygen demand (BOD) concentration (2), BOD mass loading (2), BOD percent removal (6), TSS percent removal (5) and fecal coliform (1). These effluent limitation violations are currently under review for future enforcements actions.

### F. Planned Changes

As discussed in section II.B.2 of this Fact Sheet, the Permittee is planning to construct Facility upgrades to comply with the requirements of this Order. The upgrades will include oxidation pond and wetland treatment system improvements, construction of a parallel oxidation ditch treatment system, construction of a UV disinfection system upstream of discharge to the AMWS, and an updated Facility configuration allowing for discharges from the AMWS to the brackish marsh in order to provide overall improvements to effluent quality discharged to Humboldt Bay.

The Proposed Treatment Upgrade Project will replace the chlorine disinfection system with a UV disinfection system for the peak wet weather design flows of 5.9 mgd, or greater. Emergency flows, in excess of the peak design flows of 5.9 mgd, may be disinfected with chlorine and discharged via Discharge Point 001 or via Discharge Point 003 through the adaptive management diversion line. The Permittee is investigating the possibility of disinfecting all flows with UV and would like to maintain chlorine disinfection as a backup. Eliminating the use of chlorine will reduce the number of violations for dichlorobromomethane, a chlorine disinfection by-product. The oxidation ditch and new clarifiers will provide full secondary treatment for a portion of flow, improve ammonia removal, BOD and TSS removal and likely address toxicity concerns. The new discharge location, Discharge Point 003, will allow the discharge from the Facility to enter Humboldt Bay in a diffuse manner due to the tidal mixing within the brackish marsh and subsequent flow through tidal marshes.

## III. APPLICABLE PLANS, POLICIES, AND REGULATIONS

The requirements contained in this Order are based on the requirements and authorities described in this section.

### A. Legal Authorities

This Order serves as Waste Discharge Requirements (WDRs) pursuant to article 4, chapter 4, and division 7 of the California Water Code (commencing with section 13260). This Order is also issued pursuant to section 402 of the federal Clean Water Act (CWA) and implementing regulations adopted by the U.S. Environmental Protection Agency (U.S. EPA) and chapter 5.5, division 7 of the Water Code (commencing with section 13370). It shall serve as an NPDES permit authorizing the Permittee to discharge into waters of the United States at the discharge location described in Table 2 subject to the WDRs in this Order.

### B. California Environmental Quality Act (CEQA)

Under Water Code section 13389, this action to adopt an NPDES permit is exempt from the provisions of Chapter 3 of CEQA, (commencing with section 21100) of Division 13 of the Public Resources Code.

### C. State and Federal Laws, Regulations, Policies, and Plans

1. **Water Quality Control Plan.** The Regional Water Board adopted a *Water Quality Control Plan for the North Coast Region* (hereinafter Basin Plan) that designates beneficial uses, establishes water quality objectives, and contains implementation programs and policies to achieve those objectives for all waters addressed through the plan.

The Basin Plan designates a beneficial use of municipal and domestic supply (MUN) to Humboldt Bay. In addition, the Basin Plan implements State Water Board Resolution No. 88-63, which establishes state policy that all waters, with certain exceptions, should be considered suitable or potentially suitable for MUN. Salinity in Humboldt Bay in the vicinity of the discharge was reported as high as 51,587 µS/cm, which well exceeds the salinity threshold 5,000 µS/cm included in Resolution No. 88-63. Therefore, this Order does not apply the MUN designation when considering Humboldt Bay and the brackish marsh in the vicinity of Discharge Points 001 and 003.

The MUN beneficial use has not been designated for the AMWS, as Resolution No. 88-63 exempts "*water in systems designed or modified to collect or treat municipal or industrial wastewaters…provided that the discharge from such systems is monitored to assure compliance with all relevant water quality objectives as required by the Regional Boards*."

Beneficial uses applicable to Humboldt Bay (an estuarine environment), the AMWS (a freshwater marsh system), and the brackish marsh (an estuarine environment), within the Eureka Plain Hydrologic Unit, are summarized in Table F-5, below:

**Table F-5. Basin Plan Beneficial Uses**

| Discharge Point | Receiving Water Name | Beneficial Use(s) |
|---|---|---|
| 001 and 003 | Humboldt Bay and brackish marsh within the Eureka Plain Hydrologic Unit | Existing:<br>Municipal and domestic water supply (MUN) – not applied;<br>Agricultural supply (AGR);<br>Industrial service supply (IND);<br>Freshwater replenishment (FRSH);<br>Navigation (NAV);<br>Water contact recreation (REC-1);<br>Non-contact water recreation (REC-2);<br>Commercial and sport fishing (COMM);<br>Cold freshwater habitat (COLD);<br>Wildlife habitat (WILD);<br>Rare, threatened, or endangered species (RARE);<br>Marine habitat (MAR);<br>Migration of aquatic organisms (MIGR);<br>Spawning, reproduction, and/or early development (SPWN);<br>Shellfish harvesting (SHELL);<br>Estuarine habitat (EST)<br>Aquaculture (AQUA); and<br>Native American culture (CUL).<br><br>Potential:<br>Industrial process supply (PRO); and<br>Hydropower generation (POW). |
| 002 | AMWS | Existing:<br>Non-contact water recreation (REC-2);<br>Cold freshwater habitat (COLD);<br>Wildlife habitat (WILD);<br>Wetland habitat (WET); and<br>Water quality enhancement (WQE). |

| Discharge Point | Receiving Water Name | Beneficial Use(s) |
|---|---|---|
| -- | Groundwater | Existing:<br>Municipal and domestic supply (MUN);<br>Agricultural supply (AGR);<br>Industrial service supply (IND); and<br>Native American Culture (CUL).<br><br>Potential<br>Industrial Process Supply (PRO); and<br>Aquaculture (AQUA). |

Requirements of this Order implement the Basin Plan.

2. **Enclosed Bays and Estuaries Policy.** The State Water Board adopted State Water Board Resolution No. 74-43, *Water Quality Control Policy for the Enclosed Bays and Estuaries of California* (Enclosed Bays and Estuaries Policy) on May 16, 1974. The State Water Board adopted Resolution No. 95-84 on November 16, 1995, amending the Enclosed Bays and Estuaries Policy. Chapter 1, paragraph A of the Bays and Estuaries Policy requires that the discharge of municipal wastewater to enclosed bays be phased out as early as possible, except when the discharge enhances the quality of the receiving water above that which would occur in the absence of the discharge. As described in section II.A of this Fact Sheet, the Regional Water Board adopted Resolution No. 83-9 on July 28, 1983, to allow the Permittee to discharge to Humboldt Bay in compliance with the Enclosed Bays and Estuaries Policy and State Board Order No. 79-20 and Regional Water Board Resolution No. 83-9.

3. **Thermal Plan.** The State Water Board adopted a *Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California* (Thermal Plan) on January 7, 1971 and amended this plan on September 18, 1975. This plan contains temperature objectives for coastal waters. The Permittee does not discharge thermal waste; therefore, the Order does not include effluent limitations for temperature in response to the requirements of the Thermal Plan.

4. **National Toxics Rule (NTR) and California Toxics Rule (CTR).** U.S. EPA adopted the NTR on December 22, 1992, and later amended it on May 4, 1995 and November 9, 1999. About forty criteria in the NTR applied in California. On May 18, 2000, U.S. EPA adopted the CTR. The CTR promulgated new toxics criteria for California and, in addition, incorporated the previously adopted NTR criteria that were applicable in the state. The CTR was amended on February 13, 2001. These rules contain federal water quality criteria for CTR priority pollutants.

5. **State Implementation Policy.** On March 2, 2000, the State Water Board adopted the *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California* (State Implementation Policy or SIP). The SIP became effective on April 28, 2000, with respect to the CTR priority pollutant criteria promulgated for California by the U.S. EPA through the NTR and to the CTR priority pollutant objectives established by the Regional Water Board in the Basin Plan. The SIP became effective on May 18, 2000, with respect to the CTR priority pollutant criteria promulgated by the U.S. EPA through the CTR. The State Water Board adopted amendments to the SIP on February 24, 2005, which became effective on July 13, 2005. The SIP establishes implementation provisions for CTR priority pollutant criteria and objectives and provisions for chronic toxicity control.

   Section 1.2 of the SIP allows the Regional Water Board to adjust the criteria/objective for metals with discharger-specific Water Effect Ratios (WERs) established in accordance with

U.S. EPA guidance – *Interim Guidance on Determination and Use of Water Effect Ratios for Metals* (EPA-823-B-94-001) or *Streamlined Water-Effect Ratio Procedure for Discharges of Copper* (EPA-822-R-01-005) (Streamlined Procedure). The Streamlined Procedure determines site-specific values for a WER, a criteria adjustment factor accounting for the effect of site-specific water characteristics on pollutant bioavailability and toxicity to aquatic life. Requirements of this Order implement the SIP.

6. **Compliance Schedules and Interim Requirements.** The State Water Board adopted Resolution No. 2008-0025 on April 15, 2008, titled *Policy for Compliance Schedules in National Pollutant Discharge Elimination System Permits*, which includes compliance schedule policies for pollutants that are not addressed by the SIP. This Policy became effective on August 27, 2008.

   This Order does not include any compliance schedules or interim effluent limitations.

7. **Antidegradation Policy.** Federal regulation 40 C.F.R. section 131.12 requires that the state water quality standards include an antidegradation policy consistent with the federal policy. The State Water Board established California's antidegradation policy in State Water Board Resolution No. 68-16 (*Statement of Policy with Respect to Maintaining High Quality Waters of California*). Resolution No. 68-16 incorporates the federal antidegradation policy where the federal policy applies under federal law. Resolution No. 68-16 requires that existing water quality be maintained unless degradation is justified based on specific findings. The Regional Water Board's Basin Plan implements, and incorporates by reference, both the state and federal antidegradation policies. The permitted discharge must be consistent with the antidegradation provision of 40 C.F.R. section 131.12 and State Water Board Resolution No. 68-16. As discussed in detail in section IV.D.2 of this Fact Sheet, the permitted discharge is consistent with the antidegradation provision of 40 C.F.R. section 131.12 and State Water Board Resolution No. 68-16.

8. **Anti-Backsliding Requirements.** Sections 402(o)(2) and 303(d)(4) of the CWA and federal regulations at 40 C.F.R. section 122.44(l) restrict backsliding in NPDES permits. These anti-backsliding provisions require that effluent limitations in a reissued permit must be as stringent as those in the previous permit, with some exceptions in which limitations may be relaxed. Some effluent limitations from the previous Order have been removed or are less stringent than those in the previous Order. As discussed in detail in section IV.D.1 of this Fact Sheet, removal or relaxation of effluent limitations is consistent with the anti-backsliding requirements of the CWA and federal regulations.

9. **Endangered Species Act Requirements.** This Order does not authorize an act that results in the taking of a threatened or endangered species or any act that is now prohibited, or becomes prohibited in the future, under either the California Endangered Species Act (Fish and Game Code sections 2050 or 2097) or the Federal Endangered Species Act (16 U.S.C.A sections 1531 to 1544). This Order requires compliance with effluent limits, receiving water limits, and other requirements to protect the beneficial uses of waters of the state, including protecting rare, threatened, and endangered species. The Permittee is responsible for meeting all requirements of the applicable Endangered Species Act.

## D. Impaired Water Bodies on the CWA section 303(d) List

Section 303(d) of the federal CWA requires states to identify water bodies that do not meet water quality standards and are not supporting their beneficial uses after implementation of technology-based effluent limitations on point sources. Each state must submit an updated list, the 303(d) List of Impaired Waterbodies, every two years. In addition to identifying the water bodies that are not supporting beneficial uses, the 303(d) list also identifies the pollutant or stressor causing impairment and establishes a schedule for developing a control plan to address

the impairment. The CWA requires development of a total maximum daily load (TMDL) or alternate program of implementation for each 303(d)-listed pollutant and water body to remedy the impairment. TMDLs establish the maximum quantity of a given pollutant that can be added to a water body from all sources without exceeding the applicable water quality standard for that pollutant and determine waste load allocations (the portion of a TMDL allocated to existing and future point sources) and load allocations (the portion of a TMDL attributed to existing and future nonpoint sources).

On April 6, 2018, the U.S. EPA provided final approval of the 2014 and 2016 303(d) List of Impaired Water Bodies prepared by the state. The list identifies Humboldt Bay (Eureka Plain Hydrologic Unit) as impaired by dioxin equivalents and polychlorinated biphenyls (PCBs). Pursuant to CWA section 303(d), the Regional Water Board will develop a TMDL or alternate program of implementation to address these impairments, which will be implemented through various programs, including through provisions of NPDES permits. The Regional Water Board expects to adopt TMDLs for dioxin toxic equivalents and PCBs by 2025. Discharges from the Facility have shown reasonable potential for discharges of dioxin equivalents; therefore, this Order establishes effluent limitations for dioxin equivalents at levels protective of beneficial uses.

### E. Other Plans, Policies and Regulations

**1.** On May 2, 2006, the State Water Board adopted State Water Board Order No. 2006-0003-DWQ, Statewide General WDRs for Sanitary Sewer Systems and on August 6, 2013 adopted Order No. WQ 2013-0058-EXEC Amending Monitoring and Reporting Program for Statewide General Waste Discharge Requirements for Sanitary Sewer Systems. Order No. 2006-0003-DWQ requires that all public agencies that currently own or operate sanitary sewer systems apply for coverage under the General WDRs. The deadline for dischargers to apply for coverage was November 2, 2006. The Permittee applied for coverage and is subject to the requirements of Order Nos. 2006-0003-DWQ and WQ 2013-0058-EXEC and any future revisions thereto for operation of its wastewater collection system.

**2.** State Water Board Water Quality Order No. 2014-0057-DWQ, NPDES General Permit No. CAS000001, General Permit for Storm Water Discharges Associated with Industrial Activities (Industrial Storm Water General Permit) does not require facilities to obtain coverage if discharges of storm water are regulated under another individual or general NPDES permit adopted by the State Water Board or Regional Water Board (Finding I.B.20). All storm water at the Facility is captured and directed to the Facility headworks for treatment and disposal under this Order. Therefore, coverage under the Industrial Storm Water General Permit is not required for this Facility.

## IV. RATIONALE FOR EFFLUENT LIMITATIONS AND DISCHARGE SPECIFICATIONS

The CWA requires point source dischargers to control the amount of conventional, non-conventional, and toxic pollutants that are discharged into the waters of the United States. The control of pollutants discharged is established through effluent limitations and other requirements in NPDES permits. There are two principal bases for effluent limitations in the Code of Federal Regulations: 40 C.F.R. section 122.44(a) requires that permits include applicable technology-based limitations and standards; and 40 C.F.R. section 122.44(d) requires that permits include water quality-based effluent limitations (WQBELs) to attain and maintain applicable numeric and narrative water quality criteria to protect the beneficial uses of the receiving water where a reasonable potential to exceed those criteria exists.

## A. Discharge Prohibitions

1. **Discharge Prohibition III.A.** The discharge of waste to Humboldt Bay is prohibited unless the discharge is consistent with State Board Order No. 79-20 and Regional Water Board Resolution No. 83-9.

   This prohibition justifies an exception to the Enclosed Bays and Estuaries Policy allowing the continued discharge from the Facility to Humboldt Bay "*only when a discharge enhances the quality of the receiving water above that which would occur in the absence of the discharge*." Resolution No. 83-9 acknowledged that the discharge of treated wastewater through the AMWS met the definition of "enhancement" as established by State Water Board Order No. WQ 79-20. Discharge Prohibition III.A ensures that this enhancement project will be continued and allows the Regional Water Board to continue to recognize an exception to the Enclosed Bays and Estuaries Policy for the Facility.

2. **Discharge Prohibition III.B.** The discharge of any waste not disclosed by the Permittee or not within the reasonable contemplation of the Regional Water Board is prohibited.

   This prohibition is based on the Basin Plan, the previous Order, and State Water Board Order No. WQO 2002-0012 regarding the petition of WDRs Order No. 01-072 for the East Bay Municipal Utility District and Bay Area Clean Water Agencies. In State Water Board Order No WQO 2002-0012, the State Water Board found that this prohibition is acceptable in Orders, but should be interpreted to apply only to constituents that are not disclosed by the Permittee and are not reasonably anticipated to be present in the discharge. It specifically does not apply to constituents in the discharge that do not have "reasonable potential" to exceed water quality objectives.

   The State Water Board has stated that the only pollutants not covered by this prohibition are those which were "*disclosed to the permitting authority and…can be reasonably contemplated*." [In re the Petition of East Bay Municipal Utilities District et al., (State Water Board, 2002) Order No. WQO 2002-0012, p. 24.] In that Order, the State Water Board cited a case that held the Permittee is liable for the discharge of pollutants "*not within the reasonable contemplation of the permitting authority…whether spills or otherwise*…" [*Piney Run Preservation Assn. v. County Commissioners of Carroll County, Maryland* (4th Cir. 2001) 268 F. 3d 255, 268.] Thus, the State Water Board authority provides that, to be permissible, the constituent discharged (1) must have been disclosed by the Permittee and (2) can be reasonably contemplated by the Regional Water Board.

3. **Discharge Prohibition III.C.** Creation of pollution, contamination, or nuisance, as defined by section 13050 of the Water Code is prohibited.

   This prohibition has been retained from Order No. R1-2012-0031 and is based on section 13050 of the Water Code and section 5411 of the California Health and Safety Code.

4. **Discharge Prohibition III.D.** The discharge of sludge or digester supernatant is prohibited, except as authorized under section VI.C.5.c of this Order (Sludge Disposal and Handling Requirements).

   This prohibition has been retained from Order No. R1-2012-0031 and is based on restrictions on the disposal of sewage sludge found in federal regulations [40 C.F.R. part 503 (Biosolids), part 527, and part 258] and title 27 of the CCR.

5. **Discharge Prohibition III.E.** The discharge of untreated or partially treated waste (receiving a lower level of treatment than described in section II.A of the Fact Sheet) from anywhere within the collection, treatment, or disposal systems is prohibited, except as provided for in Attachment D, Standard Provisions G (Bypass) and H (Upset).

This prohibition has been retained from Order No. R1-2012-0031 and is based on the Basin Plan to protect the beneficial uses of the receiving water from unpermitted discharges, and the intent of the Water Code sections 13260 through 13264 relating to the discharge of waste to waters of the state without filing for and being issued an Order. This prohibition applies to spills not related to sanitary sewer overflows (SSOs) and other unauthorized discharges of wastewater within the collection, treatment, and disposal facilities. The discharge of untreated or partially treated wastewater from the collection, treatment, or disposal facility represents an unauthorized bypass pursuant to 40 C.F.R. section 122.41(m) or an unauthorized discharge, which poses a threat to human health and/or aquatic life, and therefore is explicitly prohibited by this Order.

6. **Discharge Prohibition III.F.** Any SSO that results in a discharge of untreated or partially treated wastewater to (a) waters of the state or (b) land that creates pollution, contamination, or nuisance, as defined in Water Code section 13050(m) is prohibited.

   This prohibition is retained from Order No. R1-2012-0031 with a minor modification. A reference to groundwater has been removed because groundwater is captured in the broader term, "waters of the state." This prohibition applies to spills related to SSOs and is based on state standards, including section 13050 of the Water Code and the Basin Plan. This prohibition is consistent with the state's antidegradation policy as specified in State Water Board Resolution No. 68-16 (*Statement of Policy with Respect to Maintaining High Quality of Water in California*) in that the prohibition imposes conditions to prevent impacts to water quality, the degradation of water quality, negative effects on receiving water beneficial uses, and lessening of water quality beyond that prescribed in State Water Board or Regional Water Board plans and policies.

   This prohibition is stricter than the prohibitions stated in State Water Board Order No. 2006-0003-DWQ, Statewide General Waste Discharge Requirements for Sanitary Sewer Systems. Order No. 2006-0003-DWQ prohibits SSOs that result in the discharge of untreated or partially treated wastewater to waters of the United States and SSOs that cause a nuisance, compared to Discharge Prohibition III.F of this Order, which prohibits SSO discharges that create nuisance or pollution to waters of the state and land for a more complete protection of human health. The rationale for this prohibition is based on the prevalence of high groundwater quality and shallow groundwater in the North Coast Region, and this Region's reliance on groundwater as a drinking water source.

7. **Discharge Prohibition III.G.** The discharge of waste at any point not described in Finding II.B of the Fact Sheet or authorized by a permit issued by the State Water Board or another Regional Water Board is prohibited.

   This prohibition has been retained from Order No. R1-2012-0031. This prohibition is a general prohibition that allows the Permittee to discharge waste only in accordance with WDRs. It is based on sections 301 and 402 of the federal CWA and section 13263 of the Water Code.

8. **Discharge Prohibition III.H.** The average dry weather flow of waste through the Facility shall not exceed 2.3 mgd, measured daily and averaged over a calendar month. Compliance with this prohibition shall be determined as defined in section VII.K of this Order.

   This prohibition is retained from Order No. R1-2012-0031 and is based on the permitted flow and design treatment capacity of the Facility. Exceedance of this capacity may result in effluent violations and/or the need to bypass untreated effluent blended with treated effluent, which is prohibited.

9. **Discharge Prohibition III.I.** The discharge of treated effluent at Discharge Point 001 is prohibited other than that portion of the flow exceeding peak flows of 5.9 mgd.

This prohibition is retained from Order No. R1-2012-0031 and is based on Resolution No. 83-9, in which the Regional Water Board acknowledged that the discharge of treated wastewater through the AMWS met the definition of "enhancement" as established by State Water Board Order No. 79-20. Discharge Prohibition III.I ensures that water quality is enhanced by treatment through the AMWS to the fullest extent possible prior to discharge to Humboldt Bay.

Discharge Prohibition III.I shall take effect upon completion of Phase I of the Proposed Upgrade Project which includes construction of Discharge Point 003 to the Brackish Marsh.

10. **Discharge Prohibition III.J.** The discharge of any radiological, chemical, or biological warfare agent into waters of the state is prohibited under Water Code section 13375.

    This prohibition is newly established by this Order and is based on the discharge prohibitions contained in section 13375 of the Water Code.

11. **Discharge Prohibition III.K.** The acceptance of septage to a location other than an approved septage receiving station is prohibited.

    This prohibition is newly established by this Order and is necessary to ensure that septage is not accepted in the absence of a septage management program to ensure that pollutants associated with domestic septage do not pass through or interfere with the operation or performance of the Facility.

## B. Technology-Based Effluent Limitations

### 1. Scope and Authority

Section 301(b) of the CWA and implementing U.S. EPA permit regulations at 40 C.F.R. section 122.44 require that permits include conditions meeting applicable technology-based requirements, at a minimum, and any more stringent effluent limitations necessary to meet applicable water quality standards. The discharge authorized by this Order must meet minimum federal technology-based requirements based on Secondary Treatment Standards at 40 C.F.R. part 133.

Regulations promulgated in 40 C.F.R. section 125.3(a)(1) require technology-based effluent limitations for municipal dischargers to be placed in NPDES permits based on Secondary Treatment Standards or Equivalent to Secondary Treatment Standards.

The Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) established the minimum performance requirements for POTWs [defined in section 304(d)(1)]. Section 301(b)(1)(B) of that Act requires that such treatment works must, as a minimum, meet effluent limitations based on secondary treatment as defined by the U.S. EPA Administrator.

Based on this statutory requirement, U.S. EPA developed secondary treatment regulations, which are specified in 40 C.F.R. part 133. These technology-based regulations apply to all municipal wastewater treatment plants and identify the minimum level of effluent quality attainable by secondary treatment in terms of $BOD_5$, TSS, and pH, as follows:

#### a. $BOD_5$ and TSS

**i.** The 30-day average shall not exceed 30 mg/L.

**ii.** The 7-day average shall not exceed 45 mg/L

**iii.** The 30-day average percent removal shall not be less than 85 percent.

#### b. pH

The pH shall be maintained within the limits of 6.0 to 9.0.

The effluent limitation for pH required to meet the water quality objective is contained in the Basin Plan, Table 3-1.

In addition, 40 C.F.R. section 122.45(f) requires the establishment of mass-based effluent limitations for all pollutants limited in Orders, except for 1) pH, temperature, radiation, or other pollutants, which cannot be appropriately expressed by mass, 2) when applicable standards and limitations are expressed in terms of other units of measure.

Following publication of the secondary treatment regulations, legislative history indicates that congress was concerned that U.S. EPA had not "sanctioned" the use of certain biological treatment techniques that were effective in achieving significant reductions in $BOD_5$ and TSS for secondary treatment. Therefore, in order to prevent unnecessary construction of costly new facilities, Congress included language in the 1981 amendment to the Construction Grants statutes [section 23 of Pub. L. 97-147] that required U.S. EPA to provide allowance for alternative biological treatment technologies such as trickling filters or waste stabilization ponds. In response to this requirement, the definition of secondary treatment was modified on September 20, 1984 and June 3, 1985, and published in the revised secondary treatment regulations contained in section 133.105. These regulations allow alternative limitations for facilities using trickling filters and waste stabilization ponds that meet the requirements for "equivalent to secondary treatment." Equivalent to secondary treatment limitations allow *up to* 45 mg/L (monthly average) and *up to* 65 mg/L (weekly average) for $BOD_5$ and TSS.

POTWs that use waste stabilization ponds, identified in section 133.103, as the principal process for secondary treatment and whose operation and maintenance data indicate that the TSS values specified in the equivalent to secondary regulations cannot be achieved, can qualify to have their minimum levels of effluent quality for TSS adjusted upwards.

Furthermore, in order to address the variations in facility performance due to geographic, climatic, or seasonal conditions in different states, the Alternative State Requirements (ASR) provision contained in 40 C.F.R. section 133.105(d) was written. ASR allows states the flexibility to set permit limitations above the maximum levels of 45 mg/L (monthly average) and 65 mg/L (weekly average) for TSS from lagoons. However, before ASR limitations for TSS can be set, the effluent must meet the $BOD_5$ limitations as prescribed by 40 C.F.R. section 133.102(a). Presently, the maximum TSS value set by the State of California for lagoon effluent is 95 mg/L. This value corresponds to a 30-day consecutive average or an average over a duration of less than 30 days.

According to 40 C.F.R. section 125.3(a)(1), in order to be eligible for equivalent to secondary treatment limitations, a POTW must meet all of the following criteria:

**a.** The principal treatment process must be either a trickling filter or waste stabilization pond.

**b.** The effluent quality consistently achieved, despite proper operations and maintenance, is in excess of 30 mg/L $BOD_5$ and TSS.

**c.** Water quality is not adversely affected by the discharge (section 133.101(g)).

**d.** The treatment works as a whole provides significant biological treatment such that a minimum 65 percent reduction of $BOD_5$ is consistently attained (30-day average).

**2. Applicable Technology-Based Effluent Limitations**

**a. Equivalent to Secondary Treatment Standards ($BOD_5$ and TSS).** In accordance with 40 C.F.R. section 133.101, a facility that utilizes a pond or a trickling filter system and cannot meet the secondary standards after proper operation and maintenance may be

allowed to meet treatment equivalent to secondary limits. As shown in Attachment C, when emergency discharges to Discharge Point 001 will occur (i.e., when flows exceed 5.9 mgd), effluent flows will be diverted from the oxidation ponds (i.e., the waste stabilization ponds), which will be the principle treatment process, to the chlorine contact chambers. Flows exceeding the peak wet weather design flow of 5.9 mgd do not receive enhanced treatment through the AMWS.

40 C.F.R. section 133.105(f) specifies that the permit shall require more stringent effluent limitations for existing facilities that can achieve more stringent limitations through proper operation and maintenance. 40 C.F.R. section 133.101(f) defines effluent concentrations consistently achievable through proper operation and maintenance as "*(1) for a given pollutant parameter, the 95th percentile value for the 30-day average effluent quality achieved by a treatment works in a period of at least two years, excluding values attributable to upsets, bypasses, operational errors, or other unusual conditions, and (2) a 7-day average value equal to 1.5 times the value derived under paragraph (f)(1) of this section.*" An analysis of monitoring data representative of effluent quality from the oxidation ponds prior to enhanced treatment through the AMWS, collected from August 2012 through April 2019, was performed to determine the 95th percentile value for the 30-day average $BOD_5$ and TSS concentrations. The 95th percentiles of 30-day averages for $BOD_5$ and TSS were 38 mg/L and 32 mg/L, respectively.

Effluent concentrations for $BOD_5$ and TSS that are consistently achievable for the Facility's waste stabilization pond treatment train, based on the 95th percentile values, exceeded the minimum levels for secondary treated effluent. Therefore, the Permittee is eligible for alternative limits for treatment equivalent to secondary for emergency discharges at Discharge Point 001. This Order establishes average monthly effluent limitations (AMELs) for $BOD_5$ and TSS of 38 mg/L and 32 mg/L, respectively, with compliance measured at Monitoring Location EFF-001, for emergency discharges to Humboldt Bay. The AMELs for $BOD_5$ and TSS are based on the 95th percentile values for the 30-day average concentrations, calculated in accordance with 40 C.F.R. section 133.101(f)(1).

Average weekly effluent limitations (AWELs) for $BOD_5$ and TSS applied at Discharge Point 001 have been established, as required by 40 C.F.R. section 122.45(d)(2). Consistent with 40 C.F.R. section 133.101(f)(2), the 7-day average $BOD_5$ and TSS effluent concentrations achievable through proper operation and maintenance of the Facility, based on monitoring data representative of the effluent quality from the oxidations ponds collected from August 2012 through April 2019, were calculated as 1.5 times the AMEL. Based on the calculations, this Order establishes AWELs for $BOD_5$ and TSS of 57 mg/L and 48 mg/L, respectively. Compliance with the AWELs based on equivalent to secondary treatment requirements will be determined at Monitoring Location EFF-001 for emergency discharges to Humboldt Bay at Discharge Point 001.

Percent removal requirements for $BOD_5$ and TSS at Discharge Point 001 have been retained from Order No. R1-2012-0031 and are based on the equivalent to secondary treatment requirements in 40 C.F.R. section 133.105.

Equivalent to secondary treatment is consistent with WQ Order No. 79-20 because the revised secondary treatment regulations contained in 40 C.F.R. section 133.105 determined that the revised standards were equivalent to the Secondary Treatment Standards for facilities meeting the technological requirements, as described above.

**b. Secondary Treatment Standards ($BOD_5$ and TSS).** Under the upgraded Facility configuration, the Permittee will utilize oxidation ponds (i.e., waste stabilization ponds)

and a parallel oxidation ditch system to treat wastewater flows up to 5.9 mgd. Effluent from the waste stabilization pond and oxidation ditch treatment trains will be commingled prior to UV disinfection and discharge to the AMWS at Discharge Point 002. According to 40 C.F.R. section 133.101, a facility is only eligible for consideration for effluent limitations described for treatment equivalent to secondary treatment if a trickling filter or waste stabilization pond is used as the principle process. Under the upgraded Facility configuration, effluent from the waste stabilization pond treatment train will be commingled with effluent from the oxidation ditch treatment train, which does not utilize tricking filters or waste stabilization ponds as the principle process. Therefore, since equivalent to secondary treatment standards do not apply to the commingled effluent, secondary treatment standards at 40 C.F.R. part 133 apply to the discharge at Discharge Point 002 and establish the minimum level of effluent quality attainable by secondary treatment in terms of $BOD_5$ and TSS, including percent removal. Federal regulations at 40 C.F.R. section 122.45(h) allow internal monitoring points to be established when needed to determine compliance with a standard and in cases where setting an external monitoring location is not feasible. Therefore, compliance with technology-based effluent limits for $BOD_5$ and TSS based on secondary treatment requirements will be determined at Monitoring Location EFF-002 for discharges to the AMWS. Since compliance with technology-based effluent limits for $BOD_5$ and TSS will be determined at Discharge Point 002, under the upgraded Facility configuration, Discharge Point 003 does not include effluent limitations for $BOD_5$ and TSS.

**c. pH.** The secondary treatment regulations at 40 C.F.R. part 133 apply to the discharge and require that pH be maintained between 6.0 and 9.0 standard units. Federal regulations at 40 C.F.R. section 122.45(h) allow internal monitoring points to be established when needed to determine compliance with a standard and in cases where setting an external monitoring location is not feasible. Effluent limitations for pH at Discharge Point 002 are necessary to ensure efficient operation of the AMWS as part of the Facility's treatment process prior to discharge to the brackish marsh. Therefore, this Order includes effluent limitations for pH at Discharge Point 002 based on the instantaneous maximum effluent limitation of 8.5 for pH as required at Discharge Points 001 and 003 to meet the water quality objective for Humboldt Bay established by chapter 3 of the Basin Plan.

**d. Mass-Based Effluent Limitations.** Federal regulations at 40 C.F.R. section 122.45(f) require that, except under certain conditions, all permit limits, standards, or prohibitions be expressed in terms of mass units. Among the conditions exempting the application of mass-based limitations is 40 C.F.R. section 122.45(f)(1)(i), which states "*for pH, temperature, and radiation, or other pollutants which cannot appropriately be expressed by mass*" and 40 C.F.R. section 122.45(f)(1)(ii), which states "*when applicable standards and limitations are expressed in terms of other units of measurement.*"

This Order does not include mass-based effluent limitations for the following pollutants pursuant to the exceptions in 40 C.F.R. section 122.45(f)(1)(i) and (ii):

**i.** $BOD_5$ and TSS, because these two parameters are expressed in terms of concentration and percent removal; and

**ii.** pH because this parameter cannot appropriately be expressed by mass.

## C. Water Quality-Based Effluent Limitations (WQBELs)

### 1. Scope and Authority

CWA section 301(b) and 40 C.F.R. section 122.44(d) require that permits include limitations more stringent than applicable federal technology-based requirements where necessary to achieve applicable water quality standards. This Order includes requirements more stringent than secondary treatment requirements that are necessary to meet Basin Plan requirements and applicable water quality standards for protection of beneficial uses.

Section 122.44(d)(1)(i) of 40 C.F.R. requires that permits include effluent limitations for all pollutants that are or may be discharged at levels that have the reasonable potential to cause or contribute to an exceedance of a water quality standard, including numeric and narrative objectives within a standard. Where reasonable potential has been established for a pollutant, but there is no numeric criterion or objective for the pollutant, WQBELs must be established using: (1) U.S. EPA criteria guidance under CWA section 304(a), supplemented where necessary by other relevant information; (2) an indicator parameter for the pollutant of concern; or (3) a calculated numeric water quality criterion, such as a proposed state criterion or policy interpreting the state's narrative criterion, supplemented with other relevant information, as provided in section 122.44(d)(1)(vi).

The process for determining reasonable potential and calculating WQBELs when necessary is intended to protect the designated uses of the receiving water as specified in the Basin Plan, and achieve applicable water quality objectives and criteria that are contained in other state plans and policies, or any applicable water quality criteria contained in the CTR and NTR.

### 2. Applicable Beneficial Uses and Water Quality Criteria and Objectives

**a. Beneficial Uses.** Beneficial use designations for receiving waters for discharges from the Facility are presented in section III.C.1 of this Fact Sheet.

**b. Basin Plan Water Quality Objectives.** In addition to the specific water quality objectives indicated above, the Basin Plan contains narrative objectives for color, tastes and odors, floating material, suspended material, settleable material, oil and grease, biostimulatory substances, sediment, turbidity, pH, dissolved oxygen, bacteria, temperature, toxicity, pesticides, chemical constituents, and radioactivity that apply to inland surface waters, enclosed bays, and estuaries, including Humboldt Bay and the brackish marsh. For waters designated for use as MUN, the Basin Plan establishes, as applicable water quality criteria, the MCLs established by the DDW for the protection of public water supplies at title 22 of the CCR section 64431 (Inorganic Chemicals) and section 64444 (Organic Chemicals).

**c. SIP, CTR, and NTR.** Water quality criteria and objectives applicable to Humboldt Bay and the brackish marsh are established by the CTR, established by the U.S. EPA at 40 C.F.R. section 131.38; and the NTR, established by the U.S. EPA at 40 C.F.R. section 131.36. Criteria for most of the 126 CTR priority pollutants are contained within the CTR and the NTR.

The SIP, which is described in section III.C.3 of this Fact Sheet, includes procedures for determining the need for, and the calculation of, WQBELs and requires Permittees to submit data sufficient to do so.

At title 22, division 4, chapter 15 of the CCR, DDW has established MCLs for certain pollutants for the protection of drinking water. Chapter 3 of the Basin Plan establishes these MCLs as water quality objectives applicable to receiving waters with the beneficial use designation of municipal and domestic supply. As described in section

III.C.1 of this Fact Sheet, the municipal and domestic supply beneficial use is not applicable to the receiving waters in the vicinity of the discharge.

Aquatic life freshwater and saltwater criteria are identified as criterion maximum concentrations (CMC) and criterion continuous concentrations (CCC). The CTR defines the CMC as the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time without deleterious effects and the CCC as the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects. The CMC is used to calculate an acute or 1-hour average numeric effluent limitation and the CCC is used to calculate a chronic or 4-day average numeric effluent limitation. The CTR at 40 C.F.R. section 131.38(c)(3)(iii) states that the more stringent of the freshwater or saltwater criteria are applicable for water in which the salinity is between 1 and 10 parts per thousand (ppt). Based on samples collected at the tide gate from the brackish marsh, the receiving water salinity ranged from 9.6 ppt to 36.1 ppt. Additionally, the salinity of the brackish marsh is expected to be reduced upon commencement of discharge at Discharge Point 003 when it will be, at times, dominated by effluent. Humboldt Bay and the brackish marsh are estuarine environments; therefore, consistent with 40 C.F.R. section 131.38(c)(3)(iii), freshwater and saltwater aquatic life criteria were both used for the RPA for Discharge Points 001 and 003.

Human health criteria are further identified as "water and organisms" and "organisms only". "Water and organism" criteria are designed to address risks to human health from multiple exposure pathways. As stated in section III.C.1 of this Fact Sheet, the municipal and domestic supply beneficial use is not applicable to the receiving waters in the vicinity of the discharges; therefore, the "water and organisms" criteria do not apply and the "organisms only" criteria were used for the RPA.

**3. Determining the Need for WQBELs**

NPDES regulations at 40 C.F.R. section 122.44(d) require effluent limitations to control all pollutants, which are or may be discharged at a level that will cause, have the reasonable potential to cause, or contribute to an excursion above any state water quality standard. The RPA for this Facility was conducted as follows.

**a. Non-Priority Pollutants**

**i. Fecal Coliform.** Order No. R1-2012-0031 specified that the disinfected effluent discharged through Discharge Points 001 or 003 shall not contain concentrations of fecal coliform bacteria exceeding the following limitations:

**(a)** The median concentration shall not exceed a Most Probable Number (MPN) of 14 organisms per 100 mL in a calendar month, and

**(b)** Not more than 10 percent of samples collected in a calendar month shall exceed an MPN of 43 organisms per 100 mL.

These effluent limitations for fecal coliform bacteria have been retained from Order No. R1-2012-0031 and reflect water quality objectives for bacteria established by the Basin Plan for the protection of shellfish harvesting areas. For the protection of beneficial uses created by the AMWS, the point of compliance for fecal coliform bacteria effluent limitations for discharges to the brackish marsh has been moved from Discharge Point 003 to Discharge Point 002, following the UV disinfection system and prior to discharge to the AMWS. Because Humboldt Bay is home to large shellfish harvesting operations, it is appropriate to continue to retain fecal coliform limitations for the protection of shellfish harvesting areas.

The Basin Plan criteria are based on recommendations from the National Shellfish Sanitation Program's Fecal Coliform Standard for Adverse Pollution Conditions in the 2003 *Guide for the Control of Mulluscan Shellfish, Model Ordinance for Shellstock Growing Areas* (U.S. Department of Health and Human Services, Public Health Service, Food and Drug Administration).

**ii. Enterococci Coliform.** On August 7, 2018, the State Water Board adopted Part 3 of the *Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California – Bacteria Provisions and a Water Quality Standards Variance Policy* (Statewide Bacteria Provisions), which establishes water quality objectives for reasonable protection of people that recreate within all surface waters, enclosed bays, and estuaries of the state that have the water contact recreation beneficial use (REC-1). In accordance with the water quality objectives outlined in the Statewide Bacteria Provisions for the protection of freshwaters used for water contact recreation, disinfected effluent shall not contain *enterococci* bacteria exceeding the following limitations:

**(a)** The concentration of enterococci shall not exceed 30 colony forming units (cfu) per 100 milliliters (mL) as a six-week rolling geometric mean, calculated weekly.

**(b)** A statistical threshold value (STV) of 110 cfu/100 mL shall not be exceeded by more than 10 percent of the samples collected in a calendar month and calculated in a static manner.

As discussed in section IV.C.3.a.ii above, this Order contains effluent limitations for fecal coliform bacteria that reflect standards for the protection of shellfish harvesting areas. Because enterococci is a subset of the total coliform group, the enterococci limitations established in the Statewide Bacteria Provisions are not as stringent as the Basin Plan fecal coliform standards implemented in this Order.

Section IV.E.1 of the Statewide Bacteria Provisions states that "where a permit, WDR, or waiver of WDR includes an effluent limitation or discharge requirement derived from a water quality objective, guideline, or other requirement to control bacteria that is a more stringent value than the applicable bacteria water quality objective, the bacteria water quality objective shall not be implemented in the permit, WDR, or waiver of WDR."

The effluent limitations established for fecal coliform will ensure that bacterial standards for water contact recreation are maintained throughout the receiving water.

**iii. pH.** Chapter 3, Table 3-1 of the Basin Plan includes site-specific water quality objectives for pH applicable to Humboldt Bay, which specify that the pH shall not be depressed below natural background levels nor raised above 8.5. For discharges to Humboldt Bay at Discharge Point 001, 002 and 003, this Order includes an instantaneous minimum effluent limitation for pH of 6.0 based on the secondary treatment standards at 40 C.F.R. part 133 and an instantaneous maximum effluent limitation for pH of 8.5 based on the site-specific maximum water quality objective for Humboldt Bay established in chapter 3, Table 3-1 of the Basin Plan. The federal technology-based maximum requirement prescribed in the secondary treatment standards at 40 C.F.R. part 133 is not sufficient to meet the Basin Plan water quality standard.

**iv. Ammonia.** Untreated domestic wastewater contains ammonia nitrogen. Nitrification is a biological process that converts ammonia to nitrite and nitrate.

Denitrification is a process that converts nitrate to nitrogen gas, which is then released to the atmosphere. Inadequate or incomplete nitrification may result in the discharge of ammonia to Humboldt Bay and the brackish marsh.

Ammonia is known to cause toxicity to aquatic organisms in surface waters. The Basin Plan establishes a narrative water quality objective for toxicity, stating that "[a]*ll waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life*." Due to concerns regarding ammonia toxicity, the Regional Water Board relies on U.S. EPA's recommended water quality criteria for ammonia to interpret the Basin Plan's narrative objective for toxicity. For saltwater, the recommended criteria are from the April 1989 *Ambient Water Quality Criteria for Ammoni*a, EPA-440/5-88-004 (1989 Saltwater Criteria). For freshwater, the recommended criteria are from the April 2013 *Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater*, EPA 822-R-13-001 (2013 Freshwater Criteria). The 2013 Freshwater Criteria is an update to the December 1999 *Update of Ambient Water Quality Criteria for Ammonia* (1999 Freshwater Criteria).

The 1989 Saltwater Criteria document includes three tables of recommended criteria for receiving water salinities of 10 g/kg, 20 g/kg, and 30 g/kg. Based on samples collected at the tide gate from the brackish marsh, the receiving water salinity ranged from 9.6 ppt to 36.1 ppt. The salinity of the brackish marsh is expected to be reduced upon commencement of discharge at Discharge Point 003 when it will be, at times, dominated by effluent. Therefore, the table for receiving waters with salinity of 10 g/kg was used. The acute (1-hour average) and chronic (4-day average) criteria are based on pH and temperature.

The 2013 Freshwater Criteria recommends acute and chronic water quality criteria for the protection of aquatic life, including salmonids and sensitive freshwater mussel species in the Family Unionidae that are more sensitive to ammonia than salmonids. Like the 1999 Freshwater Criteria document, the 2013 Freshwater Criteria document recommends acute (1-hour average) criteria based on pH and the presence/absence of salmonids and chronic (30-day average) criteria based on pH and temperature and that no 4-day average concentration should exceed 2.5 times the 30-day chronic criterion. In addition, the 2013 Freshwater Criteria document recommends these same criteria for sensitive mussel species.

Adequate information is not available to determine if these freshwater mussels are present in the receiving water. The 2013 Freshwater Criteria document states, "*In the case of ammonia, where a state demonstrates that mussels are not present on a site-specific basis, the recalculation procedure may be used to remove the mussel species from the national criteria dataset to better represent the species present at the site*."

Effluent monitoring results ranged from 0.40 mg/L to 18 mg/L based on 18 samples collected at Monitoring Location EFF-001 between August 2012 and May 2018. Monitoring for ammonia in the receiving water was not conducted over the term of Order No. R1-2012-0031.

Because ammonia levels in the effluent have been measured at concentrations greater than EPA's 1989 Saltwater Criteria, the Regional Water Board concludes that discharges from the Facility have a reasonable potential to cause or contribute to exceedances of applicable water quality criteria for toxicity.

For this Order, the Regional Water Board has changed its approach for evaluating ammonia toxicity. This Order establishes an Ammonia Impact Ratio (AIR) for determining compliance with ammonia effluent limitations. The AIR is calculated as the ratio of the ammonia value in the effluent to the applicable 1989 Saltwater Criteria. See Attachment H of this Order for a sample log to help calculate and record the AIR values and Attachment G for applicable ph, temperature and salinity dependent criteria.

Therefore, this Order includes effluent limitations for ammonia for the protection of aquatic life. This Order establishes an average monthly effluent limitations (AMEL) and maximum daily effluent limitations (MDEL) for total ammonia, expressed as N, through the use of an AIR at Discharge Points 001 and 003 based on EPA's 1989 Saltwater Criteria. Calculations of the applicable multipliers are included in section IV.C.4 of this Fact Sheet.

**v. Biostimulatory Substances (Phosphorus and Nitrogen).** The Basin Plan contains a narrative water quality objective for biostimulatory substances that states "[w]*aters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses*." The Regional Water Board is increasingly concerned about the biostimulatory properties of discharges to surface waters in the North Coast Region. Nutrients, such as phosphorus and nitrogen containing compounds, in treated wastewater stimulate biological growth, thereby depleting dissolved oxygen and advancing eutrophication of receiving waters. At present, for interpretation of the Basin Plan's narrative water quality objective for biostimulatory substances, U.S. EPA has established recommended water quality criteria for nutrients in *Nutrient Criteria Documents for Lakes and Rivers and Nutrient Criteria Documents for Rivers and Streams*. U.S. EPA has defined 14 "ecoregions" and further categorized surface waters as lakes and reservoirs or rivers and streams for purposes of defining applicable numeric water quality criteria for nutrients. The State and Regional Water Boards continue to examine other methods of interpreting the Basin Plan's narrative water quality objective for biostimulatory substances. When the Boards determine that U.S. EPA's recommended criteria are appropriate for implementing the Basin Plan objectives, or when a more appropriate and meaningful method is established, the need for limiting nutrients in relation to biostimulatory properties, including phosphorus and nitrogen-containing compounds, in all discharges in the Region will be reassessed. In the meantime, the RPA for nutrients in relation to biostimulatory properties, performed for development of this Order, is inconclusive. The Order retains monitoring requirements for phosphorus and nitrogen containing compounds in discharges from the Facility to allow a determination of reasonable potential at such time as the State and Regional Water Boards select an appropriate method for interpretation of the Basin Plan's narrative objective.

The Permittee sampled its discharge at Monitoring Location EFF-001 quarterly between August 2012 and April 2019. Monitoring results ranged between 0.1 mg/L and 2.7 mg/L based on 26 samples. The Permittee does not exhibit reasonable potential to exceed applicable water quality criteria for the receiving water for nitrate.

**vi. Chlorine Residual.** The Basin Plan establishes a narrative water quality objective for toxicity which states "*[a]ll waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life*." The Regional Water Board considers any

chlorinated discharge as having the reasonable potential to cause or contribute to exceedances of this water quality objective for toxicity, and therefore this Order includes effluent limitations for chlorine. U.S. EPA has established the following criteria for chlorine-produced oxidants for protection of freshwater aquatic life in Quality Criteria for Water 1986 (The Gold Book, 1986, EPA 440/5-86-001).

| Chronic Criterion | Acute Criterion |
|---|---|
| 0.011 mg/L | 0.019 mg/L |

Consistent with Order No. R1-2012-0031, the water quality criteria for total chlorine residual recommended by U.S. EPA have been translated to an AMEL of 0.01 mg/L and an MDEL of 0.02 mg/L in this Order, which will be applied at all times when the Facility utilizes chlorine for disinfection at Discharge Points 001 and 002. Under the existing Facility configuration, chlorine disinfection is utilized prior to discharge to Humboldt Bay at Discharge Point 001 and to the AMWS at Discharge Point 002. However, under the upgraded Facility configuration, following the construction of the UV disinfection system upstream of Discharge Point 002, chlorine disinfection will only be utilized for emergency discharges of the portion of flow exceeding 5.9 mgd at Discharge Point 001.

vii. **Settleable Solids.** Effluent limitations for settleable solids reflect levels of treatment attainable by secondary treatment facilities. These limitations are based on the Basin Plan water quality objective prohibiting bottom deposits for all surface waters of the North Coast Region. This Order applies the effluent limitations for settleable solids at Discharge Points 001 and 003 for discharges to Humboldt Bay and the brackish marsh.

Federal regulations at 40 C.F.R. section 122.45(h) allow internal monitoring points to be established when needed to determine compliance with a standard and in cases where setting an external monitoring location is not feasible. Effluent limitations for settleable solids at Discharge Point 002 are necessary to ensure efficient operation of the AMWS as part of the Facility's treatment process prior to discharge to the brackish marsh and to protect the applicable beneficial uses. Therefore, this Order includes effluent limitations for settleable solids at Discharge Point 002 based on levels of treatment attainable by secondary treatment facilities.

**b. CTR Priority Pollutants**

The SIP establishes procedures to implement water quality criteria from the NTR and CTR and for priority, toxic pollutant objectives established in the Basin Plan. The implementation procedures of the SIP include methods to determine reasonable potential (for pollutants to cause or contribute to excursions above state water quality standards) and to establish numeric effluent limitations, if necessary, for those pollutants showing reasonable potential.

Section 1.3 of the SIP requires the Regional Water Board to use all available, valid, relevant, and representative receiving water and effluent data and information to conduct an RPA. For this Order, the Regional Water Board has conducted an RPA for discharges to Humboldt Bay at Discharge Point 001 and the brackish marsh at Discharge Point 003 using monitoring data collected at Monitoring Location EFF-001. During the term of Order No. R1-2012-0031, CTR priority pollutant sampling was conducted on August 5, 2013, October 14, 2013 (volatile organic compounds only), October 21, 2014, October 28, 2015, and September 22, 2016 at Monitoring Location EFF-001. In addition, the Permittee conducted monthly monitoring for copper and

cyanide, and quarterly monitoring for bis (2-ethylhexyl) phthalate, carbon tetrachloride, dichlorobromomethane, and TCDD-equivalents. All of this data was used to complete the RPA. No CTR priority pollutant data was available for the receiving water.

**Hardness:** The CTR and the NTR contain water quality criteria for seven metals that vary as a function of hardness; the lower the hardness, the lower the water quality criteria. The SIP requires water quality criteria be properly adjusted for hardness, using the hardness of the receiving water. The hardness-dependent metal criteria include cadmium, copper, chromium (III), lead, nickel, silver, and zinc. Receiving water hardness data was not available for Humboldt Bay or the brackish marsh in the vicinity of the outfalls. Humboldt Bay and the brackish marsh are estuarine environments, which are tidally influenced. Depending on the tide and season, these receiving waters may range from a predominantly freshwater/low hardness environment to a predominantly marine/high hardness environment. Because receiving water hardness data was not available for the RPA for Discharge Points 001 and 003, the Regional Water Board used a hardness value of 400 mg/L, which is the default high value for use in the RPA, as established in the CTR at section 131.38(c)(4)(i). This value may not be protective in all circumstances, and as receiving water hardness data is generated, the permit may be reopened to incorporate additional or more restrictive limitations, if necessary.

To conduct the RPA, Regional Water Board staff identified the maximum effluent concentration (MEC) and maximum background (B) concentration for each priority, toxic pollutant from effluent and receiving water data provided by the Permittee, and compared this information to the most stringent applicable water quality criterion (C) for each pollutant with applicable water quality criteria from the NTR, CTR, and the Basin Plan. Section 1.3 of the SIP establishes three triggers for a finding of reasonable potential.

**Trigger 1.** If the MEC is greater than C, there is reasonable potential, and an effluent limitation is required.

**Trigger 2.** If B is greater than C, and the pollutant is detected in effluent (MEC > ND), there is reasonable potential, and an effluent limitation is required.

**Trigger 3.** After a review of other available and relevant information, a permit writer may decide that a WQBEL is required. Such additional information may include, but is not limited to: the facility type, the discharge type, solids loading analyses, lack of dilution, history of compliance problems, potential toxic impact of the discharge, fish tissue residue data, water quality and beneficial uses of the receiving water, CWA 303(d) listing for the pollutant, and the presence of endangered or threatened species or their critical habitat.

**c. Reasonable Potential Determination**

The RPA demonstrated reasonable potential for discharges of copper (Discharge Point 003 only), cyanide, and TCDD-equivalents from the Facility to cause or contribute to exceedances of applicable water quality criteria. Reasonable potential could not be determined for all pollutants, as there are not applicable water quality criteria for all pollutants. The RPA determined that there is either no reasonable potential or there was insufficient information to conclude affirmative reasonable potential for 120 of the 126 CTR priority pollutants.

Table F-6 summarizes the RPA for each pollutant that was reported in detectable concentrations in the effluent or the receiving water. The MECs, most stringent water

quality objectives/water quality criteria (WQO/WQCs), and background concentrations (B) used in the RPA are presented, along with the RPA results (Yes or No and which trigger) for each toxic pollutant analyzed. No other pollutants with applicable, numeric water quality criteria from the NTR, CTR, and the Basin Plan were measured above detectable concentrations during the monitoring events conducted by the Permittee. Attachment F-1 to this Order summarizes the RPA for all 126 CTR priority pollutants.

**Table F-6. Summary of Reasonable Potential Analysis Results**

| CTR # | Pollutant | Unit | C or Most Stringent WQO/WQC | MEC or Minimum DL[1] | B or Minimum DL[1,2] | RPA Results[3] |
|---|---|---|---|---|---|---|
| 1 | Antimony | µg/L | 4,300 | 2.7 | Not Available | No |
| 2 | Arsenic | µg/L | 36 | 1.3 | Not Available | No |
| 4 | Cadmium | µg/L | 7.3 | 0.34 | Not Available | No |
| 5a | Chromium (III) | µg/L | 644 | 0.56 | Not Available | No |
| 5b | Chromium (VI) | µg/L | 11 | 6.4 | Not Available | No |
| 6 | Copper[4] | µg/L | 22[5] | 7.6 | Not Available | No |
| 6 | Copper[6] | µg/L | 3.7 | 7.6 | Not Available | Yes (Trigger 1) |
| 8 | Mercury | µg/L | 0.051 | 0.00368 | Not Available | No |
| 9 | Nickel | µg/L | 8.3 | 3.9 | Not Available | No |
| 10 | Selenium | µg/L | 5.0 | 1.1 | Not Available | No |
| 12 | Thallium | µg/L | 6.3 | 0.23 | Not Available | No |
| 13 | Zinc | µg/L | 86 | 7.2 | Not Available | No |
| 14 | Cyanide | µg/L | 1.0 | 7.0 | Not Available | Yes (Trigger 1) |
| 21 | Carbon Tetrachloride | µg/L | 4.4 | 0.80 | Not Available | No |
| 23 | Chlorodibromomethane | µg/L | 34 | 1.3 | Not Available | No |
| 26 | Chloroform | µg/L | No Criteria | 13 | Not Available | No |
| 27 | Dichlorobromomethane | µg/L | 46 | 5.7 | Not Available | No |
| 39 | Toluene | µg/L | 200,000 | 0.29 | Not Available | No |
| 54 | Phenol | µg/L | 4,600,000 | 2.1 | Not Available | No |
| 68 | Bis (2-ethylhexyl) phthalate | µg/L | 5.9 | 2.8 | Not Available | No |
| 94 | Naphthalene | µg/L | No Criteria | 0.047 | Not Available | No |
| Not Applicable | TCDD-Equivalents | µg/L | $1.4 \times 10^{-8}$ | $2.85 \times 10^{-7}$ | Not Available | Yes (Trigger 1) |

| CTR # | Pollutant | Unit | C or Most Stringent WQO/WQC | MEC or Minimum DL[1] | B or Minimum DL[1,2] | RPA Results[3] |
|---|---|---|---|---|---|---|
| Not Applicable | Ammonia | mg/L | 0.29[7] | 18 | Not Available | Yes (Trigger 1) |
| Not Applicable | Nitrate | mg/L | 10 | 2.7 | Not Available | No |

Table Notes:

1. The Maximum Effluent Concentration (MEC) or maximum background concentration (B) is the actual detected concentration unless it is preceded by "<", in which case the value shown is the minimum detection level as the analytical result was reported as not detected (ND).
2. The MEC or B is "Not Available" when there is no monitoring data for a constituent.
3. RPA Results:
   = Yes, if MEC > WQO/WQC, or B > WQO/WQC and MEC is detected.
   = No, if MEC and B or < WQO/WQC or all effluent data are undetected.
   = Undetermined (UD).
4. Applies only to Humboldt Bay at Discharge Point 001.
5. Copper WQO calculated with a water effects ratio (WER) of 5.76 and the most stringent WQO from the CTR using a hardness of 400 mg/L (5.76 x 7.3 = 22 µg/L).
6. Applies only to the brackish marsh at Discharge Point 003.
7. The saltwater criterion represented in this table is based upon chronic exposure and a temperature of 23.2°C, a pH of 8.4, and a salinity value of 10 g/kg.

Additional details regarding CTR priority pollutant constituents for which reasonable potential was found are included in the following paragraphs:

Copper. Order No. R1-2012-0031 included effluent limitations for copper. The CTR includes criteria for the protection of saltwater aquatic life and hardness-dependent criteria for the protection of freshwater aquatic life for copper. The criteria for copper is in dissolved concentrations. U.S. EPA recommends conversion factors to translate dissolved concentrations to total concentrations. The U.S. EPA default conversion factors for copper in freshwater are 0.96 for both the acute and the chronic criteria. The default WER used for calculating criteria for copper is 1.0. The Permittee has conducted a WER study to determine the site-specific toxicity of copper in the receiving water at Discharge Point 001. The Permittee's study concluded that a site specific WER of 5.76 for total recoverable copper applies to the discharge at Discharge Point 001. Using a receiving water hardness of 400 mg/L, the U.S. EPA recommended dissolved-total translator of 0.96, and the site-specific WER, the applicable chronic criterion (maximum 4-day average concentration) is adjusted to 22 µg/L and the applicable acute criterion (maximum 1-hour average concentration) is adjusted to 33 µg/L for discharges at Discharge Point 001. Because the WER study did not present data collected at Discharge Point 003, the default WER was used for calculating copper criteria for discharges to the brackish marsh. Using a receiving water hardness of 400 mg/L, the U.S. EPA recommended dissolved-total translator of 0.96, and the default WER, the applicable chronic criterion is 3.7 µg/L and the applicable acute criterion is 5.8 µg/L for discharges at Discharge Point 003.

The Permittee sampled the effluent for copper 33 times during the term of Order No. R1-2012-0068. Copper was detected in all 33 effluent samples, with results ranging from 1.4 µg/L to 7.6 µg/L. A determination of reasonable potential has been made for discharges at Discharge Point 003 only, based on the MEC of 7.6 µg/L exceeding the most stringent water quality objective of 3.7 µg/L.

Cyanide. Order No. R1-2012-0031 included effluent limitations for cyanide. The CTR establishes a water quality objective for the protection of saltwater aquatic life of 1.0 µg/L and a water quality objective for the protection of freshwater aquatic life of 5.2 µg/L for

cyanide. The Permittee sampled the effluent for cyanide 57 times during the term of Order No. R1-2012-0068. Cyanide was detected in 26 of the effluent samples, with results ranging from 0.97 µg/L to 7.0 µg/L. A determination of reasonable potential has been made for discharges from Discharge Points 001 and 003 based on the MEC of 7.0 µg/L exceeding the most stringent water quality objective of 1.0 µg/L. Effluent limitations for cyanide will be applied at Discharge Points 001 and 003.

2,3,7,8-TCDD and TCDD-Equivalents. Order No. R1-2012-0068 included effluent limitations for TCDD-equivalents. The CTR establishes a water quality criterion for the protection of human health for 2,3,7,8-TCDD of $1.3 \times 10^{-8}$ µg/L. The CTR and Basin Plan do not establish water quality objectives for TCDD-equivalents; however, the CTR criterion for 2,3,7,8-TCDD can be used to interpret the Basin Plan's narrative toxicity objective for TCDD-equivalents. The Permittee sampled the effluent for 2,3,7,8-TCDD and the other 16 dioxin and furan congeners 17 times during the term of Order No. R1-2012-0031. Congeners were detected in all 17 effluent samples, with TCDD-equivalents totals ranging from $1.99 \times 10^{-9}$ µg/L to $2.9 \times 10^{-7}$ µg/L. Additionally, there are known industrial users within the Permittee's service area and Humboldt Bay is listed in CWA section 303(d) as impaired for dioxins. Therefore, a determination of reasonable potential has been made based for TCDD-equivalents based on the MEC of $2.9 \times 10^{-7}$µg/L exceeding the most stringent applicable water quality objective of $1.3 \times 10^{-8}$ µg/L and Humboldt Bay's listing in CWA section 303(d) as impaired for dioxins. Effluent limitations for TCDD-equivalents will be applied at Discharge Points 001 and 003.

Additional details regarding CTR priority pollutant constituents for which reasonable potential was not found but warrant further explanation are included in the following paragraphs:

Carbon Tetrachloride. Order No. R1-2012-0031 included effluent limitations for carbon tetrachloride at Discharge Points 001 and 003. The CTR establishes a water quality objective for carbon tetrachloride for the protection of human health for waters from which organisms are consumed of 4.4 µg/L. The Permittee sampled the effluent for carbon tetrachloride 21 times during the term of Order No. R1-2012-0031. Carbon tetrachloride was detected in the effluent in one sample, with a result of 0.80 µg/L. Receiving water monitoring for carbon tetrachloride was not conducted over the term of Order No. R1-2012-0031. Since the MEC was less than the applicable water quality objective for carbon tetrachloride, a determination of no reasonable potential has been made and effluent limitations have not been retained in this Order.

Dichlorobromomethane. Order No. R1-2012-0031 included effluent limitations for dichlorobromomethane at Discharge Point 001. The CTR establishes a water quality objective for dichlorobromomethane for the protection of human health for waters from which organisms are consumed of 46 µg/L. The Permittee sampled the effluent for dichlorobromomethane 22 times during the term of Order No. R1-2012-0031. Dichlorobromomethane was detected in the effluent in 20 samples, with results ranging from 0.55 µg/L to 5.7 µg/L Receiving water monitoring for dichlorobromomethane was not conducted over the term of Order No. R1-2012-0031. Since the MEC was less than the applicable water quality objective for dichlorobromomethane, a determination of no reasonable potential has been made and effluent limitations at Discharge Point 001 have not been retained in this Order.

Bis (2-Ethylhexyl) Phthalate. Order No. R1-2012-0031 included effluent limitations for bis (2-ethylhexyl) phthalate at Discharge Points 001 and 003. The CTR establishes a water quality objective for bis (2-ethylhexyl) phthalate for the protection of human health for waters from which organisms are consumed of 5.9 µg/L. The Permittee sampled the effluent for bis (2-ethylhexyl) phthalate 22 times during the term of Order No. R1-2012-0031. Bis

(2-ethylhexyl) phthalate was detected in the effluent in five samples, with results ranging from 1.1 µg/L to 2.8 µg/L. Receiving water monitoring for bis (2-ethylhexyl) phthalate was not conducted over the term of Order No. R1-2012-0031. Since the MEC was less than the applicable water quality objective for bis (2-ethylhexyl) phthalate, a determination of no reasonable potential has been made and effluent limitations have not been retained in this Order.

**4. WQBEL Calculations**

Final WQBELs have been determined using the methods described in section 1.4 of the SIP.

**Step 1:** To calculate the effluent limits, an effluent concentration allowance (ECA) is calculated for each pollutant found to have reasonable potential using the following equation, which takes into account dilution and background concentrations:

ECA = C + D (C – B),

Where:

C = the applicable water quality criterion (adjusted for effluent hardness and expressed as the total recoverable metal, if necessary)

D = dilution credit (here D= 0, as the discharge does not qualify for a dilution credit)

B = background concentration

Here, no credit for dilution is allowed, which results in the ECA being equal to the applicable criterion (ECA = C).

**Step 2:** For each ECA based on an aquatic life criterion/objective (copper, cyanide, and ammonia), the long-term average discharge condition (LTA) is determined by multiplying the ECA by a factor (multiplier), which adjusts the ECA to account for effluent variability. The multiplier depends on the coefficient of variation (CV) of the data set and whether it is an acute or chronic criterion/objective. Table 1 of the SIP provides pre-calculated values for the multipliers based on the values of the CV. When the data set contains less than 10 sample results, or when 80 percent or more of the data set is reported as ND, the CV is set equal to 0.6. Derivation of the multipliers is presented in section 1.4 of the SIP.

The SIP procedure assumes a 4-day averaging period for calculating the LTA. However, U.S. EPA recommends modifying the procedure for calculating permit limits for ammonia using a 30-day averaging period for the calculation of the LTA corresponding to the 30-day CCC. Therefore, while the LTAs corresponding to the acute and 4-day chronic criteria were calculated according to SIP procedures, the LTA for ammonia corresponding to the 30-day CCC was calculated assuming a 30-day averaging period.

From Table 1 in the SIP, the ECA multipliers for calculating LTAs at the 99$^{th}$ percentile occurrence probability for copper are 0.461 (acute multiplier) and 0.662 (chronic multiplier). The ECA multipliers for cyanide are 0.247 (acute multiplier) and 0.436 (chronic multiplier). The ECA multipliers for ammonia are 0.210 (acute multiplier), 0.382 (chronic 4-day multiplier), and 0.675 (chronic 30-day multiplier). The LTAs are determined as follows in Table F-7.

**Table F-7. Determination of Long Term Averages**

| Pollutant | Units | ECA | | ECA Multiplier | | LTA | |
|---|---|---|---|---|---|---|---|
| | | Acute | Chronic | Acute | Chronic | Acute | Chronic |
| Copper, Total Recoverable | µg/L | 5.8 | 3.7 | 0.461 | 0.662 | 2.67 | 2.45 |
| Cyanide, Total (as CN) | µg/L | 1.0 | 1.0 | 0.247 | 0.436 | 0.247 | 0.436 |
| Ammonia (as N)[1] | mg/L | 1.9 | 0.29 | 0.210 | 0.382 | 0.399 | 0.111 |

Table Notes:
1. Ammonia LTAs were calculated based on applicable saltwater aquatic life criteria.

**Step 3:** WQBELs, including an AMEL and MDEL, are calculated using the most limiting (lowest) LTA. The LTA is multiplied by a factor that accounts for averaging periods and exceedance frequencies of the effluent limitations, and for the AMEL, the effluent monitoring frequency. The CV is set equal to 0.37 for copper, 0.81 for cyanide, and 0.97 for ammonia. The sampling frequency is set equal to 4 (n = 4) for both the acute and chronic criteria. The 99th percentile occurrence probability was used to determine the MDEL multiplier and a 95th percentile occurrence probability was used to determine the AMEL multiplier. From Table 2 of the SIP, the MDEL multiplier for copper is 2.17 and the AMEL multiplier is 1.33. From Table 2 of the SIP, the MDEL multiplier for cyanide is 4.05 and the AMEL multiplier is 1.76. From Table 2 of the SIP, the MDEL multiplier for ammonia is 4.76 and the AMEL multiplier is 1.91. Final WQBELs for copper and cyanide are determined as follows.

**Table F-8. Determination of Final WQBELs Based on Aquatic Life Criteria**

| Pollutant | Unit | LTA | MDEL Multiplier | AMEL Multiplier | MDEL | AMEL |
|---|---|---|---|---|---|---|
| Copper, Total Recoverable | µg/L | 2.45 | 2.17 | 1.33 | 5.3 | 3.3 |
| Cyanide, Total (as CN) | µg/L | 0.247 | 4.05 | 1.76 | 1.0 | 0.43 |

Final WQBELs for ammonia are determined by calculating the AIR for each of the ammonia standards (AMEL and MDEL). Attachment H of this Order includes two tables that display the AMEL and MDEL ammonia standards. The ammonia standards are calculated by taking the variable ammonia criteria and multiplying it by the ECA multiplier and the appropriate AMEL and MDEL multiplier. The 2013 ammonia criteria are dependent on the pH and temperature of the receiving water. For example:

$$\boldsymbol{AMEL\ Ammonia\ Standard} = \left(1989\ Chronic\ Ammonia\ Criteria\ (ECA) * AMEL\ Multiplier\ (1.91) * ECA\ Multiplier\ (0.38)\right)$$

$$\boldsymbol{MDEL\ Ammonia\ Standard} = \left(1989\ Chronic\ Ammonia\ Criteria\ (ECA) * MDEL\ Multiplier\ (4.76) * ECA\ Multiplier\ (0.38)\right)$$

The AIR, or final WQBEL, is determined by dividing the ammonia sample by the appropriate ammonia standard (AMEL and MDEL). If the AIR is greater than 1.0 then the Permittee is not in compliance with the AIR effluent limitation.

**Step 4:** When the most stringent water quality criterion/objective is a human health criterion/objective (as for TCDD-equivalents), the AMEL is set equal to the ECA. From Table 2 of the SIP, when CV = 0.85 and n = 4, the MDEL multiplier at the 99$^{th}$ percentile occurrence probability equals 4.25, and the AMEL multiplier at the 95$^{th}$ percentile occurrence probability equals 1.80 (for TCDD-equivalents). The MDEL for protection of human health is calculated by multiplying the ECA by the ratio of the MDEL multiplier to the AMEL multiplier. Final WQBELs for TCDD-equivalents are determined as follows.

**Table F-9. Determination of Final WQBELs Based on Human Health Criteria**

| Pollutant | ECA (µg/L) | MDEL/AMEL | MDEL (µg/L) | AMEL (µg/L) |
|---|---|---|---|---|
| TCDD-Equivalents | $1.4 \times 10^{-8}$ | 2.4 | $3.3 \times 10^{-8}$ | $1.4 \times 10^{-8}$ |

### 5. Whole Effluent Toxicity (WET)

Monitoring and effluent limitations for whole effluent toxicity protect the receiving water from the aggregate effect of a mixture of pollutants that may be present in the effluent. There are two types of WET tests – acute and chronic. An acute toxicity test is conducted over a short time period and measures mortality. A chronic test is conducted over a longer period of time and may measure mortality, reproduction, and/or growth.

WET requirements are derived from the CWA and the Basin Plan. The Basin Plan establishes a narrative water quality objective for toxicity that states "*All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, or aquatic life*." Detrimental responses may include, but are not limited to, decreased growth rate, decreased reproductive success of resident or indicator species, and/or significant alterations in population, community ecology, or receiving water biota. For compliance with the Basin Plan's narrative toxicity objective, this Order requires the Permittee to conduct WET testing for acute and chronic toxicity, as specified in the MRP (Attachment E, section V).

#### a. Acute Aquatic Toxicity

Consistent with Order No. R1-2012-0031, this Order includes effluent limitations for acute toxicity at Discharge Points 001 and 003 in accordance with the Basin Plan, which requires that the average survival of test organisms in undiluted effluent for any three consecutive 96-hour bioassay tests be at least 90 percent, with no single test having less than 70 percent survival.

The Order implements federal guidelines (Regions 9 and 10 Guidelines for Implementing Whole Effluent Toxicity Testing Programs) by requiring the Permittee to conduct acute toxicity tests on a fish species and on an invertebrate species to determine the most sensitive species. According to the U.S. EPA manual, *Methods for Estimating the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms* (EPA/600/4-90/-27F), the acceptable vertebrate species for the acute toxicity test are the sheepshead minnow, *Cyprinodon variegatus*, the fathead minnow, *Pimephales promelas*, and the rainbow trout, *Oncorhynchus mykiss*. The acceptable invertebrate species for the acute toxicity test are the mysid shrimp, *Mysidopsis bahia*, and the water flea, *Ceriodaphnia dubia*, *Daphnia magna*, and *D. pulex*. This Order requires the Permittee to conduct a screening test using a vertebrate and invertebrate species. After the screening test is completed, monitoring can be reduced to the most sensitive species. Attachment E of this Order requires annual acute WET monitoring.

#### b. Chronic Aquatic Toxicity

The SIP requires the use of short-term chronic toxicity tests to determine compliance with the narrative toxicity objectives for aquatic life in the Basin Plan. The SIP requires that the Permittee demonstrate the presence or absence of chronic toxicity using tests on a vertebrate, an invertebrate, and an aquatic plant, in accordance with the species identified in section V.B.4 of the MRP (Attachment E). At least one time every five years, the Permittee shall conduct a re-screen test with the three identified species and continue routine monitoring with the most sensitive species. Attachment E of this

Order requires quarterly chronic WET monitoring to demonstrate compliance with the narrative toxicity objective.

The receiving waters at Discharge Points 001 and 003 are estuarine and depending on tide and time of year, may range from predominantly freshwater environments to predominantly marine environments. Therefore, the Permittee, when collecting samples for toxicity, shall also determine the characteristics of the receiving water at the time of species screening to ensure the proper test species and method are implemented, as described in section V of the MRP (Attachment E).

The Permittee conducted chronic toxicity testing using *C. dubia*. The following table summarizes the chronic toxicity testing results from the term of Order No. R1-2012-0031.

**Table F-10. Summary of Chronic Toxicity Results**

| Date | *Ceriodaphnia dubia* | |
|---|---|---|
| | **Survival (TUc)** | **Reproduction (TUc)** |
| December 11, 2012 | 1 | 1 |
| March 5, 2013 | 1 | 1.3 |
| May 7, 2013 | 1 | 1.3 |
| June 4, 2013 | 1 | 2 |
| June 11, 2013 | 1 | 1.3 |
| June 18, 2013 | 1 | 1 |
| June 25, 2013 | 1 | 1 |
| July 9, 2013 | 1 | 1 |
| December 10, 2013 | 1 | 1.3 |
| March 17, 2014 | 1 | 1.3 |
| April 15, 2014 | 1 | 1 |
| April 22, 2014 | 1 | 1 |
| April 29, 2014 | 1 | 1 |
| May 20, 2014 | 1 | 1 |
| August 19, 2014 | 1 | 1 |
| October 14, 2014 | 1 | 2 |
| February 10, 2015 | 1 | 1.3 |
| March 12, 2015 | 1 | >8 |
| March 19, 2015 | 1 | 2 |
| March 26, 2015 | 1 | 1 |
| April 2, 2015 | 1 | 1 |
| August 18, 2015 | 1 | 1 |
| November 3, 2015 | 1 | 1 |
| February 13, 2016 | 1 | 1 |
| May 10, 2016 | 1 | 1 |
| July 19, 2016 | 1 | 1 |
| December 13, 2016 | 1 | 1 |

Based on the observed chronic toxicity to *C. dubia* reproduction on March 5, 2013, May 7, 2013, June 4, 2013, June 11, 2013, December 10, 2013, March 17, 2014, October 14, 2014 February 10, 2015, March 12, 2015, and March 19, 2015, the Regional Water Board concludes that the discharge has reasonable potential to cause or contribute to an exceedance of the Basin Plan's narrative toxicity objective. Therefore, this Order establishes a narrative effluent limitation for chronic toxicity.

Numeric chronic toxicity effluent limitations have not been included in the Order for consistency with the SIP, which implements narrative toxicity objectives in basin plans and specifies use of a numeric trigger for accelerated monitoring and implementation

of a Toxicity Reduction Evaluation (TRE) in the event that persistent toxicity is detected. The SIP contains implementation gaps regarding the appropriate form and implementation of chronic toxicity limits. This has resulted in the petitioning of a NPDES permit in the Los Angeles Region that contained numeric chronic toxicity effluent limitations. To address the petition, the State Water Board adopted WQO 2003-0012 directing its staff to revise the toxicity control provisions in the SIP. The State Water Board states the following in WQO 2003-012, "*In reviewing this petition and receiving comments from numerous interested persons on the propriety of including numeric effluent limitations for chronic toxicity in NPDES permits for publicly-owned treatment works, that discharge to inland waters, we have determined that this issue should be considered in a regulatory setting, in order to allow for full public discussion and deliberation. We intend to modify the SIP to specifically address the issue. We anticipate that review will occur within the next year. We therefore decline to make a determination here regarding the propriety of the final numeric effluent limitations for chronic toxicity contained in these permits*." The process to revise the SIP is underway. Proposed changes include clarifying the appropriate form of effluent toxicity limits in NPDES permits and general expansion and standardization of toxicity control implementation related to the NPDES permitting process. Since the toxicity control provisions in the SIP are under revision, it is infeasible to develop numeric effluent limitations for chronic toxicity at this time. The SIP revision may require a permit modification to incorporate new statewide toxicity criteria established by the upcoming SIP revision.

This Order includes a reopener that allows the Regional Water Board to reopen the Order and includes a numeric chronic toxicity limitation, a revised acute toxicity limitation, and/or a limitation for a specific toxicant identified in the TRE.

To ensure compliance with the narrative effluent limitation and the Basin Plan's narrative toxicity objective, the Permittee is required to conduct quarterly chronic WET testing at Discharge Point 003 and annual chronic WET testing at Discharge Point 001, as specified in the MRP (Attachment E, section V.B). Furthermore, the MRP (Attachment E, section V.C) requires the Permittee to investigate the causes of, and identify and implement corrective actions to reduce or eliminate effluent toxicity. If the discharge demonstrates toxicity exceeding the numeric toxicity monitoring trigger, the Permittee is required to initiate a TRE in accordance with an approved TRE Work Plan. The numeric toxicity monitoring trigger is not an effluent limitation; it is the toxicity threshold at which the Permittee is required to perform accelerated chronic toxicity monitoring, as well as the threshold to initiate a TRE if a pattern of effluent toxicity has been demonstrated.

**c. Test of Significant Toxicity (TST)**

Order No. R1-2012-0031 established numeric chronic toxicity triggers of 1.0 TUc = 100/NOEC as a three-sample median and 2.0 TUc = 100/NOEC as a single sample maximum, using a five-concentration hypothesis test. In 2010, U.S. EPA endorsed the peer-reviewed *Test of Significant Toxicity (TST) two-concentration hypothesis testing approach in National Pollutant Discharge Elimination System Test of Significant Toxicity Implementation Document* (EPA 833-R-10-003, 2010) as an improved hypothesis-testing tool to evaluate data from U.S. EPA's toxicity test methods. The TST hypothesis testing approach more reliably identifies toxicity—in relation to the chronic (0.25 or more) mean response of regulatory management concern—than the No Observed Effect Concentration (NOEC) hypothesis-testing approach. The TST hypothesis testing approach more reliably identifies toxicity – in relation to the acute (0.20 or more) mean

responses of regulatory management concern – than the NOEC approach used previously to establish effluent limitations for acute toxicity.

Since the TST approach has not previously been applied for determining reasonable potential or establishing effluent limitations for acute toxicity, this Order does not include effluent limitations for acute toxicity based on the TST approach. However, this Order does require the Permittee to monitor and report results in a manner that will allow the Regional Water Board to conduct an RPA in accordance with the TST approach at the time of the next permit renewal.

The State Water Board is developing a toxicity amendment to the Enclose Bays and Estuaries Policy that will standardize the regulation of aquatic toxicity for all non-oceanic surface waters. U.S. EPA's TST approach is an essential component of this draft toxicity amendment as it forms the basis for utilizing numeric water quality objectives and acts as the primary means of determining compliance with the proposed effluent limitations.

In a letter dated February 12, 2014, the State Water Board submitted an alternative test process (ATP) request to U.S. EPA Region 9 for the statewide use of a two-concentration toxicity test design when using the TST approach. This two-concentration test design is composed of a single effluent concentration and a control concentration. U.S. EPA approved the ATP request on March 17th, 2014. In June 2014, the approval was challenged in court on procedural grounds under the Administrative Procedures Act by the Southern California Alliance of Publicly Owned Treatment Works (SCAP) and the Central Valley Clean Water Association (CVCWA). The U.S. EPA withdrew the approval and notified State Water Board in a memo dated February 11, 2015.

It is important to note that U.S. EPA's rescission of its approval of the ATP is not based on the substantive TST statistical analysis or the scientific validity of a two-concentration test design. The withdrawal letter also states that currently there is a proposed rulemaking to change the language in the ATP regulations at 40 C.F.R. part 136.

The benefits of requiring the TST in new or amended permits include improving the statistical power of the toxicity test and simplifying the analysis as compared to the traditional hypothesis statistical approaches or point estimates. The calculations are straightforward and provide a clear pass/fail result. With the withdrawal of the two-concentration test design approval, an NPDES permit can still require the TST for statistical analyses. Toxicity tests shall be run using a multi-concentration test design in accordance with 40 C.F.R. section 136.3, and the TST shall be utilized with the biological responses from the permitted in-stream waste concentration (IWC) and the control (effluent concentration of zero). However, even with only two of the five concentration biological responses being used, cost savings in the form of time and effort are still realized for the statistical analysis and data interpretation carried out by the Permittee, lab, and permit manager. This Order requires application of the TST for statistical analysis of whole effluent toxicity data.

**Tests of Significant Toxicity Design**

The TST's null hypothesis for chronic toxicity is:

$H_0$: Mean response (IWC in % effluent) ≤ 0.75 mean response (control)

Results are analyzed using the TST approach and an acceptable level of chronic toxicity is demonstrated by rejecting the null hypothesis and reporting "Pass" or "P".

The chronic IWC (in % effluent) for Discharge Points 001 and 003 is 100%. The chronic toxicity trigger for Discharge Points 001 and 003 is expressed as a null hypothesis ($H_0$) and regulatory management decision (b value) of 0.75 for the chronic toxicity methods in the MRP. The null hypothesis for this discharge is:

$H_0$: Mean response (100% effluent) ≤ 0.75 mean response (control)

Results shall be analyzed using the TST hypothesis testing approach in section V.B.6.a of the MRP. Compliance with this chronic toxicity limitation is demonstrated by rejecting the null hypothesis and reporting "Pass" or "P".

When the chronic toxicity test results in a "Fail" or "F," the Permittee must initiate accelerated monitoring as specified in the MRP (Attachment E, section V). After accelerated monitoring, if conditions of chronic toxicity are found to persist, the Permittee will be required to conduct a TRE, as described by the MRP.

Notification requirements for chronic WET testing include a 72-hour verbal notification requirement and a 14-day written report requirement, if test results indicate toxicity. The 14-day written notification is established in the U.S. EPA WET Guidance documents cited in the MRP. The 72-hour verbal notification requirement is being added to provide the Regional Water Board with knowledge of the toxicity in advance of the written report. The 72-hour requirement is intended to give the Permittee sufficient time to make a telephone call to Regional Water Board staff and accounts for non-working days (e.g., weekends). Verbal notification of WET test exceedances may be left by voice mail if the Regional Water Board staff person is not immediately available by telephone.

This Order includes a requirement for the Permittee to conduct a screening test using at least one vertebrate, invertebrate, and plant species. After the screening test is completed, monitoring can be reduced to the most sensitive species.

Chronic WET limitations will be established if future monitoring results demonstrate that discharges from the Facility are causing or contributing to chronic toxicity in the receiving water.

## D. Final Effluent Limitation Considerations

### 1. Anti-Backsliding Requirements

Sections 402(o) and 303(d)(4) of the CWA and federal regulations at 40 C.F.R. section 122.44(l) prohibit backsliding in NPDES permits. These anti-backsliding provisions require effluent limitations in a reissued permit to be as stringent as those in the previous permit, with some exceptions where limitations may be relaxed. All effluent limitations in this Order are at least as stringent as the effluent limitations in Order No. R1-2012-0031, with the exception of mass-based effluent limitations for $BOD_5$ and TSS at Discharge Points 001 and 003; effluent limitations for dichlorobromomethane at Discharge Point 001; and effluent limitations for carbon tetrachloride, bis (2-ethylhexyl) phthalate, and TCDD-equivalents at Discharge Points 001 and 003.

Order No. R1-2012-0031established final mass-based effluent limitations for $BOD_5$ and TSS. Mass limitations for $BOD_5$ and TSS for discharges of treated wastewater have been removed because Regional Water Board staff misinterpreted the exception of 40 C.F.R. section 122.45(f)(2), which states that mass limitations are not required "*when applicable standards and limitations are expressed in terms of other units of measure*." Secondary treatment standards for $BOD_5$ and TSS in 40 C.F.R. section 133.102, on which the effluent limitations in previous permits were based, are expressed in concentration and percent removal (i.e., other units of measure). The relaxation of effluent limitations for $BOD_5$ and TSS in this Order

is permissible under CWA section 402(o)(2)(B), because Regional Water Board staff has determined that mass-based limitations for $BOD_5$ and TSS were applied in the previous permits as a result of a mistaken interpretation of law when issuing those previous permits.

Historically, the Regional Water Board routinely incorporated mass-based limits (in addition to concentration-based limits) for $BOD_5$ and TSS in NPDES permits to encourage correction of Inflow & Infiltration (I&I). Applied in this way, mass-based limitations effectively restrict a POTW's wet-weather influent flows to less than or equal to the treatment facility's design capacity in situations where POTW's experience excessive I&I as a result of climate conditions and/or aging infrastructure.

In addition, Regional Water Board staff previously held that anti-backsliding regulations prevented the removal of mass-based limitations for $BOD_5$ and TSS because they were appropriate and necessary to protect water quality and prevent water quality degradation in receiving waters. While it is conceivable that the absence of mass-based limitations for these pollutants may result in an increased pollutant loading to surface waters, even if there is a resulting increase in pollutant loading, there is no evidence that the increase will result in degradation of water quality. Therefore, relaxation of effluent limitations for $BOD_5$ and TSS in this Order is also permissible under CWA section 402(o)(2)(B), based on new information available to the Regional Water Board.

Regional Water Board staff conducted an I&I analysis utilizing the definitions of excessive I&I in the federal regulations at 40 C.F.R. sections 35.2005(b) and 133.103(d). Using influent flow data collected between August 2012 and January 2017 and a population of 18,695 as reported in the ROWD, the Regional Water Board conducted an analysis of per capita flows for comparison with the definitions of "excessive I&I" in 40 C.F.R section 35.2005(b)(28) and 133.103(d) (i.e., greater than 275 gpd per capita per day). Effluent flows exceeded 275 gpd per capita on 33 occasions.

In addition, the methodology in a report titled *Recommended Standards for Wastewater Treatment Facilities, Policy for the Design, Review, and Approval of Plans and Specifications for Wastewater Collection and Treatment Facilities*, 2014 Edition, A Report of the Wastewater Committee of the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers was used to calculate a peaking factor, above which excessive infiltration is indicated. Using Figure 1 of this methodology report, a peaking factor of 2.7 is the maximum rate of wastewater flow that is calculated for a population of 18,695. The analysis revealed 14 exceedances of the peaking factor, with exceedances ranging from 2.8 to 4.0.

The Permittee acknowledged I&I issues in the ROWD, noting that an additional 1.47 mgd flow into the treatment works during wet weather period as a result of I&I. At the time the ROWD was submitted, the Permittee had submitted an application for $7 million in Clean Water State Revolving Funds for identified I&I projects, scheduled to begin in September 2017. The Permittee has made significant repairs to the collection system in the last two years. The Permittee has plans to utilize the remaining $7 million to resolve identified I&I issues in the collection system.

Order No. R1-2012-0031 included effluent limitations for carbon tetrachloride at Discharge Points 001 and 003 based on the CTR human health criterion for waters from which both water and organisms are consumed. Based on receiving water salinity monitoring conducted by the Discharger, salinity in Humboldt Bay in the vicinity of the discharge exceeds the salinity threshold in Resolution No. 88-63. Therefore, this Order does not apply the MUN designation to Humboldt Bay and only the CTR human health criteria for waters from which organisms are consumed are applicable to the discharge. As shown in Table F-6 of this Fact Sheet, effluent monitoring data for carbon tetrachloride indicates that the

discharge does not demonstrate reasonable potential to cause or contribute to an exceedance of the applicable CTR human health criterion. The updated effluent carbon tetrachloride data and the updated receiving water salinity data constitute new information, which permits the removal of effluent limitations consistent with CWA section 402(o)(2)(B). Therefore, this Order does not retain effluent limitations for carbon tetrachloride at Discharge Point 001 nor Discharge Point 003.

Order No. R1-2012-0031 included effluent limitations for dichlorobromomethane at Discharge Point 001 based on the CTR human health criterion for waters from which both water and organisms are consumed. Based on receiving water salinity monitoring conducted by the Discharger, salinity in Humboldt Bay in the vicinity of the discharge exceeds the salinity threshold in Resolution No. 88-63. Therefore, this Order does not apply the MUN designation to Humboldt Bay and only the CTR human health criteria for waters from which organisms are consumed are applicable to the discharge. As shown in Table F-6 of this Fact Sheet, effluent monitoring data for dichlorobromomethane indicates that the discharge does not demonstrate reasonable potential to cause or contribute to an exceedance of the applicable CTR human health criterion. The updated effluent dichlorobromomethane data and the updated receiving water salinity data constitute new information, which permits the removal of effluent limitations consistent with CWA section 402(o)(2)(B). Therefore, this Order does not retain effluent limitations for dichlorobromomethane at Discharge Point 001.

Order No. R1-2012-0031 included effluent limitations for bis (2-ethylhexyl) phthalate at Discharge Points 001 and 003 based on the CTR human health criterion for waters from which both water and organisms are consumed. Based on receiving water salinity monitoring conducted by the Discharger, salinity in Humboldt Bay in the vicinity of the discharge exceeds the salinity threshold in Resolution No. 88-63. Therefore, this Order does not apply the MUN designation to Humboldt Bay and only the CTR human health criteria for waters from which organisms are consumed are applicable to the discharge. As shown in Table F-6 of this Fact Sheet, effluent monitoring data for bis (2-ethylhexyl) phthalate indicates that the discharge does not demonstrate reasonable potential to cause or contribute to an exceedance of the applicable CTR human health criterion. The updated effluent bis (2-ethylhexyl) phthalate data and the updated receiving water salinity data constitute new information, which permits the removal of effluent limitations consistent with CWA section 402(o)(2)(B). Therefore, this Order does not retain effluent limitations for bis (2-ethylhexyl) phthalate at Discharge Point 001 nor Discharge Point 003.

Order No. R1-2012-0031 included effluent limitations for TCDD-equivalents at Discharge Points 001 and 003 based on the CTR human health criterion for 2,3,7,8-TCDD, which is used to interpret the Basin Plan's narrative toxicity objective for TCDD-equivalents. This Order includes less stringent effluent limitations for TCDD-equivalents, which were calculated using an updated effluent monitoring data and a new CV. The updated effluent data used to calculate the CV constitutes new information that permits the relaxation of effluent limitations consistent with CWA section 402(o)(2)(B). Therefore, relaxation of the effluent limitations for TCDD-equivalents meets the exception in CWA section 402(o)(2)(B).

**2. Antidegradation Policies**

This Order is consistent with applicable federal and state antidegradation policies, as it does not authorize the discharge of increased concentrations of pollutants or increased volumes of treated wastewater beyond that which was permitted to discharge in accordance with Order No. R1-2012-0031.

### 3. Stringency of Requirements for Individual Pollutants

This Order contains both technology-based effluent limitations and WQBELs for individual pollutants. The technology-based effluent limitations consist of restrictions on $BOD_5$, pH, and TSS. Restrictions on these pollutants are discussed in section IV.B of this Fact Sheet. This Order's technology-based pollutant restrictions implement the minimum, applicable federal technology-based requirements. In addition, this Order contains effluent limitations for fecal coliform (Discharge Point 001, 002 and 3), pH, copper (Discharge Point 003 only), cyanide, TCDD-equivalents, ammonia, chlorine residual (Discharge Point 001 only), and settleable solids at Discharge Points 001 and 003, and effluent limitations for chlorine residual and settleable solids at Discharge Point 002, that are more stringent than the minimum, federal technology-based requirements but are necessary to meet water quality standards. These requirements are discussed in section IV.C.3 of the Fact Sheet.

WQBELs have been derived to implement water quality objectives that protect beneficial uses. Both the beneficial uses and the water quality objectives have been approved pursuant to federal law and are the applicable federal water quality standards. Most beneficial uses and water quality objectives contained in the Basin Plan were approved under state law and submitted to and approved by U.S. EPA prior to May 30, 2000. Any water quality objectives and beneficial uses submitted to U.S. EPA prior to May 30, 2000, but not approved by U.S. EPA before that date, are nonetheless "*applicable water quality standards for purposes of the CWA*" pursuant to 40 C.F.R. section 131.21(c)(1). Collectively, this Order's restrictions on individual pollutants are no more stringent than required to implement the requirements of the CWA.

The Regional Water Board has considered the factors in Water Code section 13263, including the provisions of Water Code section 13241, in establishing these requirements.

## E. Interim Effluent Limitations – Not Applicable

This Order does not establish interim effluent limitations or schedules for compliance with final limitations.

## F. Land Discharge Specifications and Requirements – Not Applicable

This Order does not authorize discharges to land.

## G. Water Recycling Specifications and Requirements – Not Applicable

This Order does not authorize discharges of recycled water.

## H. Other Requirements

1. **Disinfection Process Requirements for Ultraviolet Light (UV) Disinfection System.** This Order contains monitoring requirements for the UV disinfection system in section IV.E.1. These requirements are needed to ensure that the disinfection process achieves effective pathogen reduction.

   UV system operation requirements are necessary to ensure that adequate UV dosage is applied to the wastewater to inactivate pathogens (e.g., viruses, bacteria) in the wastewater. UV dosage is dependent on several factors such as UV transmittance, UV power setting, and wastewater flow through the UV system. Minimum dosage requirements are based on the Permittee's proposed design specifications for the UV disinfection system, which identify site-specific UV operating specifications for virus inactivation necessary to protect oyster growing areas within Humboldt Bay. Minimum UV dosage requirements specified in section IV.D.1 of the Order ensure that adequate disinfection of wastewater will be achieved.

## V. RATIONALE FOR RECEIVING WATER LIMITATIONS

### A. Surface Water

CWA section 303(a-c) requires states to adopt water quality standards, including criteria, where they are necessary to protect beneficial uses. The Regional Water Board adopted water quality criteria as water quality objectives in the Basin Plan.

The Basin Plan states that "[t]*he numerical and narrative water quality objectives define the least stringent standards that the Regional* [Water] *Board will apply to regional waters in order to protect the beneficial uses*." The Basin Plan includes numeric and narrative water quality objectives for various beneficial uses and water bodies. This Order contains Receiving Surface Water Limitations based on the Basin Plan numerical and narrative water quality objectives for biostimulatory substances, bacteria, chemical constituents, color, dissolved oxygen, floating material, oil and grease, pH, pesticides, radioactivity, sediment, settleable material, suspended material, tastes and odors, temperature, toxicity, and turbidity.

The dissolved oxygen limitation in this Order reflects the new Basin Plan dissolved oxygen limit that was adopted by the Regional Water Board on June 18, 2015, and effective beginning April 24, 2017, after receiving approval from U.S. EPA. The new Basin Plan dissolved oxygen limitation specifies limits for the WARM, COLD, and SPWN beneficial uses. The COLD and SPWN beneficial uses occur in Humboldt Bay and its tributaries. This Order includes only the SPWN limitations because it is the most restrictive and protective limit and the SPWN beneficial use is present throughout the entire discharge season.

### B. Groundwater

Groundwater limitations are included in this Order to protect the beneficial uses of the underlying groundwater. The beneficial uses of the underlying groundwater are municipal and domestic supply, industrial service supply, industrial process supply, agricultural supply, and freshwater replenishment to surface waters. Discharges from the Facility shall not cause exceedance of applicable water quality objectives or create adverse impacts to beneficial uses of groundwater. Groundwater data must be evaluated using appropriate statistical tools to determine when groundwater degradation is occurring.

The Basin Plan further requires that groundwaters shall not contain toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in humans, or that adversely affects beneficial uses. This limitation applies regardless of whether the toxicity is caused by a single substance or the synergistic effect of multiple substances.

## VI. RATIONALE FOR PROVISIONS

### A. Standard Provisions

#### 1. Federal Standard Provisions

Standard Provisions, which apply to all NPDES permits in accordance with 40 C.F.R. section 122.41, and additional conditions applicable to specified categories of permits in accordance with 40 C.F.R. section 122.42, are provided in Attachment D to the Order. The Permittee must comply with all standard provisions and with those additional conditions that are applicable under 40 C.F.R. section 122.42. The rationale for the special conditions contained in the Order is provided in section VI.B, below.

Sections 122.41(a)(1) and (b) through (n) of 40 C.F.R. establish conditions that apply to all state-issued NPDES permits. These conditions must be incorporated into the permits either expressly or by reference. If incorporated by reference, a specific citation to the regulations must be included in the Order. Section 123.25(a)(12) allows the state to omit or modify conditions to impose more stringent requirements. In accordance with 40 C.F.R. section

123.25, this Order omits federal conditions that address enforcement authority specified in 40 C.F.R. sections 122.41(j)(5) and (k)(2) because the enforcement authority under the Water Code is more stringent. In lieu of these conditions, this Order incorporates by reference Water Code section 13387(e).

**2. Regional Water Board Standard Provisions**

In addition to the Federal Standard Provisions (Attachment D), the Permittee shall comply with the Regional Water Board Standard Provisions provided in Standard Provisions VI.A.2 of the Order.

**a.** Order Provision VI.A.2.a identifies the state's enforcement authority under the Water Code, which is more stringent than the enforcement authority specified in the federal regulations (e.g., 40 C.F.R. sections 122.41(j)(5) and (k)(2)).

**b.** Order Provision VI.A.2.b requires the Permittee to notify Regional Water Board staff, orally and in writing, in the event that the Permittee does not comply or will be unable to comply with any Order requirement. This provision requires the Permittee to make direct contact with a Regional Water Board staff person.

**B. Special Provisions**

**1. Reopener Provisions**

**a. Standard Revisions (Special Provision VI.C.1.a).** Conditions that necessitate a major modification of a permit are described in 40 C.F.R. section 122.62, which include the following:

**i.** When standards or regulations on which the permit was based have been changed by promulgation of amended standards or regulations or by judicial decision. Therefore, if revisions of applicable water quality standards are promulgated or approved pursuant to section 303 of the CWA or amendments thereto, the Regional Water Board will revise and modify this Order in accordance with such revised standards.

**ii.** When new information that was not available at the time of permit issuance would have justified different permit conditions at the time of issuance.

**b. Reasonable Potential (Special Provision VI.C.1.b).** This provision allows the Regional Water Board to modify, or revoke and reissue, this Order if present or future investigations demonstrate that the Permittee governed by this Permit is causing or contributing to excursions above any applicable CTR priority pollutant criterion or objective, or adversely impacting water quality and/or the beneficial uses of receiving waters.

**c. Whole Effluent Toxicity (WET) (Special Provision VI.C.1.c).** This Order requires the Permittee to investigate the causes of, and identify corrective actions to reduce or eliminate effluent toxicity through a TRE. This Order may be reopened to include a numeric chronic toxicity limitation, new acute toxicity limitation, and/or a limitation for a specific toxicant identified in the TRE.

**d. 303(d)-Listed Pollutants (Special Provision VI.C.1.d).** This provision allows the Regional Water Board to reopen this Order to modify existing effluent limitations or add effluent limitations for pollutants that are the subject of any future TMDL action.

**e. Water Effects Ratios (WERs) and Metal Translators (Special Provision VI.C.1.e).** This provision allows the Regional Water Board to reopen this Order if future studies undertaken by the Permittee provide new information and justification for applying a

WER or metal translator to a water quality objective for one or more CTR priority pollutants.

**f. Nutrients (Special Provision VI.C.1.f).** This Order contains effluent limitations for ammonia and effluent monitoring for nutrients (ammonia, nitrate, and phosphorus). This provision allows the Regional Water Board to reopen this Order if future monitoring data indicates the need for new or revised effluent limitations for any of these parameters.

**g. Ultraviolet Light (UV) Disinfection Operating Specifications (Special Provision VI.C.1.g).** UV system operating specifications are required to ensure that the UV system is operated to achieve the required pathogen removal. UV disinfection system specifications and monitoring and reporting requirements are required to ensure that adequate UV dosage is applied to the wastewater to inactivate pathogens (e.g., viruses) in the wastewater. UV dosage is dependent on several factors, such as UV transmittance, UV power setting, wastewater turbidity, and wastewater flow through the UV disinfection system. The UV specifications in this Order are based on the Permittee's proposed design specifications for the UV disinfection system, which identify site-specific UV operating specifications for virus inactivation necessary to protect oyster growing areas within Humboldt Bay. This provision allows the Regional Water Board to reopen this Order to modify the UV specifications if the Permittee conducts additional site-specific UV engineering studies that identify necessary revisions to the site-specific UV operating specifications necessary achieve the desired virus inactivation.

**2. Special Studies and Additional Monitoring Requirements**

**a. Arcata Marsh Wildlife Sanctuary (AMWS) Evaluation (Special Provision VI.C.2.a).** A special study is necessary to maintain an appropriate monitoring and reporting plan for the AMWS. The approved plan provides adequate evaluation of the health and performance of the AMWS and protects the applicable beneficial uses. The approved plan contains the following:

**i.** Overall ecological condition of the AMWS using biological assessments;

**ii.** Nutrient levels/enrichment of the AMWS, including but not limited to monitoring[1] for ammonia according to the schedule in the AMWS special study monitoring plan to determine natural cyclical loading from the AMWS;

**iii.** Whether the AMWS condition is improving, degrading, or staying the same over time;

**iv.** Seasonal patterns in AMWS conditions;

**v.** Analysis of how increasing flows up to 5.9 mgd through the AMWS will impact water quality;

**vi.** System stressors and associated thresholds (i.e., how much the AMWS system can be disturbed without causing unacceptable changes in wetland system quality or degradation of beneficial uses).

**b. Disaster Preparedness Assessment Report and Action Plan (Special Provision VI.C.2.b).** Natural disasters, extreme weather events, sea level rise, and shifting precipitation patterns, some of which are projected to intensify due to climate change, have significant implications for wastewater treatment and operations. Some natural

[1] The AMWS special study states that monitoring for ammonia shall occur at a minimum frequency of three times per month, no less than five days apart.

disasters are expected to become more frequent and extreme according to the current science on climate change. In order to ensure that Facility operations are not disrupted, compliance with conditions of this Order are achieved, and receiving waters are not adversely impacted by permitted and unpermitted discharges, this Order requires the Permittee to submit a Disaster Preparedness Assessment Report and Action Plan.

c. **Source Control and Pretreatment Studies.** As discussed further in section VI.B.5.b of this Fact Sheet, this Order requires the Permittee to update its pretreatment program that conforms to Federal regulations. Thus, in order to prevent interference with the POTW or pass through of pollutants to the receiving water, this Order requires the Permittee to update their approved pretreatment program by conducting a local limits study and review and update, if necessary, their sewer use ordinances, legal authority, enforcement response plan and list of industrial users.

**3. Best Management Practices and Pollution Prevention**

a. **Pollutant Minimization Program (Special Provision VI.C.3.a).** This provision is included in this Order pursuant to section 2.4.5 of the SIP. The Regional Water Board includes standard provisions in all NPDES permits requiring development of a Pollutant Minimization Program when there is evidence that a toxic pollutant is present in the effluent at a concentration greater than an applicable effluent limitation.

**4. Construction, Operation, and Maintenance Specifications**

a. **Operation and Maintenance (Special Provisions VI.C.4.a and b).** 40 C.F.R. section 122.41(e) requires proper operation and maintenance of permitted wastewater systems and related facilities to achieve compliance with permit conditions. An up-to-date operation and maintenance manual, as required by Provision VI.C.4.b of this Order, is an integral part of a well-operated and maintained facility.

**5. Special Provisions for Municipal Facilities (POTWs Only)**

a. **Wastewater Collection Systems (Special Provision VI.C.5.a)**

i. **Statewide General WDRs for Sanitary Sewer Systems.** On May 2, 2006, the State Water Board adopted General Waste Discharge Requirements for Sanitary Sewer Systems, Water Quality Order No. 2006-0003-DWQ (General Order). The General Order requires public agencies that own or operate sanitary sewer systems with greater than one mile of pipes or sewer lines to enroll for coverage under the General Order. The General Order requires agencies to develop sanitary system management plans (SSMPs) and report all SSOs, among other requirements and prohibitions.

On February 20, 2008, the State Water Board adopted Order No. WQ 2008-0002-EXEC Adopting Amended Monitoring and Reporting Requirements for Statewide General Waste Discharge Requirements for Sanitary Sewer Systems, to ensure adequate and timely notifications are made to the Regional Water Board and appropriate local, state, and federal authorities in case of sewage spills. On August 6, 2013, the State Water Board adopted Order No. WQ 2013-0058-EXEC Amending Monitoring and Reporting Program for Statewide General Waste Discharge Requirements for Sanitary Sewer Systems. Order No. WQ 2013-0058-EXEC addressed compliance and enforceability of the Monitoring and Reporting Program and superseded the amendments in Order No. WQ-2008-0002-EXEC. Notification and reporting of SSOs is conducted in accordance with the requirements of Order Nos. 2006-0003-DWQ and WQ 2013-0058-EXEC, and any revisions thereto for operation of its wastewater collection system.

**b. Pretreatment of Industrial Waste (Special Provision VI.C.5.b).** Section 402(b)(8) of the CWA requires that POTWs receiving pollutants from significant industrial sources subject to section 307(b) standards establish an industrial pretreatment program to ensure compliance with these standards. The implementing regulations at 40 C.F.R. section 403.8(a) state, "*any POTW (or combination of POTWs operated by the same authority) with a total design flow greater than 5 million gallons per day (mgd) and receiving from industrial users pollutants which pass through or interfere with operation of the POTW or are otherwise subject to pretreatment standards will be required to establish a POTW pretreatment program unless the NPDES State exercises its option to assume local responsibilities as provided in 403.10(e).*" The Facility receives industrial wastewater from four non-categorical significant industrial users and two categorical industrial users and has a design treatment capacity greater than 5 mgd (peak wet weather treatment capacity of 5.9 mgd). Therefore, the Facility is subject to pretreatment standards as described in section 307(b) of the CWA and 40 C.F.R. section 403.8(a).

**c. Sludge Disposal and Handling Requirements (Special Provision VI.C.5.c).** The disposal or reuse of wastewater treatment screenings, sludges, or other solids removed from the liquid waste stream is regulated by 40 C.F.R. parts 257, 258, 501, and 503, and the State Water Board promulgated provisions of title 27 of the CCR.

**d. Operator Certification (Special Provision VI.C.5.d).** This provision requires the Facility to be operated by supervisors and operators who are certified as required by title 23, section 3680 of the CCR.

**e. Adequate Capacity (Special Provision VI.C.5.e).** The goal of this provision is to ensure appropriate and timely planning by the Permittee to ensure adequate capacity for the protection of public health and water quality.

**6. Other Special Provisions**

**a. Storm Water (Special Provision VI.C.6.a).** This provision requires the Permittee, if applicable, to obtain coverage under the State Water Board's Water Quality Order No. 2014-0057-DWQ, NPDES General Permit No. CAS000001, General Permit for Storm Water Discharges Associated with Industrial Activities (or subsequent renewed versions of the NPDES General Permit CAS000001). Currently the Facility is exempted from these requirements because all storm water is captured and treated and/or disposed of within the Facility's NPDES permitted process wastewater.

**7. Compliance Schedules – Not Applicable**

This Order does not establish interim effluent limitations or schedules of compliance for final numeric effluent limitations.

## VII. RATIONALE FOR MONITORING AND REPORTING REQUIREMENTS

Section 122.48 of 40 C.F.R. requires that all NPDES permits specify requirements for recording and reporting monitoring results. Water Code section 13383 authorizes the Regional Water Board to require technical and monitoring reports. The MRP, Attachment E, establishes monitoring and reporting requirements that implement federal and state requirements. The following provides the rationale for the monitoring and reporting requirements contained in the MRP for this Facility.

### A. Influent Monitoring

**1.** Influent monitoring requirements at Monitoring Location INF-001 for $BOD_5$ and TSS are retained from Order No. R1-2012-0031 and are necessary to determine compliance with the Order's percent removal requirements for these parameters.

2. Influent monitoring requirements for flow at Monitoring Location INF-001 are retained from Order No. R1-2012-0031.

## B. Effluent Monitoring

Effluent monitoring requirements are necessary to determine compliance with prohibitions and/or effluent limitations established by the Order. Monitoring at Monitoring Locations EFF-001, EFF-002, and EFF-003 is necessary to demonstrate compliance with effluent limitations and demonstrate whether or not the discharge poses reasonable potential for a pollutant to exceed any numeric or narrative water quality objectives.

### 1. Monitoring Location EFF-001

**a.** Effluent monitoring frequencies and sample types for flow, $BOD_5$, fecal coliform, pH, TSS, cyanide, TCDD-equivalents, ammonia, chlorine residual, nitrate, and settleable solids at Monitoring Location EFF-001 have been retained from Order No. R1-2012-0031.

**b.** Order No. R1-2012-0031 required monitoring for phosphorus "concurrent with the special study", but did not specify the frequency. This Order establishes quarterly monitoring for phosphorus at Monitoring Location EFF-001 consistent with monitoring requirements for other nutrients (e.g., ammonia and nitrate) in the effluent.

**c.** Effluent monitoring data collected during the term of Order No. R1-2012-0031 indicates that the discharge does not exhibit reasonable potential to cause or contribute to an exceedance of water quality objectives for bis (2-ethylhexyl) phthalate, carbon tetrachloride, or dichlorobromomethane. Therefore, this Order discontinues effluent monitoring requirements for bis (2-ethylhexyl) phthalate, carbon tetrachloride, and dichlorobromomethane at Monitoring Location EFF-001.

**d.** This Order establishes weekly enterococci monitoring at Monitoring Location EFF-001 in order to determine compliance with applicable REC-1 bacteria provisions established in the *Water Quality Control Plan for Inland Surface Waters, Enclosed Bays and Estuaries (ISWEBE)*. The monitoring for enterococci has been delayed until the Permittee can attain ELAP accreditation for enterococci testing.

**e.** Twice per permit term effluent monitoring for total mercury is accomplished with the priority pollutant scans required at Discharge Locations 001 and 003. The mercury monitoring established in this Order is to verify that the Subsistence Fishing (SUB) beneficial use is being protected and is consistent with the Statewide Mercury Provisions.

### 2. Monitoring Location EFF-002

**a.** Effluent monitoring frequencies and sample types for flow, $BOD_5$, pH, TSS, and settleable solids at Monitoring Location EFF-002 have been retained from Order No. R1-2012-0031.

**b.** This Order establishes weekly monitoring requirements for fecal coliform bacteria at Monitoring Location EFF-002 in order to determine compliance with applicable disinfection requirements immediately following the UV disinfection process.

**c.** Order No. R1-2012-0031 established discharge specifications for chlorine residual at Discharge Point 002 but did not require compliance monitoring at Monitoring Location EFF-002. This Order establishes continuous monitoring requirements for chlorine residual at Monitoring Location EFF-002 to determine compliance with the applicable effluent limitations. Monitoring requirements for chlorine residual may be discontinued written certification that a chlorine-based disinfection system is no

longer in use for discharges through Discharge Point 002, chlorine byproducts are no longer present, and chlorine-containing chemicals are not added to the treatment process for wastewater discharged through Discharge Point 002.

**d.** This Order establishes weekly enterococci monitoring at Monitoring Location EFF-002 in order to determine compliance with applicable REC-1 bacteria provisions established in the *Water Quality Control Plan for Inland Surface Waters, Enclosed Bays and Estuaries (ISWEBE)*. The monitoring for enterococci at EFF-002 will begin once the UV disinfection system is online. Monitoring for enterococci at EFF-002 shall start after Phase Two of the Proposed Upgrade Project is completed.

**3. Monitoring Location EFF-003**

**a.** Effluent monitoring frequencies and sample types for flow, $BOD_5$, fecal coliform bacteria, pH, TSS, copper, cyanide, TCDD-equivalents, ammonia, hardness, nitrate, phosphorus, and settleable solids at Monitoring Location EFF-003 have been retained from Order No. R1-2012-0031.

**b.** Effluent monitoring data collected during the term of Order No. R1-2012-0031 indicates that the discharge does not exhibit reasonable potential to cause or contribute to an exceedance of water quality objectives for bis (2-ethylhexyl) phthalate, carbon tetrachloride, or dichlorobromomethane. Therefore, this Order discontinues effluent monitoring requirements for bis (2-ethylhexyl) phthalate, carbon tetrachloride, and dichlorobromomethane at Monitoring Location EFF-003.

**c.** Order No. R1-2012-0031 required continuous monitoring for chlorine residual at Monitoring Location EFF-003. The Permittee is planning to replace the existing chlorine disinfection system with a UV disinfection system. Discharges at Discharge Point 003 will not commence until completion of the UV disinfection system. As a result, discharges at Discharge Point 003 are not expected to contain chlorine residual. Therefore, this Order discontinues effluent monitoring for chlorine residual.

**d.** Order No. R1-2012-0031 required monitoring for phosphorus "concurrent with the special study", but did not specify the frequency. This Order establishes quarterly monitoring for phosphorus at Monitoring Location EFF-003 consistent with monitoring requirements for other nutrients (e.g., ammonia and nitrate) in the effluent.

**e.** Order No. R1-2012-0031 required annual effluent monitoring for CTR priority pollutants. This Order requires effluent monitoring for CTR priority pollutants twice per permit term in order to generate adequate data to perform an RPA. Monitoring for CTR priority pollutants shall be conducted at Monitoring Location EFF-003. The sample type has been changed from grab to 24-hour composite for CTR priority pollutants, with the exception of those CTR priority pollutants that are volatile.

**f.** This Order eliminates the effluent monitoring requirement for title 22 pollutants since monitoring during the previous permit term demonstrated that no title 22 pollutants exhibited reasonable potential to exceed applicable water quality objectives.

### C. Whole Effluent Toxicity Testing Requirements

WET monitoring requirements are retained from Order No. R1-2012-0031 and are included in this Order to protect the receiving water quality from the aggregate effect of a mixture of pollutants in the effluent. Acute toxicity testing measures mortality in 100 percent effluent over a short test period and chronic toxicity testing is conducted over a longer time period and may measure mortality, reproduction, and/or growth.

In addition to routine toxicity monitoring, this Order requires the Permittee to maintain and update their TRE Work Plan, in accordance with appropriate U.S. EPA guidance, to ensure that the Permittee has a plan to immediately move forward with the initial tiers of a TRE in the event effluent toxicity is encountered in the future. The TRE is initiated by evidence of a pattern of toxicity demonstrated through the additional effluent monitoring provided as a result of an accelerated monitoring program.

### D. Receiving Water Monitoring

#### 1. Surface Water

**a.** Receiving water monitoring is required to demonstrate compliance with the Receiving Water Limitations. Monitoring requirements at Monitoring Location RSW-001 for pH, dissolved oxygen, floatables/discoloration, specific conductance, hardness, nitrate, salinity, temperature, total dissolved solids, turbidity, and CTR priority pollutants have been retained from Order No. R1-2012-0031.

#### 2. Groundwater – Not Required

This Order does not require groundwater monitoring at this time.

### E. Other Monitoring Requirements

1. **Disinfection Process Monitoring for UV Disinfection System.** UV disinfection system monitoring requirements at Monitoring Location INT-001 are included to assess compliance of the UV disinfection system with the NWRI Guidelines.

2. **Visual Monitoring.** This Order establishes visual monitoring requirements for the effluent (Monitoring Locations EFF-001, EFF-002 and EFF-003) and receiving water (Monitoring Locations RSW-001) to ensure compliance with receiving water limitations in section V of the Order.

3. **Biosolids Monitoring.** The Permittee monitors biosolids and reports biosolids application practices under requirements in the Biosolids General Order No. 20004-0012-DWQ.

4. **Discharge Monitoring Report Quality Assurance (DMR-QA) Study Program.** Under the authority of section 308 of the CWA (33 U.S.C. § 1318), U.S. EPA requires all permittees under the NPDES Program to participate in the annual DMR-QA Study Program. The DMR-QA Study evaluates the analytical ability of laboratories that routinely perform or support self-monitoring analyses required by NPDES permits. There are two options to satisfy the requirements of the DMR-QA Study Program: (1) The Permittee can obtain and analyze a DMR-QA sample as part of the DMR-QA Study; or (2) Per the waiver issued by U.S. EPA to the State Water Board, the Permittee can submit the results of the most recent Water Pollution Performance Evaluation Study from its own laboratories or its contract laboratories. A Water Pollution Performance Evaluation Study is similar to the DMR-QA Study. Thus, it also evaluates a laboratory's ability to analyze wastewater samples to produce quality data that ensure the integrity of the NPDES Program. The Permittee shall ensure that the results of the DMR-QA Study or the results of the most recent Water Pollution Performance Evaluation Study are submitted annually to the State Water Board. The State Water Board's Quality Assurance Program Officer will send the DMR-QA Study results or the results of the most recent Water Pollution Performance Evaluation Study to U.S. EPA's DMR-QA Coordinator and Quality Assurance Manager.

5. **Accelerated Monitoring Requirements.** Tables E-2, E-3, and E-4 of the MRP include accelerated monitoring requirements for parameters that are required to be monitored daily, weekly, monthly, and annually.

6. **Flow Monitoring.** Section I.D of the MRP requires proper installation, calibration, operation, and maintenance of flow metering devices.

7. **Spill Notification.** The MRP that is part of this Order establishes requirements for reporting spills and unauthorized discharges, with the exception of SSOs, which must be reported in accordance with the requirements of State Water Board Order No. 2006-0003-DWQ and WQ-2013-0058-EXEC.

## VIII. PUBLIC PARTICIPATION

The Regional Water Board is considering the issuance of WDRs that will serve as a NPDES permit for the City of Arcata Wastewater Treatment Facility. As a step in the WDR adoption process, the Regional Water Board staff has developed tentative WDRs. The Regional Water Board encourages public participation in the WDR adoption process.

### A. Notification of Interested Parties

The Regional Water Board notified the Permittee and interested agencies and persons of its intent to prescribe WDRs for the discharge and provided an opportunity to submit written comments and recommendations. Notification was provided through the following posting on the Regional Water Board's Internet site at: http://www.waterboards.ca.gov/northcoast/public_notices/public_hearings/npdes_permits_and_wdrs.shtml and through publication in the **Eureka Time Standard and the Santa Rosa Press Democrat** on **January 4, 2019.**

### B. Written Comments

Interested persons were invited to submit written comments concerning these tentative WDRs as provided through the notification process. Comments were due to the Regional Water Board Executive Office electronically via e-mail to NorthCoast@waterboards.ca.gov or on disk (CD or DCD) in Portable Document Format (PDF) file in lieu of paper-sourced documents. The guidelines for electronic submittal of documents can be found on the Regional Water Board website at http://www.waterboards.ca.gov/northcoast.

To be fully responded to by staff and considered by the Regional Water Board, the written comments were due at the Regional Water Board office by 5:00 p.m. on **February 4, 2019.**

### C. Public Hearing

The Regional Water Board held a public hearing on the draft WDRs during its regular Board meeting on the following date and time and at the following location:

| | |
|---|---|
| Date: | **October 17** |
| Time: | 8:30 a.m. or as announced in the Regional Water Board's agenda |
| Location: | Regional Water Board Hearing Room<br>5550 Skylane Boulevard, Suite A<br>Santa Rosa, CA 95403 |

Interested persons were invited to attend. At the public hearing, the Regional Water Board heard testimony pertinent to the discharge, WDRs, and permit. For accuracy of the record, important testimony was requested in writing.

Please be aware that dates and venues may change. Our Web address is http://www.waterboards.ca.gov/northcoast where you can access the current agenda for changes in dates and locations.

### D. Waste Discharge Requirements Petitions

Any aggrieved person may petition the State Water Board to review the decision of the Regional Water Board regarding the final WDRs. The petition must be received by the State Water Board at the following address within 30 calendar days of the Regional Water Board's action:

State Water Resources Control Board
Office of Chief Counsel
P.O. Box 100, 1001 I Street
Sacramento, CA 95812-0100

For instruction on how to file a petition for review see
http://www.waterboards.ca.gov/public_notices/petitions/water_quality/wqpetition_instr.shtml

### E. Information and Copying

The ROWD, related documents, tentative effluent limitations and special provisions, comments received, and other information are on file and may be inspected at the address identified in section VIII.C, above, at any time between 8:30 a.m. and 4:45 p.m., Monday through Friday. Copying of documents may be arranged through the Regional Water Board by calling (707) 576-2220.

### F. Register of Interested Persons

Any person interested in being placed on the mailing list for information regarding the WDRs and NPDES permit should contact the Regional Water Board, reference this facility, and provide a name, address, and phone number.

### G. Additional Information

Requests for additional information or questions regarding this order should be directed to Justin McSmith at Justin.McSmith@waterboards.ca.gov or (707) 576-2082.

## Attachment F-1 – City of Arcata RPA Summary

| Constituent | Units | Qualifier | MEC | Qualifier | B | C | CMC[1] | CCC[1] | CMC[2] | CCC[2] | Water & Org | Org. Only | MCL | Reasonable Potential |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Antimony | µg/L | J | 2.7 | -- | -- | 4,300 | -- | -- | -- | -- | -- | 4,300 | -- | No |
| Arsenic | µg/L | = | 1.3 | -- | -- | 36 | 340 | 150 | 69 | 36 | -- | -- | -- | No |
| Beryllium | µg/L | < | 0.10 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| Cadmium | µg/L | = | 0.34 | -- | -- | 7.3 | 22 | 7.3 | 42 | 9.4 | -- | -- | -- | No |
| Chromium (III) | µg/L | J | 0.56 | -- | -- | 644 | 5,400 | 640 | | | -- | -- | -- | No |
| Chromium (VI) | µg/L | = | 6.4 | -- | -- | 11 | 16 | 11 | 1,100 | 50 | -- | -- | -- | No |
| Copper | µg/L | = | 7.6 | -- | -- | 21.5 | 300[3] | 180[3] | 33[3] | 22[3] | -- | -- | -- | No |
| Copper | µg/L | = | 7.6 | -- | -- | 3.7 | 52[4] | 31[4] | 5.8[4] | 3.7[4] | -- | -- | -- | Yes |
| Lead | µg/L | < | 0.23 | -- | -- | 8.5 | 480 | 19 | 220 | 8.5 | -- | -- | -- | No |
| Mercury | µg/L | = | 0.00368 | -- | -- | 0.051 | -- | -- | -- | -- | -- | 0.051 | -- | No |
| Nickel | µg/L | = | 3.9 | -- | -- | 8.3 | 1,500 | 170 | 75 | 8.3 | -- | 4,600 | -- | No |
| Selenium | µg/L | J | 1.1 | -- | -- | 5.0 | -- | 5.0 | 291 | 71 | -- | -- | -- | No |
| Silver | µg/L | < | 0.15 | -- | -- | 2.2 | 44 | -- | 2.2 | -- | -- | -- | -- | No |
| Thallium | µg/L | J | 0.23 | -- | -- | 6.3 | -- | -- | -- | -- | -- | 6.3 | -- | No |
| Zinc | µg/L | J | 7.2 | -- | -- | 86 | 390 | 390 | 95 | 86 | -- | -- | -- | No |
| Cyanide | µg/L | = | 7.0 | -- | -- | 1.0 | 22 | 5.2 | 1.0 | 1.0 | -- | 220,000 | -- | Yes |
| Asbestos | MFL | < | 0.21 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| 2,3,7,8 TCDD | µg/L | < | $1.32 \times 10^{-7}$ | -- | -- | $1.4 \times 10^{-8}$ | -- | -- | -- | -- | -- | $1.4 \times 10^{-8}$ | -- | No |
| TCDD-equivalents | µg/L | = | $2.85 \times 10^{-7}$ | -- | -- | $1.4 \times 10^{-8}$ | -- | -- | -- | -- | -- | $1.4 \times 10^{-8}$ | -- | Yes |
| Acrolein | µg/L | < | 1.0 | -- | -- | 780 | -- | -- | -- | | -- | 780 | -- | No |
| Acrylonitrile | µg/L | < | 1.6 | -- | -- | 0.66 | -- | -- | -- | | -- | 0.66 | -- | No |
| Benzene | µg/L | < | 0.057 | -- | -- | 71 | -- | -- | -- | | -- | 71 | -- | No |
| Bromoform | µg/L | < | 0.10 | -- | -- | 360 | -- | -- | -- | | -- | 360 | -- | No |
| Carbon Tetrachloride | µg/L | = | 0.80 | -- | -- | 4.4 | -- | -- | -- | -- | -- | 4.4 | -- | No |
| Chlorobenzene | µg/L | < | 0.053 | -- | -- | 21,000 | -- | -- | -- | -- | -- | 21,000 | -- | No |
| Chlorodibromomethane | µg/L | = | 1.3 | -- | -- | 34 | -- | -- | -- | -- | -- | 34 | -- | No |
| Chloroethane | µg/L | < | 0.098 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| 2-Chloroethylvinyl ether | µg/L | < | 0.087 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| Chloroform | µg/L | = | 13 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| Dichlorobromomethane | µg/L | = | 5.7 | -- | -- | 46 | -- | -- | -- | -- | -- | 46 | -- | No |
| 1,1-Dichloroethane | µg/L | < | 0.061 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| 1,2-Dichloroethane | µg/L | < | 0.054 | -- | -- | 99 | -- | -- | -- | -- | -- | 99 | -- | No |
| 1,1-Dichloroethylene | µg/L | < | 0.092 | -- | -- | 3.2 | -- | -- | -- | -- | -- | 3.2 | -- | No |
| 1,2-Dichloropropane | µg/L | < | 0.057 | -- | -- | 39 | -- | -- | -- | -- | -- | 39 | -- | No |

| Constituent | Units | Qualifier | MEC | Qualifier | B | C | CMC[1] | CCC[1] | CMC[2] | CCC[2] | Water & Org | Org. Only | MCL | Reasonable Potential |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,3-Dichloropropylene | µg/L | < | 0.041 | -- | -- | 1,700 | -- | -- | -- | -- | -- | 1,700 | -- | No |
| Ethylbenzene | µg/L | < | 0.074 | -- | -- | 29,000 | -- | -- | -- | -- | -- | 29,000 | -- | No |
| Methyl Bromide | µg/L | < | 0.054 | -- | -- | 4,000 | -- | -- | -- | -- | -- | 4,000 | -- | No |
| Methyl Chloride | µg/L | < | 0.092 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| Methylene Chloride | µg/L | < | 0.066 | -- | -- | 16,000 | -- | -- | -- | -- | -- | 16,000 | -- | No |
| 1,1,2,2-Tetrachloroethane | µg/L | < | 0.13 | -- | -- | 11 | -- | -- | -- | -- | -- | 11 | -- | No |
| Tetrachloroethylene | µg/L | < | 0.086 | -- | -- | 8085 | -- | -- | -- | -- | -- | 8,085 | -- | No |
| Toluene | µg/L | J | 0.29 | -- | -- | 200,000 | -- | -- | -- | -- | -- | 200,000 | -- | No |
| 1,2-Trans-Dichloroethylene | µg/L | < | 0.072 | -- | -- | 140,000 | -- | -- | -- | -- | -- | 140,000 | -- | No |
| 1,1,1-Trichloroethane | µg/L | < | 0.086 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| 1,1,2-Trichloroethane | µg/L | < | 0.057 | -- | -- | 42 | -- | -- | -- | -- | -- | 42 | -- | No |
| Trichloroethylene | µg/L | < | 0.11 | -- | -- | 81 | -- | -- | -- | -- | -- | 81 | -- | No |
| Vinyl Chloride | µg/L | < | 0.11 | -- | -- | 525 | -- | -- | -- | -- | -- | 525 | -- | No |
| 2-Chlorophenol | µg/L | < | 0.53 | -- | -- | 400 | -- | -- | -- | -- | -- | 400 | -- | No |
| 2,4-Dichlorophenol | µg/L | < | 0.70 | -- | -- | 790 | -- | -- | -- | -- | -- | 790 | -- | No |
| 2,4-Dimethylphenol | µg/L | < | 0.59 | -- | -- | 2,300 | -- | -- | -- | -- | -- | 2,300 | -- | No |
| 2-Methyl- 4,6-Dinitrophenol | µg/L | < | 0.74 | -- | -- | 765 | -- | -- | -- | -- | -- | 765 | -- | No |
| 2,4-Dinitrophenol | µg/L | < | 0.51 | -- | -- | 14,000 | -- | -- | -- | -- | -- | 14,000 | -- | No |
| 2-Nitrophenol | µg/L | < | 0.50 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| 4-Nitrophenol | µg/L | < | 0.55 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| 3-Methyl 4-Chlorophenol | µg/L | < | 0.67 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| Pentachlorophenol | µg/L | < | 0.97 | -- | -- | 7.9 | 12 | 9.0 | 13 | 7.9 | -- | 8.2 | -- | No |
| Phenol | µg/L | J | 2.1 | -- | -- | 4,600,000 | -- | -- | -- | -- | -- | 4,600,000 | -- | No |
| 2,4,6-Trichlorophenol | µg/L | < | 0.71 | -- | -- | 6.5 | -- | -- | -- | -- | -- | 6.5 | -- | No |
| Acenaphthene | µg/L | < | 0.011 | -- | -- | 2,700 | -- | -- | -- | -- | -- | 2,700 | -- | No |
| Acenaphthylene | µg/L | < | 0.011 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| Anthracene | µg/L | < | 0.0072 | -- | -- | 110,000 | -- | -- | -- | -- | -- | 110,000 | -- | No |
| Benzidine | µg/L | < | 0.5 | -- | -- | 0.00054 | -- | -- | -- | -- | -- | 0.00054 | -- | No |
| Benzo(a)Anthracene | µg/L | < | 0.0098 | -- | -- | 0.049 | -- | -- | -- | -- | -- | 0.049 | -- | No |
| Benzo(a)Pyrene | µg/L | < | 0.01 | -- | -- | 0.049 | -- | -- | -- | -- | -- | 0.049 | -- | No |
| Benzo(b)Fluoranthene | µg/L | < | 0.015 | -- | -- | 0.049 | -- | -- | -- | -- | -- | 0.049 | -- | No |
| Benzo(ghi)Perylene | µg/L | < | 0.023 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| Benzo(k)Fluoranthene | µg/L | < | 0.011 | -- | -- | 0.049 | -- | -- | -- | -- | -- | 0.049 | -- | No |

| Constituent | Units | Qualifier | MEC | Qualifier | B | C | CMC[1] | CCC[1] | CMC[2] | CCC[2] | Water & Org | Org. Only | MCL | Reasonable Potential |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bis(2-Chloroethoxy) methane | µg/L | < | 0.55 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| Bis(2-Chloroethyl) Ether | µg/L | < | 0.50 | -- | -- | 1.4 | -- | -- | -- | -- | -- | 1.4 | -- | No |
| Bis(2-Chloroisopropyl) ether | µg/L | < | 0.50 | -- | -- | 170,000 | -- | -- | -- | -- | -- | 170,000 | -- | No |
| Bis(2-Ethylhexyl) phthalate | µg/L | = | 2.8 | -- | -- | 5.9 | -- | -- | -- | -- | -- | 5.9 | -- | No |
| 4-Bromophenyl Phenyl Ether | µg/L | < | 0.50 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| Butylbenzyl Phthalate | µg/L | < | 1.2 | -- | -- | 5,200 | -- | -- | -- | -- | -- | 5,200 | -- | No |
| 2-Chloronaphthalene | µg/L | < | 0.50 | -- | -- | 4,300 | -- | -- | -- | -- | -- | 4,300 | -- | No |
| 4-Chlorophenyl Phenyl Ether | µg/L | < | 0.50 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| Chrysene | µg/L | < | 0.0092 | -- | -- | 0.049 | -- | -- | -- | -- | -- | 0.049 | -- | No |
| Dibenzo(a,h) Anthracene | µg/L | < | 0.023 | -- | -- | 0.049 | -- | -- | -- | -- | -- | 0.049 | -- | No |
| 1,2-Dichlorobenzene | µg/L | < | 0.040 | -- | -- | 17,000 | -- | -- | -- | -- | -- | 17,000 | -- | No |
| 1,3-Dichlorobenzene | µg/L | < | 0.047 | -- | -- | 2,600 | -- | -- | -- | -- | -- | 2,600 | -- | No |
| 1,4-Dichlorobenzene | µg/L | < | 0.044 | -- | -- | 2,600 | -- | -- | -- | -- | -- | 2,600 | -- | No |
| 3,3 Dichlorobenzidine | µg/L | < | 0.50 | -- | -- | 0.077 | -- | -- | -- | -- | -- | 0.077 | -- | No |
| Diethyl Phthalate | µg/L | < | 0.54 | -- | -- | 120,000 | -- | -- | -- | -- | -- | 120,000 | -- | No |
| Dimethyl Phthalate | µg/L | < | 1.1 | -- | -- | 2,900,000 | -- | -- | -- | -- | -- | 2,900,000 | -- | No |
| Di-n-Butyl Phthalate | µg/L | < | 0.73 | -- | -- | 12,000 | -- | -- | -- | -- | -- | 12,000 | -- | No |
| 2,4-Dinitrotoluene | µg/L | < | 0.59 | -- | -- | 9.1 | -- | -- | -- | -- | -- | 9.1 | -- | No |
| 2,6-Dinitrotoluene | µg/L | < | 0.71 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| Di-n-Octyl Phthalate | µg/L | < | 0.72 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| 1,2-Diphenylhydrazine | µg/L | < | 0.50 | -- | -- | 0.54 | -- | -- | -- | -- | -- | 0.54 | -- | No |
| Fluoranthene | µg/L | < | 0.0096 | -- | -- | 370 | -- | -- | -- | -- | -- | 370 | -- | No |
| Fluorene | µg/L | < | 0.016 | -- | -- | 14,000 | -- | -- | -- | -- | -- | 14,000 | -- | No |
| Hexachlorobenzene | µg/L | < | 0.0070 | -- | -- | 0.00077 | -- | -- | -- | -- | -- | 0.00077 | -- | No |
| Hexachlorobutadiene | µg/L | < | 0.084 | -- | -- | 50 | -- | -- | -- | -- | -- | 50 | -- | No |
| Hexachlorocyclopentadiene | µg/L | < | 0.50 | -- | -- | 17,000 | -- | -- | -- | -- | -- | 17,000 | -- | No |
| Hexachloroethane | µg/L | < | 0.50 | -- | -- | 8.9 | -- | -- | -- | -- | -- | 8.9 | -- | No |
| Indeno(1,2,3-cd) Pyrene | µg/L | < | 0.016 | -- | -- | 0.049 | -- | -- | -- | -- | -- | 0.049 | -- | No |
| Isophorone | µg/L | < | 0.55 | -- | -- | 600 | -- | -- | -- | -- | -- | 600 | -- | No |
| Naphthalene | µg/L | J | 0.047 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| Nitrobenzene | µg/L | < | 0.52 | -- | -- | 1,900 | -- | -- | -- | -- | -- | 1,900 | -- | No |
| N-Nitrosodimethylamine | µg/L | < | 0.47 | -- | -- | 8.1 | -- | -- | -- | -- | -- | 8.1 | -- | No |
| N-Nitrosodi-n-Propylamine | µg/L | < | 0.50 | -- | -- | 1.4 | -- | -- | -- | -- | -- | 1.4 | -- | No |
| N-Nitrosodiphenylamine | µg/L | < | 0.71 | -- | -- | 16 | -- | -- | -- | -- | -- | 16 | -- | No |

| Constituent | Units | Qualifier | MEC | Qualifier | B | C | CMC[1] | CCC[1] | CMC[2] | CCC[2] | Water & Org | Org. Only | MCL | Reasonable Potential |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phenanthrene | µg/L | < | 0.012 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| Pyrene | µg/L | < | 0.033 | -- | -- | 11,000 | -- | -- | -- | -- | -- | 11,000 | -- | No |
| 1,2,4-Trichlorobenzene | µg/L | < | 0.040 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |
| Aldrin | µg/L | < | 0.0016 | -- | -- | 0.00014 | 3.0 | -- | 1.3 | -- | -- | 0.00014 | -- | No |
| alpha-BHC | µg/L | < | 0.0016 | -- | -- | 0.013 | -- | -- | -- | | -- | 0.013 | -- | No |
| beta-BHC | µg/L | < | 0.0018 | -- | -- | 0.046 | -- | -- | -- | | -- | 0.046 | -- | No |
| gamma-BHC | µg/L | < | 0.0014 | -- | -- | 0.063 | 0.95 | -- | 0.16 | | -- | 0.063 | -- | No |
| delta-BHC | µg/L | < | 0.0014 | -- | -- | No Criteria | -- | -- | -- | | -- | -- | -- | No |
| Chlordane | µg/L | < | 0.034 | -- | -- | 0.00059 | 2.4 | 0.0043 | 0.09 | 0.004 | -- | 0.00059 | -- | No |
| 4,4'-DDT | µg/L | < | 0.0010 | -- | -- | 0.00059 | 1.1 | 0.001 | 0.13 | 0.001 | -- | 0.00059 | -- | No |
| 4,4'-DDE | µg/L | < | 0.0020 | -- | -- | 0.00059 | -- | -- | -- | | -- | 0.00059 | -- | No |
| 4,4'-DDD | µg/L | < | 0.0099 | -- | -- | 0.00084 | -- | -- | -- | | -- | 0.00084 | -- | No |
| Dieldrin | µg/L | < | 0.0018 | -- | -- | 0.00014 | 0.24 | 0.056 | 0.71 | 0.0019 | -- | 0.00014 | -- | No |
| alpha-Endosulfan | µg/L | < | 0.0017 | -- | -- | 0.00087 | 0.22 | 0.056 | 0.034 | 0.0087 | -- | 240 | -- | No |
| beta-Endolsulfan | µg/L | < | 0.00092 | -- | -- | 0.00087 | 0.22 | 0.056 | 0.034 | 0.0087 | -- | 240 | -- | No |
| Endosulfan Sulfate | µg/L | < | 0.0023 | -- | -- | 240 | -- | -- | -- | -- | -- | 240 | -- | No |
| Endrin | µg/L | < | 0.0019 | -- | -- | 0.0023 | 0.086 | 0.036 | 0.037 | 0.0023 | -- | 0.81 | -- | No |
| Endrin Aldehyde | µg/L | < | 0.0020 | -- | -- | 0.81 | -- | -- | -- | -- | -- | 0.81 | -- | No |
| Heptachlor | µg/L | < | 0.0018 | -- | -- | 0.00021 | 0.52 | 0.0038 | 0.053 | 0.0036 | -- | 0.00021 | -- | No |
| Heptachlor Epoxide | µg/L | < | 0.0015 | -- | -- | 0.00011 | 0.52 | 0.0038 | 0.053 | 0.0036 | -- | 0.00011 | -- | No |
| PCBs sum | µg/L | < | 0.0010 | -- | -- | 0.00017 | -- | 0.014 | -- | 0.030 | -- | 0.00017 | -- | No |
| Toxaphene | µg/L | < | 0.052 | -- | -- | 0.00020 | 0.73 | 0.0002 | 0.21 | 0.0002 | -- | 0.00075 | -- | No |
| Ammonia Nitrogen, Total (as N) | mg/L | = | 18 | -- | -- | 0.29 | 2.59 | 1.44 | 1.90 | 0.29 | -- | -- | -- | Yes |
| Nitrate, Total (as N) | mg/L | = | 2.7 | -- | -- | No Criteria | -- | -- | -- | -- | -- | -- | -- | No |

Table Notes:

1. Water quality criteria for the protection of freshwater aquatic life.
2. Water quality criteria for the protection of saltwater aquatic life.
3. Water quality criteria calculated using a WER of 5.76 for Discharge Point 001.
4. Water quality criteria calculated using default WER of 1.0 for Discharge Point 003.

## ATTACHMENT G - AMEL AND MDEL AMMONIA STANDARDS BASED ON THE 1989 SALTWATER ACUTE CRITERIA

### Table 1: pH, Salinity and Temperature Dependent AMEL Ammonia Criteria

| | Temperature, °C | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **pH** | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 |
| | **Salinity = 10 g/kg** | | | | | | | |
| 7.0 | 30 | 21 | 15 | 10 | 6.9 | 4.8 | 3.2 | 2.3 |
| 7.2 | 19 | 13 | 8.8 | 6.4 | 4.3 | 3.0 | 2.0 | 1.5 |
| 7.4 | 12 | 8.8 | 5.7 | 3.9 | 2.7 | 1.9 | 1.3 | 0.88 |
| 7.6 | 7.3 | 5.3 | 3.7 | 2.5 | 1.8 | 1.2 | 0.88 | 0.61 |
| 7.8 | 4.8 | 3.4 | 2.3 | 1.6 | 1.1 | 0.80 | 0.55 | 0.39 |
| 8.0 | 3.0 | 2.1 | 1.5 | 1.0 | 0.71 | 0.50 | 0.34 | 0.25 |
| 8.2 | 2.0 | 1.3 | 1.0 | 0.64 | 0.45 | 0.32 | 0.23 | 0.17 |
| 8.4 | 1.2 | 0.88 | 0.59 | 0.41 | 0.30 | 0.21 | 0.15 | 0.12 |
| 8.6 | 0.80 | 0.55 | 0.39 | 0.27 | 0.20 | 0.15 | 0.11 | 0.08 |
| 8.8 | 0.50 | 0.37 | 0.25 | 0.18 | 0.13 | 0.10 | 0.08 | 0.06 |
| 9.0 | 0.32 | 0.23 | 0.17 | 0.12 | 0.10 | 0.07 | 0.06 | 0.05 |
| | | | | | | | | |
| | **Salinity = 20 g/kg** | | | | | | | |
| 7.0 | 32 | 22 | 15 | 10 | 7.1 | 4.8 | 3.4 | 2.3 |
| 7.2 | 20 | 14 | 9.5 | 6.6 | 4.5 | 3.2 | 2.2 | 1.5 |
| 7.4 | 13 | 8.8 | 5.9 | 4.1 | 3.0 | 2.0 | 1.4 | 0.95 |
| 7.6 | 8.0 | 5.5 | 3.9 | 2.5 | 1.8 | 1.2 | 0.88 | 0.61 |
| 7.8 | 5.0 | 3.4 | 2.5 | 1.7 | 1.2 | 0.80 | 0.57 | 0.39 |
| 8.0 | 3.2 | 2.2 | 1.5 | 1.1 | 0.73 | 0.53 | 0.37 | 0.25 |
| 8.2 | 2.0 | 1.4 | 0.95 | 0.69 | 0.48 | 0.34 | 0.23 | 0.18 |
| 8.4 | 1.3 | 0.88 | 0.61 | 0.43 | 0.32 | 0.22 | 0.16 | 0.12 |
| 8.6 | 0.80 | 0.57 | 0.41 | 0.30 | 0.20 | 0.15 | 0.11 | 0.09 |
| 8.8 | 0.53 | 0.37 | 0.27 | 0.19 | 0.14 | 0.10 | 0.08 | 0.06 |
| 9.0 | 0.34 | 0.25 | 0.18 | 0.13 | 0.10 | 0.07 | 0.06 | 0.05 |
| | | | | | | | | |
| | **Salinity = 30 g/kg** | | | | | | | |
| 7.0 | 34 | 23 | 16 | 11 | 8.0 | 5.3 | 3.7 | 2.5 |
| 7.2 | 21 | 15 | 10 | 7.1 | 4.8 | 3.4 | 2.3 | 1.6 |
| 7.4 | 14 | 9.5 | 6.4 | 4.1 | 3.0 | 2.1 | 1.5 | 1.0 |
| 7.6 | 8.8 | 5.9 | 4.1 | 2.7 | 2.3 | 1.3 | 0.95 | 0.66 |
| 7.8 | 5.5 | 3.7 | 2.5 | 1.8 | 1.2 | 0.88 | 0.59 | 0.41 |
| 8.0 | 3.4 | 2.3 | 1.6 | 1.2 | 0.80 | 0.55 | 0.39 | 0.27 |
| 8.2 | 2.2 | 1.5 | 1.0 | 0.73 | 0.50 | 0.37 | 0.25 | 0.18 |
| 8.4 | 1.4 | 0.95 | 0.66 | 0.45 | 0.32 | 0.23 | 0.17 | 0.12 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 8.6 | 0.88 | 0.61 | 0.43 | 0.30 | 0.22 | 0.16 | 0.12 | 0.09 |
| 8.8 | 0.57 | 0.39 | 0.27 | 0.20 | 0.15 | 0.11 | 0.08 | 0.07 |
| 9.0 | 0.37 | 0.25 | 0.19 | 0.14 | 0.10 | 0.08 | 0.06 | 0.05 |

**Table 2: pH, Salinity and Temperature Dependent MDEL Ammonia Criteria**

| | **Temperature, °C** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **pH** | **0** | **5** | **10** | **15** | **20** | **25** | **30** | **35** |
| | **Salinity = 10 g/kg** | | | | | | | |
| 7.0 | 75 | 53 | 36 | 25 | 17 | 12 | 8.0 | 5.6 |
| 7.2 | 47 | 33 | 22 | 16 | 11 | 7.5 | 5.1 | 3.6 |
| 7.4 | 31 | 22 | 14 | 9.6 | 6.7 | 4.7 | 3.3 | 2.2 |
| 7.6 | 18 | 13 | 9.1 | 6.2 | 4.4 | 3.1 | 2.2 | 1.5 |
| 7.8 | 12 | 8.6 | 5.6 | 4.0 | 2.7 | 2.0 | 1.4 | 0.96 |
| 8.0 | 7.5 | 5.3 | 3.6 | 2.5 | 1.8 | 1.3 | 0.86 | 0.62 |
| 8.2 | 4.9 | 3.3 | 2.4 | 1.6 | 1.1 | 0.80 | 0.56 | 0.42 |
| 8.4 | 3.1 | 2.2 | 1.5 | 1.0 | 0.75 | 0.53 | 0.38 | 0.29 |
| 8.6 | 2.0 | 1.4 | 0.96 | 0.67 | 0.49 | 0.36 | 0.27 | 0.20 |
| 8.8 | 1.3 | 0.91 | 0.62 | 0.46 | 0.33 | 0.25 | 0.20 | 0.15 |
| 9.0 | 0.80 | 0.56 | 0.42 | 0.31 | 0.24 | 0.18 | 0.15 | 0.13 |
| | | | | | | | | |
| | **Salinity = 20 g/kg** | | | | | | | |
| 7.0 | 80 | 55 | 38 | 25 | 18 | 12 | 8.6 | 5.6 |
| 7.2 | 49 | 35 | 24 | 16 | 11 | 8.0 | 5.5 | 3.8 |
| 7.4 | 33 | 22 | 15 | 10 | 7.5 | 4.9 | 3.5 | 2.4 |
| 7.6 | 20 | 14 | 10 | 6.2 | 4.6 | 3.1 | 2.2 | 1.5 |
| 7.8 | 13 | 8.6 | 6.2 | 4.2 | 2.9 | 2.0 | 1.4 | 0.96 |
| 8.0 | 8.0 | 5.5 | 3.8 | 2.7 | 1.8 | 1.3 | 0.91 | 0.62 |
| 8.2 | 5.1 | 3.5 | 2.4 | 1.7 | 1.2 | 0.86 | 0.56 | 0.44 |
| 8.4 | 3.3 | 2.2 | 1.5 | 1.1 | 0.80 | 0.55 | 0.40 | 0.29 |
| 8.6 | 2.0 | 1.4 | 1.0 | 0.75 | 0.51 | 0.36 | 0.27 | 0.22 |
| 8.8 | 1.3 | 0.91 | 0.67 | 0.47 | 0.35 | 0.25 | 0.20 | 0.15 |
| 9.0 | 0.86 | 0.62 | 0.44 | 0.33 | 0.24 | 0.18 | 0.15 | 0.13 |
| | | | | | | | | |
| | **Salinity = 30 g/kg** | | | | | | | |
| 7.0 | 86 | 56 | 40 | 27 | 20 | 13 | 9.1 | 6.2 |
| 7.2 | 53 | 36 | 25 | 18 | 12 | 8.6 | 5.6 | 4.0 |
| 7.4 | 35 | 24 | 16 | 10 | 7.5 | 5.3 | 3.6 | 2.5 |
| 7.6 | 22 | 15 | 10 | 6.7 | 5.6 | 3.3 | 2.4 | 1.6 |
| 7.8 | 14 | 9.1 | 6.2 | 4.4 | 3.1 | 2.2 | 1.5 | 1.0 |
| 8.0 | 8.6 | 5.6 | 4.0 | 2.9 | 2.0 | 1.4 | 0.96 | 0.67 |
| 8.2 | 5.5 | 3.8 | 2.5 | 1.8 | 1.3 | 0.91 | 0.62 | 0.46 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 8.4 | 3.5 | 2.4 | 1.6 | 1.1 | 0.80 | 0.56 | 0.42 | 0.31 |
| 8.6 | 2.2 | 1.5 | 1.1 | 0.75 | 0.55 | 0.40 | 0.29 | 0.22 |
| 8.8 | 1.4 | 0.96 | 0.67 | 0.49 | 0.36 | 0.27 | 0.20 | 0.16 |
| 9.0 | 0.91 | 0.62 | 0.47 | 0.35 | 0.25 | 0.20 | 0.15 | 0.13 |

## ATTACHMENT H – PDF EXAMPLE OF THE AIR CALCULATOR

| A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|
| Date of Sample | Ammonia Value in Effluent (mg/L N) | Receiving Water pH | Receiving Water Temperature (°C) | Receiving Water Salinity (g/kg) | Ammonia Standard as determined from Ammonia Criteria Tables | MDEL Ammonia Impact Ratio (Column B/Column F) | AMEL Ammonia Impact Ratio (Column B/Column F) |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

# ATTACHMENT 27

City of Arcata. 2020. *Letter to California Coastal Commission Federal Consistency Division.* Sent 08/12/20.

City of ARCATA

736 F Street
Arcata CA 95501

| City Manager | Environmental Services | Police | Recreation |
|---|---|---|---|
| 707-822-5953 | 707-822-8184 | 707-822-2428 | 707-822-7091 |
| *Community Development* | *Finance* | *Public Works* | *Transportation* |
| 707-822-5955 | 707-822-5951 | 707-822-5957 | 707-822-3775 |


August 12, 2020

Larry Simon, Energy, Ocean Resources and Federal Consistency Manager
Energy, Ocean Resources, and Federal Consistency Division
45 Fremont Street
Suite 2000
San Francisco, California 94105-2219

Dear Mr. Simon:

Thank you for considering the federal consistency process for the Arcata Wastewater Treatment Facility (Facility) Project. The City is in the process of undertaking its environmental review of the proposed improvements to the City's pre-existing wastewater treatment facility located at 601 South "G" Street in Arcata. The Environmental Review process includes both NEPA and CEQA. NEPA is required for the City's Community Development Block Grant (CDBG) funds. Environmental clearance is required before the project's Coastal Development Permit (CDP) can be submitted. A brief summary of the project and related federal funding sources is outlined below. We are happy to provide additional details upon request.

The City of Arcata proposes to construct upgrades to the existing Arcata Wastewater Treatment Facility to update aging infrastructure to serve the existing City population, and comply with the requirements of the Regional Water Quality Control Board Order No. 1-2019-0006. Ongoing preventative maintenance has kept the treatment plant in operation but there has been little replacement of equipment or structures since original construction, and maintenance to the natural treatment system will also be required.

In 2012, the Facility began operating under a new National Pollutant Discharge Elimination System (NPDES) permit that specifically addressed several long-term issues to effluent quality. In addition, new wastewater discharge requirements have rendered the Facility out of compliance. The new permit required changes to be made to improve wastewater treatment, protect beneficial uses, increase energy efficiency, and reduce chemical usage in treatment, thereby reducing the potential for permit violations. In response to the new permit requirements, the City initiated an updated Facility Plan intended to address these issues. The majority of site improvement activities will be undertaken using EPA's Clean Water State Revolving Loan Funds in partnership with the California State Water Resources Control Board.

In addition to proposed oxidation pond and wetland treatment system improvements, the project scope also includes construction of an Ultraviolet (UV) disinfection system upstream of discharge to the Enhancement Marshes. The installation of a 9.8 MGD capacity UV disinfection system and replacement of the primary disinfection system utilizing chlorine gas will reduce the number of violations for dichlorobromomethane, a chlorine disinfection by-product. The upgraded UV System equipment will be purchased and installed using CDBG funds. CDBG funds are administered by the State Community Development Department, but are pass-through funds originating from the Federal Housing and Community Development Department.

This funding source has triggered the requirement to prepare an Environmental Assessment analyzing the whole of the proposed action. Proving consistency with the Coastal Zone Management Act is required prior to release of funds. City staff hopes to release and circulate a Finding of No Significant Impact (FONSI) per NEPA

requirements by the beginning of September. Your assistance in this matter will ensure we are able to meet this timeline. Once the required environmental review of the project is completed and the City is authorized to expend grant funds, the project team will begin the application process for other required permits, including a CDP from the Coastal Commission.

Further project information may be viewed on the City's website at: https://www.cityofarcata.org/856/Wastewater-Treatment-Facilities-Improvem . Please let us know if you require any additional information from staff in order to make a consistency determination, and we appreciate your assistance and look forward to hearing from you.

Sincerely,




David Loya

Community Development Director

# ATTACHMENT 28

California Coastal Commission Federal Consistency Branch. 2020. *Federal Consistency Letter.*

STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY GAVIN NEWSOM, *GOVERNOR*

**CALIFORNIA COASTAL COMMISSION**
455 MARKET STREET, SUITE 228
SAN FRANCISCO, CA 94105-2219
VOICE (415) 904-5200
FAX (415) 904-5400

August 20, 2020

David Loya
Community Development Director
City of Arcata
736 F Street
Arcata, CA 95501

Subject: Arcata Wastewater Treatment Facility

Dear Mr. Loya,

The Coastal Commission staff has received your request to identify Commission jurisdiction for the purposes of processing an application for federal funding from the USEPA and the Federal Housing and Community Development Department for improvements to the City of Arcata's wastewater treatment facility. Pursuant to the federal Coastal Zone Management Act (CZMA) and the associated implementing regulations, the aforementioned federal funding agencies cannot grant the subject funds to the City until the City has complied with the requirements of Section 307(d) of the CZMA (16 USC § 1456(d)) and the associated regulations (15 CFR Part 930, Subpart F). The City can meet these requirements by receiving a Commission concurrence with either: (1) a consistency certification prepared by the applicant; or (2) a showing that the activity does not affect the coastal zone; or (3) a showing that regulatory processes are in place that will enable ultimate determinations, prior to construction, that the project is consistent with the Coastal Act.

The Coastal Commission declines to assert federal consistency jurisdiction at this time, due to the fact that: (1) the project involves federal funding for a project located within or partially within the coastal zone; (2) project components within the coastal zone will need to receive one or more coastal development permits from the Commission; (3) the project does not present any fundamental conflicts with Coastal Act policies at this time; and (4) if the Commission has any concerns over effects on coastal resources, it will have the opportunity to resolve those concerns through the coastal development permit process.

Please contact me at Larry.Simon@coastal.ca.gov should you have any questions regarding this matter.

Sincerely,

Larry Simon
Manager, Federal Consistency Unit

cc: Bob Merrill, CCC – North Coast District
Tamara Gedik, CCC – North Coast District

# ATTACHMENT 29

SHN Engineers. May 2020. *Soil and Groundwater Management Contingency Plan. Arcata Corp Yard, Arcata California, Case No. 1NHU767.*

# Soil and Groundwater Management Contingency Plan

**Arcata Corp Yard**
**Arcata, California**
**Case No. 1NHU767**









Prepared for:

**The City of Arcata**

**May 2020**
**018080.100**

812 W. Wabash Ave., Eureka, CA 95501-2138 707-441-8855
Civil Engineering, Environmental Services, Geosciences, Planning & Permitting, Surveying

Reference: 018080.100

May 6, 2020

Paul Nelson, PG, CHG
North Coast Regional Water Quality Control Board
5550 Skylane Blvd. Suite A
Santa Rosa, CA 95403-1072

**Subject: Soil and Groundwater Management Contingency Plan, Arcata Corp Yard, Arcata, California; Case No. 1NHU767**

Dear Paul Nelson:

SHN has prepared this soil and groundwater management contingency plan for the Arcata Corp Yard site on behalf of the City of Arcata. This contingency plan provides guidance in the event that residual petroleum hydrocarbons in soil and/or groundwater are encountered during future development work at the site.

Respectfully submitted,

**SHN**



Erik Nielson, PG, CHG
Senior Project Hydrogeologist

EJN:lms

Enclosures: Report
c. w/Encl.: Mark Andre, Environmental Services Director, City of Arcata

Reference: 018080.100

# Soil and Groundwater Management Contingency Plan

## Arcata Corp Yard
## Arcata, California
## Case No. 1NHU767

Prepared for:
**City of Arcata**




Prepared by:

812 W. Wabash Ave.
Eureka, CA 95501-2138
707-441-8855

May 2020

QA/QC:EJN EJN

# Table of Contents


**Page**

Abbreviations and Acronyms ..... ii

1.0 Introduction ..... 1
- 1.1 Purpose ..... 1
- 1.2 Site History ..... 1

2.0 Contingency Plan ..... 2
- 2.1 Notifications to be Performed Before Working in Suspected Contaminated Areas ..... 2
- 2.2 Actions to be Taken Before Working in Contaminated Areas ..... 2
- 2.3 Actions to be Taken Upon Encountering Contaminated Material ..... 2
- 2.4 Construction Practices to Minimize the Disruption and Potential for Transport of Contaminated Material ..... 2
- 2.5 How to Properly Handle and Dispose of Contaminated Material ..... 2

3.0 References Cited ..... 3

**Appendix 1. Historical Site Data**


# List of Illustrations


**Figures** **Follows Page**

1. Site Location Map ..... 1
2. Site Plan ..... 1
3. Summary of Final Groundwater Analytical Results ..... 1
4. Summary of Soil Analytical Results ..... 1

# Abbreviations and Acronyms

| | |
|---|---|
| < | "less than" the stated method reporting limit |
| °F | degrees Fahrenheit |
| fpm | feet per minute |
| in. | inches |
| mg/kg | milligrams per kilogram |
| mg/L | milligrams per liter |
| mV | millivolt |
| ppm | parts per million |
| ug/L | micrograms per liter |
| | |
| ACY | Arcata Corp Yard |
| B-# | boring-number |
| BGS | below ground surface |
| BTEX | benzene, toluene, ethylbenzene, and total xylenes |
| $CaCO_3$ | calcium carbonate |
| $DCO_2$ | dissolved carbon dioxide |
| DIPE | diisopropyl ether |
| DO | dissolved oxygen |
| ETBE | ethyl tertiary-butyl ether |
| $H_2O$ | water |
| MSL | mean sea level |
| MTBE | methyl tertiary-butyl ether |
| MW-# | monitoring well-number |
| NA | not analyzed |
| NM | not measured |
| NR | not referenced |
| NS | not sampled |
| ORP | oxidation-reduction potential |
| RWQCB | North Coast Regional Water Quality Control Board |
| S-# | air sparge riser-number |
| SGMCP | soil and groundwater management contingency plan |
| TAME | tertiary-amyl methyl ether |
| TBA | tertiary butyl alcohol |
| TPHD | total petroleum hydrocarbons as diesel |
| TPHG | total petroleum hydrocarbons as gasoline |
| USGS | United States Geological Survey |
| WP-# | well point-number |

# 1.0 Introduction

SHN developed this soil and groundwater management contingency plan (SGMCP) for the Arcata Corp Yard (ACY) located at 600 South G Street, in Arcata, California (Figure 1). The ACY (Case No. 1NHU767) is under the oversight of the North Coast Regional Water Quality Control Board (RWQCB) and is currently going through the regulatory site closure process. This SGMCP has been prepared to address potential worker safety issues associated with future site development because areas of residual soil and groundwater contamination remain in place. This plan contains information about site history, and describes the appropriate actions for working in areas with contaminated soil and/or groundwater. A site plan is included as Figure 2.

## 1.1 Purpose

This SGMCP provides the property owner with a usable document to protect site construction workers in the event that contaminated soil and/or groundwater is encountered during future site activities. It also includes appropriate actions to address handling and disposal of contaminated soil and/or groundwater, if necessary. The complete set of documents regarding site investigation and remediation activities is available for review on the State of California Geotracker website.

Site contamination appears largely attributable to the gasoline and diesel fuel lines that failed the pressure test on May 11, 2000, and the 550-gallon release of gasoline that occurred between October 25 and 30, 2000. Low concentrations of petroleum hydrocarbons may also be present in some areas of the site due to the fact that the site has served as a municipal corporate yard, where excavation equipment, large trucks, and other motor vehicles have been maintained and operated for at least 56 years. This SGMCP is based on final conditions encountered at the site following investigation, remediation and monitoring. Contaminants will continue to degrade over time, resulting in the variability of such contamination that may be encountered. It is the responsibility of the property owner to retain this document and provide it to contractors prior to conducting subsurface work.

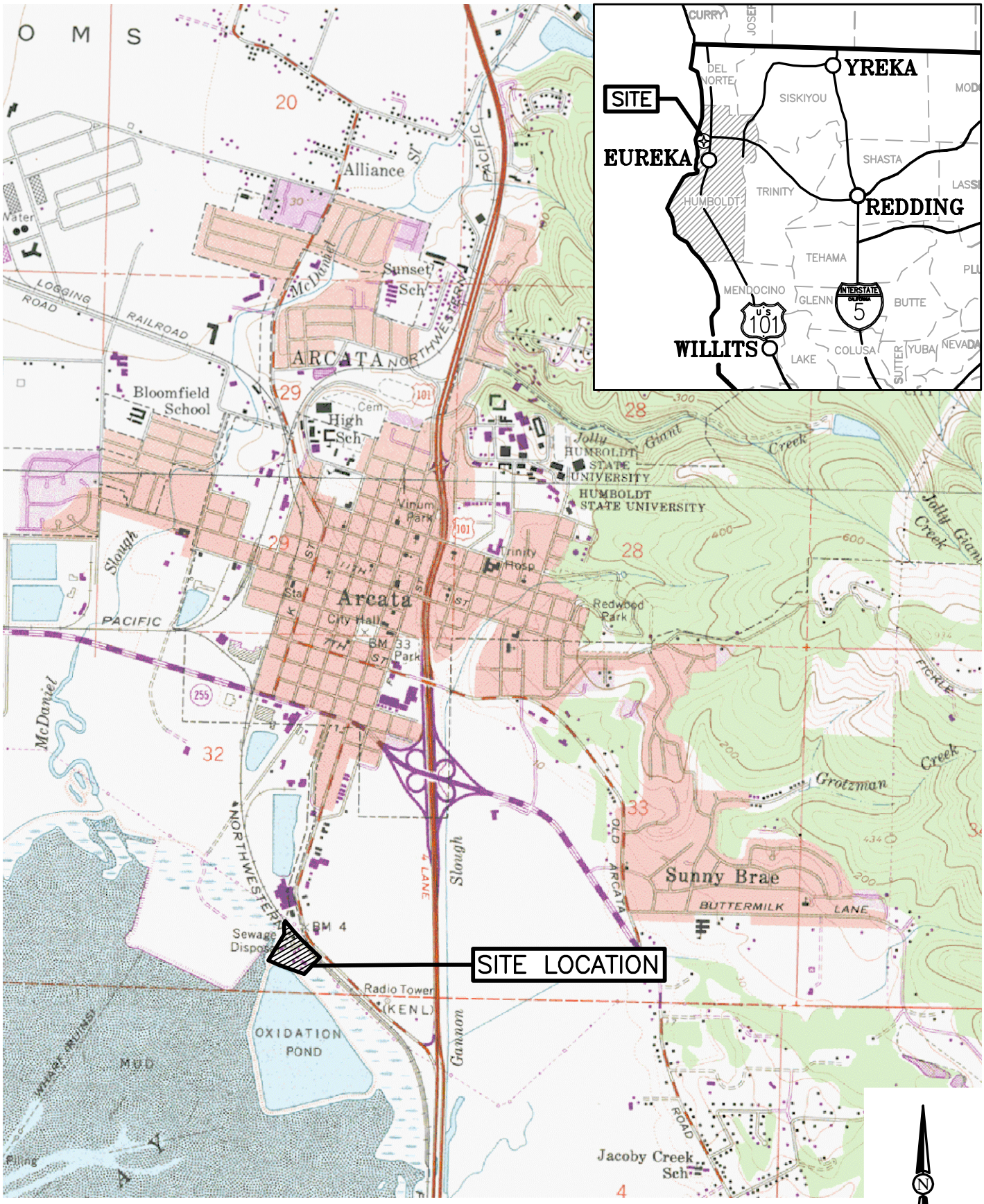
## 1.2 Site History

### 1.2.1 Historical Extent of Petroleum-Impacted Soil

Figure 2 shows the extent of soil excavation conducted at the site in November 2000 and October 2001. Based on the information, the extent of the source area appears to have been defined with the highest concentration of contaminants detected in soil from samples collected at boring location WP-8 (SHN, 2010). Analytical results for soils remaining at the ACY are shown on Figure 3 and the historical summary for all soil samples collected are included in Appendix 1. Primary contaminants at the site include total petroleum hydrocarbons as diesel (TPHD) and as gasoline (TPHG) and the fuel oxygenate methyl tertiary-butyl ether (MTBE).

### 1.2.2 Historical Extent of Petroleum-Impacted Groundwater

Results from the final groundwater monitoring event (May 2018 and February 2019) are illustrated in Figure 4. Primary contaminants of concern have steadily declined during the site's monitoring history and are now at relatively low concentrations (SHN, 2018). Full historical groundwater contaminant concentration data for the ACY is provided in Appendix 1. Groundwater at the site is expected to be encountered at a depth of 1 to 3 feet below grade.

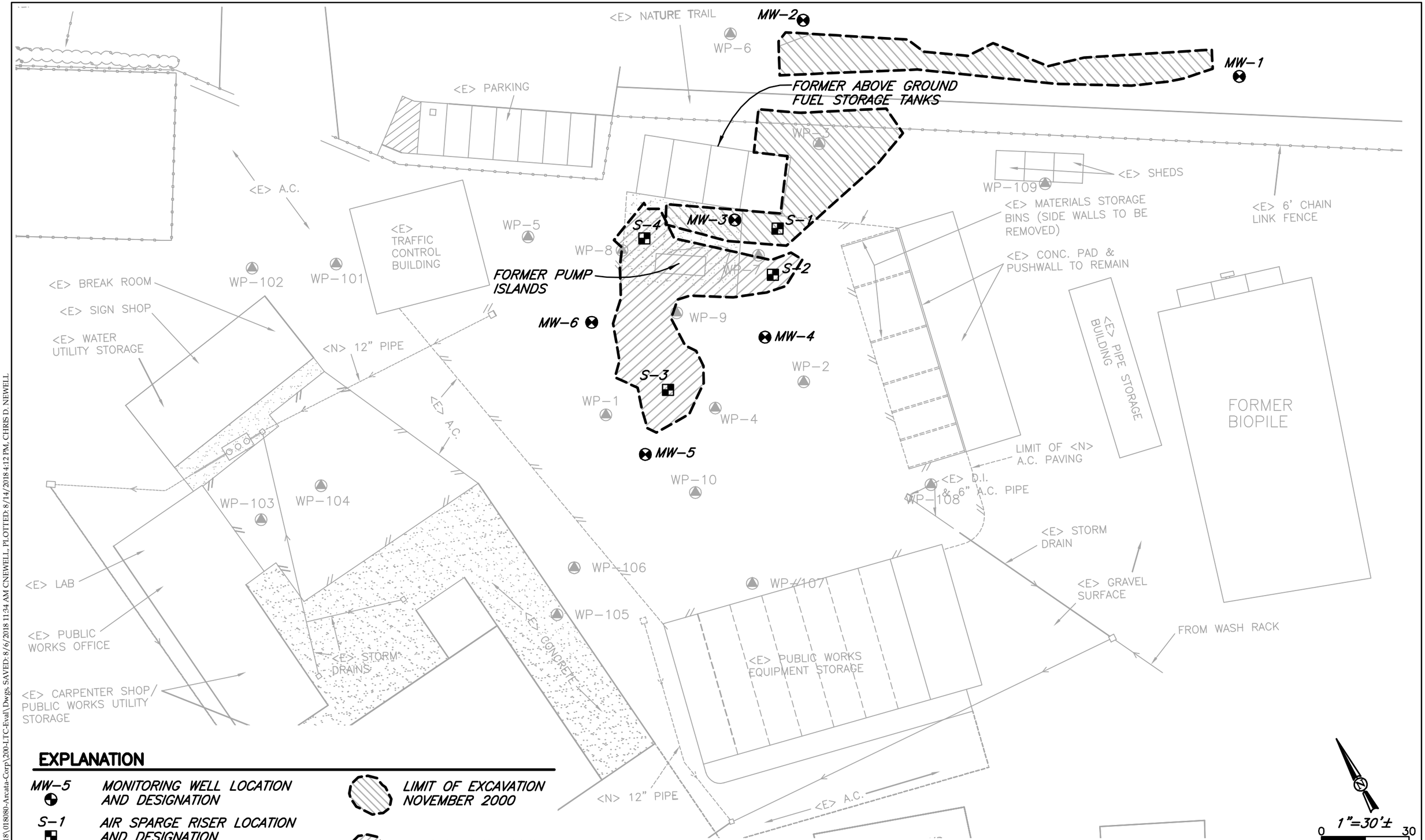



SOURCE: ARCATA NORTH & SOUTH USGS 7.5 MINUTE QUADRANGLE

1"=2000'±

| | | |
|---|---|---|
| Consulting Engineers & Geologists, Inc. | City of Arcata Corp. Yard<br>600 South G Street<br>Arcata, California | Site Location Map<br>SHN 018080.200 |
| | August 2018 | 018080-200-SITE-LCTN | Figure 1 |

\\Eureka\Projects\2018\018080-Arcata-Corp\200-LTC-Eval\Dwgs, SAVED: 8/6/2018 1:28 PM CNEWELL, PLOTTED: 8/14/2018 4:11 PM, CHRIS D. NEWELL




## EXPLANATION

| | |
|---|---|
| MW-5 | MONITORING WELL LOCATION AND DESIGNATION |
| S-1 | AIR SPARGE RISER LOCATION AND DESIGNATION |
| WP-1 | SOIL BORING/TEMPORARY WELL POINT LOCATION AND DESIGNATION |
| | LIMIT OF EXCAVATION NOVEMBER 2000 |
| | LIMIT OF EXCAVATION OCTOBER 2001 |

Consulting Engineers & Geologists, Inc.

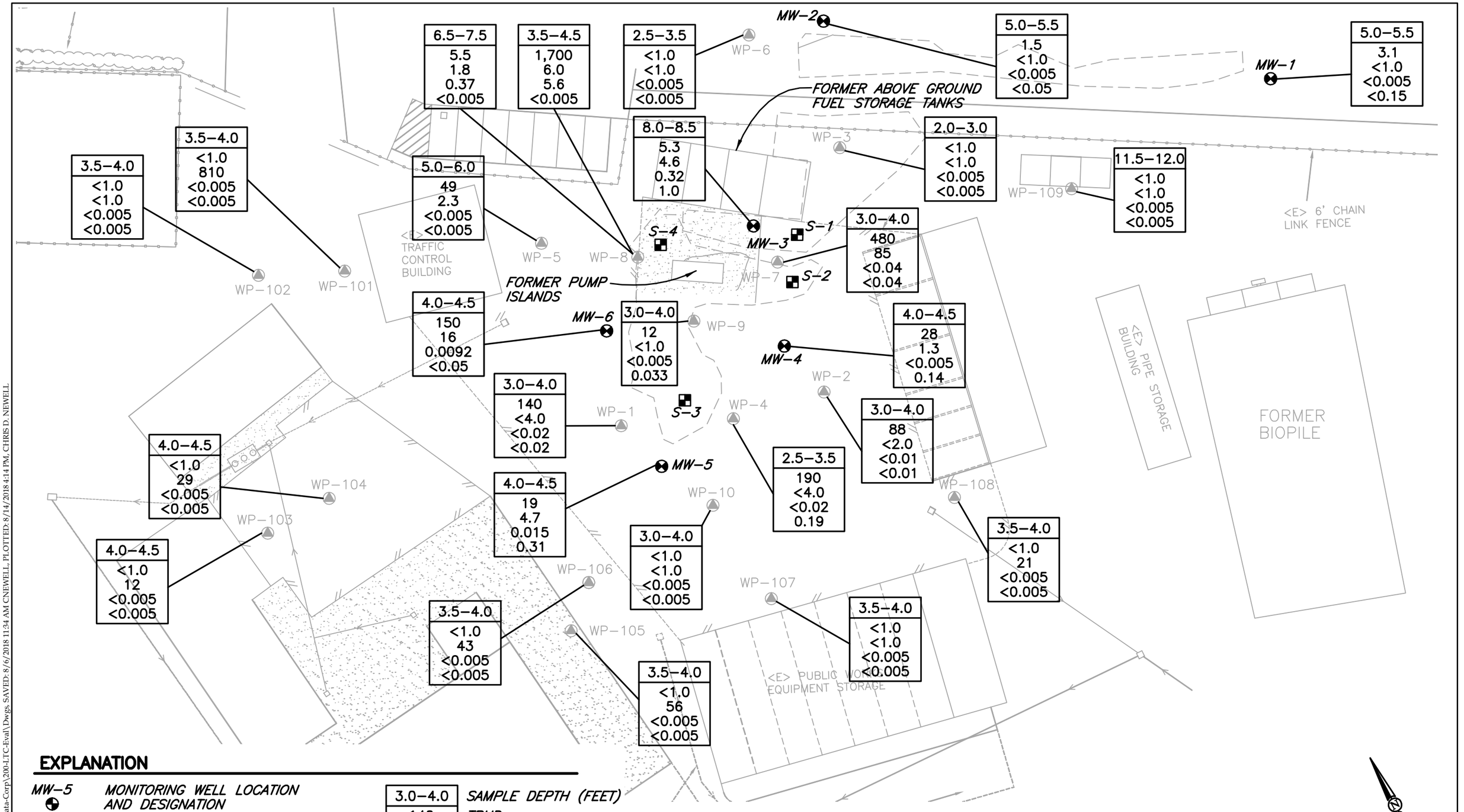
City of Arcata Corp. Yard
600 South G Street
Arcata, California

Site Plan

SHN 018080.200

August 2018 | 018080-200-SITE | Figure 2

\\Eureka\Projects\2018\018080-Arcata-Corp\200-LTC-Eval\Dwgs, SAVED: 8/6/2018 11:34 AM CNEWELL, PLOTTED: 8/14/2018 4:12 PM, CHRIS D. NEWELL




## EXPLANATION

- MW-5 — MONITORING WELL LOCATION AND DESIGNATION
- S-1 — AIR SPARGE RISER LOCATION AND DESIGNATION
- WP-1 — SOIL BORING/TEMPORARY WELL POINT LOCATION AND DESIGNATION
- LIMITS OF EXCAVATION

| | |
|---|---|
| 3.0–4.0 | SAMPLE DEPTH (FEET) |
| 140 | TPHD |
| <4.0 | TPHG |
| <0.02 | BENZENE |
| <0.05 | MTBE |

ALL RESULTS IN mg/kg

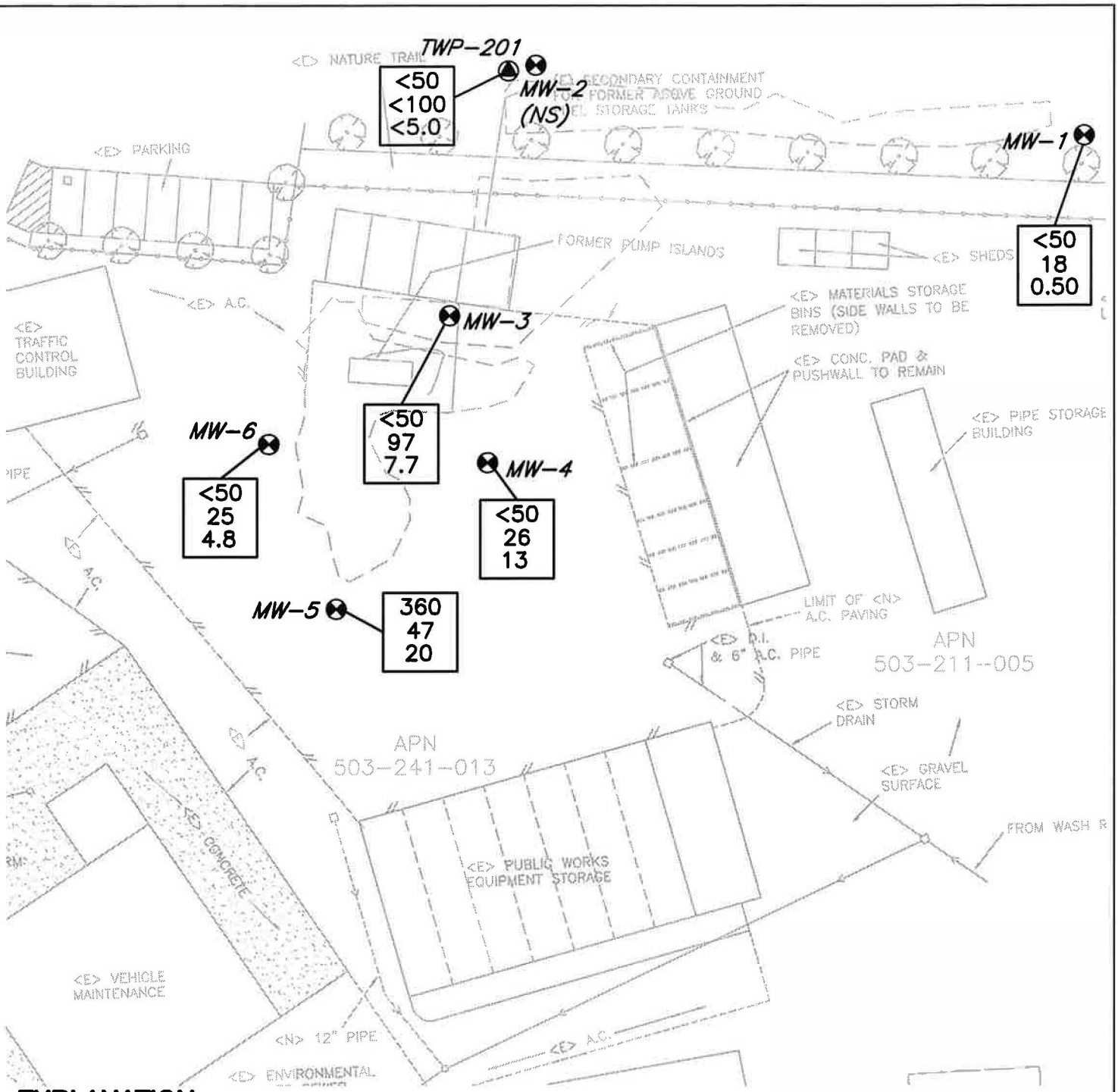
**NOTE:** SAMPLES WP-1 TO WP-10 COLLECTED 6/1/2000
SAMPLES WP-101 TO WP-109 COLLECTED 8/22/2008
SAMPLES MW-1 TO MW-6 COLLECTED 9/18–19/2002

1"=30'± (0 – 30)

Consulting Engineers & Geologists, Inc.

| | | |
|---|---|---|
| City of Arcata Corp. Yard<br>600 South G Street<br>Arcata, California | | Summary of Soil Analytical Results<br>SHN 018080.200 |
| August 2018 | 018080-200-SAR | Figure 3 |

\\Eureka\Projects\2018\018080-Arcata-Corp\200-LTC-Eval\Dwgs, SAVED: 8/6/2018 11:34 AM CNEWELL, PLOTTED: 8/14/2018 4:14 PM, CHRIS D. NEWELL




## EXPLANATION

| | |
|---|---|
| MW-5 | MONITORING WELL LOCATION AND DESIGNATION |
| TWP-201 | TEMPORARY WELL POINT LOCATION AND DESIGNATION |
| 250<br>390<br>64 | TPHD*<br>TPHG<br>MTBE<br>RESULTS IN ug/L |
| (NS) | NOT SAMPLED |
| * | RESULTS WITH SILICA GEL CLEANUP |

1"=40'±

0 40

| | | |
|---|---|---|
| SHN | City of Arcata Corp. Yard<br>600 South G Street<br>Arcata, California | Summary of Final Groundwater Analytical Results<br>SHN 018080.300 |
| | March 2019 \| 018080-300-FINAL-GAR | Figure 4 |

\\Eureka\Projects\2018\018080-Arcata-Corp\300-Well-Install\Dwgs, SAVED: 3/27/2019 10:28 AM CNEWELL, PLOTTED: 4/1/2019 9:14 AM, CHRIS D. NEWELL

# 2.0 Contingency Plan

This SGMCP is intended to minimize the threat of exposure to workers from residual contamination that remains in place and to outline the necessary actions to be taken in the event that contaminated soil and/or groundwater is encountered during future site development activities.

## 2.1 Notifications to be Performed Before Working in Suspected Contaminated Areas

Prior to conducting any subsurface work in the site area, the owner of the property will provide the contractor with this document. The contractor's site supervisor will read this document and become familiar with the potential hazards associated with working in contaminant-impacted areas of the site. The site supervisor will conduct a site meeting with all personnel who may potentially encounter contaminated soil and/or groundwater. During the site meeting, the site supervisor will instruct the site personnel on the appropriate actions to be taken in the event that subsurface contamination is encountered. A copy of this document will be kept with the owner or contractor at the site during construction activities that involve excavation and/or trenching. The contractor will additionally provide a site safety plan for the construction work.

## 2.2 Actions to be Taken Before Working in Contaminated Areas

Prior to working in any subsurface area identified as being impacted by contaminants, workers will review this document and familiarize themselves with the actions necessary if they are exposed to contamination. If there is any uncertainty about the actions to be taken, the worker will consult the site supervisor.

## 2.3 Actions to be Taken Upon Encountering Contaminated Material

If contaminated material is encountered, the site supervisor will be notified. The site supervisor will then determine whether the workers have adequate training and proper protective equipment to continue working in the area. Work will not resume until properly trained and equipped workers are present. A hazard analysis must be performed in accordance with the site safety plan to determine the appropriate level of personnel protection.

## 2.4 Construction Practices to Minimize the Disruption and Potential for Transport of Contaminated Material

Prior to beginning construction in areas where trenching or other earthwork is to be performed, the site map that delineates the impacted areas (Figure 2) will be reviewed by the site supervisor. If possible, work scheduled for potentially contaminated areas will be relocated to minimize the disturbance or removal of contaminated material. If work in contaminated zones cannot be avoided, it will be conducted in a manner that minimizes the disturbance and removal of contaminated material. If trenches extend into the shallow groundwater, cement cofferdams may be required in the trench backfill to minimize the potential for utility trenches to act as a preferential pathway.

## 2.5 How to Properly Handle and Dispose of Contaminated Material

Any contaminated soil encountered that requires removal (such as, soil removed during trenching activities), will be moved for temporary stockpiling to a secure area of the site that is away from routine traffic and is

high enough that water will not pond on or around the soil. The contaminated soil will be placed on, and covered with, 6-mil plastic (Visqueen®) in such a way that the soil pile is protected from water runon and runoff.

Soil samples will be collected for laboratory analysis from the stockpile using laboratory-supplied containers. The samples will be analyzed for contaminants as required by an approved disposal facility. The analytical results of the soil stockpile sample will be used to determine the proper handling and disposal method for the soil. In the event that the soil requires offsite disposal, a contractor licensed to transport such material will be used. The contractor will arrange transportation for the contaminated soil to a facility that is licensed to accept such soil. All contaminated soil shall be removed from the site within 90 days of generation, as required.

Any contaminated groundwater encountered that requires removal will be pumped into appropriate containers. If only a small volume of water is removed, Department of Transportation-approved 55-gallon steel drums may be appropriate. If a large volume of water needs to be removed, a Baker tank or equivalent may be necessary.

The removed water will be analyzed for contaminants as required by an approved disposal facility to determine the appropriate disposal method. The analytical results of the groundwater sample will be used to determine the proper handling and disposal method for the water. In the event that the water requires treatment and offsite disposal, a contractor licensed to handle such material will transport the material to a facility licensed to accept such material for treatment and disposal.

# 3.0 References Cited

SHN Consulting Engineers & Geologists, Inc. (January 2010). *Fourth Quarter 2009 Groundwater Monitoring Report and Request for Site Closure, City Of Arcata Corporation Yard, 600 South G Street, Arcata, California*. Eureka, CA:SHN.

--. (August 2018). Groundwater Monitoring Report and Low Threat Closure Evaluation, City of Arcata Corporation Yard, 600 South G Street, Arcata, California; RWQCB Case Number 1NHU767.

United States Geological Survey. (NR). "Arcata North and South 7.5 Minute Quadrangle." NR:USGS.

# Historical Site Data 1

**Table 1-1**
**Well Construction Details**
**City of Arcata Corporation Yard, Arcata, California**

| Sample Location | Date Installed | Casing Material | Screen Slot Size | Screened Interval (feet BGS)[1] | Sand Interval (feet BGS) | Sanitary Seal (feet BGS) |
|---|---|---|---|---|---|---|
| MW-1 | 9/18/2002 | 2-inch Schedule 40 Polyvinyl Chloride casing and screen | 0.020 | 5-15 | 4-15 | 0-4 |
| MW-2 | 9/18/2002 | | 0.020 | 5-15 | 4-15 | 0-4 |
| MW-3 | 9/19/2002 | | 0.020 | 5-15 | 4-15 | 0.5-4 |
| MW-4 | 9/19/2002 | | 0.020 | 5-15 | 4-15 | 0.5-4 |
| MW-5 | 9/19/2002 | | 0.020 | 5-15 | 4-15 | 0.5-4 |
| MW-6 | 9/19/2002 | | 0.020 | 5-15 | 4-15 | 0.5-4 |

1. BGS: below ground surface

**Table 1-2**
**Historical Groundwater Elevations**
**City of Arcata Corporation Yard, Arcata, California**

| Sample Location | Sample Date | Top of Casing Elevation[1] (feet MSL)[2] | Depth-to-Water (feet)[3] | Groundwater Elevation (feet MSL) |
|---|---|---|---|---|
| MW-1 | 9/26/2002 | 8.73 | 7.73 | 1.00 |
| | 1/22/2003 | | 5.79 | 2.94 |
| | 4/23/2003 | | 5.33 | 3.40 |
| | 7/23/2003 | | 6.60 | 2.13 |
| | 10/22/2003 | | 7.34 | 1.39 |
| | 1/21/2004 | | 3.90 | 4.83 |
| | 4/21/2004 | | 3.81 | 4.92 |
| | 7/21/2004 | | 5.72 | 3.01 |
| | 10/7/2004 | | 7.33 | 1.40 |
| | 1/19/2005 | | 5.80 | 2.93 |
| | 4/20/2005 | | 4.73 | 4.00 |
| | 7/20/2005 | | 5.35 | 3.38 |
| | 10/19/2005 | | 6.94 | 1.79 |
| | 1/18/2006 | | 3.41 | 5.32 |
| | 4/19/2006 | | 3.82 | 4.91 |
| | 7/19/2006 | | 6.38 | 2.35 |
| | 10/25/2006 | | 6.93 | 1.80 |
| | 1/17/2007 | | 3.95 | 4.78 |
| | 4/18/2007 | | 3.55 | 5.18 |
| | 7/18/2007 | | 6.60 | 2.13 |
| | 10/18/2007 | | 6.65 | 2.08 |
| | 1/16/2008 | | 3.70 | 5.03 |
| | 4/15/2008 | | 4.10 | 4.63 |
| | 7/16/2008 | | 6.30 | 2.43 |
| | 10/15/2008 | | 7.70 | 1.03 |
| | 1/14/2009 | | 3.65 | 5.08 |
| | 4/15/2009 | | 3.80 | 4.93 |
| | 7/17/2009 | | 6.72 | 2.01 |
| | 10/7/2009 | | NM[4] | NM |
| | 5/22/2018 | | 4.29 | 4.44 |
| MW-2 | 9/27/2002 | 9.86 | 8.82 | 1.04 |
| | 1/22/2003 | | 6.44 | 3.42 |
| | 4/23/2003 | | 9.38 | 0.48 |
| | 7/23/2003 | | 8.90 | 0.96 |
| | 10/22/2003 | | 8.70 | 1.16 |
| | 1/21/2004 | | 7.38 | 2.48 |
| | 4/21/2004 | | 9.53 | 0.33 |
| | 7/21/2004 | | 8.10 | 1.76 |
| | 10/7/2004 | | 8.76 | 1.10 |
| | 1/19/2005 | | 9.00 | 0.86 |
| | 4/20/2005 | | 8.72 | 1.14 |
| | 7/20/2005 | | 8.70 | 1.16 |

**Table 1-2**
**Historical Groundwater Elevations**
**City of Arcata Corporation Yard, Arcata, California**

| Sample Location | Sample Date | Top of Casing Elevation[1] (feet MSL)[2] | Depth-to-Water (feet)[3] | Groundwater Elevation (feet MSL) |
|---|---|---|---|---|
| MW-2 Cont'd | 10/19/2005 | 9.86 | 8.26 | 1.60 |
| | 1/18/2006 | | 6.50 | 3.36 |
| | 4/19/2006 | | 6.40 | 3.46 |
| | 7/19/2006 | | 7.70 | 2.16 |
| | 10/25/2006 | | 8.20 | 1.66 |
| | 1/17/2007 | | 7.10 | 2.76 |
| | 4/18/2007 | | 6.56 | 3.30 |
| | 7/18/2007 | | 8.20 | 1.66 |
| | 10/18/2007 | | 7.60 | 2.26 |
| | 1/16/2008 | | 6.53 | 3.33 |
| | 4/15/2008 | | 6.90 | 2.96 |
| | 7/16/2008 | | 7.80 | 2.06 |
| | 10/15/2008 | | 8.73 | 1.13 |
| | 1/14/2009 | | 6.75 | 3.11 |
| | 4/15/2009 | | 6.70 | 3.16 |
| | 7/17/2009 | | 7.80 | 2.06 |
| | 10/7/2009 | | 8.20 | 1.66 |
| | 5/22/2018 | | NM | NM |
| MW-3 | 9/26/2002 | 6.97 | 2.84 | 4.13 |
| | 1/22/2003 | | 1.36 | 5.61 |
| | 4/23/2003 | | 1.11 | 5.86 |
| | 7/23/2003 | | 2.50 | 4.47 |
| | 10/22/2003 | | 2.81 | 4.16 |
| | 1/21/2004 | | 3.27 | 3.70 |
| | 4/21/2004 | | 1.00 | 5.97 |
| | 7/21/2004 | | 2.95 | 4.02 |
| | 10/7/2004 | | 3.59 | 3.38 |
| | 1/19/2005 | | 1.45 | 5.52 |
| | 4/20/2005 | | 1.02 | 5.95 |
| | 7/20/2005 | | 2.10 | 4.87 |
| | 10/19/2005 | | 2.60 | 4.37 |
| | 1/18/2006 | | 0.33 | 6.64 |
| | 4/19/2006 | | 1.55 | 5.42 |
| | 7/19/2006 | | 2.98 | 3.99 |
| | 10/25/2006 | | 3.10 | 3.87 |
| | 1/17/2007 | | 1.70 | 5.27 |
| | 4/18/2007 | | 2.70 | 4.27 |
| | 7/18/2007 | | 2.60 | 4.37 |
| | 10/18/2007 | | 2.60 | 4.37 |
| | 1/16/2008 | | 1.65 | 5.32 |
| | 4/15/2008 | | 1.80 | 5.17 |
| | 7/16/2008 | | 3.10 | 3.87 |

**Table 1-2**
**Historical Groundwater Elevations**
**City of Arcata Corporation Yard, Arcata, California**

| Sample Location | Sample Date | Top of Casing Elevation[1] (feet MSL)[2] | Depth-to-Water (feet)[3] | Groundwater Elevation (feet MSL) |
|---|---|---|---|---|
| MW-3 Cont'd | 10/15/2008 | 6.97 | 3.20 | 3.77 |
| | 1/14/2009 | | 1.50 | 5.47 |
| | 4/15/2009 | | 1.60 | 5.37 |
| | 7/17/2009 | | 2.60 | 4.37 |
| | 10/7/2009 | | 2.70 | 4.27 |
| | 5/22/2018 | | 0.68 | -0.68 |
| MW-4 | 9/27/2002 | 6.96 | 4.01 | 2.95 |
| | 1/22/2003 | | 2.36 | 4.60 |
| | 4/23/2003 | | 2.35 | 4.61 |
| | 7/23/2003 | | 2.50 | 4.46 |
| | 10/22/2003 | | 4.34 | 2.62 |
| | 1/21/2004 | | 1.26 | 5.70 |
| | 4/21/2004 | | 3.67 | 3.29 |
| | 7/21/2004 | | 5.20 | 1.76 |
| | 10/7/2004 | | 4.15 | 2.81 |
| | 1/19/2005 | | 3.75 | 3.21 |
| | 4/20/2005 | | 3.52 | 3.44 |
| | 7/20/2005 | | 2.00 | 4.96 |
| | 10/19/2005 | | 4.24 | 2.72 |
| | 1/18/2006 | | 3.50 | 3.46 |
| | 4/19/2006 | | 2.20 | 4.76 |
| | 7/19/2006 | | 3.91 | 3.05 |
| | 10/25/2006 | | 4.40 | 2.56 |
| | 1/17/2007 | | 3.40 | 3.56 |
| | 4/18/2007 | | 2.88 | 4.08 |
| | 7/18/2007 | | 4.10 | 2.86 |
| | 10/18/2007 | | 4.20 | 2.76 |
| | 1/16/2008 | | 3.02 | 3.94 |
| | 4/15/2008 | | 3.30 | 3.66 |
| | 7/16/2008 | | 3.10 | 3.86 |
| | 10/15/2008 | | 4.25 | 2.71 |
| | 1/14/2009 | | 3.55 | 3.41 |
| | 4/15/2009 | | 3.10 | 3.86 |
| | 7/17/2009 | | 3.80 | 3.16 |
| | 10/7/2009 | | 4.30 | 2.66 |
| | 5/22/2018 | | 0.19 | 6.77 |
| MW-5 | 9/26/2002 | 6.83 | 2.70 | 4.13 |
| | 1/22/2003 | | 1.24 | 5.59 |
| | 4/23/2003 | | 1.05 | 5.78 |
| | 7/23/2003 | | 2.30 | 4.53 |
| | 10/22/2003 | | 2.68 | 4.15 |
| | 1/21/2004 | | 1.18 | 5.65 |

**Table 1-2**
**Historical Groundwater Elevations**
**City of Arcata Corporation Yard, Arcata, California**

| Sample Location | Sample Date | Top of Casing Elevation[1] (feet MSL)[2] | Depth-to-Water (feet)[3] | Groundwater Elevation (feet MSL) |
|---|---|---|---|---|
| MW-5 Cont'd | 4/21/2004 | 6.83 | 0.50 | 6.33 |
| | 7/21/2004 | | 3.80 | 3.03 |
| | 10/7/2004 | | 2.95 | 3.88 |
| | 1/19/2005 | | 1.41 | 5.42 |
| | 4/20/2005 | | 1.05 | 5.78 |
| | 7/20/2005 | | 1.90 | 4.93 |
| | 10/19/2005 | | 2.45 | 4.38 |
| | 1/18/2006 | | 0.50 | 6.33 |
| | 4/19/2006 | | 1.50 | 5.33 |
| | 7/19/2006 | | 2.55 | 4.28 |
| | 10/25/2006 | | 2.90 | 3.93 |
| | 1/17/2007 | | 1.60 | 5.23 |
| | 4/18/2007 | | 1.30 | 5.53 |
| | 7/18/2007 | | 2.50 | 4.33 |
| | 10/18/2007 | | 2.70 | 4.13 |
| | 1/16/2008 | | 1.40 | 5.43 |
| | 4/15/2008 | | 1.80 | 5.03 |
| | 7/16/2008 | | 2.55 | 4.28 |
| | 10/15/2008 | | 2.93 | 3.90 |
| | 1/14/2009 | | 3.30 | 3.53 |
| | 4/15/2009 | | 1.45 | 5.38 |
| | 7/17/2009 | | 2.50 | 4.33 |
| | 10/7/2009 | | 2.70 | 4.13 |
| | 5/22/2018 | | 0.64 | -0.64 |
| MW-6 | 9/27/2002 | 6.73 | 5.11 | 1.62 |
| | 1/22/2003 | | 3.23 | 3.50 |
| | 4/23/2003 | | 1.91 | 4.82 |
| | 7/23/2003 | | 5.60 | 1.13 |
| | 10/22/2003 | | 3.75 | 2.98 |
| | 1/21/2004 | | 1.71 | 5.02 |
| | 4/21/2004 | | 5.65 | 1.08 |
| | 7/21/2004 | | 2.70 | 4.03 |
| | 10/7/2004 | | 3.16 | 3.57 |
| | 1/19/2005 | | 1.80 | 4.93 |
| | 4/20/2005 | | 1.00 | 5.73 |
| | 7/20/2005 | | 1.70 | 5.03 |
| | 10/19/2005 | | 2.96 | 3.77 |
| | 1/18/2006 | | 1.20 | 5.53 |
| | 4/19/2006 | | 2.40 | 4.33 |
| | 7/19/2006 | | 3.70 | 3.03 |
| | 10/25/2006 | | 2.50 | 4.23 |
| | 1/17/2007 | | 2.70 | 4.03 |

**Table 1-2**
**Historical Groundwater Elevations**
**City of Arcata Corporation Yard, Arcata, California**

| Sample Location | Sample Date | Top of Casing Elevation[1] (feet MSL)[2] | Depth-to-Water (feet)[3] | Groundwater Elevation (feet MSL) |
|---|---|---|---|---|
| MW-6 Cont'd | 4/18/2007 | 6.73 | 2.14 | 4.59 |
| | 7/18/2007 | | 4.00 | 2.73 |
| | 10/18/2007 | | 3.30 | 3.43 |
| | 1/16/2008 | | 1.50 | 5.23 |
| | 4/15/2008 | | 1.85 | 4.88 |
| | 7/16/2008 | | 2.50 | 4.23 |
| | 10/15/2008 | | 2.90 | 3.83 |
| | 1/14/2009 | | 2.80 | 3.93 |
| | 4/15/2009 | | 2.00 | 4.73 |
| | 7/17/2009 | | 3.10 | 3.63 |
| | 10/7/2009 | | 3.50 | 3.23 |
| | 5/22/2018 | | 1.75 | -1.75 |

1. Top of casing elevation referenced to City of Arcata Bench Mark #4, elevation
2. MSL: mean sea level
3. below top of casing
4. NM: not measured

**Table 1-3**
**Historical Groundwater Analytical Results**
**City of Arcata Corporation Yard, Arcata, California**
**(in ug/L)[1]**

| Sample Location | Date | TPHD[2] | TPHG[3] | B[3] | T[3] | E[3] | X[3] | MTBE[3] | TBA[3] | DIPE[3] | ETBE[3] | TAME[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-1 | 9/26/2002 | <50[4] | <50 | <0.50 | <0.50 | <0.50 | <0.50 | **4.3** | <20 | <1.0 | <1.0 | <1.0 |
| | 1/22/2003 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | **34** | <20 | <1.0 | <1.0 | **1.3** |
| | 4/23/2003 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | **21** | <20 | <1.0 | <1.0 | **1.1** |
| | 7/23/2003 | <50 | **76** | <0.50 | <0.50 | <0.50 | <0.50 | **100** | <20 | <1.0 | <1.0 | **4.4** |
| | 10/22/2003 | <50 | **75** | <0.50 | <0.50 | <0.50 | <0.50 | **35** | <20 | <1.0 | <1.0 | **1.6** |
| | 1/21/2004 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | **5.0** | <20 | <1.0 | <1.0 | <1.0 |
| | 4/21/2004 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | **9.1** | <10 | <1.0 | <1.0 | <1.0 |
| | 7/21/2004 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | **31** | <10 | <1.0 | <1.0 | **1.1** |
| | 10/7/2004 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **20** | <10 | <1.0 | <1.0 | <1.0 |
| | 1/19/2005 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **4.6** | <10 | <1.0 | <1.0 | <1.0 |
| | 4/20/2005 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **5.9** | <10 | <1.0 | <1.0 | <1.0 |
| | 7/20/2005 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **14** | <10 | <1.0 | <1.0 | <1.0 |
| | 10/19/2005 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **15** | <10 | <1.0 | <1.0 | <1.0 |
| | 1/18/2006 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **6.3** | <10 | <1.0 | <1.0 | <1.0 |
| | 4/19/2006 | <50 | <50 | <0.50 | **0.85** | <0.50 | **0.84** | **9.9** | <10 | <1.0 | <1.0 | <1.0 |
| | 7/19/2006 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **14** | <10 | <1.0 | <1.0 | <1.0 |
| | 10/25/2006 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **8.8** | <10 | <1.0 | <1.0 | <1.0 |
| | 1/17/2007 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **2.5** | <10 | <1.0 | <1.0 | <1.0 |
| | 4/18/2007 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **3.1** | <10 | <1.0 | <1.0 | <1.0 |
| | 7/18/2007 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **7.2** | <10 | <1.0 | <1.0 | <1.0 |
| | 10/18/2007 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **5.3** | <10 | <1.0 | <1.0 | <1.0 |
| | 1/16/2008 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **1.9** | <10 | <1.0 | <1.0 | <1.0 |
| | 4/15/2008 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **2.0** | <10 | <1.0 | <1.0 | <1.0 |
| | 7/16/2008 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **5.0** | <10 | <1.0 | <1.0 | <1.0 |
| | 10/15/2008 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **3.2** | <10 | <1.0 | <1.0 | <1.0 |
| | 1/14/2009 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **2.0** | <10 | <1.0 | <1.0 | <1.0 |
| | 4/15/2009 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **1.6** | <10 | <1.0 | <1.0 | <1.0 |
| w/silica gel | 4/15/2009 | <50 | Not subjected to silica gel cleanup | | | | | | | | | |
| | 7/17/2009 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **11** | <10 | <1.0 | <1.0 | <1.0 |
| | Well was removed from monitoring & reporting schedule. | | | | | | | | | | | |
| | 5/22/2018 | **16 J** | **18 J** | <0.50 | <0.50 | <0.50 | <1.0 | **0.50** | <10 | <1.0 | <1.0 | <0.50 |
| MW-2 | 9/27/2002 | **820** | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <1.0 | <20 | <1.0 | <1.0 | <1.0 |
| | 1/22/2003 | <50 | **72** | <0.50 | <0.50 | <0.50 | <0.50 | **130** | <20 | <1.0 | <1.0 | **9.8** |
| | 4/23/2003 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | **57** | <20 | <1.0 | <1.0 | **3.5** |
| | 7/23/2003 | <50 | **52** | <0.50 | <0.50 | <0.50 | <0.50 | **59** | <20 | <1.0 | <1.0 | **3.4** |
| | 10/22/2003 | <50 | **64** | <0.50 | <0.50 | <0.50 | <0.50 | **37** | <20 | <1.0 | <1.0 | **2.2** |
| | 1/21/2004 | <50 | **83** | <0.50 | <0.50 | <0.50 | <0.50 | **61** | <20 | <1.0 | <1.0 | **3.8** |
| | 4/21/2004 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | **22** | <10 | <1.0 | <1.0 | **1.5** |
| | 7/21/2004 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | **24** | <10 | <1.0 | <1.0 | **1.5** |
| | 10/7/2004 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **26** | <10 | <1.0 | <1.0 | **1.5** |
| | 1/19/2005 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **33** | <10 | <1.0 | <1.0 | **1.7** |
| | 4/20/2005 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **31** | <10 | <1.0 | <1.0 | **1.8** |
| | 7/20/2005 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **22** | <10 | <1.0 | <1.0 | **1.3** |

**Table 1-3**
**Historical Groundwater Analytical Results**
**City of Arcata Corporation Yard, Arcata, California**
**(in ug/L)[1]**

| Sample Location | Date | TPHD[2] | TPHG[3] | B[3] | T[3] | E[3] | X[3] | MTBE[3] | TBA[3] | DIPE[3] | ETBE[3] | TAME[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-2 | 10/19/2005 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **16** | <10 | <1.0 | <1.0 | **1.1** |
| cont'd | 1/18/2006 | <50 | **50** | <0.50 | <0.50 | <0.50 | <1.0 | **28** | <10 | <1.0 | <1.0 | **1.6** |
| | 4/19/2006 | <50 | **50** | <0.50 | **0.70** | <0.50 | **0.73** | **21** | <10 | <1.0 | <1.0 | **1.7** |
| | 7/19/2006 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **18** | <10 | <1.0 | <1.0 | **1.4** |
| | 10/25/2006 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **17** | <10 | <1.0 | <1.0 | **1.2** |
| | 1/17/2007 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **17** | <10 | <1.0 | <1.0 | **1.1** |
| | 4/18/2007 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **18** | <10 | <1.0 | <1.0 | **1.2** |
| | 7/18/2007 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **14** | <10 | <1.0 | <1.0 | **1.1** |
| | 10/18/2007 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **13** | <10 | <1.0 | <1.0 | <1.0 |
| | 1/16/2008 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **12** | <10 | <1.0 | <1.0 | **1.0** |
| | 4/15/2008 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **11** | <10 | <1.0 | <1.0 | <1.0 |
| | 7/16/2008 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **12** | <10 | <1.0 | <1.0 | <1.0 |
| | 10/15/2008 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **11** | <10 | <1.0 | <1.0 | <1.0 |
| | 1/14/2009 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **13** | <10 | <1.0 | <1.0 | <1.0 |
| | 4/15/2009 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **12** | <10 | <1.0 | <1.0 | <1.0 |
| w/silica gel | 4/15/2009 | <50 | Not subjected to silica gel cleanup | | | | | | | | | |
| | 7/17/2009 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **13** | <10 | <1.0 | <1.0 | <1.0 |
| | 10/7/2009 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **12** | <10 | <1.0 | <1.0 | <1.0 |
| w/silica gel | 10/7/2009 | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| MW-3 | 9/26/2002 | <50 | **990** | **63** | <0.50 | <0.50 | <0.50 | **860** | **58** | <1.0 | <1.0 | **55** |
| | 1/22/2003 | **220** | **1,600** | **110** | **13** | **41** | **50.9** | **990** | **250** | <1.0 | <1.0 | **75** |
| | 4/23/2003 | **150** | **660** | **55** | **1.1** | **3.0** | **1.5** | **720** | **82** | <1.0 | <1.0 | **48** |
| | 7/23/2003 | **83** | **210** | **120** | <0.50 | <0.50 | <0.50 | **530** | **94** | <1.0 | <1.0 | **11** |
| | 10/22/2003 | **330** | **720** | **26** | <0.50 | <0.50 | <0.50 | **570** | **32** | <1.0 | <1.0 | **32** |
| | 1/21/2004 | **78** | **740** | **58** | **5.7** | **17** | **8.2** | **310** | <90 | <1.0 | <1.0 | **25** |
| | 4/21/2004 | <50 | **360** | **77** | **1.4** | **1.7** | **0.88** | **120** | <28 | <1.0 | <1.0 | **7.2** |
| | 7/21/2004 | **130** | **260** | <0.50 | <0.50 | <0.50 | <0.50 | **280** | **43** | <1.0 | <1.0 | **9.7** |
| | 10/7/2004 | **57** | **640** | **1.6** | <0.50 | <0.50 | <1.0 | **450** | **64** | <1.0 | <1.0 | **28** |
| | 1/19/2005 | <50 | **120** | **1.5** | <0.50 | <0.50 | <1.0 | **110** | <45 | <1.0 | <1.0 | **4.0** |
| | 4/20/2005 | <50 | **67** | **0.59** | <0.50 | <0.50 | <1.0 | **65** | <15 | <1.0 | <1.0 | **2.0** |
| | 7/20/2005 | <50 | **200** | <0.50 | <0.50 | <0.50 | <1.0 | **220** | <50 | <1.0 | <1.0 | **7.6** |
| | 10/19/2005 | <50 | **190** | **1.1** | <0.50 | <0.50 | <1.0 | **85** | <30 | <1.0 | <1.0 | **6.2** |
| | 1/18/2006 | <50 | **140** | <0.50 | <0.50 | <0.50 | <1.0 | **100** | <30 | <1.0 | <1.0 | **3.3** |
| | 4/19/2006 | <50 | <50 | <0.50 | **0.54** | <0.50 | **0.65** | **4.7** | <10 | <1.0 | <1.0 | <1.0 |
| | 7/19/2006 | <50 | <50 | **1.2** | <0.50 | <0.50 | <1.0 | **4.0** | <10 | <1.0 | <1.0 | <1.0 |
| | 10/25/2006 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **4.2** | <10 | <1.0 | <1.0 | <1.0 |
| | 1/17/2007 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **2.0** | <10 | <1.0 | <1.0 | <1.0 |
| | 4/18/2007 | **63** | <50 | <0.50 | <0.50 | <0.50 | <1.0 | <1.0 | <10 | <1.0 | <1.0 | <1.0 |
| | 7/18/2007 | <50 | <50 | **0.80** | <0.50 | <0.50 | <1.0 | **6.1** | <10 | <1.0 | <1.0 | <1.0 |
| | 10/18/2007 | **110** | <50 | <0.50 | <0.50 | <0.50 | <1.0 | <1.0 | <10 | <1.0 | <1.0 | <1.0 |
| | 1/16/2008 | **55** | <50 | <0.50 | <0.50 | <0.50 | <1.0 | <1.0 | <10 | <1.0 | <1.0 | <1.0 |
| | 4/15/2008 | **160** | <50 | <0.50 | <0.50 | <0.50 | <1.0 | <1.0 | <10 | <1.0 | <1.0 | <1.0 |
| | 7/16/2008 | **55** | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **1.0** | <10 | <1.0 | <1.0 | <1.0 |

**Table 1-3**
**Historical Groundwater Analytical Results**
**City of Arcata Corporation Yard, Arcata, California**
**(in ug/L)[1]**

| Sample Location | Date | TPHD[2] | TPHG[3] | B[3] | T[3] | E[3] | X[3] | MTBE[3] | TBA[3] | DIPE[3] | ETBE[3] | TAME[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-3 | 10/15/2008 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **1.4** | <10 | <1.0 | <1.0 | <1.0 |
| cont'd | 1/14/2009 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **7.4** | <10 | <1.0 | <1.0 | <1.0 |
| | 4/15/2009 | **89** | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **17** | <10 | <1.0 | <1.0 | **1.3** |
| w/silica gel | 4/15/2009 | <50 | Not subjected to silica gel cleanup | | | | | | | | | |
| | 7/17/2009 | **110** | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **26** | <10 | <1.0 | <1.0 | **1.3** |
| w/silica gel | 7/17/2009 | <50 | Not subjected to silica gel cleanup | | | | | | | | | |
| | 10/7/2009 | **97** | **52** | <0.50 | <0.50 | <0.50 | <1.0 | **25** | <10 | <1.0 | <1.0 | **1.4** |
| w/silica gel | 10/7/2009 | <50 | Not subjected to silica gel cleanup | | | | | | | | | |
| | 5/22/2018 | **55** | **97** | **0.29 J** | <0.50 | <0.50 | **0.37 J** | **7.7** | <10 | <1.0 | <1.0 | **0.47 J** |
| w/silica gel | 5/22/2018 | <50 | Not subjected to silica gel cleanup | | | | | | | | | |
| MW-4 | 9/27/2002 | <50 | **270** | <0.50 | <0.50 | <0.50 | <0.50 | **270** | **32** | <1.0 | <1.0 | **6.2** |
| | 1/22/2003 | **150** | **250** | <0.50 | <0.50 | <0.50 | <0.50 | **340** | **170** | <1.0 | <1.0 | **13** |
| | 4/23/2003 | **110** | **520** | <0.50 | <0.50 | <0.50 | <0.50 | **350** | **160** | <1.0 | <1.0 | **11** |
| | 7/23/2003 | <50 | **1,000** | **160** | **3.0** | **0.78** | **4.1** | **330** | **66** | <1.0 | <1.0 | **41** |
| | 10/22/2003 | **130** | **290** | <0.50 | <0.50 | <0.50 | <0.50 | **260** | **62** | <1.0 | <1.0 | **6.5** |
| | 1/21/2004 | **97** | **550** | <0.50 | <0.50 | <0.50 | <0.50 | **580** | **190** | <1.0 | <1.0 | **16** |
| | 4/21/2004 | <50 | **480** | <0.50 | <0.50 | <0.50 | <0.50 | **490** | **130** | <1.0 | <1.0 | **15** |
| | 7/21/2004 | **140** | **380** | **25** | <0.50 | <0.50 | <0.50 | **500** | **29** | <1.0 | <1.0 | **22** |
| | 10/7/2004 | <50 | **440** | <0.50 | <0.50 | <0.50 | <1.0 | **380** | **110** | <1.0 | <1.0 | **8.5** |
| | 1/19/2005 | <50 | **410** | <0.50 | <0.50 | <0.50 | <1.0 | **380** | <10 | <1.0 | <1.0 | **12** |
| | 4/20/2005 | <50 | **320** | <0.50 | <0.50 | <0.50 | <1.0 | **370** | <100 | <1.0 | <1.0 | **12** |
| | 7/20/2005 | <50 | **370** | <0.50 | <0.50 | <0.50 | <1.0 | **380** | **95** | <1.0 | <1.0 | **11** |
| | 10/19/2005 | <50 | **350** | <0.50 | <0.50 | <0.50 | <1.0 | **230** | **86** | <1.0 | <1.0 | **7.9** |
| | 1/18/2006 | <50 | **300** | <0.50 | <0.50 | <0.50 | <1.0 | **270** | **56** | <1.0 | <1.0 | **7.6** |
| | 4/19/2006 | <50 | **250** | <0.50 | <0.50 | <0.50 | **0.58** | **220** | <110 | <1.0 | <1.0 | **8.5** |
| | 7/19/2006 | <50 | **260** | <0.50 | <0.50 | <0.50 | <1.0 | **260** | <80 | <1.0 | <1.0 | **8.1** |
| | 10/25/2006 | **130** | **410** | <0.50 | <0.50 | <0.50 | <1.0 | **230** | **55** | <1.0 | <1.0 | **7.4** |
| | 1/17/2007 | **110** | **170** | <0.50 | <0.50 | <0.50 | <1.0 | **95** | <30 | <1.0 | <1.0 | **3.5** |
| | 4/18/2007 | **99** | **120** | <0.50 | <0.50 | <0.50 | <1.0 | **92** | <30 | <1.0 | <1.0 | **3.4** |
| | 7/18/2007 | <50 | **150** | <0.50 | <0.50 | <0.50 | <1.0 | **140** | **23** | <1.0 | <1.0 | **4.8** |
| | 10/18/2007 | **130** | **210** | <0.50 | <0.50 | <0.50 | <1.0 | **140** | <60 | <1.0 | <1.0 | **4.5** |
| | 1/16/2008 | **68** | **90** | <0.50 | <0.50 | <0.50 | <1.0 | **59** | <20 | <1.0 | <1.0 | **2.3** |
| | 4/15/2008 | <50 | **86** | <0.50 | <0.50 | <0.50 | <1.0 | **63** | <20 | <1.0 | <1.0 | **2.2** |
| | 7/16/2008 | **73** | **130** | <0.50 | <0.50 | <0.50 | <1.0 | **97** | <30 | <1.0 | <1.0 | **3.2** |
| | 10/15/2008 | **68** | **170** | <0.50 | <0.50 | <0.50 | <1.0 | **100** | <40 | <1.0 | <1.0 | **3.5** |

**Table 1-3**
**Historical Groundwater Analytical Results**
**City of Arcata Corporation Yard, Arcata, California**
**(in ug/L)[1]**

| Sample Location | Date | TPHD[2] | TPHG[3] | B[3] | T[3] | E[3] | X[3] | MTBE[3] | TBA[3] | DIPE[3] | ETBE[3] | TAME[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-4 | 1/14/2009 | <50 | **68** | <0.50 | <0.50 | <0.50 | <1.0 | **51** | <10 | <1.0 | <1.0 | **2.3** |
| cont'd | 4/15/2009 | **120** | **86** | <0.50 | <0.50 | <0.50 | <1.0 | **39** | <10 | <1.0 | <1.0 | **1.5** |
| w/silica gel | 4/15/2009 | <50 | Not subjected to silica gel cleanup | | | | | | | | | |
| | 7/17/2009 | **110** | **67** | <0.50 | <0.50 | <0.50 | <1.0 | **73** | <20 | <1.0 | <1.0 | **2.6** |
| w/silica gel | 7/17/2009 | <50 | Not subjected to silica gel cleanup | | | | | | | | | |
| | 10/7/2009 | **75** | **140** | <0.50 | <0.50 | <0.50 | <1.0 | **85** | <10 | <1.0 | <1.0 | **2.8** |
| w/silica gel | 10/7/2009 | <50 | Not subjected to silica gel cleanup | | | | | | | | | |
| | 5/22/2018 | **75** | **26 J** | <0.50 | <0.50 | <0.50 | <1.0 | **13** | **48** | <1.0 | <1.0 | **0.40 J** |
| w/silica gel | 5/22/2018 | <50 | Not subjected to silica gel cleanup | | | | | | | | | |
| MW-5 | 9/26/2002 | **160** | **750** | <0.50 | <0.50 | <0.50 | <0.50 | **490** | **66** | <1.0 | <1.0 | **12** |
| | 1/22/2003 | **1,300** | **590** | <0.50 | **0.87** | <0.50 | <0.50 | **330** | **160** | <1.0 | <1.0 | **13** |
| | 4/23/2003 | **1,100** | **520** | <0.50 | <0.50 | <0.50 | <0.50 | **280** | **56** | <1.0 | <1.0 | **8.1** |
| | 7/23/2003 | **930** | **150** | <0.50 | <0.50 | <0.50 | <0.50 | **300** | **35** | <1.0 | <1.0 | **6.2** |
| | 10/22/2003 | **3,400** | **780** | <0.50 | <0.50 | <0.50 | <0.50 | **320** | **41** | <1.0 | <1.0 | **7.7** |
| | 1/21/2004 | **810** | **610** | <0.50 | <0.50 | <0.50 | <0.50 | **300** | <120 | <1.0 | <1.0 | **8.2** |
| | 4/21/2004 | **180** | **430** | <0.50 | <0.50 | <0.50 | <0.50 | **200** | <60 | <1.0 | <1.0 | **6.2** |
| | 7/21/2004 | **50** | **320** | <0.50 | <0.50 | <0.50 | <0.50 | **420** | **110** | <1.0 | <1.0 | **12** |
| | 10/7/2004 | **610** | **780** | <0.50 | <0.50 | <0.50 | <1.0 | **290** | **57** | <1.0 | <1.0 | **7.2** |
| | 1/19/2005 | **440** | **530** | <0.50 | <0.50 | <0.50 | <1.0 | **240** | <90 | <1.0 | <1.0 | **6.0** |
| | 4/20/2005 | **120** | **210** | <0.50 | <0.50 | <0.50 | <1.0 | **160** | <30 | <1.0 | <1.0 | **5.3** |
| | 7/20/2005 | **880** | **550** | <0.50 | <0.50 | <0.50 | <1.0 | **230** | **39** | <1.0 | <1.0 | **5.3** |
| | 10/19/2005 | **410** | **490** | <0.50 | <0.50 | <0.50 | <1.0 | **160** | <60 | <1.0 | <1.0 | **4.4** |
| | 1/18/2006 | **280** | **390** | <0.50 | <0.50 | <0.50 | <1.0 | **150** | <40 | <1.0 | <1.0 | **3.9** |
| | 4/19/2006 | **270** | **440** | <0.50 | <0.50 | <0.50 | **0.58** | **140** | <50 | <1.0 | <1.0 | **4.7** |
| | 7/19/2006 | **330** | **470** | <0.50 | <0.50 | <0.50 | <1.0 | **170** | <50 | <1.0 | <1.0 | **4.2** |
| | 10/25/2006 | **740** | **510** | <0.50 | <0.50 | <0.50 | <1.0 | **170** | **29** | <1.0 | <1.0 | **4.6** |
| | 1/17/2007 | **91** | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **3.0** | <10 | <1.0 | <1.0 | <1.0 |
| | 4/18/2007 | **690** | **280** | <0.50 | <0.50 | <0.50 | <1.0 | **89** | <30 | <1.0 | <1.0 | **2.5** |
| | 7/18/2007 | **340** | **390** | <0.50 | <0.50 | <0.50 | <1.0 | **140** | **27** | <1.0 | <1.0 | **3.5** |
| | 10/18/2007 | **660** | **410** | <0.50 | <0.50 | <0.50 | <1.0 | **120** | <50 | <1.0 | <1.0 | **2.9** |
| | 1/16/2008 | **670** | **260** | <0.50 | <0.50 | <0.50 | <1.0 | **64** | <20 | <1.0 | <1.0 | **1.8** |
| | 4/15/2008 | <50 | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **2.4** | <10 | <1.0 | <1.0 | <1.0 |
| | 7/16/2008 | **88** | <50 | <0.50 | <0.50 | <0.50 | <1.0 | <1.0 | <10 | <1.0 | <1.0 | <1.0 |
| | 10/15/2008 | **710** | **430** | <0.50 | <0.50 | <0.50 | <1.0 | **88** | <30 | <1.0 | <1.0 | **2.3** |
| | 1/14/2009 | **250**[5] | **380** | <0.50 | <0.50 | <0.50 | <1.0 | **50** | <10 | <1.0 | <1.0 | **1.5** |
| | 4/15/2009 | **960** | **480** | <0.50 | <0.50 | <0.50 | <1.0 | **50** | **13** | <1.0 | <1.0 | **1.4** |
| w/silica gel | 4/15/2009 | **270** | Not subjected to silica gel cleanup | | | | | | | | | |
| | 7/17/2009 | **970** | **390** | <0.50 | <0.50 | <0.50 | <1.0 | **64** | <20 | <1.0 | <1.0 | **1.5** |
| w/silica gel | 7/17/2009 | **250** | Not subjected to silica gel cleanup | | | | | | | | | |
| | 10/7/2009 | **790** | **310** | <0.50 | <0.50 | <0.50 | <1.0 | **87** | **11** | <1.0 | <1.0 | **1.8** |
| w/silica gel | 10/7/2009 | **440** | Not subjected to silica gel cleanup | | | | | | | | | |
| | 5/22/2018 | **650** | **47 J** | <0.50 | <0.50 | <0.50 | **0.45 J** | **20** | <10 | <1.0 | <1.0 | **0.54** |
| w/silica gel | 5/22/2018 | **360** | Not subjected to silica gel cleanup | | | | | | | | | |

**Table 1-3**
**Historical Groundwater Analytical Results**
**City of Arcata Corporation Yard, Arcata, California**
**(in ug/L)[1]**

| Sample Location | Date | TPHD[2] | TPHG[3] | B[3] | T[3] | E[3] | X[3] | MTBE[3] | TBA[3] | DIPE[3] | ETBE[3] | TAME[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-6 | 9/27/2002 | **78** | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <1.0 | <20 | <1.0 | <1.0 | <1.0 |
| | 1/22/2003 | **280** | **170** | <0.50 | <0.50 | <0.50 | <0.50 | **250** | **55** | <1.0 | <1.0 | **5.5** |
| | 4/23/2003 | **320** | **250** | <0.50 | <0.50 | <0.50 | <0.50 | **290** | **45** | <1.0 | <1.0 | **7.9** |
| | 7/23/2003 | <50 | **510** | <0.50 | <0.50 | <0.50 | **0.55** | **190** | **38** | <1.0 | <1.0 | **7.7** |
| | 10/22/2003 | **290** | **340** | **0.83** | <0.50 | <0.50 | <0.50 | **290** | **36** | <1.0 | <1.0 | **7.0** |
| | 1/21/2004 | **290** | **310** | <0.50 | <0.50 | <0.50 | <0.50 | **270** | <120 | <1.0 | <1.0 | **7.6** |
| | 4/21/2004 | <50 | **290** | **0.67** | <0.50 | <0.50 | <0.50 | **260** | **43** | <1.0 | <1.0 | **7.7** |
| | 7/21/2004 | **1,000** | **470** | <0.50 | <0.50 | <0.50 | <0.50 | **350** | **39** | <1.0 | <1.0 | **7.0** |
| | 10/7/2004 | **110** | **260** | <0.50 | <0.50 | <0.50 | <1.0 | **210** | <80 | <1.0 | <1.0 | **5.7** |
| | 1/19/2005 | **81** | **170** | <0.50 | <0.50 | <0.50 | <1.0 | **130** | **46** | <1.0 | <1.0 | **4.1** |
| | 4/20/2005 | **440** | **500** | <0.50 | <0.50 | <0.50 | <1.0 | **180** | <50 | <1.0 | <1.0 | **5.5** |
| | 7/20/2005 | **410** | **210** | <0.50 | <0.50 | <0.50 | <1.0 | **180** | <60 | <1.0 | <1.0 | **5.6** |
| | 10/19/2005 | **420** | **150** | <0.50 | <0.50 | <0.50 | <1.0 | **89** | <40 | <1.0 | <1.0 | **3.4** |
| | 1/18/2006 | **140** | **130** | <0.50 | <0.50 | <0.50 | <1.0 | **100** | <30 | <1.0 | <1.0 | **2.8** |
| | 4/19/2006 | <50 | **140** | **8.1** | <0.50 | <0.50 | **0.68** | **94** | <36 | <1.0 | <1.0 | **3.3** |
| | 7/19/2006 | **200** | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **7.6** | <10 | <1.0 | <1.0 | <1.0 |
| | 10/25/2006 | **150** | <50 | **0.73** | <0.50 | <0.50 | <1.0 | **7.0** | <10 | <1.0 | <1.0 | <1.0 |
| | 1/17/2007 | **570** | **380** | <0.50 | <0.50 | <0.50 | <1.0 | **100** | <25 | <1.0 | <1.0 | **2.5** |
| | 4/18/2007 | **220** | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **3.0** | <10 | <1.0 | <1.0 | <1.0 |
| | 7/18/2007 | **57** | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **4.6** | <10 | <1.0 | <1.0 | <1.0 |
| | 10/18/2007 | **96** | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **1.8** | <10 | <1.0 | <1.0 | <1.0 |
| | 1/16/2008 | **160** | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **3.2** | <10 | <1.0 | <1.0 | <1.0 |
| | 4/15/2008 | **1,400** | **310** | <0.50 | <0.50 | <0.50 | <1.0 | **75** | <20 | <1.0 | <1.0 | **1.9** |
| | 7/16/2008 | **530** | **430** | <0.50 | <0.50 | <0.50 | <1.0 | **76** | <35 | <1.0 | <1.0 | **2.3** |
| | 10/15/2008 | **70** | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **1.4** | <10 | <1.0 | <1.0 | <1.0 |
| | 1/14/2009 | **82**[5] | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **2.5** | <10 | <1.0 | <1.0 | <1.0 |
| | 4/15/2009 | **95** | **53** | <0.50 | <0.50 | <0.50 | <1.0 | **11** | <10 | <1.0 | <1.0 | <1.0 |
| w/silica gel | 4/15/2009 | <50 | Not subjected to silica gel cleanup | | | | | | | | | |
| | 7/17/2009 | **110** | <50 | <0.50 | <0.50 | <0.50 | <1.0 | **44** | <10 | <1.0 | <1.0 | **1.4** |
| w/silica gel | 7/17/2009 | <50 | Not subjected to silica gel cleanup | | | | | | | | | |
| | 10/7/2009 | **110** | **89** | <0.50 | <0.50 | <0.50 | <1.0 | **50** | <10 | <1.0 | <1.0 | **1.4** |
| w/silica gel | 10/7/2009 | <50 | Not subjected to silica gel cleanup | | | | | | | | | |
| | 5/22/2018 | **140** | **25 J** | <0.50 | <0.50 | <0.50 | **0.37 J** | **4.8** | **38** | <1.0 | <1.0 | **0.18 J** |
| w/silica gel | 5/22/2018 | <50 | Not subjected to silica gel cleanup | | | | | | | | | |

1. ug/L: micrograms per liter
2. TPHD: total petroleum hydrocarbons as diesel, analyzed in general accordance with EPA Method 8015B
3. TPHG: total petroleum hydrocarbons as gasoline, benzene (B), toluene (T), ethylbenzene (E), and total xylenes (X), methyl tertiary-butyl ether (MTBE), tertiary-butyl alcohol (TBA), diisopropyl ether (DIPE), ethyl tertiary-butyl ether (ETBE), tertiary-amyl butyl ether (TAME), analyzed in general accordance with EPA Method 8260B Modified
4. <: "less than" the stated method reporting limit
5. Samples were passed through a silica gel column

**Table 1-4**
**Historical Natural Attenuation Parameters**
**City of Arcata Corporation Yard, Arcata, California**

| Well Location | Sample Date | DO[1] (ppm)[2] | $DCO_2$[3] (ppm) | ORP[4] (mV)[5] | Alkalinity (mg/L $CaCO_3$)[6] | Dissolved Iron (ug/L)[7] | Sulfate (mg/L) | Nitrate (mg/L) | Dissolved Manganese (ug/L) |
|---|---|---|---|---|---|---|---|---|---|
| MW-1 | 4/18/2007 | 0.04 | 75 | 80 | **170** | **360** | **34** | <0.10[8] | **730** |
| MW-2 | 4/18/2007 | 0.41 | 275 | -37 | **630** | **23,000** | **21** | <0.10 | **550** |
| MW-3 | 4/18/2007 | 5.57 | 15 | -53 | **110** | <100 | **17** | **0.27** | <2.0 |
| MW-4 | 4/18/2007 | 0.09 | 350 | -71 | **420** | **3,000** | **0.53** | <0.10 | **2,200** |
| MW-5 | 4/18/2007 | 0.17 | 275 | 16 | **390** | **23,000** | <0.50 | <0.10 | **2,000** |
| MW-6 | 4/18/2007 | 0.02 | 50 | -68 | **180** | <100 | **50** | **0.10** | **1,500** |

1. DO: dissolved oxygen, field measured using portable instrumentation
2. ppm: Measurement concentration, in parts per million
3. $DCO_2$: dissolved carbon dioxide, field measured using a field test kit
4. ORP: oxidation-reduction potential measured using portable instrumentation
5. mV: millivolts
6. mg/L CaCO3: milligrams per liter of calcium carbonate
7. ug/L: micrograms per liter
8. <: "less than" the stated method reporting limit

**Table 1-5**
**Sparge System Monitoring Data**
**City of Arcata Corporation Yard, Arcata, California**

| Date | Hour Meter | Manifold Readings | | | | Sparge Well Velocity | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Inlet Vacuum (in. $H_2O$)[1] | Temp. (°F)[2] | Output Pressure (in. $H_2O$) | Flow Velocity (fpm)[3] | S-1 (fpm) | S-2 (fpm) | S-3 (fpm) | S-4 (fpm) |
| 4/13/2006 | 0.2 | 6 | 110 | 44 | 9,300 | 2,400 | 2,700 | 2,300 | 2,400 |
| 4/14/2006 | 16.8 | 7 | 100 | 42 | 8,500 | 2,300 | 2,500 | 2,600 | 2,100 |
| 4/25/2006 | 280.1 | 6 | 102 | 50 | 7,950 | 2,100 | 2,200 | 2,150 | 2,200 |
| 5/16/2006 | 787.0 | 7 | 116 | 44 | 8,920 | 2,400 | 2,300 | 2,380 | 2,450 |
| 6/27/2006 | 1,794.2 | 7 | 112 | 40 | NM[4] | 1,990 | 1,950 | 1,980 | 2,020 |
| 8/29/2006 | 2,900.7 | 8 | 116 | 36 | 8,410 | 2,540 | 2,310 | 2,390 | 2,500 |
| 9/29/2006 | 3,644.6 | 8 | 104 | 37 | 7,630 | 2,390 | 2,440 | 2,450 | 2,340 |
| 10/19/2006 | 4,120.6 | 8 | 108 | 34 | 8,100 | 2,680 | 2,700 | 2,600 | 2,620 |
| 12/5/2006 | 5,253.6 | 7 | 115 | 47 | NM | NM | NM | NM | NM |
| 1/16/2007 | 5,390.7 | 9 | 84 | 35-40 | 7,320 | 5,300 | 75 | 1,640 | 380 |
| 2/28/2007 | 6,345.2 | 7.5 | 102 | 40-45 | 6,380 | 4,950 | 160 | 1,680 | 630 |
| 3/13/2007 | 6,665.3 | 8 | 102 | 40 | 6,640 | 4,270 | 170 | 2,750 | 780 |
| 4/16/2007 | 7,483.4 | 8 | 118 | 45 | 6,190 | 2,130 | 170 | 2,750 | 1,320 |
| 5/7/2007 | NM | 7 | 134 | 45 | 5,660 | 1,520 | 320 | 1,560 | 1,980 |
| 6/11/2007 | 8,649.8 | 8 | 110 | 40 | 6,330 | 1,950 | 1,560 | 1,890 | 1,910 |
| 7/2/2007 | 9,175.7 | 9 | 114 | 37 | 6,730 | 1,790 | 1,920 | 1,700 | 1,780 |
| 8/1/2007 | 9,611.5 | 9 | 112 | 35 | 6,730 | 1,840 | 1,890 | 1,820 | 1,810 |
| 9/11/2007 | 10,598.5 | 9 | 112 | 33 | 6,930 | 2,060 | 1,820 | 1,980 | 1,920 |
| 10/4/2007 | 11,149.6 | 9 | 108 | 32 | 7,450 | 1,880 | 1,850 | 1,850 | 1,910 |
| 11/7/2007 | 11,707.4 | 9 | 110 | 42 | 6,200 | 1,790 | 1,490 | 1,620 | 1,650 |
| 12/10/2007 | 12,098.7 | 8 | 94 | 40 | 5,810 | 420 | 250 | 1,230 | 370 |
| 1/8/2008 | 12,272.9 | 8 | 96 | 50 | 6,190 | 4,700 | 170 | 700 | 370 |
| 2/20/2008 | 13,303.0 | 9 | 106 | 35 | 6,240 | 5,060 | 290 | 1,820 | 516 |
| 3/6/2008 | 13,328.6 | 8.5 | 106 | 40-45 | 5,750 | 3,120 | 230 | 1,680 | 880 |
| 4/8/2008 | 14,117.9 | 9 | 114 | 43 | 5,670 | 1,400 | 1,080 | 1,580 | 1,320 |
| 5/2/2008 | 14,669.9 | 8.5 | 112 | 45 | 6,190 | 1,890 | 1,230 | 1,680 | 1,280 |
| 6/9/2008 | 15,574.7 | 9 | 118 | 38 | 6,430 | 1,590 | 1,630 | 1,580 | 1,720 |
| 7/11/2008 | 16,343.3 | 9 | 116 | 33 | 6,880 | 1,970 | 1,870 | 2,020 | 1,850 |
| 8/4/2008 | 16,920.4 | 9.5 | 104 | 34 | 7,050 | 1,870 | 1,740 | 1,980 | 1,950 |
| 10/8/2008 | 18,477.4 | 10 | 112 | 32 | 6,740 | 1,780 | 1,730 | 1,720 | 1,810 |
| 11/4/2008 | 19,128.9 | 10 | 94 | 28 | 7,780 | 2,950 | 300 | 3,020 | 2,030 |
| 11/26/2008[5] | 19,654.2 | 9.5 | 96 | 35 | 7,220 | 3,840 | 280 | 2,540 | 1,490 |
| 11/26/2008 | 19,654.2 | **Offline** | | | | | | | |

1. in. $H_2O$: inches of water column
2. °F: degrees Fahrenheit
3. fpm: feet per minute
4. NM: not measured
5. Initial readings before system was taken offline

**Table 1-6**
**Historical Soil Analytical Results**
**City of Arcata Corporation Yard, Arcata, California**
**(mg/kg)[1]**

| Sample Location | Sample Date | Depth (feet) | TPHD[2] | TPHG[3] | B[4] | T[4] | E[4] | X[4] | MTBE[5] | TBA[5] | DIPE[5] | ETBE[5] | TAME[5] | Lead |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WP-1 | 6/1/2000 | 3.0-4.0 | **140** | <4.0[6] | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <2.0 | <0.08 | <0.08 | <0.08 | **20** |
| WP-2 | 6/1/2000 | 3.0-4.0 | **88** | <2.0 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <1.0 | <0.04 | <0.04 | <0.04 | **38** |
| WP-3 | 6/1/2000 | 2.0-3.0 | <1.0 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.5 | <0.02 | <0.02 | <0.02 | **12** |
| WP-4 | 6/1/2000 | 2.5-3.5 | **190** | <4.0 | <0.02 | <0.02 | <0.02 | <0.02 | **0.19** | <2.0 | <0.08 | <0.08 | <0.08 | **130** |
| WP-5 | 6/1/2000 | 5.0-6.0 | **49** | **2.3** | <0.005 | **0.005** | <0.005 | **0.0057** | <0.005 | <0.5 | <0.02 | <0.02 | <0.02 | **51** |
| WP-6 | 6/1/2000 | 2.5-3.5 | <1.0 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.5 | <0.02 | <0.02 | <0.02 | **3.3** |
| WP-7 | 6/1/2000 | 3.0-4.0 | **480** | **85** | <0.04 | <0.04 | <0.04 | <0.04 | <0.04 | <4.0 | <0.16 | <0.16 | <0.16 | **8.0** |
| WP-8 | 6/1/2000 | 3.5-4.5 | **1,700** | **610** | **5.6** | **0.86** | **9.8** | **12** | <0.005 | <0.5 | <0.02 | <0.02 | <0.02 | **20** |
| WP-8 | 6/1/2000 | 6.5-7.5 | **5.5** | **1.8** | **0.37** | **0.34** | **0.013** | **0.047** | <0.005 | <0.5 | <0.02 | <0.02 | <0.02 | **6.9** |
| WP-9 | 6/1/2000 | 3.0-4.0 | **12** | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | **0.033** | <0.5 | <0.02 | <0.02 | <0.02 | **25** |
| WP-10 | 6/1/2000 | 3.0-4.0 | <1.0 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.5 | <0.02 | <0.02 | <0.02 | **5.7** |
| WP-101 | 8/22/2000 | 3.5-4 | <1.0 | **810** | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.010 | <0.0050 | <0.0050 | <0.0050 | NA[7] |
| WP-102 | 8/22/2000 | 3.5-4 | <1.0 | <1.0 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | NA |
| WP-103 | 8/22/2000 | 4-4.5 | <1.0 | **12** | <0.0050 | <0.0050 | <0.0050 | **0.018** | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | NA |
| WP-104 | 8/22/2000 | 4-4.5 | <1.0 | **29** | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | NA |
| WP-105 | 8/22/2000 | 3.5-4 | <1.0 | **56** | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | NA |
| WP-106 | 8/22/2000 | 3.5-4 | <1.0 | **43** | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | NA |
| WP-107 | 8/22/2000 | 3.5-4 | <1.0 | <1.0 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | NA |
| WP-108 | 8/22/2000 | 3.5-4 | <1.0 | **21** | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | NA |
| WP-109 | 8/22/2000 | 11.5-12 | <1.0 | <1.0 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | NA |
| MW-1 @ 5’ | 9/18-19/2002 | 5.0-5.5 | **3.1** | <1.0 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.15 | NA | NA | NA | NA | NA |
| MW-2 @ 5’ | 9/18-19/2002 | 5.0-5.5 | **1.5** | **<**1.0 | <0.0050 | <0.0050 | <0.0050 | <0.0050 | <0.05 | NA | NA | NA | NA | NA |
| MW-3 @ 8’ | 9/18-19/2002 | 8.0-8.5 | **5.3** | **4.6** | **0.32** | **0.028** | **0.050** | **0.10** | **1.0** | NA | NA | NA | NA | NA |
| MW-4 @ 4’ | 9/18-19/2002 | 4.0-4.5 | **28** | **1.3** | <0.005 | 0.022 | <0.005 | **0.0054** | **0.14** | NA | NA | NA | NA | NA |
| MW-5 @ 4’ | 9/18-19/2002 | 4.0-4.5 | **19** | **4.7** | **0.015** | **0.015** | **0.02** | <0.030 | **0.31** | NA | NA | NA | NA | NA |
| MW-6 @ 4’ | 9/18-19/2002 | 4.0-4.5 | **150** | **16** | **0.0092** | **0.018** | **0.045** | **0.17** | <0.05 | NA | NA | NA | NA | NA |

1. mg/kg: milligrams per kilogram
2. TPHD: total petroleum hydrocarbons as diesel
3. TPHG: total petroleum hydrocarbons as gasoline
4. BTEX: benzene, toluene, ethylbenzene, and xylenes
5. Fuel Oxygenates: methyl tertiary-butyl ether, (MTBE), di-isopropyl ether (DIPE), ethyl tertiary-butyl ether (ETBE), tertiary-butyl alcohol (TBA), and tertiary-amyl methyl ether (TAME)
6. <: less than the stated method reporting limit
7. NA: not analyzed

**Table 1-7**
**Historical Well Point Groundwater Analytical Results**
**City of Arcata Corporation Yard, Arcata, California**
**(in ug/L)[1]**

| Sample Location | Sample Date | TPHD[2] | TPHG[3] | B[4] | T[4] | E[4] | X[4] | MTBE[5] | TBA[3] | DIPE[3] | ETBE[3] | TAME[3] | Lead |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WP-1 | 6/1/2000 | **2,600** | <250[6] | **1.4** | **2.8** | <1.0 | <2.0 | **150** | <50 | <2.5 | <2.5 | **5.3** | <20 |
| WP-2 | 6/1/2000 | **150** | <250 | <2.5 | <2.5 | <2.5 | <5.0 | <2.5 | <50 | <5.0 | <5.0 | <5.0 | <20 |
| WP-3 | 6/1/2000 | **160** | <100 | <0.5 | <0.5 | <0.5 | <1.0 | <0.50 | <20 | <1.0 | <1.0 | <1.0 | <20 |
| WP-4 | 6/1/2000 | **7,400** | **9,200** | <25 | <25 | <25 | <50 | **15,000** | <500 | <50 | <50 | **290** | <20 |
| WP-5 | 6/1/2000 | **2,400** | <250 | **3.5** | **6.0** | **3.1** | **21.9** | <2.5 | <50 | <5.0 | <5.0 | <5.0 | <20 |
| WP-6 | 6/1/2000 | <50 | <50 | <0.5 | <0.5 | <0.5 | <1.0 | <0.50 | <10 | <1.0 | <1.0 | <1.0 | <20 |
| WP-7 | 6/1/2000 | NA[7] | <250 | **1.4** | <1.0 | <1.0 | <2.0 | **74** | <50 | <2.5 | <2.5 | <2.5 | <20 |
| WP-8 | 6/1/2000 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| WP-9 | 6/1/2000 | **7,100,000** | **4,700** | **20** | <4.0 | <4.0 | <8.0 | **4,200** | **590** | <10 | <10 | **54** | <20 |
| WP-10 | 6/1/2000 | **120** | <100 | <0.5 | <0.5 | <0.5 | <1.0 | <0.50 | <20 | <1.0 | <1.0 | <1.0 | <20 |
| WP-101 | 8/23/2000 | <50[6] | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | **5.9** | <0.50 | <0.50 | <0.50 | NA |
| WP-102 | 8/23/2000 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <5.0 | <0.50 | <0.50 | <0.50 | NA |
| WP-103 | 8/23/2000 | <50 | **120** | <0.50 | <0.50 | **0.5** | **3.6** | <0.50 | <5.0 | <0.50 | <0.50 | <0.50 | NA |
| WP-104 | 8/23/2000 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <5.0 | <0.50 | <0.50 | <0.50 | NA |
| WP-105 | 8/23/2000 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <5.0 | <0.50 | <0.50 | <0.50 | NA |
| WP-106 | 8/23/2000 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <5.0 | <0.50 | <0.50 | <0.50 | NA |
| WP-107 | 8/23/2000 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <5.0 | <0.50 | <0.50 | <0.50 | NA |
| WP-108 | 8/23/2000 | <50 | <50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <5.0 | <0.50 | <0.50 | <0.50 | NA |
| WP-109 | 8/23/2000 | **76** | <50 | <0.50 | <0.50 | <0.50 | <0.50 | **0.76** | <5.0 | <0.50 | <0.50 | <0.50 | NA |

1. ug/L: micrograms per liter
2. TPHD: total petroleum hydrocarbons as diesel
3. TPHG: total petroleum hydrocarbons as gasoline
4. benzene (B), toluene (T), ethylbenzene (E) and total xylenes (X)
5. MTBE: methyl tertiary-butyl ether (MTBE), tertiary-butyl alcohol (TBA), diisopropyl ether (DIPE), ethyl tertiary-butyl ether (ETBE), and tertiary-amyl butyl ether (TAME)
6. <: "less than" the stated method reporting limit
7. NA: not analyzed

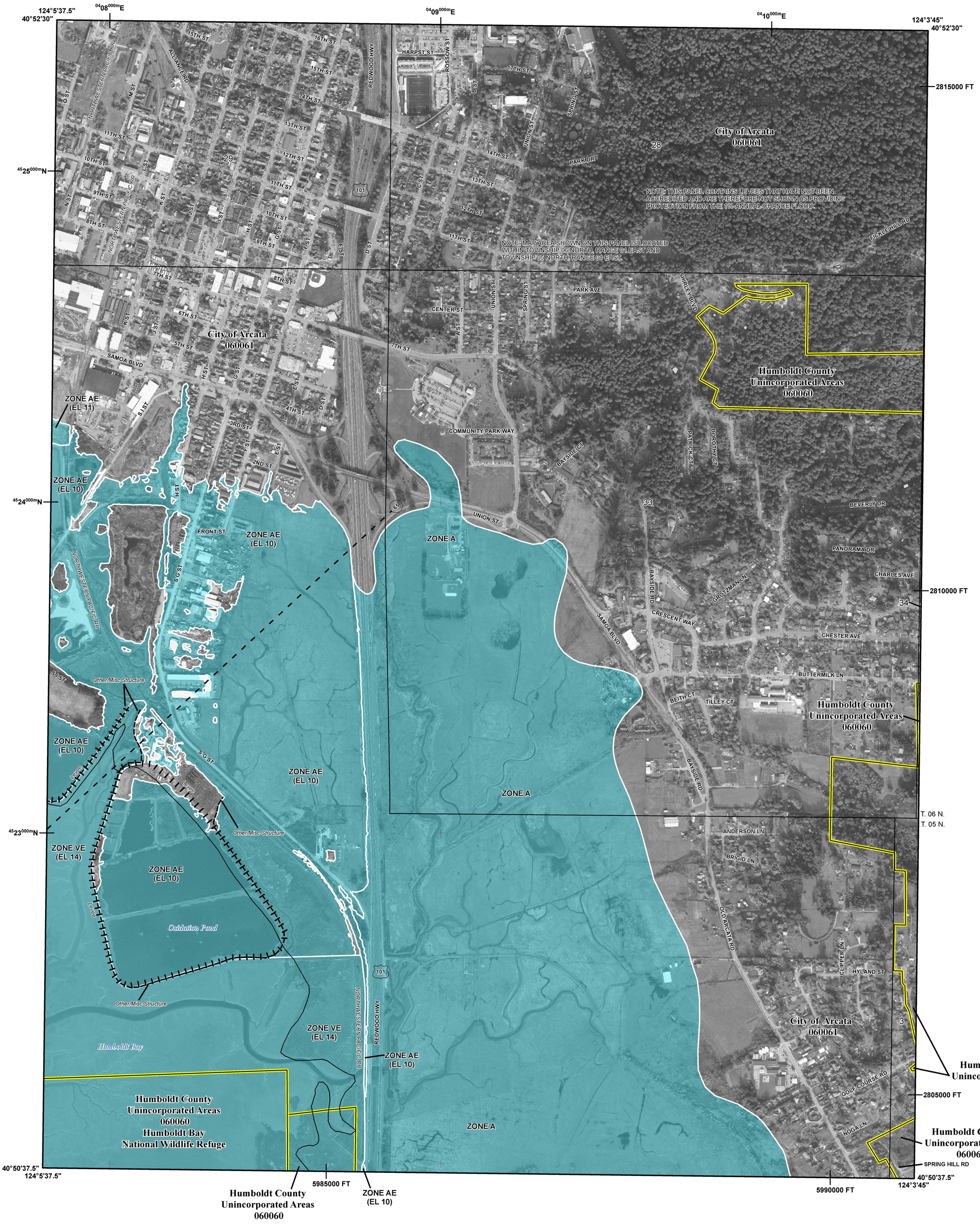


Eureka, CA | Arcata, CA | Redding, CA | Willits, CA | Coos Bay, OR | Klamath Falls, OR

**www.shn-engr.com**

# ATTACHMENT 30

Federal Emergency Management Agency. 2017. *Flood Insurance Rate Maps.* Updated June 21, 2017.




## FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTP://MSC.FEMA.GOV

**SPECIAL FLOOD HAZARD AREAS**

- Without Base Flood Elevation (BFE) *Zone A,V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

**OTHER AREAS OF FLOOD HAZARD**

- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee See Notes. *Zone X*

**OTHER AREAS**

- NO SCREEN Areas of Minimal Flood Hazard *Zone X*
- Area of Undetermined Flood Hazard *Zone D*

**GENERAL STRUCTURES**

- Channel, Culvert, or Storm Sewer
- Accredited or Provisionally Accredited Levee, Dike, or Floodwall
- Non-accredited Levee, Dike, or Floodwall

**OTHER FEATURES**

- E 18.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
- 8 Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

## NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction. To determine if flood insurance is available in the community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base Map information shown on this FIRM was derived from multiple sources. Coastal California LiDAR and Digital Imagery dated 2011 was compiled from the Coastal Services Center where available, and it was supplemented with 2012 USDA National Agriculture Imagery Program 2012 (NAIP) Imagery.

## SCALE

N

Map Projection:

NAD83 UTM Zone 10N
Western Hemisphere; Vertical Datum: NAVD88

1 inch = 500 feet 1:6,000

0 1,000 2,000 Feet

0 250 500 Meters

## PANEL LOCATOR




* PANEL NOT PRINTED

FEMA National Flood Insurance Program

# NATIONAL FLOOD INSURANCE PROGRAM
## FLOOD INSURANCE RATE MAP

## HUMBOLDT COUNTY, CALIFORNIA

PANEL 852 OF 2050

FEMA

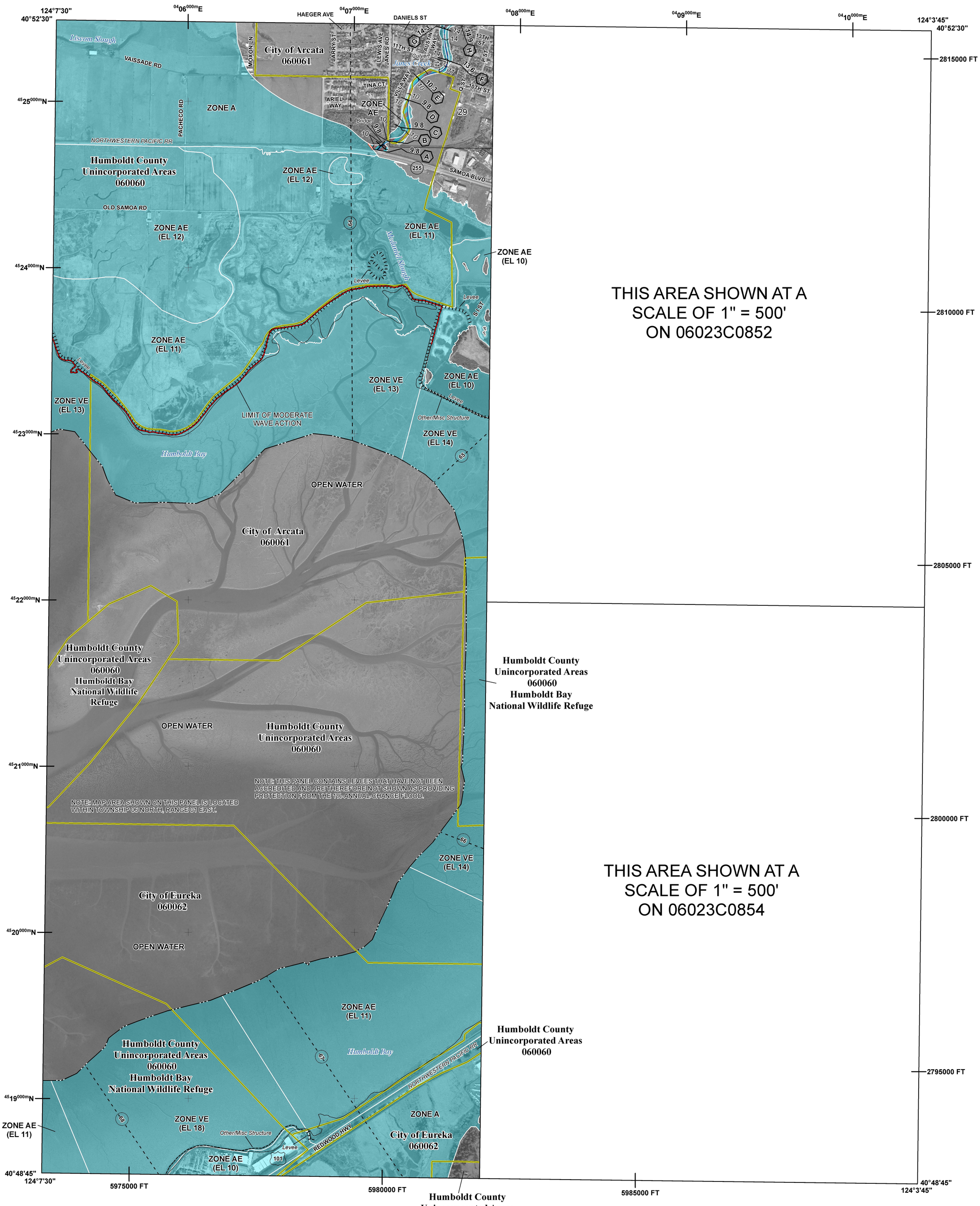
Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|---|---|---|---|
| ARCATA, CITY OF | 060061 | 0852 | G |
| HUMBOLDT COUNTY | 060060 | 0852 | G |

VERSION NUMBER
2.3.2.0

MAP NUMBER
06023C0852G

MAP REVISED
June 21, 2017




## FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTP://MSC.FEMA.GOV

**SPECIAL FLOOD HAZARD AREAS**

- Without Base Flood Elevation (BFE) *Zone A,V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

**OTHER AREAS OF FLOOD HAZARD**

- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee See Notes. *Zone X*

**OTHER AREAS**

- NO SCREEN Areas of Minimal Flood Hazard *Zone X*
- Area of Undetermined Flood Hazard *Zone D*

**GENERAL STRUCTURES**

- Channel, Culvert, or Storm Sewer
- Accredited or Provisionally Accredited Levee, Dike, or Floodwall
- Non-accredited Levee, Dike, or Floodwall

**OTHER FEATURES**

- E 18.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
- 8 Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

## NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction. To determine if flood insurance is available in the community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base Map information shown on this FIRM was derived from multiple sources. Coastal California LiDAR and Digital Imagery dated 2011 was compiled from the Coastal Services Center where available, and it was supplemented with 2012 USDA National Agriculture Imagery Program 2012 (NAIP) Imagery.

The AE Zone category has been divided by a Limit of Moderate Wave Action (LiMWA). The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA (or between the shoreline and the LiMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

Limit of Moderate Wave Action (LiMWA)

## SCALE

Map Projection:

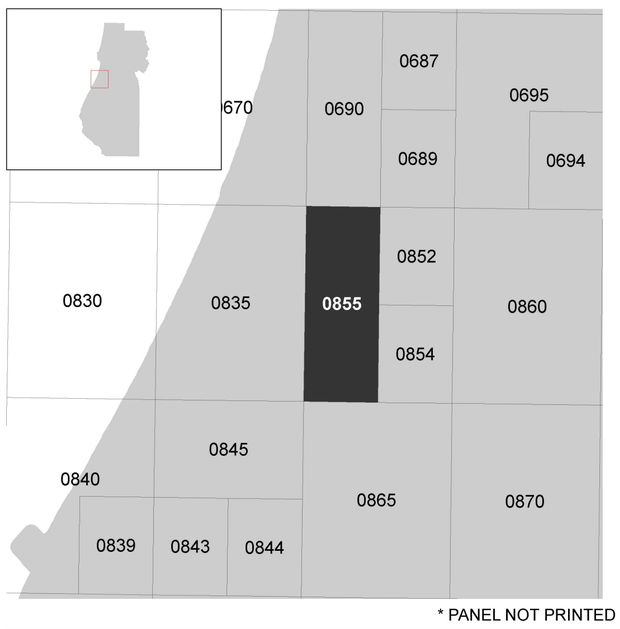
NAD83 UTM Zone 10N
Western Hemisphere; Vertical Datum: NAVD88

1 inch = 1,000 feet 1:12,000

0 1,000 2,000 4,000 Feet

0 250 500 1,000 Meters

## PANEL LOCATOR




* PANEL NOT PRINTED

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

HUMBOLDT COUNTY, CALIFORNIA

PANEL 855 OF 2050

FEMA

Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|---|---|---|---|
| ARCATA, CITY OF | 060061 | 0855 | G |
| EUREKA, CITY OF | 060062 | 0855 | G |
| HUMBOLDT COUNTY | 060060 | 0855 | G |

VERSION NUMBER
2.3.2.0

MAP NUMBER
06023C0855G

MAP REVISED
June 21, 2017

# ATTACHMENT 31

City of Arcata. 2020. *Biological Assesment.*

# Biological Assessment- September 2020

# City of Arcata- Wastewater Treatment Facility Upgrades Project

## 1.0 Summary

The proposed City of Arcata Wastewater Treatment Facility Upgrade Project involves updating aging infrastructure and complying with the requirements of Regional Water Quality Control Board (RWQCB) Order No. 1-2019-0006. Primary objectives of the project include reconfiguring flow to a single-pass system, installing a UV disinfection system to replace the existing Chlorine disinfection system, improving wet weather system functioning, improving secondary treatment capacity, and maximizing beneficial uses of treated wastewater through construction and usage of Outfall 003. Thirteen federally-listed plant and animal species were identified in the Arcata North and Arcata South quadrangles, and included on the IPAC species list. It was determined that five species have Low or No potential to occur, and eight species have Moderate to High potential to occur within the project corridor's action area.

Critical habitat exists within the project study area for tidewater goby, chinook salmon, coho salmon, steelhead, and green sturgeon. It was determined that Marbled murrelet *(Brachyramphus marmoratus),* Northern Spotted Owl (*Strix occidentalis caurina),* Western Snowy Plover *(Charadrius nivosus nivosus*), Green Sea Turtle *(Chelonia mydas),* and Western Lily *(Lilium occidentale)* and Fisher *(Pekania pennant)* have Low or No potential to occur within the project's Action Area. Yellow Billed Cuckoo *(Coccyzus americanus),* Coho salmon - southern Oregon / northern California ESU *(Oncorhynchus kisutch),* Steelhead - northern California DPS *(Oncorhynchus mykiss irideus),* Green Sturgeon (*Acipenser medirostris),* Tidewater Goby *(Eucyclogobius newberryi),* Chinook Salmon - California coastal ESU (*Oncorhynchus tshawytscha),* Eulachon (*Thaleichthys pacificus)* have Moderate or High potential to occur within the project's Action Area.

Due to the nature of the project, there is a **potential for adverse effects** to some species and their habitats; however, avoidance measures have been applied through project design and further conservation measures will be implemented to ensure that the project minimizes any adverse effects. These measures are described as conservation measures within the project description and they are specifically ascribed to address potential impacts to the range of listed species that may occur within the project area.

Since no habitat occurs within the study area to support Marbled murrelet, Northern Spotted Owl, Western Snowy Plover, Green Sea Turtle, or Fisher the project will have **"no effect"** on these species. Project construction "**may affect, but is not likely to adversely affect**" the Yellow Billed Cuckoo, Coho salmon - southern Oregon / northern California ESU, Steelhead, Green Sturgeon, Tidewater Goby, Chinook Salmon, Eulachon, and Western Lily, as long as the conservation measures are upheld during project construction. Long term operational effects or changes in the project vicinity and the habitats for sensitive species are limited to Outfall 003, which will have a net beneficial impact.

# 2.0 Introduction

## 2.1 Purpose

The purpose of this Biological Assessment is to assess the effects of the City of Arcata's Wastewater Treatment Facility Upgrades Project (Project) on federally-listed endangered or threatened plant and animal species and their critical habitats. Construction of the project will include federal funding sources and will require issuance of a Section 404 permit from the Army Corps of Engineers (ACOE).

This Biological Assessment is needed to meet the requirements of Section 7 of the federal Endangered Species Act (ESA) of 1973, which requires consultation with the United States Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration's Fisheries Service formerly referred to as National Marine Fisheries Service (NOAA Fisheries) for projects that may affect federally-listed plant and animal species by construction and operation of the Project.

## 2.2 Project Description

The Project is required to comply with the Regional Water Quality Control Board Order No. 1-2019-0006 and to complete the creation of the Brackish Marsh by constructing Outfall 003, which was originally planned as part of the McDaniel Slough Restoration Project. The Project includes improvements to the City's existing wastewater treatment facility, which are intended to improve effluent water quality as well as overall functioning of the facility. The Project will be constructed within the existing footprint of the Arcata Wastewater Treatment Plant and within the larger Arcata Marsh and Wildlife Sanctuary. The Arcata Marsh and Wildlife Sanctuary and Arcata Wastewater Treatment Plant together comprise the Arcata Wastewater Treatment Facility.

The terms, used in various reports, maps, signage, etc., for features within the Arcata Wastewater Treatment Facility (AWTF) have been used interchangeably over the last forty years. For instance, the AWTF consists of both the Arcata Wastewater Treatment Plant (AWTP) and the Arcata Marsh and Wildlife Sanctuary (AMWS). Treatment wetlands are sometimes referred to as treatment marshes; enhancement wetlands as enhancement marshes; Brackish Marsh as Brackish Pond; Outfall 003 as Discharge Point 003. The reader should be aware that these terms refer to the same features.

### Existing Conditions

The Arcata Wastewater Treatment Plant currently includes headworks, primary clarifiers, oxidation ponds, treatment wetlands, and chlorine disinfection. The Arcata Marsh and Wildlife Sanctuary includes three Enhancement Marshes which are part of the wastewater treatment system, as well as adjacent , salt marsh habitat, Klopp Lake, recreational trails, South I Street and parking area. During dry weather, average influent flows to the wastewater treatment system range between 0.886 to 1.453 MGD. In wet weather, influent flows range between 1.250 to 9.908 MGD.

For flows up to 5 MGD, preliminary treatment occurs via the headworks for screening, and grit removal. Primary treatment occurs via two circular primary clarifiers. Flows are then routed to the Oxidation Ponds and then Treatment Marshes for secondary treatment. After secondary treatment, water is disinfected by chlorination and dechlorinated with sulfur dioxide; and up to 2 mgd pass through Outfall 002 into the three Enhancement Marshes for enhanced treatment. Following treatment, up to 2 mgd is pumped from the Enhancement Marshes back to the Wastewater Treatment Plant where it is combined with the wastewater from the Treatment Wetlands and disinfected again prior to discharge. During the winter (wet weather period) the sewer collection system also receives inflow (rain) and infiltration (groundwater)which increases flows to the treatment system. At these peak times the AWTP can receive flows above the design capacity for the headworks (5 mgd). At these times raw (diluted) sewage bypasses the headworks at the AWTP and is pumped from the Influent Storm Pump (located immediately before the headworks) and the First Street Lift Station directly to the Oxidation Pond 1 for primary treatment, by-passing physical screening, grit removal and primary clarification. At all times disinfection utilizing chlorination and sulfur dioxide dechlorination occurs prior to discharge to the Enhancement Marshes as well as any discharge to Humboldt Bay at Outfall 001. **Current Wastewater Treatment Facility Operations** are depicted in **Appendix 2.**

Much of the Project area has been studied, as part of environmental review for the previously described projects and have been continuously studied/monitored. These past projects have received past federal and state agency permits/approvals, which have been used to inform the currently Proposed Project. Certain features at the AWTF have been determined by previous permits to be, or not be, WOTS or WOTUS, as defined in Table 2.2-1.

Table 2.2-1

| **Feature** | **WOTS** | **WOTUS** |
|---|---|---|
| Oxidation Ponds | No | No |
| Treatment Wetlands | No | No |
| Enhancement Wetlands | Yes | No |
| Brackish Marsh | Yes | Yes |

**Proposed Upgrade**

Proposed upgrades include oxidation pond and wetland treatment system improvements, construction of a parallel oxidation ditch treatment system, construction of a UV disinfection system upstream of discharge to the Wildlife Sanctuary enhancement wetlands, and an updated Facility configuration allowing for discharges to the Brackish Marsh (Outfall 003), either directly from the UV disinfection system or after being treated by the Enhancement Wetlands to provide a freshwater input to the Brackish Marsh. **Appendix 3** depicts the **proposed flow schematic**. These upgrades provide overall improvements to effluent quality discharged to Humboldt Bay. They are required to comply with National Pollutant Discharge Elimination System permit requirements (ORDER NO. R1-2019-0006) under the authority of the North Coast Regional Water Quality Control Board, and the discharge to the Brackish Marsh also fulfills the final project objective of the McDaniel Slough Restoration Project (US Army Corps of Engineers, 2008a). The full scope of the upgrades will be undertaken in two separate phases. **Appendix 4** depicts all **proposed upgrades by Phase**.

Phase 1 will focus on rehabilitation of the current natural system (oxponds/wetland) and reconfiguring the flow to a single path. Rehabilitation will be done to the natural system facilities (i.e. ponds and the wetlands) and to the aging infrastructure. It will include replacing and installing new equipment (i.e. pumps, aerators and monitoring equipment), increasing resilience for various facilities for treatment and hydraulic capacities and includes the construction of the following elements:

- Replacement/upgrading of vertical pumping stations within the plant and at Hauser Marsh pump station with submersible variable speed pumping systems.
- 1000' extension of 16" diameter discharge pipe to new Outfall 003 from the existing Hauser pump station
- Construction of Outfall 003 in the south east corner of the Brackish Marsh
- Electrical service drop from PG&E
- Electrical building with diesel-powered emergency generator rated at 0.75Mw and removal of an existing natural gas powered 150 KW generator
- Installation of a 9.8 MGD ultra-violet UV disinfection system into one half of the existing chlorine contact basin (CCB), eliminating the use of chlorine gas and sulfur dioxide for disinfection except in an emergency wet weather flow disinfection scenario (flows > 9.8 MGD) or if emergency power is interrupted.
- Excavation and contouring for improved water quality and maintenance at the outlet of the Hauser Enhancement Marsh
- Placement of up to 24 new 12.5 Hp mixer aerators to improve treatment within Oxidation Pond #2.
- Placement of electrical conduit will extend across Butcher Slough on the existing bridge and continue in a 2.2'x2.2' trench straddling the top of the Klopp Lake exterior levees to the South I Street parking lot/Hauser Marsh pump station. The old existing pedestrian concrete bridge deck across Butcher Slough will be removed and this crossing will be converted to accommodate the new electrical and telemetry conduits required for the upgrading of the Hauser pump station.
- Placement of structural fill up to 1.5' deep to elevate existing 16' wide roadway between The Hauser Treatment Marsh and Gearheart Treatment Marsh to minimum elevation of 8.0' NAVD.
- Proposed improvements to the AWTP existing stormwater treatment and pumping system will also be sized for an anticipated 1% probability storm year storm event. The existing storm drain pump station, located adjacent to the chlorine contact basins, will have the two existing pumps replaced to provide the required storm water pumping capacity to Oxidation Pond #1

Additionally, the AWTF is adjacent to the Arcata Bay section of Humboldt Bay and the entire facility is located at low elevations. The current Base Flood Elevation (BFE) for a 100-year flood is 10.05 ft (NAVD 88). Current plans call for any new structures and above ground electrical equipment or connections to be located a minimum of 2.0 feet above the Zone "AE" base flood elevations within the existing protective bayfront levee within the AWTP core and Corporation Yard. In addition to elevations of new structures, to comply with FEMA standards, the **protective levees surrounding the AWTP** and oxidation pond/wetlands will be raised to a minimum of 14 feet within the FEMA (VE zones), areas identified for storm driven (erosive) waves or to a minimum of 12 feet at the additional FEMA (AE zones) surrounding all critical AWTP infrastructure (**Appendix 6**). All levee augmentation will occur on top of or on the inboard sides of levees. Engineered Fill will vary from between 0'-3' predominantly from the south eastern and eastern side of the Oxidation Pond earthen levee, and along the trail access to the existing trail parking

lot. Approximately 1.25 miles of levees will be augmented, maintaining a minimum driving surface width of 8 feet wide. Interior side slopes will be a maximum 1:1.5 or per engineered recommendations with a light rock facing. These actions will allow for the AWTP to be protected from the most credible extreme storm events and have the protective infrastructure in place to increase levee elevations according to the best available trends and technologies.

In general, Phase 2 builds on the performance of Phase 1 improvements and includes new concrete mechanical structures to improve the resiliency, redundancy and treatment level at the existing AWTF. Phase 2 will focus on constructing the additional secondary treatment system, as well as additional site improvements within the AWTP and the City of Arcata Corp Yard. Phase 2 will construct all the additional facilities needed for the parallel secondary treatment facility, including the oxidation ditch, two new secondary clarifiers and pumping for the return activated sludge (RAS) and the waste activated sludge (WAS). The footprint of the preferred Phase 2 design will be entirely within the AWTP/Corporation Yard and require relocation of some of the AWTP facilities and the City of Arcata Corp Yard facilities.
Phase 2 will include construction of the following:

- Two 75' diameter secondary clarifiers.
- One 3.6 MGD oxidation ditch (265' x 65') with activated sludge pumps for waste and recirculation in the oxidation ditch at approximately 17' NAVD elevation to match the primary clarifier elevation and utilizing existing water surface elevations from the headworks to allow for gravity flow through the system.
- If determined necessary, following ongoing Phase 1 performance, an alkalinity feed system may be constructed within the existing developed AWTP.

In general, potential direct impacts to Federally listed species would be limited to construction of Outfall 003 and a small amount of riparian impacts (at the Corporation Yard boundary, surrounding oxidation ponds, at Hauser Marsh outlet, and near proposed Outfall 003). These locations are identified within the **Action Area (Appendix 1)**

## 2.3 Conservation Measures

To minimize potential adverse impacts, the following conservation measures will be incorporated:

*Avian Nesting Surveys*: To minimize potential adverse impacts to avian species associated with vegetation removal, vegetation removal will occur outside of the avian nesting season (generally March - August) to the extent practicable. If vegetation removal or disturbance cannot be confined to periods outside of the nesting season, a qualified biologist shall conduct pre-construction surveys, within the vicinity of the Proposed Project to check for nesting activity and to evaluate the site for presence of special-status bird species. The biologist shall conduct a minimum of one day pre-construction survey within the 7-day period prior to vegetation removal and ground-disturbing activities. If ground disturbance and vegetation removal work lapses for seven days or longer during the breeding season, a qualified biologist shall conduct a supplemental avian pre-construction survey before project work is reinitiated.

If active nests are detected within the construction footprint or within the construction buffer established by the Project biologist, the biologist shall flag a buffer around each nest. Construction activities shall avoid nest sites until the biologist determines that the young have fledged, or nesting activity has ceased. If nests are documented outside of the construction (disturbance)

footprint, but within the construction buffer, nest buffers would be implemented as needed. Buffer sizes would take into account factors such as (1) noise and human disturbance levels at the construction site at the time of the survey and the noise and disturbance expected during the construction activity; (2) distance and amount of vegetation or other screening between the construction site and the nest; and (3) sensitivity of individual nesting species and behaviors of the nesting birds.

If active nests are detected during the survey, the qualified biologist shall monitor all nests at least once per week to determine whether birds are being disturbed. Activities that might, in the opinion of the qualified biologist, disturb nesting activities (e.g., excessive noise), shall be prohibited within the buffer zone until such a determination is made. If signs of disturbance or distress are observed, the qualified biologist shall immediately implement adaptive measures to reduce disturbance. These measures may include, but are not limited to, increasing buffer size, halting disruptive construction activities in the vicinity of the nest until fledging is confirmed, placement of visual screens or sound dampening structures between the nest and construction activity, reducing speed limits, replacing and updating noisy equipment, queuing trucks to distribute idling noise, locating vehicle access points and loading and shipping facilities away from noise-sensitive receptors, reducing the number of noisy construction activities occurring simultaneously, and/or reorienting and/or relocating construction equipment to minimize noise at noise-sensitive receptors.

*Fish Relocation -* Prior to construction, areas of the Brackish Marsh where construction will occur will be isolated and surveyed for aquatic species, which will be relocated to adjacent appropriate areas if found. Surveys and relocation will be completed by a qualified biologist. All translocation and surveys of Federally-listed species will be conducted under a scientific recovery permit.

*Isolated Work Area* - Prior to construction and after fish relocation, the work area surrounding Outfall 003 will be isolated and dewatered to minimize potential sedimentation and turbidity-related impacts to aquatic species

*Sedimentation and Turbidity Best Management Practices:* Areas where sedimentation or turbidity impacts could occur will use best management practices (BMPS) to minimize potential impacts. This could include implementation of fiber rolls, silt fences, and post-construction stabilization/revegetation to ensure bare soil is not left exposed. All non-biodegradable temporary erosion control measures will be removed from wetlands and waters of the US/State immediately on cessation of construction.

*Spill Prevention and Clean-up:* To prevent potential spills or leaks associated with construction activities, construction crews will be trained on spill prevention, response, and good housekeeping. Additionally, spill clean-up kits will be readily available onsite during construction activities to ensure appropriate and timely response to any spills or leaks, should they occur.

*Construction Equipment Maintenance:* Refueling or maintenance of construction vehicles or equipment will only occur in upland environments. If equipment must be washed, washing will occur where wash water cannot flow into wetlands or waters of the US/State.

*Vegetation Surveys:* Areas where vegetation removal is planned to occur will be surveyed at the appropriate time of year for best detection for Western Lily prior to removal. Should any species be found within the construction vicinity, it will be flagged for avoidance.

*Compensatory Vegetation Mitigation:* In the very low chance that a Western Lily be encountered and avoidance is not feasible, the species will be relocated and monitored for survival. Should the survival be unsuccessful, the City will work with USFWS to ensure appropriate compensatory mitigation.

# 3.0 Action Area

## 3.1 Driving Directions

The action area can be accessed from CA-255 (Samoa Boulevard) in Arcata, California by heading south on South I Street and South G Street.

## 3.2 Action Area

The Action Area encompasses the Arcata Wastewater Treatment Facility, which includes the Arcata Wastewater Treatment Plant and Arcata Marsh and Wildlife Sanctuary. The Treatment Plant is located at 600 South G Street in Arcata, Humboldt County, California. The portions of the broader Arcata Marsh and Wildlife Sanctuary where project activities will occur include the southern edge of Gearheart treatment marsh, the northern and southern edges of Hauser treatment marsh, the south east corner of Brackish Marsh, and portions of levees, trails, and roadways within the AMWS. The **Action Area** is identified in **Appendix 1.** Furthermore, locations within the Action Area where direct impacts may occur, are identified.

While the overall Action Area encompasses the larger Arcata Wastewater Treatment Facility, areas with the potential to have direct or indirect impacts to Federal species are limited to the construction of the following elements of the project description:

- Construction of Outfall 003 in the Brackish Marsh
- Placement of electrical conduit will extend across Butcher Slough on the existing bridge and continue in a 2.2'x2.2' trench straddling the top of the Klopp Lake exterior levees to the South I Street parking lot/Hauser Marsh pump station. The old existing pedestrian concrete bridge deck across Butcher Slough will be removed and this crossing will be converted to accommodate the new electrical and telemetry conduits required for the upgrading of the Hauser pump station.
- The protective levees surrounding the AWTP and oxidation pond/wetlands will be raised to a minimum of 14 feet (NAVD 88). Within the FEMA (VE zones), areas identified for storm driven (erosive) waves or to a minimum of 12 feet' at the additional FEMA (AE zones) surrounding all critical AWTP infrastructure. All levee augmentation will occur on top of, or the interior sides of levees. Engineered FIll will maintain a minimum driving surface width of 8' wide and will vary from between 0'-3'. Interior side slopes will be a maximum 1:1.5 or per engineered recommendations with a light rock facing.

- Riparian vegetation removal including the perimeter of the oxidation ponds, trenching along the perimeter of the Corporation Yard between the Humboldt Bay Trail North, and at the outlet of Hauser Marsh.

Post-construction, the one operational change that could impact Federal Species is the operation of Outfall 003, which will be a new freshwater input to the Brackish Marsh, which is currently a fully tidal marine environment with only winter rainfall freshwater input and includes Critical Habitat for five species.

### 3.3 Natural Environment within Action Area

The Project is located within the Humboldt Bay Subwatershed (Hydrologic Unit Code [HUC] 12: 180101020601) of the Humboldt Bay-Frontal Pacific Ocean watershed in the North Coast Hydrologic Region and within the Jacoby Creek Watershed of the Eureka Plain Hydrologic Unit No. 110.00. The Project is also within the Janes Creek and Jolly Giant Creek watersheds within the City of Arcata. The Action Area abuts Arcata Bay, the northernmost portion of Humboldt Bay.

The Arcata Wastewater Treatment Facility is a unique hybrid of wastewater treatment and wildlife habitat. A series of oxidation ponds, treatment wetlands and enhancement marshes are used to treat Arcata's wastewater. The marshes also serve as a wildlife refuge, and are on the Pacific Flyway, a major north-south corridor for migratory birds, extending from Alaska to Patagonia (Flyways-Administrative, USFWS). Arcata's Wastewater Treatment Plant is an existing facility that, in conjunction with the Arcata Marsh and Wildlife Sanctuary, by providing fresh water and brackish habitat adjacent to Humboldt Bay has resulted in a net benefit for a variety of wildlife species.

The Treatment Facility human-made freshwater marshes in the AMWS include Allen Marsh, Hauser Marsh, Gearheart Marsh, as well as the Brackish Marsh. Water flowing through Allen, Gearheart, and Hauser enhancement marshes originates from the disinfection basins of the WastewaterTreatment Facility. The Brackish Marsh has a direct connection to Humboldt Bay (via McDaniel Slough) via a 48" diameter float actuated fish passage tidegate that has a smaller hinged square barn door and hinged topgate capable of passing up to 80 CFS. Currently, the Brackish Marsh's only source of water is the McDaniel Slough tidegate and rainfall. The only planned future connection will be the fully treated effluent from the AMWS marshes that are part of the AWTF. It is anticipated that these flows to the Brackish Marsh will range from 0-6 MGD.

## 4.0 Methods

### 4.1 Survey Methods

To determine which species may be present, a Rarefind5 query of the California Natural Diversity Database was conducted for known occurrences within the Arcata North and South Quadrangles; a CA Fish and Wildlife BIOS viewer species list was generated for Arcata North and South

Quadrangles; a USFWS Information for Planning and Conservation Species list was generated that includes the Action Area; the California Native Plant Society Inventory of Rare and Endangered Plants of California, 6th Edition was reviewed; existing City biological surveys and reports for the project area were reviewed; and previously conducted environmental review documents for nearby similar projects were reviewed.

To determine Critical Habitat present in the project area, the US Fish and Wildlife Service IPaC Resources List for the project area was generated; National Oceanic and Atmospheric Administration Fisheries West Coast Critical Habitat Maps were used; and Designations of Critical Habitat for species that may be present in the project area were reviewed in the Federal Register.

### 4.2 Evaluation Methods

Factors considered in evaluating project impacts included the species' dependence on specific habitat components removed or modified, the abundance and distribution of habitat, habitat components in the project vicinity, distribution and population levels of the species (if known), the possibility of direct impact to fish, the degree of habitat impact, and the potential for mitigation of adverse effects. The analysis used the methods outlined in "Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale" (NMFS, 1996) to determine the potential for project impacts on water quality, and in-stream and riparian habitat quality.

### 4.3 Consultation to Date

As part of the McDaniel Slough Project, a Biological Opinion was issued by the Army Corps of Engineers, prepared by the US Fish and Wildlife Service (ACOE 2008a; 2008b) which included analysis of impacts associated with the proposed Outfall 003.

The City met with USFWS on May 7, 2019, to discuss potential impacts to Goby associated with the Wastewater Treatment Plant Upgrades project.

The City will continue to engage USFWS and NOAA Fisheries throughout the finalization of this Biological Assessment.

## 5.0 Federally-Listed Species Evaluation

There are 13 species federally-listed as Endangered or Threatened, Proposed, or Candidate plant and animal species, as well as Critical Habitat distinctions that may be present in the project area

Table 5.0-1 outlines plant and animal species federally-listed as Endangered, Threatened, Proposed and Candidate that were considered, including potential habitat present, critical habitat present, and potential occurrence.

| **Table 5.0-1: Federally-listed Species Considered** | | | | | |
|---|---|---|---|---|---|
| **Scientific Name** | **Common Name** | **Status** | **Description/Habitat** | **Suitable Habitat Present** | **Critical Habitat Present** |
| **Birds** | | | | | |
| Brachyramphus marmoratus | Marbled murrelet | FT | Rocky seastacks, nests in old growth redwoods | No suitable habitat within Action Area, no known occurrences | No |
| Strix occidentalis caurina | Northern Spotted Owl | FT | Mature forest | No suitable habitat within Action Area, no known occurrences | No |
| Charadrius nivosus nivosus | Western Snowy Plover | FT | Ocean beaches, gravel bars in Eel River | No suitable habitat within Action Area, no known occurrences | No |
| Coccyzus americanus | Yellow Billed Cuckoo | FT | Dense riparian vegetation | Yes | No |
| **Aquatic Species** | | | | | |
| Oncorhynchus kisutch | coho salmon - southern Oregon / northern California ESU | FT | Anadromous, breeds in rivers and streams | Yes | Yes |

| Table 5.0-1: Federally-listed Species Considered | | | | | |
|---|---|---|---|---|---|
| **Scientific Name** | **Common Name** | **Status** | **Description/Habitat** | **Suitable Habitat Present** | **Critical Habitat Present** |
| Oncorhynchus mykiss irideus | steelhead - northern California DPS | FT | Anadromous, breeds in rivers and streams | Yes | Yes |
| Acipenser medirostris | green sturgeon | FT | Ocean and estuary; present in Humboldt Bay | Yes | Yes |
| Eucyclogobius newberryi | tidewater goby | FE | Shallow lagoons and coastal streams with brackish to fresh and slow-moving or fairly still water | Yes | Yes |
| Oncorhynchus tshawytscha | chinook salmon - California coastal ESU | FT | Anadromous, breeds in rivers and streams | Yes | Yes |
| Thaleichthys pacificus | eulachon | FT | Marine/estuarine | Yes | No |
| **Reptiles** | | | | | |
| Chelonia mydas | green sea turtle | FT | Nearshore, in bays, and on reefs | No suitable habitat within Action Area, no known occurrences | No |
| **Plants** | | | | | |
| Western Lily | Lilium occidentale | FE | sphagnum bogs, thicket openings along the margins of ephemeral ponds, and | Suitable habitat within Action Area, | No |

| Table 5.0-1: Federally-listed Species Considered | | | | | |
|---|---|---|---|---|---|
| **Scientific Name** | **Common Name** | **Status** | **Description/Habitat** | **Suitable Habitat Present** | **Critical Habitat Present** |
| | | | coastal prairie/scrub near the ocean where fog is common | but unlikely to occur | |
| **Mammals** | | | | | |
| Pekania pennant | Fisher | FT | Low- to mid-elevation coniferous forests | No suitable habitat within Action Area, no known occurrences | No |

## 5.1 Critical Habitat Within Action Area

**Coho Salmon -** Southern Oregon / northern California ESU **(***Oncorhynchus kisutch*)**:** Critical Habitat was designated for the coho salmon, Southern Oregon/Northern California ESU, effective June 4, 1999 (64 FR 24049). Critical habitat encompasses accessible reaches of all rivers (including estuarine areas and tributaries) between the Mattole River in California and the Elk River in Oregon, inclusive. Critical Habitat within the Action Area includes the Brackish Marsh.

**Steelhead -** Northern California DPS *(Oncorhynchus mykiss irideus)*: Critical Habitat was designated for the Northern California steelhead ESU, effective March 17, 2000 (65 FR 7764). Critical Habitat for this species in Humboldt Bay is defined by, "The perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater" (50 CFR §226.211). Critical Habitat within the Action Area includes the Brackish Marsh.

**Green Sturgeon -** Southern DPS (*Acipenser medirostris*): Critical habitat was designated for the green sturgeon southern DPS, on October 9, 2009 (74 FR 52300). Critical Habitat for this species in Humboldt Bay is defined as, " All tidally influenced areas of Humboldt Bay up to the elevation of mean higher high water" (50 CFR §226.219), which includes the Brackish Marsh within the Action Area.

**Tidewater Goby** *(Eucyclogobius newberryi):* Critical Habitat was designated for the Tidewater Goby effective March 8, 2013 (78 FR 8745). Critical Habitat for this species is divided into units, and the Brackish Marsh is included within a Critical Habitat Unit.

**Chinook salmon -** California Coastal ESU *(Oncorhynchus tshawytscha):* Critical Habitat was designated for the California coastal chinook salmon effective March 17, 2000 (65 FR 7764). Critical Habitat for this species in Humboldt Bay is defined by, "The perimeter of the water body

as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater" (50 CFR 226.211). Critical Habitat within the Action Area includes the Brackish Marsh.

## 5.2 Species Information

The following are descriptions, life histories and occurrence data for each of the listed plant and animal species in Table 5.0-1.

**BIRDS**

**Marbled murrelet** (*Brachyramphus marmoratus*)
Federal Status: Threatened
Critical Habitat: Designated, but outside of the project area

The marbled murrelet is a small seabird about 10 in. in length. Its range extends from the central California coast to the Gulf of Alaska and the Aleutian Islands. Marbled murrelets spend the majority of their lives in the near-shore marine environments. They are usually found within 1-2 miles of the shore and prefer to forage along rocky coastal areas. They feed by diving up to 100 ft. for small fish and invertebrates, generally in waters up to 240 ft. deep, but may also forage on rivers and inland lakes. Marbled murrelets nest inland, usually in the canopy of large diameter trees (>30 in.), typically in coastal redwood and Douglas-fir forests. Because they do not build nests, they are dependent on the presence of suitable nesting platforms large enough to incubate their single egg clutch. Suitable nesting platforms can include large or forked, moss-covered limbs, mistletoe infections, and other tree deformities. Nesting occurs from late March to late September, with highest activity in mid-April to mid-July. Although adequate nesting habitat may occur in younger forests, it typically occurs in large forest stands greater than 200-years-old. While one parent is on the nest, the other is foraging at sea. Incubation usually takes 30 days and chicks fledge in 27 to 40 days. After the chick has hatched both parents go to sea to forage, usually returning with a single fish in the early morning or late evening hours (USFWS, 1997; 2015; NatureServe, 2020). Proximity of nesting habitat to foraging habitat is an important factor in determining murrelet distribution. Typically, concentrations of murrelets in the marine environment occur just offshore from large tracts of mature and old growth forests. In coastal areas, adjacent extensive clear clear-cutting means marbled murrelets are usually absent. Likewise nesting usually occurs in proximity to adequate foods sources, and murrelet nesting sites are limited to a narrow swath of forest not usually greater than 30 mi. from the coast (USFWS 1997, 2015). Loss of habitat due to timber harvesting is a major contributor to the species decline. Further, edge effects resulting from clear-cuts adjacent to nest sites may contribute to increased predation rates, as forest edges are preferred by many murrelet predators including jays, crows, ravens, accipiters, squirrels, marten, and fisher. Marbled murrelet populations are considered to be highly sensitive to forest fragmentation, and are nearly absent from much of their historic range. Other threats include gill-net fishing, marine pollution and disease (USFWS, 1997; 2015).

Occurrence data: The marbled murrelet has low potential to occur in the project area. While there is no suitable nesting habitat in the project area, Critical Habitat does occur approximately eight miles to the south and 15 miles to the east. The possibility of murrelets flying over the project area

to/from nesting and foraging sites cannot be ruled out.

**Northern spotted owl** (*Strix occidentalis caurina*)
Federal Status: Threatened
Critical Habitat: Designated, but outside of the project area

The northern spotted owl is medium-sized, dark brown with white spots on the head and chest and dark brown eyes set in prominent facial disks. The owl's range is from southwestern British Columbia to Marin County, California (NatureServe, 2020; USFWS 2015). Spotted owls tend to require an old-growth forest structure with large trees (dbh >30 in.) to provide a moderate to high canopy closure (60-90%). A multi-layered, multi-species sub-canopy cover with large cavity trees, large snags, fallen trees as well as an open understory are needed for nesting, roosting and foraging. However, they may be found in younger forests with similar structural characteristics of older forests, particularly along the coast of northern California redwood and mixed conifer-hardwood forests. A mosaic of old-growth habitat mixed with other forest successional stages may benefit the northern spotted owl more than large homogenous oldgrowth forests. Predictable availability of prey is an important factor in spotted owl occurrence. In 1992, nearly 7 million acres of Critical Habitat Units were identified in Washington (2.2 M), Oregon (3.3 M) and California (1.4 M) (USFWS, 2011). Northern spotted owls reach sexual maturity after two years, and pair up in a monogamous relationship. Females lay from 1-4 eggs per clutch, not always successfully, and do not nest every year. They are mostly nocturnal, hunting for rodents including, northern flying squirrels, woodrats, voles, mice, rabbits, birds and sometimes insects (USFWS, 2015; 2011). Historically, threats to the northern spotted owl were largely due to lost suitable habitat from logging, as well as from wildfires, volcanic eruptions and disease. Currents threats still include timber harvesting and wildfires, as well as competition from the barred owl and predation. New potential threats may come from West Nile virus, sudden oak death and loss of genetic variation due to the recent genetic bottleneck (USFWS, 2011).

Occurrence data: The northern spotted owl has low potential to occur within the Action Area. The relatively young riparian forests within the broader Arcata Marsh and WIldlife Sanctuary does not provide the suitable habitat complexity of moderate to high canopy cover of large, mature trees with an open understory with large snags and fallen trees. Further, riparian impacts are limited to a very small area: approximately 0.2 acres of temporary impacts and .03 acres of permanent impacts.

**Western snowy plover** (*Charadrius alexandrinus nivosus*)
Federal Status: Threatened
Critical Habitat: Designated, but outside of the project area.

The snowy plover is a small, 6 in. long, light colored shorebird. It is distinguishable from other shorebirds by its black beak, dark bars on either side of its breast, and dark ear patches. Two distinct breeding populations of snowy plovers are known: the Pacific coast population, and an interior population. The Pacific coast population nests in coastal areas of California, Mexico, Oregon, and Washington (USFWS, 2007; 2015). The Pacific coast population of western snowy

plover nests on beaches from the central Washington coast to the tip of the Baja Peninsula, Mexico. It prefers to nest on sand spits, dunebacked beaches, un-vegetated beach strands, and open areas near river mouths and estuaries, where vegetation and driftwood are sparse or absent. The breeding season of the Pacific coast western snowy plover lasts from mid-March through mid-September. Wintering areas are usually similar to those used for nesting. Clutches tend to be three eggs and are laid in scrapes or depressions in the sand (USFWS, 2007; 2015). Small invertebrates comprise the bulk of the snowy plover's diet. Pacific coast snowy plovers commonly forage amongst piles of beached kelp and in the wet sand of the intertidal zone. Above the high tide line, they feed in dry sandy areas, saltpans, spoil sites, and along the edges of salt marshes and ponds (USFWS, 2007; 2015). Poor reproductive success and the long-term loss of suitable habitat are responsible for the decline of snowy plovers along the Pacific coast. To maintain a stable population it is estimated that western snowy plovers must fledge 0.8 young per nesting female. At many coastal sites, human disturbance, predation, and inclement weather have caused reproductive success to fall well below this level. Furthermore, loss of nesting resulting from the invasion of European beachgrass and urban development have led to declines in both wintering and nesting populations of western snowy plovers along the pacific coast (USFWS, 2007; 2015). Coastal populations of the Western snowy plover were listed as threatened in 1993. More recently, the USFWS identified Critical Habitat components essential for the primary biological needs of foraging, nesting, rearing of young, roosting, and dispersal, or the capacity to develop those habitat components. The primary constituent elements exist in areas that support or have the potential to support intertidal beaches (between mean low and mean high tide), associated dune systems, and river estuaries. Important components of the beach/dune/estuarine ecosystem include surf-cast kelp, sparsely-vegetated foredunes (beach area immediately in front of a sand dune), interdunal flats (flat land between dunes), spits, washover areas, blowouts (a hole or cut in a dune caused by storm action), intertidal flats, salt flats, flat rocky outcrops, and gravel bars (USFWS, 2007; 2015).

Occurrence data: The western snowy plover has no potential to occur within the Action Area, as it requires open sand dune habitat. The Action Area neither contains nor is near any open sand dune habitat. The closest plover occurrences are on Clam Beach toward the north and along the coast-side southern spit of Humboldt Bay.

**Western yellow-billed cuckoo** (*Coccyzus americanus*)
Federal Status: Threatened
Critical Habitat: None designated

The western yellow-billed cuckoo is a slim and long-tailed bird, about one-foot long with a slightly down-curving bill. West of the Rocky Mountains it is considered a distinctly different population. This species breeds and nests in open deciduous woodlands and riparian (cottonwood and willow) woodlands, while preferring to nest 3-10 feet above ground in a dense understory. They may also nest in orchards and thickets and forage in forests, woodlands or scrub habitats. Western yellow-billed cuckoo mostly eat caterpillars and other insects as well as some fruits, small lizards, frogs and other bird eggs (NatureServe, 2020). Predation of adult western yellow-billed cuckoo by raptors is known, as is predation of eggs by jays, chipmunks and others

(NatureServe, 2020).

Occurrence data: While there are no occurrences of western yellow-billed cuckoo in the project area in the CNDDB, there have been occurrences at the AMWS as reported by EBIrd, and based on reports at the Arcata Marsh Interpretive Center (G. Ziminsky, personal communication, August 6, 2020). Riparian portions where construction will occur may provide suitable habitat for this species.

**AQUATIC SPECIES**

**Coho salmon - southern Oregon / northern California ESU** *(Oncorhynchus kisutch)* :
Federal Status: Threatened
Critical Habitat: Designated within the project area

The Southern Oregon/Northern California coho salmon (Southern Oregon/Northern California ESU) was federally listed as a threatened species by NMFS (62 FR 33038; dated June 18, 1997). This ESU is defined as all coho salmon naturally produced in streams between Cape Blanco in southern Oregon and Punta Gorda in northern California, Humboldt County. Marine invertebrates, such as copepods, euphausiids, amphipods, and crab larvae, are the primary food when coho first enter salt water. Fish represent an increasing proportion of the diet as coho salmon grow and mature. In the Southern Oregon/Northern California Coast ESU, the decline of coho salmon has been attributed to several human-caused factors such as: habitat degradation (i.e. increased water temperatures, pesticides, non-point source runoff, etc.); harvesting of trees; water diversions; and artificial propagation of salmon. These factors, in turn, exacerbate the adverse effects of the natural environmental variability from drought and poor ocean conditions. Coho salmon spawn in coastal streams in fall or winter, and remain in fresh water for about a year.

Occurrence data: Coho spawn in all of the Humboldt Bay tributary watersheds, and juveniles and yearlings spend various amounts of time in the freshwater/estuary transition zone, averaging about a month but up to two months, with spring being the heaviest time of use (Wallace, 2019). As part of the McDaniel Slough monitoring efforts, bimonthly fish surveys were conducted on a regular basis from 2014-2017. While coho were documented in portions of the McDaniel Slough complex, there was only one detection downstream of the Highway 255 bridge, and none were detected in the Brackish Marsh. However, the Brackish Marsh provides potential foraging habitat and therefore they may be present, on a transient basis only. Aside from the Brackish Marsh, other portions of the Action Area do not provide suitable habitat for Coho.

**Steelhead** (Northern California) (*Oncorhynchus mykiss*)
Federal Status: Threatened
Critical Habitat: Designated within the project area

The Northern California steelhead (Northern California ESU) is listed as a threatened species (65 FR 36074). This coastal steelhead ESU occupies river basins from Redwood Creek in Humboldt County, California to the Gualala River near the Mendocino/Sonoma County line, inclusive. In the

Northern California ESU, the decline of steelhead has been attributed to factors such as: watershed disturbances, including logging on steep slopes, grazing, road building; water diversions; and severe habitat degradation caused by timber harvest and intensive agricultural practices, resulting in decreased flows, loss of riparian habitat, channel widening, and increased water temperatures. Despite this decline, north coast rivers and streams have the greatest amount of steelhead habitat in the State and most abundant populations of steelhead (i.e. Klamath- Trinity River system). Steelhead is the anadromous form of rainbow trout, although steelhead is more similar to Pacific salmon than trout in their ecological requirements. Therefore, steelhead is also known as "Pacific salmon." Unlike salmon, steelhead do not necessarily die after spawning, steelhead juveniles typically have a longer freshwater rearing requirement, and both adults and juveniles are much more variable in the amount of time spent in fresh and saltwater. Steelhead typically migrate to the marine environment after spending one to three years in fresh water. In the marine environment, steelhead typically rear for one to three years prior to returning to fresh water to spawn primarily as three- and four-year olds. "Half-pounders", which are sexually immature steelhead that return to fresh water after spending less than a year in the ocean, are unique to this ESU. The Northern California ESU includes both winter and summer steelhead. Summer steelhead populations (i.e. in Smith, Klamath, Trinity, Mad, and Eel Rivers and Redwood Creek) are not as abundant, and runs in many streams consist of less than 100 fish. As with the Klamath River, some of the larger rivers in this ESU have migrating steelhead year-round, and seasonal runs have been named (i.e. Klamath, Mad, and Eel support a sizeable fall-run of steelhead that migrate into fresh water from late summer through fall). Generally, in this ESU, steelhead are winter-run returning to fresh water from August through June, spawning from December through April, with peak spawning in January in the larger basins, and late February and March in the smaller coastal basins.

Occurrence data: The Humboldt Bay estuary is used for rearing and migration of this steelhead ESU, although very limited numbers of steelhead have been recorded in various locations in northeast Humboldt Bay. As part of the McDaniel Slough monitoring efforts, bimonthly fish surveys were conducted on a regular basis from 2014-2017. No steelhead were documented within the survey area. However, the Brackish Marsh provides suitable habitat and therefore they may be present, likely on a transient basis only. Aside from the Brackish Marsh, other portions of the Action Area do not provide suitable habitat for Steelhead.

**Green sturgeon** (*Acipenser medirostris*)
Federal Status: Threatened
Critical Habitat: Designated within the project area

Green sturgeon are anadromous fish, which spawn and rear in freshwater environments and spend the remainder of their lifecycle in saltwater habitats (NOAA Fisheries, 2020a) The green sturgeon Southern Distinct Population Segment (DPS) was listed as threatened on April 7, 2006 (71 FR 17757). Tagging or genetics data are needed to identify an individual fish to DPS (NMFS, 2005). The Southern DPS is known to breed only in the upper Sacramento River. Spawning occurs in late spring and early summer. Eggs are broadcast-spawned and externally fertilized in relatively fast water flows in depths greater than 3 inches, and usually in deep pools (Moyle,

2002). Silt is known to prevent the eggs from adhering to each other. Female green sturgeon produce 60,000 to 140,000 eggs. Larvae grow quickly, reaching a length of 74 mm within 45 days after hatching (Deng, 2000), 300 mm by one year, and 600 mm by two years (Nakamoto et al., 1995). Juveniles are thought to spend one to three years in freshwater before entering the ocean (Nakamoto et al., 1995), where they disperse widely. At maturity, (15 to 30 years for males and 17 to 40 years for females) green sturgeon return to freshwater spawning grounds. Spawning is thought to occur every three to five years. Juveniles that are smaller than 300 mm are not tolerant of salinity, and would not be expected to occur in Humboldt Bay. The green sturgeon is a primitive fish that is a benthic feeder that feeds on small fish. It is found in estuaries, lower reaches of large rivers, and salt or brackish waters off river mouths. It is a demersal species that prefers saline waters and during high freshwater inflow, it may move out of the area. The green sturgeon is a long-lived fish that can reach lengths of up to 7 feet. A number of threats have been identified for the green sturgeon Southern DPS, including impassable barriers (dams), adult migration barriers, insufficient flow, increased temperatures, juvenile entrainment, exotic species, poaching, pesticides and heavy metals, and local harvest (NMFS, 2005). According to NMFS (2005), "the principal threat to this DPS comes from the reduction of green sturgeon spawning area to a single population in the Sacramento River."

Occurrence data: The majority of Green sturgeon detections in Humboldt Bay are of the Southern DPS from the Sacramento River (Pinnix, 2010). There are much smaller numbers of Northern DPS green sturgeon, which tend to stay in closer proximity to their known breeding areas in the Klamath and Rogue Rivers. As part of the McDaniel Slough monitoring efforts, bimonthly fish surveys were conducted on a regular basis from 2014-2017. No sturgeon were documented within the survey area. However, the Brackish Marsh provides suitable habitat and therefore they may be present, likely on a transient basis only. Aside from the Brackish Marsh, other portions of the Action Area do not provide suitable habitat for Sturgeon.

**Tidewater goby** (Eucyclogobius newberryi)
Federal Status: Endangered
Critical Habitat: Designated within the project area

The tidewater goby is generally found in fresh or low salinity (brackish) water (less than ten parts per thousand) of shallow (less than one meter) lagoons, coastal wetlands, and lower stream reaches where the water is fairly still but not stagnant. The preferred habitat for both spawning (usually occurs spring to early summer) and juveniles is slack, shallow water, seasonally disconnected from the ocean or tidally muted lagoons, estuaries, and sloughs. High-water refugia for juveniles and adults include "perched" habitats, off-channel sloughs, and pockets of still water. Threats at numerous sites with suitable habitat in Humboldt Bay include operation of tide gates to control water flow, grazing, oil spill contamination, contamination from adjacent paper and lumber mill sites, highway construction and maintenance, alteration of stream flood flows, and possibly sedimentation. The Primary Constituent Elements (PCEs) for tidewater goby are 1) Persistent, shallow (~0.1- 2m), still to slow moving water with 0.5-20 ppt salinity; 2) Silt, sand and mud substrates that can be used for burrows; 3) Vegetative protection of submerged and

emergent species (e.g. Potamogeton pectinatus, Ruppia maritima, Typha latifolia, and Scirpus spp.); and 4) Sandbar(s) that close (fully or partially) an estuary or lagoon during late spring to fall for stable salinity and water flow (NOAA, 2013).

Occurrence data:
Currently, the tidewater goby is known to occur in Humboldt Bay. As part of the McDaniel Slough monitoring efforts, bimonthly fish surveys were conducted on a regular basis from 2014-2017, and tidewater gobies have been found within the Action Area; specifically within the Brackish Marsh.

**Chinook salmon** (CA coastal) (Oncorhynchus tshawytscha)
Federal Status: Threatened
Critical Habitat: Designated within the project area
The California coastal chinook salmon (Southern Oregon/California Coastal ESU) was listed by the Federal Government as a threatened species on September 16, 1999. California coastal chinook salmon are a distinct population of chinook salmon that reside from Redwood Creek in Humboldt County, south through the Russian River in Sonoma County. Overall, they spawn and rear in coastal and interior rivers in Northern California and Southern Oregon, and forage in vast nearshore and marine zones of the Northern Pacific Ocean. California coastal chinook salmon spawn and rear in coastal and interior rivers in Northern California and Southern Oregon. Ocean-type chinook (fall run) rear for less than one year in freshwater, while stream-type chinook (spring run) remain in freshwater for one year or more before emigrating to forage in coastal and marine zones of California and Oregon for two to five years (Healey, 1991). Currently, only fall-run chinook appear to be extant in the DPS (NMFS, 2007; NOAA 2016). The destruction and modification of historic spawning habitat, including areas now inaccessible because of dams or other barriers, has been an important contributor to historic declines. Land use activities (logging, road construction, streambank alterations, etc.), water diversions and overutilization for recreational purposes are also major factors of decline. Native predation and genetic integrity are important, but not considered primary factors of decline. The main limitations to this chinook ESU are low abundance, low distribution and negative population trends. The uncertainty of the data is also considered a risk. Fish passage barriers, over-harvesting, floodplain connectivity and function, as well as stream flow and predation are considered moderate to very high threats to this ESU.

Occurrence data: The range of California coast chinook includes all of Humboldt Bay. However, the very limited data on occurrences within Humboldt Bay suggest presence only in Jacoby Creek and Gannon Slough (PGE, 2005). There are many recorded observations for nearby Freshwater Creek to the south, which shows a positive trend of approximately 20 to over 100 individuals from 1994 to 2001, including a large number of hatchery fish (Good et al., 2005). However, as part of the McDaniel Slough monitoring efforts, bimonthly fish surveys were conducted on a regular basis from 2014-2017. No Chinook were documented within the survey area. However, the Brackish Marsh provides suitable habitat and therefore they may be present, likely on a transient basis only. Aside from the Brackish Marsh, other portions of the Action Area do not provide suitable habitat for Chinook.

**Southern eulachon DPS** (Thaleichthys pacificus)
Federal Status: Threatened
Critical Habitat: None designated

The southern DPS of this small, anadromous smelt was federally-listed as a threatened species effective May 17, 2010 (75 FR 13012). The species occurs from Alaska south to northern California. Spawning occurs in the lower reaches of streams from December to June. Juveniles move fairly quickly into estuarine areas, and then into deeper offshore waters up to 180 meters in depth. At any given time most of their adult population would be expected to inhabit deeper waters beyond Humboldt Bay, and any fish present would most likely be active in the mid-water column. Climate related changes in ocean conditions have been identified as the most significant threat to the species, with dams and overfishing noted as lesser threats. There is very little information available on the distribution or abundance of this species, but northern California populations have been dramatically reduced in size since the 1970s (Drake et al., 2010).

Occurrence data: Recent occurrence data for eulachon in northern California are limited. In May 1977 one report states that adult eulachon spawning in Jacoby and Jolly Giant Creeks were “rare” (Jennings, 1996). Other past reports stated that Eulachon have either not been observed (Eldridge and Bryan, 1972) or are occasionally present in Humboldt Bay tributaries, but have been reported within the Bay itself (Barnhart et al., 1992). Lack of long-term monitoring of eulachon has made it difficult to determine abundance. Historically, most large spawning runs in California occurred in the Klamath River and occasionally in the Mad River and Redwood Creek, and the Eulachon Biological Research Team indicated that large, noticeable runs of eulachon are not currently spawning in northern California Rivers (Drake et al., 2010). As part of the McDaniel Slough monitoring efforts, bimonthly fish surveys were conducted on a regular basis from 2014-2017. No eulachon were documented within the survey area. However, the Brackish Marsh provides suitable habitat and therefore they may be present, likely on a transient basis only. Aside from the Brackish Marsh, other portions of the Action Area do not provide suitable habitat for eulachon.

**REPTILES**
**Green Sea Turtle** (Chelonia mydas)
Federal Status: threatened
Critical Habitat: Designated, but outside of project area

The green turtle is one of the largest hard-shelled sea turtles. They are unique among sea turtles in that they are herbivores, eating mostly seagrasses and algae. Adult and juvenile green turtles are generally found nearshore as well as in bays and lagoons, on reefs, and especially in areas with seagrass beds.
Adults migrate from foraging areas to nesting beaches and may travel hundreds or thousands of kilometers each way. After emerging from the nest, hatchlings swim to offshore areas, where they live for several years. Once the juveniles reach a certain age/size range, they leave the open

ocean habitat and travel to nearshore foraging grounds. In the eastern North Pacific, green turtles have been sighted from Baja California to southern Alaska, but most commonly occur from San Diego south. The primary threats facing green turtles are bycatch in commercial and recreational fishing gear, direct killing of turtles and harvest of eggs, vessel strikes, loss and alteration of nesting habitat, degradation and loss of foraging habitat, and entanglement in or ingestion of marine debris.

Occurrence data: There are no documented occurrences within Humboldt Bay or the Action Area. While Humboldt Bay may provide suitable seagrass foraging habitat, there have been no known occurrences and this habitat is not included within the Action Area.

**PLANTS**
Western lily (Lilium occidentale)
Federal Status: Endangered
Critical Habitat: N/A

The western lily is an annual herb found within 4 miles of the northern California and southern Oregon coast, including the Humboldt Bay headlands. It grows up to 5 feet in height with long and pointed leaves, whorled or single, along an unbranched stem. It occurs on the edges of sphagnum bogs, ephemeral ponds and small channels in forest openings, and it may also occur in coastal dune, prairie and scrub where there is ample moisture from ocean fog. Western lily is mainly hummingbird pollinated; secondarily by bee. There are currently less than 30 known small and isolated populations (USFWS, 2015). Shoots typically begin in March and April. In June or July the green buds usually turn red for 3- 5 days, spend 1-2 days opening, with the open, nodding flowers lasting 7-10 days. New plants often only have one flower, and older plants may produce more flowers if the habitat permits. Flower stalks remain standing with fruit capsules maturing over 40-50 days. Non-flowering plants can live for many years under closed-canopy forests. Each fall, the plant dies back and remains dormant as an underground rhizome/bulb until the following spring (USFWS, 2015). The main threats to the western lily are habitat loss due to mid- to late-plant succession, hydrological/wetland modifications, development and grazing. Horticultural plant collection also contributes to the species decline (USFWS, 2015).

Occurrence data: The western lily has little potential to occur within the project corridor, as there is no preferred habitat of coastal bluff scrub and prairies or openings in coast coniferous forests. The freshwater marshes and swamps of the Arcata WWTF may provide marginal habitat. Field reconnaissance conducted within the Action Area by City staff during April and May 2020 did not reveal the presence of any lily species.

**MAMMALS**
**Fisher, West Coast DPS** (Martes pennanti)
Federal Status: Threatened
Critical Habitat: None designated

The fisher is a terrestrial, forest-dwelling mammal of the weasel family. It has a broad head with a flat, pointed muzzle. Its legs are short, body long with a long, bushy tail. Its fur is usually light to

dark brown, but the face and neck may be lighter gray. Fishers live primarily in late-successional coniferous or mixed conifer-deciduous forests with a dense overstory. They prefer large interior areas of forests, and generally do not use areas with little forest cover or where humans have caused major disturbance. Fishers are often found in riparian areas, which are protected from logging and have more complex forest structure with more snags and large woody debris. Fallen logs, snags and large hollow trees (dbh < 20 in.) appear to be important habitat components for fishers, as they use these areas as den sites. They may use younger forests if it provides similar habitat structure. Fishers are active day and night. They mostly eat rodents, squirrels, hares and other small mammals, but also birds, carrion and fruit (NatureServe, 2020). Forest loss and fragmentation due to logging, development, recreation and wildfires are the main causes of fisher declines. Predation, vehicle mortalities and poaching are other threats to their survival. Some reintroductions have been successful, and there are efforts to reintroduce fishers along the Pacific coast. Conservation measures for the northern spotted owl and marbled murrelet will also favor fishers (NatureServe, 2020).

Occurrence data: The fisher has little to no potential to occur within the Action Area. The vegetated areas of AWTF do not provide late-successional conifer or mixed conifer forests or riparian areas where humans have not caused major disturbances. Further, mammal cameras have been regularly deployed for several years within the AWTF and fishers have not been discovered.

# 6.0 Potential Effects, Avoidance, and Conservation Measures

Following is an analysis of how the project may affect protected resources that may be present within the Action Area, in addition to avoidance and conservation measures.

### 6.1 Direct Effects

**Birds**

The Yellow-billed Cuckoo is the only Federally-listed bird species with suitable habitat within the Action Area. Potential impacts include vegetation removal and noise associated with construction (City of Arcata, 2010) . Should this species be present in the vicinity of noise-generating construction, it may temporarily leave the area until noise disturbance has ceased. However, noise impacts will be temporary and limited to relatively small areas within the broader AMWS. Therefore, any temporary displacement of this species during construction will not create an adverse impact because there will be sufficient suitable habitat in adjacent areas. Potential vegetation removal impacts to riparian will be limited to willow along the north edge of Hauser, areas at the edge of the Corporation adjacent to the Humboldt Bay Trail, and areas adjacent to the oxidation pond upgrades. The Arcata Marsh and Wildlife Sanctuary includes numerous areas of willow habitat more remote from the proposed action area for Yellow billed Cuckoo as well as other avian species that utilize riparian/willow habitat. To ensure adverse impacts to not occur, the following avoidance and conservation measures will be implemented:

*Avian Nesting Surveys*: To minimize potential adverse impacts to avian species (including the yellow-billed cuckoo) associated with vegetation removal, vegetation removal will occur outside of the avian nesting season (generally March - August) to the extent practicable.

If vegetation removal or disturbance cannot be confined to periods outside of the nesting season, a qualified biologist shall conduct pre-construction surveys, within the vicinity of the Proposed Project to check for nesting activity and to evaluate the site for presence of special-status bird species. The biologist shall conduct a minimum of one day pre-construction survey within the 7-day period prior to vegetation removal and ground-disturbing activities. If ground disturbance and vegetation removal work lapses for seven days or longer during the breeding season, a qualified biologist shall conduct a supplemental avian pre-construction survey before project work is reinitiated.

If active nests are detected within the construction footprint or within the construction buffer established by the Project biologist, the biologist shall flag a buffer around each nest. Construction activities shall avoid nest sites until the biologist determines that the young have fledged, or nesting activity has ceased. If nests are documented outside of the construction (disturbance) footprint, but within the construction buffer, nest buffers would be implemented as needed. Buffer sizes would take into account factors such as (1) noise and human disturbance levels at the construction site at the time of the survey and the noise and disturbance expected during the construction activity; (2) distance and amount of vegetation or other screening between the construction site and the nest; and (3) sensitivity of individual nesting species and behaviors of the nesting birds.

If active nests are detected during the survey, the qualified biologist shall monitor all nests at least once per week to determine whether birds are being disturbed. Activities that might, in the opinion of the qualified biologist, disturb nesting activities (e.g., excessive noise), shall be prohibited within the buffer zone until such a determination is made. If signs of disturbance or distress are observed, the qualified biologist shall immediately implement adaptive measures to reduce disturbance. These measures may include, but are not limited to, increasing buffer size, halting disruptive construction activities in the vicinity of the nest until fledging is confirmed, placement of visual screens or sound dampening structures between the nest and construction activity, reducing speed limits, replacing and updating noisy equipment, queuing trucks to distribute idling noise, locating vehicle access points and loading and shipping facilities away from noise-sensitive receptors, reducing the number of noisy construction activities occurring simultaneously, and/or reorienting and/or relocating construction equipment to minimize noise at noise-sensitive receptors.

**Aquatic Species**

Tidewater Goby is the only Federally-listed species that has been documented within the Action Area, and is known to inhabit the Brackish Marsh. However, suitable habitat for Coho Salmon, Steelhead, Green Sturgeon, Chinook, and Southern Eulachon exists within the Action Area and therefore potential effects to these species is also analyzed. Suitable habitat for Federally-listed species within the Action Area includes the Brackish Marshand bayward sides of the Klopp Lake levee where utility trenching is proposed, as well as bayward sides of the levees identified for augmentation. While no construction disturbance is planned for the bayward sides of levees, there is a potential for unintended impacts associated with spills, leaks, or construction-related

sedimentation. Besides the Brackish Marsh where Outfall 003 will be constructed, other aquatic environments where project activities will occur consist of the oxidation ponds, treatment wetlands, and enhancement marshes, which do not provide suitable habitat for listed aquatic species.

**Outfall 003 Construction-Related Effects**

Construction of Outfall 003 includes work below the mean high tide line, where aquatic species may be present. Potential in-water impacts could alter normal feeding and usage activities for aquatic species. The effects would primarily be temporary and localized and cease after construction of Outfall 003 is completed.To minimize potential impacts to salmonids, work will be scheduled between July and September, when salmonids are least likely to be present. In addition, to ensure that adverse impacts to aquatic species associated with construction do not occur, the following conservation measures will be implemented:

*Fish Relocation -* Prior to construction, areas of the Brackish Marsh where construction will occur will be isolated and surveyed for aquatic species, which will be relocated to adjacent appropriate areas if found. Surveys and relocation will be completed by a qualified biologist. All translocation and surveys of Federally-listed species will be conducted under a scientific recovery permit.

*Isolated Work Area* - Prior to construction and after fish relocation, the work area surrounding Outfall 003 will be isolated and dewatered to minimize potential sedimentation and turbidity-related impacts to aquatic species

**Water Quality Effects**

Water quality is an important component of salmonid habitat. The condition and quality of the water that the fish encounter on their migration can determine such things as feeding and breeding success rates, disease levels, growth rates, and predation rates. Major elements of water quality critical to salmon consist of turbidity/sediment levels, chemical contamination, dissolved oxygen levels and temperature. Fine sediments can reduce prey detection, alter trophic levels, reduce oxygen, smother redds, and damage gills, as well cause other deleterious effects. The presence of construction equipment near/above/within streams and estuarine environments creates the potential for introducing new suspended sediment loads and toxic materials from ground disturbance, accidental spills, or mechanical failure (City of Arcata, 2010).

Water quality impacts could occur within the Brackish Marsh during construction of Outfall 003, and on bayward sides of levees where construction is proposed within the Action Area. To minimize potential adverse impacts to water quality, the following will be implemented:

*Sedimentation and Turbidity Best Management Practices:* Areas where sedimentation or turbidity impacts could occur will use best management practices (BMPS) to minimize potential impacts. This could include implementation of fiber rolls, silt fences, and post-construction stabilization/revegetation to ensure bare soil is not left exposed. All non-biodegradable temporary erosion control measures will be removed from wetlands and waters of the US/State immediately on cessation of construction.

*Spill Prevention and Clean-up:*
To prevent potential spills or leaks associated with construction activities, construction crews will be trained on spill prevention, response, and good housekeeping. Additionally, spill clean-up kits will be readily available onsite during construction activities to ensure appropriate and timely response to any spills or leaks, should they occur.

*Construction Equipment Maintentance:*
Refueling or maintenance of construction vehicles or equipment will only occur in upland environments. If equipment must be washed, washing will occur where wash water cannot flow into wetlands or waters of the US/State.

**Direct Effects to Critical Habitat for Aquatic Species**
The Brackish Marsh and associated construction of Outfall 003 is the only location that will involve impacts below mean high tide and within designated Critical Habitat. Construction will cause direct, temporary impacts that may affect any listed fish species in the area. However, after construction, impacts to Critical Habitat will be minimal.

After construction, Critical Habitat impacts will be associated with the input of a new freshwater source into the Brackish Marsh from Outfall 003. The Brackish Marsh was formerly an agricultural grazing field, and was constructed as part of the McDaniel Slough project. One of the project objectives of the McDaniel Slough project was to, "Complete infrastructure for brackish pond and begin operation of brackish marsh" (US Army Corps of Engineers, 2008a) More specifically, the objective stated:

> "The City will work with both the [US Fish and Wildlife] Service and Regional Water Quality Control Board Staff to design the brackish pond to meet State and Federal standards for use of fully treated waste water to enhance wildlife habitat in this pond. The design will include flexibility to provide optimal fresh water flow rates and tidal exchange volumes both daily and seasonally to mimic the local hydrologic regime in other Humboldt Bay tributaries. The brackish marsh inlet and outlet will be adjustable to mute the tidal cycle and to provide flexibility to adjust salinity to desired ranges. The pond will receive controlled freshwater inflow of fully treated wastewaters, being discharged by the City's wastewater treatment system and stormwater flowing from the South I Street area and South I Street pond."

As part of the McDaniel Slough Project, Brackish Marsh was excavated to appropriate elevations for mixing bay water with treated wastewater to create the brackish wetland habitat. Approximately 1.5 -9 cubic feet per second (CFS) of treated wastewater was planned to be gravity fed to Brackish Marsh. Flow volumes were planned to be managed to mimic natural seasonal fluctuations in other Humboldt Bay tributaries. The Brackish Marsh outlet is adjustable in order to mute the tidal cycle and to provide flexibility to adjust salinity to desired ranges. Desired salinity ranges of 5-10 parts per thousand (ppt) within Brackish Marsh will be suitable for tidewater gobies.

The finding that tidewater goby habitat will be improved through construction and maintenance of Outfall 003 was also supported by analysis undertaken in 2008 by the US Fish and Wildlife

Service in a formal biological opinion created in consultation with the USACE regarding the McDaniel Slough Wetland

Enhancement Project. It was determined that some elements of the Restoration would involve a small incidental take of tidewater goby, but construction of the Brackish Marsh and the planned Outfall 003 would have a net beneficial impact on tidewater goby. This beneficial effect included approximately 6 ac (2.4 ha) of habitat with depth and diversity, and an expected range of salinity suitable for the tidewater goby. (US Army Corps of Engineers, 2008a)

The Brackish Marsh and associated infrastructure work has been completed, however the freshwater input of fully treated wastewater has been to be implemented. This component of the McDaniel Slough project is being undertaken by the currently proposed Wastewater Treatment Facility Upgrade Project. Once the Project has been completed, it will have a net beneficial impact to Critical Habitat for listed aquatic species.

### Plants

The Western Lily has little potential for occurrence within the project area. However, should it be present, impacts would be limited to direct removal associated with construction. To ensure adverse impacts to not occur, the following avoidance and conservation measures will be implemented:

*Vegetation Surveys:* Areas where vegetation removal is planned to occur will be surveyed at the appropriate time of year for best detection for Western Lily prior to removal. Should any species be found within the construction vicinity, it will be flagged for avoidance.

*Compensatory Vegetation Mitigation:* In the very low chance that a Western Lily be encountered and avoidance is not feasible, the species will be relocated and monitored for survival. Should the survival be unsuccessful, the City will work with USFWS to ensure appropriate compensatory mitigation.

### 6.2 Indirect Effects

Indirect effects of the project are those impacts that are expected to occur later in time. Impacts could be both short- and/or long-term in nature. Aside from impacts related to the operation of Outfall 003 on critical habitat (discussed above under Direct Impacts to Critical Habitat for Aquatic Species), there are minimal indirect impacts to Federally-listed species. Project activities associated with electrical conduit trenching, levee augmentation, and removal of the bridge over Butcher Slough will have no indirect impacts. All impacts will be limited to during construction. After construction activities, the existing footprints will be restored to pre-project conditions, except there will be reduced shading impacts in Butcher Slough as a result of Butcher Slough Bridge removal. There will be no increase in wastewater treatment capacity resulting from the Project.

### 6.3 Cumulative Effects

Cumulative effects are those impacts of future state, local, and private actions affecting listed species that are reasonably certain to occur in the Action Area. The action area is owned by the

City of Arcata, and there are no future projects that are currently planned to occur in the Action Area. Furthermore, future projects that result in a federal action will be subject to consultation requirements established in Section 7 of the Endangered Species Act.

## 7.0 Conclusion and Determination of Effects

Based on the project description, minimization and avoidance measures incorporated into the project design and with the proposed conservation measures, the project is not likely to adversely affect listed endangered, threatened, or sensitive species or their habitat. More specifically:

The City of Arcata Wastewater Treatment Facility Upgrade Project will have “No Effect” on the following species, which are not believed to occur in the project area:

- Marbled murrelet *(Brachyramphus marmoratus)*
- Northern Spotted Owl (*Strix occidentalis caurina)*
- Western Snowy Plover *(Charadrius nivosus nivosus*)
- Green Sea Turtle *(Chelonia mydas)*
- Fisher *(Pekania pennant)*

The City of Arcata Wastewater Treatment Facility Upgrade “May Affect, Not Likely to Adversely Affect” the following species. Concurrence is requested for these findings:

- Yellow Billed Cuckoo *(Coccyzus americanus)*
- Coho salmon - southern Oregon / northern California ESU *(Oncorhynchus kisutch)*
- Steelhead - northern California DPS *(Oncorhynchus mykiss irideus)*
- Green Sturgeon (*Acipenser medirostris)*
- Tidewater Goby *(Eucyclogobius newberryi)*
- Chinook Salmon - California coastal ESU (*Oncorhynchus tshawytscha)*
- Eulachon (*Thaleichthys pacificus)*
- Western Lily *(Lilium occidentale)*

## 8.0 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act mandates inter-agency cooperation in achieving protection, conservation, and enhancement of Essential Fish Habitat (EFH). EFH designations serve to highlight the importance of habitat conservation for sustainable fisheries and sustaining valuable fish populations. EFH relates directly to the physical fish habitat and indirectly to factors that contribute to degradation of this habitat. Important features of marine EFH that deserve attention are adequate water quality, temperature, food source, water depth, and cover/marine vegetation. EFH has been designated for adult and juvenile coho and chinook under the Act. EFH for coast groundfish and pelagic species also exists throughout the marine environment. Numerous studies have demonstrated that land use activities associated with urban development have significantly altered the quality and quantity of salmonid habitat. Impacts of concern associated with these activities include alteration of stream bank and channel

morphology, alteration of stream water temperatures, alteration of the magnitude and timing of annual stream flow patterns, elimination of spawning and rearing habitat, fragmentation of available habitats, elimination of downstream recruitment of spawning gravels and large woody debris, removal of riparian vegetation resulting in increased erosion, and degradation of water quality. Freshwater spawning habitat requirements and rearing are very similar for steelhead and coho. Steelhead depend on an abundance of cool (4.4o C to 12.8o C) and well oxygenated water with spawning occurring in suitable gravels ranging from 6 to 100 mm. Breeding locations typically occur in streambed gravels just upstream from riffles. In addition to physical streambed requirements for spawning, salmonids require an adequate food supply for growth and survival of young fish. The aquatic insects that serve as the major sources of food inhabit the part of the streambed that requires a perennial flow of cool, highly oxygenated water. Overhanging vegetation is also a source of food. No spawning or breeding habitats exist at the project site for the coho or other salmonids due to the saltwater nature of the site. Requirements for estuarine and oceanic juvenile chinook salmon include well-oxygenated water (lethal at <2mg/L) with temperatures of 0-26 o Celsius (optimum of 12-14 o C). Juveniles prefer water column depth of 30 to 80 meters. Requirements for adult chinook salmon include well oxygenated (>5 mg/L) water with temperatures of 0-16 o Celsius (optimum of <14 o C). Mature chinook reside for the most part at depths greater than 30 meters, based on commercial fishery trolling Requirements for marine juvenile coho salmon include well-oxygenated (>5 mg/L) water with temperatures of less than 15 o Celsius. Juveniles prefer water column depth of less than 10 meters. The project does not include spawning habitat, but the Brackish Marsh may provide rearing and foraging habitat. The proposed Outfall 003 will provide a freshwater input, which is a necessary habitat feature to create a brackish environment. Riparian vegetation is an important habitat feature because it serves to stabilize banks (which reduces sedimentation), provide shade (which helps to maintain cool water), and provide a source of food (falling invertebrates). There will be no significant riparian vegetation removal surrounding aquatic environments that provide habitat for Federally listed species.

Important features of marine EFH that deserve attention are adequate water quality, temperature, food source, water depth, and cover/marine vegetation, all for purposes of fish migration and juvenile rearing habitat. Short-term adverse water quality impacts will be minimized, and there will be a long-term beneficial impact to water quality. Short-term turbidity issues would be addressed by securing a Water Quality Certification from RWQCB (pending) and with the best management practices prescribed in this document. No significant impacts to water quality (including temperature), food sources, water depths, or vegetation (riparian or marine) are expected to occur as a result of the proposed project. No effects on fish abundance, health, or long-term sustainability of groundfish, pelagics, or salmon fisheries are expected to result from the proposed bridge and trail construction activities.

## 10.0 Alternatives Analysis

The City of Arcata performed an alternatives screening analysis and screened out the “No Action” and “offsite” alternatives as infeasible, as discussed below.

1. Locate the Project Outside of the Floodplain and Wetland (Offsite Alternative)

The project's intent is to rehabilitate and improve the existing system, and a full relocation would not fit these parameters. This objective is based on both the logistic and economic and time constrained infeasibility of a full relocation of the facility. Arcata's treatment facility is an integral part of the City's environmental and cultural identity; its unique pairing of technical and natural treatment is one of the City's landmark successes and its relocation would involve a redesign of the existing marsh system as well as the purchase and construction of a new facility offsite. There are only a handful of parcels within City limits that could house such a large facility, and the majority of them are already developed. In addition, many of the suitable industrially-zoned parcels in the northern portion of the City are subject to inundation in the case of a catastrophic failure of Matthew's Dam at Ruth Lake. Suitably large parcels in the southern or eastern portion of Arcata would likely require conversion of prime agricultural lands, and would remain located in the Coastal Zone with similar impacts and permit processes. A further logistical challenge of a full relocation would be re-configuring the existing accompanying infrastructure, including pump stations and lines, which would involve a complete flow reconfiguration if and when the site is relocated in future.

Arcata is a small community of less than 20,000 inhabitants, roughly half of which are students; the cost of a full relocation has been estimated at up to $150 million by the City engineer. The City has approved a utility rate increase in the fee schedule to service the debt of the loans through the State Revolving Fund. The City is also currently re-assessing the Capital Connection Fee rate for expansion and new connections to the treatment facility.

While there may be reduced impacts to Federally listed species during construction, locating the Facility off-site would be a net negative impact to Federally listed species over the long term, because it would not include the beneficial impacts to the water quality of Humboldt Bay, including the proposed freshwater input associated with construction of Outfall 003.

2. No Action Alternative

Arcata's wastewater treatment system must comply with regulatory requirements established by its NPDES permit issued by the California Regional Water Quality Control Board. As described in the City's Wastewater Treatment Facility Plan (2017a), effluent monitoring data shows that there have been ongoing exceedances of discharge limits on total suspended solids (TSS), biochemical oxygen demand (BOD, a measure of biodegradable organic matter), pH, dichlorobromomethane, chronic toxicity, chlorine, and fecal coliform since 2004.

The Treatment Facility system relies heavily on land-based, natural treatment systems. This system has served the City well but has a number of drawbacks in that there is not sufficient room to further expand the natural treatment systems for additional capacity, and natural systems are inherently greatly affected by the weather (temperature and precipitation). As regulatory requirements have gotten more stringent over the years and with the initiation of mandatory minimum penalties in 2000, it has become more difficult to reliably meet permit

compliance with the land-based natural system. In 2012, the Facility began operating under a new NPDES permit that specifically addressed several long-term issues regarding disinfection, treatment units, and outfalls. The new permit enabled changes to be made to improve wastewater treatment, protect beneficial uses, increase energy efficiency, reduce chemical usage, and reduce the potential for permit violations. Accordingly, the City initiated the Facility Plan and plant improvement project analyzed herein, which proposes a variety of improvements to the wastewater treatment system to increase treatment capacity and prevent the exceedance of discharge limitations. The Proposed Project addresses the following issues that must be addressed:

- Meet permit/regulatory requirements that protect public health and the environment; and in particular, address ongoing NPDES permit violations and regulatory compliance.
- Repair or rehabilitate aging infrastructure and address deferred maintenance.
- Provide reliable hydraulic and treatment capacity for both wet and dry weather flows, both now and in the future.
- Address City and Agency goals for facility resilience to flooding and sea level rise.

If the Proposed Project is not undertaken, ammonia discharge to Humboldt Bay will not improve and eventually the Facility would not be able to operate, which would render Arcata essentially uninhabitable for all residents and businesses. It has been determined that moving the facility is not warranted or feasible, as the facility also serves as the City's corporation yard for the streets, utilities and equipment maintenance departments.at the present time due to both lack of available land and cost. The facility must continue to operate at its present site for the next 30-40 years at minimum. If the Proposed Project in not undertaken, the Facility will remain out of compliance with the requirements of the NPDES permit and the quality of treated effluent discharged into Humboldt Bay will not be addressed, which has the potential to result in a variety of negative effects to humans and wildlife. The City's continued ability to utilize the Treatment Facility relies on undertaking the improvements discussed in this environmental assessment.

2. Other Alternatives Considered

Arcata considered several alternative sites actions believed to satisfy the objectives, purpose, and need of the project based on the required common improvements required. Alternatives addressed the needed improvements in various ways.

Four alternatives were developed in the prepared Facility Plan (City of Arcata, 2017a) to address improvements needed for the AWTF. Alternatives were conceived through a collaboration between City staff, LACO Associates, Carollo Engineers, and the community through public discussions in a series of public workshops.

**Alternative 1: Existing System Rehabilitation**

Alternative 1 proposes rehabilitating the existing system without constructing an additional secondary treatment system. Flows up to 5.9 mgd would go through primary treatment and flow through the oxidation ponds. Flows less than 2.3 mgd would then enter the treatment wetlands.

Flows greater than 2.3 mgd would bypass the treatment wetlands and be mixed with the treatment wetlands effluent. Blended effluent less than 2.3 mgd would route to the enhancement wetlands. Blended treatment wetland effluent greater than 2.3 mgd would be mixed with enhancement wetlands effluent before entering the UV disinfection system and discharging into the Brackish Marsh (Outfall 003). Wet weather flows greater than 5.9 mgd would be stored in the Oxidation Pond 1. Flows exceeding storage would be pumped to the chlorine contact basin and discharged into Humboldt Bay (Outfall 001).

**Alternative 2: Existing System with Side-Stream Treatment**

Alternative 2 proposes constructing a side-stream secondary treatment system. Influent up to 5.9 mgd would be routed to the primary clarifiers and then be split to either the natural system or a side-stream secondary treatment system. Normal flows up to 2.3 mgd would be treated through the oxidation ponds and the treatment wetlands. Minimum flow between 0.5 mgd and 2.0 mgd would be routed to the side-stream secondary treatment. The effluent from the side-stream treatment system could be routed to the Treatment Wetlands or blended with the natural system effluent. The two secondary effluents would be combined and flows below 2.3 mgd would be sent to the enhancement wetlands. Flows between 2.3 and 5.9 mgd would be mixed with the enhancement wetland effluent, disinfected in the UV system and discharged into the Brackish Marsh (Outfall 003). Wet weather flows above 5.9 mgd would be stored in Oxidation Pond 1. Flows exceeding storage would be pumped to the chlorine contact basin and discharged into Humboldt Bay (Outfall 001).

**Alternative 3: Existing System with Parallel Treatment**

Alternative 3 reduces the flow entering the natural system (oxidation ponds, treatment wetlands and enhancement wetlands) to 1.8 mgd year-round. This low capacity would maintain treatment and permit compliance. Flows between 1.8 mgd and 5.9 mgd would be sent to the parallel secondary treatment train. The two effluents would be mixed prior to entering the UV disinfection system. The proportion could be adjusted to achieve desired effluent water quality. Flow exceeding 5.9 mgd would be stored in the Oxidation Pond 1 or, if needed, routed to the chlorine contact basin, treated and discharged to Humboldt Bay through Outfall 001.

**Alternative 4: Enhanced Natural System with Parallel Treatment**

Alternative 4 allows the natural system to handle 1.8 mgd during dry weather flows and up to 2.3 mgd during peak wet weather flows. The natural system includes the oxidation ponds and the treatment wetlands. Plant effluent between 2.3 mgd and 5.9 mgd would be sent to the parallel secondary treatment system (oxidation ditch). The two secondary effluents would be blended, sent to the new UV system and then discharged into the enhancement wetlands. The UV system would have a 9.8 mgd capacity. The enhancement wetland pump station would be replaced and would pump effluent from the enhancement wetlands to the Brackish Marsh (Outfall 003). Peak Influent flows greater than 5.9 mgd would be stored in Oxidation Ponds. If storage is at capacity, flows could be sent to the UV disinfection (up to 9.8 mgd) and discharged to Humboldt Bay (Outfall 001) as well as Outfall 003.

**Alternative Comparison**

The following section compares the above alternatives based on economics, construction and operation factors. Table 10.0-1 compares the cost of each alternative. Cost estimates include construction, engineering, legal, administrative, permitting costs and estimating contingencies. Cost estimates are not escalated for future years.

***Table 10.0-1:*** *Cost comparison between each alternative. Costs are shown per million dollars*

| Alt. | Description | Total Project Cost with 10% Growth | Total Project Cost with 20% Growth | O&M Cost | | Lifecycle Cost |
|---|---|---|---|---|---|---|
| | | | | Annual | Present Worth | |
| 1 | Existing System Rehabilitation | $35.1 | $35.2 | $0.67 | $11.7 | $46.9 |
| 2 | Existing System Rehabilitation with Side-Stream Treatment | $44.7 | $45.7 | $0.76 | $13.3 | $58.0 |
| 3 | Existing System Rehabilitation with Parallel Treatment | $43.8 | $45.5 | $0.43 | $7.6 | $51.3 |
| 4 | Enhanced Natural System with Parallel Treatment | - | $52.4 | $0.78 | $13.6 | $66.1 |

Note: Costs do not include levee improvements

Table 10.0-2 compares the non-economic factors that the City deemed important when considering different alternatives. The City determined the five criteria that were important for the project and ranked each project. A score of 1 is the least favorable, while a score of 4 is the most favorable.

***Table 10.0-2:*** *Alternative comparison of non-economic criteria (adapted from 2017 Facility Plan)*

| Alternatives | Meets Permit | Ease of O&M | Constructability | Reliability | Ammonia Removal |
|---|---|---|---|---|---|
| 1. Existing System Rehabilitation | 1 | 4 | 1 | 1 | 1 |
| 2. Existing System with Side-Stream Treatment | 2 | 1 | 2 | 2 | 2 |
| 3. Existing System Rehabilitation with Parallel Treatment | 3 | 3 | 3 | 4 | 4 |
| 4. Enhanced Natural System with Parallel Treatment | 4 | 2 | 4 | 3 | 3 |

- Alternative 1 was the least expensive alternative, however it received the lowest scores for meeting permit requirements, constructability, reliability and ammonia removal. The current facility has a limited BOD treatment capacity and relies on the chlorine disinfection system for additional BOD treatment. The new UV disinfection system required for all alternatives will reduce the BOD treatment capacity. Alternative 1 will rely only on the natural system for BOD removal. Improvements to the natural system will improve BOD treatment capacity. However, it will not be enough year round and with population growth. Alternative 1 will also not consistently meet ammonia and nitrogen limits.

- Alternative 2 provides an additional secondary treatment system that will provide BOD treatment and meet ammonia and nitrogen limits. Alternative 2 is the second most expensive alternative and received low ranking regarding the non-economic criteria. The low ranking was due to Alternative 2 requiring the most project elements. This would increase the difficulty of operating and maintaining the treatment processes and facilities. Additionally, Alternative 2 still has limited capacities regarding the natural system and enhancement wetlands.

- Alternative 3 constructs an additional secondary treatment system with a larger capacity than Alternative 2 because less treatment will occur in the natural system, Alternative 3 requires less construction and maintenance than Alternative 2. Alternative 3 was the highest scoring alternative for the non-economic criteria. It achieved high rankings in reliability and ammonia removal due to the larger treatment capacity of the oxidation ditches compared to Alternative 2.

- Alternative 4 was developed after the first three alternatives were presented to the Regional Water Quality Control Board. The RWQCB found that these three alternatives would not achieve the requirements of the permit. Alternatives 1, 2 and 3 did not provide the peak wet weather flow capacity (5.9 mgd) to pass through the Enhancement Wetlands. This is not in compliance with the Enclosed Bays and Estuaries Policy. Alternative 4 allows a peak pumped flow of 5.9 mgd at Outfall-003 to utilize the Enhancement Wetlands for additional treatment and meet the discharge requirements.

**Selected Project**

Alternative 4: Enhanced Natural System with Parallel Treatment was selected as the preferred alternative. Alternative 4 was preferred because it would have the best chance to meet treatment objectives in the 2019 NPDES permit year-round. This alternative is the most expensive and has the largest physical footprint. This alternative enables the City to meet new permit discharge requirements while continuing to promote the beneficial uses of the system for the future. The Proposed Project would undertake the necessary site improvements and would enable the City to comply with its NPDES requirements.

## 9.0 References


Barnhart, R. A., M. J. Boyd, and J. E. Pequegnat, 1992. The ecology of Humboldt Bay, California: An estuarine profile. U.S. Fish and Wildlife Service Biol. Rep. No. 1.

California Department of Fish and Wildlife (CDFW) BIOS viewer species list, Arcata North and South Quadrangles. (2020). Accessed June 2020, from https://apps.wildlife.ca.gov/bios/ .

CDFW, 2020. Rarefind5 query of the California Natural Diversity Database (CNDDB). Accessed June 2020 from https://apps.wildlife.ca.gov/myaccount/login?ReturnUrl=%2frarefind%2fview%2fRareFind.aspx

City of Arcata, 2006. McDaniel's Slough restoration environmental impact report (SCH 2003022091).

City of Arcata, 2010. Biological assessment for the Arcata rail with trail connectivity project. Prepared by Winzler & Kelly for the City of Arcata.

City of Arcata 2014-2017. McDaniel Slough fisheries monitoring.

City of Arcata 2017a. Facility plan: City of Arcata wastewater treatment facility improvements project. Prepared by LACO/ Carollo for the City of Arcata.

City of Arcata. 2017b. McDaniel Slough (south) tidewater goby detections map.

City of Arcata, 2020. Preliminary delineation of waters and wetlands. Prepared by Stillwater Sciences for the City of Arcata.

Deng, X., 2000. Artificial reproduction and early life stages of the green sturgeon (Acipenser medirostris). Unpubl. PhD thesis. University of California, Davis.

Drake, J., R. Emmet, K. Fresh, R. Gustofson, M. Rowse, D. Teel, M. Wilson, P. Adams, E. Spangler, and R. Spangler, 2010. Status review update for eulachon in Washington, Oregon, and California. Eulachon biological review team, January 20, 2010.

Ebird database, 2015. Accessed June 2020, from https://ebird.org/hotspot/L189487/media?yr=all&m=#yebcuc

Eldridge, M. B., and C. F. Bryan, 1972. Larval fish survey of Humboldt Bay, California. U.S. Dept. Commer., NOAA Tech. Rep. NMFS-SSRF-665.

Good, T.P., R.S. Waples, and P. Adams (editors)., 2005. Updated status of federally listed ESUs of West Coast salmon and steelhead. U.S. Dept. Commer., NOAA Tech. Memo. NMFSNWFSC-66, 598 p.

Healey, M.C., 1991. Life History of chinook salmon (Oncorhynchus tshawytscha). In: pacific salmon life histories (Ed. by Groot, C. & Margolis, L.). UBC Press. Vancouver, BC. pp. 311-393.

Jennings, M. R., 1996. Past occurrence of eulachon, Thaleichthys pacificus, in streams tributary to Humboldt Bay, California. Calif. Fish Game 82(6):147–148.

Moyle, P. B., 2002. Inland fishes of California. Univ. California Press, Berkeley.

Nakamoto, R. J., T. T. Kisanuki, and G. H. Goldsmith, 1995. Age and growth of Klamath River green sturgeon (Acipenser medirostris). U.S. Fish and Wildlife Service, Project #93-FP-13. 20p.

National Marine Fisheries Service (NMFS), 1996. Making endangered species act determinations of effect for individual or grouped actions at the watershed scale. NMFS, Environmental and Technical Services Division, Habitat Conservation Branch.

NMFS, 2005. Green sturgeon (Acipenser medirostris) status review update. Biological Review Team, Santa Cruz Laboratory, Southwest Fisheries Science Center.

NMFS, 2007. Federal recovery outline for the evolutionarily significant unit of California coastal chinook salmon. Prepared by the National Marine Fisheries Service, Southwest Regional Office

NatureServe, 2020. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Accessed June, 2020 from http://www.natureserve.org/explorer.

National Oceanic and Atmospheric Administration (NOAA) Fisheries, 1999a. Designated critical Habitat; Central California Coast and Southern Oregon/Northern California Coasts Coho Salmon. 64 Fed. Reg 24049-24062.

NOAA Fisheries, 1999b. Endangered and Threatened Species; Threatened Status for Two Chinook Salmon Evolutionarily Significant Units (ESUs) in California. 64 Fed. Reg. 50394-50415.

NOAA Fisheries, 2000a. Designated Critical Habitat: Critical Habitat for 19 Evolutionarily Significant Units of Salmon and Steelhead in Washington, Oregon, Idaho, and California. 65. Fed Reg. 7764-7787.

NOAA Fisheries, 2000b. Endangered and Threatened Species: Threatened Status for One Steelhead Evolutionarily Significant Unit (ESU) in California. 65 Fed Reg 36074-36094.

NOAA Fisheries, 2006**.** Endangered and Threatened Wildlife and Plants: Threatened Status for Southern Distinct Population Segment of North American Green Sturgeon. 71 Fed Reg. 17757-17766.

NOAA Fisheries, 2009. Endangered and Threatened Wildlife and Plants: Final Rulemaking To Designate Critical Habitat for the Threatened Southern Distinct Population Segment of North American Green Sturgeon. 74 Fed Reg. 52299-52351.

NOAA Fisheries, 2010. Endangered and Threatened Wildlife and Plants: Threatened Status for Southern Distinct Population Segment of Eulachon. 75 Fed Reg. 13012-13024.

NOAA Fisheries, 2013. Endangered and threatened wildlife and plants; designation of critical habitat for the tidewater goby. 78 Fed Reg. 8745-8819.

NOAA Fisheries, 2016. Final coastal multispecies recovery plan for California coastal chinook salmon, northern California steelhead and central California coast steelhead.

NOAA Fisheries. 2020a. Species directory, green sturgeon. Available at https://www.fisheries.noaa.gov/species/green-sturgeon.

NOAA Fisheries, 2020b. West coast species critical habitat lists. Accessed June 2020, from https://www.fisheries.noaa.gov/resources/maps?title=&tid%5B1000001126%5D=1000001126&field_map_category_value%5Bhabitat%5D=habitat&field_species_vocab_target_id&sort_by=created&webdam_inserts=&page=0

Pacific Gas and Electric Company (PGE), 2005. Biological assessment for the Pacific Gas and Electric Company G/L 137B Gannon Slough erosion control Project, Humboldt County.

Pinnix, B., 2010. “Green Sturgeon Monitoring in Humboldt Bay.” Presented at the Humboldt Bay Symposium, April 23, 2010. Eureka, CA.

US Fish and Wildlife Service (USFWS), 1997. Recovery plan for the threatened marbled murrelet in Washington, Oregon, and California.

USFWS, 2007. Recovery Plan for the pacific coast population of the western snowy plover. California/Nevada Operations Office.

USFWS, 2011. Revised Recovery Plan for the northern spotted owl. Portland, OR. https://www.fws.gov/oregonfwo/Species/Data/NorthernSpottedOwl/Recovery/Library/Documents/RevisedNSORecPlan2011.pdf

USFWS, 2013. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Tidewater Goby. Fed Reg 78 8745-8819

USFWS, 2015. Plant and animal species information. Arcata Fish and Wildlife Office, Endangered Species Program. Accessed June 2020 from https://www.fws.gov/arcata/es/listedspecies.html

USFWS, 2020. (NR).Flyways-Administrative. https://www.fws.gov/birds/management/flyways.php.

USFWS Information for Planning and Conservation (IPaC) Species list, 2020. Accessed June 2020 from https://ecos.fws.gov/ipac/location/index

US Army Corps of Engineers (ACOE), 2008a. Formal Consultation on the proposed McDaniel Slough Wetland Enhancement Project located in Humboldt County, California (File No. 27340N). Prepared by U.S. Fish and Wildlife Service for the US Army Corps of Engineers. June 2008.

ACOE, 2008b. Reinitiation of formal Consultation on the proposed McDaniel Slough Wetland Enhancement Project located in Humboldt County, California (File No. 2002-274340). Prepared by the United States Fish and Wildlife Service. September 2009.

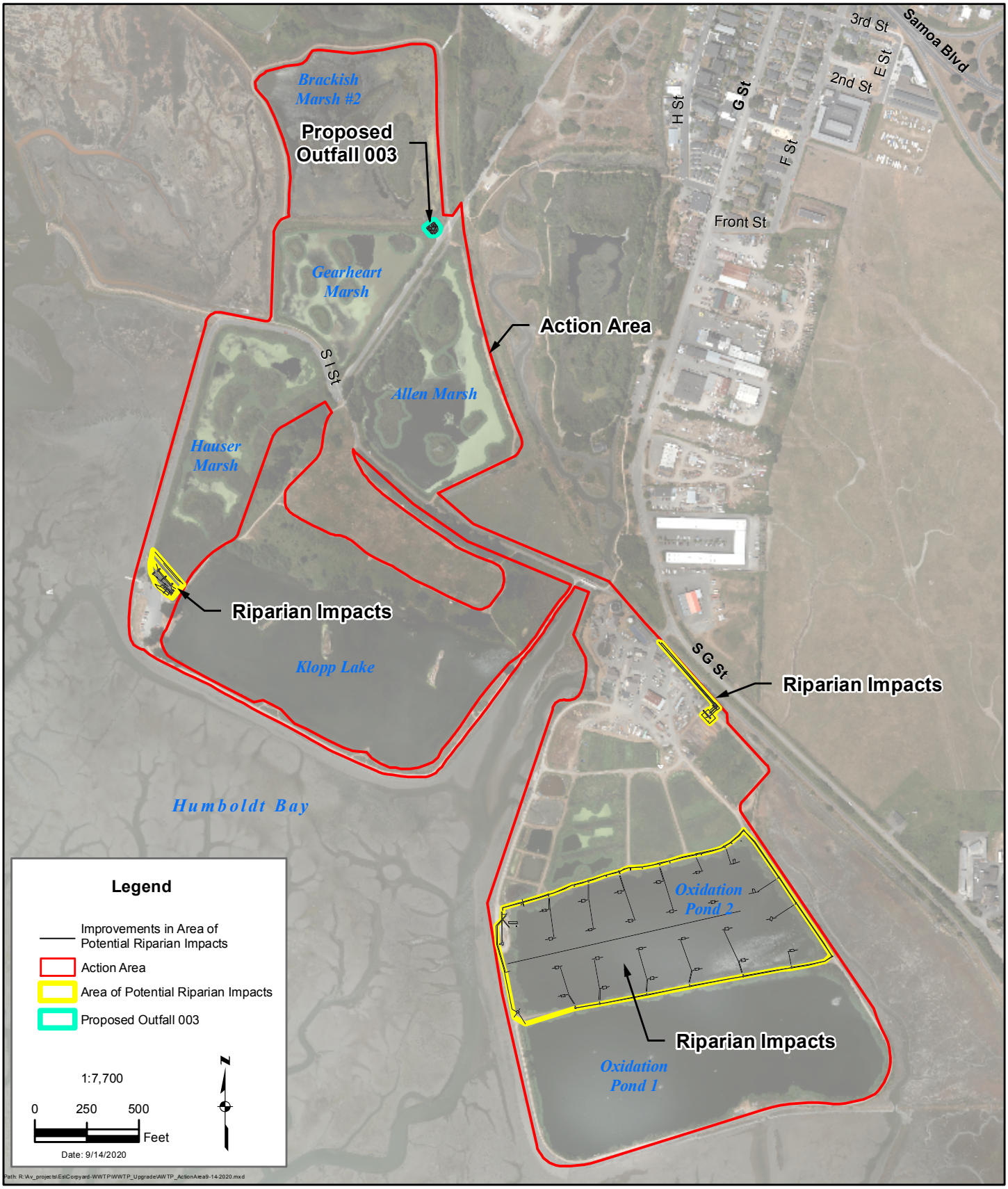
Wallace, M., 2019. "The Old Man and the SEE: Lessons Learned from 15 Years of Coho Salmon Life History and Habitat Restoration Monitoring in the Stream-Estuary Ecotone." Presented at the Humboldt Bay Symposium, April 12, 2019. Eureka, CA.

## 10.0 List of Contacts Made and Preparers

Emily Benvie, Environmental Programs Manager
Delo Freitas, Senior Planner
Julie Neander, Deputy Director Environmental Services

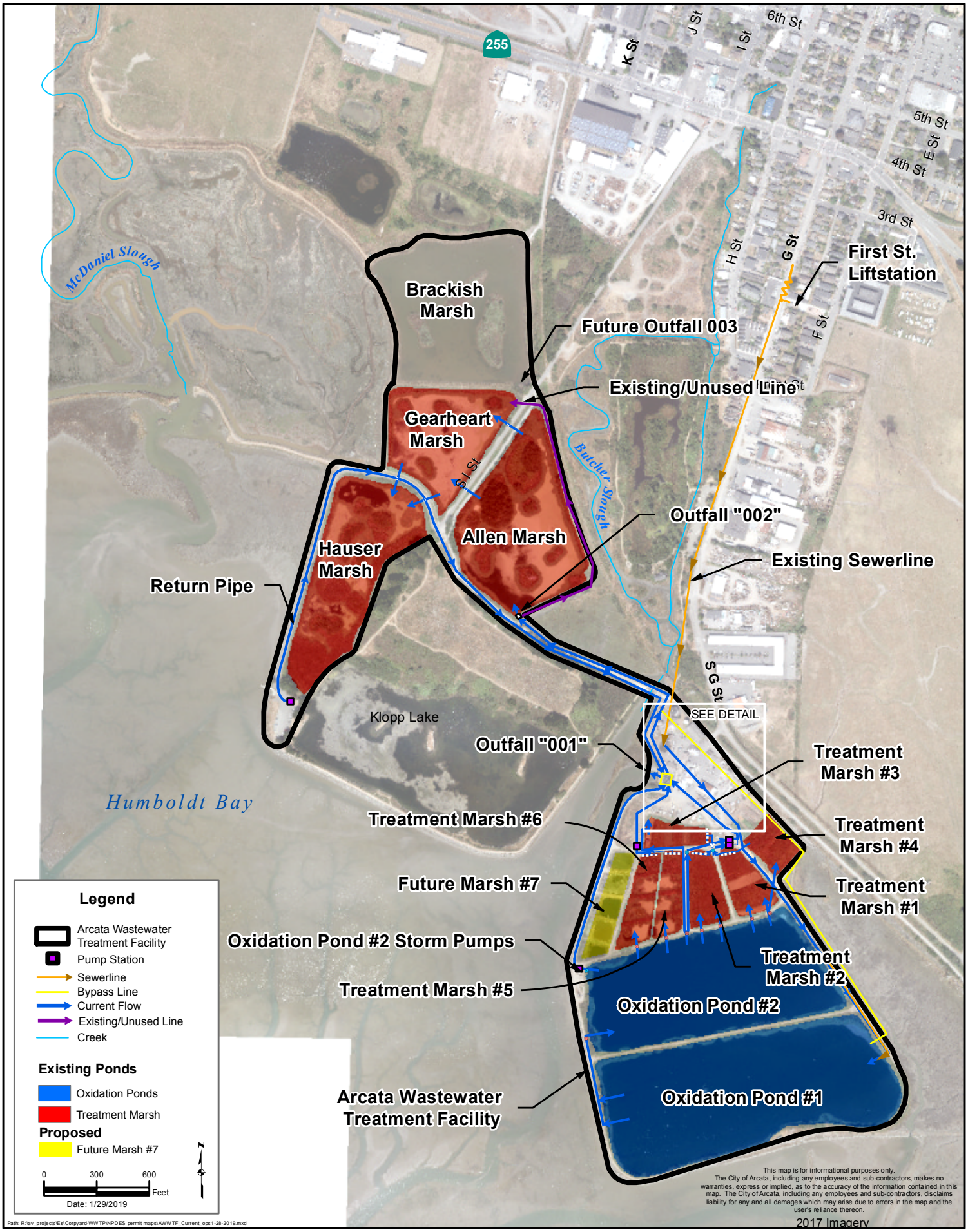
# Appendix 1 – Action Area

# Arcata Wastewater Treatment Facility Upgrade - Action Area

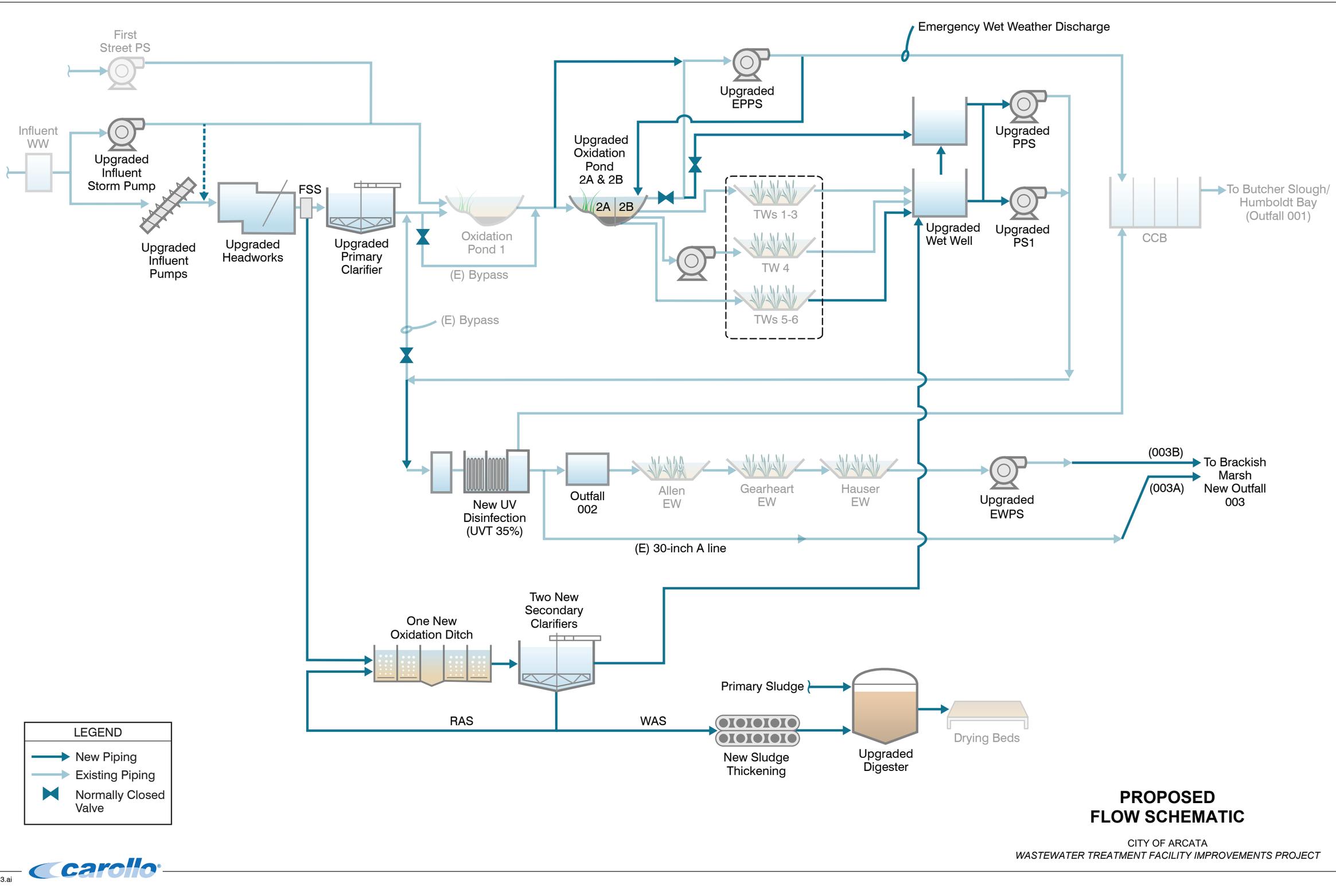


# Appendix 2 – Arcata Wastewater Treatment Facility Current Operations

# Current Operations
# Arcata Wastewater Treatment Facility



# Appendix 3 – Proposed Flow Schematic




# PROPOSED FLOW SCHEMATIC

CITY OF ARCATA

*WASTEWATER TREATMENT FACILITY IMPROVEMENTS PROJECT*

carollo

arc0720rf3-9913.ai

# Appendix 4 – Arcata Wastewater Treatment Facility Upgrade Site Plans

Plot Date: 7/23/2020 8:12:36 AM

LEGEND

- Phase 1
- Phase 2
- Existing
- New
- Future

OUTFALL 003

BRACKISH MARSH

GEARHEART ENHANCEMENT WETLAND

ALLEN ENHANCEMENT WETLAND

BUTCHER'S SLOUGH

TREATMENT WETLAND NO. 4

TREATMENT WETLAND NO. 1

TREATMENT WETLAND NO. 3

TREATMENT WETLAND NO. 2

TREATMENT WETLAND NO. 5

TREATMENT WETLAND NO. 6

OXIDATION POND NO. 2

OXIDATION POND NO. 1

HAUSER ENHANCEMENT WETLAND

KLOPP LAKE

HUMBOLDT BAY

ENHANCEMENT WETLANDS PUMP STATION

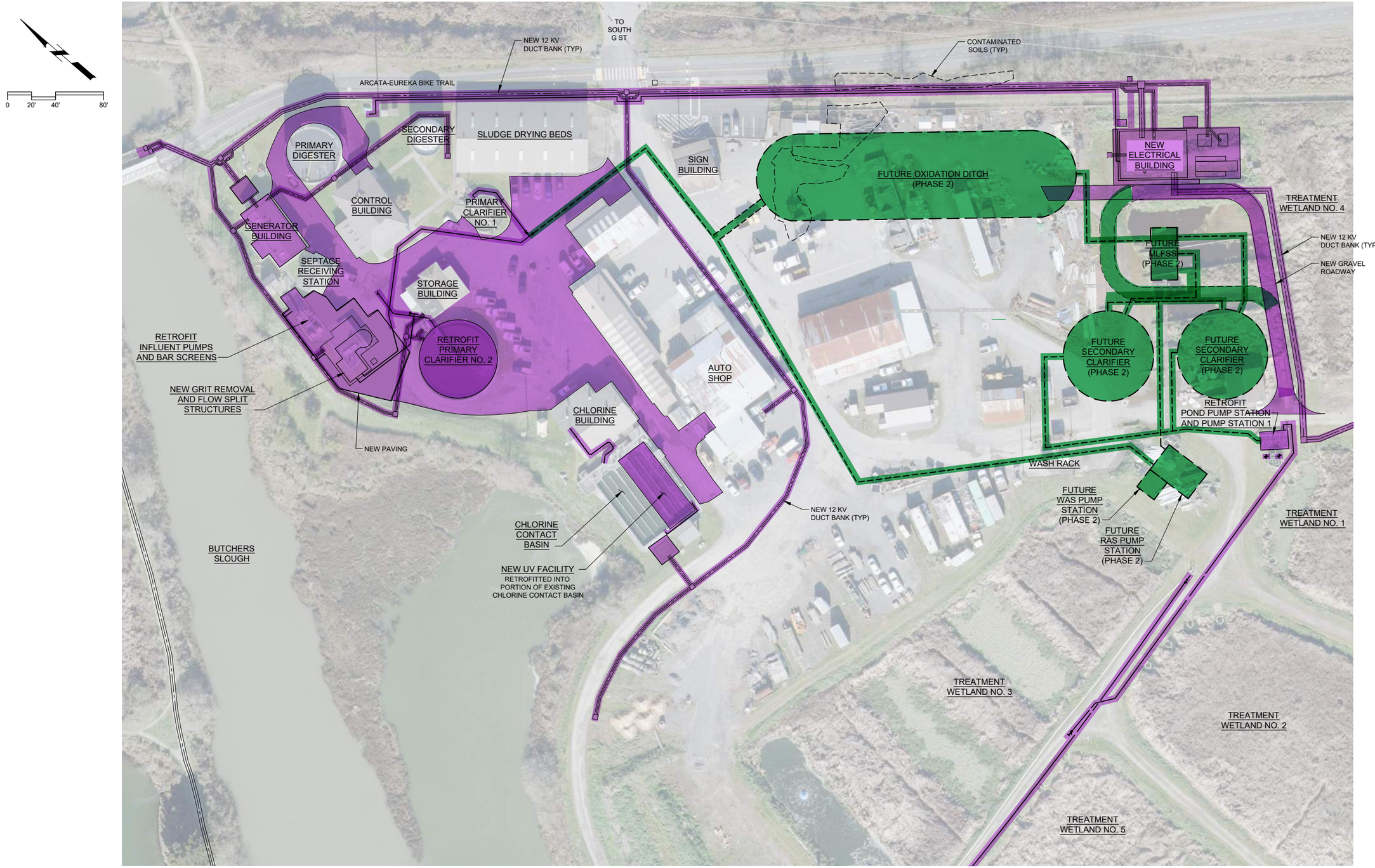
HUMBOLDT BAY

# OVERALL SITE PLAN

CITY OF ARCATA

carollo

arc0720rf7-9913.ai

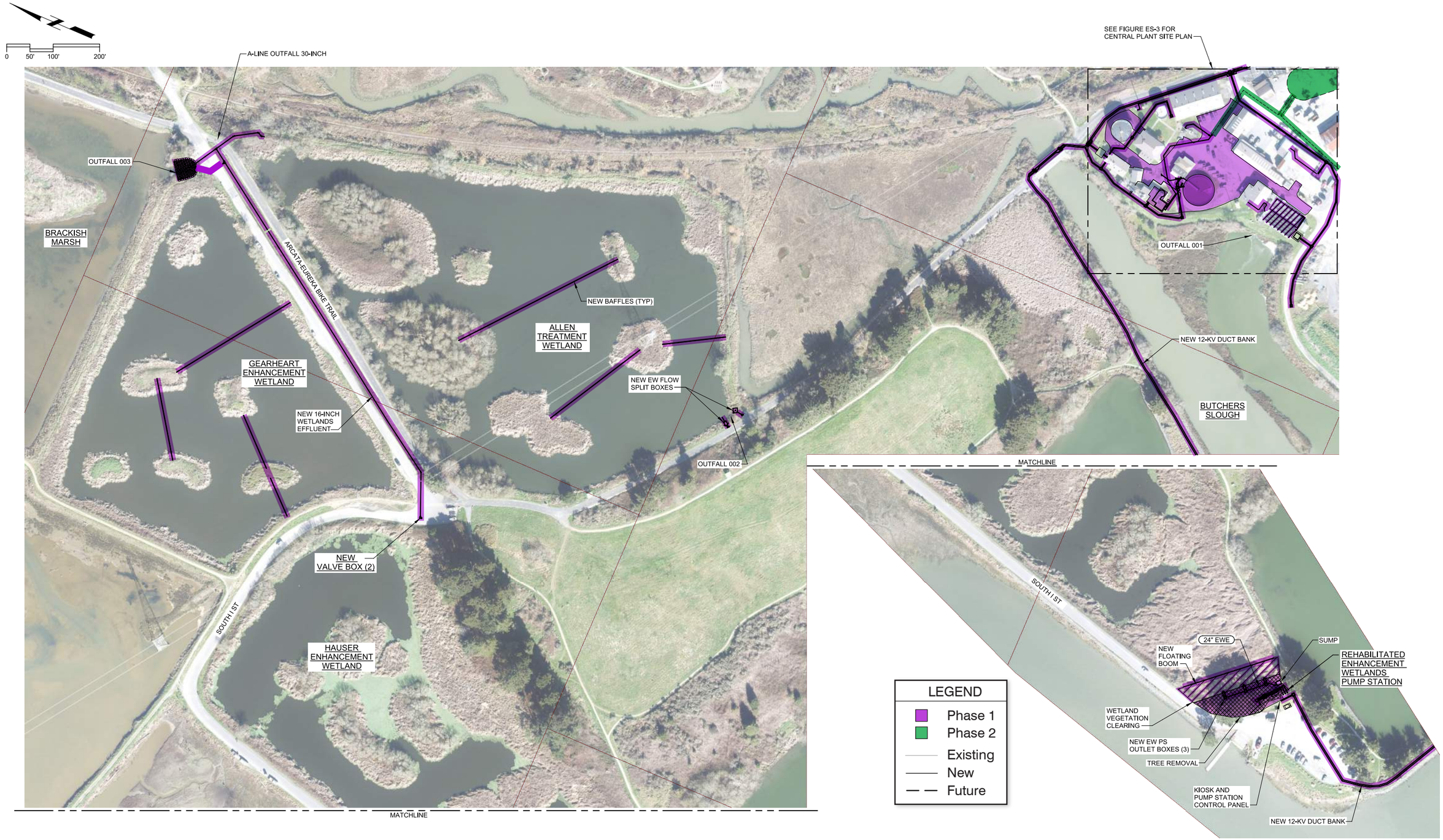



**CENTRAL SITE PLAN**

CITY OF ARCATA

carollo

arc0720rf6-9913.ai




**ENHANCEMENT WETLANDS SITE PLAN**

CITY OF ARCATA

carollo

File: E:\ICSforPDFWorking\160217\1008788_2\9913B10FIGES-2.dgn

Plot Date: 23-JUL-2020 7:55:55 AM

User: svcPW

arc0720rf5-9913.ai

File: E:\ICSforPDFWorking\160217\1008788_3\9913B10FIGES-1.dgn
Plot Date: 23-JUL-2020 7:55:53 AM
User: svcPW

0 50' 100' 200'

SEE FIGURE ES-3 FOR CENTRAL PLANT SITE PLAN

SOUTH G ST

ARCATA-EUREKA BIKE TRAIL

NEW 12KV DUCT BANK (TYP)

NEW PUMP STATION NO. 4

18" OPE

TREATMENT WETLAND NO. 4

NEW STILLING WELL

NEW AERATOR (TYP)

1

TREATMENT WETLAND NO. 1

PUMP STATION NO. 1

NEW MOTOR ACTUATOR

6" TWE

TREATMENT WETLAND NO. 2

OXIDATION POND NO. 1

POND NO. 1 AERATOR ELECTRICAL BUILDING

OXIDATION POND NO. 2

OUTFALL 001

24" TWE

OUTLET 5 RETROFIT WITH NEW WEIR GATE AND MOTOR ACTUATOR. OUTLET 6 NEW MOTOR ACTUATOR.

NEW RADIO SYSTEM FOR SCADA INTEGRATION

TREATMENT WETLAND NO. 5 & 6

2 PUMP STATION NO. 2

REPLACE WEIR GATE AND MOTOR ACTUATOR

FUTURE TRANSFER STRUCTURE

18" OPE (FUTURE)

BUTCHERS SLOUGH

EMERGENCY POND PUMP STATION

REPLACE EXISTING TRANSFORMER

NEW BOAT RAMP AND RELOCATE EXISTING STILLING WELL

NEW OXIDATION POND TRANSFER STRUCTURE

HUMBOLT BAY

14" OPE

30" OPE

REPLACE EXISTING TRANSFORMER

KEY NOTES:

1. TEMPORARY PUMP STATION NO. 4 AND PIPELINE WILL BE DEMOLISHED WITH THE PROJECT.
2. PUMP STATION NO. 2 AND TEMPORARY PIPELINE WILL BE DEMOLISHED WITH THE PROJECT PENDING POTHOLING.

LEGEND

- Phase 1
- Phase 2
- Existing
- New
- Future

# OXIDATION PONDS AND TREATMENT WETLANDS SITE PLAN

CITY OF ARCATA

carollo

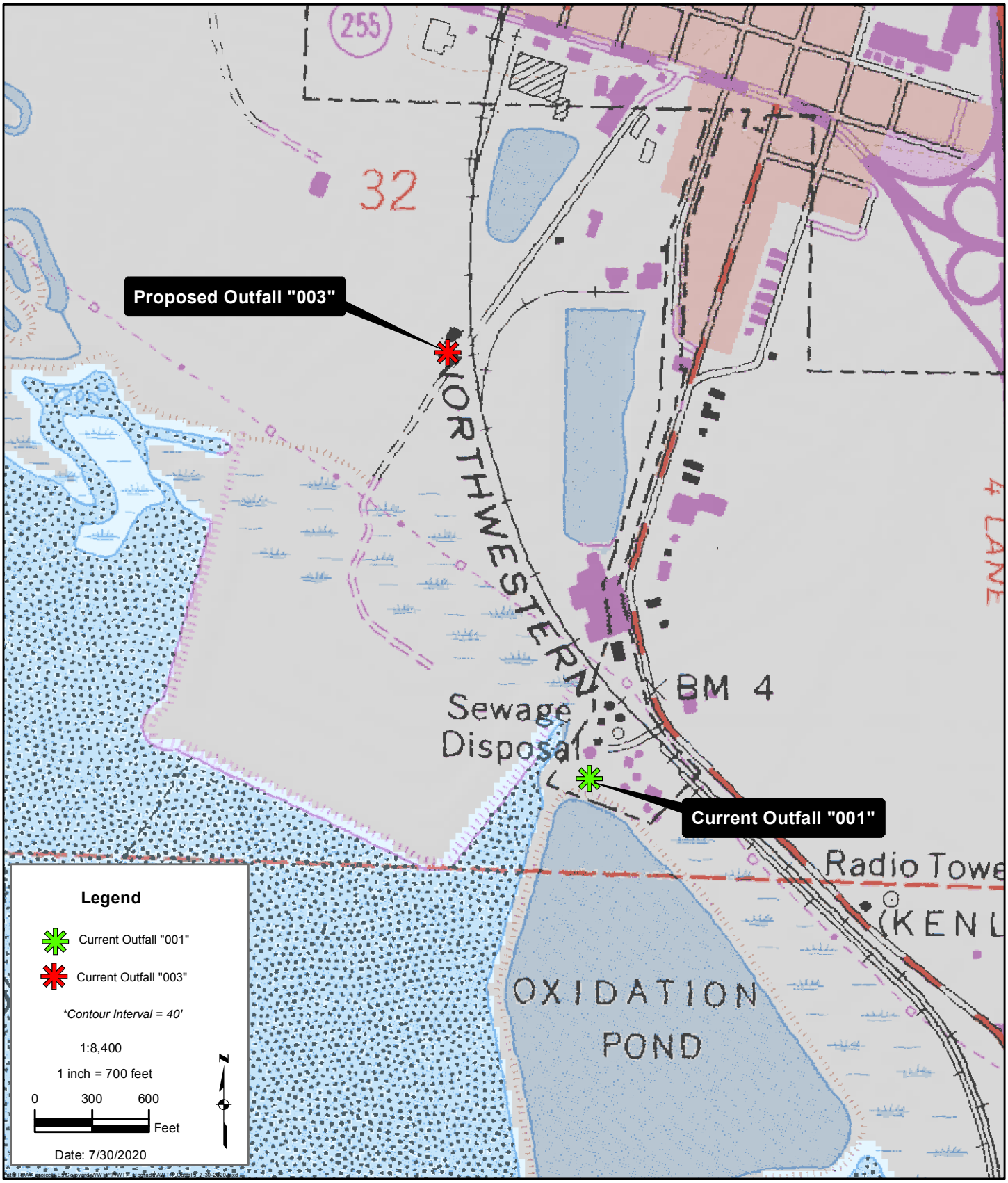
arc0720rf4-9913.ai

# Appendix 5 - Existing and Proposed Outfalls

# Current & Proposed Outfalls

## Arcata Wastewater Treatment Upgrade

U.S.G.S. 7.5 Minute Topographic Map: Arcata South Quadrangle
Section 31 T.6.N., R.1.E. of H.B. & M.

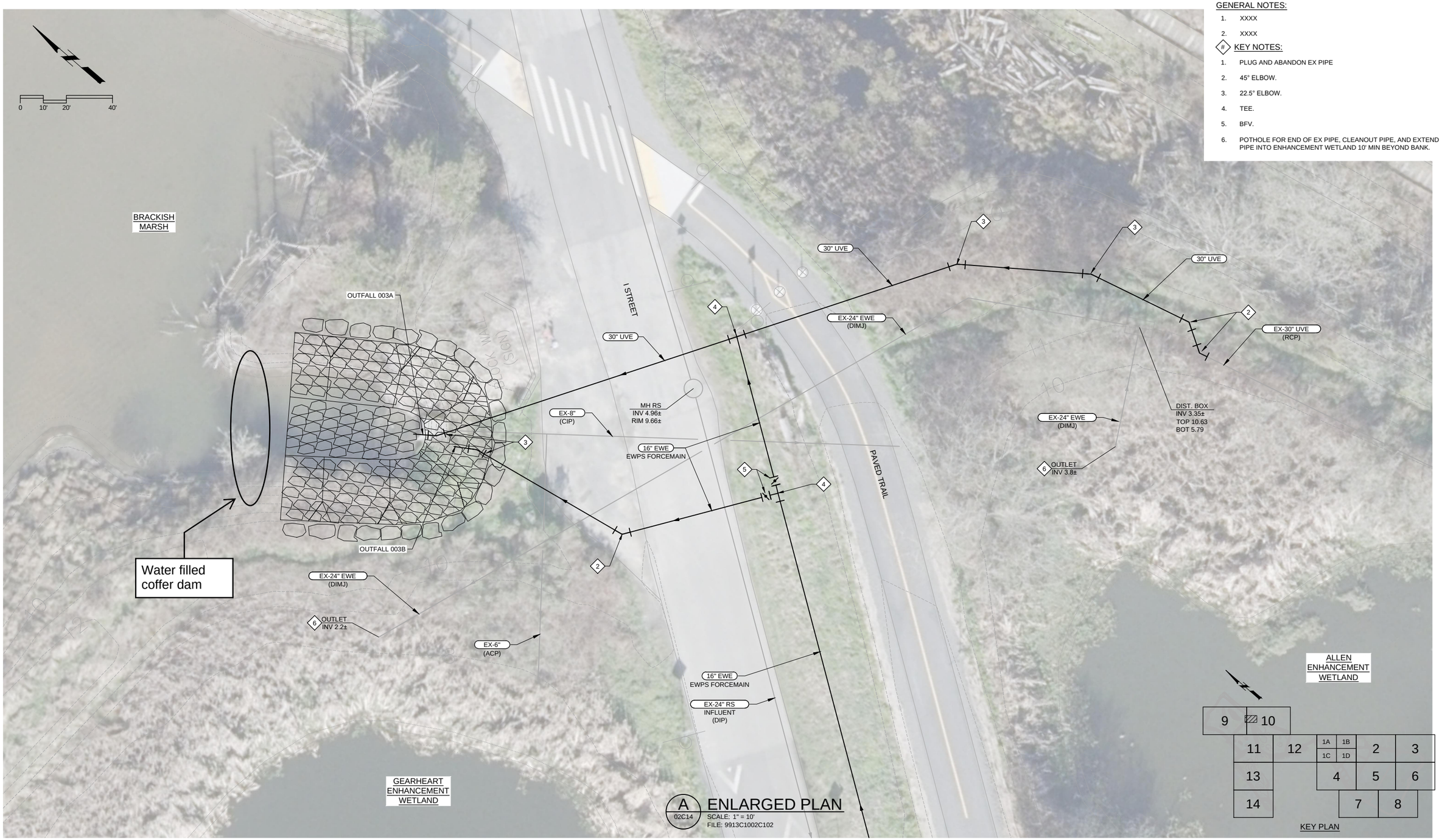


Plot Date: 7/17/2020 4:18:47 PM

FILE NAME: 9913C1018C03.dwg

PROJECT NO. 9913C1S_P1

LAST SAVED BY: Luke.Halonen




GENERAL NOTES:

1. XXXX
2. XXXX

KEY NOTES:

1. PLUG AND ABANDON EX PIPE
2. 45° ELBOW.
3. 22.5° ELBOW.
4. TEE.
5. BFV.
6. POTHOLE FOR END OF EX PIPE, CLEANOUT PIPE, AND EXTEND PIPE INTO ENHANCEMENT WETLAND 10' MIN BEYOND BANK.

A ENLARGED PLAN
02C14
SCALE: 1" = 10'
FILE: 9913C1002C102

| REV | DATE | BY | DESCRIPTION |
|---|---|---|---|
| | | | 90% SUBMITTAL NOT FOR CONSTRUCTION |

DESIGNED LDH
DRAWN LDH
CHECKED SXM
DATE AUGUST 2020

REGISTERED PROFESSIONAL ENGINEER STEVEN X. MCKINNEY No. C47590 CIVIL STATE OF CALIFORNIA

carollo IN ASSOCIATION WITH GHD

City of ARCATA

CITY OF ARCATA
AWTF IMPROVEMENTS PROJECT PHASE 1
CIVIL
OUTFALL 003 ENLARGED PLAN

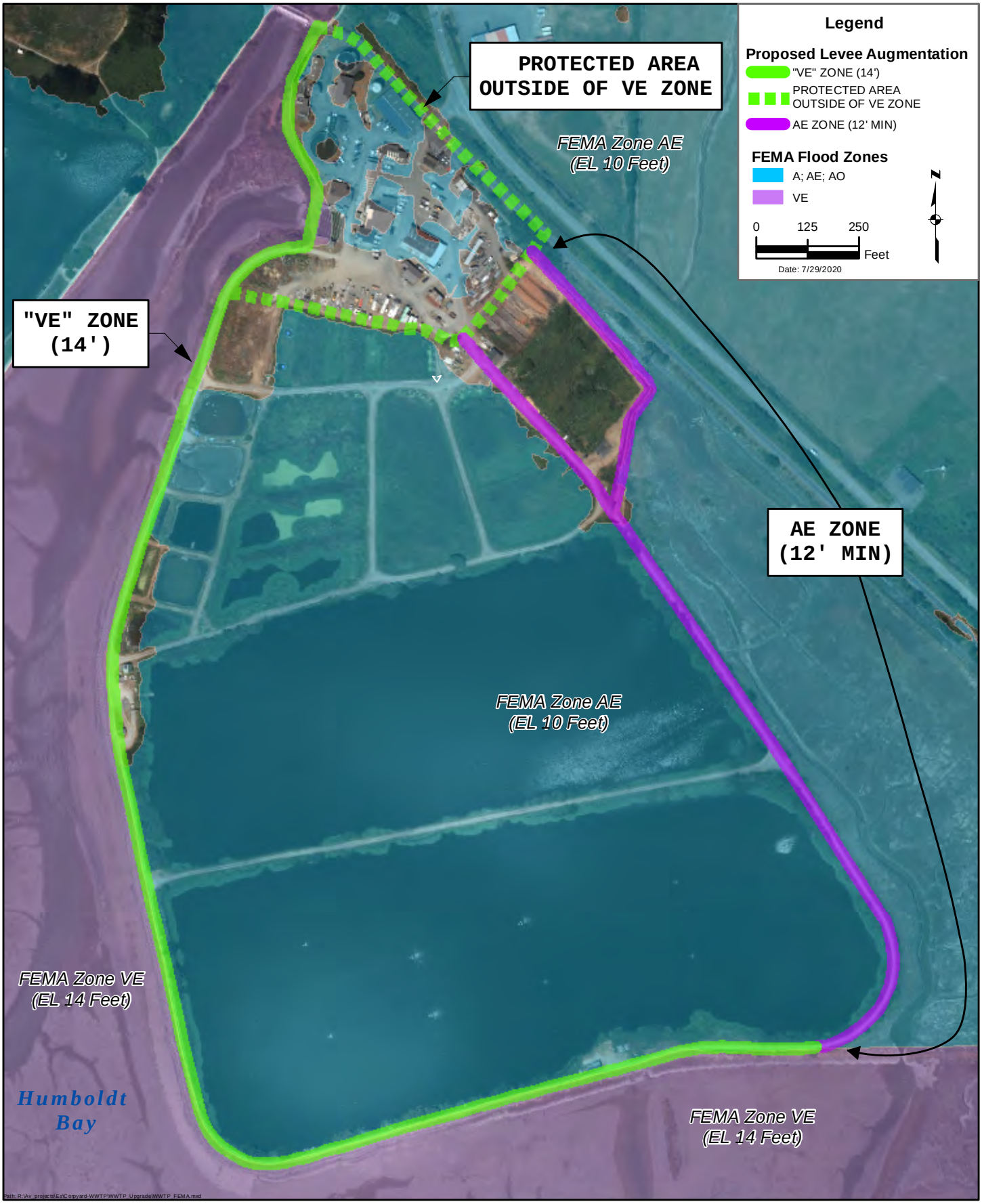
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 9913C.10
DRAWING NO. 18C03
SHEET NO. OF XXX

# Appendix 6 – Proposed Levee Augmentation

# Arcata Wastewater Treatment Upgrade

## Proposed AWTP Levee Augmentation



# Appendix 7 – IPaC Resources List

**IPaC** **U.S. Fish & Wildlife Service**

# IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

NOT FOR CONSULTATION

## Location

Humboldt County, California




## Local office

Arcata Fish And Wildlife Office

(707) 822-7201
(707) 822-8411

1655 Heindon Road

Arcata, CA 95521-4573

NOT FOR CONSULTATION

# Endangered species

**This resource list is for informational purposes only and does not constitute an analysis of project level impacts.**

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

---

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of

NOT FOR CONSULTATION

Commerce.

The following species are potentially affected by activities in this location:

# Birds

| NAME | STATUS |
|---|---|
| Marbled Murrelet Brachyramphus marmoratus<br>There is **final** critical habitat for this species. Your location is outside the critical habitat.<br>https://ecos.fws.gov/ecp/species/4467 | Threatened |
| Northern Spotted Owl Strix occidentalis caurina<br>There is **final** critical habitat for this species. Your location is outside the critical habitat.<br>https://ecos.fws.gov/ecp/species/1123 | Threatened |
| Western Snowy Plover Charadrius nivosus nivosus<br>There is **final** critical habitat for this species. Your location is outside the critical habitat.<br>https://ecos.fws.gov/ecp/species/8035 | Threatened |
| Yellow-billed Cuckoo Coccyzus americanus<br>There is **proposed** critical habitat for this species. Your location is outside the critical habitat.<br>https://ecos.fws.gov/ecp/species/3911 | Threatened |

# Reptiles

| NAME | STATUS |
|---|---|
| Green Sea Turtle Chelonia mydas<br>No critical habitat has been designated for this species.<br>https://ecos.fws.gov/ecp/species/6199 | Threatened |

# Fishes

| NAME | STATUS |
|---|---|
| Tidewater Goby Eucyclogobius newberryi<br>There is **final** critical habitat for this species. Your location overlaps the critical habitat.<br>https://ecos.fws.gov/ecp/species/57 | Endangered |

# Flowering Plants

NOT FOR CONSULTATION

| NAME | STATUS |
| --- | --- |
| Western Lily Lilium occidentale<br>No critical habitat has been designated for this species.<br>https://ecos.fws.gov/ecp/species/998 | Endangered |

# Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

This location overlaps the critical habitat for the following species:

| NAME | TYPE |
| --- | --- |
| Tidewater Goby Eucyclogobius newberryi<br>https://ecos.fws.gov/ecp/species/57#crithab | Final |

NOT FOR CONSULTATION

# Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasu

MIGRATORY BIRD INFORMATION IS NOT AVAILABLE AT THIS TIME

**Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.**

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

**What does IPaC use to generate the migratory birds potentially occurring in my specified location?**

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

**What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?**

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

**How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?**

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

**What are the levels of concern for migratory birds?**

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

NOT FOR CONSULTATION

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

**Details about birds that are potentially affected by offshore projects**

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

**What if I have eagles on my list?**

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

**Proper Interpretation and Use of Your Migratory Bird Report**

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ “What does IPaC use to generate the migratory birds potentially occurring in my specified location”. Please be aware this report provides the “probability of presence” of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the “no data” indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn

NOT FOR CONSULTATION

more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

# Facilities

## National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

This location overlaps the following National Wildlife Refuge lands:

| LAND | ACRES |
|---|---|
| Humboldt Bay National Wildlife Refuge | 3,367.01 acres |

(707) 733-5406
(707) 733-1946

MAILING ADDRESS
P.O. Box 576
Loleta, CA 95551-9633

PHYSICAL ADDRESS
1020 Ranch Road
Loleta, CA 95551-9633

https://www.fws.gov/refuges/profiles/index.cfm?id=81590

NOT FOR CONSULTATION

## Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

# Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

WETLAND INFORMATION IS NOT AVAILABLE AT THIS TIME

This can happen when the National Wetlands Inventory (NWI) map service is unavailable, or for very large projects that intersect many wetland areas. Try again, or visit the NWI map to view wetlands at this location.

**Data limitations**

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

**Data exclusions**

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

**Data precautions**

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

NOT FOR CONSULTATION

# ATTACHMENT 32

City of Arcata. September 2020. *US Department of Housing and Urban Development: 8-Step Process. Arcata Wastewater Treatment Facility Upgrades Project-Arcata, CA.*

# U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT:

# 8-STEP PROCESS

**Arcata Wastewater Treatment Facility Upgrades Project – Arcata, CA**
Project No.17-CDBG-12017
Decision Process for E.O. 11988 as Provided by 24 CFR §55.20

**Step 1:** ***Determine whether the action is located in a 100-year floodplain (or a 500-year floodplain for critical actions) or wetland.***

The City of Arcata, under Part 58 of Title 24 Code of Federal Regulation, has determined that the following proposed action under the Community Development Block Grant Program and contract number 17-CDBG-12017 is located in the 100-year floodplain and may impact up to 0.2 acres of semi-permanently flooded palustrine persistent emergent wetland.

- This action is located in an Area of Potential Effect within the 1% (100-year) floodplain as indicated on Flood Insurance Rate Map Panel numbers 5301260026R and 06023C0855G, revised June 21, 2017. The FIRM Panels are attached to this document. The wastewater treatment facility is not in a regulatory floodway and the Proposed Project will not impede flood flows. The treatment facility is designated AE with associated required base elevations as set by the City's Floodplain Ordinance as shown on the attached FIRM Panel.
- The Area of Potential Effect also includes wetlands, as identified in the Wetland Delineation prepared by Stillwater Sciences in August 2020. Impacted wetlands are also mapped on the Fish and Wildlife Service- National Wetlands Inventory. Stillwater staff delineated all potential wetlands in the area of potential effect and found 2.0 acres of wetland within the project area. Some wetland areas within the Area of Potential Effect may be temporarily impacted by construction activities but will be re-vegetated upon project completion. There are four identified areas of potenital permanent wetland impacts in the project area. The prepared wetland delineation is attached to this document.

The Proposed Project will upgrade elements of the existing Arcata Wastewater Treatment Facility located at 601 G Street in Arcata, Humboldt County. Arcata's Wastewater Treatment Facility (Facility) includes the Arcata Marsh and Wildlife Sanctuary, and utilizes innovative treatment methods utilizing treatment wetlands. The City of Arcata is proposing to replace a portion of existing Facility infrastructure and upgrade several components as part of the Arcata Wastewater Treatment Facility Upgrades Project. The work will include installation of buried pipe for the flow reconfiguration of disinfected enhancement wetlands effluent, installing a discharge pipe into a constructed Brackish Marsh at the north end of the Arcata Bay section of Humboldt Bay (Outfall 003), relocation of the electrical equipment building in the Facility to allow for improved road access for fire and emergency services (requiring installation of a new utility service line), construction of a mitigation wetland area, and raising

levees to 14' and 12' respectively in zone VE and AE. Proposed scope of work includes improvements to the internal stormwater system to ensure capacity for a 100-year storm event. The project will not eliminate any floodplain and will not create a net rise in flood waters.

E.O. 11988- Floodplain Management and E.O. 11990- Wetlands Protection apply to this project. City staff consulted with HUD Region 9 Environmental Officer Morgan Griffin and it was determined the project does not meet any of the exceptions at 24 CFR 55.12 and therefore requires an 8-step analysis of the direct and indirect impacts associated with modifications to the floodplain and wetlands within the Area of Potential Effect.

**Step 2:** ***Notify the public for early review of the proposal and involve the affected and interested public in the decision making process.***

A public notice describing the project was published in the Mad River Union, the local and regional paper, on Wednesday July 8th, 2020. The ad targeted local residents, including those in the floodplain. The notice was also sent to interested Federal, State, local agencies, and non-profit groups such as the state floodplain manager, and environmental protection groups. A list of specific agencies and individuals and a copy of the published notification is kept in the project's environmental review record and attached to this document. A copy was also posted on the City of Arcata website. The required 15 calendar days were allowed for public comment. The notice also included the name, proposed location and description of the activity, total number of floodplain and wetland acres involved, and the responsible entity contact information (David Loya, Community Development Director) as well as a website and the location of the office at which a full description of the proposed action can be viewed. The notice was reviewed and approved by the Region 9 Environmental Officer prior to publishing.

One comment was received by the California Department of Fish and Wildlife's Coastal Conservation Planning Team. The comment is attached to this document. The commenter noted CDFW anticipates receiving additional information and referrals through the protocols of the California Environmental Quality Act (CEQA), California Coastal Act (CCA), and National Environmental Policy Act (NEPA).
CDFW will likely provide additional comments after review of pending related environmental documents. The commenter generally noted an interest in reviewing more information regarding project impacts on water quality with respect to biological resources as part of future environmental review processes. No other comments were received opposing or supporting the project.

The City Engineer and Floodplain Administrator were contacted concerning mitigation requirements of the National Flood Insurance Program (NFIP) as well as local ordinances that must be implemented as part of NFIP.

**Step 3:** ***Identify and evaluate practicable alternatives.***

At the most basic level, the overarching purpose of the Arcata Wastewater Treatment Facility Upgrades Project is to replace aging infrastructure, improve quality of treated effluent discharged into Humboldt Bay, and meet discharge requirements.

Mechanical equipment is old and no longer performing efficiently. The natural systems have reduced treatment and hydraulic capacities due to years of solids accumulation and vegetation growth. This has resulted in numerous water quality violations that must be addressed. The Proposed Project addresses public health needs, including improving the hydraulic and treatment capacity of the treatment facility and meeting National Pollutant Discharge Elimination System (NPDES) permit requirements. The installation of Ultraviolet (UV) disinfectant equipment, proposed flow reconfiguration, and new State required effluent limits are driving factors for this project. The need to improve hydraulic and treatment capacity stems from the need to replace the chlorine disinfection system with UV and the need for ammonia treatment.

The primary objectives of the Proposed Project are as follows:

- The City's primary objective is to provide wastewater treatment and disposal while improving existing levels of regulatory compliance for the protection of water quality and public health.
- The City seeks to address existing effluent violations and to produce a higher quality effluent that can be beneficially reused.
- The City seeks to operate the improved treatment facility with cost-effective methods available that meet the City's overall system performance goals while improving the existing natural system and constructing a mechanical system to assure compliance with regulatory requirements.
- The City's goal to minimize or eliminate disinfection byproducts associated with the use of chlorine and health hazards associated with the use and storage of large chlorine cylinders is another major project objective.
- The City seeks to move the existing outfall from the bay at Butcher Slough Outfall 001 to the "Brackish" Marsh Outfall 003 to maximize the volume of effluent receiving enhanced treatment and maximize the beneficial use of treated wastewater for habitat purposes. *It is important to note that the "Brackish" Marsh was constructed from the City's previous McDaniel Slough Restoration project, and will not contain brackish waters until Outfall 003 is installed to decrease the salinity of the waters, which are tidally influenced.*

Arcata performed an alternatives screening analysis and screened out the "No Action" and "offsite" alternatives as infeasible, as discussed below.

1. Locate the Project Outside of the Floodplain and Wetland (Offsite Alternative)

The project's intent is to rehabilitate and improve the existing system, and a full relocation would not fit these parameters. This objective is based on both the logistic and economic and time constrained infeasibility of a full relocation of the facility. Arcata's treatment facility is an integral part of the City's environmental and cultural identity; its unique pairing of technical and natural treatment is one of the City's landmark successes and its relocation would

involve a redesign of the existing marsh system as well as the purchase and construction of a new facility offsite. There are only a handful of parcels within City limits that could house such a large facility, and the majority of them are already developed. In addition, many of the suitable industrially-zoned parcels in the northern portion of the City are subject to inundation in the case of a catastrophic failure of Matthew's Dam at Ruth Lake. Suitably large parcels in the southern or eastern portion of Arcata would likely require conversion of prime agricultural lands, and would remain located in the Coastal Zone with similar impacts and permit processes. A further logistical challenge of a full relocation would be re-configuring the existing accompanying infrastructure, including pump stations and lines, which would involve a complete flow reconfiguration if and when the site is relocated in future.

Arcata is a small community of less than 20,000 inhabitants, roughly half of which are students; the cost of a full relocation has been estimated at up to $150 million by the City engineer. The City has approved a utility rate increase in the fee schedule to service the debt of the loans through the State Revolving Fund. The City is also currently re-assessing the Capital Connection Fee rate for expansion and new connections to the treatment facility.

2. No Action Alternative

Arcata's wastewater treatment system must comply with regulatory requirements established by its NPDES permit issued by the California Regional Water Quality Control Board. As described in the City's Wastewater Treatment Facility Improvements Project Report (2016c), effluent monitoring data shows that there have been ongoing exceedances of discharge limits on total suspended solids (TSS), biochemical oxygen demand (BOD, a measure of biodegradable organic matter), pH, dichlorobromomethane, chronic toxicity, chlorine, and fecal coliform since 2004.

The Treatment Facility system relies heavily on land-based, natural treatment systems. This system has served the City well but has a number of drawbacks in that there is not sufficient room to further expand the natural treatment systems for additional capacity, and natural systems are inherently greatly affected by the weather (temperature and precipitation). As regulatory requirements have gotten more stringent over the years and with the initiation of mandatory minimum penalties in 2000, it has become more difficult to reliably meet permit compliance with the land-based natural system. In 2012, the Facility began operating under a new NPDES permit that specifically addressed several long-term issues regarding disinfection, treatment units, and outfalls. The new permit enabled changes to be made to improve wastewater treatment, protect beneficial uses, increase energy efficiency, reduce chemical usage, and reduce the potential for permit violations. Accordingly, the City initiated the Facility Plan and plant improvement project analyzed herein, which proposes a variety of improvements to the wastewater treatment system to increase treatment capacity and prevent the exceedance of discharge limitations. The Proposed Project addresses the following issues that must be addressed:

- Meet permit/regulatory requirements that protect public health and the environment; and in particular, address ongoing NPDES permit violations and regulatory compliance.
- Repair or rehabilitate aging infrastructure and address deferred maintenance.

- Provide reliable hydraulic and treatment capacity for both wet and dry weather flows, both now and in the future.
- Address City and Agency goals for facility resilience to flooding and sea level rise.

If the Proposed Project is not undertaken, ammonia discharge to Humboldt Bay will not improve and eventually the Facility would not be able to operate, which would render Arcata essentially uninhabitable for all residents and businesses. It has been determined that moving the facility is not warranted or feasible, as the facility also serves as the City's corporation yard for the streets, utilities and equipment maintenance departments.at the present time due to both lack of available land and cost. The facility must continue to operate at its present site for the next 30-40 years at minimum. If the Proposed Project in not undertaken, the Facility will remain out of compliance with the requirements of the NPDES permit and the quality of treated effluent discharged into Humboldt Bay will not be addressed, which has the potential to result in a variety of negative effects to humans and wildlife. The City's continued ability to utilize the Treatment Facility relies on undertaking the improvements discussed in this environmental assessment.

2. Other Alternatives Considered

Arcata considered several alternative sites actions believed to satisfy the objectives, purpose, and need of the project based on the required common improvements outlined below. Alternatives addressed the needed improvements in various ways.

- **Headworks Improvement:** Improve existing headworks equipment including new screw pump(s), new bars screens and vortex grit chamber replacement. A new flow split chamber to direct wastewater to the primary clarifier or the proposed oxidation ditch. No increase in the flow capacity of the headworks is proposed from 5.0 mgd.
- **Primary Clarifiers:** Replacement or rehabilitation of the primary clarifiers due to poor condition and age. Replacement capacity varies with alternative.
- **Primary Sludge and Scum Pumps:** Replace the primary sludge and scum pumps due to condition and age. Replacement capacity varies with alternative.
- **Oxidation Ponds Solids Removal and Transfer Structure Reconfiguration:** Dredging, dewatering and disposal of accumulated sludge in the oxidation ponds was proposed to address decreased capacity. Installation of new aeration and mixers to improve treatment. Reconfigure pond transfer structures for better flow and distribution.
- **Emergency Pond Pump Station:** Add suction and discharge piping to allow the pump station to pump out of Oxidation Pond 1 and into Oxidation Pond 2 for Pond(s) storage control and storm/extreme high flow pumping. Improve existing building structure and resiliency against storm or flooding conditions.
- **Treatment Wetland Nos. 1 – 4 Solids and Vegetation Maintenance:** Improve the hydraulic capacity and treatment occurring in Treatment

Wetlands 1 – 4 by removing solids and vegetation, regrading deep and shallow zones and replanting vegetation.

- **Treatment Wetland No. 4 Influent Pumps and Treatment Wetlands Pump:** Treatment Wetland No. 4 was regraded and is being reconstructed for continued use in the wetlands treatment system.
- **Enhancement Wetlands Improvements:** Vegetation maintenance, new baffles and new inlet/outlet structures to improve treatment and hydraulic efficiency and capacity.
- **Pond Pump Station/Pump Station 1:** Replace mechanical equipment and upgrade to a combined wet well in order to improve flow by gravity. Replacement capacity will vary with each alternative up to 10 mgd.
- **Enhancement Wetlands (Hauser) Pump Station:** Replace mechanical equipment due to poor condition and age and permit requirements. Replacement pump capacity will be based on new permit requirements of up to 6 mgd.
- **Anaerobic Digesters and Sludge Heat/Mixing System:** Improve structural and mechanical equipment in phases. Project varies with alternative.
- **Outfall 003:** Install new pipes for discharge to Outfall 003 from HPS (EWPs) up to 6 mgd.. Outfall 003 will discharge at the Brackish Marsh and be sized for up to approximately 6 mgd
- **UV Disinfection:** Install a 9.8 mgd capacity UV disinfection system within the existing CCB structure.to replace the primary disinfection utilizing a chlorine gas disinfection system.
- **Secondary Treatment Unit:** A majority of the alternatives propose an additional secondary treatment unit to help meet treatment standards. Conventional activated sludge, oxidation ditch, and trickling filters were all considered as secondary treatment options. The oxidation ditch was the preferred secondary treatment system due to its reliability, simplicity and lower maintenance. Each alternative that incorporates an additional secondary treatment system will use oxidation ditches. Oxidation ditches require secondary clarifiers and a waste sludge pumping and thickening system.
- Flooding Risk Reduction: The following projects are also part of each alternative to protect the AWTF from flooding risk:
  - Raise the levee(s) around the oxidation ponds, treatment wetlands, and the treatment plant/City Corporation Yard to minimum FEMA base flood elevations.
  - Develop an adaptive management strategy and resiliency plan for anticipated environmental changes and natural disasters.
  - Construct new facilities at higher base elevations that account for increased severity of storms, flooding hazards and wave action.
  - Elevate all New/upgraded electrical connections a minimum of 2.0’ above the FEMA flood elevations inside of the AWTF protective levee system.

- Improve the internal stormwater routing collection, pumping and treatment system to accommodate the 1% Storm Event (100-year Storm Event)

Four alternatives were developed in the prepared Facility Plan (Carollo Engineers, 2017) to address improvements needed for the AWTF. Alternatives were conceived through a collaboration between City staff, LACO Associates, Carollo Engineers, and the community through public discussions in a series of public workshops.

**Alternative 1: Existing System Rehabilitation**

Alternative 1 proposes rehabilitating the existing system without constructing an additional secondary treatment system. Flows up to 5.9 mgd would go through primary treatment and flow through the oxidation ponds. Flows less than 2.3 mgd would then enter the treatment wetlands. Flows greater than 2.3 mgd would bypass the treatment wetlands and be mixed with the treatment wetlands effluent. Blended effluent less than 2.3 mgd would route to the enhancement wetlands. Blended treatment wetland effluent greater than 2.3 mgd would be mixed with enhancement wetlands effluent before entering the UV disinfection system and discharging into the Brackish Marsh (Outfall 003). Wet weather flows greater than 5.9 mgd would be stored in the Oxidation Pond 1. Flows exceeding storage would be pumped to the chlorine contact basin and discharged into Humboldt Bay (Outfall 001).

Specific improvements unique to Alternative 1 include:

- Constructing two new primary clarifiers, each with a 3.0 mgd capacity. This includes replacing the primary sludge and scum pumps and upgrading the sludge digestion system to accommodate the new capacity.
- Adding new aerators to Oxidation Pond 2 to improve BOD treatment capacity.
- Constructing a new Treatment Wetland No. 7 to increase the hydraulic capacity of the treatment wetlands from 1.8 mgd to 2.3 mgd.
- Replace Treatment Wetlands Pumps Station 1 pumps due to age and condition.
- Replace the Pond Pump Station with new pumps to increase capacity from 2.9 mgd to 3.6 mgd.
- Replace Enhancement Wetlands (Hauser) Pump Station pumps to increase capacity from 1.2 mgd to 2.4 mgd.

**Alternative 2: Existing System with Side-Stream Treatment**

Alternative 2 proposes constructing a side-stream secondary treatment system. Influent up to 5.9 mgd would be routed to the primary clarifiers and then be split to either the natural system or a side-stream secondary treatment system. Normal flows up to 2.3 mgd would be treated through the oxidation ponds and the treatment wetlands. Minimum flow between 0.5 mgd and 2.0 mgd would be routed to the side-stream secondary treatment. The effluent from the side-stream treatment system could be routed to the Treatment Wetlands or blended with the natural system effluent. The two secondary effluents would be combined and flows below 2.3 mgd would be sent to the enhancement wetlands. Flows between 2.3 and 5.9 mgd would

be mixed with the enhancement wetland effluent, disinfected in the UV system and discharged into the Brackish Marsh (Outfall 003). Wet weather flows above 5.9 mgd would be stored in Oxidation Pond 1. Flows exceeding storage would be pumped to the chlorine contact basin and discharged into Humboldt Bay (Outfall 001).

Specific improvements unique to Alternative 2 include:

- Construct two new primary clarifiers each with a 3.0 mgd capacity.
- Adding aerators to Oxidation Pond 2 to improve mixing and reduce treatment capacity of the side-stream secondary treatment.
- Construct an oxidation ditch and a primary clarifier with a 2.0 mgd capacity. The oxidation would need to able to reduce the flow to 0.5 mgd.
- Additional sludge digestion capacity for the sludge from the secondary clarifier.
- Install a sludge thickening system for the oxidation ditch.

**Alternative 3: Existing System with Parallel Treatment**

Alternative 3 reduces the flow entering the natural system (oxidation ponds, treatment wetlands and enhancement wetlands) to 1.8 mgd year-round. This low capacity would maintain treatment and permit compliance. Flows between 1.8 mgd and 5.9 mgd would be sent to the parallel secondary treatment train. The two effluents would be mixed prior to entering the UV disinfection system. The proportion could be adjusted to achieve desired effluent water quality. Flow exceeding 5.9 mgd would be stored in the Oxidation Pond 1 or, if needed, routed to the chlorine contact basin, treated and discharged to Humboldt Bay through Outfall 001.

Specific improvements unique to Alternative 3 include:

- Constructing one new primary clarifier with a 1.8 mgd capacity. Primary sludge and scum pumps would also be replaced with pumps sized for the 1.8 mgd clarifier.
- Construct two oxidation ditches and secondary clarifiers. Each oxidation ditch and secondary clarifier will have a 2.0 mgd capacity and the total system capacity will be 4.1 mgd.
- Increase the capacity of the sludge digestion system to account for the secondary clarifier.
- Install a sludge thickening system for the oxidation ditch.

Because this system decreases the hydraulic capacity of the natural system to 1.8 mgd, the construction of Treatment Wetland No, 7 is not required. Construction is still recommended as a future, separate project.

**Alternative 4: Enhanced Natural System with Parallel Treatment**

Alternative 4 allows the natural system to handle 1.8 mgd during dry weather flows and up to 2.3 mgd during peak wet weather flows. The natural system includes the oxidation ponds and the treatment wetlands. Plant effluent between 2.3 mgd and 5.9 mgd would be sent to the

parallel secondary treatment system (oxidation ditch). The two secondary effluents would be blended, sent to the new UV system and then discharged into the enhancement wetlands. The UV system would have a 9.8 mgd capacity. The enhancement wetland pump station would be replaced and would pump effluent from the enhancement wetlands to the Brackish Marsh (Outfall 003). Peak Influent flows greater than 5.9 mgd would be stored in Oxidation Ponds. If storage is at capacity, flows could be sent to the UV disinfection (up to 9.8 mgd) and discharged to Humboldt Bay (Outfall 001) as well as Outfall 003.

Specific improvements unique to Alternative 4 include:

- Reconstruct the primary clarifier with one rated for 2.3 mgd
- Install aerators in Oxidation Pond 2
- Construct oxidation ditches and secondary clarifiers that would handle flows between 2.3 and 5.9 mgd.
- Increase capacity of sludge digestion system and construct a sludge thickening system.
- Increase the pump capacity of the enhancement wetlands to 5.9 mgd.
- Construct the 9.8 mgd UV treatment system and use a single pass system where enhancement marsh (EM) waters are no longer brought back to the plant for disinfection for a second time

**Alternative Comparison**

The following section compares the above alternatives based on economics, construction and operation factors. Table 1 compares the cost of each alternative. Cost estimates include construction, engineering, legal, administrative, permitting costs and estimating contingencies. Cost estimates are not escalated for future years.

***Table 1:*** *Cost comparison between each alternative. Costs are shown per million dollars*

| Alt. | Description | Total Project Cost with 10% Growth | Total Project Cost with 20% Growth | O&M Cost | | Lifecycle Cost |
|---|---|---|---|---|---|---|
| | | | | Annual | Present Worth | |
| 1 | Existing System Rehabilitation | $35.1 | $35.2 | $0.67 | $11.7 | $46.9 |
| 2 | Existing System Rehabilitation with Side-Stream Treatment | $44.7 | $45.7 | $0.76 | $13.3 | $58.0 |
| 3 | Existing System Rehabilitation with Parallel Treatment | $43.8 | $45.5 | $0.43 | $7.6 | $51.3 |
| 4 | Enhanced Natural System with Parallel Treatment | - | $52.4 | $0.78 | $13.6 | $66.1 |

Note: Costs do not include levee improvements

Table 2 compares the non-economic factors that the City deemed important when considering different alternatives. The City and consultants (LACO Associates and Carollo Engineers) determined the five criteria that were important for the project and ranked each project. A score of 1 is the least favorable, while a score of 4 is the most favorable.

***Table 2:*** *Alternative comparison of non-economic criteria (adapted from 2017 Facility Plan)*

| Alternatives | Meets Permit | Ease of O&M | Constructability | Reliability | Ammonia Removal |
|---|---|---|---|---|---|
| 1. Existing System Rehabilitation | 1 | 4 | 1 | 1 | 1 |
| 2. Existing System with Side-Stream Treatment | 2 | 1 | 2 | 2 | 2 |
| 3. Existing System Rehabilitation with Parallel Treatment | 3 | 3 | 3 | 4 | 4 |
| 4. Enhanced Natural System with Parallel Treatment | 4 | 2 | 4 | 3 | 3 |

- Alternative 1 was the least expensive alternative, however it received the lowest scores for meeting permit requirements, constructability, reliability and ammonia removal. The current facility has a limited BOD treatment capacity and relies on the chlorine disinfection system for additional BOD treatment. The new UV disinfection system required for all alternatives will reduce the BOD treatment capacity. Alternative 1 will rely only on the natural system for BOD removal. Improvements to the natural system will improve BOD treatment capacity. However, it will not be enough year round and with population growth. Alternative 1 will also not consistently meet ammonia and nitrogen limits.

- Alternative 2 provides an additional secondary treatment system that will provide BOD treatment and meet ammonia and nitrogen limits. Alternative 2 is the second most expensive alternative and received low ranking regarding the non-economic criteria. The low ranking was due to Alternative 2 requiring the most project elements. This would increase the difficulty of operating and maintaining the treatment processes and facilities. Additionally, Alternative 2 still has limited capacities regarding the natural system and enhancement wetlands.

- Alternative 3 constructs an additional secondary treatment system with a larger capacity than Alternative 2 because less treatment will occur in the natural system, Alternative 3 requires less construction and maintenance than Alternative 2. Alternative 3 was the highest scoring alternative for the non-economic criteria

presented in Table 4.2. It achieved high rankings in reliability and ammonia removal due to the larger treatment capacity of the oxidation ditches compared to Alternative 2.

- Alternative 4 was developed after the first three alternatives were presented to the Regional Water Quality Control Board. The RWQCB found that these three alternatives would not achieve the requirements of the permit. Alternatives 1, 2 and 3 did not provide the peak wet weather flow capacity (5.9 mgd) to pass through the Enhancement Wetlands. This is not in compliance with the Enclosed Bays and Estuaries Policy. Alternative 4 allows a peak pumped flow of 5.9 mgd at Outfall-003 to utilize the Enhancement Wetlands for additional treatment and meet the discharge requirements.

**Selected Project**

Alternative 4: Enhanced Natural System with Parallel Treatment was selected as the preferred alternative. Alternative 4 was preferred because it would have the best chance to meet treatment objectives in the 2019 NPDES permit year-round. This alternative is the most expensive and has the largest physical footprint. This alternative enables the City to meet new permit discharge requirements while continuing to promote the beneficial uses of the system for the future. The Proposed Project would undertake the necessary site improvements and would enable the City to comply with its NPDES requirements.

**Step 4:** ***Identify Potential Direct and Indirect Impacts of Associated with Floodplain Development.***

The Proposed Project involves rehabilitation improvements to the existing wastewater treatment facility, which was intentionally built in close proximity to the Bay and surrounding wetlands, as the treatment system uses surrounding marshes and ponds for treatment of wastewater. The Proposed Project does not involve the creation or rehabilitation of existing housing units; there are no residential users in the Area of Potential Effect. The treatment facility is roughly 40 years old and in need of improvements to operate efficiently. Lands adjacent to Humboldt Bay are natural floodplains but have been diked to reduce flood risk to property. The project will not eliminate any floodplain and will not create a net rise in flood waters. As the site is pre-existing and contains no residential users, and the project includes facility upgrades to increase the site's ability to withstand storm events, the project will not increase risk of loss of life.

Undertaking the project at the current treatment facility located per the current proposal will have minimum impacts to the floodplain because 1) the site is pre-existing and the new structures will be elevated a minimum of 2.0' in the AE zone internal and the existing protective levee will be raised to a minimum of 14 feet NAVD in the VE zone surrounding the oxidation ponds, treatment plant and corporation yard. All other protective levees will be raised to a minimum of 12' in the AE zone not subject to erosive waves; 2) the site is not a residential use and contains no residential users and loss of life will not be risked by locating new residential units or rehabilitating existing units in the floodplain; and 3) new construction will be undertaken within the footprint of the wastewater treatment plant core area, which is previously disturbed lands, and does not include wetlands areas; 4) all construction and rehabilitation will be undertaken in compliance with the City's adopted Floodplain Ordinance to the satisfaction of the City's Floodplain Administrator; and 5) the only permanently affected

wetland area will be in the vicinity of the proposed Outfall 003, and are proposed to be replaced at a minimum 1:1 ratio. The area has experienced some flooding in the past but never above the proposed elevation.

**Impacts to Floodplain**

- The site's pre-existing levee system will be augmented to further protect users. The additional elevation will also help to protect the financial investment of the proposed facility improvements. The treatment facility is currently partially protected by a newly repaired (2009 FEMA funded) rock armored levee (approx. 1.0 mile) constructed of native derived soils of elevation range 10.5' to 14' NAVD borrowed immediately from the bay side of the ringed facility. The levee separates the AE zone (Base Flood Elevation, 1% annual change of flooding) from the VE zone (Coastal High Hazard Area, 1% annual chance of flooding plus associated storm waves). The existing armored western facing dike adjacent to any VE zone will be raised to 14' min. NAVD on top of the dike at a 1.5 to 1 max slope with an armored engineered fill soil prism to protect the dike and inner Facility from erosive storm driven wave action (4500 linear feet) and also an interior non armored crown dike encircling the facility's core area (1775 linear feet). The remaining portions of dike (2200 linear feet) will be raised to 12' min. NAVD for remaining dike areas along southeast and east sides of the Facility on the dike to meet the zone AE (BFE 10' NAVD 88) requirements plus 2' Safety factor. See Appendix A-Figure 2 for proposed levee augmentation.

- In addition to levee augmentation, the core Facility (6.5 acres) is equipped with a stormwater collection and pumping system. The system will be sized to accommodate the 100-year return event within the core facility and will be pumped into the to the City's facility for treatment prior to discharge with the plant effluent. All work that is performed inboard of the levees surrounding the entire WWTP drain to the wastewater system.

- Impacts to the floodplain will also be limited due to construction occurring within the previously developed site. The project will have no net increase in flood water elevations in the floodplain.

- The City of Arcata is a member of the National Flood Insurance Program and structures located in the flood zone must comply with the local flood ordinance. The City of Arcata's Flood Ordinance sets standards for the development and rehabilitation of structures in areas of special flood hazard, including Zones A and V. In general, the Ordinance prohibits encroachments, including fill, new construction, substantial improvements, and other development in areas of special flood hazard unless certification by a registered civil engineer is provided demonstrating that encroachments shall not result in any increase in flood levels during the occurrence of the base flood discharge.

- HUD requires projects located in the floodplain to maintain flood insurance for the life of the property. The City maintains REMIF insurance for all City-owned facilities regardless of designated flood zone.

By elevating the buildings and minimizing impervious surfaces in and around the floodplain to the extent feasible, construction will have minimal effects on water resources. The City's project engineer and floodplain administrator were consulted in order to design the building and the site plan in such a way that natural flood and erosion control, water quality, and groundwater recharge are preserved.

**Impacts to Wetlands**

In addition to concerns for life and property, the city considered the natural and beneficial values of the floodplain. The natural resources of the floodplain include water, biological, and societal resources. A Wetland Delineation and a Biological Assessment have been undertaken for the project.

- A delineation of potential jurisdictional waters and wetlands were conducted by qualified personnel on October 2–3, 8, and 17, 2019, and March 12, 2020.The delineation included any feature that could potentially meet the definition of a water protected under the Clean Water Act (and thus be subject to USACE-jurisdiction), the Porter Cologne Act (SWRCB [State]-jurisdiction), Section 1602 of Streambed Alteration Agreement (California Department of Fish and Wildlife [CDFW]-jurisdiction) and the California Coastal Commission/City of Arcata LCP (LCP-jurisdiction). LCP-jurisdiction includes one-parameter wetlands within the coastal zone.

- The Survey area contains 3.0 acres of potentially USACE-jurisdictional waters of the U.S., and 2.0 acres of potentially USACE-jurisdictional wetlands adjacent to these waters. Potentially jurisdictional waters of the U.S. are also considered waters of the State under State- and LCP-jurisdiction. In addition, there are 10.87 acres of wetlands that are only subject to State- and LCP-jurisdiction. The Proposed Project element that will result in permanent wetland impacts. The Proposed Project contains four elements that may result in permanent wetland impacts per Stillwater's impacts assessment: two elements that may impact Waters of the United States and two elements that may impact Waters of the State. Total anticipated area of permanent impact is estimated at approximately 0.07 acres. Actual disturbance will not be calculable until project activities are underway, however, permanently impacted wetlands will be replaced on a minimum 1:1 basis. Calculated temporary impacted areas total approximately 0.44 acres. This area totals potential impacts identified by Stillwater staff (.1 acres of US Army Corps-jurisdiction wetlands, 0.05 acres of additional WOTS, and 0.11 acres LCP-jurisdiction wetlands) in addition to approximately 0.18 acres of temporary disturbance in the vicinity of the outlet of Hauser Marsh. All temporarily disturbed areas will be revegetated prior to completion of work, as currently required per City Best Management Practices.

- The US Fish and Wildlife Service and National Marine Fisheries Service have determined that the construction of the buildings within the corporation yard and treatment plant area will have no quantifiable impact on nearby plant and animal life when conducted using standard City Best Management Practices. Impacts to wildlife from the construction and use of proposed Outfall 003 will be mitigated to a less than

significant level through the Section 7 Consultation Process. Impacts to permanently impacted wetlands in the vicinity of Outfall 003 will be mitigated through a minimum 1:1 replacement of wetlands within the Area of Potential Effect at one of three potential locations as identified in Figure 1 in Appendix A. Temporary impacts to wetlands will be mitigated through onsite re-vegetation post-construction, as identified in the project's mitigation monitoring and reporting program per CEQA.

- Societal and aesthetic resources were also considered during the design process. Improvements to structures within the existing treatment plant will be shielded from public view by trees and shrubs. The Outfall 003 discharge pipe will be blended into the natural surroundings with native vegetation screening. The site will also maintain an open space for recreational opportunities.

By mitigating for permanently impacted wetlands at a minimum 1:1 ratio; revegetating all temporarily impacted wetland areas; and entering into continued consultation with the US Army Corps of Engineers, US Fish and Wildlife, National Marine Fisheries Services, and the State Water Resources Control Board, construction will have minimal effects on wetlands and associated wildlife.

**Step 5:** ***Where practicable, design or modify the proposed action to minimize the potential adverse impacts to lives, property, and natural values within the floodplain and to restore, and preserve the values of the floodplain.***

The proposed Action has been designed to minimize the potential adverse impacts to lives, property, and natural values within the floodplain, and to preserve the values of the floodplain.

**Preserving Lives and Preserving Property:** The project is limited to rehabilitation of an existing wastewater treatment facility. There are no residents onsite. No housing units are proposed to be constructed or rehabilitated through this project. Employees are briefed on the location of the flood hazard area and evacuation plans and all onsite staff undertake periodic safety trainings in accordance to the site's adopted risk management plan. All new structures will be elevated to 14 feet NAVD above base flood elevation to protect both employees and the facility in case of flooding/tsunami. All construction will be elevated consistent with FEMA's Lowest Floor Guide (*http://www.fema.gov/pdf/nfip/manual200605/07lfg.pdf*) and use flood resistant materials consistent with FEMA bulletins (*https://www.fema.gov/media-library/assets/documents/2655?id=1580*) and the requirements of the City's Local Adopted Floodplain Ordinance. The City participates in the National Flood Insurance Program, and the treatment facility is insured under the City's existing REMIF insurance, as are all City facilities, regardless of flood zone.

**Preserving Natural Values and Minimizing Impacts:** The site design chosen as outlined in Step 3 will have minimal floodplain impacts. By elevating the buildings, creating provisions for draining and stormwater reuse, retaining pervious surfaces throughout the treatment plant site, and compliance with State and federal stormwater regulations, construction will have

minimal effects on water resources. All work that is performed inboard of the levees surrounding the entire WWTP drain to the wastewater system. Impacts to the floodplain will also be limited due to construction occurring within the previously developed site. USFW and NMFS will also advise the City of Arcata on preservation of special-status vegetation and wildlife through the Section 7 consultation process which will be undertaken by the State Water Resources Control Board as part of the Stet Revolving Loan Funds process (an EPA program). Additionally, the City has implemented a policy of "no net loss" for all wetlands impacts though a restoration and compensatory mitigation program. The project also includes proposed energy conservation measures including replacing outdated bulbs and equipment with more energy efficient models, and adding additional solar panels to the roof of the drying beds to offset onsite energy use.

**Step 6:** ***Reevaluate the Alternatives.***

Although the current treatment facility is in a floodplain, the treatment relies on proximity to the Bay and associated wetlands for secondary treatment, and the site's upgrades include site armoring to minimize site risk. Additionally, steps were taken in order to minimize effects to floodplain values by ensuring permanently impacted wetlands are replaced on a minimum 1:1 basis.

As documented in Step 3, construction outside of the floodplain is not viable because the sites would not reuse the existing facility, and do not address the purpose and need of the project:

- The City's primary objective is to provide wastewater treatment and disposal while improving existing levels of regulatory compliance for the protection of water quality and public health.
- The City seeks to address existing effluent violations and to produce a higher quality effluent that can be beneficially reused.
- The City seeks to operate the improved treatment facility with cost-effective methods available that meet the City's overall system performance goals while improving the existing natural system and constructing a mechanical system to assure compliance with regulatory requirements.
- The City's goal to minimize or eliminate disinfection byproducts associated with the use of chlorine and health hazards associated with the use and storage of large chlorine cylinders is another major project objective.
- The City seeks to move the existing outfall from the bay at Butcher Slough Outfall 001 to the "Brackish" Marsh Outfall 003 to maximize the volume of effluent receiving enhanced treatment and maximize the beneficial use of treated wastewater for habitat purposes. *It is important to note that the "Brackish" Marsh was constructed from the City's previous McDaniel Slough Restoration project, and will not contain brackish waters until Outfall 003 is installed to decrease the salinity of the waters, which are tidally influenced.*

The no action alternative is also impractical because it will not satisfy the need to come into compliance with the State Water Board's Time Schedule Order, will not improve effluent

quality discharged into Humboldt Bay, and will not meet the requirements of the City's most recently adopted NPDES permit.

It has been determined that it is infeasible to move the treatment facility to a different location, or to not undertake the proposed upgrades to the facility. Of the proposed alternatives to rehabilitate onsite, it was determined Alternative 4 was the only alternative that would allow the facility to remain in compliance with NPDES requirements year-round.

**Step 7:** ***Determination of No Practicable Alternative***

It is the City of Arcata's determination that there is no practicable alternative for locating the project out of the flood zone. This is due to: 1) the need to continue to utilize the existing treatment facility; 2) the need to rehabilitate the facility to meet NPDES permit requirements; 3) the need to construct an economically feasible project; 4) the need to utilize the site's existing permitting apparatus; and 5) the ability to mitigate and minimize impacts on human health, public property, and floodplain values. The project has been designed to minimize impacts to the floodplain and minimize property and human risk from exposure to the flood zone. All project improvements shall be required to adhere to the requirements of the City's adopted Floodplain Ordinance, including anchoring and construction methods and practices to minimize flood damage, to the satisfaction of the City's designated Floodplain Administrator. As a result of the proposed Action, the facility will be stronger and more resilient to wave damage.

A final notice was published and posted consistent with the prior notice, more than seven days prior to the project's Finding of No Significant Impact (FONSI). The notice explained the reasons why the modified project must be located in the floodplain, offers a list of alternatives considered at Steps 3 and 6, and describes all mitigation measures at Step 5 taken to minimize adverse impacts and preserve natural and beneficial floodplain values. The notice is attached to this document. No comments were received and no concerns were expressed by the public concerning this notice.

**Step 8:** ***Implementation of the Proposed Action***

The City of Arcata will assure that this plan, as modified and described above, is executed and necessary language will be included in all agreements with participating parties. The City will also take an active role in monitoring the construction process to ensure no unnecessary impacts occur nor unnecessary risks are taken. The flood insurance requirement for the life of the property will continue to be monitored by staff as part of the City's REMIF coverage.

# Appendix A

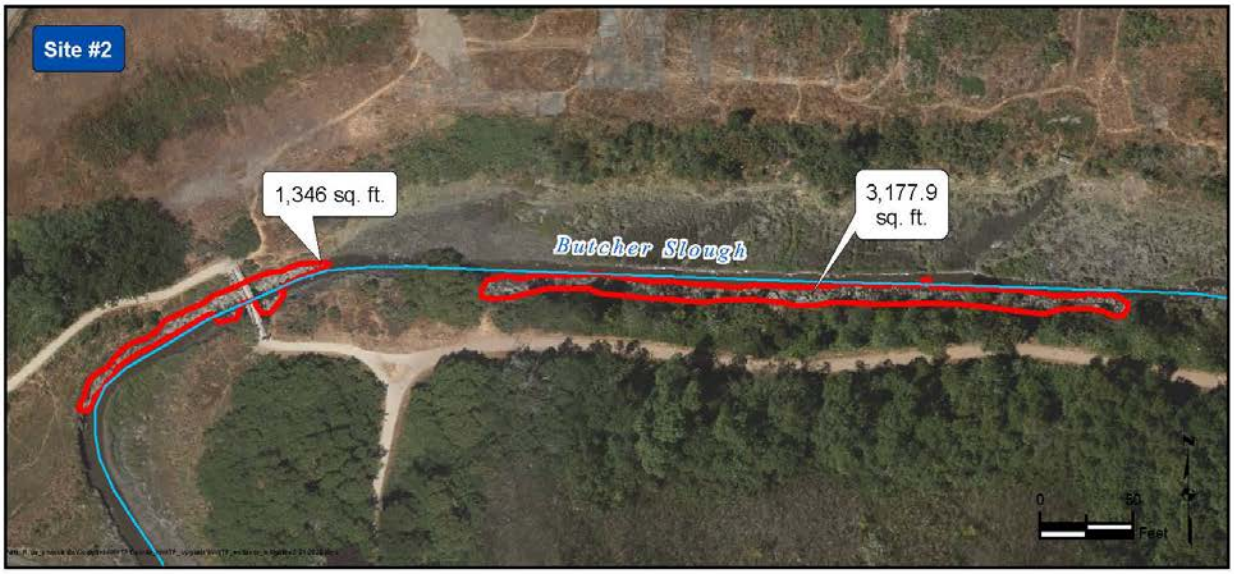
## Figures

# Arcata Waste Water Treatment Plant Ugrade
# Wetland Mitigation Areas



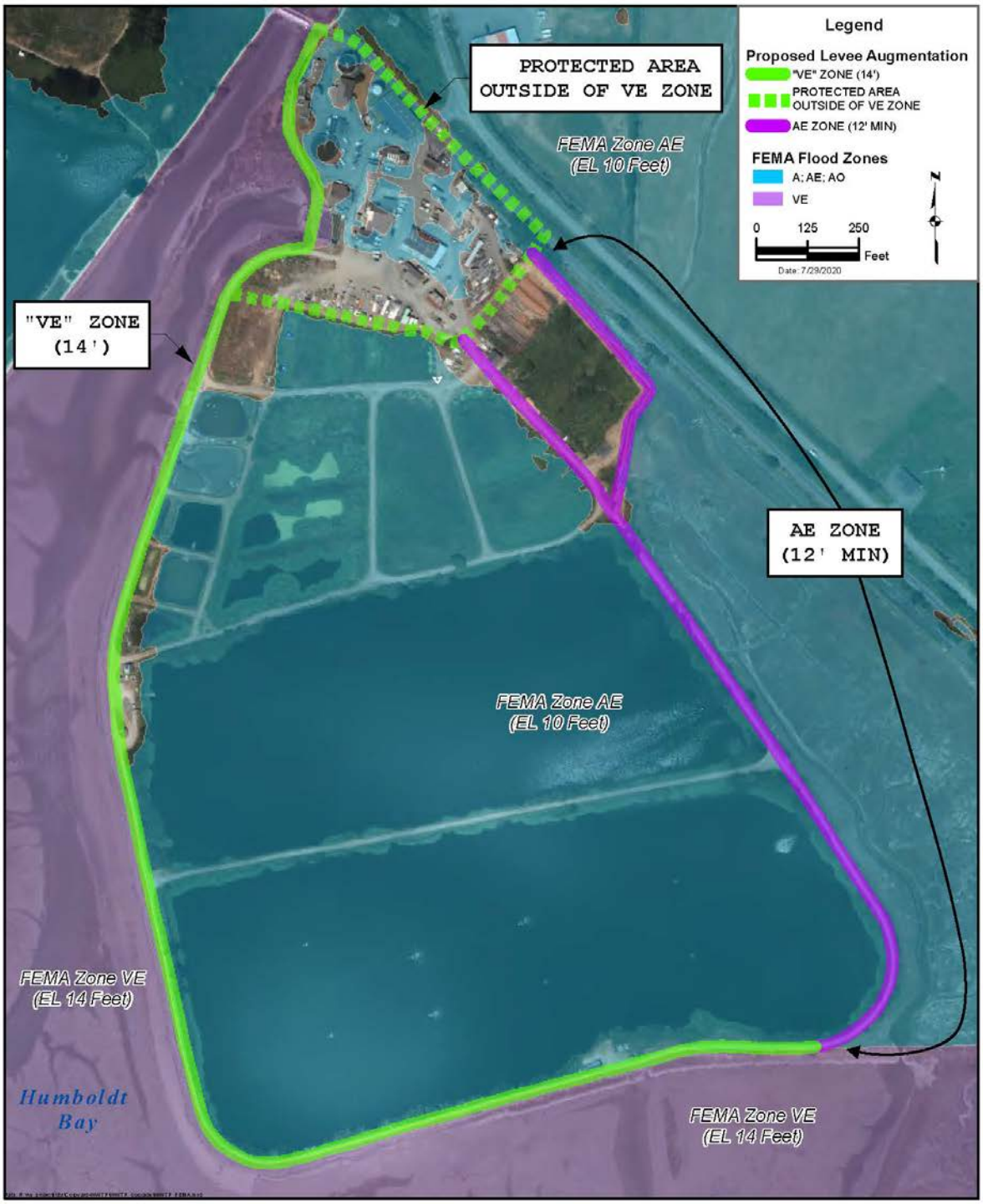






Arcata Wastewater Treatment Upgrade

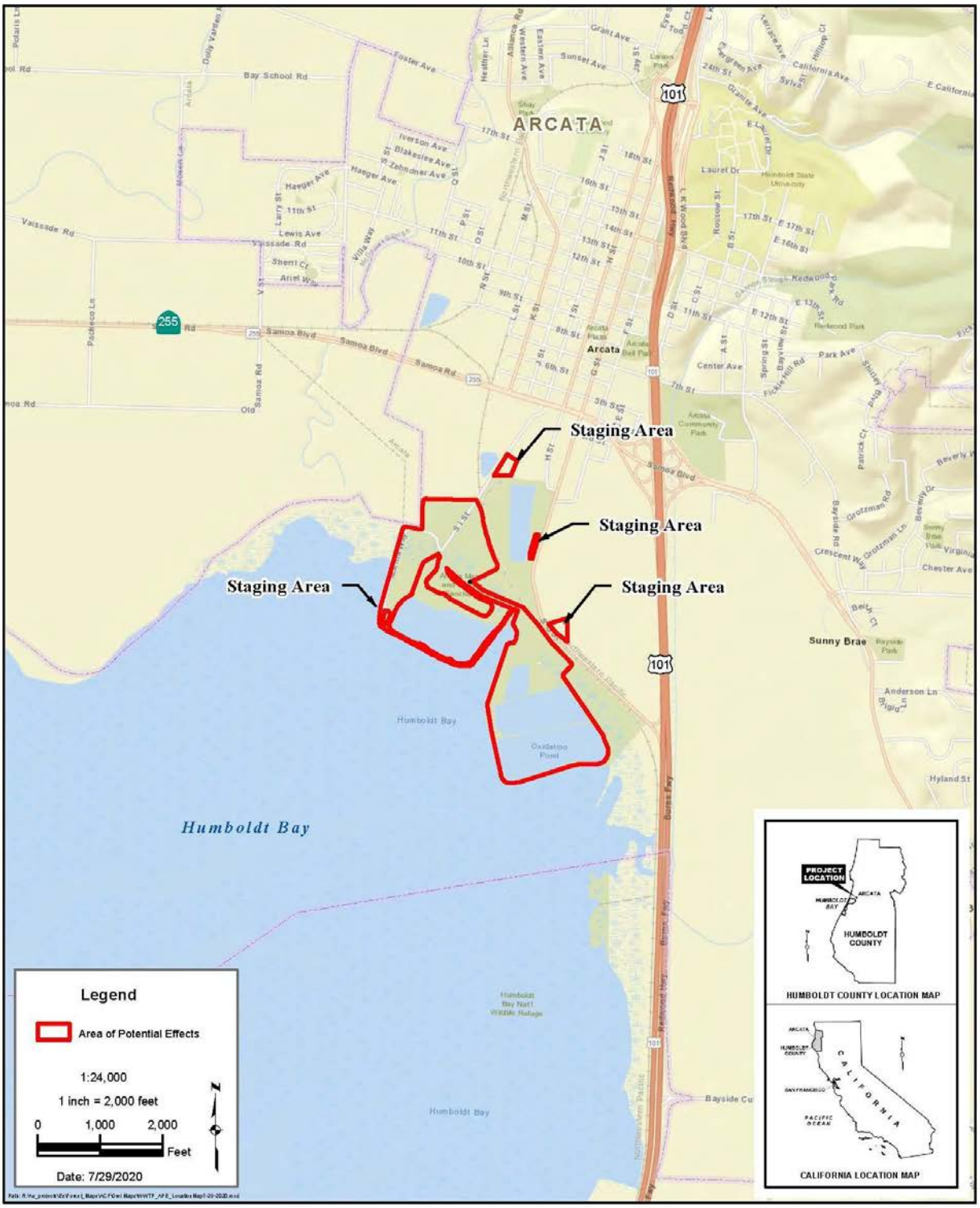
## Proposed AWTP Levee Augmentation

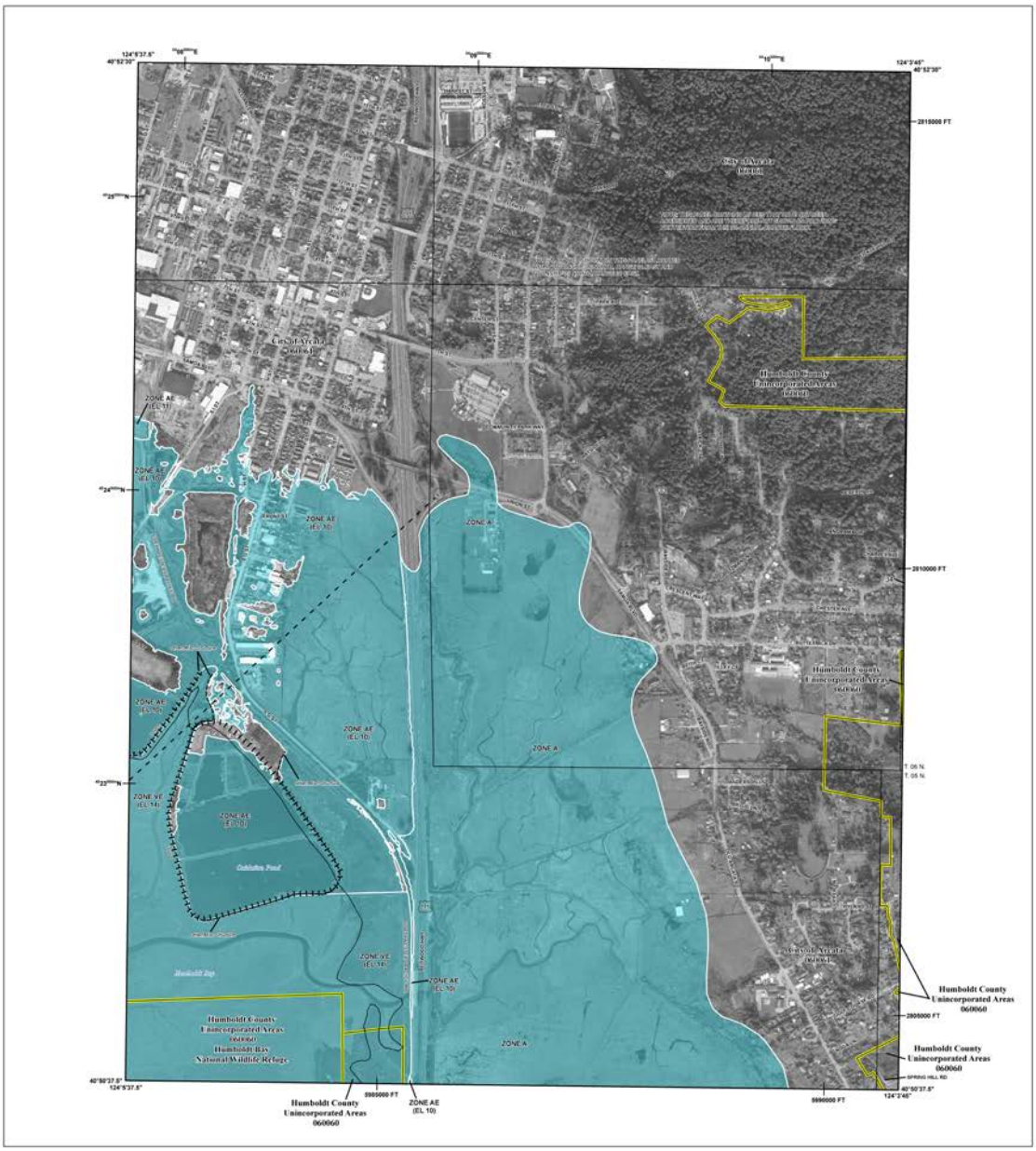


# Attachment B

# FIRM Panels and Area of Potential Effect (APE) Map

# Area of Potential Effects
# Arcata Wastewater Treatment Upgrade
## Location Map






## FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTP://MSC.FEMA.GOV

| | |
|---|---|
| SPECIAL FLOOD HAZARD AREAS | Without Base Flood Elevation (BFE) Zone A, V, A99 |
| | With BFE or Depth Zone AE, AO, AH, VE, AR |
| | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X |
| | Future Conditions 1% Annual Chance Flood Hazard Zone X |
| | Area with Reduced Flood Risk due to Levee See Notes. Zone X |
| OTHER AREAS | Areas of Minimal Flood Hazard Zone X |
| | Area of Undetermined Flood Hazard Zone D |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer |
| | Accredited or Provisionally Accredited Levee, Dike, or Floodwall |
| | Non-accredited Levee, Dike, or Floodwall |
| | 18.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE) |
| | Coastal Transect |
| | Coastal Transect Baseline |
| OTHER FEATURES | Profile Baseline |
| | Hydrographic Feature |
| | Base Flood Elevation Line (BFE) |
| | Limit of Study |
| | Jurisdiction Boundary |

## NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction. To determine if flood insurance is available in the community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base Map information shown on this FIRM was derived from multiple sources. Coastal California LiDAR and Digital Imagery dated 2011 was compiled from the Coastal Services Center where available, and it was supplemented with 2012 USDA National Agriculture Imagery Program 2012 (NAIP) imagery.

## SCALE

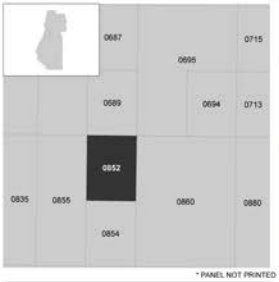
Map Projection:
NAD83 UTM Zone 10N
Western Hemisphere. Vertical Datum NAVD88

1 inch = 500 feet 1:6,000

0 1,000 2,000 Feet

0 250 500 Meters

## PANEL LOCATOR




* PANEL NOT PRINTED

FEMA

National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

HUMBOLDT COUNTY, CALIFORNIA

PANEL 852 OF 2050

FEMA

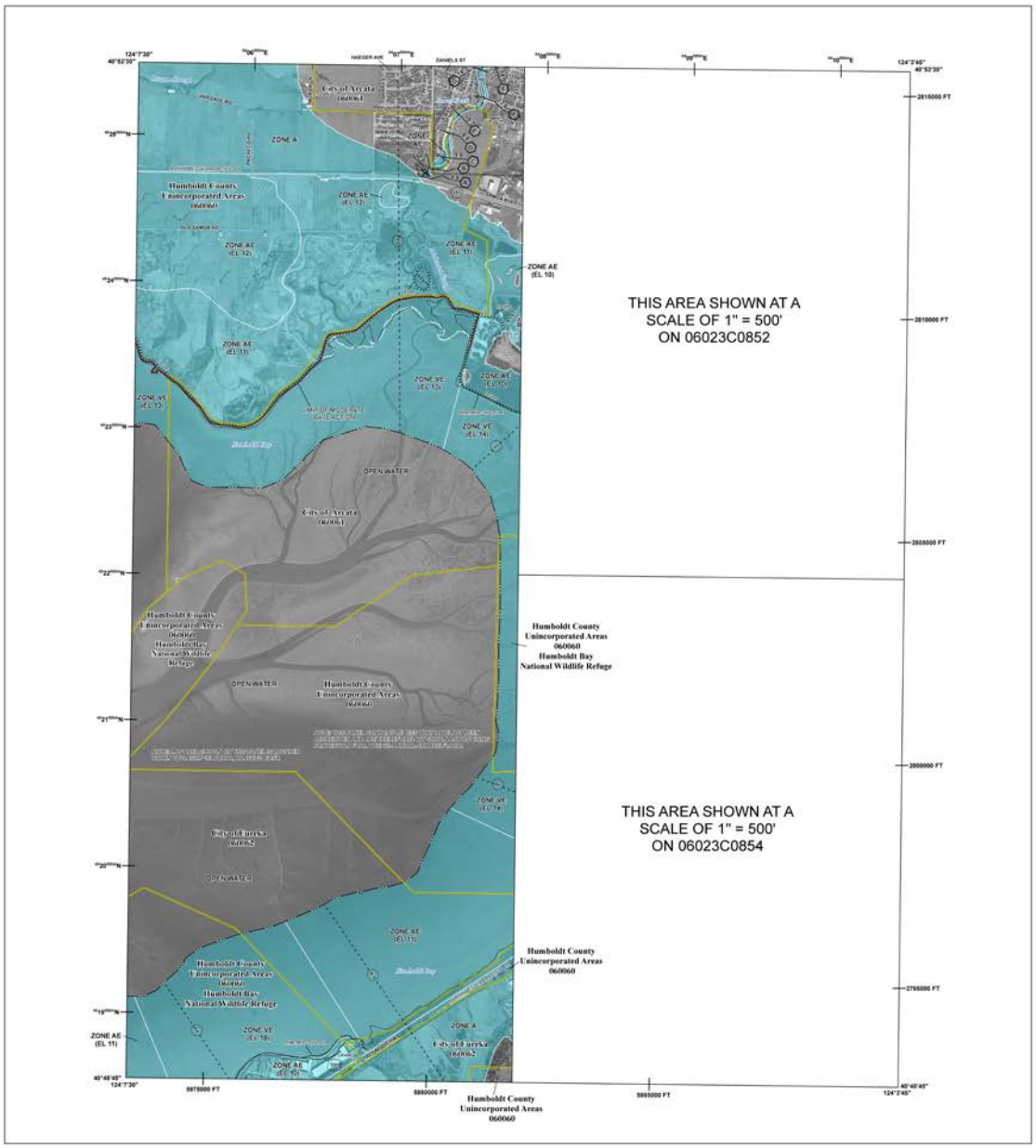
Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|---|---|---|---|
| ARCATA, CITY OF | 060061 | 0852 | G |
| HUMBOLDT COUNTY | 060060 | 0852 | G |

VERSION NUMBER
2.3.2.0

MAP NUMBER
06023C0852G

MAP REVISED
June 21, 2017




## FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTP://MSC.FEMA.GOV

| | |
|---|---|
| SPECIAL FLOOD HAZARD AREAS | Without Base Flood Elevation (BFE) Zone A, V, A99<br>With BFE or Depth Zone AE, AO, AH, VE, AR<br>Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X<br>Future Conditions 1% Annual Chance Flood Hazard Zone X<br>Area with Reduced Flood Risk due to Levee See Notes. Zone X |
| OTHER AREAS | NO SCREEN Areas of Minimal Flood Hazard Zone X<br>Area of Undetermined Flood Hazard Zone D |
| GENERAL STRUCTURES | Channel, Culvert, or Storm Sewer<br>Accredited or Provisionally Accredited Levee, Dike, or Floodwall<br>Non-accredited Levee, Dike, or Floodwall<br>Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)<br>Coastal Transect<br>Coastal Transect Baseline<br>Profile Baseline<br>Hydrographic Feature<br>Base Flood Elevation Line (BFE) |
| OTHER FEATURES | Limit of Study<br>Jurisdiction Boundary |

## NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of the map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction. To determine if flood insurance is available in the community, contact your insurance agent or call the National Flood Insurance Program at: 1-800-638-6620.

Base Map information shown on this FIRM was derived from multiple sources. Coastal California LiDAR and Digital Imagery dated 2011 was compiled from the Coastal Services Center where available, and it was supplemented with 2012 USDA National Agriculture Imagery Program 2012 (NAIP) imagery.

The A1-3 Zone category has been divided by a Limit of Moderate Wave Action (LiMWA). The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA (or between the shoreline and the LiMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

Limit of Moderate Wave Action (LiMWA)

## SCALE

Map Projection:
NAD83 UTM Zone 10N
Western Hemisphere. Vertical Datum NAVD88

1 inch = 1,000 feet 1:12,000

0 1,000 2,000 4,000 Feet

0 250 500 1,000 Meters

## PANEL LOCATOR




* PANEL NOT PRINTED

FEMA

National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

HUMBOLDT COUNTY, CALIFORNIA

PANEL 855 OF 2050

FEMA

Panel Contains:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|---|---|---|---|
| ARCATA, CITY OF | 060061 | 0855 | G |
| EUREKA, CITY OF | 060062 | 0855 | G |
| HUMBOLDT COUNTY | 060060 | 0855 | G |

VERSION NUMBER
2.3.2.0

MAP NUMBER
06023C0855G

MAP REVISED
June 21, 2017

# Attachment C

# Final Wetland Delineation

# August 2020

FINAL REPORT ◦ AUGUST 2020

# Preliminary Delineation of Waters and Wetlands for the City of Arcata Wastewater Treatment Plant Improvement Project, California










PREPARED FOR
City of Arcata
736 F Street
Arcata, CA 95521

PREPARED BY
Stillwater Sciences
850 G Street, Suite K
Arcata, CA 95521

Suggested citation:
Stillwater Sciences. 2020. Preliminary Delineation of Waters and Wetlands for the City of Arcata Wastewater Treatment Plant Improvement Project, California. Final Report. Prepared by Stillwater Sciences, Arcata, California.

Cover photos: Wetland delineation Survey area, Arcata, California, Stillwater Sciences 2019 and 2020.

# Table of Contents

**1 INTRODUCTION ..... 1**

1.1 Project Description and Proponent ..... 1
1.2 Project Location and Survey area ..... 1
1.3 Purpose of the Wetland Delineation ..... 2

**2 METHODS ..... 4**

2.1 Existing Conditions ..... 4
2.2 Field Delineation ..... 4
2.2.1 Waters determination ..... 4
2.2.2 Wetland determination ..... 5

**3 RESULTS ..... 6**

3.1 Historical Conditions ..... 6
3.2 Existing Conditions ..... 7
3.2.1 Hydrology ..... 7
3.2.2 Soil units ..... 9
3.2.3 Vegetation ..... 11
3.2.4 Precipitation ..... 11
3.3 Preliminary Jurisdictional Waters and Wetlands ..... 12
3.3.1 Waters ..... 24
3.3.2 Wetlands ..... 25
3.3.3 Upland developed ..... 30

**4 REFERENCES ..... 31**

## Tables

Table 1. Preliminary USACE-jurisdictional waters of the U.S., including wetlands, waters of the State, and LCP-jurisdictional wetlands in the Survey area. ..... 12
Table 2. Preliminary LCP-jurisdictional wetlands in the Survey area. ..... 29

## Figures

Figure 1. Project location and waters/wetland delineation Survey area. ..... 3
Figure 2. National Wetlands Inventory map of the Survey area. ..... 8
Figure 3. Mapped soil units in the Survey area. ..... 10
Figure 4. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 13
Figure 5. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 14
Figure 6. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 15
Figure 7. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 16
Figure 8. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 17
Figure 9. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 18
Figure 10. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 19
Figure 11. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 20
Figure 12. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 21
Figure 13. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 22
Figure 14. Preliminary jurisdictional waters and wetlands in the Survey area. ..... 23

## Appendices

Appendix A. Wetland Delineation Datasheets

# 1 INTRODUCTION

## 1.1 Project Description and Proponent

The City of Arcata owns the wastewater collection, treatment, and disposal facilities that serve approximately 16,800 residents in the service area. The Arcata Wastewater Treatment Facility (AWTF) currently discharges treated wastewater to Humboldt Bay in conjunction with enhanced treatment wastewater to constructed freshwater marshes in the Arcata Marsh Wildlife Sanctuary (AMWS). These features collectively form the Arcata Wastewater Treatment Plant (WWTP).

The City of Arcata is proposing to replace a portion of existing Arcata WWTP infrastructure and upgrade several components as part of the Arcata WWTP Improvement Project (hereinafter, Project). The work will include installation of buried pipe for the flow reconfiguration of disinfected enhancement wetlands effluent, installing a discharge pipe into a constructed brackish marsh at the north end of the Arcata Bay section of Humboldt Bay (future outfall discharge point), relocation of the electrical equipment building in the AWTF to allow for improved road access for fire and emergency services (requiring installation of a new utility service line), and constructing a mitigation wetland area.

The Project proponent, City of Arcata, may be contacted at:

Mark Andre, Environmental Services-Director
City of Arcata
736 F Street
Arcata, CA 95521
(707) 822-8184
MAndre@cityofarcata.org

## 1.2 Project Location and Survey area

The Project is located at 600 South G Street in Arcata, Humboldt County, California (Figure 1). The Survey area includes:

- Areas associated with the current and future Arcata WWTP including the southern edge of Gearheart enhancement marsh, the northern, eastern, and southern edges of Hauser enhancement marsh, the south east corner of Brackish Pond, and the adjacent levees, trails, and roadways within the AMWS;
- The AWTF including the levees surrounding various treatment marshes and oxidation ponds and the area northeast to South G Street;
- Multiple staging areas within paved and gravel parking lots; and
- A potential wetland mitigation area just south of Humboldt State University's Samoa Facility (just east of Post Mile 8.00) to the northern edge of Western Pond.

These locations can be accessed from CA-255 (Samoa Boulevard) in Arcata, California by heading south on South I Street and South G Street (Figure 1). The potential wetland mitigation area can be accessed south of Post Mile 8.00 on CA-255 (Figure 1). The Survey area is in Section 34 of Township 6 North, Range 1 East of the Arcata North U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle. Elevations range from 0 to 18 feet above mean sea level.

The entire Survey area is within the City of Arcata's Coastal Zone governed by the City's Local Coastal Program—LCP and Land Use and Development Guide (LUDG) General Plan (City of Arcata 2008). A portion of the potential mitigation area near Western Pond and a staging area along South I Street also fall within the appeal zone for the California Coastal Commission (CCC), where coastal development permits may be appealed to the CCC.

## 1.3 Purpose of the Wetland Delineation

The purpose of this delineation is to: (1) assess the geographic extent of water and wetland resources in the Survey area; (2) delineate any waters of the U.S., including wetlands, potentially subject to the jurisdiction of the U.S. Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act (CWA) and/or Section 10 of the Rivers and Harbors Act of 1899; (3) delineate any additional waters of the State that may be subject to the jurisdiction of the State Water Resources Control Board (SWRCB), California Department of Fish and Wildlife (CDFW), and/or City of Arcata LCP/LUDG and CCC.

The wetland features in the Survey area are considered preliminary until verified by the San Francisco Regulatory Branch of the USACE. The USACE determines CWA jurisdiction of the wetland features in the Survey area. Previous correspondence between the USACE and the City of Arcata indicates that portions of the Arcata Wastewater Treatment Marsh are exempt from USACE-jurisdiction (City of Arcata 2010, Attachment 5). Per the April 21, 2020 final rule of the *Navigable Waters Protection Rule* (85 FR 22250), waste treatment systems, defined as "all components, including lagoons and treatment ponds (such as settling or cooling ponds), designed to either convey or retain, concentrate, settle, reduce, or remove pollutants, either actively or passively, from wastewater prior to discharge (or eliminating any such discharge)," are non-jurisdictional waters (i.e., not waters of the United States) (33 CFR 328). Furthermore, waters and features that are excluded in the final rule cannot be determined to be jurisdictional even when the water satisfies one or more of the conditions to be a jurisdictional water (e.g., lakes and ponds, and impoundments of jurisdictional waters). The final rule also notes that when an applicant receives a permit to impound a water of the United States in order to construct a waste treatment system (i.e., the permit received in 1956 for construction of the AWTF oxidation ponds and surrounding levees within the Humboldt Bay tidelands), the permitting agencies have affirmatively relinquished jurisdiction over the resulting waste treatment system as long as it is used for this permitted purpose.




**Figure 1.** Project location and waters/wetland delineation Survey area.

# 2 METHODS

## 2.1 Existing Conditions

Prior to the delineation, existing information on soils, hydrology, and precipitation in the Survey area was evaluated. Information on potential jurisdictional waters and wetlands was obtained from the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) online application, *Wetlands Mapper* (USFWS 2019) and the LCP *Coastal Wetlands Map* (City of Arcata 1989). Available data from the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) Web Soil Survey website were reviewed for the Survey area and nearby vicinity (NRCS 2019a). Mean high water shoreline data for Humboldt Bay (Northern Hydrology & Engineering 2014) were incorporated into Geographic Information Systems (GIS) and reviewed. Precipitation and climate records from the National Climatic Data Center (NCDC 2019 and 2020) were reviewed for nearby weather station Eureka Weather Forecast Office (WFO), Woodley Island, California.

## 2.2 Field Delineation

A delineation of potential jurisdictional waters and wetlands were conducted by qualified personnel on October 2–3, 8, and 17, 2019, March 12, 2020, and May 29, 2020 in accordance with the *Corps of Engineers Wetlands Delineation Manual* (1987 Manual, USACE 1987), *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Version 2.0)* (WMVC Supplement; USACE 2010), and USACE *Regulatory Guidance Letter (RGL) No. 05-05* (USACE 2005). The delineation included any feature that could potentially meet the definition of a water protected under the Clean Water Act (and thus be subject to USACE-jurisdiction), the Porter Cologne Act (SWRCB [State]-jurisdiction), Section 1602 of Streambed Alteration Agreement (California Department of Fish and Wildlife [CDFW]-jurisdiction) and the City of Arcata LCP/LUDG (LCP-jurisdiction). LCP-jurisdiction includes one-parameter wetlands within the coastal zone and two-parameter wetlands within the City of Arcata. In addition, any wetland feature delineated within the Coastal Zone was reviewed for consistency against the LCP Coastal Wetland Map and the USFWS NWI map.

### 2.2.1 Waters determination

Under Section 404 of the CWA, the limits of USACE jurisdiction is defined at the High Tide Line (HTL) or Ordinary High Water Mark (OHWM). Under Section 10 of the Rivers and Harbors Act of 1899 for activities in navigable waters (i.e., Humboldt Bay) the limits of USACE jurisdiction is defined at Mean High Water (MHW). Furthermore, waters of the State include any surface water or groundwater, including saline waters, within the boundaries of the state (Porter-Cologne Act, Section 13050). All waters associated with the Arcata WWTP including Gearheart, Hauser, and Allen enhancement marshes and the AWTF treatment marshes and oxidation ponds (Figure 1) are exempt from USACE-jurisdiction per the final rule (33 CFR Part 328); however, they were delineated as waters of the State (State-jurisdiction).

The extent of waters in the Survey area were delineated by the location of the OHWM, HTL, and MHW. The OHWM is defined as the elevation established on the shore by water fluctuations, and is indicated by physical characteristics such as: (a) a clear, natural line impressed on the bank; (b) shelving; (c) changes in the character of soil; (d) destruction of terrestrial vegetation; (e) the presence of litter and debris; or (f) other appropriate means that consider the characteristics of the surrounding areas. The OHWM was identified in accordance with the USACE RGL 05-05

(USACE 2005) and the OHWM Guide (Mersel and Lichvar 2014). 33 CFR 328.3(d) defines the HTL as the line of intersection of the land with the water's surface at the maximum height reached by a rising tide and may be determined, in the absence of actual data, by: (a) a line of oil or scum along shore objects; (b) a more or less continuous deposit of fine shell or debris on the foreshore or berm; (c) other physical markings or characteristics; (d) vegetation lines; or (e) tidal gages, or other suitable means that delineate the general height reached by a rising tide. The HTL encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm. The 2014 mean high water shoreline data for Humboldt Bay (Northern Hydrology & Engineering 2014) was used to delineate the extent of Section 10 waters.

Prior to the wetland delineation surveys, aerial photographs and topographic maps were reviewed to identify limits and connections of potential wetlands to traditional navigable waters (TNW) such as the Humboldt Bay. During the wetland delineation, waters in the Survey area were further reviewed for their connectivity to a TNW based on culvert connections and the existing drainage network. The OHWM and HTL of potentially jurisdictional waters were delineated in the field. Boundaries were mapped via a sub-meter Global Positioning System (GPS) unit (Trimble Geo 7x) and later post-processed, corrected, and incorporated into GIS where maps detailing the delineation results were generated.

### 2.2.2 Wetland determination

Wetlands were delineated in accordance with the 1987 Manual (USACE 1987) and WMVC Supplement (USACE 2010). The 1987 Manual and WMVC Supplement provide technical guidelines and methods for the three-parameter approach to determining the location and boundaries of USACE jurisdictional wetlands. This approach requires that an area must support positive indicators of hydrophytic vegetation, hydric soils, and wetland hydrology to be considered a jurisdictional wetland. A three-parameter wetland with a direct hydrological surface connection to a jurisdictional water in a typical year is considered an USACE jurisdictional wetland (i.e., adjacent wetlands). Connectivity of delineated wetlands to jurisdictional waters was evaluated in accordance with USACE RGL 07-01 (USACE 2007). As the Survey area is located within the Coastal Zone, all wetland features were also evaluated for potential LCP-jurisdiction which requires that only one or two of the three USACE wetland parameters (hydrophytic vegetation, hydric soils, and/or wetland hydrology) be present (1976 California Coastal Act, Public Resources Code Section 30000 *et seq*., City of Arcata 2008).

A total of 28 data points were sampled in potential USACE- and LCP-jurisdictional wetlands in the Survey area. If a data point met all three wetland parameters, it was considered an USACE wetland; if a point only met one or two wetland parameters, it was considered a LCP wetland; if a point met no wetland parameters, it was considered upland. Potential wetland areas were identified based on information generated from the pre-field review (e.g., the NWI *Wetland Mapper* results) and observations of hydrology and vegetation in the field. If a data point met all three parameters for a USACE jurisdictional wetland, then a paired data point was placed along the preliminary transition zone (the area in which a change from wetland to non-wetland conditions occurs) to determine the wetland/upland boundary. If a wetland was sampled and no adjacent uplands were identified within the Survey area, then a paired upland data point was not sampled. At each data point, a soil pit was dug and the following information was recorded using the USACE (2010) data forms:

1. **Vegetation**: Dominant plant species for each stratum (i.e., tree, sapling/shrub, herb, woody vine) by scientific name (genus and species) following the taxonomy the online *Jepson eFlora* (Jepson Flora Project 2019). Absolute percent cover and dominance were determined using the 50/20 rule outlined in the *WMVC Supplement*, and the wetland indicator status (OBL [obligate], FACW [facultative-wet], FAC [facultative], FACU [facultative-upland], and UPL [upland]) defined for the WMVC Region in the *National Wetland Plant List: 2016 Wetland Ratings* (Lichvar et al. 2016). Plant species not listed in the *2016 National Wetland Plant List* were considered upland (UPL) species. A dominance test was performed to determine if the data point exhibited hydrophytic vegetation. If the dominance test was not conclusive and wetland hydrology and hydric soils were present, then the prevalence index was calculated.
2. **Hydrology**: Presence and depth of surface water, groundwater, and/or soil saturation were recorded. In addition, if primary (e.g., oxidized rhizospheres along living roots) and secondary indicators (e.g., drainage patterns, dry-season water table, saturation visible on aerial imagery) were observed, then they were also recorded at each data point.
3. **Soils**: Moistened soil matrix descriptions were recorded for each data point using the following: depth of the sample, color (as defined in Munsell soil color charts [Munsell Color 2000]), and texture. If present, redox features were then described by type (e.g., concentration, depletion, reduced matrix) and location (e.g., pore lining, root channel, or matrix). Hydric soils were determined using the *WMVC Supplement* primary indicators, such as sandy redox (S5). In addition, mapped soil units (described in Section 3.1.2) were considered and the current National List of Hydric Soils (NRCS 2019b) was consulted.

The location of each data point and wetland boundaries were recorded using a sub-meter accuracy GPS and photographs were taken of the representative site characteristics. All GPS data were post-processed, corrected, and incorporated into GIS. Mapped wetlands were classified according to the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979, Federal Geographic Data Committee [FCDC] 2013) based on the vegetation composition and structure at the data points.

# 3 RESULTS

## 3.1 Historical Conditions

Historically, the Survey area was composed of Arcata Bay tidelands (i.e., tidal sloughs and marshes) (U.S. Coast Survey 1870). In the late 1800s, much of the Survey area was used for various industrial activities (e.g., wharf, railroad, timber transport) and later diked for agricultural purposes (i.e., farming and pasture) and nearby lumber mill operations. The WWTP enhancement marshes and AWTF oxidation ponds and treatment marshes were constructed between 1949–1983. Construction of the AWTF oxidation ponds and its surrounding levees within the tidelands of Humboldt Bay (approximately 70 acres) was authorized on May 17, 1956 by the USACE San Francisco District. Prior to the recent restoration associated with the McDaniel Slough Marsh Enhancement Project (City of Arcata 2013) and other mitigation efforts, a portion of the potential mitigation area near Western Pond was used for agricultural grazing. Brackish Pond, Western Pond, and North Pond were formerly grazed pasture prior to construction in 2007 and 2013.

The conversion of land and the historical industrial and agricultural land use in the Survey area has altered the natural vegetation, hydrology, and soils. Normal conditions have since established for much of the Survey area's restored and undeveloped areas.

## 3.2 Existing Conditions

### 3.2.1 Hydrology

The Project is in the Mad River Lowland Subbasin of the Mad River Groundwater Basin. This basin includes the coastal floodplain from the Freshwater Fault north to the Mad River and is primarily composed of alluvium that is underlain by the Pleistocene Hookton Formation. This water-bearing formation consists of clay, sand, and gravel (CDWR 2004). The Hookton Formation is recharged by rainfall in the upland recharge areas east of Arcata (DWR 1973) in addition to lateral water movement into the alluvium from adjacent formations and some upward movement from leakage due to differences in head between the alluvium and underlying formations (Fuller 1975).

The Project is located within the Humboldt Bay Subwatershed (Hydrologic Unit Code [HUC] 12: 180101020601) of the Humboldt Bay-Frontal Pacific Ocean watershed in the North Coast Hydrologic Region and within the Jacoby Creek Watershed of the Eureka Plain Hydrologic Unit No. 110.00 (NRCWCB 2019). The Project is also within the Janes Creek and Jolly Giant Creek watersheds within the City of Arcata (City of Arcata 2016). The Survey area abuts Arcata Bay, the northernmost estuary of Humboldt Bay (a TNW). Arcata Bay occupies the low seaward end of several valleys which have been filled by floodplain and tidal flat deposits (Murray and Wunner 1988). The Project also includes Butcher Slough, a tributary to Arcata Bay (Figure 1).

The WWTP man-made freshwater enhancement marshes in the Survey area include Hauser Marsh, Gearheart Marsh, and Allen Marsh. Water associated with these enhancement marshes originates from the disinfection basins of the WWTP. This treated wastewater is eventually pumped back to the AWTF for final disinfection then discharged via an outfall pipe into the Arcata Bay section of Humboldt Bay. Additional man-made features in the Survey area include Brackish Pond, Western Pond, and North Pond (Figure 1). Brackish and Western ponds have direct connections (e.g., drainpipes with tidal flap, tide gate) to McDaniel Slough and eventually the Arcata Bay section of Humboldt Bay. The future outfall of treated AWTF effluent will discharge into Brackish Pond. The North Pond does not have a surface water connection to adjacent water bodies (Figure 1). The roadside ditch along South G Street near the AWTF has surface water connection to a tributary to Butcher Slough (Figure 1). Additional man-made waters adjacent to the Survey area include Klopp Lake and the AWTF oxidation ponds and treatment marshes. At these locations, the proposed Project construction occurs within the upland constructed levees above the mean high, high water and the normal water surface elevation of the AWTF oxidation ponds and treatment marshes.

The NWI *Wetlands Mapper* includes various palustrine and estuarine wetlands the Survey area (Figure 2). These features largely correlate with the LCP Coastal Wetlands Map and the field delineation results (Section 3.3).

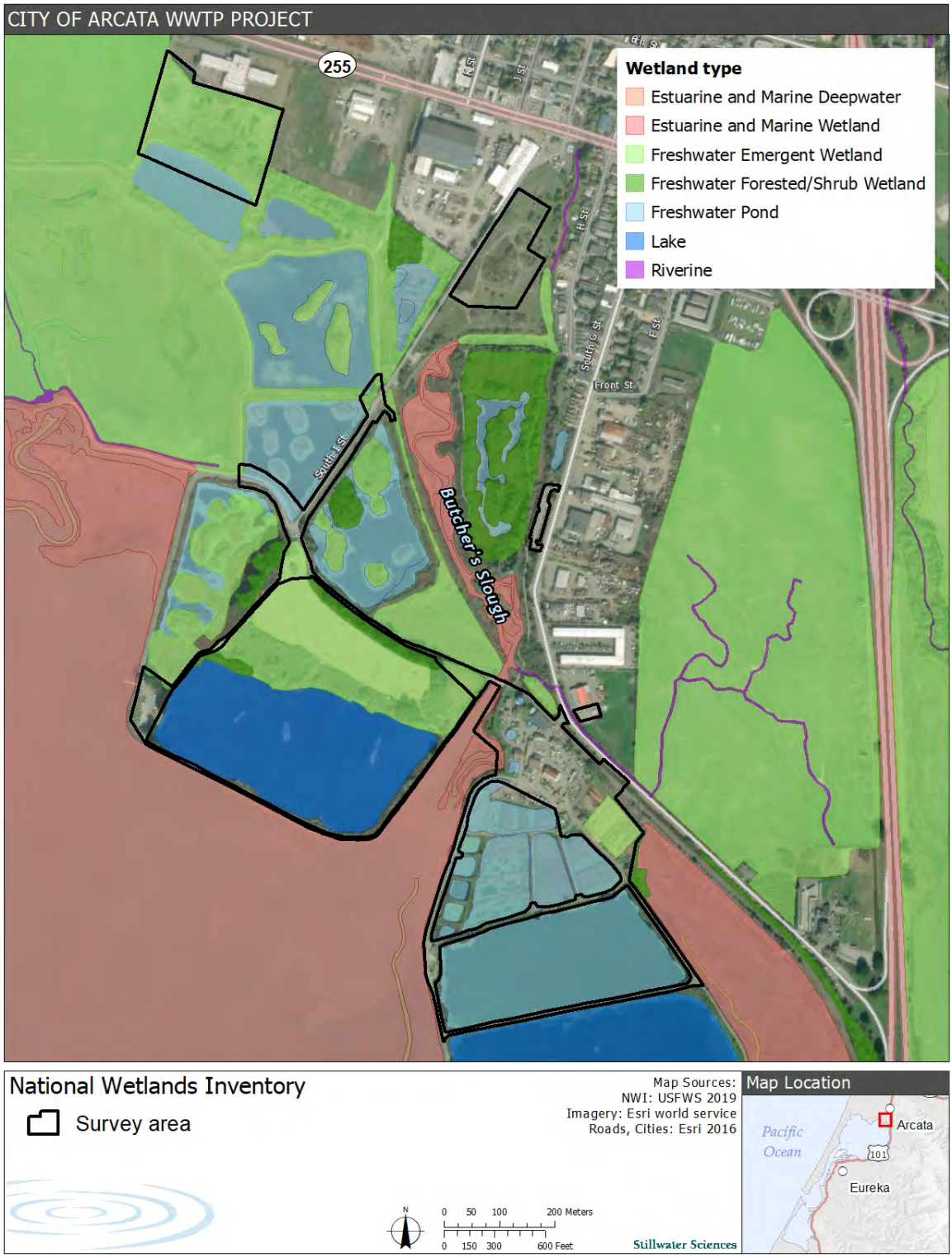



**Figure 2.** National Wetlands Inventory map of the Survey area (Source: USFWS 2020).

### 3.2.2 Soil units

Soil units in the Survey area included Occidental, 0–2% slopes; Hydraquents-Wassents mucky silt loam, strongly saline, 0–3 % slopes, very frequently flooded; and Urban land-Anthraltic Xerorthents association, 0–2% slopes (Figure 3). The NRCS soil survey mapped the AMWS and AWTF oxidation ponds and treatment marshes as water and no mapped soil unit was described within these limits (Figure 3). Prior to the current setting (i.e., AMWS, AWTF, McDaniel Slough Restoration), this region was composed of bay tidelands that were eventually diked and used for various industrial and agricultural purposes. As such, soils at these locations are disturbed and contain dredge spoils and nonnative fill material.

Occidental (0 to 2% slopes) is found in areas with elevations that range from 0 to 30 feet above mean sea level and with a mean annual precipitation of 35–80 inches, a mean annual air temperature of 50–55º F, and a frost-free period of 275–330 days (NRCS 2019a). The Occidental series is primarily located along the backslope of salt marshes. A typical profile consists of peat in the upper 0–3 inches (Oi horizon) with silty clay loam forming all other horizons below. It has a drainage class of very poorly drained with a depth to water table and redoximorphic features ranging from 0–4 inches (NRCS 2017, 2019a). It frequently ponds and is occasionally flooded with a slightly saline to strong saline profile. Occidental series is listed as a hydric soil in the region (NRCS 2019a) with an aquic soil regime (NRCS 2017). The water table from August through November is typically ≥35 inches (NRCS 2017) however ranges from 0–35 inches depth in December–July. The Project's potential mitigation site near the McDaniel Slough and one staging area on the South I Street were located within this mapped soil unit.

Hydraquents-Wassents mucky silt loam, strongly saline, 0–3 % slopes, very frequently flooded, is composed of 50% Hydraquents, low tidal and similar soils, 40% Wassents, and 10% minor components. It is found from 0 to 10 feet above mean sea level with a mean annual precipitation of 35–80 inches, a mean annual air temperature of 50–55ºF, and a frost-free period of 275–365 days (NRCS 2019a). Hydraquents, low tidal is located on tidal flats with a parent material of mucky, silty, and clayey estuarine deposits and a slope of 0–3%. A typical profile consists entirely (0–59 inches) of mucky silty clay loam. It has a drainage class of very poorly drained, a depth to water table of 0 inches, is very frequently flooded, and strongly saline (NRCS 2019a). Hydraquents, low tidal is listed as a hydric soil in the region. The Wassents series shares Hydraquents properties and qualities except for its typical profile has mucky silt loam in the upper 6 inches, has a slope of 0–1%, and a subaqueous drainage class. Wassents is also listed as a hydric soil in the region. Minor components of this map unit include the Hydraquents, high tidal (5%) and marine waters (5%) (NRCS 2019a). The Arcata Bay section of Humboldt Bay is mapped as this soil unit type.

Urban land-Anthraltic Xerorthents association (0 to 2% slopes) is composed of 80% urban land, industrial and 20% anthralitic xerorthents and similar soils. This association is found from 0 to 10 feet above mean sea level with a mean annual precipitation of 41–43 inches, a mean annual air temperature of 50–55ºF, and a frost-free period of 275–330 days (NRCS 2019a). Anthraltic Xerorthents is located on backslopes of fluviomarine terraces with a parent material of coarse-loamy fluviomarine deposit or coarse-loamy dredge spoils. A typical profile consists of gravelly loamy fine sand within the upper 0–6 inches with sandy loam, gravelly sand, and sand forming the horizons below. It has a drainage class of moderately well drained (NRCS 2019a). The AWTF and levees adjacent to the Arcata Bay section of Humboldt Bay as well as the industrial areas along South G Street are included in this mapped soil unit.

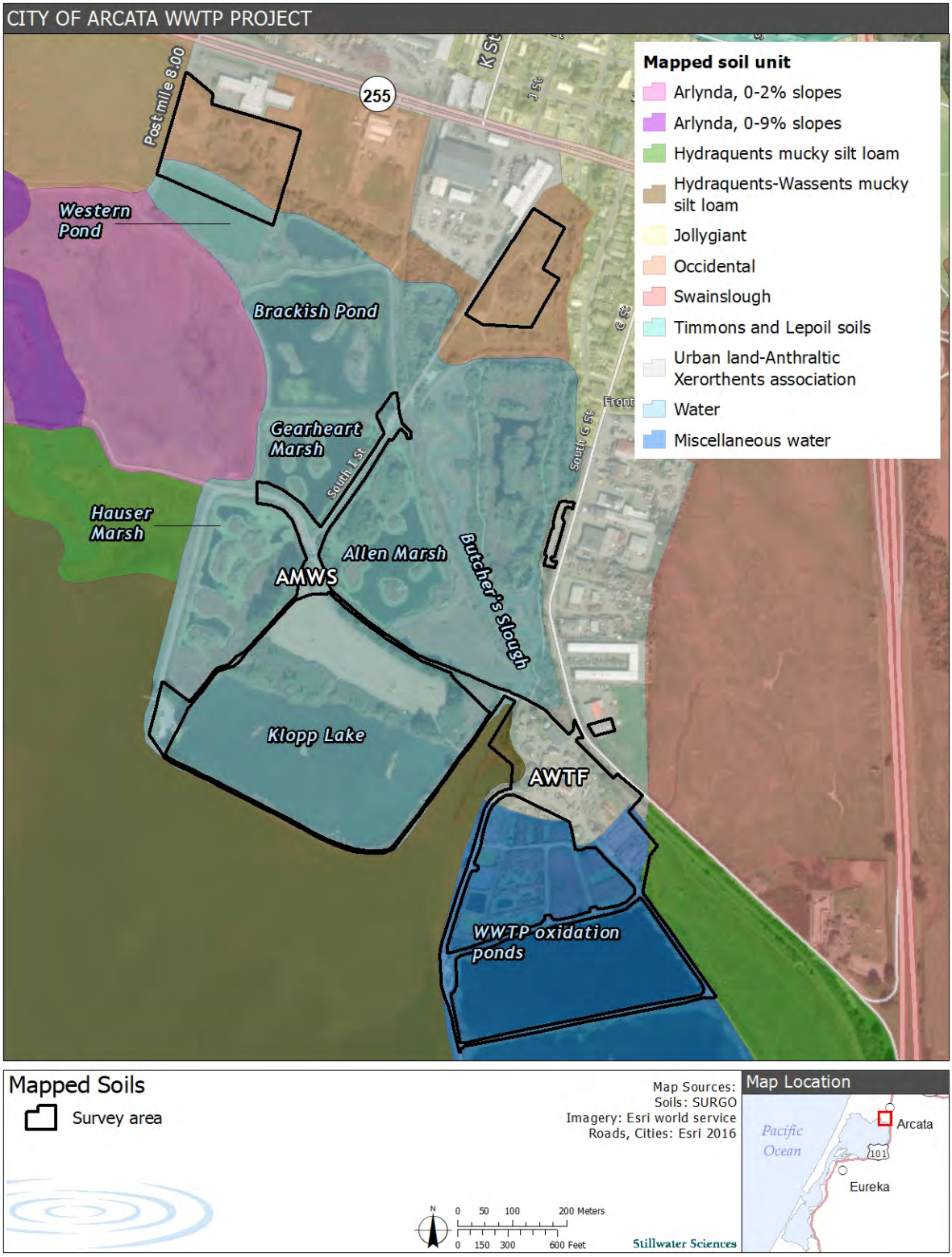



**Figure 3.** Mapped soil units in the Survey area.

Palustrine wetland data points closely resembled the hydric soil Occidental series (NRCS 2019a) with matrix colors ranging from 10YR (value of 2–4 and chroma of 1–2), 5Y 4/1, and 2.5Y (value of 2.5 and 5 and chroma of 1–2) (Appendix A). Data points commonly contained clay loam, silty clay, silty loam, silty clay loam and sandy loam. Soil samples were considered hydric when a positive primary indicator, such as redox depressions, depleted matrix, or loamy gleyed matrix was identified (data points W2–W7 in Appendix A). Estuarine wetland data point W1 confirmed the mapped hydric soil Wassents mucky silt loam (Appendix A). The soil matrix profile was 2.5Y and Gley 1 and confirmed hydric soils with hydrogen sulfide (A4) and loamy gleyed matrix (F2) (Appendix A). Estuarine wetland data point W8 contained a soil profile composed of sandy clay with significant redox features and closely resembled the mapped soil unit Anthraltic Xerorthents (Appendix A).

### 3.2.3 Vegetation

In undeveloped and restored areas, native vegetation is predominant. Vegetation communities documented in the Survey area include coastal scrub, riparian scrub, riparian forest, coastal and introduced grasslands, north coast salt marsh, and freshwater and brackish marshes. Stands of nonnative and landscaped vegetation were mostly observed along developed areas in the Survey area (e.g., roadside corridors, areas surrounding parking areas, and graveled low-use areas).

### 3.2.4 Precipitation

Local climate conditions are moist, cool, and influenced by the conditions of the Pacific Ocean, with wet cool winters and cool summers with frequent fog and strong winds. Rainfall occurs primarily between October through May, with mean annual rainfall ranging from 40–49 inches (based on the 1981–2010 period of record monthly normal [normal] for nearby Eureka WFO weather station) (NCDC 2019). The average monthly temperature range is approximately 46–49º F in winter and 54–59º F in the summer (NCDC 2019).

The Eureka WFO weather station recorded twice the normal monthly precipitation in September 2019 (i.e., 1.92 inches recorded in September 2019). The majority of which (i.e., 1.05 inches) was derived from a rain event two weeks preceding the initial field delineation in October 2019. No features from this precipitation event (i.e., ponding, high-water table, upper soil surface saturation) were observed, which indicated sufficient time had elapsed to drain shallow subsurface storm flow; as such, conditions were considered typical for the early October field delineation. Overall, the cumulative precipitation recorded for October 2019 (i.e., 1.51 inches) was below the normal average of 2.87 inches indicating conditions were drier for the month. However, the United States (U.S.) Drought Monitor did not indicate abnormally dry or drought conditions for Humboldt County in October 2019 (National Drought Mitigation Center 2019). Weather conditions during the October 2019 delineation varied from sunny and clear to scattered clouds with a high of 61–64º F, which was warmer than the Eureka WFO weather station normal average temperature of 54.4º F for October (NCDC 2019).

In March 2020, the Eureka WFO weather station recorded a total of 3.7 inches precipitation, less than the monthly normal (5.3 inches in March) (NCDC 2020). Low precipitation was recorded prior to the March 12, 2020 wetland delineation (0.1 inches accumulated since March 1) and the U.S. Drought Monitor indicated abnormally dry conditions for the region (National Drought Mitigation Center 2020). Weather was sunny with clear skies during the March 12, 2020 delineation with a high temperature of 56º F (within the monthly normal temperature range for March [43–57º F]).

The slightly drier and/or warmer conditions during the October 2019 and March 2020 wetland delineations are unlikely to have influenced the delineation results as wetland features remained evident regardless of precipitation and temperature throughout the Survey area.

Prior to the May 29, 2020 delineation, the Eureka WFO weather station recorded above normal precipitation for the month (<2 inches above normal). All recorded precipitation occurred between May 2 and May 18. Consequently, any temporarily saturated and/or ponded features from this period had sufficient time to drain prior to the May wetland delineation. As a result, the earlier precipitation events were not likely to have influenced delineation results.

## 3.3 Preliminary Jurisdictional Waters and Wetlands

The Survey area contains 3 acres of potentially USACE-jurisdictional waters of the U.S. and 2acres of potentially USACE-jurisdictional wetlands adjacent to these waters (Table 1, Figures 4 through 7 and 14, Appendix A). The potentially jurisdictional waters of the U.S. are also considered to be waters of the State under State- and LCP-jurisdiction. In addition, there are 10.87 acres of wetlands that are only subject to State- and LCP-jurisdiction (Table 1; Figures 4 through 9, 11, 13, and 14; Appendix A).

**Table 1.** Preliminary USACE-jurisdictional waters of the U.S., including wetlands, waters of the State, and LCP-jurisdictional wetlands in the Survey area.

| Description | Acreage |
|---|---|
| ***Waters*** | |
| Arcata Bay (Humboldt Bay) (W-1) [1, 2] | 0.3 |
| Brackish Pond (W-2) [1] | 0.1 |
| Western Pond (W-3) [1] | 1.8 |
| North Pond (W-4) [3] | 0.7 |
| Roadside Ditch (W-5) [1] | <0.1 (0.04) |
| Tributary to Butcher Slough (W-6) | <0.1 (0.01) |
| Arcata WWTP enhancement marshes (SW-01 and SW-02)[3, 4] | 0.6 |
| AWTF oxidation ponds and treatment marshes (SW-03 through SW-11) | 3.0 |
| ***Wetlands*[1]** | |
| Seasonally saturated palustrine persistent emergent wetlands (SS-01 through SS-05) | 0.7 |
| Seasonally flooded palustrine persistent emergent wetlands (SF-01) | 0.4 |
| Semipermanently flooded palustrine persistent emergent wetlands (SP-01) | <0.1 (0.06) |
| Seasonally saturated/flooded palustrine broadleaved deciduous scrub-shrub wetlands (BL-01 and BL-04) | 0.6 |
| Estuarine regularly flooded persistent emergent wetlands (EP-01 and EP-02) | 0.3 |
| ***Additional LCP-jurisdictional wetlands*** | |
| One-parameter wetlands within the City of Arcata Coastal Zone (OP-01) | 1.5 |
| One-parameter riparian within the City of Arcata Coastal Zone (R-01 through R-14) | 0.8 |
| Two-parameter wetlands within the City of Arcata Coastal Zone (TP-01 through TP-13) | 5.0 |

[1] Subject to Section 404 of the CWA thus under USACE-jurisdiction as well as State- and LCP-jurisdiction.
[2] Subject to Section 10 of the Rivers and Harbors Act and USACE-jurisdictional
[3] Subject to State- and LCP-jurisdiction
[4] The constructed freshwater WWTP enhancement ponds in the Survey area were not considered USACE-jurisdictional waters and are described in Section 3.2.1.2.




**Figure 4.** Preliminary jurisdictional waters and wetlands in the Survey area.




| *Section 10 and 404 Waters* | |
|---|---|
| W-1 | 0.30 |
| *Section 404 Waters* | |
| W-2 | 0.10 |
| W-3 | 1.81 |
| W-4 | 0.74 |
| W-5 | 0.04 |
| W-6 | 0.01 |
| **Total 404 W** | **2.99** |
| *Adjacent Wetlands* | |
| BL-01 | 0.26 |
| BL-02 | 0.08 |
| BL-03 | 0.16 |
| BL-04 | 0.07 |
| **Total BL** | **0.57** |
| EP-01 | 0.26 |
| EP-02 | 0.02 |
| **Total EP** | **0.29** |
| SF-01 | 0.38 |
| SS-01 | 0.05 |
| SS-02 | 0.03 |
| SS-03 | 0.12 |
| SS-04 | 0.42 |
| SS-05 | 0.09 |
| **Total SS** | **0.71** |
| SP-01 | 0.06 |
| **Total USACE Jurisdictional=** | **5.00** |
| *Additional State- and LCP-Jurisdictional Features* | |
| SW-01–SW-11 | 3.63 |
| TP-01–TP-13 | 5.02 |
| OP-01 | 1.45 |
| R-01–R-14 | 0.77 |

CITY OF ARCATA WWTP IMPROVEMENT PROJECT-ARCATA, CALIFORNIA

*SURVEYED WATERS*

Survey area
Adjacent tile
**Data point**
Wetland
Upland

SCALE & NORTH ARROW

0 25 50 100 Feet
0 7.5 15 30 Meters

1:1,210 1 in = 101 feet

REFERENCE BLOCK

Coordinate System: NAD1983 UTM Z10N
Township, range, section: T6N S34 R1E
USGS 1:24k quadrangle: Arcata North
USGS 1:250k quadrangle: Eureka
Hydrologic Unit Code [HUC] 12: 180101020601
Delineators: Emmalien Craydon and Emily Teraoka
Preparation date: 6 December 2019,
Revision dates: 17 April 2020, 6 August 2020

DATA SOURCES
Imagery and topography: ESRI world service 2016
Roads, cities, streams and waterbodies: ESRI 2016

Stillwater Sciences







**Figure 5.** Preliminary jurisdictional waters and wetlands in the Survey area.

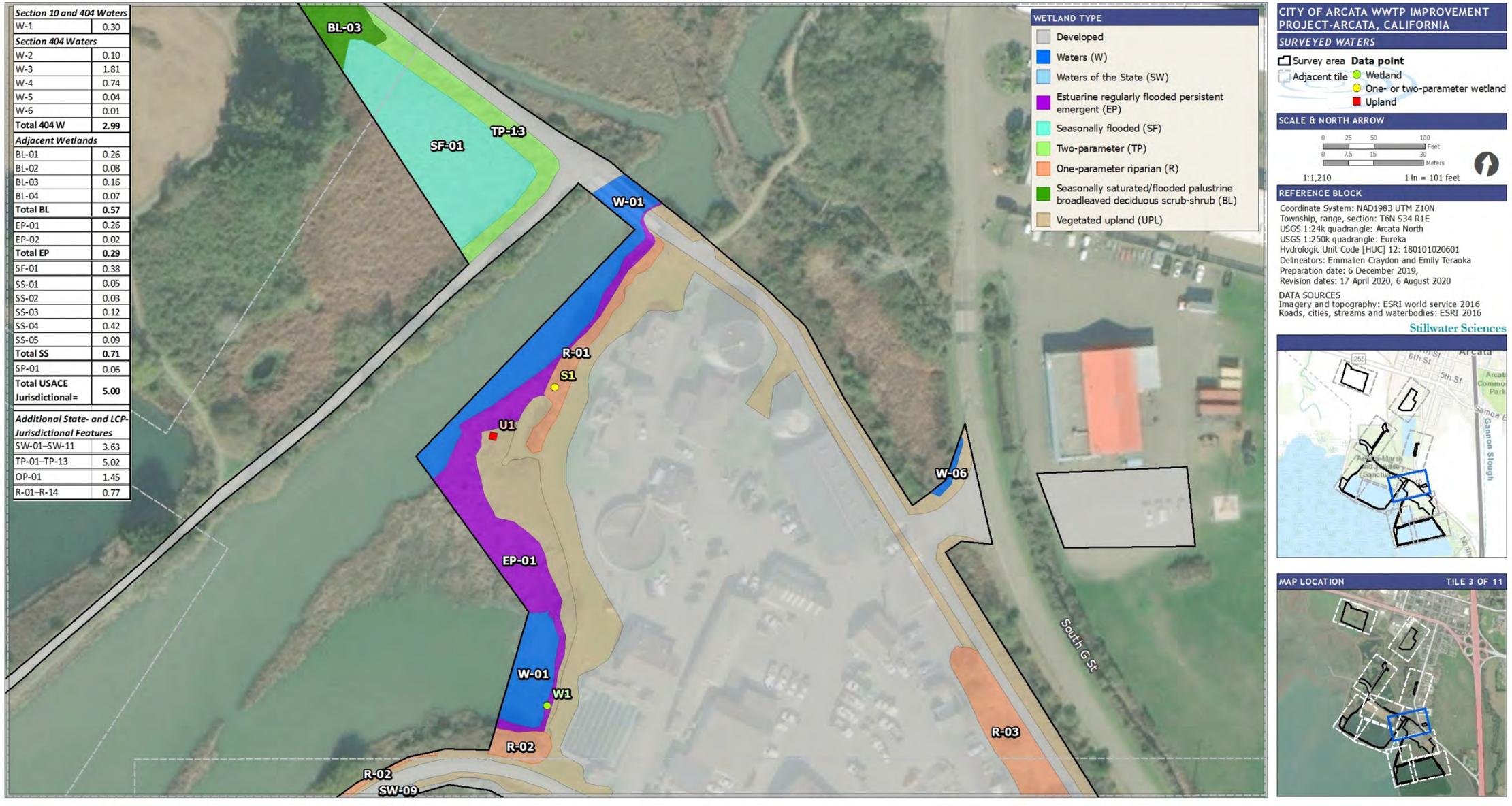



**Figure 6.** Preliminary jurisdictional waters and wetlands in the Survey area.




| *Section 10 and 404 Waters* | |
|---|---|
| W-1 | 0.30 |
| ***Section 404 Waters*** | |
| W-2 | 0.10 |
| W-3 | 1.81 |
| W-4 | 0.74 |
| W-5 | 0.04 |
| W-6 | 0.01 |
| **Total 404 W** | **2.99** |
| ***Adjacent Wetlands*** | |
| BL-01 | 0.26 |
| BL-02 | 0.08 |
| BL-03 | 0.16 |
| BL-04 | 0.07 |
| **Total BL** | **0.57** |
| EP-01 | 0.26 |
| EP-02 | 0.02 |
| **Total EP** | **0.29** |
| SF-01 | 0.38 |
| SS-01 | 0.05 |
| SS-02 | 0.03 |
| SS-03 | 0.12 |
| SS-04 | 0.42 |
| SS-05 | 0.09 |
| **Total SS** | **0.71** |
| SP-01 | 0.06 |
| **Total USACE Jurisdictional=** | **5.00** |
| ***Additional State- and LCP-Jurisdictional Features*** | |
| SW-01–SW-11 | 3.63 |
| TP-01–TP-13 | 5.02 |
| OP-01 | 1.45 |
| R-01–R-14 | 0.77 |

**Figure 7.** Preliminary jurisdictional waters and wetlands in the Survey area.




| | |
|---|---|
| ***Section 10 and 404 Waters*** | |
| W-1 | 0.30 |
| ***Section 404 Waters*** | |
| W-2 | 0.10 |
| W-3 | 1.81 |
| W-4 | 0.74 |
| W-5 | 0.04 |
| W-6 | 0.01 |
| **Total 404 W** | **2.99** |
| ***Adjacent Wetlands*** | |
| BL-01 | 0.26 |
| BL-02 | 0.08 |
| BL-03 | 0.16 |
| BL-04 | 0.07 |
| **Total BL** | **0.57** |
| EP-01 | 0.26 |
| EP-02 | 0.02 |
| **Total EP** | **0.29** |
| SF-01 | 0.38 |
| SS-01 | 0.05 |
| SS-02 | 0.03 |
| SS-03 | 0.12 |
| SS-04 | 0.42 |
| SS-05 | 0.09 |
| **Total SS** | **0.71** |
| SP-01 | 0.06 |
| **Total USACE Jurisdictional=** | **5.00** |
| ***Additional State- and LCP-Jurisdictional Features*** | |
| SW-01–SW-11 | 3.63 |
| TP-01–TP-13 | 5.02 |
| OP-01 | 1.45 |
| R-01–R-14 | 0.77 |

**Figure 8.** Preliminary jurisdictional waters and wetlands in the Survey area.




**Figure 9.** Preliminary jurisdictional waters and wetlands in the Survey area.




**Figure 10.** Preliminary jurisdictional waters and wetlands in the Survey area.




**Figure 11.** Preliminary jurisdictional waters and wetlands in the Survey area.




**Figure 12.** Preliminary jurisdictional waters and wetlands in the Survey area.

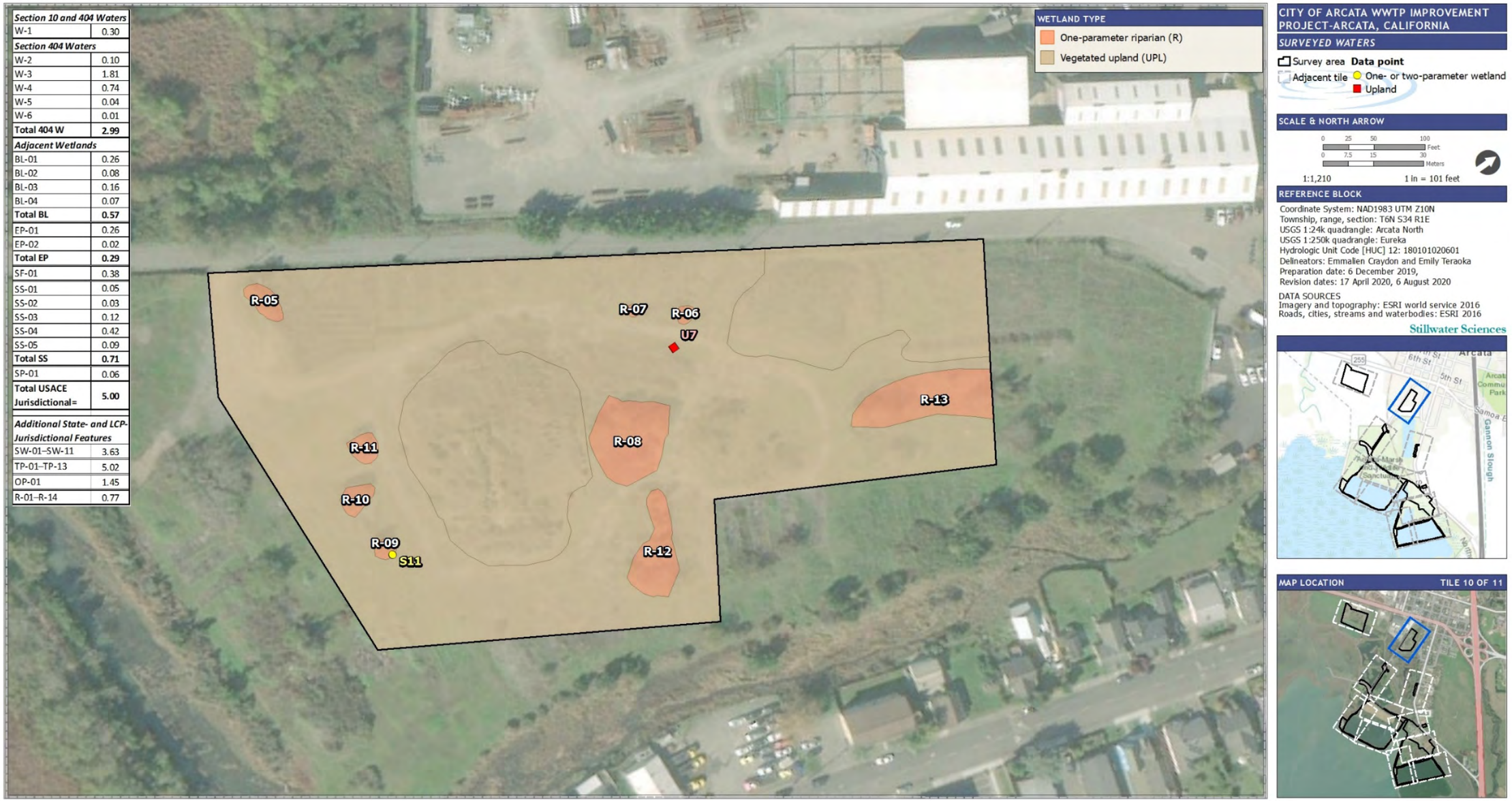



**Figure 13.** Preliminary jurisdictional waters and wetlands in the Survey area.

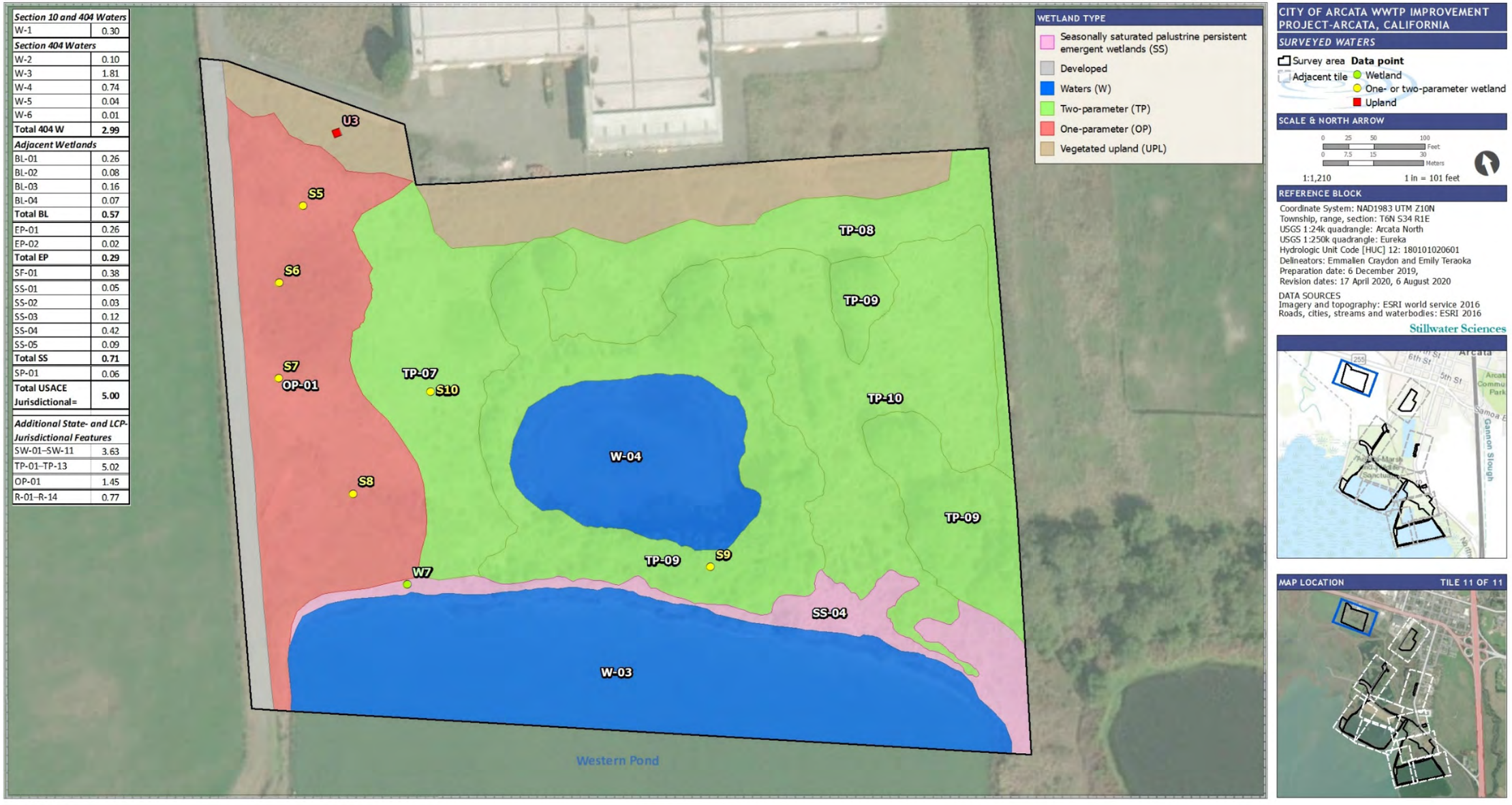



**Figure 14.** Preliminary jurisdictional waters and wetlands in the Survey area.

### 3.3.1 Waters

The Survey area includes 3.0 acres of potential USACE- jurisdictional waters subject to Section 10 and/or Section 404 of the CWA (W-1 through W-6) as well as an additional 3.6 acres of non-federal waters of the State (SW-01 and SW-11) (Table 1, Figures 4, 6–9, 11, and 14).

#### 3.3.1.1 Waters of the U.S.

Tidal waters of the Arcata Bay section of Humboldt Bay are the Navigable Waters of the U.S. documented in the Survey area (W-1, Figure 6). Humboldt Bay includes the Port of Humboldt Bay, a protected deep-water port with harbor facilities designed to serve cargo and other vessels, and a number of marinas that serve hundreds of small to mid-size boats and pleasure crafts (Humboldt Bay Harbor, Recreation, and Conservation District 2019). Furthermore, commercial oyster production operations that produce more than half of all oysters farmed in California are located in Humboldt Bay (Pomeroy et al. 2010).

Navigable Waters of the U.S. in the Survey Area (W-1) were categorized by the MHW (Sections 10 and 404 waters) and the ground-truthed HTL (Section 404 waters) (Figure 6, Table 1). HTL indicators were a line of scum and wracking debris along the shore, as well as the transition of vegetated and unvegetated habitat (i.e., the boundary between open mudflat and north coast salt marsh). In cases where that HTL included north coast salt marsh habitat the HTL was adjusted to the lower extent of this habitat. The north coast salt marsh habitat was categorized as estuarine wetlands and is described in Section 3.2.2. The upland levee crest boundaries surrounding the man-made Klopp Lake were delineated and indicated on Figures 6, 10, and 11.

Other Waters of the U.S. in the Survey area totaled 2.7 acres and included the nontidal waters Western Pond, Brackish Pond, North Pond, and a roadside ditch along South G Street that connects to a tributary to Butcher Slough (W-2 through W-6, respectively; all Section 404 waters) (Table 1, Figures 4, 6, 7, and 14). Both Western Pond and Brackish Pond are excavated ponds that are separated from the adjacent tidal waters of McDaniel Slough and eventually the Arcata Bay section of Humboldt Bay by a constructed eco-levee. Water is exchanged between these water bodies through drainpipes and a tide gate in the eco-levee. North Pond (W-4) is manmade pond with no direct surface connection to nearby waterbodies. Future construction may connect this water to the Arcata Bay. The perennial roadside ditch along South G Street, W-5, connects to a tributary to Butcher Slough (W-6) and eventually the Arcata Bay (Figures 6 and 7). At all four locations, the OHWM was identified in the field by a change in slope, lack of vegetation, and/or change in vegetation.

#### 3.3.1.2 Waters of the State and LCP-jurisdictional waters

In addition to all potential USACE-jurisdictional waters described in Section 3.3.1.1, non-federal waters of the State totaled 3.6 acres in the Survey area and included the Arcata WWTP enhancement marshes (SW-01 and SW-02) and AWTF oxidation ponds and treatment marshes (SW-03 through SW-11) (Table 1, Figures 4, 7–9, and 11). These waters are also potential LCP-jurisdictional waters.

Hauser, Gearheart, and Allen enhancement marshes in or adjacent to the Survey area function as enhancement marshes that treat wastewater within the Arcata WWTP. Waters associated with these ponds eventually feedback into the AWTF prior to the receiving waters of the Arcata Bay. These marshes were composed of a mixture of open water and herbaceous emergent vegetation (i.e., *Typha latifolia* [broad-leaved cattail], *Schoenoplectus acutus* var. *occidentalis* [common

tule]). The primary OHWM indicators at these locations included a break in slope and changes in vegetation. Upland vegetation bordered the southern and eastern ends of Hauser Marsh (SW-02) and was best characterized by data point U6 (Appendix A, Figure 6). Vegetation was composed of *Pinus radiata* (Monterey pine, UPL) with an understory of nonnative grasses and forbs. This feature lacked both wetland hydrology and hydric soils.

The AWTF treatment marshes and oxidation ponds are bound by constructed upland levees. The upland levee crests were included in the Survey area. If any riparian vegetation was noted along the levee crest then the riparian canopy edge was delineated as the upland boundary (Figures 7 through 9).

### 3.3.2 Wetlands

There is a total of 2.0 acres of potential USACE-jurisdictional wetlands and an additional 7.2 acres of LCP-jurisdictional wetlands in the Survey area (Table 1; Figures 4–7, 11, 13, and 14; Appendix A).

Wetland types within the Survey area include both nontidal (i.e., palustrine seasonally saturated/flooded or semi-permanently flooded persistent emergent wetlands and palustrine seasonally saturated broadleaved deciduous scrub-shrub wetlands), and tidal (i.e., estuarine regularly flooded persistent emergent wetlands). FGDC (2013) defines the palustrine system as all nontidal wetlands dominated by trees, shrubs, persistent emergent plants, emergent mosses or lichens (i.e., non-vascular) and all similar wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 parts per thousand. Estuarine system is defined as consisting of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land. Emergent wetlands are characterized by erect, rooted herbaceous hydrophytes, excluding mosses and lichens, that are the tallest life form, have at least 30% areal coverage, and are present for most of the growing season in most years (FGDC 2013). Broadleaved deciduous scrub-shrub wetlands are characterized by woody plants of this leaf type that are less than 20 feet tall and are the dominant life form with at least 30% areal coverage (FGDC 2013).

In general, due to landscape position and historic land modification, delineated wetlands did not always border a vegetated upland and a wetland data point was not paired. All constructed features (e.g., paved and graveled roads, trails) in the Survey area were delineated as upland.

#### 3.3.2.1 USACE-jurisdictional wetlands

**Palustrine emergent wetlands**

There are five seasonally saturated palustrine emergent wetlands (0.7 ac), one semi-permanently flooded palustrine emergent wetland (<0.1 ac), and one seasonally flooded palustrine emergent wetland (0.4 ac)in the Survey area (Table 1).

*Seasonally saturated wetlands*

Three seasonally saturated wetlands were located in low gradient depressions between developed trails and South I Street near Gearheart Marsh (SS-01, SS-02, and SS-05, Figure 4). At these locations, vegetation varied from mixed facultative forbs and grasses (SS-01, SS-02) to a dense patch of *Carex obnupta* (slough sedge, OBL; SS-05). Data point W3 characterizes these palustrine emergent wetlands. Dominant vegetation at this location included *Symphyotrichum chilense* (common Pacific aster, FAC), *Juncus effusus* (soft rush, FACW), and *Agrostis capillaris*

(colonial bent, FAC); application of the dominance test using the "50/20 rule" confirmed hydrophytic vegetation was present. The soil profile consisted of clay loam that contained prominent redox concentrations (2–10%) within the upper 15 inches of the soil profile and confirmed the primary hydric soil indicator as redox depressions (F8). Wetland hydrology was established from the presence of oxidized rhizospheres along living roots (C3) (Appendix A). The paired upland data point S2 characterized a two-parameter wetland (TP-01) which lacked hydrophytic vegetation (Figure 4). Dominant upland vegetation at data point S2 included *Convolvulus arvensis* (bindweed, NL/UPL) and *Rubus ursinus* (California blackberry, UPL) (Appendix A).

Another seasonally saturated emergent wetland (SS-03) was located along a vegetated berm adjacent to Brackish Pond (W-2) (Figure 4). Wetland SS-03 is composed of a mixture of facultative plants (e.g., common Pacific aster, *Dipsacus fullonum* [wild teasel], and *Conium maculatum* [poison hemlock]) and upland coastal scrub species (*Baccharis pilularis* [coyote brush]). These facultative species tend to occur in disturbed and, at least periodic, saturated soils in the North Coast region. Some gravel fill was noted within the upper four inches and below 10 inches of the soil profile, however an intact soil horizon was observed within the sample (4–10 inches) and the primary hydric soil indicator of depleted matrix (F3) was confirmed (data point W5, Appendix A). The presence of this hydric soil indicated enough time had elapsed since the 2007 ground disturbance from the creation of Brackish Pond and the area was saturated for long enough period to develop redoximorphic features. Wetland hydrology was established from the presence of the primary indicator, oxidized rhizospheres along living roots (C3) (Appendix A). The upland boundary at this location was delineated by the parking and developed areas along South I Street as well as developed trails (Figure 4).

Seasonal-saturated wetland SS-04 was adjacent to Western Pond (W-3) near a potential mitigation area (Figure 14). Dominant hydrophytic vegetation included *Salix* spp. saplings (various willows, FAC and FACW), *Deschampsia cespitosa* (tufted hair grass, FACW), *Festuca arundinacea* (tall fescue, FAC), and colonial bent. Redoximorphic features within the upper 12 inches of the soil sample confirmed the hydric soil indicator redox dark surface (F6) and the presence of oxidized rhizospheres along living roots confirmed wetland hydrology at this location (Appendix A). Upland boundaries were defined by one- and two-parameter wetlands: OP-01, TP-07, TP-09 and TP-10 (Figure 14).

#### *Semi-permanently flooded wetlands*

A semi-permanently flooded wetland (SP-01) was delineated along the levee toeslope immediately adjacent to Brackish Pond (W-2) (Figure 4). Hydrophytic plant species at this location included common Pacific aster, *Atriplex prostrata* (fat-hen, FAC), *Potentilla anserina* subsp. *pacifica* (Pacific silverweed, OBL), and tufted hair grass. Overstory canopy included *Sequoia sempervirens* (coast redwood, NL/UPL) (data point W6, Appendix A). The soil profile consisted of silty clay loam that contained greater than 60% gleyed matrix and confirmed the primary hydric soil indicator as loamy gleyed matrix (F2). Wetland hydrology was established from the presence of a high-water table five inches from the soil surface with saturation extending to the surface of the soil pit (Appendix A). Wetland SP-01 was bordered by upland developed areas and the wetland SS-03 (Figure 4).

#### *Seasonally flooded wetlands*

The feature known as "No Name Pond" in the AMWS was previously delineated in 2010. This feature was classified as a seasonally flooded wetland (SF-01) during the May 2020 delineation. Review of aerial imagery over the last three decades indicate that most of the open water area in this wetland has since filled in with dense emergent vegetation. Vegetation was primarily

composed of *Typha latifolia* (broadleaved cattail). The northern extent of SF-01 is bound by the Humboldt Bay Trail and the easterly extent is bound by a segment of the AMWS trial network (Figure 6). *Rubus armeniacus* [Himalayan blackberry, FAC] along with other coastal scrub species (i.e., coyote brush, twinberry, California blackberry) form a dense upland thicket along the shoulder and backslope of the adjacent levee/trail prisms.

#### Palustrine broadleaved deciduous scrub-shrub wetlands

Palustrine broadleaved deciduous scrub-shrub wetlands, BL-01 through BL-04, totaled 0.6 acre in the Survey area. BL-01 was located along the seasonally saturated shoulder and backslope of the Hauser Marsh levee along South I Street Road (Figure 4). BL-02 extended along the west side of the Humboldt Bay Trail near the AWTF (Figure 7). BL-03 and BL-04 were just south of the Humboldt Bay Trail segment between AWTF and South I Street (Figure 5).

Canopy within wetland BL-01 included *Salix lasiolepis* (arroyo willow, FACW) and Sitka willow. Herbaceous understory species included nonnative facultative plants common to disturbed sites (i.e., *Trifolium repens* [white clover], *Lotus corniculatus* [bird's-foot trefoil], colonial bent, and *Festuca perennis* [rye grass, FAC]). Hydric soils were determined by the primary indicator depleted matrix and oxidized rhizospheres along living roots confirmed wetland hydrology (data point W4, Appendix A). No paired upland point was identified rather the upland region was delineated by the developed areas of South I Street (Figure 4).

Wetlands BL-02 and BL-03 were previously delineated in 2010 for the Humboldt Bay Trail (North) Project (see Wetland 12 and 14 *in* Winzler & Kelly 2010). Wetlands BL-02 through BL-04 receive seasonal runoff from the adjacent areas (i.e., trails, roadsides, and hillslope) and were primarily composed of woody vegetation (i.e., arroyo willow, *Morella californica* [wax myrtle, FACW], *Rubus ursinus* [California blackberry, FACU], Himalayan blackberry). As such, these features were typed as palustrine seasonally flooded broadleaved deciduous scrub-shrub wetlands during the 2020 delineations (Figures 5 and 7).

Wetland BL-02 formed a low-gradient drainage that connects to the estuarine wetland EP-02 (Figure 7). Riparian vegetation was mostly composed of arroyo willow and wax myrtle. Riparian canopy that extended beyond the drainage area was classified as one-parameter riparian wetlands, R-03 and R-04 (Figure 7). Adjacent upland habitat (UPL-05) was described by data point U4 which is composed of mostly nonnative upland grasses and lacks wetland hydrology and hydric soil indicators (Figure 7, Appendix A).

Wetland BL-03 included the low depressional ditch between the Humboldt Bay Trail and the historic landfill in the AMWS. It connects to the seasonally flooded wetland SF-03 through a culvert (Figure 5). This wetland was composed of arroyo willow, *Lonicera involucrata* (twinberry), *Sambucus racemosa* (red elderberry), and California and Himalayan blackberry. Wetland BL-04 is east of SS-05 and Hauser Marsh within a topographic low depression. It is composed of mostly arroyo willow, Himalayan blackberry, and slough sedge (Figure 5).

#### Estuarine persistent emergent wetlands

Estuarine persistent emergent wetlands (EP-01 and EP-02) in the Survey area contained north coast salt marsh habitat. Wetland EP-01 is regularly flooded by Arcata Bay tidal waters (W-01) (Figure 6). Hydrophytic salt marsh species observed within this wetland included *Salicornia pacifica* (common pickleweed, OBL), *Distichlis spicata* (salt grass, FACW), *Triglochin maritima* (common arrow-grass, OBL), *Jaumea carnosa* (marsh jaumea, OBL), *Spartina densiflora* (dense-flowered cord grass, OBL), fat-hen, tufted hair grass, and *Limonium californicum* (western marsh-rosemary, OBL) (data point W1, Appendix A). Anaerobic soils (e.g., hydrogen sulfide odor) along with other primary indicators (e.g., loamy gleyed matrix and a high-water table) confirmed hydric soils and wetland hydrology at data point W1 (Appendix A). This wetland is bordered by coastal scrub uplands (UPL-02, data point U1) composed of coyote brush, *Helminthotheca echioides* (bristly ox-tongue, FAC), *Rubus armeniacus* (Himalayan blackberry, FAC), California blackberry, poison hemlock, radish, common Pacific aster, and rye grass and one-parameter riparian habitat (R-01 and R-02) (Figure 6, Appendix A).

EP-02 was identified along the west side of the Humboldt Bay Trail (North) and connects to palustrine wetland BL-02 (Figure 7). This feature was located at the upper extent of the HTL and abuts Arcata Bay to the southeast (Figures 1 and 7). EP-02 is composed of north coast salt marsh species, characterized by data point W8 (Figure 7). Hydrophytic vegetation included high cover from tufted hair grass (Appendix A). The soil profile consisted of a matrix 2.5Y4/2–5/2 with high redox concentrations (30%) and depletions (5–15%) and confirmed the hydric soil indicator sandy redox (S5). A high water table was observed at 9.5 inches below the surface. Surrounding uplands, UPL-05, lacked hydric soils and wetland hydrology. Upland vegetation included *Dactylis glomerata* (orchard grass, FACU), *Anthoxanthum odoratum* (sweet vernal grass, FAC), and coyote brush (UPL). An additional upland data point (U5) was collected within the nearby vegetated areas of AWTF (Figure 7). No wetland parameters were observed at this location (Appendix A).

### 3.3.2.2 LCP-jurisdictional wetlands

In addition to all potential USACE-jurisdictional waters and adjacent wetlands described in Sections 3.2.1 and 3.2.2, an additional 6.9 acres of potential LCP-jurisdictional wetlands were identified in the Survey area (Table 1, Figures 4–7, 11, 13, and 14). Boundaries for these wetlands were delineated from data points with one or two positive primary wetland parameters located within the Coastal Zone. Table 2 provides the acreage of each delineated feature in the Survey area.

**Table 2.** Preliminary LCP-jurisdictional wetlands in the Survey area.

| Description | Acreage |
|---|---|
| ***Two-parameter wetlands*** | |
| TP-01 | 0.03 |
| TP-02 | 0.13 |
| TP-03 | 0.05 |
| TP-04 | 0.04 |
| TP-05 | 0.07 |
| TP-06 | 0.02 |
| TP-07 | 0.85 |
| TP-08 | 0.68 |
| TP-09 | 1.70 |
| TP-10 | 1.21 |
| TP-11 | 0.05 |
| TP-12 | 0.03 |
| TP-13 | 0.15 |
| ***One-parameter wetlands*** | |
| R-01 | 0.07 |
| R-02 | 0.06 |
| R-03 | 0.22 |
| R-04 | 0.01 |
| R-05 | 0.02 |
| R-06 | 0.01 |
| R-07 | 0.003 |
| R-08 | 0.12 |
| R-09 | 0.01 |
| R-10 | 0.02 |
| R-11 | 0.02 |
| R-12 | 0.07 |
| R-13 | 0.13 |
| R-14 | 0.03 |
| OP-01 | 1.45 |
| **Overall** | **7.24** |

Two-parameter wetlands (TP-01 and TP-02) between South I Street and Gearheart Marsh lacked hydrophytic vegetation; however, both hydric soils and hydrology were observed (Figure 4). Dominant upland plant species included bindweed and California blackberry. This upland plant composition is likely due to the slightly higher topographic position of these features. TP-11 through TP-13 were similarly positioned along upper shoulder and crest of surrounding levees of Hauser Marsh and No Name Pond and mostly composed of California blackberry with some shrubs of Himalayan blackberry, red elderberry, twinberry, willow, and coyote brush (Figure 11). Additional two-parameter wetlands TP-03 through TP-06 were located in patches along a managed (i.e., mowed) vegetated area between Gearheart and Allen marshes (Figure 4). These wetlands were located along the lower end of the adjacent trail prism and all but TP-03 contained dominant hydrophytic vegetation comprised primarily by *Scirpus microcarpus* (small-fruited bulrush, OBL) with a mixture of facultative and upland species common to disturbed sites (i.e., rye grass, *Raphanus sativus* [radish, NL/UPL], Himalayan blackberry) (Appendix A). A small stand of *Picea sitchensis* (Sitka spruce, FAC) formed TP-03. These two-parameter wetlands were best characterized by data point S4 (Appendix A). Hydrophytic vegetation was dominant and wetland hydrology was confirmed by a high water table at 11.5 inch depth from surface, while

hydric soils were lacking. The upland boundary for these wetlands were delineated by parking and managed areas along South I Street and developed trails as well as by vegetated uplands (UPL-03) characterized by upland data point U2 (Figure 4). At this upland data point, vegetation was dominated by upland ruderal plant species including *Daucus carota* (wild carrot, FACU), rye grass, and radish; both hydric soil and wetland hydrology were lacking (Appendix A).

One- and two-parameter wetlands located at the potential mitigation area near Western Pond did not have wetland hydrology indicators within the sampled soil pits, indicating the water table and saturation were generally below 16 inches in depth but at or near the land surface for a duration sufficient to promote the formation of hydric soils (TP-07–TP-10) and/or to support the growth of hydrophytes (TP-07–TP-10, OP-01) (Appendix A, Figure 14). These wetlands are characterized by vegetation communities commonly associated with seasonally wet conditions including tall fescue meadows (TP-07), *Juncus lescurii* (San Francisco rush, FACW) swales (TP-08), and various aged willow stands (TP-10 [<5 years] and TP-09 [<10 years]). These vegetation communities are common to brackish marshes and low-gradient areas with some tidal influence. Data point S10 best characterizes TP-07 and TP-08 wetlands; data point S9 describes TP-09 and TP-10 (Appendix A). Uplands were delineated where the upland scrub species (e.g., California blackberry) (UPL-02 had established dominant cover and hydric soils and hydrology were lacking (data point U3, Appendix A; Figure 14).

One-parameter riparian wetlands in the Survey area include R-01 through R-13. Wetlands R-01 and R-02 were positioned along the crest and upper slopes of the AWTF levee along Butcher Slough and Arcata Bay (W-1) (Figure 6). Vegetation was primarily hydrophytic tree and shrub species including *Alnus rubra* (red alder, FACW), *Pinus contorta* subsp. *contorta* (shore pine, FAC), wax myrtle, and *Salix* spp. (various willows). The one-parameter riparian wetlands R-01 and R-02 were bound by uplands UPL-01 and UPL-02, which were often managed (i.e., mowed) and composed of upland ruderal herbaceous forbs and grasses (Figure 6, Appendix A). The riparian canopy that extended beyond the narrow drainages near the Humboldt Bay Trail (North) and South G street formed the one-parameter riparian wetlands R-03 and R-04 (Figure 7). The riparian canopy overhang from Allen Marsh was captured in R-14 which abutted the upland AMWS trail network (Figure 4).

The staging area on the northern end of South I Street contains several patches of one-parameter riparian wetlands composed of willow scrub (e.g., arroyo and shining willow) (R-05 through R-13, Figure 13). This staging area is primarily upland developed habitat containing graveled and paved roads as well as large vegetated mounds/spoil piles (Figure 13). Data point S11 best characterizes the one-parameter riparian wetlands observed at this location (Appendix A). Hydrophytic vegetation was dominant while both hydric soils and wetland hydrology were lacking. Other vegetated areas in this staging area were composed of upland ruderal herbaceous species (UPL-07; data point U6, Appendix A). Dominant vegetation at these locations included nonnative *Bromus hordeaceus* (soft chess, FACU), *Plantago lanceolata* (English plantain, FACU), and wild teasel (Appendix A).

### 3.3.3 Upland developed

Four staging areas were assessed during the March 12, 2020 wetland delineation. Except for the staging area along the northern end of South I Street (Figure 13), these features were paved and/or graveled areas with frequent use by the public (e.g., vehicle parking, access) and lacked wetland hydrology, hydrophytic vegetation and hydric soils (Figures 6, 11, and 12). In general, all paved and graveled areas in the Survey area were delineated as upland developed habitat. Data points U6 and U7 characterize the adjacent vegetated upland habitat for the two staging areas

along South I Street (Figures 11 and 13, Appendix A). These features contain upland grassland and coastal scrub species and Monterey pine. The adjacent vegetated habitats of the two staging areas along South G Street were not assessed as the Project activities will not extend beyond the paved/graveled features (Figures 6 and 12). All active trail networks and levee crests in the Survey area were delineated as upland developed habitat (Figures 4 through 11).

# 4 REFERENCES


Baldwin, B. G., D. H. Goldman, D. J. Keil, R. Patterson, and T. J. Rosatti, editors. 2012. The Jepson manual, vascular plants of California. Second edition. University of California Press, Berkeley, California.

CDWR (California Department of Water Resources). 2004, updated. California's groundwater: Bulletin 118. 2003 basins and subbasins of the North Coast Hydrologic Region. http://www.water.ca.gov/groundwater/bulletin118/northcoast.cfm

City of Arcata. 1989. Local Coastal Program (Coastal land use element and implementing ordinances). https://www.cityofarcata.org/DocumentCenter/View/45/1989-Certified-Local-Coastal-Program---Coastal-Land-Use-Element-and-Implementing-Ordinances-PDF

City of Arcata. 2008. City of Arcata General Plan. Arcata, California. https://www.cityofarcata.org/DocumentCenter/View/43/Chapter-4-Environmental-Quality--Management---2-Resource-Conservation--Management-Element-PDF

City of Arcata. 2013. City of Arcata McDaniel Slough Wetland Enhancement Project. Status final report. Arcata, California.

City of Arcata. 2010. Request for Jurisdictional Determination regarding non-waters of the United States; or alternatively, application for waste treatment exemption for existing Arcata Wastewater Treatment ponds/marshes and wetlands.

City of Arcata. 2016. City of Arcata Watersheds. Available online at https://www.cityofarcata.org/DocumentCenter/View/8456/City-of-Arcata-Watersheds-PDF [Accessed November 2019].

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. FWS/OBS-79/31. U.S. Fish and Wildlife Service, Washington, D.C.

FGDC (Federal Geographic Data Committee). 2013. Classification of wetlands and deepwater habitats of the United States. Adapted from Cowardin et al. 1979. Prepared by the Wetlands Subcommittee, Federal Geographic Data Committee, Reston, Virginia.

Fuller, R. H. 1975. Water quality in the Mad River basin, Humboldt and Trinity counties, California. Water Resources Investigations Report, 44-75. USGS, Water Resources Division, Menlo Park, California.

Humboldt Bay Harbor, Recreation, and Conservation District. 2019. Humboldt Bay Harbor, Recreation, and Conservation District. Website. www.humboldtbay.org [December 2019].

Jepson Flora Project, editors. 2019. Jepson eFlora. Website. http://ucjeps.berkeley.edu/eflora/ [Accessed December 2019].

Lichvar, R. W., D. L. Banks, W. N. Kirchner, and N. C. Melvin. 2016. The National wetland plant list: 2016 wetland ratings. Phytoneuron 2016-30: 1–17.

Mersel, M. K., and R. W. Lichvar. 2014. A guide to ordinary high water mark (OHWM) delineation for non-perennial streams in the Western Mountains, Valleys, and Coast Region of the United States. ERDC/CRREL TR-14-1. USACE, Hanover, New Hampshire.

Munsell Color. 2000. Munsell soil color charts, revised washable edition. Munsell Color, Grand Rapids, Michigan.

Murray, A., and R. Wunner. 1988. The Jacoby Creek watershed: past, present, and future. Prepared by Natural Resources Division, Redwood Community Action Agency for the California Wildlife Conservation Board.

National Drought Mitigation Center. 2019. United States Drought Monitor, California. Query for 1 October –29 October 2019. Prepared by B. Fuchs, R. Heim, and D. Simeral, National Drought Mitigation Center. Website. https://droughtmonitor.unl.edu/).

National Drought Mitigation Center. 2020. United States Drought Monitor, California. Query for 3 March –17 March 2020. Prepared by A. Hartman, and D. Bathke, National Drought Mitigation Center. Website. https://droughtmonitor.unl.edu/.

NCDC (National Climatic Data Center). 2019. Climate data. Website. http://www.ncdc.noaa.gov/cdo-web/datatools/ [Accessed December 2019].

NCDC. 2020. Climate data. Website. http://www.ncdc.noaa.gov/cdo-web/datatools/ [Accessed April 2020].

Northern Hydrology & Engineering. 2015. Mean High Water shoreline data, Year 2012. ArcGIS Shape files. Humboldt Bay: sea level rise, hydrodynamic modeling, and inundation vulnerability mapping. Prepared for the California State Coastal Conservancy and the Coastal Ecosystems Institute of Northern California. Prepared by Northern Hydrology & Engineering, McKinleyville, California.

NRCS (U.S. Department of Agriculture Natural Resource Conservation Service). 2017. NRCS Official soil series description: Occidental series. Website. https://soilseries.sc.egov.usda.gov/OSD_Docs/O/OCCIDENTAL.html [Accessed December 2019].

NRCS. 2019a. National list of hydric soils. Website. http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/use/hydric/ [Accessed December 2019 and April 2020].

NRCS. 2019b. Custom soil resource report for Humboldt County, Central Part, California; Wetland Delineation for the Arcata WWTP Improvement Project. Downloaded from NRCS Websoil Survey website: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

NRCWCB (North Coast Regional Water Quality Control Board). 2019. Eureka Plain. Website. https://www.waterboards.ca.gov/northcoast/water_issues/programs/watershed_info/eureka_plain/ [Accessed December 2019].

Pomeroy, C., C. J. Thomson, and M. M. Stevens. 2010. California's North Coast fishing communities historical perspective and recent trends: Eureka fishing community profile. National Oceans and Atmospheres Administration California Sea Grant Program.

USACE (U.S. Army Corps of Engineers). 1956. Office of the District Engineer permit to construct levees to provide a sewage oxidation pond in Humboldt Bay, California. 17 May 1956, to City of Arcata, California from San Francisco District, California, USACE.

USACE. 1987. Corps of Engineers wetlands delineation manual. Technical Report Y-87-1. USACE, Environmental Laboratory, Waterways Experiment Station, Vicksburg, Mississippi.

USACE. 2005. Ordinary high water mark identification. Regulatory Guidance Letter No. 05-05.

USACE. 2007. Practices for documenting jurisdiction under Section 404 of the Clean Water Act (CWA) and Sections 9 & 10 of the Rivers & Harbors Act (RHA) of 1899. Regulatory Guidance Letter 07-01.

USACE. 2010. Regional supplement to the Corps of Engineers wetland delineation manual: western mountains, valleys, and coast region (Version 2.0). Prepared by USACE, Vicksburg, Mississippi.

USEPA (U.S. Environmental Protection Agency) and USACE. 2008. Clean Water Act jurisdiction following the U.S. Supreme Court's decision in Rapanos v. United States & Carabell v. United States. Available at https://www.epa.gov/cwa-404/2008-rapanos-guidance-and-related-documents

USFWS (United States Fish and Wildlife Service). 2020. National Wetlands Inventory (NWI) wetlands and riparian polygon data. Geospatial wetlands data. USFWS, Arlington, Virginia. Website. http://www.fws.gov/wetlands/

Winzler & Kelly. 2010. Wetlands delineation and habitat mapping Rail-With-Trail Connectivity Project, City of Arcata Humboldt County, California. Prepared for K. Diemer, Environmental Services Department, City of Arcata, by Winzler & Kelly, Eureka, California.

# Appendices

# Appendix A

# Wetland Delineation Datasheets

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/2/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: W1

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): tidal marsh; toe slope along levee Local relief (concave, convex, none): none Slope (%): 0-2

Subregion (LRR): LRRA Lat: See EP-01 wetland; data point W1 in map Long: Datum: WGS 84

Soil Map Unit Name: Hydraquents - wassents mucky silt loam NWI classification: E2AB3M

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes X No _____ |
| Hydric Soil Present? | Yes X No _____ | |
| Wetland Hydrology Present? | Yes X No _____ | |

Remarks:

All three wetland parameters are present in the sampled area. Sampled location is within salt marsh along Arcata Bay and is within the Coastal Zone.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 2m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 2m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 1m^2) | | | |
| 1. Spartina densiflora | 60 | Yes | |
| 2. Salicornia pacifica | 25 | Yes | |
| 3. Atriplex prostrata | 5 | | |
| 4. Deschampsia cespitosa | 5 | | |
| 5. Jaumea carnosa | 3 | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 98 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 1m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 10

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No _____

Remarks:

Dominant vegetation is composed of hydrophytic salt marsh species. Additional species include Distichlis spicata and Limonium californicum.

## SOIL

Sampling Point: W1

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Redox Features Type[1] | Redox Features Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-6 | 2.5Y 3/1 | 100 | | | | | mucky silt loam | w/ gravel fill |
| 6-14 | GLEY 14/N | 100 | | | | | mucky silt loam | w/ gravel fill |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☑ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☑ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): 14

**Hydric Soil Present?** Yes X No _____

Remarks:

Gleyed matrix colors confirmed hydric soil indicator loamy gleyed matrix. (Gravel/fill assoicated with adjacent levee) Confirmed Wassents - (Hydric soil)

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☑ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☑ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes X No _____ Depth (inches): 6" from surface

Saturation Present? (includes capillary fringe) Yes X No _____ Depth (inches): 6" to surface

**Wetland Hydrology Present?** Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Arcata Bay tidelands (U.S. Coast Survey 1870)

Remarks:

Multiple primary and secondary indications of wetland hydrology present.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/8/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: W2

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): depression, diked former bay tidelands Local relief (concave, convex, none): concave Slope (%): 0

Subregion (LRR): LRRA Lat: see SS-01 wetland, data point W2 in map Long: Datum: WGS 84

Soil Map Unit Name: Water NWI classification: no listing

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes x No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes x No _____ | **Is the Sampled Area within a Wetland?** Yes x No _____ |
| Hydric Soil Present? | Yes x No _____ | |
| Wetland Hydrology Present? | Yes x No _____ | |

Remarks:

All three wetland parameters are present in the sampled area. Sampled location is within the Coastal Zone.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 2m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 2m2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | = Total Cover | | |
| **Herb Stratum** (Plot size: 2m2) | | | |
| 1. Bromus carinatus | 20 | YES | NL/UPL |
| 2. Holcus lanatus | 20 | YES | FAC |
| 3. Symphyotrichum chilense | 15 | YES | FAC |
| 4. Sonchus asper | 5 | NO | |
| 5. Equisetum arvense | 10 | NO | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 70 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 2m2) | | | |
| 1. Rubus armeniacus | 10 | YES | FAC |
| 2. | | | |
| | 10 = Total Cover | | |

% Bare Ground in Herb Stratum 20

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes x No _____

Remarks:

Dominant vegetation is primarily composed of facultative species and the dominance test passed for hydrophytic vegetation. Vegetation is routinely mowed, location between S. I Street and trail in the Arcata Marsh Wildlife Sanctuary.

## SOIL

Sampling Point: W2

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-8 | 2.5Y 5/2 | 98 | 10YR 5/8 | 2 | C | PL | Clay loam | |
| 8-15 | 5Y 4/1 | 90 | 7.5 YR 4/6 | 10 | C | PL | Clay loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☑ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes X No _____

Remarks:

Located within a low depression, and redoximorphic features present in soil profiled confirming hydric soil indicator redox depressions.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☑ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No high water table or saturation present at location however primary wetland hydrology indicator oxidized rhizospheres along living roots was evident.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/8/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: W3

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): depression, diked former bay tidelands Local relief (concave, convex, none): concave Slope (%): 0

Subregion (LRR): LRRA Lat: see SS-02 wetland; data point W3 in map Long: Datum: WGS 84

Soil Map Unit Name: WATER NWI classification: no listing

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation some, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes X No _____ |
| Hydric Soil Present? | Yes X No _____ | |
| Wetland Hydrology Present? | Yes X No _____ | |

Remarks:

All three wetland parameters are present in the sampled area. Sampled location is within the Coastal Zone.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 3m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 3m2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 3m2) | | | |
| 1. Achillea millefolium | 2 | | |
| 2. Rumex crispus | 10 | | |
| 3. Symphyotrichum chilense | 60 | YES | FAC |
| 4. Ranunculus repens | 3 | | |
| 5. Cyperus eragrostis | 3 | | |
| 6. Juncus effusus | 15 | YES | FACW |
| 7. Oenanthe sarmentosa | 2 | | |
| 8. Agrostis capillaris | 15 | YES | FAC |
| 9. Holcus lanatus | 5 | | |
| 10. Sonchus oleraceus | 10 | | |
| 11. | | | |
| | 125 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 3m2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species | x 1 = |
| FACW species | x 2 = |
| FAC species | x 3 = |
| FACU species | x 4 = |
| UPL species | x 5 = |
| Column Totals: (A) | (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No _____

Remarks:

Dominant vegetation is primarily composed of facultative species and the dominance test passed for hydrophytic vegetation. Vegetation is routinely mowed, location between S. I Street and trail in the Arcata Marsh Wildlife Sanctuary.

## SOIL

Sampling Point: W3

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | % | Redox Features Color (moist) | % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-8 | 2.5Y 5/2 | 98 | 10YR 5/8 | 2 | C | PL | Clay loam | |
| 8-15 | 5Y 4/1 | 90 | 7.5 YR 4/6 | 10 | C | PL | Clay loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☑ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** **Yes** X **No** _____

Remarks:

Located within a low depression, and redoximorphic features present in soil profiled confirming hydric soil indicator redox depressions.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☑ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** X **No** _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No high water table or saturation present at location however primary wetland hydrology indicator oxidized rhizospheres along living roots was evident.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/8/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: W4

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Vegetated levee (former bay tidelands, diked) Local relief (concave, convex, none): none Slope (%): 0-1

Subregion (LRR): LRRA Lat: See BL-01 wetland; data point W4 in maps Long: See GPS WPT 130 Datum: WGS 84

Soil Map Unit Name: Water NWI classification: no listing

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes x No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes x No _____ | **Is the Sampled Area within a Wetland?** Yes x No _____ |
| Hydric Soil Present? | Yes x No _____ | |
| Wetland Hydrology Present? | Yes x No _____ | |

Remarks:

All three wetland parameters are present in the sampled area. Sampled location is within the Coastal Zone. Area located between South I Street and Arcata WWTP Gearheart treatment marsh.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 3m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. Salix lasiolepis | 80 | Yes | FACW |
| 2. Salix (sitchensis) | 20 | Yes | FACW |
| 3. | | | |
| 4. | | | |
| | 80 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 3m2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 3m2) | | | |
| 1. Trifolium repens | 20 | Yes | FAC |
| 2. Lotus corniculatus | 20 | Yes | FAC |
| 3. Agrostis capillaris | 25 | Yes | FAC |
| 4. Festuca perennis | 10 | | |
| 5. Symphyotrichum chilense | 5 | | |
| 6. Juncus effusus | 10 | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 90 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 3m2) | | | |
| 1. Rubus armeniacus | 15 | Yes | FAC |
| 2. | | | |
| | 15 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes x No _____

Remarks:

Dominant midstory canopy composed of fac-wet willow species; herbaceous vegetation is primarily composed of facultative species and the dominance test passed for hydrophytic vegetation. Regular vegetation management (mowing) immediately adjacent to S. I Street

## SOIL

Sampling Point: W4

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-6 | 10YR 4/2 | 100 | | | | | silty clay loam | |
| 6-15 | 10YR 4/1 | 10 | 10YR 6/1 | 50 | D | M | silty clay loam | |
| | | | 7.5YR 5/8 | 40 | C | PL | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes X No _____

Remarks:

Soil profile contains a depleted matrix with redox concentrations.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☑ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☑ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No high water table or saturation present at location however primary wetland hydrology indicator oxidized rhizospheres along living roots was evident

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/3/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: W5

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Vegetated levee berm (Former bay tidelands, diked) Local relief (concave, convex, none): flat/berm Slope (%): 0

Subregion (LRR): LRR A Lat: See SS-03 wetland; Data point W5 in maps Long: Datum: WGS 84

Soil Map Unit Name: Water NWI classification: PEM1B

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes x No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes x No _____ | **Is the Sampled Area within a Wetland?** Yes x No _____ |
| Hydric Soil Present? | Yes x No _____ | |
| Wetland Hydrology Present? | Yes x No _____ | |

Remarks:

All three wetland parameters are present in the sampled area. Sampled area is within the Coastal Zone. Sampled area is along a vegetated levee berm between two Arcata WTTP treatment marshes. Artificial fill within the soil profile.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 4 m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 4 m^2) | | | |
| 1. Baccharis pilularis | 35 | Yes | UPL |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 4 m^2) | | | |
| 1. Symphyotrichum chilense | 40 | Yes | FAC |
| 2. Rumex crispus | 3 | No | |
| 3. Dipsacus fullonum | 2 | No | |
| 4. Daucus carota | 1 | No | |
| 5. Conium maculatum | 2 | No | |
| 6. Juncus effusus | 20 | No | |
| 7. Holcus lanatus | 5 | No | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 73 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 4 m^2) | | | |
| 1. Rubus armeniacus | 45 | Yes | FAC |
| 2. | | | |
| | 45 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 67 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes x No _____

Remarks:

Dominant vegetation is primarily composed of facultative species and the dominance test passed for hydrophytic vegetation.

## SOIL

Sampling Point: W5

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-4 | 10YR 2/1 | 100 | | | | | clay loam | 60% rock |
| 4-8 | 10YR 4/1 | 90 | 10YR 4/6 | 10 | C | PL | silty clay | matrix w/ depleted color |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: base-fill

Depth (inches): 8

**Hydric Soil Present?** Yes X No ____

Remarks:

Disturbed area ; fill observed within the soil sample however band of intact soil layer with redox concentrations in a depleted matrix

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☑ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes ____ No X Depth (inches): ____

Water Table Present? Yes ____ No X Depth (inches): ____

Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): ____

**Wetland Hydrology Present?** Yes X No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Formerly bay tidelands (U.S. Coast Survey 1870); then diked and land had modified use (pasture/industrial)

Remarks:

No high water table or saturation present at location however primary wetland hydrology indicator oxidized rhizospheres along living roots was evident.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/3/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: W6

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): toeslope of levee; fringe to Brackish Pond Local relief (concave, convex, none): concave-flat Slope (%): 0-1

Subregion (LRR): LRRA Lat: See SP-01 wetland, data point W6 in map Long: Datum: WGS 84

Soil Map Unit Name: Water NWI classification: PEM1B

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes X No _____ |
| Hydric Soil Present? | Yes X No _____ | |
| Wetland Hydrology Present? | Yes X No _____ | |

Remarks:

All three wetland parameters are present in the sampled area. Immediately adjacent to Brackish Pond. Sampled location is within the Coastal Zone.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 4 m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. Sequoia sempervirens | 45 | Yes | NL/UPL |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 45 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 4 m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 4 m^2) | | | |
| 1. Symphyotrichum chilense | 40 | Yes | FAC |
| 2. Atriplex prostrata | 40 | Yes | FAC |
| 3. Polypogon monspliensis | 15 | No | |
| 4. Potentilla anserina | 5 | No | |
| 5. Triglochin maritima | 5 | No | |
| 6. Deschampsia cespitosa | 5 | No | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 110 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 4 m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 5

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 67 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes x No _____

Remarks:

Dominant vegetation is primarily composed of facultative species and the dominance test passed for hydrophytic vegetation.

## SOIL

Sampling Point: W6

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-4 | 10YR 3/1 | 100 | | | | | clay loam | |
| 4-11 | GLEY 1 2.5/N | 50 | GLEY 1 4/N | 35 | D | M | silty clay loam | |
| | | | 10YR 4/6 | 15 | C | M | silty clay | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☑ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: Fill/Rock

Depth (inches): 11

**Hydric Soil Present?** Yes X No ____

Remarks:

Soil profile contains a gleyed matrix and confirmed hyrdic soil indicator loamy gleyed matrix.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes ____ No X Depth (inches): ____

Water Table Present? Yes X No ____ Depth (inches): 5" below surface

Saturation Present? (includes capillary fringe) Yes X No ____ Depth (inches): surface to below

**Wetland Hydrology Present?** Yes X No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

A high water table and saturation present throughout the entire soil pit and wetland hydrology was confirmed at this location.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/2/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: W7

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Fringe of excavated pond Local relief (concave, convex, none): concave edge Slope (%): 1

Subregion (LRR): LRRA Lat: See wetland SS-04; data point W7 Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: PEM1D

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes X No _____ |
| Hydric Soil Present? | Yes X No _____ | |
| Wetland Hydrology Present? | Yes X No _____ | |

Remarks:

All three wetland parameters are present in the sampled area. Sampled location is within the Coastal Zone. Adjacent to Western Pond.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 4m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum (Plot size: 4m^2)** | | | |
| 1. Salix (sitchensis) | 5 | Yes | FACW |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 5 = Total Cover | | |
| **Herb Stratum (Plot size: 2m^2)** | | | |
| 1. Deschampsia cespitosa | 25 | Yes | FACW |
| 2. Festuca arundinacea | 30 | Yes | FAC |
| 3. Helminthotheca echioides | 10 | | |
| 4. Agrostis capillaris | 15 | Yes | FAC |
| 5. Achillea millefolium | 5 | | |
| 6. Plantago lanceolata | 5 | | |
| 7. Leontodon saxatilis | 5 | | |
| 8. Potentilla anserina | 2 | | |
| 9. Daucus carota | 15 | Yes | FACU |
| 10. Juncus effusus | 2 | | |
| 11. Lotus corniculatus | 5 | | |
| | 119 = Total Cover | | |
| **Woody Vine Stratum (Plot size: 2m^2)** | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 80 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No _____

Remarks:

Dominant vegetation is primarily composed of facultative species and the dominance test passed for hydrophytic vegetation.

## SOIL

Sampling Point: W7

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | % | Redox Features Color (moist) | % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-4 | 10YR 4/1 | 85 | 10YR 5/8 | 15 | C | PL | silty clay loam | |
| 4-12 | 2.5YR 2.5/1 | 95 | 2.5YR 4/8 | 5 | C | PL | silty clay | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☑ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes X No _____

Remarks:

Soil profile matrix color's with redox concentrations confirms hydric soil indicator redox dark surface.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☑ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial); currently restored wetland along excavated/created Western Pond (McDaniel Slough Project)

Remarks:

No high water table or saturation present at location however primary wetland hydrology indicator oxidized rhizospheres along living roots was evident.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 3/12/2020

Applicant/Owner: City of Arcata State: CA Sampling Point: W8

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): coastal marsh Local relief (concave, convex, none): concave Slope (%): 0

Subregion (LRR): LRRA Lat: see EP-02 Long: Datum: WGS 84

Soil Map Unit Name: Urban land-Anthraltic Xerorthents association, 0–2% slopes. NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No see notes (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No ____ | **Is the Sampled Area within a Wetland?** Yes X No ____ |
| Hydric Soil Present? | Yes X No ____ | |
| Wetland Hydrology Present? | Yes X No ____ | |

Remarks:

The sampled area is within an one-parameter wetland within the Coastal Zone/City of Arcata LCP-jurisdiction. Only hydrophytic vegetation observed at this location. Precipitation below monthly normal, abnormally dry conditions reported (Nat Drought Mit Center 2020)

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 5m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum (Plot size: 3m2)** | | | |
| 1. Baccharis piluaris | 20 | Yes | NL-UPL |
| 2. Salix (hookeriana) | 5 | Yes | FACW |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 25 = Total Cover | | |
| **Herb Stratum (Plot size: 3m2)** | | | |
| 1. Deschampsia cespitosa | 70 | Yes | FAC |
| 2. Holcus lanatus | 8 | No | |
| 3. Foeninulum vulgare | 1 | No | |
| 4. Syphyotrichum chilense | 5 | No | |
| 5. Dispacus fullonum | 5 | No | |
| 6. Helminotheca echoides | 1 | No | |
| 7. Juncus lescurii | 5 | No | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 95 = Total Cover | | |
| **Woody Vine Stratum (Plot size: 3m2)** | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 67 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No ____

Remarks:

Dominance test passed for hydrophytic vegetation. Species composition is a mixture of saltmarsh species bordered by coyote brush and willow

## SOIL

Sampling Point: W8

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | % | Redox Features Color (moist) | % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-14 | 2.5Y4/2 | 65 | 7.5YR5/8 | 30 | C | Pl | sandy clay | |
| " | " | | 2.5Y6/1 | 5 | D | M | Sandy clay | |
| 14-17 | 2.5Y5/2 | 55 | 10YR5/8 | 30 | C | Pl | sandy clay | |
| " | " | | 2.5Y7/1 | 15 | D | M | sandy clay | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☑ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** **Yes** X **No** _____

Remarks:

Soil profile contains redox concentrations in upper 12 inches

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☑ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes X No _____ Depth (inches): 9.5" below surface

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** X **No** _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (industrial)

Remarks:

High water table within the upper 12 inches indicating wetland hydrology in the sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 5/29/2020

Applicant/Owner: City of Arcata State: CA Sampling Point: W9

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): toeslope, drainage on artificial fill Local relief (concave, convex, none): concave Slope (%): 1

Subregion (LRR): LRRA Lat: See BL-03 Long: See GPS WPT Datum: WGS 84

Soil Map Unit Name: Water NWI classification: PSS1C

Are climatic / hydrologic conditions on the site typical for this time of year? Yes _____ No X (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes X No _____ |
| Hydric Soil Present? | Yes X No _____ | |
| Wetland Hydrology Present? | Yes X No _____ | |

Remarks:

All three wetland parameters are present in the sampled area. Sampled area is within the Coastal Zone. Precipitation in May 2020 was above "monthly normal" for the region.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 5m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. Salix lasiolepis | 20 | Yes | FACW |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 20 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 5m2) | | | |
| 1. Salix lasiolepis | 100 | Yes | FACW |
| 2. Lonicera involucrata | 30 | Yes | FAC |
| 3. Sambucus racemosa | 10 | No | FACU |
| 4. | | | |
| 5. | | | |
| | 140 = Total Cover | | |
| **Herb Stratum** (Plot size: 5m2) | | | |
| 1. Ranunculus repens | 5 | Yes | FAC |
| 2. Polystichum munitum | 5 | Yes | FACU |
| 3. Deschampsia cespitosa | 2 | No | FACW |
| 4. Festuca perenne | 5 | Yes | FAC |
| 5. Holcus lanatus | 5 | Yes | FAC |
| 6. Epilobium ciliatum | 5 | Yes | FACW |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 27 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 5m2) | | | |
| 1. Rubus ursinus | 20 | Yes | FACU |
| 2. Rubus armeniacus | 50 | Yes | FAC |
| | 70 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 8 (A)

Total Number of Dominant Species Across All Strata: 10 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 80 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No _____

Remarks:

## SOIL

Sampling Point: W9

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-6 | 7.5YR2.5/1 | 100 | | | | | sandy clay loam | |
| 6-15 | 7.5YR 2.5/1 | 80 | 7.5YR5/8 | 20 | C | PL | sandy clay loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☑ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes X No _____

Remarks:

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☑ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☑ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Three secondary indicators of wetland hydrology are present at this sampling location.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/2/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: S1

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): crest/ upper edge of levee; fluviomarine terrace Local relief (concave, convex, none): convex to flat Slope (%): 0

Subregion (LRR): LRRA Lat: See R-01 riparian, data point S1 in map Long: Datum: WGS 84

Soil Map Unit Name: Urban land-Anthraltic Xerorthents association, 0–2% slopes. NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes _____ No X |
| Hydric Soil Present? | Yes _____ No X | |
| Wetland Hydrology Present? | Yes _____ No X | |

Remarks:

One wetland parameter present (hydrophytic vegetation) and the sampled area is within the Coastal Zone. Riparian vegetation present at this location.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 5 m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. Alnus rubra | 85 | Yes | FACW |
| 2. Pinus contorta ssp. contorta | 15 | No | |
| 3. | | | |
| 4. | | | |
| | 100 | = Total Cover | |
| **Sapling/Shrub Stratum** (Plot size: 5 m^2) | | | |
| 1. Baccharis pilularis | 10 | Yes | NL-UPL |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 10 | = Total Cover | |
| **Herb Stratum** (Plot size: 2 m^2) | | | |
| 1. Symphyotrichum chilense | 20 | Yes | FAC |
| 2. Daucus carota | 5 | No | |
| 3. Vicia sativa ssp. sativa | 2 | No | |
| 4. Raphanus sativus | 5 | No | |
| 5. Achillea millefolium | 2 | No | |
| 6. Plantago lanceolata | 2 | No | |
| 7. Cynosurus echinatus | 5 | No | |
| 8. Festuca perennis | 50 | Yes | FAC |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 101 | = Total Cover | |
| **Woody Vine Stratum** (Plot size: 2 m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 | = Total Cover | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No _____

Remarks:

Dominant vegetation is primarily composed of facultative and fac-wet species and the dominance test passed for hydrophytic vegetation.

## SOIL

Sampling Point: S1

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-13 | 10YR 3/1 | 100 | | | C | PL | sandy loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** **Yes** _____ **No** X

Remarks:

No hydric soil indicators observed in sampled soil profile.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/8/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: S2

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): depression (historic bay tidelands, diked ) Local relief (concave, convex, none): slight concave Slope (%): 1

Subregion (LRR): LRRA Lat: See TP-01 wetland; data point S2 in map Long: Datum: WGS 84

Soil Map Unit Name: Water NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes x No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes _____ | No x | **Is the Sampled Area within a Wetland?** Yes _____ No x |
| Hydric Soil Present? | Yes x | No _____ | |
| Wetland Hydrology Present? | Yes x | No _____ | |

Remarks:

The sampled area is within a two-parameter wetland within the Coastal Zone/City of Arcata LCP-jurisdiction. Both hydric soil and wetland hydrology were identified, however dominant vegetation was composed of upland species.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 3m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 3m2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 2m2) | | | |
| 1. Convolvulus arvensis | 80 | Yes | NL-UPL |
| 2. Holcus lanatus | 20 | No | |
| 3. Agrostis capillaris | 5 | No | |
| 4. Raphanus sativus | 5 | No | |
| 5. Brassica rapa | 5 | No | |
| 6. Festuca perennis | 5 | No | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 120 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 2m2) | | | |
| 1. Rubus ursinus | 30 | Yes | FACU |
| 2. | | | |
| | 30 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes _____ No x

Remarks:

Dominant vegetation is not hydrophytic. Dominance test failed for hydrophytic vegetation. Vegetation is routinely mowed, location between S. I Street and trail in the Arcata Marsh Wildlife Sanctuary.

## SOIL

Sampling Point: S2

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | % | Redox Features Color (moist) | % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-8 | 2.5Y5/2 | 98 | 10YR5/8 | 2 | C | PL | CLAY LOAM | |
| 8-15 | 5Y4/1 | 90 | 7.5YR4/6 | 10 | C | PL | CLAY LOAM | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes X No _____

Remarks:

Soil profile contains a depleted matrix with redox concentrations and confirms hydric soil indicator depleted matrix.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☑ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial); now Arcata Marsh Wildlife Sanctuary

Remarks:

No high water table or saturation present at location however primary wetland hydrology indicator oxidized rhizospheres along living roots was evident.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/8/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: S3

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): fringe of WWTP treatment marsh Local relief (concave, convex, none): sloped Slope (%): 10

Subregion (LRR): LRRA Lat: See TP-02 wetland, data point S3 in map Long: Datum: WGS 84

Soil Map Unit Name: Water NWI classification: PAB3Hh

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes _____ | No X | **Is the Sampled Area within a Wetland?** Yes _____ No X |
| Hydric Soil Present? | Yes X | No _____ | |
| Wetland Hydrology Present? | Yes X | No _____ | |

Remarks:

The sampled area is within a two-parameter wetland within the Coastal Zone/City of Arcata LCP-jurisdiction. Both hydric soil and wetland hydrology were identified, however dominant vegetation was composed of upland species. Adjacent to WWTP treatment marsh.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 3m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 3m2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 3m2) | | | |
| 1. Equisetum arvense | 20 | Yes | FAC |
| 2. Convolvulus arvensis | 15 | Yes | NL-UPL |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 35 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 3m2) | | | |
| 1. Rubus ursinus | 100 | Yes | FACU |
| 2. Rubus armeniacus | 5 | No | |
| | 105 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes _____ No X

Remarks:

Dominance test failed for hydrophytic vegetation. Dominant vegetation is primarily upland species.

## SOIL

Sampling Point: S3

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | % | Redox Features Color (moist) | % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-7 | 10YR 4/1 | 85 | 10YR 5/8 | 15 | C | PL | clay loam | |
| 7-14 | 10YR 4/1 | 80 | 10YR 4/6 | 20 | C | PL | clay loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☑ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** **Yes** X **No** _____

Remarks:

Soil profile matrix color's with redox concentrations confirms hydric soil indicator redox dark surface.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☑ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial); currently adjacent to Arcata WWTP treatment marsh

Remarks:

No high water table or saturation present at location however primary wetland hydrology indicator oxidized rhizospheres along living roots was evident.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/17/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: S4

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): base of trail prism, toeslope (historic bay tidelands/marsh, diked) Local relief (concave, convex, none): toeslope Slope (%): 0

Subregion (LRR): LRRA Lat: See TP-05 wetland; Data point S4 in map Long: Datum: WGS 84

Soil Map Unit Name: Water NWI classification: no listing

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation some, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes _____ No X |
| Hydric Soil Present? | Yes _____ No X | |
| Wetland Hydrology Present? | Yes X No _____ | |

Remarks:

The sampled area is within a two-parameter wetland within the Coastal Zone/City of Arcata LCP-jurisdiction. Both hydrophytic vegetation and wetland hydrology were identified, however hydric soils were lacking.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 4m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 4m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 4m^2) | | | |
| 1. Scirpus microcarpus | 30 | Yes | OBL |
| 2. Raphanus sativus | 20 | Yes | NL/UPL |
| 3. Ranunculus repens | 8 | No | |
| 4. Juncus effusus | 10 | No | |
| 5. Festuca perennis | 20 | Yes | FAC |
| 6. Holcus lanatus | 5 | No | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 93 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 4m^2) | | | |
| 1. Rubus armeniacus | 15 | Yes | FAC |
| 2. | | | |
| | 15 = Total Cover | | |

% Bare Ground in Herb Stratum 15

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No _____

Remarks:

Vegetation is routinely mowed, location between S. I Street and trail in the Arcata Marsh Wildlife Sanctuary.

## SOIL

Sampling Point: S4

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Redox Features Type[1] | Redox Features Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-11 | 10YR 3/2 | 100 | | | | | clay loam w/ gravel | |
| 11-20 | 10YR 3/1 | 100 | | | | | clay loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): n/a

**Hydric Soil Present?** **Yes** _____ **No** X

Remarks:

No hydric soil indicators observed in sampled soil profile.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☑ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes X No _____ Depth (inches): 11.5

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** X **No** _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial); currently Arcata Marsh Wildlife Sanctuary

Remarks:

Water table present 11.5 inches below surface.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/3/2019

Applicant/Owner: City of Arcata/HSU State: CA Sampling Point: S5

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Diked former pasture (historic bay tidelands) Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: See OP-01 wetland, Data point S5 in map Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: PEM1D

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes x No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes x No _____ | **Is the Sampled Area within a Wetland?** Yes _____ No x |
| Hydric Soil Present? | Yes _____ No x | |
| Wetland Hydrology Present? | Yes _____ No x | |

Remarks:

This location is a one-parameter wetland (only hydrophytic vegetation present) within the City of Arcata LCP-jurisdiction/Coastal Zone.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 4 m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 4 m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 4 m^2) | | | |
| 1. Festuca arundinacea | 80 | Yes | FAC |
| 2. Helminthotheca echioides | 10 | No | |
| 3. Dipsacus fullonum | 5 | No | |
| 4. Conium maculatum | 5 | No | |
| 5. Holcus lanatus | 15 | No | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 115 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 4 m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes x No _____

Remarks:

Dominant vegetation is primarily composed of facultative species and the dominance test passed for hydrophytic vegetation.

## SOIL

Sampling Point: S5

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-10 | 10YR 3/2 | 100 | | | | | silt loam | |
| 10-12 | 10YR 3/1 | 98 | 10YR 5/6 | 2 | C | PL | silt loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** **Yes** _____ **No** X

Remarks:

Although some redox features were present, the soil profile did not meet hydric soil indicator parameters.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/17/2019

Applicant/Owner: City of Arcata/HSU State: CA Sampling Point: S6

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Diked former pasture (historic bay tidelands) Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: See OP-01 wetland, Data point S6 in map Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: PEM1D

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No ____ | **Is the Sampled Area within a Wetland?** Yes ____ No X |
| Hydric Soil Present? | Yes ____ No X | |
| Wetland Hydrology Present? | Yes ____ No X | |

Remarks:

This location is a one-parameter wetland (only hydrophytic vegetation present) within the City of Arcata LCP-jurisdiction/Coastal Zone.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 4m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 4m2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 4m2) | | | |
| 1. Conium maculatum | 15 | Yes | FAC |
| 2. Epilobium ciliatum | 5 | Yes | FACW |
| 3. Cirsium vulgare | 5 | Yes | FACU |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 25 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 4m2) | | | |
| 1. Rubus armeniacus | 80 | Yes | FAC |
| 2. | | | |
| | 80 = Total Cover | | |

% Bare Ground in Herb Stratum 20

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No ____

Remarks:

Dominance test passed for hydrophytic vegetation. Species composition is mostly nonnative weed species that are facultative.

## SOIL

Sampling Point: S6

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | % | Redox Features Color (moist) | % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-18 | 10YR 3/2 | 100 | | | | | Silt loam | |
| 18-22 | 10YR 3/2 | 97 | 10YR 5/8 | 1 | C | Pl | Silt loam | |
| | | | 10YR 5/1 | 2 | D | M | Silt loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** **Yes** _____ **No** X

Remarks:

Although some redox features were present, the soil profile did not meet hydric soil indicator parameters.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/17/2019

Applicant/Owner: City of Arcata/HSU State: CA Sampling Point: S7

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Diked coast pasture (former bay tidelands/marsh) Local relief (concave, convex, none): flat Slope (%): 0

Subregion (LRR): LRRA Lat: See OP-02 wetland, data point S7 in map Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: PEM1D

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No ____ (If no, explain in Remarks.)

Are Vegetation X, Soil X, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes ____ No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No ____ | **Is the Sampled Area within a Wetland?** Yes ____ No X |
| Hydric Soil Present? | Yes ____ No X | |
| Wetland Hydrology Present? | Yes ____ No X | |

Remarks:

This location is a one-parameter wetland (only hydrophytic vegetation present) within the City of Arcata LCP-jurisdiction/Coastal Zone.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 4m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 4m2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 4m2) | | | |
| 1. Festuca arundinacea | 15 | No | FAC |
| 2. Elymus repens | 85 | Yes | FAC |
| 3. Holcus lanatus | 5 | No | |
| 4. Daucus carota | 5 | No | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 110 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: ____) | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No ____

Remarks:

## SOIL

Sampling Point: S7

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-17 | 10 YR 3/1 | 98 | 10 YR 5/8 | 1 | C | PL | Silty Loam | |
| | | | 10 YR 6/1 | <1 | D | M | Silty Loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** **Yes** _____ **No** X

Remarks:

No hydric soil indicators observed in sampled soil profile.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/3/2019

Applicant/Owner: City of Arcata/HSU State: CA Sampling Point: S8

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Diked former pasture (historic bay tidelands) Local relief (concave, convex, none): none Slope (%): 0-2

Subregion (LRR): LRRA Lat: See OP-01 wetland, Data point S8 in map Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: PEM1D

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes _____ No X |
| Hydric Soil Present? | Yes _____ No X | |
| Wetland Hydrology Present? | Yes _____ No X | |

Remarks:

This location is a one-parameter wetland (only hydrophytic vegetation present) within the City of Arcata LCP-jurisdiction/Coastal Zone.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 2m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 2m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 2m^2) | | | |
| 1. Conium maculatum | 5 | No | |
| 2. Festuca perennis | 45 | Yes | FAC |
| 3. Symphyotrichum chilense | 45 | Yes | FAC |
| 4. Lotus corniculatus | 5 | No | |
| 5. Trifoilum repens | 10 | No | |
| 6. Raphanus sativus | 10 | No | |
| 7. Ranunculus repens | 10 | No | |
| 8. Cirsium vulgare | 2 | No | |
| 9. Plantago major | 5 | No | |
| 10. Dipsacus fulanum | 15 | No | |
| 11. Daucus carota | 5 | No | |
| | 157 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 2m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No _____

Remarks:

Dominant vegetation is primarily composed of facultative species and the dominance test passed for hydrophytic vegetation.

## SOIL

Sampling Point: S8

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-10 | 10YR 2/2 | 100 | | | | | | fill within profile |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): gravel/fill throughout

**Hydric Soil Present? Yes** _____ **No** X

Remarks:

No hydric soil indicators observed in sampled soil profile.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present? Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/3/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: S9

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Diked former pasture (historic bay tidelands) Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: See TP-09 wetland, Data point S9 in map Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: PEM1D

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes X No _____ |
| Hydric Soil Present? | Yes X No _____ | |
| Wetland Hydrology Present? | Yes _____ No X | |

Remarks:

The sampled area is within a two-parameter wetland within the Coastal Zone/City of Arcata LCP-jurisdiction. Both hydrophytic vegetation and hydric soils were identified and no wetland hydrology indicators were present. Restoration activities (willow plantings) fairly recent.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 8 m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. Picea sitchensis | 10 | | |
| 2. Salix (lasiolepis) | 40 | Yes | FACW |
| 3. Salix lasiandra | 30 | Yes | FACW |
| 4. Salix (sitchensis) | 40 | Yes | FACW |
| | 120 | = Total Cover | |
| **Sapling/Shrub Stratum** (Plot size: 2 m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 | = Total Cover | |
| **Herb Stratum** (Plot size: 2 m^2) | | | |
| 1. Ranunculus repens | 15 | Yes | FAC |
| 2. Conium maculatum | 5 | No | |
| 3. Juncus (patens) | 2 | No | |
| 4. Agrostis capillaris | 20 | Yes | FAC |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 42 | = Total Cover | |
| **Woody Vine Stratum** (Plot size: 2 m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 | = Total Cover | |

% Bare Ground in Herb Stratum 65

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No _____

Remarks:

Dominant vegetation is primarily composed of facultative and fac-wet species and the dominance test passed for hydrophytic vegetation.

## SOIL

Sampling Point: S9

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | % | Redox Features Color (moist) | % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-14 | 10YR 2/1 | 98 | 10YR 5/8 | 2 | C | PL | clay loam | |
| 14-16 | 10YR 2/1 | 90 | 10YR 5/8 | 10 | C | PL | clay loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☑ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): 16

**Hydric Soil Present?** Yes X No _____

Remarks:

Soil profile matrix color's with redox concentrations confirms hydric soil indicator redox dark surface.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial); now restored McDaniel Slough Project

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/17/2019

Applicant/Owner: City of Arcata/HSU State: CA Sampling Point: S10

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Diked former pasture (historic bay tidelands) Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: See TP-07 wetland, Data point S10 in map Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: PEM1D

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes X No _____ | **Is the Sampled Area within a Wetland?** Yes _____ No X |
| Hydric Soil Present? | Yes X No _____ | |
| Wetland Hydrology Present? | Yes _____ No X | |

Remarks:

The sampled area is within a two-parameter wetland within the Coastal Zone/City of Arcata LCP-jurisdiction. Both hydrophytic vegetation and hydric soil were identified, however wetland hydrology indicators were not observed.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 4m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 4m2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 4m2) | | | |
| 1. Conium maculatum | 45 | Yes | FAC |
| 2. Epilobium ciliatum | 1 | No | |
| 3. Festuca arundinaceae | 90 | Yes | FAC |
| 4. Rumex crispus | 5 | No | |
| 5. Holcus lanatus | 8 | No | |
| 6. Galium sp. | 5 | No | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 154 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 4m2) | | | |
| 1. | | | |
| 2. | | | |
| | _____ = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No _____

Remarks:

Dominance test passed for hydrophytic vegetation. Species composition is mostly nonnative species that are facultative.

## SOIL

Sampling Point: S10

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | % | Redox Features Color (moist) | % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-8 | 10YR 3/2 | 100 | | | | | clay loam | |
| 8-16 | 10YR 3/2 | 20 | 10YR 5/8 | 20 | C | Pl | clay loam | |
| 8-16 | | | 10YR 5/1 | 60 | D | M | clay loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☑ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes X No _____

Remarks:

Soil profile contains a depleted matrix with redox concentrations and confirms hydric soil indicator depleted matrix.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 3/12/2020

Applicant/Owner: City of Arcata State: CA Sampling Point: S11

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): coastal plain Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: see R-05 through R-12/13 Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No see notes (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes X | No ____ | **Is the Sampled Area within a Wetland?** Yes ____ No X |
| Hydric Soil Present? | Yes ____ | No X | |
| Wetland Hydrology Present? | Yes ____ | No X | |

Remarks:

The sampled area is within an one-parameter wetland within the Coastal Zone/City of Arcata LCP-jurisdiction. Only hydrophytic vegetation observed at this location. Precipitation below monthly normal, abnormally dry conditions reported (Nat Drought Mit Center 2020)

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 10m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. Salix lasiandra | 10 | Yes | FACW |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 10 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 10m2) | | | |
| 1. Salix (sitchensis) | 10 | Yes | FACW |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 10 = Total Cover | | |
| **Herb Stratum** (Plot size: 5m2) | | | |
| 1. Vicia sativa sativa | 15 | Yes | UPL |
| 2. Mentha puleginum | 10 | Yes | OBL |
| 3. Plantago lanceolata | 5 | No | |
| 4. Cyperus eragrostis | 5 | No | |
| 5. Festuca perenne | 5 | No | |
| 6. Holcus lanatus | 10 | Yes | FAC |
| 7. Bromus hordeacous | 15 | Yes | FACU |
| 8. Trifolium repens | 5 | No | |
| 9. Dipscasus fullonum | 10 | Yes | FAC |
| 10. Anthoxanthum odoratum | 5 | No | |
| 11. | | | |
| | 85 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 5m2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 15

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 71 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes X No ____

Remarks:

Dominance test passed for hydrophytic vegetation. Species composition is a mixture of willow with an understory of mostly herbaceous nonnative species.

## SOIL

Sampling Point: S11

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | % | Redox Features Color (moist) | % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-9 | 10YR 3/1 | 100 | | | | | silty clay loam | contains gravel/fill |
| 9-12 | 10YR 3/1 | 98 | 10YR 4/6 | 2 | C | Pl | silty clay loam | contains gravel/fill |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** **Yes** _____ **No** X

Remarks:

Soil profile contains redox concentrations however located below 6 inches from surface and less than 3" in upper 12" of soil profile and a hydric soil indicator was not confirmed

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/2/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: U1

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Fluviomarine terrace Local relief (concave, convex, none): none Slope (%): 1

Subregion (LRR): LRRA Lat: See UPL-01 upland; data point U1 in map Long: Datum: WGS 84

Soil Map Unit Name: Urban land-Anthraltic Xerorthents association, 0–2% slopes. NWI classification: No listing

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes ____ | No X | **Is the Sampled Area within a Wetland?** Yes ____ No X |
| Hydric Soil Present? | Yes ____ | No X | |
| Wetland Hydrology Present? | Yes ____ | No X | |

Remarks:

No wetland parameters were present and the sampled area is within an upland.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 5 m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. Pinus contorta ssp. contorta | 5 | No | |
| 2. Alnus rubra | 25 | Yes | FAC |
| 3. | | | |
| 4. | | | |
| | 30 | = Total Cover | |
| **Sapling/Shrub Stratum** (Plot size: 5 m^2) | | | |
| 1. Baccharis pilularis | 60 | Yes | NL-UPL |
| 2. Genista monspessulana | 10 | No | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 70 | = Total Cover | |
| **Herb Stratum** (Plot size: 5 m^2) | | | |
| 1. Symphyotrichum chilense | 8 | Yes | FAC |
| 2. Daucus carota | 8 | Yes | FACU |
| 3. Angelica lucida | 1 | No | |
| 4. Dipsacus fullonum | 5 | No | |
| 5. Avena barbata | 2 | No | |
| 6. Anthoxanthum odoratum | 10 | Yes | FACU |
| 7. Plantago lanceolata | 5 | No | |
| 8. Foeniculum vulgare | 3 | No | |
| 9. Festuca arundinacea | 2 | No | |
| 10. Cynosurus echinatus | 5 | No | |
| 11. | | | |
| | 49 | = Total Cover | |
| **Woody Vine Stratum** (Plot size: 5 m^2) | | | |
| 1. Rubus armeniacus | 45 | Yes | FAC |
| 2. | | | |
| | 45 | = Total Cover | |

% Bare Ground in Herb Stratum 45

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes ____ No X

Remarks:

Dominance test not conclusive for hydrophytic vegetaiton and prevalence test not required since hydric soils and wetland hydrology were not observed. Based on dominant upland plant species composition, vegetation is considered upland.

## SOIL

Sampling Point: U1

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-13 | 10YR 3/1 | 100 | | | | | Sandy loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** **Yes** _____ **No** X

Remarks:

No hydric soil indicators observed in sampled soil profile.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/17/2019

Applicant/Owner: City of Arcata State: CA Sampling Point: U2

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): near base of trial prism, toeslope Local relief (concave, convex, none): none Slope (%): 1

Subregion (LRR): LRRA Lat: See UPL-03 upland; datapoint U2 Long: Datum: WGS 84

Soil Map Unit Name: Water NWI classification: no listing

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)

Are Vegetation X, Soil X, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes X No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes _____ | No X | **Is the Sampled Area within a Wetland?** Yes _____ No X |
| Hydric Soil Present? | Yes _____ | No X | |
| Wetland Hydrology Present? | Yes _____ | No X | |

Remarks:

No wetland parameters were present and the sampled area is within an upland.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 4m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 4m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 4m^2) | | | |
| 1. Festuca perennis | 25 | Yes | FAC |
| 2. Ranunculus repens | 2 | | |
| 3. Daucus carota | 25 | Yes | FACU |
| 4. Raphanus sativus | 60 | Yes | NL/UPL |
| 5. Symphyotrichum chilense | 5 | | |
| 6. Geranium (molle) | 2 | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 119 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 4m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 35

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes _____ No X

Remarks:

Dominance test failed for hydrophytic vegetation. Dominant vegetation is primarily upland species. Vegetation is routinely mowed, location between S. I Street and trail in the Arcata Marsh Wildlife Sanctuary.

## SOIL

Sampling Point: U2

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-12 | 7.5YR 3/1 | 100 | | | | | sandy loam | lots of rocks |
| 12-17 | 7.5YR 3/1 | 99 | 7.5YR 5/8 | 1 | C | PL | sandy loam | less fill, lots of sand |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes _____ No X

Remarks:

A lot of mixed fill within the soil profile. Although some redox features were present, the soil profile did not meet hydric soil indicator parameters.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes X No _____ Depth (inches): 14"

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Although water table was observed in the soil pit it was below 12" from the surface and did not pass wetland hydrology parameters for high water table.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 10/3/2019

Applicant/Owner: City of Arcata/HSU State: CA Sampling Point: U3

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): Diked former pasture (historic bay tidelands) Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: See UPL-04 upland, Data point U3 in map Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: PEM1D

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes x No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes _____ | No x | **Is the Sampled Area within a Wetland?** Yes _____ No x |
| Hydric Soil Present? | Yes _____ | No x | |
| Wetland Hydrology Present? | Yes _____ | No x | |

Remarks:

No wetland parameters were present and the sampled area is within an upland.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 2 m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 2m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 2 m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 0 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 2 m^2) | | | |
| 1. Rubus ursinus | 100 | Yes | FACU |
| 2. | | | |
| | 100 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 0 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species _____ | x 1 = _____ |
| FACW species _____ | x 2 = _____ |
| FAC species _____ | x 3 = _____ |
| FACU species _____ | x 4 = _____ |
| UPL species _____ | x 5 = _____ |
| Column Totals: _____ (A) | _____ (B) |

Prevalence Index = B/A = _____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes _____ No x

Remarks:

Dominance test failed for hydrophytic vegetation. Vegetative cover entirely comprised of the upland species California blackberry.

## SOIL

Sampling Point: U3

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-10 | 10YR 3/2 | 100 | | | | | silt loam | |
| 10-12 | 10YR 3/1 | 98 | 10YR 5/6 | 2 | C | PL | silt loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** **Yes** _____ **No** X

Remarks:

Although some redox features were present, the soil profile did not meet hydric soil indicator parameters.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** **Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (pasture/industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 3/12/2020

Applicant/Owner: City of Arcata State: CA Sampling Point: U4

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): coastal plain Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: see UPL-05 Long: Datum: WGS 84

Soil Map Unit Name: Urban land-Anthraltic Xerorthents association, 0–2% slopes NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No see notes (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes x No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes ____ | No x | **Is the Sampled Area within a Wetland?** Yes ____ No x |
| Hydric Soil Present? | Yes ____ | No x | |
| Wetland Hydrology Present? | Yes ____ | No x | |

Remarks:

No wetland parameters were present and the sampled area is within an upland.

Precipitation below monthly normal, abnormally dry conditions reported (Nat Drought Mit Center

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 3m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 3m^2) | | | |
| 1. Baccharis piluaris | 5 | Yes | NL- UPL |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 5 = Total Cover | | |
| **Herb Stratum** (Plot size: 3m^2) | | | |
| 1. Dactylis glomerata | 50 | Yes | FACU |
| 2. Geranium dissectum | 5 | No | |
| 3. Foeniculum vulgare | 5 | No | FACU |
| 4. Rubus armeniacus | 5 | No | |
| 5. Prunella vulgaris | 2 | No | |
| 6. Vicia sp. | 2 | No | |
| 7. Anthoxanthum odoratum | 15 | Yes | FAC |
| 8. Daucus carota | 5 | No | |
| 9. Helminotheca echoides | 2 | No | |
| 10. Holcus lanatus | 10 | No | |
| 11. | | | |
| | 101 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 3m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 10

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes ____ No x

Remarks:

Dominance test failed for hydrophytic vegetation. Vegetative cover comprised of upland species.

## SOIL

Sampling Point: U4

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-6 | 10YR 4/2 | 100 | | | | | mixed fill | fill/gravel |
| 6-10 | 10YR 4/2 | 96 | 10YR5/8 | 4 | C | PL | sandy clay loam | |
| 10-17 | 10YR5/2 | 65 | 10YR5/8 | 30 | C | PL | sandy clay loam | |
| | | | 10YR7/1 | 5 | D | M | sandy clay loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes _____ No X

Remarks:

Redox features were below 6 inches of soil profile and depletions were less than 2 inches in the upper 12 inches from the surface. The soil profile did not meet hydric soil indicator parameters.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 3/12/2020

Applicant/Owner: City of Arcata State: CA Sampling Point: U5

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): coastal plain Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: see UPL-05 Long: Datum: WGS 84

Soil Map Unit Name: Urban land-Anthraltic Xerorthents association, 0–2% slopes NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No see notes (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes x No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes ____ | No x | **Is the Sampled Area within a Wetland?** Yes ____ No x |
| Hydric Soil Present? | Yes ____ | No x | |
| Wetland Hydrology Present? | Yes ____ | No x | |

Remarks:

No wetland parameters were present and the sampled area is within an upland.

~~Precipitation below monthly normal, abnormally dry conditions reported (Nat Drought Mit Center 2020)~~

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 3m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 3m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 3m^2) | | | |
| 1. Bromus diandrus | 45 | Yes | NL-UPL |
| 2. Foeniculum vulgare | 10 | No | |
| 3. Brassica rapa | 20 | Yes | FACU |
| 4. Trifolium dubium | 10 | No | |
| 5. Lamium purpureum | 5 | No | |
| 6. Anthoxanthum odoratum | 5 | No | |
| 7. Festuca (microstachys) | 15 | No | |
| 8. Poa annua | 5 | No | |
| 9. Geranium dissectum | 10 | No | |
| 10. Glyceria declinata | 1 | No | |
| 11. | | | |
| | 126 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 3m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 = Total Cover | | |

% Bare Ground in Herb Stratum 20

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes ____ No x

Remarks:

Dominance test failed for hydrophytic vegetation. Vegetative cover comprised of upland species.

## SOIL

Sampling Point: U5

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-12 | 10YR 3/1 | 100 | | | | | sandy loam | with fill |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: mixed fill/gravel

Depth (inches): 12

**Hydric Soil Present? Yes** ____ **No** X

Remarks:

No redox features present and the soil profile did not meet hydric soil indicator parameters.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes ____ No X Depth (inches): ____

Water Table Present? Yes ____ No X Depth (inches): ____

Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): ____

**Wetland Hydrology Present? Yes** ____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 3/12/2020

Applicant/Owner: City of Arcata State: CA Sampling Point: U6

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): berm Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: see UPL-06 Long: Datum: WGS 84

Soil Map Unit Name: Water NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No see notes (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes x No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes ____ | No x | **Is the Sampled Area within a Wetland?** Yes ____ No x |
| Hydric Soil Present? | Yes ____ | No x | |
| Wetland Hydrology Present? | Yes ____ | No x | |

Remarks:

No wetland parameters were present and the sampled area is within an upland.
Precipitation below monthly normal, abnormally dry conditions reported (Nat Drought Mit Center 2020)

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 5m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. Pinus radiata | 60 | Yes | UPL |
| 2. Pinus contorta contorta | 10 | No | FAC |
| 3. | | | |
| 4. | | | |
| | 70 | = Total Cover | |
| **Sapling/Shrub Stratum** (Plot size: 3m^2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 | = Total Cover | |
| **Herb Stratum** (Plot size: 3m^2) | | | |
| 1. Raphanus sativus | 15 | Yes | NI-UPL |
| 2. Festuca microstachys | 35 | Yes | NI-UPL |
| 3. Briza major | 15 | Yes | NI-UPL |
| 4. Rumex acetosella | 10 | No | |
| 5. Plantago lanceolata | 5 | No | |
| 6. Daucus carota | 2 | No | |
| 7. Holcus lanatus | 10 | No | |
| 8. Eschscholzia californica | 5 | No | |
| 9. Allium triquentra | 8 | No | |
| 10. Anthoxanthum odoratum | 10 | No | |
| 11. | | | |
| | 115 | = Total Cover | |
| **Woody Vine Stratum** (Plot size: 3m^2) | | | |
| 1. | | | |
| 2. | | | |
| | 0 | = Total Cover | |

% Bare Ground in Herb Stratum 10

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes ____ No x

Remarks:

Dominance test failed for hydrophytic vegetation. Vegetative cover comprised of upland species.

## SOIL

Sampling Point: U6

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-12 | 10YR 3/2 | 100 | | | | | mixed fill/ sandy loam | fill/gravel |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present?** Yes _____ No X

Remarks:

The soil profile did not meet hydric soil indicator parameters.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present?** Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 3/12/2020

Applicant/Owner: City of Arcata State: CA Sampling Point: U7

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): coastal plain Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): LRRA Lat: see UPL-07 Long: Datum: WGS 84

Soil Map Unit Name: Occidental, 0 to 2 percent slopes NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No see notes (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes x No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes ____ | No x | **Is the Sampled Area within a Wetland?** Yes ____ No x |
| Hydric Soil Present? | Yes ____ | No x | |
| Wetland Hydrology Present? | Yes ____ | No x | |

Remarks:

No wetland parameters were present and the sampled area is within an upland.
Precipitation below monthly normal, abnormally dry conditions reported (Nat Drought Mit Center 2020)

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 3 m^2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum (Plot size: 3m^2)** | | | |
| 1. Baccharis piluaris | 15 | Yes | NL-UPL |
| 2. Salix hookeriana | 10 | Yes | FACW |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 25 = Total Cover | | |
| **Herb Stratum (Plot size: 3m^2)** | | | |
| 1. Trifolium dubium | 5 | No | |
| 2. Bromus hordeaceaus | 45 | Yes | FACU |
| 3. Plantago lanceolata | 5 | No | |
| 4. Briza major | 5 | No | |
| 5. Daucus carota | 5 | No | |
| 6. Plantago lanceolata | 8 | Yes | FACU |
| 7. Conium maculatum | 5 | No | |
| 8. Lotus corniculatus | 2 | No | |
| 9. Festuca (microstachys) | 2 | No | |
| 10. Brassica rapa | 5 | No | |
| 11. Dispacus fullonum | 8 | Yes | FAC |
| | 95 = Total Cover | | |
| **Woody Vine Stratum (Plot size: 2 m^2)** | | | |
| 1. Rubus armeniacus | 100 | Yes | FACU |
| 2. | | | |
| | 100 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes ____ No x

Remarks:

Dominance test not conclusive for hydrophytic vegetation. Vegetative cover comprised of upland species.

## SOIL

Sampling Point: U7

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-12 | 10YR 3/2 | 100 | | | | | sandy loam | a lot of fill/gravel |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: fill/gravel/rock

Depth (inches): 12

**Hydric Soil Present? Yes ____ No X**

Remarks:

No redox features were present within upper 12 inches of the soil profile which had a lot of fill/gravel and no hydric soil indicator parameters observed.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes ____ No X Depth (inches): ____

Water Table Present? Yes ____ No X Depth (inches): ____

Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): ____

**Wetland Hydrology Present? Yes ____ No X**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Historic bay tidelands (U.S. Coast Survey 1870); formerly diked with modified land use (industrial)

Remarks:

No wetland hydrology indicators observed in sampled area.

## WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: City of Arcata WWTP Improvement City/County: Arcata/ Humboldt Sampling Date: 5/29/2020

Applicant/Owner: City of Arcata State: CA Sampling Point: U8

Investigator(s): Emmalien Craydon/Emily King Teraoka Section, Township, Range: CA T6N (R1E)

Landform (hillslope, terrace, etc.): compacted imported fill, near historic landfill Local relief (concave, convex, none): none Slope (%): 1

Subregion (LRR): LRRA Lat: Long: See GPS WPT Datum: WGS 84

Soil Map Unit Name: Water NWI classification: PEM1A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No X (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

### SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | |
|---|---|---|
| Hydrophytic Vegetation Present? | Yes ____ No X | **Is the Sampled Area within a Wetland?** Yes ____ No X |
| Hydric Soil Present? | Yes ____ No X | |
| Wetland Hydrology Present? | Yes ____ No X | |

Remarks:

No wetland parameters are present and the sampled area is within an upland. Sampled area is within the Coastal Zone. Precipitation in May 2020 was above "monthly normal" for the region.

### VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 3m2) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 0 = Total Cover | | |
| **Sapling/Shrub Stratum** (Plot size: 3m2) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 0 = Total Cover | | |
| **Herb Stratum** (Plot size: 3m2) | | | |
| 1. Anthoxanthum odoratum | 50 | Yes | FACU |
| 2. Festuca perenne | 5 | No | |
| 3. Vicia gigantea | 25 | Yes | NL-UPL |
| 4. Raphanus sativa | 5 | No | |
| 5. Pkantago lanceolata | 1 | No | |
| 6. Hypocharis radicata | 3 | No | |
| 7. Symphyotrichum chilense | 3 | No | |
| 8. Daucus carota | 1 | No | |
| 9. Holcus lanatus | 2 | No | |
| 10. Bromus/Agrostis | 5 | No | |
| 11. Vicia sativa | 5 | No | |
| | 105 = Total Cover | | |
| **Woody Vine Stratum** (Plot size: 3m2) | | | |
| 1. Rubus armeniacus | 15 | Yes | FAC |
| 2. | | | |
| | 15 = Total Cover | | |

% Bare Ground in Herb Stratum 0

**Dominance Test worksheet:**

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33 (A/B)

**Prevalence Index worksheet:**

| Total % Cover of: | Multiply by: |
|---|---|
| OBL species ____ | x 1 = ____ |
| FACW species ____ | x 2 = ____ |
| FAC species ____ | x 3 = ____ |
| FACU species ____ | x 4 = ____ |
| UPL species ____ | x 5 = ____ |
| Column Totals: ____ (A) | ____ (B) |

Prevalence Index = B/A = ____

**Hydrophytic Vegetation Indicators:**

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ 5 - Wetland Non-Vascular Plants[1]
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

**Hydrophytic Vegetation Present?** Yes ____ No X

Remarks:

Dominant vegetation failed the dominance test for hydrophytic vegetation.

## SOIL

Sampling Point: U8

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox Features % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0-8 | 10 YR4/2 | 100 | | | | | silty clay loam | |
| 8-15 | 10YR 4/1 | 90 | 10YR5/8 | 10 | C | PL | silty clay loam | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]:**

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

**Restrictive Layer (if present):**

Type: _____

Depth (inches): _____

**Hydric Soil Present? Yes** _____ **No** X

Remarks:

No hydric soil indicators are present.

## HYDROLOGY

**Wetland Hydrology Indicators:**

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks (D7)

**Field Observations:**

Surface Water Present? Yes _____ No X Depth (inches): _____

Water Table Present? Yes _____ No X Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): _____

**Wetland Hydrology Present? Yes** _____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

No wetland hydrology indicators are present at this sampling location.

**Table 2.** Preliminary LCP-jurisdictional wetlands in the Survey area.

| Description | Acreage |
|---|---|
| ***Two-parameter wetlands*** | |
| TP-01 | 0.03 |
| TP-02 | 0.13 |
| TP-03 | 0.05 |
| TP-04 | 0.04 |
| TP-05 | 0.07 |
| TP-06 | 0.02 |
| TP-07 | 0.85 |
| TP-08 | 0.68 |
| TP-09 | 1.70 |
| TP-10 | 1.21 |
| TP-11 | 0.05 |
| ***One-parameter wetlands*** | |
| R-01 | 0.07 |
| R-02 | 0.04 |
| R-03 | 0.05 |
| R-04 | 0.01 |
| R-05 | 0.02 |
| R-06 | 0.01 |
| R-07 | 0.003 |
| R-08 | 0.12 |
| R-09 | 0.01 |
| R-10 | 0.02 |
| R-11 | 0.02 |
| R-12 | 0.07 |
| R-13 | 0.13 |
| OP-01 | 1.45 |
| **Overall** | **6.9** |

Two-parameter wetlands (TP-01 and TP-02) between South I Street and Gearheart Marsh lacked hydrophytic vegetation; however, both hydric soils and hydrology were observed (Figure 5). Dominant upland plant species included bindweed and California blackberry. This upland plant composition is likely due to the slightly higher topographic position of these features. TP-11 was similarly positioned along the southern extent of Hauser Marsh and mostly comprised of California blackberry (Figure 6). Additional two-parameter wetlands TP-03 through TP-06 were located in patches along a managed (i.e., mowed) vegetated area between Gearheart and Allen marshes (Figure 5). These wetlands were located along the lower end of the adjacent trail prism and all but TP-03 contained dominant hydrophytic vegetation comprised primarily by *Scirpus microcarpus* (small-fruited bulrush, OBL) with a mixture of facultative and upland species common to disturbed sites (i.e., rye grass, *Raphanus sativus* [radish, NL/UPL], Himalayan blackberry) (Appendix A). A small stand of *Picea sitchensis* (Sitka spruce, FAC) formed TP-03. These two-parameter wetlands were best characterized by data point S4 (Appendix A). Hydrophytic vegetation was dominant and wetland hydrology was confirmed by a high water table at 11.5 inch depth from surface, while hydric soils were lacking. The upland boundary for these wetlands were delineated by parking and managed areas along South I Street and developed trails as well as by vegetated uplands (UPL-03) characterized by upland data point U2 (Figure 5). At this upland data point, vegetation was dominated by upland ruderal plant species including

*Daucus carota* (wild carrot, FACU), rye grass, and radish; both hydric soil and wetland hydrology were lacking (Appendix A).

One- and two-parameter wetlands located at the potential mitigation area near Western Pond did not have wetland hydrology indicators within the sampled soil pits, indicating the water table and saturation were generally below 16 inches in depth but at or near the land surface for a duration sufficient to promote the formation of hydric soils (TP-07–TP-10) and/or to support the growth of hydrophytes (TP-07–TP-10, OP-01) (Appendix A, Figure 7). These wetlands are characterized by vegetation communities commonly associated with seasonally wet conditions including tall fescue meadows (TP-07), *Juncus lescurii* (San Francisco rush, FACW) swales (TP-08), and various aged willow stands (TP-10 [<5 years] and TP-09 [<10 years]). These vegetation communities are common to brackish marshes and low-gradient areas with some tidal influence. Data point S10 best characterizes TP-07 and TP-08 wetlands; data point S9 describes TP-09 and TP-10 (Appendix A). Uplands were delineated where the upland scrub species (e.g., California blackberry) (UPL-02 had established dominant cover and hydric soils and hydrology were lacking (data point U3, Appendix A; Figure 7).

One-parameter riparian wetlands in the Survey area include R-01 through R-13. Wetlands R-01 and R-02 were positioned along the crest and upper slopes of the AWTF levee along Butcher Slough and Arcata Bay (W-1) (Figure 4). Vegetation was primarily hydrophytic tree and shrub species including *Alnus rubra* (red alder, FACW), *Pinus contorta* subsp. *contorta* (shore pine, FAC), wax myrtle, and *Salix* spp. (various willows). The one-parameter riparian wetlands R-01 and R-02 were bound by uplands UPL-01 and UPL-02, which were often managed (i.e., mowed) and composed of upland ruderal herbaceous forbs and grasses (Figure 4, Appendix A). The riparian canopy that extended beyond the narrow drainages near the Humboldt Bay Trail (North) and South G street formed the one-parameter riparian wetlands R-03 and R-04 (Figure 4).

The staging area on the northern end of South I Street contains several patches of one-parameter riparian wetlands composed of willow scrub (e.g., arroyo and shining willow) (R-05–R-13, Figure 8). This staging area is primarily upland developed habitat containing graveled and paved roads as well as large vegetated mounds/spoil piles (Figure 8). Data point S11 best characterizes the one-parameter riparian wetlands observed at this location (Appendix A). Hydrophytic vegetation was dominant while both hydric soils and wetland hydrology were lacking. Other vegetated areas in this staging area was comprised of upland ruderal herbaceous species (UPL-07; data point U6 Appendix A). Dominant vegetation at these locations included nonnative *Bromus hordeaceus* (soft chess, FACU), *Plantago lanceolata* (English plantain, FACU), and wild teasel (Appendix A).

### 3.3.3 Upland developed

Four staging areas were assessed during the March 12, 2020 wetland delineation. Except for the staging area along the northern end of South I Street, these features were paved and/or graveled areas with frequent use by the public (e.g., vehicle parking, access) and lacked wetland hydrology, hydrophytic vegetation and hydric soils (Figures 4, 6, 8, and 9). In general, all paved and graveled areas in the Survey area were delineated as upland developed habitat. Data points U6 and U7 characterize the adjacent vegetated upland habitat for the two staging areas along South I Street (Figures 6 and 8, Appendix A). These features contain upland grassland and coastal scrub species and Monterey pine. The adjacent vegetated habitats of the two staging areas along South G Street were not assessed as the Project activities will not extend beyond the paved/graveled features (Figures 4 and 9).

# 4 REFERENCES


Baldwin, B. G., D. H. Goldman, D. J. Keil, R. Patterson, and T. J. Rosatti, editors. 2012. The Jepson manual, vascular plants of California. Second edition. University of California Press, Berkeley, California.

CDWR (California Department of Water Resources). 2004, updated. California's groundwater: Bulletin 118. 2003 basins and subbasins of the North Coast Hydrologic Region. http://www.water.ca.gov/groundwater/bulletin118/northcoast.cfm

City of Arcata. 1989. Local Coastal Program (Coastal land use element and implementing ordinances). https://www.cityofarcata.org/DocumentCenter/View/45/1989-Certified-Local-Coastal-Program---Coastal-Land-Use-Element-and-Implementing-Ordinances-PDF

City of Arcata. 2008. City of Arcata General Plan. Arcata, California. https://www.cityofarcata.org/DocumentCenter/View/43/Chapter-4-Environmental-Quality--Management---2-Resource-Conservation--Management-Element-PDF

City of Arcata. 2013. City of Arcata McDaniel Slough Wetland Enhancement Project. Status final report. Arcata, California.

City of Arcata. 2010. Request for Jurisdictional Determination regarding non-waters of the United States; or alternatively, application for waste treatment exemption for existing Arcata Wastewater Treatment ponds/marshes and wetlands.

City of Arcata. 2016. City of Arcata Watersheds. Available online at https://www.cityofarcata.org/DocumentCenter/View/8456/City-of-Arcata-Watersheds-PDF [Accessed November 2019].

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. FWS/OBS-79/31. U.S. Fish and Wildlife Service, Washington, D.C.

FGDC (Federal Geographic Data Committee). 2013. Classification of wetlands and deepwater habitats of the United States. Adapted from Cowardin et al. 1979. Prepared by the Wetlands Subcommittee, Federal Geographic Data Committee, Reston, Virginia.

Fuller, R. H. 1975. Water quality in the Mad River basin, Humboldt and Trinity counties, California. Water Resources Investigations Report, 44-75. USGS, Water Resources Division, Menlo Park, California.

Humboldt Bay Harbor, Recreation, and Conservation District. 2019. Humboldt Bay Harbor, Recreation, and Conservation District. Website. www.humboldtbay.org [December 2019].

Jepson Flora Project, editors. 2019. Jepson eFlora. Website. http://ucjeps.berkeley.edu/eflora/ [Accessed December 2019 and April 2020].

Lichvar, R. W., D. L. Banks, W. N. Kirchner, and N. C. Melvin. 2016. The National wetland plant list: 2016 wetland ratings. Phytoneuron 2016-30: 1–17.

Mersel, M. K., and R. W. Lichvar. 2014. A guide to ordinary high water mark (OHWM) delineation for non-perennial streams in the Western Mountains, Valleys, and Coast Region of the United States. ERDC/CRREL TR-14-1. USACE, Hanover, New Hampshire.

Munsell Color. 2000. Munsell soil color charts, revised washable edition. Munsell Color, Grand Rapids, Michigan.

Murray, A., and R. Wunner. 1988. The Jacoby Creek watershed: past, present, and future. Prepared by Natural Resources Division, Redwood Community Action Agency for the California Wildlife Conservation Board.

National Drought Mitigation Center. 2019. United States Drought Monitor, California. Query for 1 October –29 October 2019. Prepared by B. Fuchs, R. Heim, and D. Simeral, National Drought Mitigation Center. Website. https://droughtmonitor.unl.edu/).

National Drought Mitigation Center. 2020. United States Drought Monitor, California. Query for 3 March –17 March 2020. Prepared by A. Hartman, and D. Bathke, National Drought Mitigation Center. Website. https://droughtmonitor.unl.edu/.

NCDC (National Climatic Data Center). 2019. Climate data. Website. http://www.ncdc.noaa.gov/cdo-web/datatools/ [Accessed December 2019].

NCDC. 2020. Climate data. Website. http://www.ncdc.noaa.gov/cdo-web/datatools/ [Accessed April 2020].

Northern Hydrology & Engineering. 2015. Mean High Water shoreline data, Year 2012. ArcGIS Shape files. Humboldt Bay: sea level rise, hydrodynamic modeling, and inundation vulnerability mapping. Prepared for the California State Coastal Conservancy and the Coastal Ecosystems Institute of Northern California. Prepared by Northern Hydrology & Engineering, McKinleyville, California.

NRCS (U.S. Department of Agriculture Natural Resource Conservation Service). 2017. NRCS Official soil series description: Occidental series. Website. https://soilseries.sc.egov.usda.gov/OSD_Docs/O/OCCIDENTAL.html [Accessed December 2019].

NRCS. 2019a. National list of hydric soils. Website. http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/use/hydric/ [Accessed December 2019 and April 2020].

NRCS. 2019b. Custom soil resource report for Humboldt County, Central Part, California; Wetland Delineation for the Arcata WWTP Improvement Project. Downloaded from NRCS Websoil Survey website: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

NRCWCB (North Coast Regional Water Quality Control Board). 2019. Eureka Plain. Website. https://www.waterboards.ca.gov/northcoast/water_issues/programs/watershed_info/eureka_plain/ [Accessed December 2019].

Pomeroy, C., C. J. Thomson, and M. M. Stevens. 2010. California's North Coast fishing communities historical perspective and recent trends: Eureka fishing community profile. National Oceans and Atmospheres Administration California Sea Grant Program.

USACE (U.S. Army Corps of Engineers). 1987. Corps of Engineers wetlands delineation manual. Technical Report Y-87-1. USACE, Environmental Laboratory, Waterways Experiment Station, Vicksburg, Mississippi.

USACE. 2005. Ordinary high water mark identification. Regulatory Guidance Letter No. 05-05.

USACE. 2007. Practices for documenting jurisdiction under Section 404 of the Clean Water Act (CWA) and Sections 9 & 10 of the Rivers & Harbors Act (RHA) of 1899. Regulatory Guidance Letter 07-01.

USACE. 2010. Regional supplement to the Corps of Engineers wetland delineation manual: western mountains, valleys, and coast region (Version 2.0). Prepared by USACE, Vicksburg, Mississippi.

USEPA (U.S. Environmental Protection Agency) and USACE. 2008. Clean Water Act jurisdiction following the U.S. Supreme Court's decision in Rapanos v. United States & Carabell v. United States. Available at https://www.epa.gov/cwa-404/2008-rapanos-guidance-and-related-documents

USFWS (United States Fish and Wildlife Service). 2020. National Wetlands Inventory (NWI) wetlands and riparian polygon data. Geospatial wetlands data. USFWS, Arlington, Virginia. Website. http://www.fws.gov/wetlands/

Winzler & Kelly. 2010. Wetlands delineation and habitat mapping Rail-With-Trail Connectivity Project, City of Arcata Humboldt County, California. Prepared for K. Diemer, Environmental Services Department, City of Arcata, by Winzler & Kelly, Eureka, California.

| Survey area features | Permanent impacts (acre) | Temporary Impacts (acre) | No Impacts (acre) | Total Acreage in Survey area |
|---|---|---|---|---|
| ***Preliminary USACE-jurisdictional waters of the U.S., including wetlands*** | | | | |
| **Seasonally saturated/flooded palustrine broadleaved deciduous scrub-shrub wetlands** | **0.001** | **0.04** | **0.53** | **0.57** |
| BL-01 | | | 0.26 | 0.26 |
| *BL-02* | *0.001* | *0.04* | *0.03* | *0.08* |
| BL-03 | | | 0.16 | 0.16 |
| BL-04 | | | 0.07 | 0.07 |
| **Estuarine regularly flooded persistent emergent wetlands** | **0** | **0.002** | **0.28** | **0.29** |
| EP-01 | | | 0.26 | 0.26 |
| *EP-02* | | *0.002* | *0.02* | *0.02* |
| **Seasonally flooded palustrine persistent emergent wetlands** | **0** | **0** | **0.38** | **0.38** |
| SF-01 | | | 0.38 | 0.38 |
| **Seasonally saturated palustrine persistent emergent wetlands** | **0.01** | **0.03** | **0.67** | **0.71** |
| SS-01 | | | 0.05 | 0.05 |
| SS-02 | | | 0.03 | 0.03 |
| *SS-03* | *0.01* | *0.03* | *0.08* | *0.12* |
| SS-04 | | | 0.42 | 0.42 |
| SS-05 | | | 0.09 | 0.09 |
| **Semipermanently flooded palustrine persistent emergent wetlands** | **0.02** | **0.02** | **0.02** | **0.06** |
| *SP-01* | *0.02* | *0.02* | *0.02* | *0.06* |
| **Waters** | **0.01** | **0.01** | **2.98** | **2.99** |
| Arcata Bay (Humboldt Bay) (W-1) | | | 0.30 | 0.30 |
| *Brackish Pond (W-2)* | *0.01* | *0.01* | *0.09* | *0.10* |
| Western Pond (W-3) | | | 1.81 | 1.81 |
| North Pond (W-4) | | | 0.74 | 0.74 |
| Roadside Ditch (W-5) | | | 0.04 | 0.04 |
| Tributary to Butcher Slough (W-06) | | | 0.01 | 0.01 |
| **Total** | **0.04** | **0.10** | **4.86** | **5.00** |
| ***Additional Waters of the State*** | | | | |
| **Waters of the State (Arcata WWTP enhancement marshes)** | **0** | **0** | **0.58** | **0.58** |
| SW-01 | | | 0.42 | 0.42 |
| SW-02 | | | 0.17 | 0.17 |
| **Waters of the State (AWTF treatment marshes and oxidation ponds)** | **0.0004** | **0.05** | **2.99** | **3.04** |
| *SW-03* | | *0.00005* | *0.19* | *0.19* |
| SW-04 | | | 0.07 | 0.07 |
| SW-05 | | | 0.10 | 0.10 |
| *SW-06* | *0.0004* | *0.05* | *1.02* | *1.06* |
| SW-07 | | | 0.14 | 0.14 |
| SW-08 | | | 0.02 | 0.02 |
| SW-09 | | | 0.07 | 0.07 |
| SW-10 | | | 0.03 | 0.03 |
| *SW-11* | | *0.001* | *1.36* | *1.36* |
| **Total** | **0.0004** | **0.05** | **3.58** | **3.63** |
| ***Additional LCP-jurisdictional wetlands*** | | | | |
| **Two-parameter** | **0** | **0.05** | **4.97** | **5.02** |
| TP-01 | | | 0.03 | 0.03 |
| TP-02 | | | 0.13 | 0.13 |
| *TP-03* | | *0.01* | *0.04* | *0.05* |
| *TP-04* | | *0.02* | *0.02* | *0.04* |
| *TP-05* | | *0.02* | *0.06* | *0.07* |
| *TP-06* | | *0.01* | *0.01* | *0.02* |
| TP-07 | | | 0.85 | 0.85 |
| TP-08 | | | 0.68 | 0.68 |
| TP-09 | | | 1.70 | 1.70 |

| | | | | |
|---|---|---|---|---|
| TP-10 | | | 1.21 | 1.21 |
| TP-11 | | | 0.05 | 0.05 |
| TP-12 | | | 0.03 | 0.03 |
| TP-13 | | | 0.15 | 0.15 |
| **One-parameter** | **0** | **0** | **1.45** | **1.45** |
| OP-01 | | | 1.45 | 1.45 |
| **Riparian** | **0** | **0.06** | **0.71** | **0.77** |
| R-01 | | | 0.07 | 0.07 |
| R-02 | | | 0.06 | 0.06 |
| *R-03* | | *0.05* | *0.17* | *0.22* |
| R-04 | | | 0.01 | 0.01 |
| R-05 | | | 0.02 | 0.02 |
| R-06 | | | 0.01 | 0.01 |
| R-07 | | | 0.00 | 0.003 |
| R-08 | | | 0.12 | 0.12 |
| R-09 | | | 0.01 | 0.01 |
| R-10 | | | 0.02 | 0.02 |
| R-11 | | | 0.02 | 0.02 |
| R-12 | | | 0.07 | 0.07 |
| R-13 | | | 0.13 | 0.13 |
| *R-14* | | *0.003* | *0.03* | *0.03* |
| **Total** | **0** | **0.11** | **7.13** | **7.24** |
| | | ***Non-Jurisdictional Uplands*** | | |
| **Vegetated upland** | **0.01** | **0.38** | **8.89** | **9.28** |
| *UPL-01* | *0.00* | *0.09* | *0.49* | *0.58* |
| UPL-02 | | | 0.16 | 0.16 |
| *UPL-03* | | *0.07* | *0.17* | *0.24* |
| UPL-04 | | | 0.83 | 0.83 |
| *UPL-05* | *0.002* | *0.12* | *0.89* | *1.01* |
| *UPL-06* | *0.001* | *0.05* | *0.51* | *0.56* |
| UPL-07 | | | 3.45 | 3.45 |
| *UPL-08* | *0.001* | *0.01* | *0.11* | *0.12* |
| *UPL-09* | | *0.02* | *0.16* | *0.18* |
| UPL-10 | | | 0.01 | 0.01 |
| *UPL-11* | *0.0003* | *0.02* | *0.01* | *0.03* |
| UPL-12 | | | 0.17 | 0.17 |
| UPL-13 | | | 0.02 | 0.02 |
| UPL-14 | | | 0.45 | 0.45 |
| *UPL-15* | *0.001* | *0.01* | *0.08* | *0.08* |
| *UPL-16* | | *0.01* | *0.02* | *0.03* |
| UPL-17 | | | 0.07 | 0.07 |
| UPL-18 | | | 0.59 | 0.59 |
| UPL-19 | | | 0.70 | 0.70 |
| **Developed** | **0.02** | **1.32** | **13.16** | **14.50** |
| **Total** | **0.03** | **1.70** | **22.05** | **23.77** |




# ARCATA WWTP UPGRADES, CALIFORNIA

## *PROJECT IMPACTS*

DATA SOURCES
Imagery: ESRI world service
Roads, cities, streams and waterbodies: ESRI world service

MAP PROJECTION
NAD_1983_UTM_Zone_10N
Transverse_Mercator

## LEGEND

- Adjacent tile
- Survey area
- Permanent impact
- Temporary impact

**Wetland type**

- Seasonally saturated palustrine persistent emergent wetlands (SS)
- Semipermanently flooded palustrine persistent emergent (SP)
- Developed
- Waters (W)
- Two-parameter (TP)
- One-parameter riparian (R)
- Vegetated upland (UPL)

Stillwater Sciences

## SCALE & NORTH ARROW

0 50 100 200 Feet
0 15 30 60 Meters

1:2,000 1 in = 51 meters

## MAP LOCATION TILE 1 OF 4






# ARCATA WWTP UPGRADES, CALIFORNIA

## *PROJECT IMPACTS*

DATA SOURCES
Imagery: ESRI world service
Roads, cities, streams and waterbodies: ESRI world service

MAP PROJECTION
NAD_1983_UTM_Zone_10N
Transverse_Mercator

### LEGEND

- Adjacent tile
- Survey area
- Permanent impact
- Temporary impact

**Wetland type**

- Developed
- Vegetated upland (UPL)

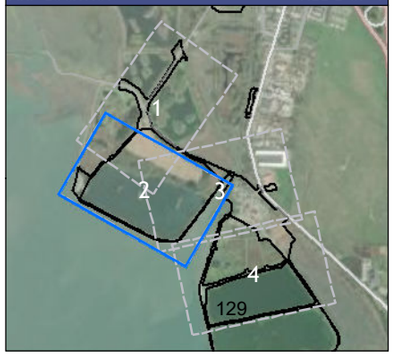
Stillwater Sciences

### SCALE & NORTH ARROW

0 50 100 200 Feet
0 15 30 60 Meters

1:2,000 1 in = 51 meters

### MAP LOCATION TILE 2 OF 4






# ARCATA WWTP UPGRADES, CALIFORNIA

## *PROJECT IMPACTS*

DATA SOURCES
Imagery: ESRI world service
Roads, cities, streams and waterbodies: ESRI world service

MAP PROJECTION
NAD_1983_UTM_Zone_10N
Transverse_Mercator

### LEGEND

- Adjacent tile
- Survey area
- Permanent impact
- Temporary impact

**Wetland type**

- Developed
- Estuarine regularly flooded persistent emergent (EP)
- One-parameter riparian (R)
- Seasonally saturated/flooded palustrine broadleaved deciduous scrub-shrub (BL)
- Vegetated upland (UPL)

Stillwater Sciences

### SCALE & NORTH ARROW

0 50 100 200 Feet
0 15 30 60 Meters

1:2,000 1 in = 51 meters

### MAP LOCATION TILE 3 OF 4






# ARCATA WWTP UPGRADES, CALIFORNIA

## *PROJECT IMPACTS*

DATA SOURCES
Imagery: ESRI world service
Roads, cities, streams and waterbodies: ESRI world service

MAP PROJECTION
NAD_1983_UTM_Zone_10N
Transverse_Mercator

### LEGEND

- Adjacent tile
- Survey area
- Permanent impact
- Temporary impact

**Wetland type**

- Developed
- Waters of the State (SW)
- Vegetated upland (UPL)

Stillwater Sciences

### SCALE & NORTH ARROW

0 50 100 200 Feet
0 15 30 60 Meters

1:2,000 1 in = 51 meters

### MAP LOCATION TILE 4 OF 4



# Attachment D

# City of Arcata Floodplain Ordinance

# Adopted November 2, 2016

**ORDINANCE NO. 1479**

**AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF ARCATA AMENDING THE ARCATA MUNICIPAL CODE PERTAINING TO FLOOD HAZARD MITIGATION STANDARDS**

The City Council of the City of Arcata does ordain as follows:

Section 1: Title VII—Building Regulations, Chapter 4—Flood Hazard Mitigation Standards of the Arcata Municipal Code is hereby adopted as follows:

**TITLE VIII—Building Regulations**
**CHAPTER 4—Flood Hazard Mitigation Standards**

**SEC. 8400. Purpose.**

The provisions of this Chapter are intended to protect the public health, safety, and general welfare, and to minimize public and private losses due to flood conditions in specific areas by minimum floodplain standards designed:

A. To protect human life and health;

B. To minimize expenditure of public money for costly flood control projects;

C. To minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;

D. To minimize prolonged business interruptions;

E. To minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets and bridges located in areas of special flood hazard;

F. To help maintain a stable tax base by providing for the second use and development of areas of special flood hazard so as to minimize future flood blight areas;

G. To insure that potential buyers are notified that property is in an area of special flood hazard; and

H. To insure that those who occupy the areas of special flood hazard assume responsibility for their actions.

This Chapter also implements regulations to meet Federal Emergency Management Agency (FEMA) requirements for managing flood hazards.

**SEC. 8401. Definitions.** Unless a provision explicitly states otherwise, the following terms and phrases, as used in the Chapter, are defined as follows:

"**A zone**" means "Special flood hazard area," as defined herein.

"**Accessory structure**" means a structure that is either:

A. Solely for the parking of no more than 2 cars; or

B. A small, low cost shed for limited storage, less than 150 square feet and $1,500 in value.

"**Accessory use**" means a use which is incidental and subordinate to the principal use of the parcel of land on which it is located.

"**Alluvial fan**" means a geomorphologic feature characterized by a cone or fan-shaped deposit of boulders, gravel, and fine sediments that have been eroded from mountain slopes, transported by flood flows, and then deposited on the valley floors, and which is subject to flash flooding, high velocity flows, debris flows, erosion, sediment movement and deposition, and channel migration.

"**Apex**" means a point on an alluvial fan or similar landform below which the flow path of the major stream that formed the fan becomes unpredictable and alluvial fan flooding can occur.

**"Area of shallow flooding"** means a designated AO, AH or Zone on the Flood Insurance Rate Map (FIRM). The base flood depth ranges from one to three feet; a clearly defined channel does not exist; the path of flooding is unpredictable and indeterminate; and velocity flow may be evident. Such flooding is characterized by ponding or sheet flow.

"**Area of special flood hazard**" means "Special flood hazard area" as defined herein.

**"Base flood"** means a flood which has a one percent chance of being equaled or exceeded in any given year (also called the "100-year flood"). Base flood is the term used throughout this Chapter.

"**Base flood elevation**" (BFE) means the elevation shown on the Flood Insurance Rate Map for Zones AE, VE, and B and C that indicates the water surface elevation resulting from a flood that has a 1-percent or greater chance of being equaled or exceeded in any given year.

**"Basement"** means any area of a building having its floor subgrade—i.e. below ground level—on all sides.

**"Breakaway wall"** means any type of wall, whether solid or lattice, and constructed of concrete, masonry, wood, metal, plastic or any other suitable building material that is not part of the structural support of the building, and is designed to break away under abnormally high tides or wave action without causing any damage to the structural integrity of the building on which they are used or any building to which they might be carried by flood waters. A breakaway wall shall have a safe design loading resistance of not less than ten and no more than twenty pounds per square foot. The use of breakaway walls must be certified by a registered civil engineer or architect and shall meet the following conditions:

A. Breakaway wall collapse shall result from a water load less than that which would occur during the base flood; and
B. The elevated portion of the building shall not incur structural damage due to the effects of wind and water loads acting simultaneously in the event of the base flood.

**"Building**" means "Structure."

**"Coastal High Hazard Area"** means an area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources. It is an area subject to high velocity waters, including

coastal and tidal inundation or tsunamis. The area is designated on a Flood Insurance Rate Map (FIRM) as Zone VE, or V.

"**Development**" means any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

"**Encroachment**" means the advance or infringement of uses, plant growth, fill, excavation, buildings, permanent structures or development into a floodplain which may impede or alter the flow capacity of a floodplain.

**"Exception"** means a grant of relief from the requirements of this Chapter pursuant to Section 8406, which permits construction in a manner that would otherwise be prohibited by this Chapter.

"**Existing manufactured home park or subdivision**" means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including, at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed before November 4, 2016 .

"**Expansion to an existing manufactured home park or subdivision**" means the preparation of additional sites by the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads).

"**Flood, flooding, or flood water**" means:

A. A general and temporary condition of partial or complete inundation of normally dry land areas from the overflow of inland or tidal waters; the unusual and rapid accumulation or runoff of surface waters from any source; and/or mudslides (i.e., mudflows); and

B. The condition resulting from flood-related erosion.

**"Flood Boundary, and Floodway Map (FBFM)"** means the official map on which the Federal Emergency Management Agency or Federal Insurance Administration has delineated both the areas of special flood hazards and the floodway.

**"Flood Insurance Rate Map (FIRM)"** means the official map on which the Federal Emergency Management Agency or Federal Insurance Administration has delineated both the areas of special flood hazards and the risk premium zones applicable to the community.

**"Flood Insurance Study"** means the official report provided by the Federal Insurance Administration that includes flood profiles, the FIRM, the Flood Boundary and Floodway Map, and the water surface elevation of the base flood.

"**Floodplain or flood-prone area**" means any land area susceptible to being inundated by water from any source—see "Flooding."

"**Floodplain Administrator**" is the community official designated by title to administer and enforce the floodplain management regulations .

**“Floodplain management**” means the operation of an overall program of corrective and preventive measures for reducing flood damage and preserving and enhancing, where possible, natural resources in the floodplain, including but not limited to emergency preparedness plans, flood control works, flood plain management regulations and open space plans.

**“Floodplain management regulations”** means Chapter 4 of Title VIII of the Arcata Municipal Code and any zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances (such as grading ordinance and erosion control) and other applications of police power which control development in flood-prone areas. This term describes federal, state or local regulations in any combination, which provide standards for the purpose of flood loss and damage prevention and reduction.

**“Floodproofing”** means any combination of structural and non-structural additions, changes, or adjustments to structures which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures and their contents. For guidelines on dry and wet floodproofing, see FEMA Technical Bulletins TB 1-93, TB 3-93 and TB 7-93.

**“Floodway”** means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot. Also referred to as "Regulatory Floodway."

**“Floodway fringe”** means that area of the floodplain on either side of the "Regulatory Floodway" where encroachment may be permitted.

"**Fraud and victimization**" as related to Section 8406 of this Chapter, means that the variance granted must not cause fraud on or victimization of the public. In examining this requirement, the City of Arcata will consider the fact that every newly constructed building adds to government responsibilities and remains a part of the community for fifty to one-hundred years. Buildings that are permitted to be constructed below the base flood elevation are subject during all those years to increased risk of damage from floods, while future owners of the property and the community as a whole are subject to all the costs, inconvenience, danger, and suffering that those increased flood damages bring. In addition, future owners may purchase the property, unaware that it is subject to potential flood damage, and can be insured only at very high flood insurance rates.

**“Functionally Dependent Use”** means a use that cannot perform its intended purpose unless it is located or carried out in close proximity to water. The term includes only docking facilities, port facilities that are necessary for the loading and unloading of cargo or passengers, and ship building and ship repair facilities, but does not include long-term storage or related manufacturing facilities.

"**Governing body**" means the City Council of the City of Arcata.

"**Hardship**" as related to Section 8406 of this Chapter means the exceptional hardship that would result from a failure to grant the requested exception. The City of Arcata requires that the exception be unusual and peculiar to the property involved. Mere economic or financial hardship alone is not exceptional. Inconvenience, aesthetic considerations, physical handicaps, personal preferences, or the disapproval of one's neighbors likewise cannot, as a rule, qualify as an exceptional hardship. All of these problems can be resolved through other means without granting an exception, even if the alternative is more expensive, or requires the property owner to build elsewhere or put the parcel to a different use than originally intended.

**“Highest adjacent grade”** means the highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure.

"**Historic structure**" means any structure that is:

A. Listed individually in the National Register of Historic Places (a listing maintained by the Department of Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register;
B. Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district;
C. Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of Interior; or
D. Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either by an approved state program as determined by the Secretary of the Interior or directly by the Secretary of the Interior in states without approved programs.

"**Levee**" means a man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control or divert the flow of water so as to provide protection from temporary flooding.

"**Levee system**" means a flood protection system which consists of a levee, or levees, and associated structures, such as closure and drainage devices, which are constructed and operated in accord with sound engineering practices.

"**Lowest floor**" means the lowest floor of the lowest enclosed area, including basement (see “Basement,” defined herein).

A. An unfinished or flood resistant enclosure below the lowest floor that is usable solely for parking of vehicles, building access or storage in an area other than a basement area, is not considered a building’s lowest floor provided it conforms to applicable non-elevation design requirements, including, but not limited to:

    1. The flood openings standard in Section 8405.A.5;
    2. The anchoring standards in Section 8405.A.1;
    3. The construction materials and methods standards in Section 8405.A.2; and
    4. The standards for utilities in Section 8405.B.

B. For residential structures, all subgrade enclosed areas are prohibited as they are considered to be basements (see “Basement” defined herein). This prohibition includes below-grade garages and storage areas.

"**Manufactured home**" means a structure, transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when attached to the required utilities. The term "manufactured home" does <u>not</u> include a "recreational vehicle".

"**Manufactured home park or subdivision**" means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

**“Mean Sea Level”** means for purposes of the National Flood Insurance Program, the National Geodetic Vertical Datum (NGVD) of 1929, the North American Vertical Datum (NAVD) of 1988, or other data, to which base flood elevations shown on a community's Flood Insurance Rate Map are referenced.

**“National Flood Insurance Program (NFIP)”** means the federal program that authorizes the sale of federally subsidized flood insurance in communities where such flood insurance is not available privately.

**“New construction”** means, for purposes of this Chapter, structures for which the "start of construction" commenced on or after the effective date of a floodplain management regulation adopted by this community.

"**New manufactured home park or subdivision**" means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after November 5, 2016.

"**Obstruction**" includes, but is not limited to, any dam, wall, wharf, embankment, levee, dike, pile, abutment, protection, excavation, channelization, bridge, conduit, culvert, building, wire, fence, rock, gravel, refuse, fill, structure, vegetation or other material in, along, across or projecting into any watercourse which may alter, impede, retard or change the direction and/or velocity of the flow of water, or due to its location, its propensity to snare or collect debris carried by the flow of water, or its likelihood of being carried downstream.

**“100-Year Flood”** means "base flood."

**“Primary frontal dune”** means a continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes immediately landward and adjacent to the beach and subject to erosion and overtopping from high tides and waves during major coastal storms. The inland limit of the primary frontal dune occurs at the point where there is a distinct change from a relatively mild slope.

“**Program deficiency**” means a defect in a community’s floodplain management regulations or administrative procedures that impairs effective implementation of those floodplain management regulations.

“**Public safety and nuisance”** means, for purposes related to Section 8406 of this Chapter, that the granting of a variance must not result in anything which is injurious to safety or health of an entire community or neighborhood, or any considerable number of persons, or unlawfully obstructs the free passage or use, in the customary manner, of any navigable lake, or river, bay, stream, canal, or basin.

**“Recreational vehicle”** means a vehicle which is:

A. Built on a single chassis;
B. 400 square feet or less when measured at the largest horizontal projection;
C. Designed to be self-propelled or permanently towable by a light-duty truck; and
D. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use.

"**Regulatory floodway**" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot.

**"Remedy a violation"** means to bring the structure or other development into compliance with State or local flood plain management regulations, or, if this is not possible, to reduce the impacts of its noncompliance. Ways that impacts may be reduced include protecting the structure or other affected development from flood damages, implementing the enforcement provisions of the Article or otherwise deterring future similar violations, or reducing Federal financial exposure with regard to the structure or other development.

**"Riverine"** means relating to, formed by, or resembling a river (including tributaries), street, brook, etc.

**"Sand dunes"** means naturally occurring accumulations of sand in ridges or mounds landward of the beach.

**"Special Flood Hazard Area (SFHA)"** means an area in the floodplain subject to a one percent or greater chance of flooding in a given year. It is shown on an FHBM or FIRM as Zones A, AE, V, VE or X.

**"Start of construction"** includes substantial improvement and other proposed new development, and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, rehabilitation, addition, placement, or other improvement was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for a basement, footings, piers, or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

**"Structure"** means a walled and roofed building that is principally above ground; this includes a gas or liquid storage tank or a manufactured home.

"**Substantial damage**" means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

"**Substantial improvement**" means any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the "start of construction" of the improvement. This term includes structures which have incurred "substantial damage," regardless of the actual repair work performed. The term does not, however, include either:

1. Any project for improvement of a structure to correct existing violations or state or local health, sanitary, or safety code specifications which have been identified by the local code

enforcement official and which are the minimum necessary to assure safe living conditions; or

2. Any alteration of a "historic structure," provided that the alteration will not preclude the structure's continued designation as a "historic structure."

The Floodplain Administrator shall utilize the FEMA publication: “Substantial Improvement/ Substantial Damage Desk Reference *FEMA P-758 / May 2010,”* as amended or replaced by additional FEMA publication for guidance in identifying substantial improvements..

"**Variance**" means a grant of relief from the requirements of this ordinance which permits construction in a manner that would otherwise be prohibited by this ordinance.

**“Violation”** means the failure of a structure or other development to be fully compliant with the community's flood plain management regulations. A structure or other development without the elevation certificate, other certifications, or other evidence of compliance required in this Article is presumed to be in violation until such time as that documentation is provided.

"**Water surface elevation**" means the height, in relation to the National Geodetic Vertical Datum (NGVD) of 1929, North American Vertical Datum (NAVD) of 1988, or other datum, of floods of various magnitudes and frequencies in the floodplains of coastal or riverine areas.

"**Watercourse**" means a lake, river, creek, stream, wash, arroyo, channel or other topographic feature on or over which waters flow at least periodically. Watercourse includes specifically designated areas in which substantial flood damage may occur.

**SEC. 8402. Applicability.**

**A. Basis for establishing areas of special flood hazards.** The areas of special flood hazard identified by the Federal Insurance Administration (FIA) of the Federal Emergency Management Agency (FEMA) in a scientific and engineering report entitled "Flood Insurance Study" for the City of Arcata dated November 5, 1997, and accompanying Flood Insurance Rate Maps (FIRMS), and the Humboldt County Flood Insurance Rate Map Index dated February 8, 1999, and Flood Insurance Study dated August 5, 1986 and Flood Boundary and Floodway Maps, and all subsequent amendments and/or revisions are hereby adopted by reference and declared to be a part of this Land Use Code, and this Chapter. This Flood Insurance Study and attendant mapping is the minimum area of applicability of this Chapter and may be supplemented by studies for other areas which allow implementation of this Chapter and which are recommended to the City of Arcata by the Flood Plain Administrator. The Flood Insurance Study is on file at the Engineering Department of the City of Arcata

**B. Compliance with Chapter required.** No structure or land shall hereafter be constructed, located, extended, converted, or altered without full compliance with the terms of this Chapter, and other applicable regulations including the City of Arcata Land Use Code (LUC). Violations of the provisions of this Chapter by failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with conditions) may constitute a misdemeanor, and be charged by the City Attorney as either an infraction or misdemeanor. Nothing herein shall prevent the City from taking lawful action as is necessary to prevent or remedy any violation.

**C. Abrogation and greater restrictions.** This Chapter is not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this Chapter and another regulation, easement, covenant, or deed restriction conflict or overlap, whichever imposes the more stringent restrictions shall prevail.

**D. Interpretation.** In the interpretation and application of this Chapter, all provisions shall be:

1. Considered as minimum requirements;

2. Liberally construed in favor of the governing body; and,

3. Deemed neither to limit nor repeal any other powers granted under state statutes.

**E. Warning and disclaimer of liability.** The degree of flood protection required by this Chapter is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Larger floods can and will occur on rare occasions. Flood heights may be increased by man-made or natural causes. This Chapter does not imply that land outside the areas of special flood hazards, or uses permitted within such areas will be free from flooding or flood damages. This Chapter shall not create liability on the part of the City of Arcata, any officer or employee thereof, the Federal Emergency Management Agency, or State of California, for any flood damages that result from reliance on this Chapter or any administrative decision lawfully made in compliance with this Chapter.

**SEC. 8403. Administration**.

**A. Designation of Floodplain Administrator.** The City Engineer is hereby appointed to administer, implement, and enforce this Chapter by granting or denying development permits in accordance with its provisions.

**B. Duties and responsibilities of Floodplain Administrator.** The Floodplain Administrator shall have the following duties and responsibilities.

1. Permit review**.** The Floodplain Administrator shall review all development permits to determine that:

    a) The permit requirements of this Chapter have been satisfied including determination of substantial improvement and substantial damage of existing structures;

    b) All other required state and federal permit requirements have been obtained;

    c) The site is reasonably safe from flooding;

    d) The proposed development does not adversely affect the carrying capacity of areas where base flood elevations have been determined but a floodway has not been designated. For purposes of this Chapter, "adversely affects" means that the cumulative effect of the proposed development when combined with all other existing and anticipated development will increase the water surface elevation of the base flood more than one foot at any point; and

    e) All Letters of Map Revision (LOMR's) for flood control projects are approved prior to the issuance of building permits. Building permits must not be issued based on Conditional Letters of Map Revision (CLOMR's). Approved CLOMR's allow construction of the proposed flood control project and land preparation as specified in the "start of construction" definition.

2. Notification of Other Agencies. Other agencies shall be notified as follows for the following circumstances:

   a) Alteration or relocation of a watercourse:

      (1) Notify adjacent communities and the California Department of Water Resources prior to alteration or relocation;

      (2) Submit evidence of such notification to the Federal Emergency Management Agency; and

      (3) Assure that the flood carry capacity within the altered or relocated portion of said watercourse is maintained.

   b) Base Flood Elevation changes due to physical alterations:

      (1) Within 6 months of information becoming available or project completion, whichever comes first, the Floodplain Administrator shall submit or assure that the permit applicant submits technical or scientific data to FEMA for a Letter of Map Revision (LOMR).

      (2) All LOMR's for flood control projects are approved prior to the issuance of building permits. Building Permits must not be issued based on Conditional Letters of Map Revision (CLOMR's). Approved CLOMR's allow construction of the proposed flood control project and land preparation as specified in the "start of construction" definition.

   Such submissions are necessary so that upon confirmation of those physical changes affecting flooding conditions, risk premium rates and floodplain management requirements are based on current data.

   c) Changes in Corporate Boundaries. Notify FEMA in writing whenever the corporate boundaries have been modified by annexation or other means and include a copy of the map of the community clearly delineating the new corporate limits.

3. Certifications**.** Obtain and maintain for public inspection and make available as needed the certifications required by Section 8405 (Standards for Flood Hazard Reduction).

4. Interpretations**.** Make interpretations where needed, as to the location of the boundaries of the areas of special flood hazards. Where there appears to be a conflict between a mapped boundary and actual field conditions, grade and base flood elevations shall be used to determine the boundaries of the special flood hazard area. The person contesting the location of the boundary shall be given a reasonable opportunity to appeal the interpretation provided in Section 8406 (Flood Standard Exceptions).

5. Base flood elevation data. When base flood elevation data has not been provided in accordance with Section 8402.A (Basis for establishing areas of special flood hazards), the Floodplain Administrator shall obtain, review, and reasonably utilize any base flood elevation and floodway data available from a federal or state agency, or other source, in the administration and review process.

**C. Enforcement.** Take action to remedy violations of this Chapter as specified in this Chapter or other applicable law.

**SEC. 8404. Permit Requirements.**

A Development Permit shall be obtained before construction or development within any area of special flood hazard identified in compliance with Section 8402.A (Basis for establishing areas of special flood hazards). Application for a Development Permit shall include:

A. Plans in duplicate, drawn to scale, showing:

1. Location, dimensions, and elevation of the area in question, existing or proposed structures, storage of materials and equipment and their location;
2. Proposed locations of water supply, sanitary sewer, and other utilities;
3. Grading information showing existing and proposed contours, any proposed fill, and drainage facilities;
4. Location of the regulatory floodway when applicable;
5. Base flood elevation information as specified in Section 8403.B.5;
6. Proposed elevation in relation to mean sea level, of the lowest floor (including basement) of all structures; and
7. Proposed elevation in relation to mean sea level to which any nonresidential structure will be floodproofed, as required in Section 8405.A.4.

B. Proposed elevation in relation to mean sea level, of the lowest floor (including basement) of all structures;

C. Proposed elevation in relation to mean sea level to which any structure will be floodproofed if required in Section 8405.A.4 (Elevation and floodproofing - Nonresidential construction), that is also in compliance with all applicable City regulations including those in the Land Use Code (LUC).

D. All appropriate certifications required by this Chapter;

E. Description of the extent to which any watercourse will be altered or relocated as a result of proposed development; and

F. Documentation of CEQA compliance for all discretionary projects.

**SEC. 8405. Standards for Flood Hazard Reduction**

**A. Construction standards.** The following standards apply in all areas of special flood hazards.

1. Anchoring.

   (a) All new construction and substantial improvements shall be anchored to prevent flotation, collapse or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy.

   (b) All manufactured homes shall meet the anchoring standards of 8405.D (Mobile homes, manufactured homes, and mobile home parks and subdivisions).

2. Construction materials and methods**.**

a) All new construction and substantial improvements shall be constructed with materials and utility equipment resistant to flood damage.
b) All new construction and substantial improvements shall be constructed using methods and practices that minimize flood damage.

c) All new construction and substantial improvements shall be constructed with electrical, heating, ventilation, plumbing and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.

d) Within Zones AH or AO, adequate drainage paths around structures on slopes to guide flood waters around and away from proposed structures are required.

3. Elevation and flood proofing—Residential construction**.** Upon completion of the structure, the elevation of the lowest floor, including basement, shall be certified by a registered civil engineer or licensed surveyor, and verified by the Building Inspector, to be properly elevated. The certification and verification shall be provided to the Floodplain Administrator.

All new construction or substantial improvements of residential structures shall have the lowest floor, including basement:

a) In AE Zones, elevated at least one foot above the base flood elevation.

b) In an AO Zone, elevated above the highest adjacent grade to a height at least one foot above the depth number specified in feet on the FIRM, or elevated at least 2 feet above the highest adjacent grade if no depth number is specified.

c) In an A Zone, without BFE's specified on the FIRM (unnumbered A Zone), elevated at least one foot above the base flood elevation, as determined under Section 9.60.050.B.5.

d) Manufactured homes shall also meet the standards in Subsection D.

4. Elevation and flood proofing—Nonresidential construction. Nonresidential construction, new or substantial Improvements, shall either be elevated to conform with Subsection A.3, above (Elevation and flood proofing—Residential construction), or:

a) Be flood proofed, together with attendant utility and sanitary facilities, below the elevation specified in Subsection A.3, so that the structure is watertight with walls substantially impermeable to the passage of water; and

b) Have structural components capable of resisting hydrostatic and hydrodynamic loads and effects of buoyancy, and;

c) Be certified by a registered civil engineer or licensed surveyor that the standards of this subsection are satisfied. The certification shall be provided to the Floodplain Administrator.

5. Flood Openings. All new construction and substantial improvements of structures with fully enclosed areas below the lowest floor (excluding basements) that are usable solely for parking of vehicles, building access or storage, and which are subject to flooding, shall be

designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for automatic entry and exit of floodwater. Designs for meeting this requirement must meet the following minimum criteria:

a) For non-engineered openings:

(1) Have a minimum of two openings on different sides having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding;
(2) The bottom of all openings shall be no higher than one foot above grade;
(3) Openings may be equipped with screens, louvers, valves or other coverings or devices provided that they permit the automatic entry and exit of floodwater; and
(4) Buildings with more than one enclosed area must have openings on exterior walls for each area to allow flood water to directly enter; or

b) Be certified by a registered civil engineer or architect.

6. Garages and low cost Accessory Structures.

a) Attached Garages.

(1) A garage attached to a residential structure, constructed with the garage floor slab below the BFE, must be designed to allow for the automatic entry of flood waters. See Subsection 8405.A.5. Areas of the garage below the BFE must be constructed with flood resistant materials. See Subsection 8405.A.2.

(2) A garage attached to a nonresidential structure must meet the above requirements or be dry floodproofed. For guidance on below grade parking areas, see FEMA Technical Bulletin TB-6.

b) Detached garages and accessory structures.

(1) "Accessory structures" used solely for parking (2 car detached garages or smaller) or limited storage (small, low-cost sheds), as defined in 8401, may be constructed such that its floor is below the base flood elevation (BFE), provided the structure is designed and constructed in accordance with the following requirements:

i. Use of the accessory structure must be limited to parking or limited storage;

ii. The portions of the accessory structure located below the BFE must be built using flood-resistant materials;

iii. The accessory structure must be adequately anchored to prevent flotation, collapse and lateral movement;

iv. Any mechanical and utility equipment in the accessory structure must be elevated or floodproofed to or above the BFE;

v. The accessory structure must comply with floodplain encroachment provisions in Subsection 8405.F; and

vi. The accessory structure must be designed to allow for the automatic entry of

flood waters in accordance with Subsection 8405.F.

(2) Detached garages and accessory structures not meeting the above standards must be constructed in accordance with all applicable standards in Section 8405.

**B. Utilities.** All new and replacement water supply and sanitary sewage systems shall be designed to prohibit the infiltration of flood waters into the system and discharge from systems into flood waters. On-site waste disposal systems shall be located to avoid impairment to them, or contamination from them during flooding.

**C. Subdivisions.**

1. All new subdivision proposals and other proposed development, including proposals for manufactured home parks and subdivisions, greater than 50 lots or 5 acres, whichever is the lesser, shall:

   a) Identify the Special Flood Hazard Areas (SFHA) and Base Flood Elevations (BFE).
   b) Identify the elevations of lowest floors of all proposed structures and pads on the final plans.
   c) If the site is filled above the base flood elevation, the following as-built information for each structure shall be certified by a Registered Civil Engineer or Licensed Land Surveyor and provided as part of an application for a Letter of Map Revision based on Fill (LOMR-F) to the Floodplain Administrator;

      (1) Lowest floor elevation.
      (2) Pad elevation.
      (3) Lowest adjacent grade.

2. All subdivision proposals and other proposed development shall be consistent with the need to minimize flood damage.
3. All subdivision proposals and other proposed development shall have public utilities and facilities such as sewer, gas, electrical and water systems located and constructed to minimize flood damage.
4. All subdivisions and other proposed development shall provide adequate drainage to reduce exposure to flood hazards.

**D. Mobile homes, manufactured homes, and mobile home parks and subdivisions.**

1. All manufactured homes that are placed or substantially improved on sites located: (1) outside of a manufactured home park or subdivision; (2) in a new manufactured home park or subdivision; (3) in an expansion to an existing manufactured home park or subdivision; or (4) in an existing manufactured home park or subdivision upon which a manufactured home has incurred "substantial damage" as the result of a flood, shall:

   a) Within Zones A, AH, and AE on the community's Flood Insurance Rate Map, be elevated on a permanent foundation such that the lowest floor of the manufactured home is elevated to or above the base flood elevation and be securely fastened to an adequately anchored foundation system to resist flotation, collapse, and lateral movement.

   b) Within Zones V, and VE on the community's Flood Insurance Rate Map, meet the requirements of Section 8405.G.

2. All manufactured homes to be placed or substantially improved on sites in an existing manufactured home park or subdivision within Zones A, AH, AE, V, and VE on the community's Flood Insurance Rate Map that are not subject to the provisions of Subsection 8405.D.1 will be securely fastened to an adequately anchored foundation system to resist flotation, collapse, and lateral movement, and be elevated so that either the:

    a) Lowest floor of the manufactured home is at or above the base flood elevation; or

    b) Manufactured home chassis is supported by reinforced piers or other foundation elements of at least equivalent strength that are no less than 36 inches in height above grade.

Upon the completion of the structure, the elevation of the lowest floor including basement shall be certified by a Registered Civil Engineer or Licensed Land Surveyor, and verified by the community building inspector to be properly elevated. Such certification and verification shall be provided to the Floodplain Administrator.

E. **Recreational vehicles.**

1. Each recreational vehicle placed on a site within Zones A, AH, and AE on the Flood Insurance Rate Map shall either:

    a) Be on the site for fewer than 180 consecutive days, and be fully licensed and ready for highway use. (A recreational vehicle is ready for highway use if it is on its wheels or jacking system, is attached to the site only by quick disconnect type utilities and security devices, and has no permanently attached additions), or

    b) Meet the permit requirements of Section 8404 (Permit Requirements), and the elevation and anchoring requirements for manufactured homes in Subsection D.

2. A recreational vehicle placed on sites within Zones V and VE on the Flood Insurance Rate Map shall comply with the requirements of Subsections F.1, and G.

**F. Floodways.** Within the areas of special flood hazard established in Section 8402.A (Applicability—Basis for establishing areas of special flood hazards), are areas designated as floodways. Since the floodway is an extremely hazardous area due to the velocity of flood waters which carry debris, potential projectiles, and erosion potential, the following provisions apply:

1. Prohibit encroachments, including fill, new construction, substantial improvements, and other development unless certification by a registered civil engineer is provided demonstrating that encroachments shall not result in any increase in flood levels during the occurrence of the base flood discharge.

2. If the requirements of this Subsection F are satisfied, all new construction and substantial improvements shall comply with all other applicable flood hazard reduction provisions of this Chapter.

Until a regulatory floodway is adopted, no new construction, substantial development, or other development (including fill) shall be permitted within Zones A and AE, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other development, will not increase the water surface elevation of the base flood more than 1 foot at any point within the City of

Arcata.

**G. Coastal High Hazard Areas.** Unless exempted by General Plan: 2020 policies PS-4b, PS-4g, and any other applicable City regulation or standard, it is the general policy of the City not to allow any development in the area identified as Coastal Flooding (V Zones) on the FIRM Map.

**H. Exceptions.** The improvement, repair, or rehabilitation of an existing residential building or structure, or an existing nonresidential building or structure built prior to May 2, 1983, where the cost of the improvement, repair, or rehabilitation does not equal or exceed 50 percent of the replacement cost of the structure shall not be subject to the standards and requirements of this Section. In all circumstances, exceptions may be made only in accordance with the requirements in Section 8406 (Flood Standard Exceptions), in compliance with Section 60.6 of the National Flood Insurance Program Regulations, Federal Emergency Management Agency, Federal Insurance Administration and in California Administrative Code Title 14 for Coastal Zone Areas.

**SEC. 8406. Flood Standard Exceptions.**

The issuance of an exception is for floodplain management purposes only. Insurance premium rates are determined by statute according to actuarial risk and will not be modified by the granting of an exception.

The variance criteria set forth in this section of the ordinance are based on the general principle of zoning law that variances pertain to a piece of property and are not personal in nature. A variance may be granted for a parcel of property with physical characteristics so unusual that complying with the requirements of this ordinance would create an exceptional hardship to the applicant or the surrounding property owners. The characteristics must be unique to the property and not be shared by adjacent parcels. The unique characteristic must pertain to the land itself, not to the structure, its inhabitants, or the property owners.

It is the duty of the City of Arcata to help protect its citizens from flooding. This need is so compelling and the implications of the cost of insuring a structure built below flood level are so serious that exceptions from the flood elevation or from other requirements in the flood ordinance are quite rare. The long term goal of preventing and reducing flood loss and damage can only be met if exceptions are strictly limited. Therefore, the exception guidelines provided in this ordinance are more detailed and contain multiple provisions that must be met before an exception can be properly granted. The criteria are designed to screen out those situations in which alternatives other than an exception are more appropriate.

Exceptions to Section 8405 (Standards for Flood Hazard Reduction) may be granted by the Floodplain Administrator in compliance with the following provisions.

**A. Notices and hearings.** The processing of a Flood Standard Exception shall occur in compliance with the provisions of Section 9.72.080 for Minor Use Permits.

**B. Factors to be considered.** In reviewing and deciding upon applications for Flood Standard Exceptions, the Floodplain Administrator shall consider all technical evaluations, all relevant factors, standards specified in other sections of this Chapter, and the:

1. Danger that materials may be swept onto other lands to the injury of others;

2. Dangers to life and property because of flooding or erosion damage;

3. Susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner.

4. Importance of the services provided by the proposed facility to the community;

5. Necessity to the facility of a waterfront location, where applicable;

6. Availability of alternative locations for the proposed use which are not subject to flooding or erosion damage;

7. Compatibility of the proposed use with existing and anticipated development;

8. Relationship of the proposed use to the comprehensive plan and floodplain management program for that area;

9. Safety of access to the property in time of flood for ordinary and emergency vehicles;

10. Expected heights, velocity, duration, rate of rise, and sediment transport of the flood waters expected at the site; and,

11. Costs of providing governmental services during and after flood conditions, including maintenance and repair of public utilities and facilities such as sewer, gas, electrical, and water system, and streets and bridges.

**C. Exception criteria.** Generally, a Flood Standard Exception may be issued for new construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, provided that the issues listed in Subsections B.1 through B.11 have been fully considered. As lot size increases beyond one-half acre, the technical justification required for issuing the Exception increases.

1. An Exception may be issued for the repair, rehabilitation, or restoration of a historic structure upon a determination that the proposed repair, rehabilitation, or restoration will not preclude the structure's continued designation as an historic structure and the exception is the minimum necessary to preserve the historic character and design of the structure.

2. An Exception shall not be issued within any designated floodway if any increase in flood levels during the base flood discharge would result.

3. An Exception shall only be issued upon a determination that the exception is the minimum necessary, considering the flood hazard, to afford relief.

4. An Exception shall only be issued upon:

    a) A showing of good and sufficient cause;

    b) A determination that failure to grant the exception would result in exceptional hardship to the applicant; and

    c) A determination that the granting of a exception will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws or ordinances.

5. An Exception may be issued for new construction and substantial improvements and for other development necessary for the conduct of a functionally dependent use provided that the above provisions of this Subsection C. are satisfied, and that the structure or other development is protected by methods that minimize flood damages during the base flood and create no additional threats to public safety.

**D. Conditions of approval.** Upon consideration of the factors in Subsection C., and the purposes of this Chapter, the Flood Plain Administrator may attach conditions to the granting of exceptions as it deems necessary to further the purposes of this Chapter.

**E. Notice to applicant.** An applicant to whom a Flood Standard Exception is granted shall be given written notice that the structure will be permitted to be built with a lowest floor elevation below the base flood elevation and that the cost of flood insurance will be commensurate with the increased risk resulting from the reduced lowest floor elevation. A copy of the notice shall be recorded by the Flood Plain Administrator in the office of the Humboldt County Recorder.

**F. Records.** The Flood Plain Administrator shall maintain the records of all appeal actions, including justification for their issuance, and report any exceptions to the Federal Insurance Administration upon request.

**SEC. 8407. Appeal**

Any permit applicant, or permit holder affected by any decision of the Floodplain Administrator, may file with the City Manager a written request for reconsideration within 10 days of such decision, action, or determination, setting forth in detail the facts supporting the applicant's request for reconsideration. The City Manager shall make a final ruling on the appeal within 15 days of the close of the meeting.

If the ruling made by the City Manager is unsatisfactory to the person requesting reconsideration, he/she may within 10 days after notification of the City Manager's action, file a written appeal to the City Council. The written appeal shall be heard by the Council within 60 days from the date of filing. The City Manager's decision, action, or determination shall remain in effect during such period of reconsideration.

Section 3: Severability. If any section, subsection, sentence, clause or phrase of this chapter is for any reason held to be invalid or unconstitutional, the decision shall not affect the validity of the remaining portions of the Chapter. The City Council hereby declares that it would have passed this Chapter, and each section, subsection, sentence, clause and phrase thereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses or phrases be declared invalid under law.

Section 4: This ordinance is exempt from the California Environmental Quality Act (CEQA) pursuant to Section 15061(b)(3) of the CEQA Guidelines, because it can be seen with certainty that there is no possibility that adoption of the ordinance may have a significant effect on the environment.

Section 5: The City Council finds that:

1. The Federal Emergency Management Agency (FEMA) has established the National Flood Insurance Program (NFIP) pursuant to the National Flood Insurance Act of 1968. The general purpose of the NFIP is both to offer primary flood insurance to properties with significant

flood risk, and to reduce flood risk through the application of local floodplain management standards.

2. Generally, local governments voluntarily participate in the NFIP to allow local property owners to have access to flood insurance. Participation requires the local government to adopt minimum floodplain standards. Participating communities that fail to maintain minimum floodplain standards can be put on probation or suspended from the NFIP, with the result that individuals cannot purchase NFIP flood insurance.

3. FEMA has revised its local flood insurance rate maps (FIRMs) establishing new minimum floodplain standards for NFIP participation effective November 4, 2016.

4. The City of Arcata's current floodplain standards will not meet the revised minimum standards required unless updated. In order for property owners to remain eligible for NFIP participation, the City must update its flood plain management standards through adoption of this Ordinance no later than November 4, 2016.

Based on the findings set forth herein, for the immediate preservation of the public peace, health or safety, this Ordinance shall go into effect and be in full force and operation upon its final passage and adoption, pursuant to Government Code Section 36937.

DATE: November 2, 2016

ATTEST: APPROVED:

/s/ Kara Newman
Deputy City Clerk, City of Arcata

/s/ Paul J. Pitino
Mayor, City of Arcata

**CLERK'S CERTIFICATE**

I hereby certify that the foregoing is a true and correct copy of Ordinance No. 1479 passed and adopted at a regular meeting of the City Council of the City of Arcata, County of Humboldt, State of California on the 2nd day of November, 2016, by the following vote:

AYES: **PITINO, ORNELAS, PEREIRA, WINKLER**

NOES: **NONE**

ABSENT: **WHEETLEY**

ABSTENTIONS: **NONE**

/s/ Kara Newman
Deputy City Clerk, City of Arcata

# Attachment E

## List of Contacted Agencies and Individuals

Federal Emergency Management Agency
United States Army Corps of Engineers
Humboldt Baykeeper
Audobon Society
California Department of Fish and Wildlife
United States Fish and Wildlife
National Oceanic and Atmospheric Administration Fisheries

rras@rras.org;
L.K.Sirkin@usace.army.mil;
kasheena.m.brooks@usacoe.army.mil;
jennifer.olson@wildlife.ca.gov;
jkalt@humboldtbaykeeper.org
Michael.Ward@water.ca.gov
Gregory.OConnell@Wildlife.ca.gov
clint_pogue@fws.gov
matt.goldsworthy@noaa.gov

# Attachment F

# Early and Final 8-Step Notices

## Early Notice and Public Review of Proposed Activities in 100-Year Floodplain and Mapped Wetland Area

To: All interested Agencies, Groups, and Individuals:

This is to give notice that the City of Arcata, under Part 58 of Title 24 Code of Federal Regulation, has determined that the following proposed action under the Community Development Block Grant Program and contract number 17-CDBG-12017 is located in the 100-year floodplain and may permanently impact an identified freshwater emergent wetland. The City of Arcata is required to identify and evaluate practicable alternatives to locating the action in the 100-year floodplain and wetland, and the potential impacts on the floodplain and wetland from the proposed action, as required by Executive Orders 11988 and 11990, in accordance with HUD regulations at 24 CFR 55.20 Subpart C Procedures for Making Determinations on Floodplain Management and Protection of Wetlands.

The proposed project will upgrade elements of the existing Arcata Wastewater Treatment Facility located at 601 G Street in Arcata, Humboldt County. Arcata's Wastewater Treatment Facility (Facility) is located within the Arcata Marsh and Wildlife Sanctuary, and utilizes innovative treatment methods using treatment ponds within the marsh area. The City of Arcata is proposing to replace a portion of existing Facility infrastructure and upgrade several components as part of the Arcata Wastewater Treatment Facility Improvement Project. The work will include installation of buried pipe for the flow reconfiguration of disinfected enhancement wetlands effluent, installing a discharge pipe into a constructed brackish marsh at the north end of the Arcata Bay section of Humboldt Bay (future outfall discharge point), relocation of the electrical equipment building in the Facility to allow for improved road access for fire and emergency services (requiring installation of a new utility service line), and constructing a mitigation wetland area.

A major project objective is to minimize disinfection byproducts associated with the use of chlorine and health hazards associated with the use and storage of large chlorine cylinders onsite. The City of Arcata has received a Community Development Block Grant (CDBG) to purchase Ultraviolet (UV) equipment to treat wastewater in place of chlorine in order to comply with the National Pollution Discharge Elimination System (NPDES) requirements for treated effluent. This funding has triggered the examination of alternatives.

The Facility is located in the "AE" zone, which has an annual 1% probability of flooding. The project scope includes the installation of a new discharge pipe for treated effluent into an existing brackish marsh created for the purposes of treating wastewater. The perimeter of the brackish marsh has been identified as containing 0.1 acres of freshwater emergent wetland which may be permanently impacted by the project (Stillwater Sciences, 2020). This wetland area is subject to Section 404 of the Clean Water Act and thus under USACE-jurisdiction as well as State- and LCP-jurisdiction.

The entire Facility is currently protected by a newly repaired (2009 FEMA funded) rock armored levee (approx. 1.0 mile) constructed of native derived soils of elevation range 10.5' to 14' NGVD borrowed immediately from the bay side of the ringed facility. The existing armored western facing dike adjacent to any VE zone will be raised to 14' min. on top of the dike at a 1.5 to 1 max slope with an armored engineered fill soil prism to protect the dike and inner Facility from erosive storm driven wave action (4500LF ) and also an interior non armored crown dike encircling the Facility core area (1775LF). The

remaining portions of dike (2200LF) will be raised to 12' min. for remaining dike areas along southeast and east sides of the Facility on the dike to meet the zone AE (BFE 10' NGVD 88) requirements plus 2' Safety factor.

The core Facility (6.5 acres) is equipped with a stormwater collection and pumping system. The system will be sized to accommodate the 100-year return event within the core Facility and will be pumped into the to the City's Facility for treatment prior to discharge with the plant effluent.

There are three primary purposes for this notice. First, people who may be affected by activities in floodplains and wetlands and those who have an interest in the protection of the natural environment should be given an opportunity to express their concerns and provide information about these areas. Commenters are encouraged to offer alternative sites outside of the floodplain or wetland, alternative methods to serve the same project purpose, and methods to minimize and mitigate impacts. Second, an adequate public notice program can be an important public educational tool. The dissemination of information and requests for public comment about floodplains and wetlands can facilitate and enhance Federal efforts to reduce the risks and impacts associated with the occupancy and modification of these special areas. Third, as a matter of fairness, when the Federal government determines it will participate in actions taking place in floodplains and wetlands, it must inform those who may be put at greater or continued risk.

Comments must be received by the City of Arcata, either in writing or by email, at the following address on or before Friday July 24, 2020: 736 "F" Street, Arcata CA 95521, phone number (707) 822-5955, Attention: David Loya, Community Development Director. Comments may also be submitted via email at comdev@cityofarcata.org. More information on the project may also be reviewed at https://www.cityofarcata.org/856/Wastewater-Treatment-Facilities-Improvem.

**Final Notice and Public Explanation of a Proposed Activity in a Wetland**

To: All interested Agencies, Groups and Individuals:

This is to give notice that the City of Arcata has conducted an evaluation as required by Executive Orders 11988 and 11990, and as implemented by U.S. Department of Housing and Urban (HUD) Regulations found at 24 CFR 55.20, to determine the potential effect that its activity in the floodplain and wetland will have on the human environment, for the proposed Arcata Wastewater Treatment Facility Upgrades Project under contract number 17-CDBG-12017. HUD has allocated Community Development Block Grant funds for the acquisition and installation of UV equipment, which would be dispersed through the City of Arcata as the Responsible Entity for the proposed project; therefore, the City of Arcata is the Lead Agency for National Environmental Policy Act (NEPA) review.

There are three primary purposes for this notice. First, people who may be affected by activities in wetlands and those who have an interest in the protection of the natural environment should be given an opportunity to express their concerns and provide information about these areas. Second, an adequate public notice program can be an important public educational tool. The dissemination of information about wetlands can facilitate and enhance Federal efforts to reduce the risks associated with the occupancy and modification of these special areas. Third, as a matter of fairness, when the Federal government determines it will participate in actions taking place in wetlands, it must inform those who may be put at greater or continued risk.

The Proposed Project will rehabilitate the City's existing wastewater treatment facility located at 601 G Street in Arcata, Humboldt County, California. Arcata's Wastewater Treatment Facility (Facility) is located within the Arcata Marsh and Wildlife Sanctuary, and utilizes innovative treatment methods using treatment ponds within the marsh area. The City of Arcata is proposing to replace a portion of existing Facility infrastructure and upgrade several components as part of the Arcata Wastewater Treatment Facility Improvement Project. The work includes installation of buried pipe for the flow reconfiguration of disinfected enhancement wetlands effluent, installing a discharge pipe into a constructed brackish marsh at the north end of the Arcata Bay section of Humboldt Bay (future outfall discharge point), relocation of the electrical equipment building in the Facility to allow for improved road access for fire and emergency services (requiring installation of a new utility service line), installing a new ultraviolet light disinfection system, and constructing a mitigation wetland area. For a full description of proposed activities, visit the City's Facility Upgrades page at: https://www.cityofarcata.org/856/Wastewater-Treatment-Facilities-Improvem

The Facility is located in the "AE" Flood zone, which has an annual 1% probability of flooding. Additionally, the project scope includes the installation of a new discharge pipe for treated effluent into an existing Brackish Marsh, which was constructed as part of the McDaniel Slough Restoration Project with the express intent of treating discharged wastewater. The Final Wetland Delineation identified the Outfall area as containing 0.23 acres of freshwater emergent wetland, a portion of which may be permanently impacted by the project (Stillwater Sciences Final Delineation of Waters and Wetlands, August 2020). This wetland area is subject to Section 404 of the Clean Water Act and thus under USACE-

jurisdiction as well as State- and LCP-jurisdiction. The Early Notice and Public Review of Proposed Activities in 100-Year Floodplain and Mapped Wetland Area, published July 8, 2020, shared the current available data at the time, which assumed 0.1 acres of wetland in the area of the Brackish Marsh may be affected (Stillwater Sciences Preliminary Delineation of Waters and Wetlands, April 2020). The final 8-Step Analysis and assumptions noted herein reviewed project effects and alternatives using the final calculated wetlands acreage of 0.23 acres.

The City of Arcata has considered the following alternatives and mitigation measures to be taken to minimize adverse impacts and to restore and preserve natural and beneficial values:

**Locate the Project Outside of the Floodplain and Wetland (Offsite Alternative)**: The project's intent is to rehabilitate and improve the existing system, and a full relocation would not fit these parameters. This objective is based on both the logistic and economic and time constrained infeasibility of a full relocation of the facility. Arcata is a small community of less than 20,000 inhabitants, roughly half of which are students; the cost of a full relocation has been estimated at up to $150 million by the City engineer. There are only a handful of parcels within City limits that could house such a large facility, and the majority of them are already developed. In addition, many of the suitable industrially-zoned parcels in the northern portion of the City are subject to inundation in the case of a catastrophic failure of Matthew's Dam at Ruth Lake. Suitably large parcels in the southern or eastern portion of Arcata would likely require conversion of prime agricultural lands, and would remain located in the Coastal Zone with similar impacts and permit processes.

**No Action Alternative:** The project purpose and need would not be met with the No Action alternative. The No Action alternative assumes that no new upgrades to the existing facility would occur. In the absence of these upgrades, the Facility will remain out of compliance with the requirements of the NPDES permit and the quality of treated effluent discharged into Humboldt Bay will not be addressed, which has the potential to result in a variety of negative effects to humans and wildlife. The City's continued ability to utilize the Treatment Facility relies on undertaking the improvements discussed in this environmental assessment.

**Onsite configuration Alternatives (includes Preferred Alternative):** Four alternatives augmenting the existing facility treatment system were developed in the prepared Facility Plan (Carollo Engineers, 2017) to address improvements needed for the AWTF. The four alternatives included common improvements, including actions to reduce flood risk, vegetation maintenance, and ultraviolet disinfection, among others. A full list of common improvements can be found in the 8-Step Analysis, which can be viewed at City Hall or online at the link listed at the end of this Notice.

Alternatives were conceived through a collaboration between City staff, LACO Associates, Carollo Engineers, and the community through public discussions in a series of public workshops. The City and consultants (LACO Associates and Carollo Engineers) determined the five criteria that were important for the project and ranked each project. The five criteria were: meets permit requirements; ease of operation and maintenance; constructability; reliability; and ammonia removal.

Alternative 1 was the least expensive alternative, however it received the lowest scores for meeting permit requirements, constructability, reliability and ammonia removal. Alternative 2 provides an additional secondary treatment system that will provide BOD treatment and meet ammonia and nitrogen limits. Alternative 2 is the second most expensive alternative and received

low ranking regarding the non-economic criteria. The low ranking was due to Alternative 2 requiring the most project elements. This would increase the difficulty of operating and maintaining the treatment processes and facilities. Alternative 3 constructs an additional secondary treatment system with a larger capacity than Alternative 2 because less treatment will occur in the natural system, Alternative 3 requires less construction and maintenance than Alternative 2. Alternative 3 was the highest scoring alternative for the non-economic criteria. It achieved high rankings in reliability and ammonia removal due to the larger treatment capacity of the oxidation ditches compared to Alternative 2.

Alternative 4 (Preferred Alternative) was developed after the first three alternatives were presented to the Regional Water Quality Control Board (Water Board). The Water Board found that these three alternatives would not achieve the requirements of the permit. Alternatives 1, 2 and 3 did not provide the peak wet weather flow capacity (5.9 mgd) to pass through the Enhancement Wetlands. This is not in compliance with the Enclosed Bays and Estuaries Policy. Alternative 4 allows a peak pumped flow of 5.9 mgd at Outfall-003 to utilize the Enhancement Wetlands for additional treatment and meet the discharge requirements.

It has been determined that the Preferred Alternative would provide improved water treatment for the existing City population, and would address rehabilitation needs of critical city infrastructure. While the Preferred Alternative would change the elevation of the floodplain in the vicinity of the proposed project, it would not change the occupancy of the floodplain and would not have effects on flood velocities upstream or downstream. Once implemented, the improved levee system will be designed to withstand storm surge velocities and wave action for the 100-year-storm event. The Preferred Alternative would therefore minimize the potential effects that could be expected to occur within the floodplain and further mitigation or compliance measures will not be required. While there would be adverse effects to regulated wetlands resulting from construction of the proposed project, the Preferred Alternative would not significantly adversely affect wetland resources in the area and all permanently affect wetlands will be mitigated onsite at a minimum 1:1 ratio, in compliance with state and local wetland protection procedures. Furthermore, the project area is already developed and the treatment facility is pre-existing; implementation of the Preferred Alternative would not encourage further new development within the floodplain or wetlands in the proposed project area.

The City of Arcata has reevaluated the alternatives to building in the wetland and has determined that it has no practicable alternative. Therefore, the City determines that the proposed project complies with EOs 11988 and 11990, and 44 CFR 60.3. Environmental files that document compliance with steps 3 through 6 of EO 11988 are available for public review with the Community Development Department, located at Arcata City Hall at 736 F Street, Arcata CA, (707) 822-5955, and may be examined or copied on weekdays between 11:00 AM and 5:00 PM. The documents may also be found at:
https://www.cityofarcata.org/856/Wastewater-Treatment-Facilities-Improvem

PUBLIC COMMENTS

Pursuant to 24 CFR Part 55, an Early Notice and Public Review of a Proposed Activity in a 100-Year Floodplain and Wetland, was published on July 8, 2020. Publication of this notice was followed by a 28 day comment period, in which one public comment was received. The comment was from a partner agency and did not substantively address the proposed use of federal funds to support the construction of the proposed project in a floodplain and / or

wetland, but primarily requested further information related to project impacts to fish and wildlife, which will be further analyzed in the project's Environmental Assessment. These comments will be included as an appendix to the Final Environmental Assessment.

All interested persons, groups and agencies are invited to submit written comments to the Community Development Department of the City of Arcata regarding the proposed use of federal funds to support the construction of the proposed project in a floodplain and / or wetland, at the following email address: comdev@cityofarcata.org or the address listed above. The Community Development Department will consider all comments received by close of business on September 24, 2020.

# ATTACHMENT 33

North Coast Unified Air Quality Management District. 2015. *Rule 110 – New Source Review (NSR) And Prevention of Significant Deterioration (PSD).* Published 07/09/20.

# Regulation I
# Rule 110 – New Source Review (NSR) And Prevention of Significant Deterioration (PSD)

The content of this Rule was first adopted as part of Regulation I in 1982.
The current version was adopted by the Governing Board via Resolution 2015-9 on July 9 2015.

TABLE OF CONTENTS


A. PURPOSE

B. APPLICABILITY

C. EFFECTIVE DATE

D. DEFINITIONS

E. REQUIREMENTS

F. CALCULATIONS

G. AIR QUALITY IMPACT ANALYSIS

H. ADMINISTRATIVE REQUIREMENTS

I. POWER PLANT REVIEW PROCEDURE

J. EXCLUSIONS

K. PREVENTION OF SIGNIFICANT DETERIORATION

L. RESERVED

# RULE 110
# NEW SOURCE REVIEW (NSR) AND
# PREVENTION OF SIGNIFICANT DETERIORATION

**A. PURPOSE:**

**1.** The purpose of this Rule is to establish pre-construction review requirements for new and modified stationary sources of air pollution and to provide mechanisms, including emission offsets, by which authorities to construct for such sources may be granted without interfering with the attainment or maintenance of ambient air quality standards.

**2.** This Rule shall provide for no net increase in emissions, pursuant to Section 40918 of the H&SC, from new or modified stationary sources which emit, or have the potential to emit, 25 tons per year or more of any non-attainment pollutant or its precursors. [*Note: This subsection will not be included in the Federal SIP submittal of this rule.]*

**B. APPLICABILITY:**

**1.** This Rule shall apply to all new stationary sources and emission units and all modifications to existing stationary sources and emissions units that, after construction, emit or may emit any affected pollutant within the District.

a. The Regulations in effect at the time any application for an Authority to Construct for a new or modified source is deemed complete shall apply to that source except when a new federal requirement not yet incorporated into this Rule applies to the new or modified source. In such a case, the new federal rules shall apply to the source.

**2.** Any facility or source subject to this rule which has ceased operation for two or more continuous years, excluding minimal maintenance activities, shall be presumed to have been permanently shutdown.

a. Any permanently shutdown facility or source which then seeks reactivation is subject to re-evaluation under the requirements of Rule 110, NSR and PSD, including the requirement for BACT, offsets and modeling, as applicable.

b. The presumption a facility is permanently shutdown is refutable, and the burden of disproving the presumption rests with the permittee. In rebutting this presumption, the APCO shall take into consideration the totality of the circumstances including but not limited to: intent of the owner or operator, age of the facility, likelihood of reactivated operations may cause or contribute to a public nuisance, conflicting statements of intent by the owner and operator, frequency of equipment and facility upsets and equipment breakdowns, and ongoing maintenance.

c. Every facility and source subject to the provisions of this Rule which has not operated for five (5) or more continuous years shall be considered permanently shutdown for the purposes of this Rule.

**C. EFFECTIVE DATE:** This Rule shall become effective December 9, 2010

**D. DEFINITIONS:** The following definitions apply for all terms used in this Rule. If a term is not defined below, then the definitions provided in Rule 502 Application & Permit Requirements , Rule 101 Definitions, and Rule 106 Emission Reduction Credits, shall apply in that hierarchical order:

1. **Actual Emissions** means emissions (air pollutants) which have been released into the atmosphere from a source or emissions unit. The amount or quantity of emissions shall be determined based upon source test data, actual fuel consumption or process data, or monitoring data. If source test or monitoring data is not available, other appropriate, APCO-approved, emission factors may be used. Fugitive emissions associated with the emissions unit shall be included in the actual emissions of the emissions unit.

2. **Allowable Emissions:** The emissions rate of a stationary source or an emissions unit calculated using the maximum rated capacity of the source (unless the source is subject to a federally enforceable or practically and legally enforceable limit, which restricts the operating rate, hours of operation, or both) and the most stringent of the following:
   a. Any applicable standards set forth in the District Rules and Regulations (Rules) and 40 CFR Part 60, 61, or 63;
   b. Any applicable emission limitation in the State Implementation Plan (SIP), including those with a future compliance date; or
   c. The emissions rate specified as a federally enforceable permit condition, including those with a future compliance date.

3. **Affected Pollutant** means an air pollutant for which an ambient air quality standard has been established by the United States Environmental Protection Agency (EPA) or the California Air Resources Board (CARB), the precursors to such pollutants, and those substances regulated by EPA or CARB, or listed under Section 5.1 of this Rule.

4. **Ambient Air Quality Standards** means those ambient air quality standards which include Federal and State ambient air quality standards. For purposes of applicability of this Rule to the State Implementation Plan (SIP), all references to ambient air quality standards shall be interpreted as National Ambient Air Quality Standards. For the purposes of applicability of this Rule to the District's Air Quality Attainment Plan, all references to ambient air quality standards shall be interpreted as State Ambient Air Quality Standards.

5. **Best Available Control Technology (BACT)** means for any emissions unit, the more stringent of:
   a. The most effective emission control device, emission limit, or technique which has been required or used for the type of equipment comprising such emissions unit unless the applicant demonstrates to the satisfaction of the APCO that such limitations are not achievable; or
   b. Any other emission control device or technique, alternative basic equipment, different fuel or process, determined to be technologically feasible and cost-effective by the APCO. The cost-effective analysis shall be performed in accordance with the methodology and criteria specified by the APCO.

   Under no circumstances shall BACT be determined to be less stringent than the emission control required by any applicable provision of District, State, or federal laws or regulations, unless the applicant demonstrates to the satisfaction of the APCO that such limitations are not achievable.

6. **Complete Application** means an application that contains all information required by the District to adequately evaluate the nature and extent of potential emissions of the new or modified emissions unit proposed for use in accordance with a list of required information as adopted by the District.

7. **Contiguous Property** means two or more parcels of land with a common boundary or separated solely by a public or private roadway or other public right-of-way.

8. **Cost-Effective** means a cost per pound of emission reduction which is deemed to be acceptable and feasible, on a pollutant and emissions unit basis, by the APCO.

9. **Daily Emissions Limitation** means one or a combination of permit conditions specific to an emissions unit which restricts its maximum daily emissions in pounds per day, at or below the emissions associated with the maximum design capacity. A daily emissions limitation must be:
   a. Contained in the latest Authority to Construct and contained in or enforceable by the latest Permit to Operate for the emissions unit; and
   b. Enforceable on a daily basis; and,
   c. Established pursuant to permitting action occurring after January 12, 1993 and used in the calculation of the net emissions change.

10. **Emissions Unit** means an identifiable operation or piece of process equipment such as an article, machine, or other contrivance which emits, may emit, or results in the emission of any affected pollutant directly or as fugitive emissions.

11. **Fluorides** means elemental fluorine and all fluoride compounds.

12. **Fugitive Emissions** means those emissions which could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening.

13. **Functionally Equivalent Emission Unit:** An emission unit that serves the identical function as the unit being replaced. The maximum rating and the potential to emit any pollutant shall not be greater from the functionally equivalent emission unit than the replaced unit. The emission increase from any such replacement shall not result in a major modification.

14. **Halogenated Hydrocarbons** means one or more of the following substances:
   a. 1, 1, 1-trichloroethane,
   b. methylene chloride
   c. 2,2-dichloro-1,1,1-trifluoroethane (HCFC-123)
   d. 2-chloro-1,1,1,2-tetrafluroethane (HCFC-124)
   e. trichlorofluoromethane (CFC-11)
   f. dichlorodifluoromethane (CFC-12)
   g. 1,1,1-trichloro-2,2,2-trifluoroethane (CFC-113)
   h. 1-chloro-1,1-difluoro-2,2-difluoroethane (CFC-114)
   i. chloropentafluoroethane (CFC-115)
   j. pentafluoroethane (HFC-125)
   k. 1,1,2,2-tetrafluoroethane (HFC-134)
   l. 1,1,2,2-tetrafluoroethane (HFC-134a)
   m. 1,1-dichloro-1-fluoroethane (HCFC-141b)
   n. 1-chloro-1,1-difluoroethane (HFC-142b)
   o. 1,1,1-trifluoroethane (HFC-143a)
   p. chlorodifluoromethane (HCFC-22)
   q. trifluoroethane (HFC-23)

r. 1,1-difluoroethane (HFC-152a)
s. The following four classes of perfluorocarbon compounds:
   i. Cyclic, branched, or linear, completely fluorinated alkanes.
   ii. Cyclic, branched, or linear, completely fluorinated ethers, with no saturations.
   iii. Cyclic, branched, or linear, completely fluorinated tertiary amines with no unsaturations.
   iv. sulfur-containing perfluorocarbons with no unsaturations and with sulfur bonds only to carbon and fluorine.
   v. Perfluorocarbon compounds will be assumed to be absent from a product or process unless a manufacturer or facility operator identifies the specific individual compounds (from the broad classes of perfluorocarbon compounds) and the amounts present in the product or process and provides a validated test method which can be used to quantify the specific compounds.

**15. Impact Analysis** means an air quality modeling analysis used to estimate the maximum ground level concentration from the project for any pollutant subject to this Rule. Maximum ground level concentration added to background levels shall be compared to ambient air quality standards.

**16. Lowest Achievable Emission Reduction (LAER)** means, for any source, the more stringent rate of emissions based on the following:
   a. The most stringent emission limitation which is contained in the implementation plan of any state for such class of category of stationary source, unless the owner or operator of the proposed major stationary source demonstrates that such limitations are not achievable; or
   b. The most stringent emission limitation which is achieved in practice by such class or category of stationary sources. This limitation, when applied to a major modification, means the LAER for the new or modified emissions units within the stationary source. In no event shall the application of the term permit a proposed new or modified stationary source to emit any pollutant in excess of the amount allowable under an applicable new source standard of performance.

   For purposes of this definition only, the term "any state" means a state, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands.

**17. Modification** means any physical change or operational change to an existing emissions unit, including changing hours of operation or production rate, which would necessitate a change in permit conditions. A modification to a stationary source shall include any modification of its permitted emissions units or addition of any new emissions units. A reconstructed stationary source shall be treated as a new stationary source and not as a modification. A modification also occurs when there is an increase of emissions from an emissions unit which is not subject to a daily emissions limitation. The following shall not be considered a modification:
   a. Routine maintenance or repair.
   b. A change in ownership.

**18. Net Air Quality Benefit** means a net improvement in air quality resulting from actual emissions reductions impacting the same general area affected by the new or modified source.

**19. Non-attainment Pollutant** means any pollutant, as well as any precursors of such pollutant, which has been designated non-attainment by EPA as codified in 40 CFR 81.305, or which has been designated non-attainment by CARB pursuant to H&SC Section 39607.

20. **NSR Regulated Pollutant** means a pollutant for which a National Ambient Air Quality Standard has been established by the EPA, and the precursors to such pollutants, including but not limited to, reactive organic compounds (ROC), nitrogen oxides (NOx), sulfur oxides (Sox), PM10, PM2.5, carbon monoxide (CO), and lead.

21. **$PM_{10}$** means particulate matter with aerodynamic diameter smaller than or equal to a nominal 10 microns.

22. **$PM_{2.5}$** means particulate matter with aerodynamic diameter smaller than or equal to a nominal 2.5 microns.

23. **Potential to Emit** means the maximum daily and/or annual capacity of an emission unit to emit a pollutant under its physical and operational design. Any physical or operational limitation on the capacity of the unit to emit a pollutant, including pollution control equipment and restrictions in hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design only if the limitation or the effect it would have on emissions is incorporated into the applicable permit as a federally enforceable or a practically and legally enforceable permit condition. Fugitive emissions associated with the emissions unit or stationary source shall be included in the potential to emit of the emissions unit or stationary source.

24. **Precursor** means a pollutant that, when emitted into the atmosphere, may undergo either a chemical or physical change which then produces another pollutant for which an ambient air quality standard has been adopted. The following precursor-secondary air contaminant relationships shall be used for the purposes of this rule:

| Precursor | Secondary Air Contaminant |
|---|---|
| Reactive Organic Compound | Photochemical oxidants (Ozone)<br>Organic fraction of PM10 |
| Nitrogen Oxides | Nitrogen dioxide<br>Nitrate fraction of PM10<br>Nitrate fraction of PM2.5<br>Photochemical oxidants (Ozone) |
| Sulfur Oxides | Sulfur dioxide<br>Sulfates<br>Sulfate fraction of PM10<br>Sulfate fraction of PM2.5 |

25. **Quarterly:** Calendar quarters beginning January 1, April 1, July 1, and October 1.

26. **Reactive Organic Compound or Reactive Organic Gas (ROC or ROG)** means any compound meeting the definition of VOC as listed in 40 CFR 51.100(s).

27. **Reconstructed Source** means any source undergoing physical modification where the fixed capital cost of the new components exceeds 50% of the fixed capital cost of a comparable entirely new stationary source. Fixed capital cost means that capital needed to provide all the depreciable components.

28. **Reduced Sulfur Compounds** means the sulfur compounds hydrogen sulfide, carbon disulfide, and carbonyl sulfide.

29. **Replacement Emission Unit**: An emissions unit for which both the criteria listed below are met. No creditable emission reductions shall be generated from shutting down the existing emissions unit that is replaced unless:
    a. The emissions unit is a reconstructed unit within the meaning of 40 CFR 60.15(b)(1), or the emissions unit completely takes the place of an existing emissions unit; or the emissions unit is an identical emission unit or a functionally equivalent emission unit; or the replacement does not alter the basic design parameters of the process unit; and
    b. The replaced emissions unit is permanently removed from the stationary source, otherwise permanently disabled, or permanently barred from operation by a permit that is enforceable as a practical matter. If the replaced emissions unit is brought back into operation, it shall constitute a new emissions unit.

30. **Stationary Source (Facility)** means any building, structure, or emissions unit which emits or may emit any affected pollutant directly or as a fugitive emission. "Emissions unit" includes any operation, article, machine, equipment or other contrivance which emits or may emit any affected pollutant. "Building or structure" includes all pollutant-emitting activities including emissions units which:
    a. are located on one or more contiguous or adjacent properties, and which may be separated by a public right-of-way; and,
    b. are under the same or common ownership, operation, or control, or which are owned or operated by entities which are under common control and belong to the same industrial grouping, either by virtue of falling within the same two-digit Standard Industrial Classification (SIC) Code or by virtue of being part of a common industrial process, manufacturing process, or connected process involving a common raw material.

31. **Total Reduced Sulfur Compounds** means the sulfur compounds hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide.

**E. REQUIREMENTS:** Any emissions unit subject to this Rule shall be subject to the following requirements:

1. **Best Available Control Technology (BACT):** An applicant shall apply BACT to any new emissions unit or modification of an existing emissions unit, if the change would result in an increase in the potential to emit from the new unit or modification of existing equipment. BACT shall be applied to each new unit or modification only for the pollutant(s) emitted in excess of the threshold(s) listed in Table 1.0 Significance Thresholds below. [*Note: This subsection will not be included in the Federal SIP submittal of this rule.]*

Table 1.0 Significance Thresholds

| Pollutant | Significance Thresholds | |
|---|---|---|
| | Daily (pounds per day) | Annual (tons per year) |
| Carbon monoxide | 500.0 | 100 |
| Fluorides | 15.0 | 3.0 |
| Hydrogen sulfide | 50.0 | 10.0 |
| Lead | 3.2 | 0.6 |
| Nitrogen oxides | 50.0 | 40.0 |
| Particulate matter (PM10) | 80.0 | 15.0 |
| Particulate matter (PM2.5) | 50.0 | 10.0 |

| | | |
|---|---|---|
| Reactive organic compounds | 50.0 | 40.0 |
| Reduced sulfur compounds | 50.0 | 10.0 |
| Sulfur oxides | 80.0 | 40.0 |
| Sulfuric acid mist | 35.0 | 7.0 |
| Total reduced sulfur compounds | 50.0 | 10.0 |

2. **Offset Requirements, General:** Emission reductions shall be required from existing emission sources, sufficient to offset calendar quarter emission increases of non-attainment pollutants or their precursors associated with a new or modified stationary source and shall be determined as follows:
   a. Offsets shall be required for a new stationary source with a potential to emit, calculated pursuant to Section (F)(5) of this Rule, non-attainment pollutants or their precursors equal to or exceeding 25 tons per year. The amount of offsets required shall be at least equal to that portion of the potential to emit which exceeds 25 tons per year.
   b. Offsets shall be required for a modified stationary source under the following conditions:
      i. An existing stationary source which has a potential to emit less than 25 tons per year as of January 12, 1993, of non-attainment pollutants or their precursors shall offset that portion of the stationary source's potential to emit which, after modification of the stationary source, exceeds 25 tons per year from new or modified emissions units. A stationary source's potential to emit shall be calculated pursuant to Section (F)(5) of this Rule. After the potential to emit for a stationary source has exceeded these levels, and the applicant has provided actual emissions reductions to offset emission increases in excess of these levels, all future increases from new or modified emissions units shall be offset; and
      ii. An existing stationary source which has a potential to emit, calculated pursuant to Section (F)(5) of this Rule, of non-attainment pollutants or their precursors equal to or exceeding 25 tons per year as of January 12, 1993, shall offset any increases in potential to emit resulting from the permitting of a new or modified emissions unit.
   c. Offset requirements for increases in carbon monoxide: Offsets shall not be required for increases in carbon monoxide if the applicant demonstrates to the satisfaction of the APCO, through an impact analysis, that the ambient air quality standards are not violated in the areas to be affected, and such emissions will not cause or contribute to a violation of National Ambient Air Quality Standards.

3. **Location of Offsets and Offset Ratios**
   a. Offset ratios and the corresponding distances from the proposed stationary source shall be:
      i. on-site, at a ratio of 1:1;
      ii. within 20 miles, at a ratio of 1.2:1;
      iii. from 20 miles to 50 miles, at a ratio of 1.5:1;
      iv. over 50 miles, at a ratio of 2:1.
      Use of offsite offsets must result in a net air quality benefit, as determined by the APCO.

   b. Offsets which are obtained from a source located in another District may be used only if the provisions of H&SC 40709.6 are met, EPA approval is obtained and the involved Districts enter into an agreement formalized by a memorandum of understanding.

4. **Inter-pollutant Offsets:** The APCO may approve inter-pollutant offsets on a case-by-case basis, provided that the applicant demonstrates to the satisfaction of the APCO, through the use of an impact analysis, that the emission increases from the new or modified source will result in a net air quality benefit and will not cause or contribute to a violation of any air quality standard. In such cases, the APCO may, based

upon an air quality analysis, impose offset ratios greater than the requirements of this Rule. The project must also obtain EPA approval for the use of inter-pollutant offsets.

5. **Ambient Air Quality Standards:** In no case shall the emissions from the new or modified stationary source cause or worsen the violation of an ambient air quality standard. An impact analysis may be used to estimate the effects of a new or modified source. In making this determination, the APCO shall take into account the mitigation of emissions through offsets obtained pursuant to this Rule.

6. **Denial, Failure to Meet Standards:** The District shall deny any Authority to Construct or Permit to Operate if the APCO finds that the subject of the application would not comply with the standards set forth in this Rule.

7. **Compliance by Other Owned, Operated, or Controlled Sources:** The owner or operator of a proposed new or modified source shall certify to the APCO that all sources having a potential to emit in excess of 100 tons per year that are owned or operated by such person (or by an entity controlling, controlled by, or under common control) in California are in compliance, or on a schedule for compliance, with all applicable emission limitations and standards.

## F. CALCULATIONS:

1. **Purpose:** The following calculations procedures shall be used to determine:
   a. the emissions change for all new or modified emissions units; and
   b. actual emissions reductions for all shutdowns and modified emissions units; and
   c. the cumulative emissions increase from all new and modified emissions units for a stationary source.

2. **Definitions:** The following terms are used in the calculations procedure and are defined as follows:
   a. **Control Efficiency** means the estimated control efficiency of the proposed air pollution control technology which will be incorporated, by means of (an) enforceable permit condition(s), in the Authority to Construct and Permit to Operate. Emission reductions attributed to lowering throughput rates or operating hours shall not be considered in determining control efficiency.
   b. **Historic Actual Emissions** means actual emissions averaged over the two (2) year period immediately preceding the date of application. If the last two (2) years are unrepresentative of normal operations as determined by the APCO, then two (2) consecutive years of the last five (5) years may be used. Where an emissions unit has been in operation for less than two (2) years, a shorter averaging period of at least one (1) year may be used, providing it represents the full operational history of the emissions unit. If, at any time during the specified period, actual emissions exceeded allowed emission levels, then actual emissions shall be reduced to reflect emission levels that would have occurred if in compliance with all applicable limitations and rules.
   c. **Historic Emissions** means the potential to emit of an existing emissions unit prior to modification. For a new emissions unit, historic emissions are equal to zero.
   d. **Proposed Emissions** means the potential to emit for a new or post-modification emissions unit.

3. **Procedure:** The calculation procedure shall be performed separately for each pollutant and each emissions unit. Emission increases and decreases shall be calculated separately for each calendar quarter pursuant to the following procedure:
   a. Calculate the emissions change for each new or modified emissions unit and for each pollutant using Section (F)(4) of this Rule.

b. If an increase is calculated for a pollutant, follow the procedures in Sections (E)(2) of this Rule to determine the amount of offsets required.
c. If a decrease is calculated for a pollutant, follow the procedures in Section (F)(4)(b)of this Rule to determine if emission reduction credits (ERC's) are generated.

If no emissions change is calculated for a pollutant, no further calculations are required.

**4. Calculating Emissions Changes**

a. Emissions Increase
   i. New or Modified Emissions Unit: The emissions change for a new or modified emissions unit shall be calculated by subtracting historic emissions from proposed emissions:
b. Emissions change = Proposed emissions minus Historic Emissions
c. Actual Emissions Reductions (AER)
   i. Shutdown of an Emissions Unit: AER = Historic actual emissions
   ii. Modification consisting solely of application of control equipment or implementation of more efficient process: AER = Historic actual emissions multiplied by Control efficiency
   iii. Other Modifications: AER = Historic actual emissions minus Proposed emissions

**G. AIR QUALITY IMPACT ANALYSIS:** In no case shall emissions from a new or modified emissions unit cause or worsen the violation of an ambient air quality standard. The APCO may require an applicant to use an air quality model to estimate the effects of a new or modified emissions unit. For the purpose of performing an impact analysis, the following shall apply:

**1.** Air quality models shall be consistent with the requirements specified in 40 CFR Part 51, Appendix W ("Guideline on Air Quality Models"), unless the APCO finds that such model is inappropriate for use. After making such a finding, the APCO may designate an alternative model only after allowing for public comment and only with the written concurrence of CARB and EPA. All modeling costs associated with the site of a new or modified emissions unit shall be borne by the applicant. In addition, use of a modified or substituted model must be subject to notice and opportunity for public comment.

**2.** In performing an impact analysis, if the proposed stack height is higher than is dictated by good engineering practices, the actual height used for the purposes of modeling shall be calculated in accordance with good engineering practices.

**H. ADMINISTRATIVE REQUIREMENTS:** The following administrative requirements shall apply to this Rule:

**1. Complete Application:** The APCO shall determine whether the application is complete not later than thirty (30) days after receipt of the application, or after such longer time mutually agreeable to the applicant and the APCO. If the APCO determines that the application is not complete, the applicant shall be notified in writing of the decision and of the required additional information. Upon receipt of any re-submittal of the application, a new thirty (30)-day period to determine the completeness shall begin. Completeness or re-submittal of an application shall be evaluated on the basis of the information requirements set forth in District Regulations as they exist on the date on which the application or re-submitted application was received. Upon determination that the application is complete, the APCO shall notify the applicant in writing. The APCO may, during the processing of the application, request an applicant to clarify, amplify, correct, or otherwise supplement the information submitted in the application.

**2. Reserved.**

3. **Preliminary Decision:** Following acceptance of an application as complete, the APCO shall perform the evaluations required to determine the compliance with this Rule and make a preliminary written decision as to whether an Authority to Construct should be approved, conditionally approved, or disapproved. The decision shall be supported by a written analysis.

4. **Publication and Public Comment:**
   a. **Applicability:** This Section shall only apply to an emissions unit when:
      i. BACT is required to be applied to a new unit or a modification to an existing unit in accordance with Section (E)(1) of this Rule; or
      ii. A stationary source has requested to assume a federally enforceable emissions limit such that the increase in the potential to emit from a new emissions unit or modification to an emissions unit is artificially constrained.
   b. **Written Notice:** Within ten (10) calendar days following a preliminary decision on the Authority to Construct, the APCO shall publish in at least one (1) newspaper of general circulation in the District, a notice stating the preliminary decision of the APCO noting how pertinent information can be obtained, and inviting written public comment for a thirty (30)-day period following the date of publication. Copies of such notice shall be sent to CARB and EPA.
   c. **Public Inspections:** The APCO shall make available at the District offices the information submitted by the applicant and the APCO's analysis no later than the time that the notice of preliminary decision is published. All such information shall also be transmitted, no later than the date of publication, to CARB and EPA. Information submitted which contains trade secrets shall be handled in accordance with Section 6254.7 of the Government Code and relevant sections of the Administrative Code of the State of California.

5. **Denial, Failure To Meet Standards:** The APCO shall deny any Authority to Construct or Permit to Operate if the APCO finds that the subject of the application would not comply with the standards set forth in District, State, or federal rules or regulations.

6. **Authority to Construct, Final Action:** Within 180 days after acceptance of an application as complete, the APCO shall take final action on the application after considering all written comments. The APCO shall provide written notification of the final action to the applicant, CARB, and EPA, and shall make the notification and all supporting documents available for public inspection at the District offices for all Authorities to Construct issued for emissions units subject to the requirements of Section (E)(1) of this Rule.

7. **Requirements for Permits to Operate:** As a condition for the issuance of a Permit to Operate, the APCO shall require that the new source or modification, and any sources which provide offsets will be operated in the manner assumed in making the analysis to determine compliance with this Rule. The Permit to Operate shall include daily emissions limitations which reflect applicable emissions limitations, including BACT. As a condition for the issuance of a Permit to Operate, any stationary source which provides emission offsets shall be subject to enforceable permit conditions, containing specific emissions limitations, and/or operational limitations which ensure that the emission reductions will be provided in accordance with the provisions of this Rule and shall continue for the reasonably expected life of the proposed source. When the source of offsets is not subject to a permit, a written contract shall be required between the applicant and the owner or operator of such offset source, which contract, by its terms, shall be enforceable by the APCO. A violation of the emission limitation provisions of any such contract shall be chargeable to the applicant.

a. Where the source of offsets is a non-permitted source, the District shall require the non-permitted source to obtain an enforceable permit, complete with operational and emission limitations. If the source of offsets is a permit-exempt piece of equipment, that particular source must relinquish its exempt status.
b. If the District, pursuant to state laws or District Regulations, cannot permit the source of offsets, the source creating the offsets shall execute a legally binding contract between the applicant and the owner or operator of such offset source, which contract, by its terms, shall be enforceable by the APCO. A violation of the emission limitation provisions of any such contract shall be chargeable to the applicant. [*Note: This subsection will not be included in the Federal SIP submittal of this rule.]*

**8. Issuance of Permits to Operate:** The APCO shall issue a Permit to Operate for any stationary source which meets the requirements of this Rule. Any offsets required as a condition of an Authority to Construct or amendment to a Permit to Operate shall commence not later than the initial operation of the new or modified source, and the offsets shall be maintained throughout the operation of the new or modified source which is the beneficiary of the offsets. Further, the APCO shall determine that all conditions specified in the Authority to Construct have been or will be complied with by any dates specified. Where a new or modified stationary source is, in whole or part, a replacement for an existing stationary source on the same property, the APCO may allow a maximum of one hundred and eighty (180) days as a start-up period for simultaneous operations of the existing stationary source and the new source or replacement.

**9. Reserved.**

**10. Permit Conditions:** The APCO shall have the authority to place conditions on the Authority to Construct and/or Permit to Operate which will ensure that the construction, modification, or operation of such source will comply with all applicable rules and regulations. Such conditions may include, but not be limited to: hours of operation; processing parameters; periods of use; and emission limitations on an hourly, daily, or yearly basis.

**I. POWER PLANT PROCEDURES:** A power plant shall be defined as a stationary source that produces electricity. This section shall apply to all power plants proposed to be constructed in the district and for which a Notice of Intention (NOI) or Application for Certification has been accepted by the California Energy Commission (CEC). The APCO may apply for reimbursement of all costs incurred, including lost fees, in order to comply with the provisions of this section.

**1. Intent to Participate and Preliminary Report:** Within fourteen (14) days of receipt of an NOI, the APCO shall notify CARB and the CEC of the District's intent to participate in the NOI proceeding. If the District chooses to participate in the NOI proceeding, the APCO shall prepare and submit a report to CARB and the CEC prior to the conclusion of the non-adjudicatory hearing specified in Section 25509.5 of the Public Resources Code. That report shall include, at a minimum:
a. A preliminary specific definition of BACT for the proposed facility; and
b. A preliminary discussion of whether there is a substantial likelihood that the requirements of this Rule and all other District Regulations can be satisfied by the proposed facility; and
c. A preliminary list of conditions which the proposed facility must meet in order to comply with this Rule or any other applicable District Regulation.

The preliminary determinations contained in the report shall be as specific as possible within the constraints of the information contained in the NOI.

2. **Determination of Compliance Review:** Upon receipt of an Application for Certification (AFC) for a power plant, the APCO shall conduct a Determination of Compliance review. This determination shall consist of a review identical to that which would be performed if an application for an Authority to Construct had been received for the power plant. If the information contained in the AFC does not meet the requirements of this Rule, the APCO shall, within twenty (20) calendar days of receipt of the AFC, so inform the Commission, and the AFC shall be considered incomplete and returned to the applicant for re-submittal.

3. **Equivalency of Application:** The APCO shall consider the AFC to be equivalent to an application for an Authority to Construct during the Determination of Compliance review, and shall apply all provisions of this Rule which apply to an application for an Authority to Constuct.

4. **Need for Additional Information:** The APCO may request from the applicant any information necessary for the completion of the Determination of Compliance review. If the APCO is unable to obtain the information, the APCO may petition the presiding Commissioner for an order directing the applicant to supply such information.

5. **Preliminary Determination:** Within 180 days of accepting an AFC as complete, the APCO shall make a preliminary decision on:
   a. whether the proposed power plant meets the requirements of this Rule and all other applicable District Regulations; and
   b. in the event of compliance, what permit conditions will be required, including the specific BACT requirements and a description of required mitigation measures. The preliminary written decision under Section (H)(3) of this Rule shall be treated as a preliminary decision under Section (H)(5) of this Rule, and shall be finalized by the APCO only after being subject to the public notice and comment requirements of Sections (H)(4) through (H)(6) of this Rule. The APCO shall not issue a Determination of Compliance unless all requirements of this Rule are met.

6. **Determination of Compliance:** Within 240 days of the filing date, the APCO shall issue and submit to the Commission a Determination of Compliance or, if such a determination cannot be issued, shall inform the CEC. A Determination of Compliance shall confer the same rights and privileges as an Authority to Construct only when and if the Commission approves the AFC, and the Commission certificate includes all conditions of the Determination of Compliance.

7. **Permit to Operate:** Any applicant receiving a certificate from the CEC Pursuant to this Section and in compliance with all conditions of the certificate shall be issued a Permit to Operate by the APCO.

## J. EXCLUSIONS:

1. New Source Review Procedures in accordance with Rule 110 shall not be required for temporary stationary sources which will be in operation for less than 90 days duration provided BACT is applied in accordance with Section 5.1 and such operations will not interfere with the control strategy of the SIP.

2. **Reserved.**

**K. PREVENTION OF SIGNIFICANT DETERIORATION (PSD):** The provisions of this section shall only apply to new or modified sources which have the potential to emit greater than the applicable annual significance threshold of the NSR Regulated Pollutant(s) listed in Table 1.0 Significance Thresholds of Section (E)(1).

**1.** Pursuant to the CAA in addition to any other requirements imposed in these Rules and Regulations, and not withstanding any other permit requirements, no sources subject to these Rules and Regulations shall be permitted to release emissions into the atmosphere which cause or create an exceedance of the maximum allowable prevention of significant deterioration (PSD) increments for Class I, Class II, or Class III areas as defined in Regulation I, Rule 101**.**

**2.** An air quality analysis of the ambient impacts associated with the construction and operation of the proposed new source or modification shall be prepared to determine if the new emission emitted from the proposed major source or, modification, in conjunction with other applicable emissions from existing sources (including secondary emission from growth associated with the new project), will not cause or contribute to a violation of any PSD increment.

**3.** A separate air quality analysis must be submitted for each regulated pollutant if the applicant proposes to emit a pollutant in a significant amount from a new major stationary source, or proposes to cause a significant net emission increase from a major modification.

**4.** Generally, the air quality analysis shall involve; (1) an assessment of existing air quality, which may include ambient air monitoring date and air quality dispersion modeling result, and (2) predictions, using dispersion modeling, of ambient concentrations that will result from the applications proposed project and future growth associated with the project.

**5.** All increment consumptions shall be determined using a baseline emission date established as a reference point for determining air quality deterioration in an area. The baseline concentration is pollutant specific and is essentially the air quality level existing at the time of the first complete PSD permit application submittal in the District. On or before the first PSD application, emissions are considered to be part of the baseline concentration, and emissions changes after that date affect the amount available PSD increments.

**6.** The amount of PSD increment that has been consumed in a PSD area is determined from the emissions increases and decreases which have occurred from sources since the applicable baseline date. In order to determine the amount of PSD increment consumed (or the amount of available increment), no determination of the baseline concentration needs to be made. Instead, increment consumption calculations must reflect only the ambient pollutant concentration change attributable to increment-affecting emissions. Emissions increases that consume a portion of the applicable increment are, in general, all those not accounted for in the baseline concentration and specifically include actual emissions increased occurring after the major source baseline date, which are associated with physical changes or changes in the method of operation (i.e., construction) at a major stationary source. The amount of available increment may be added to, or "expanded".

**7.** From the reduction of actual emissions after the major source baseline date, if the reduction results from a physical change or change in the method of operation (i.e., construction) at a major stationary source. The reduction will add to the available increment only if the reduction is included in the federally enforceable permit or SIP provision.

**8.** The credible increase of an existing stack height or the application of any other credible dispersion technique may affect increment consumption or expansion in the same manner as an actual emissions increase or decrease. (The effects that a change in the effective stack height would have on ground level pollutant concentrations generally should be factored into increment analysis.) Any increase in a stack eight, in order to be creditable, must be consistent with the EPA's stack height regulations; credit cannot be given for that portion of the new height which exceeds the height demonstrated to be the good engineering practice (GEP) stack height.

**9.** Increment consumption (and expansion) will generally be based on changes in actual emissions reflected by the normal source operation for a period of 2 years. However, if the little or no operating data are available, as in the case of permitted emission units not yet in operation at the time of the increment analysis, the potential to emit must be used instead.

**10. Reserved.**

# ATTACHMENT 34

CAPCOA. 2017. California Emission Estimator Model (CalEEMod). Version 2016.3.2. Model for project used on: 8/7/20 and 9/15/20.

# Arcata Wastewater Treatment Facility Improvement Project (Phase 1)

**Humboldt County, Summer**

## 1.0 Project Characteristics

### 1.1 Land Usage

| Land Uses | Size | Metric | Lot Acreage | Floor Surface Area | Population |
|---|---|---|---|---|---|
| General Heavy Industry | 17.25 | 1000sqft | 0.40 | 17,250.00 | 0 |
| Other Asphalt Surfaces | 36.00 | 1000sqft | 0.83 | 36,000.00 | 0 |
| Other Non-Asphalt Surfaces | 12.00 | 1000sqft | 0.28 | 12,000.00 | 0 |

### 1.2 Other Project Characteristics

| | | | | | |
|---|---|---|---|---|---|
| **Urbanization** | Rural | **Wind Speed (m/s)** | 2.2 | **Precipitation Freq (Days)** | 103 |
| **Climate Zone** | 1 | | | **Operational Year** | 2022 |
| **Utility Company** | Pacific Gas & Electric Company | | | | |
| **CO2 Intensity (lb/MWhr)** | 641.35 | **CH4 Intensity (lb/MWhr)** | 0.029 | **N2O Intensity (lb/MWhr)** | 0.006 |

### 1.3 User Entered Comments & Non-Default Data

Arcata Wastewater Treatment Facility Improvement Project (Phase 1) - Humboldt County, Summer

Project Characteristics -

Land Use - "General Heavy Industry" was used for buildings and equipment. "Other Asphalt Surfaces" was used for paving of access roads. "Other Non-Asphalt Surfaces" was used for ductbank construction.

Construction Phase - Constructon schedule provided by project engineer.

Off-road Equipment - Equipment list supplemented by project engineer.

Off-road Equipment - Equipment list provided by project engineer.

Grading - It is assumed that the project site will be crossed over twice during grading and site preparation.

Demolition -

Off-road Equipment -

Architectural Coating - The project will use low VOC paint that is 50 g/L or less.

Area Coating - The project will use low VOC paint that is 50 g/L or less.

Area Mitigation - The project will use low VOC paint that is 50g/L or less.

| Table Name | Column Name | Default Value | New Value |
|---|---|---|---|
| tblArchitecturalCoating | EF_Nonresidential_Exterior | 250.00 | 50.00 |
| tblArchitecturalCoating | EF_Nonresidential_Interior | 250.00 | 50.00 |
| tblArchitecturalCoating | EF_Parking | 250.00 | 50.00 |
| tblAreaCoating | Area_EF_Nonresidential_Exterior | 250 | 50 |
| tblAreaCoating | Area_EF_Nonresidential_Interior | 250 | 50 |
| tblAreaCoating | Area_EF_Parking | 250 | 50 |
| tblAreaMitigation | UseLowVOCPaintParkingCheck | False | True |
| tblConstructionPhase | NumDays | 200.00 | 160.00 |
| tblConstructionPhase | NumDays | 20.00 | 32.00 |
| tblConstructionPhase | NumDays | 4.00 | 20.00 |
| tblConstructionPhase | NumDays | 10.00 | 5.00 |
| tblConstructionPhase | NumDays | 2.00 | 10.00 |
| tblConstructionPhase | PhaseEndDate | 3/10/2022 | 4/20/2022 |
| tblConstructionPhase | PhaseEndDate | 2/10/2022 | 4/7/2022 |

| | | | |
|---|---|---|---|
| tblConstructionPhase | PhaseEndDate | 4/28/2021 | 5/14/2021 |
| tblConstructionPhase | PhaseEndDate | 5/6/2021 | 6/23/2021 |
| tblConstructionPhase | PhaseEndDate | 2/24/2022 | 8/27/2021 |
| tblConstructionPhase | PhaseEndDate | 4/30/2021 | 5/27/2021 |
| tblConstructionPhase | PhaseStartDate | 2/25/2022 | 4/7/2022 |
| tblConstructionPhase | PhaseStartDate | 5/7/2021 | 8/27/2021 |
| tblConstructionPhase | PhaseStartDate | 5/1/2021 | 5/27/2021 |
| tblConstructionPhase | PhaseStartDate | 2/11/2022 | 8/23/2021 |
| tblConstructionPhase | PhaseStartDate | 4/29/2021 | 5/14/2021 |
| tblGrading | AcresOfGrading | 7.50 | 4.00 |
| tblGrading | AcresOfGrading | 5.00 | 2.05 |
| tblGrading | MaterialExported | 0.00 | 6,200.00 |
| tblGrading | MaterialImported | 0.00 | 880.00 |
| tblOffRoadEquipment | LoadFactor | 0.37 | 0.37 |
| tblOffRoadEquipment | LoadFactor | 0.38 | 0.38 |
| tblOffRoadEquipment | LoadFactor | 0.50 | 0.50 |
| tblOffRoadEquipment | OffRoadEquipmentType | | Tractors/Loaders/Backhoes |
| tblOffRoadEquipment | OffRoadEquipmentType | | Cranes |
| tblOffRoadEquipment | OffRoadEquipmentType | | Excavators |
| tblOffRoadEquipment | OffRoadEquipmentType | | Bore/Drill Rigs |
| tblProjectCharacteristics | UrbanizationLevel | Urban | Rural |

## 2.0 Emissions Summary

## 2.1 Overall Construction (Maximum Daily Emission)

### Unmitigated Construction

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | lb/day | | | | | | | | | | lb/day | | | | | |
| 2021 | 3.9814 | 43.6924 | 28.1875 | 0.0642 | 11.1333 | 1.8095 | 12.5916 | 5.6700 | 1.6786 | 7.0136 | 0.0000 | 6,464.1378 | 6,464.1378 | 1.1711 | 0.0000 | 6,491.2963 |
| 2022 | 11.3211 | 20.2602 | 20.0113 | 0.0430 | 0.4759 | 0.8637 | 1.3397 | 0.1277 | 0.8284 | 0.9562 | 0.0000 | 4,053.0343 | 4,053.0343 | 0.7612 | 0.0000 | 4,072.0633 |
| **Maximum** | **11.3211** | **43.6924** | **28.1875** | **0.0642** | **11.1333** | **1.8095** | **12.5916** | **5.6700** | **1.6786** | **7.0136** | **0.0000** | **6,464.1378** | **6,464.1378** | **1.1711** | **0.0000** | **6,491.2963** |

### Mitigated Construction

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | lb/day | | | | | | | | | | lb/day | | | | | |
| 2021 | 3.9814 | 43.6924 | 28.1875 | 0.0642 | 11.1333 | 1.8095 | 12.5916 | 5.6700 | 1.6786 | 7.0136 | 0.0000 | 6,464.1378 | 6,464.1378 | 1.1711 | 0.0000 | 6,491.2963 |
| 2022 | 11.3211 | 20.2602 | 20.0113 | 0.0430 | 0.4759 | 0.8637 | 1.3397 | 0.1277 | 0.8284 | 0.9562 | 0.0000 | 4,053.0343 | 4,053.0343 | 0.7612 | 0.0000 | 4,072.0633 |
| **Maximum** | **11.3211** | **43.6924** | **28.1875** | **0.0642** | **11.1333** | **1.8095** | **12.5916** | **5.6700** | **1.6786** | **7.0136** | **0.0000** | **6,464.1378** | **6,464.1378** | **1.1711** | **0.0000** | **6,491.2963** |

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio-CO2 | Total CO2 | CH4 | N20 | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Percent Reduction** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |

## 2.2 Overall Operational

### Unmitigated Operational

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Area | 0.4105 | 6.0000e-005 | 6.6700e-003 | 0.0000 | | 2.0000e-005 | 2.0000e-005 | | 2.0000e-005 | 2.0000e-005 | | 0.0143 | 0.0143 | 4.0000e-005 | | 0.0152 |
| Energy | 1.7900e-003 | 0.0163 | 0.0137 | 1.0000e-004 | | 1.2400e-003 | 1.2400e-003 | | 1.2400e-003 | 1.2400e-003 | | 19.5157 | 19.5157 | 3.7000e-004 | 3.6000e-004 | 19.6317 |
| Mobile | 0.0841 | 0.5057 | 1.0415 | 2.6900e-003 | 0.2134 | 3.5500e-003 | 0.2170 | 0.0572 | 3.3500e-003 | 0.0606 | | 271.6829 | 271.6829 | 0.0136 | | 272.0224 |
| **Total** | **0.4964** | **0.5221** | **1.0618** | **2.7900e-003** | **0.2134** | **4.8100e-003** | **0.2182** | **0.0572** | **4.6100e-003** | **0.0618** | | **291.2129** | **291.2129** | **0.0140** | **3.6000e-004** | **291.6693** |

### Mitigated Operational

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Area | 0.4105 | 6.0000e-005 | 6.6700e-003 | 0.0000 | | 2.0000e-005 | 2.0000e-005 | | 2.0000e-005 | 2.0000e-005 | | 0.0143 | 0.0143 | 4.0000e-005 | | 0.0152 |
| Energy | 1.7900e-003 | 0.0163 | 0.0137 | 1.0000e-004 | | 1.2400e-003 | 1.2400e-003 | | 1.2400e-003 | 1.2400e-003 | | 19.5157 | 19.5157 | 3.7000e-004 | 3.6000e-004 | 19.6317 |
| Mobile | 0.0841 | 0.5057 | 1.0415 | 2.6900e-003 | 0.2134 | 3.5500e-003 | 0.2170 | 0.0572 | 3.3500e-003 | 0.0606 | | 271.6829 | 271.6829 | 0.0136 | | 272.0224 |
| **Total** | **0.4964** | **0.5221** | **1.0618** | **2.7900e-003** | **0.2134** | **4.8100e-003** | **0.2182** | **0.0572** | **4.6100e-003** | **0.0618** | | **291.2129** | **291.2129** | **0.0140** | **3.6000e-004** | **291.6693** |

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio-CO2 | Total CO2 | CH4 | N20 | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Percent Reduction** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |

## 3.0 Construction Detail

**Construction Phase**

| Phase Number | Phase Name | Phase Type | Start Date | End Date | Num Days Week | Num Days | Phase Description |
|---|---|---|---|---|---|---|---|
| 1 | Demolition | Demolition | 4/1/2021 | 5/14/2021 | 5 | 32 | |
| 2 | Site Preparation | Site Preparation | 5/14/2021 | 5/27/2021 | 5 | 10 | |
| 3 | Grading | Grading | 5/27/2021 | 6/23/2021 | 5 | 20 | |
| 4 | Building Construction | Building Construction | 8/27/2021 | 4/7/2022 | 5 | 160 | |
| 5 | Paving | Paving | 8/23/2021 | 8/27/2021 | 5 | 5 | |
| 6 | Architectural Coating | Architectural Coating | 4/7/2022 | 4/20/2022 | 5 | 10 | |
| 7 | Trenching | Trenching | 6/23/2021 | 8/23/2021 | 5 | 44 | |

**Acres of Grading (Site Preparation Phase): 2.05**

**Acres of Grading (Grading Phase): 4**

**Acres of Paving: 1.11**

**Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 25,875; Non-Residential Outdoor: 8,625; Striped Parking Area: 2,880 (Architectural Coating – sqft)**

**OffRoad Equipment**

Arcata Wastewater Treatment Facility Improvement Project (Phase 1) - Humboldt County, Summer

| Phase Name | Offroad Equipment Type | Amount | Usage Hours | Horse Power | Load Factor |
|---|---|---|---|---|---|
| Architectural Coating | Air Compressors | 1 | 6.00 | 78 | 0.48 |
| Paving | Cement and Mortar Mixers | 1 | 6.00 | 9 | 0.56 |
| Demolition | Concrete/Industrial Saws | 1 | 8.00 | 81 | 0.73 |
| Building Construction | Generator Sets | 1 | 8.00 | 84 | 0.74 |
| Building Construction | Cranes | 1 | 6.00 | 231 | 0.29 |
| Building Construction | Forklifts | 1 | 6.00 | 89 | 0.20 |
| Site Preparation | Graders | 1 | 8.00 | 187 | 0.41 |
| Paving | Pavers | 1 | 6.00 | 130 | 0.42 |
| Paving | Rollers | 1 | 7.00 | 80 | 0.38 |
| Demolition | Rubber Tired Dozers | 1 | 8.00 | 247 | 0.40 |
| Grading | Rubber Tired Dozers | 1 | 6.00 | 247 | 0.40 |
| Building Construction | Tractors/Loaders/Backhoes | 1 | 6.00 | 97 | 0.37 |
| Demolition | Tractors/Loaders/Backhoes | 3 | 8.00 | 97 | 0.37 |
| Grading | Tractors/Loaders/Backhoes | 1 | 7.00 | 97 | 0.37 |
| Paving | Tractors/Loaders/Backhoes | 1 | 8.00 | 97 | 0.37 |
| Site Preparation | Tractors/Loaders/Backhoes | 1 | 8.00 | 97 | 0.37 |
| Grading | Graders | 1 | 6.00 | 187 | 0.41 |
| Paving | Paving Equipment | 1 | 8.00 | 132 | 0.36 |
| Site Preparation | Rubber Tired Dozers | 1 | 7.00 | 247 | 0.40 |
| Building Construction | Welders | 3 | 8.00 | 46 | 0.45 |
| Trenching | Tractors/Loaders/Backhoes | 1 | 8.00 | 97 | 0.37 |
| Building Construction | Cranes | 1 | 6.00 | 231 | 0.29 |
| Trenching | Excavators | 2 | 8.00 | 158 | 0.38 |
| Building Construction | Bore/Drill Rigs | 1 | 6.00 | 221 | 0.50 |

**Trips and VMT**

| Phase Name | Offroad Equipment Count | Worker Trip Number | Vendor Trip Number | Hauling Trip Number | Worker Trip Length | Vendor Trip Length | Hauling Trip Length | Worker Vehicle Class | Vendor Vehicle Class | Hauling Vehicle Class |
|---|---|---|---|---|---|---|---|---|---|---|
| Demolition | 5 | 13.00 | 0.00 | 20.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Site Preparation | 3 | 8.00 | 0.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Grading | 3 | 8.00 | 0.00 | 775.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Building Construction | 9 | 27.00 | 11.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Paving | 5 | 13.00 | 0.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Architectural Coating | 1 | 5.00 | 0.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Trenching | 3 | 8.00 | 0.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |

## 3.1 Mitigation Measures Construction

## 3.2 Demolition - 2021

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Fugitive Dust | | | | | 0.1378 | 0.0000 | 0.1378 | 0.0209 | 0.0000 | 0.0209 | | | 0.0000 | | | 0.0000 |
| Off-Road | 1.9930 | 19.6966 | 14.4925 | 0.0241 | | 1.0409 | 1.0409 | | 0.9715 | 0.9715 | | 2,322.7171 | 2,322.7171 | 0.5940 | | 2,337.5658 |
| **Total** | **1.9930** | **19.6966** | **14.4925** | **0.0241** | **0.1378** | **1.0409** | **1.1787** | **0.0209** | **0.9715** | **0.9923** | | **2,322.7171** | **2,322.7171** | **0.5940** | | **2,337.5658** |

## 3.2 Demolition - 2021

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 5.5000e-003 | 0.1902 | 0.0297 | 5.0000e-004 | 0.0109 | 8.6000e-004 | 0.0117 | 2.9700e-003 | 8.2000e-004 | 3.7900e-003 | | 52.3285 | 52.3285 | 1.5100e-003 | | 52.3663 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.1322 | 0.1201 | 0.9918 | 1.5400e-003 | 0.1661 | 1.4600e-003 | 0.1675 | 0.0440 | 1.3500e-003 | 0.0454 | | 152.9014 | 152.9014 | 9.8600e-003 | | 153.1480 |
| **Total** | **0.1377** | **0.3103** | **1.0214** | **2.0400e-003** | **0.1769** | **2.3200e-003** | **0.1792** | **0.0470** | **2.1700e-003** | **0.0492** | | **205.2300** | **205.2300** | **0.0114** | | **205.5143** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Fugitive Dust | | | | | 0.1378 | 0.0000 | 0.1378 | 0.0209 | 0.0000 | 0.0209 | | | 0.0000 | | | 0.0000 |
| Off-Road | 1.9930 | 19.6966 | 14.4925 | 0.0241 | | 1.0409 | 1.0409 | | 0.9715 | 0.9715 | 0.0000 | 2,322.7171 | 2,322.7171 | 0.5940 | | 2,337.5658 |
| **Total** | **1.9930** | **19.6966** | **14.4925** | **0.0241** | **0.1378** | **1.0409** | **1.1787** | **0.0209** | **0.9715** | **0.9923** | **0.0000** | **2,322.7171** | **2,322.7171** | **0.5940** | | **2,337.5658** |

## 3.2 Demolition - 2021

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 5.5000e-003 | 0.1902 | 0.0297 | 5.0000e-004 | 0.0109 | 8.6000e-004 | 0.0117 | 2.9700e-003 | 8.2000e-004 | 3.7900e-003 | | 52.3285 | 52.3285 | 1.5100e-003 | | 52.3663 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.1322 | 0.1201 | 0.9918 | 1.5400e-003 | 0.1661 | 1.4600e-003 | 0.1675 | 0.0440 | 1.3500e-003 | 0.0454 | | 152.9014 | 152.9014 | 9.8600e-003 | | 153.1480 |
| **Total** | **0.1377** | **0.3103** | **1.0214** | **2.0400e-003** | **0.1769** | **2.3200e-003** | **0.1792** | **0.0470** | **2.1700e-003** | **0.0492** | | **205.2300** | **205.2300** | **0.0114** | | **205.5143** |

## 3.3 Site Preparation - 2021

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Fugitive Dust | | | | | 5.4867 | 0.0000 | 5.4867 | 2.9199 | 0.0000 | 2.9199 | | | 0.0000 | | | 0.0000 |
| Off-Road | 1.5558 | 17.4203 | 7.5605 | 0.0172 | | 0.7654 | 0.7654 | | 0.7041 | 0.7041 | | 1,666.5174 | 1,666.5174 | 0.5390 | | 1,679.9920 |
| **Total** | **1.5558** | **17.4203** | **7.5605** | **0.0172** | **5.4867** | **0.7654** | **6.2521** | **2.9199** | **0.7041** | **3.6241** | | **1,666.5174** | **1,666.5174** | **0.5390** | | **1,679.9920** |

## 3.3 Site Preparation - 2021

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.0813 | 0.0739 | 0.6103 | 9.5000e-004 | 0.1022 | 9.0000e-004 | 0.1031 | 0.0271 | 8.3000e-004 | 0.0279 | | 94.0932 | 94.0932 | 6.0700e-003 | | 94.2449 |
| **Total** | **0.0813** | **0.0739** | **0.6103** | **9.5000e-004** | **0.1022** | **9.0000e-004** | **0.1031** | **0.0271** | **8.3000e-004** | **0.0279** | | **94.0932** | **94.0932** | **6.0700e-003** | | **94.2449** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Fugitive Dust | | | | | 5.4867 | 0.0000 | 5.4867 | 2.9199 | 0.0000 | 2.9199 | | | 0.0000 | | | 0.0000 |
| Off-Road | 1.5558 | 17.4203 | 7.5605 | 0.0172 | | 0.7654 | 0.7654 | | 0.7041 | 0.7041 | 0.0000 | 1,666.5174 | 1,666.5174 | 0.5390 | | 1,679.9920 |
| **Total** | **1.5558** | **17.4203** | **7.5605** | **0.0172** | **5.4867** | **0.7654** | **6.2521** | **2.9199** | **0.7041** | **3.6241** | **0.0000** | **1,666.5174** | **1,666.5174** | **0.5390** | | **1,679.9920** |

## 3.3 Site Preparation - 2021

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.0813 | 0.0739 | 0.6103 | 9.5000e-004 | 0.1022 | 9.0000e-004 | 0.1031 | 0.0271 | 8.3000e-004 | 0.0279 | | 94.0932 | 94.0932 | 6.0700e-003 | | 94.2449 |
| **Total** | **0.0813** | **0.0739** | **0.6103** | **9.5000e-004** | **0.1022** | **9.0000e-004** | **0.1031** | **0.0271** | **8.3000e-004** | **0.0279** | | **94.0932** | **94.0932** | **6.0700e-003** | | **94.2449** |

## 3.4 Grading - 2021

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Fugitive Dust | | | | | 4.7687 | 0.0000 | 4.7687 | 2.5116 | 0.0000 | 2.5116 | | | 0.0000 | | | 0.0000 |
| Off-Road | 1.2884 | 14.3307 | 6.3314 | 0.0141 | | 0.6379 | 0.6379 | | 0.5869 | 0.5869 | | 1,365.0648 | 1,365.0648 | 0.4415 | | 1,376.1020 |
| **Total** | **1.2884** | **14.3307** | **6.3314** | **0.0141** | **4.7687** | **0.6379** | **5.4066** | **2.5116** | **0.5869** | **3.0985** | | **1,365.0648** | **1,365.0648** | **0.4415** | | **1,376.1020** |

## 3.4 Grading - 2021

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.3410 | 11.7936 | 1.8401 | 0.0310 | 0.6735 | 0.0533 | 0.7268 | 0.1842 | 0.0510 | 0.2352 | | 3,244.3693 | 3,244.3693 | 0.0937 | | 3,246.7124 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.0813 | 0.0739 | 0.6103 | 9.5000e-004 | 0.1022 | 9.0000e-004 | 0.1031 | 0.0271 | 8.3000e-004 | 0.0279 | | 94.0932 | 94.0932 | 6.0700e-003 | | 94.2449 |
| **Total** | **0.4223** | **11.8675** | **2.4504** | **0.0319** | **0.7757** | **0.0542** | **0.8298** | **0.2113** | **0.0518** | **0.2631** | | **3,338.4625** | **3,338.4625** | **0.0998** | | **3,340.9573** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Fugitive Dust | | | | | 4.7687 | 0.0000 | 4.7687 | 2.5116 | 0.0000 | 2.5116 | | | 0.0000 | | | 0.0000 |
| Off-Road | 1.2884 | 14.3307 | 6.3314 | 0.0141 | | 0.6379 | 0.6379 | | 0.5869 | 0.5869 | 0.0000 | 1,365.0648 | 1,365.0648 | 0.4415 | | 1,376.1020 |
| **Total** | **1.2884** | **14.3307** | **6.3314** | **0.0141** | **4.7687** | **0.6379** | **5.4066** | **2.5116** | **0.5869** | **3.0985** | **0.0000** | **1,365.0648** | **1,365.0648** | **0.4415** | | **1,376.1020** |

## 3.4 Grading - 2021

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.3410 | 11.7936 | 1.8401 | 0.0310 | 0.6735 | 0.0533 | 0.7268 | 0.1842 | 0.0510 | 0.2352 | | 3,244.3693 | 3,244.3693 | 0.0937 | | 3,246.7124 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.0813 | 0.0739 | 0.6103 | 9.5000e-004 | 0.1022 | 9.0000e-004 | 0.1031 | 0.0271 | 8.3000e-004 | 0.0279 | | 94.0932 | 94.0932 | 6.0700e-003 | | 94.2449 |
| **Total** | **0.4223** | **11.8675** | **2.4504** | **0.0319** | **0.7757** | **0.0542** | **0.8298** | **0.2113** | **0.0518** | **0.2631** | | **3,338.4625** | **3,338.4625** | **0.0998** | | **3,340.9573** |

## 3.5 Building Construction - 2021

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Off-Road | 2.3168 | 19.5515 | 15.9498 | 0.0335 | | 0.9011 | 0.9011 | | 0.8602 | 0.8602 | | 3,107.7411 | 3,107.7411 | 0.7151 | | 3,125.6196 |
| **Total** | **2.3168** | **19.5515** | **15.9498** | **0.0335** | | **0.9011** | **0.9011** | | **0.8602** | **0.8602** | | **3,107.7411** | **3,107.7411** | **0.7151** | | **3,125.6196** |

## 3.5 Building Construction - 2021

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0492 | 1.2962 | 0.3293 | 2.8600e-003 | 0.0672 | 5.1600e-003 | 0.0723 | 0.0193 | 4.9400e-003 | 0.0243 | | 299.0670 | 299.0670 | 0.0145 | | 299.4300 |
| Worker | 0.2745 | 0.2494 | 2.0598 | 3.2000e-003 | 0.3449 | 3.0300e-003 | 0.3479 | 0.0915 | 2.7900e-003 | 0.0943 | | 317.5645 | 317.5645 | 0.0205 | | 318.0766 |
| **Total** | **0.3237** | **1.5456** | **2.3891** | **6.0600e-003** | **0.4121** | **8.1900e-003** | **0.4202** | **0.1108** | **7.7300e-003** | **0.1185** | | **616.6315** | **616.6315** | **0.0350** | | **617.5066** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Off-Road | 2.3168 | 19.5515 | 15.9498 | 0.0335 | | 0.9011 | 0.9011 | | 0.8602 | 0.8602 | 0.0000 | 3,107.7411 | 3,107.7411 | 0.7151 | | 3,125.6196 |
| **Total** | **2.3168** | **19.5515** | **15.9498** | **0.0335** | | **0.9011** | **0.9011** | | **0.8602** | **0.8602** | **0.0000** | **3,107.7411** | **3,107.7411** | **0.7151** | | **3,125.6196** |

## 3.5 Building Construction - 2021

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0492 | 1.2962 | 0.3293 | 2.8600e-003 | 0.0672 | 5.1600e-003 | 0.0723 | 0.0193 | 4.9400e-003 | 0.0243 | | 299.0670 | 299.0670 | 0.0145 | | 299.4300 |
| Worker | 0.2745 | 0.2494 | 2.0598 | 3.2000e-003 | 0.3449 | 3.0300e-003 | 0.3479 | 0.0915 | 2.7900e-003 | 0.0943 | | 317.5645 | 317.5645 | 0.0205 | | 318.0766 |
| **Total** | **0.3237** | **1.5456** | **2.3891** | **6.0600e-003** | **0.4121** | **8.1900e-003** | **0.4202** | **0.1108** | **7.7300e-003** | **0.1185** | | **616.6315** | **616.6315** | **0.0350** | | **617.5066** |

## 3.5 Building Construction - 2022

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Off-Road | 2.0973 | 17.3496 | 15.6842 | 0.0335 | | 0.7740 | 0.7740 | | 0.7392 | 0.7392 | | 3,109.2621 | 3,109.2621 | 0.7069 | | 3,126.9338 |
| **Total** | **2.0973** | **17.3496** | **15.6842** | **0.0335** | | **0.7740** | **0.7740** | | **0.7392** | **0.7392** | | **3,109.2621** | **3,109.2621** | **0.7069** | | **3,126.9338** |

## 3.5 Building Construction - 2022

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0458 | 1.2334 | 0.3012 | 2.8400e-003 | 0.0672 | 4.6100e-003 | 0.0718 | 0.0193 | 4.4100e-003 | 0.0237 | | 297.0748 | 297.0748 | 0.0141 | | 297.4266 |
| Worker | 0.2622 | 0.2268 | 1.8667 | 3.1100e-003 | 0.3449 | 2.8700e-003 | 0.3477 | 0.0915 | 2.6500e-003 | 0.0941 | | 308.1791 | 308.1791 | 0.0185 | | 308.6411 |
| **Total** | **0.3079** | **1.4602** | **2.1678** | **5.9500e-003** | **0.4121** | **7.4800e-003** | **0.4195** | **0.1108** | **7.0600e-003** | **0.1178** | | **605.2539** | **605.2539** | **0.0326** | | **606.0677** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Off-Road | 2.0973 | 17.3496 | 15.6842 | 0.0335 | | 0.7740 | 0.7740 | | 0.7392 | 0.7392 | 0.0000 | 3,109.2621 | 3,109.2621 | 0.7069 | | 3,126.9338 |
| **Total** | **2.0973** | **17.3496** | **15.6842** | **0.0335** | | **0.7740** | **0.7740** | | **0.7392** | **0.7392** | **0.0000** | **3,109.2621** | **3,109.2621** | **0.7069** | | **3,126.9338** |

## 3.5 Building Construction - 2022

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0458 | 1.2334 | 0.3012 | 2.8400e-003 | 0.0672 | 4.6100e-003 | 0.0718 | 0.0193 | 4.4100e-003 | 0.0237 | | 297.0748 | 297.0748 | 0.0141 | | 297.4266 |
| Worker | 0.2622 | 0.2268 | 1.8667 | 3.1100e-003 | 0.3449 | 2.8700e-003 | 0.3477 | 0.0915 | 2.6500e-003 | 0.0941 | | 308.1791 | 308.1791 | 0.0185 | | 308.6411 |
| **Total** | **0.3079** | **1.4602** | **2.1678** | **5.9500e-003** | **0.4121** | **7.4800e-003** | **0.4195** | **0.1108** | **7.0600e-003** | **0.1178** | | **605.2539** | **605.2539** | **0.0326** | | **606.0677** |

## 3.6 Paving - 2021

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Off-Road | 0.7739 | 7.7422 | 8.8569 | 0.0135 | | 0.4153 | 0.4153 | | 0.3830 | 0.3830 | | 1,296.8664 | 1,296.8664 | 0.4111 | | 1,307.1442 |
| Paving | 0.4349 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | | 0.0000 | | | 0.0000 |
| **Total** | **1.2088** | **7.7422** | **8.8569** | **0.0135** | | **0.4153** | **0.4153** | | **0.3830** | **0.3830** | | **1,296.8664** | **1,296.8664** | **0.4111** | | **1,307.1442** |

## 3.6 Paving - 2021

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.1322 | 0.1201 | 0.9918 | 1.5400e-003 | 0.1661 | 1.4600e-003 | 0.1675 | 0.0440 | 1.3500e-003 | 0.0454 | | 152.9014 | 152.9014 | 9.8600e-003 | | 153.1480 |
| **Total** | **0.1322** | **0.1201** | **0.9918** | **1.5400e-003** | **0.1661** | **1.4600e-003** | **0.1675** | **0.0440** | **1.3500e-003** | **0.0454** | | **152.9014** | **152.9014** | **9.8600e-003** | | **153.1480** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Off-Road | 0.7739 | 7.7422 | 8.8569 | 0.0135 | | 0.4153 | 0.4153 | | 0.3830 | 0.3830 | 0.0000 | 1,296.8664 | 1,296.8664 | 0.4111 | | 1,307.1442 |
| Paving | 0.4349 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | | 0.0000 | | | 0.0000 |
| **Total** | **1.2088** | **7.7422** | **8.8569** | **0.0135** | | **0.4153** | **0.4153** | | **0.3830** | **0.3830** | **0.0000** | **1,296.8664** | **1,296.8664** | **0.4111** | | **1,307.1442** |

## 3.6 Paving - 2021

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.1322 | 0.1201 | 0.9918 | 1.5400e-003 | 0.1661 | 1.4600e-003 | 0.1675 | 0.0440 | 1.3500e-003 | 0.0454 | | 152.9014 | 152.9014 | 9.8600e-003 | | 153.1480 |
| **Total** | **0.1322** | **0.1201** | **0.9918** | **1.5400e-003** | **0.1661** | **1.4600e-003** | **0.1675** | **0.0440** | **1.3500e-003** | **0.0454** | | **152.9014** | **152.9014** | **9.8600e-003** | | **153.1480** |

## 3.7 Architectural Coating - 2022

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Archit. Coating | 8.6628 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | | 0.0000 | | | 0.0000 |
| Off-Road | 0.2045 | 1.4085 | 1.8136 | 2.9700e-003 | | 0.0817 | 0.0817 | | 0.0817 | 0.0817 | | 281.4481 | 281.4481 | 0.0183 | | 281.9062 |
| **Total** | **8.8674** | **1.4085** | **1.8136** | **2.9700e-003** | | **0.0817** | **0.0817** | | **0.0817** | **0.0817** | | **281.4481** | **281.4481** | **0.0183** | | **281.9062** |

## 3.7 Architectural Coating - 2022

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.0486 | 0.0420 | 0.3457 | 5.8000e-004 | 0.0639 | 5.3000e-004 | 0.0644 | 0.0169 | 4.9000e-004 | 0.0174 | | 57.0702 | 57.0702 | 3.4200e-003 | | 57.1558 |
| **Total** | **0.0486** | **0.0420** | **0.3457** | **5.8000e-004** | **0.0639** | **5.3000e-004** | **0.0644** | **0.0169** | **4.9000e-004** | **0.0174** | | **57.0702** | **57.0702** | **3.4200e-003** | | **57.1558** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Archit. Coating | 8.6628 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | | 0.0000 | | | 0.0000 |
| Off-Road | 0.2045 | 1.4085 | 1.8136 | 2.9700e-003 | | 0.0817 | 0.0817 | | 0.0817 | 0.0817 | 0.0000 | 281.4481 | 281.4481 | 0.0183 | | 281.9062 |
| **Total** | **8.8674** | **1.4085** | **1.8136** | **2.9700e-003** | | **0.0817** | **0.0817** | | **0.0817** | **0.0817** | **0.0000** | **281.4481** | **281.4481** | **0.0183** | | **281.9062** |

## 3.7 Architectural Coating - 2022

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.0486 | 0.0420 | 0.3457 | 5.8000e-004 | 0.0639 | 5.3000e-004 | 0.0644 | 0.0169 | 4.9000e-004 | 0.0174 | | 57.0702 | 57.0702 | 3.4200e-003 | | 57.1558 |
| **Total** | **0.0486** | **0.0420** | **0.3457** | **5.8000e-004** | **0.0639** | **5.3000e-004** | **0.0644** | **0.0169** | **4.9000e-004** | **0.0174** | | **57.0702** | **57.0702** | **3.4200e-003** | | **57.1558** |

## 3.8 Trenching - 2021

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Off-Road | 0.6472 | 6.2165 | 8.8274 | 0.0135 | | 0.3212 | 0.3212 | | 0.2955 | 0.2955 | | 1,305.0661 | 1,305.0661 | 0.4221 | | 1,315.6182 |
| **Total** | **0.6472** | **6.2165** | **8.8274** | **0.0135** | | **0.3212** | **0.3212** | | **0.2955** | **0.2955** | | **1,305.0661** | **1,305.0661** | **0.4221** | | **1,315.6182** |

## 3.8 Trenching - 2021

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.0813 | 0.0739 | 0.6103 | 9.5000e-004 | 0.1022 | 9.0000e-004 | 0.1031 | 0.0271 | 8.3000e-004 | 0.0279 | | 94.0932 | 94.0932 | 6.0700e-003 | | 94.2449 |
| **Total** | **0.0813** | **0.0739** | **0.6103** | **9.5000e-004** | **0.1022** | **9.0000e-004** | **0.1031** | **0.0271** | **8.3000e-004** | **0.0279** | | **94.0932** | **94.0932** | **6.0700e-003** | | **94.2449** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Off-Road | 0.6472 | 6.2165 | 8.8274 | 0.0135 | | 0.3212 | 0.3212 | | 0.2955 | 0.2955 | 0.0000 | 1,305.0661 | 1,305.0661 | 0.4221 | | 1,315.6182 |
| **Total** | **0.6472** | **6.2165** | **8.8274** | **0.0135** | | **0.3212** | **0.3212** | | **0.2955** | **0.2955** | **0.0000** | **1,305.0661** | **1,305.0661** | **0.4221** | | **1,315.6182** |

### 3.8 Trenching - 2021

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.0813 | 0.0739 | 0.6103 | 9.5000e-004 | 0.1022 | 9.0000e-004 | 0.1031 | 0.0271 | 8.3000e-004 | 0.0279 | | 94.0932 | 94.0932 | 6.0700e-003 | | 94.2449 |
| **Total** | **0.0813** | **0.0739** | **0.6103** | **9.5000e-004** | **0.1022** | **9.0000e-004** | **0.1031** | **0.0271** | **8.3000e-004** | **0.0279** | | **94.0932** | **94.0932** | **6.0700e-003** | | **94.2449** |

## 4.0 Operational Detail - Mobile

### 4.1 Mitigation Measures Mobile

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Mitigated | 0.0841 | 0.5057 | 1.0415 | 2.6900e-003 | 0.2134 | 3.5500e-003 | 0.2170 | 0.0572 | 3.3500e-003 | 0.0606 | | 271.6829 | 271.6829 | 0.0136 | | 272.0224 |
| Unmitigated | 0.0841 | 0.5057 | 1.0415 | 2.6900e-003 | 0.2134 | 3.5500e-003 | 0.2170 | 0.0572 | 3.3500e-003 | 0.0606 | | 271.6829 | 271.6829 | 0.0136 | | 272.0224 |

## 4.2 Trip Summary Information

| | Average Daily Trip Rate | | | Unmitigated | Mitigated |
|---|---|---|---|---|---|
| Land Use | Weekday | Saturday | Sunday | Annual VMT | Annual VMT |
| General Heavy Industry | 25.88 | 25.88 | 25.88 | 99,967 | 99,967 |
| Other Asphalt Surfaces | 0.00 | 0.00 | 0.00 | | |
| Other Non-Asphalt Surfaces | 0.00 | 0.00 | 0.00 | | |
| Total | 25.88 | 25.88 | 25.88 | 99,967 | 99,967 |

## 4.3 Trip Type Information

| | Miles | | | Trip % | | | Trip Purpose % | | |
|---|---|---|---|---|---|---|---|---|---|
| Land Use | H-W or C-W | H-S or C-C | H-O or C-NW | H-W or C-W | H-S or C-C | H-O or C-NW | Primary | Diverted | Pass-by |
| General Heavy Industry | 14.70 | 6.60 | 6.60 | 59.00 | 28.00 | 13.00 | 92 | 5 | 3 |
| Other Asphalt Surfaces | 14.70 | 6.60 | 6.60 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| Other Non-Asphalt Surfaces | 14.70 | 6.60 | 6.60 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |

## 4.4 Fleet Mix

| Land Use | LDA | LDT1 | LDT2 | MDV | LHD1 | LHD2 | MHD | HHD | OBUS | UBUS | MCY | SBUS | MH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| General Heavy Industry | 0.489041 | 0.045286 | 0.209606 | 0.134980 | 0.040724 | 0.006674 | 0.014654 | 0.046205 | 0.003398 | 0.001529 | 0.005553 | 0.001505 | 0.000846 |
| Other Asphalt Surfaces | 0.489041 | 0.045286 | 0.209606 | 0.134980 | 0.040724 | 0.006674 | 0.014654 | 0.046205 | 0.003398 | 0.001529 | 0.005553 | 0.001505 | 0.000846 |
| Other Non-Asphalt Surfaces | 0.489041 | 0.045286 | 0.209606 | 0.134980 | 0.040724 | 0.006674 | 0.014654 | 0.046205 | 0.003398 | 0.001529 | 0.005553 | 0.001505 | 0.000846 |

## 5.0 Energy Detail

Historical Energy Use: N

### 5.1 Mitigation Measures Energy

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| NaturalGas Mitigated | 1.7900e-003 | 0.0163 | 0.0137 | 1.0000e-004 | | 1.2400e-003 | 1.2400e-003 | | 1.2400e-003 | 1.2400e-003 | | 19.5157 | 19.5157 | 3.7000e-004 | 3.6000e-004 | 19.6317 |
| NaturalGas Unmitigated | 1.7900e-003 | 0.0163 | 0.0137 | 1.0000e-004 | | 1.2400e-003 | 1.2400e-003 | | 1.2400e-003 | 1.2400e-003 | | 19.5157 | 19.5157 | 3.7000e-004 | 3.6000e-004 | 19.6317 |

## 5.2 Energy by Land Use - NaturalGas

**Unmitigated**

| | NaturalGas Use | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land Use | kBTU/yr | lb/day | | | | | | | | | | lb/day | | | | | |
| General Heavy Industry | 165.884 | 1.7900e-003 | 0.0163 | 0.0137 | 1.0000e-004 | | 1.2400e-003 | 1.2400e-003 | | 1.2400e-003 | 1.2400e-003 | | 19.5157 | 19.5157 | 3.7000e-004 | 3.6000e-004 | 19.6317 |
| Other Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **1.7900e-003** | **0.0163** | **0.0137** | **1.0000e-004** | | **1.2400e-003** | **1.2400e-003** | | **1.2400e-003** | **1.2400e-003** | | **19.5157** | **19.5157** | **3.7000e-004** | **3.6000e-004** | **19.6317** |

**Mitigated**

| | NaturalGas Use | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land Use | kBTU/yr | lb/day | | | | | | | | | | lb/day | | | | | |
| General Heavy Industry | 0.165884 | 1.7900e-003 | 0.0163 | 0.0137 | 1.0000e-004 | | 1.2400e-003 | 1.2400e-003 | | 1.2400e-003 | 1.2400e-003 | | 19.5157 | 19.5157 | 3.7000e-004 | 3.6000e-004 | 19.6317 |
| Other Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **1.7900e-003** | **0.0163** | **0.0137** | **1.0000e-004** | | **1.2400e-003** | **1.2400e-003** | | **1.2400e-003** | **1.2400e-003** | | **19.5157** | **19.5157** | **3.7000e-004** | **3.6000e-004** | **19.6317** |

## 6.0 Area Detail

## 6.1 Mitigation Measures Area

Use Low VOC Paint - Non-Residential Interior

Use Low VOC Paint - Non-Residential Exterior

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Mitigated | 0.4105 | 6.0000e-005 | 6.6700e-003 | 0.0000 | | 2.0000e-005 | 2.0000e-005 | | 2.0000e-005 | 2.0000e-005 | | 0.0143 | 0.0143 | 4.0000e-005 | | 0.0152 |
| Unmitigated | 0.4105 | 6.0000e-005 | 6.6700e-003 | 0.0000 | | 2.0000e-005 | 2.0000e-005 | | 2.0000e-005 | 2.0000e-005 | | 0.0143 | 0.0143 | 4.0000e-005 | | 0.0152 |

## 6.2 Area by SubCategory

**Unmitigated**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SubCategory | lb/day | | | | | | | | | | lb/day | | | | | |
| Architectural Coating | 0.0237 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | | 0.0000 | | | 0.0000 |
| Consumer Products | 0.3862 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | | 0.0000 | | | 0.0000 |
| Landscaping | 6.2000e-004 | 6.0000e-005 | 6.6700e-003 | 0.0000 | | 2.0000e-005 | 2.0000e-005 | | 2.0000e-005 | 2.0000e-005 | | 0.0143 | 0.0143 | 4.0000e-005 | | 0.0152 |
| **Total** | **0.4105** | **6.0000e-005** | **6.6700e-003** | **0.0000** | | **2.0000e-005** | **2.0000e-005** | | **2.0000e-005** | **2.0000e-005** | | **0.0143** | **0.0143** | **4.0000e-005** | | **0.0152** |

**Mitigated**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SubCategory | lb/day | | | | | | | | | | lb/day | | | | | |
| Architectural Coating | 0.0237 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | | 0.0000 | | | 0.0000 |
| Consumer Products | 0.3862 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | | 0.0000 | | | 0.0000 |
| Landscaping | 6.2000e-004 | 6.0000e-005 | 6.6700e-003 | 0.0000 | | 2.0000e-005 | 2.0000e-005 | | 2.0000e-005 | 2.0000e-005 | | 0.0143 | 0.0143 | 4.0000e-005 | | 0.0152 |
| **Total** | **0.4105** | **6.0000e-005** | **6.6700e-003** | **0.0000** | | **2.0000e-005** | **2.0000e-005** | | **2.0000e-005** | **2.0000e-005** | | **0.0143** | **0.0143** | **4.0000e-005** | | **0.0152** |

## 7.0 Water Detail

### 7.1 Mitigation Measures Water

## 8.0 Waste Detail

### 8.1 Mitigation Measures Waste

## 9.0 Operational Offroad

| Equipment Type | Number | Hours/Day | Days/Year | Horse Power | Load Factor | Fuel Type |
|---|---|---|---|---|---|---|

## 10.0 Stationary Equipment

**Fire Pumps and Emergency Generators**

| Equipment Type | Number | Hours/Day | Hours/Year | Horse Power | Load Factor | Fuel Type |
|---|---|---|---|---|---|---|

**Boilers**

| Equipment Type | Number | Heat Input/Day | Heat Input/Year | Boiler Rating | Fuel Type |
|---|---|---|---|---|---|

**User Defined Equipment**

| Equipment Type | Number |
|---|---|

## 11.0 Vegetation

# Arcata Wastewater Treatment Facility Project (Phase 2)

**Humboldt County, Summer**

## 1.0 Project Characteristics

### 1.1 Land Usage

| Land Uses | Size | Metric | Lot Acreage | Floor Surface Area | Population |
|---|---|---|---|---|---|
| General Heavy Industry | 24.72 | 1000sqft | 0.57 | 24,720.00 | 0 |
| Other Asphalt Surfaces | 49.50 | 1000sqft | 1.14 | 49,500.00 | 0 |
| Other Non-Asphalt Surfaces | 1.98 | 1000sqft | 0.05 | 1,980.00 | 0 |

### 1.2 Other Project Characteristics

| | | | | | |
|---|---|---|---|---|---|
| **Urbanization** | Rural | **Wind Speed (m/s)** | 2.2 | **Precipitation Freq (Days)** | 103 |
| **Climate Zone** | 1 | | | **Operational Year** | 2025 |
| **Utility Company** | Pacific Gas & Electric Company | | | | |
| **CO2 Intensity (lb/MWhr)** | 641.35 | **CH4 Intensity (lb/MWhr)** | 0.029 | **N2O Intensity (lb/MWhr)** | 0.006 |

### 1.3 User Entered Comments & Non-Default Data

Arcata Wastewater Treatment Facility Project (Phase 2) - Humboldt County, Summer

Project Characteristics -

Land Use - "General Heavy Industry" was used for buildings and equipment. "Other Asphalt Surfaces" was used for paving of access roads. "Other Non-Asphalt Surfaces" was used for ductbank construction.

Construction Phase - Construction schedule provided project engineer.

Off-road Equipment - Default equipment list for building construction supplemented by project engineer.

Off-road Equipment - Equipment list for trenching provided by project engineer.

Grading - It is assumed that the project site will be crossed over twice during grading and site preparation.

Demolition - Estimate of demolition debris provided by project engineer.

Architectural Coating - The project will use low VOC paint that is 50 g/L or less.

Area Coating - The project will use low VOC paint that is 50 g/L or less.

Construction Off-road Equipment Mitigation -

Area Mitigation -

| Table Name | Column Name | Default Value | New Value |
|---|---|---|---|
| tblArchitecturalCoating | EF_Nonresidential_Exterior | 250.00 | 50.00 |
| tblArchitecturalCoating | EF_Nonresidential_Interior | 250.00 | 50.00 |
| tblArchitecturalCoating | EF_Parking | 250.00 | 50.00 |
| tblAreaCoating | Area_EF_Nonresidential_Exterior | 250 | 50 |
| tblAreaCoating | Area_EF_Nonresidential_Interior | 250 | 50 |
| tblAreaCoating | Area_EF_Parking | 250 | 50 |
| tblAreaMitigation | UseLowVOCPaintParkingCheck | False | True |
| tblConstructionPhase | NumDays | 200.00 | 160.00 |
| tblConstructionPhase | NumDays | 20.00 | 10.00 |
| tblConstructionPhase | NumDays | 4.00 | 30.00 |
| tblConstructionPhase | NumDays | 10.00 | 5.00 |
| tblConstructionPhase | NumDays | 2.00 | 20.00 |
| tblConstructionPhase | PhaseEndDate | 3/10/2025 | 3/20/2025 |
| tblConstructionPhase | PhaseEndDate | 2/10/2025 | 3/7/2025 |

| | | | |
|---|---|---|---|
| tblConstructionPhase | PhaseEndDate | 4/26/2024 | 4/12/2024 |
| tblConstructionPhase | PhaseEndDate | 5/6/2024 | 6/19/2024 |
| tblConstructionPhase | PhaseEndDate | 2/24/2025 | 7/29/2024 |
| tblConstructionPhase | PhaseEndDate | 4/30/2024 | 5/9/2024 |
| tblConstructionPhase | PhaseStartDate | 2/25/2025 | 3/7/2025 |
| tblConstructionPhase | PhaseStartDate | 5/7/2024 | 7/29/2024 |
| tblConstructionPhase | PhaseStartDate | 5/1/2024 | 5/9/2024 |
| tblConstructionPhase | PhaseStartDate | 2/11/2025 | 7/23/2024 |
| tblConstructionPhase | PhaseStartDate | 4/27/2024 | 4/12/2024 |
| tblGrading | AcresOfGrading | 11.25 | 3.90 |
| tblGrading | AcresOfGrading | 10.00 | 2.10 |
| tblGrading | MaterialExported | 0.00 | 20,000.00 |
| tblGrading | MaterialImported | 0.00 | 3,350.00 |
| tblOffRoadEquipment | LoadFactor | 0.37 | 0.37 |
| tblOffRoadEquipment | LoadFactor | 0.38 | 0.38 |
| tblOffRoadEquipment | OffRoadEquipmentType | | Bore/Drill Rigs |
| tblOffRoadEquipment | OffRoadEquipmentType | | Tractors/Loaders/Backhoes |
| tblOffRoadEquipment | OffRoadEquipmentType | | Excavators |
| tblOffRoadEquipment | OffRoadEquipmentUnitAmount | 1.00 | 2.00 |
| tblProjectCharacteristics | UrbanizationLevel | Urban | Rural |

## 2.0 Emissions Summary

## 2.1 Overall Construction (Maximum Daily Emission)

### Unmitigated Construction

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | lb/day | | | | | | | | | | lb/day | | | | | |
| 2024 | 3.4732 | 37.9764 | 27.0146 | 0.0967 | 11.7764 | 1.1158 | 12.7036 | 5.8700 | 1.0354 | 6.7246 | 0.0000 | 9,873.1396 | 9,873.1396 | 1.1400 | 0.0000 | 9,901.3229 |
| 2025 | 14.4121 | 16.5998 | 19.3132 | 0.0434 | 0.5587 | 0.5960 | 1.1547 | 0.1498 | 0.5699 | 0.7198 | 0.0000 | 4,098.1800 | 4,098.1800 | 0.7299 | 0.0000 | 4,116.4276 |
| **Maximum** | **14.4121** | **37.9764** | **27.0146** | **0.0967** | **11.7764** | **1.1158** | **12.7036** | **5.8700** | **1.0354** | **6.7246** | **0.0000** | **9,873.1396** | **9,873.1396** | **1.1400** | **0.0000** | **9,901.3229** |

### Mitigated Construction

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | lb/day | | | | | | | | | | lb/day | | | | | |
| 2024 | 3.4732 | 37.9764 | 27.0146 | 0.0967 | 6.2087 | 1.1158 | 7.1359 | 2.8893 | 1.0354 | 3.7439 | 0.0000 | 9,873.1396 | 9,873.1396 | 1.1400 | 0.0000 | 9,901.3229 |
| 2025 | 14.4121 | 16.5998 | 19.3132 | 0.0434 | 0.5587 | 0.5960 | 1.1547 | 0.1498 | 0.5699 | 0.7198 | 0.0000 | 4,098.1800 | 4,098.1800 | 0.7299 | 0.0000 | 4,116.4276 |
| **Maximum** | **14.4121** | **37.9764** | **27.0146** | **0.0967** | **6.2087** | **1.1158** | **7.1359** | **2.8893** | **1.0354** | **3.7439** | **0.0000** | **9,873.1396** | **9,873.1396** | **1.1400** | **0.0000** | **9,901.3229** |

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio-CO2 | Total CO2 | CH4 | N20 | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Percent Reduction** | **0.00** | **0.00** | **0.00** | **0.00** | **45.14** | **0.00** | **40.18** | **49.51** | **0.00** | **40.04** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |

## 2.2 Overall Operational

### Unmitigated Operational

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Area | 0.5813 | 7.0000e-005 | 7.7600e-003 | 0.0000 | | 3.0000e-005 | 3.0000e-005 | | 3.0000e-005 | 3.0000e-005 | | 0.0167 | 0.0167 | 4.0000e-005 | | 0.0178 |
| Energy | 2.5600e-003 | 0.0233 | 0.0196 | 1.4000e-004 | | 1.7700e-003 | 1.7700e-003 | | 1.7700e-003 | 1.7700e-003 | | 27.9669 | 27.9669 | 5.4000e-004 | 5.1000e-004 | 28.1331 |
| Mobile | 0.0947 | 0.5220 | 1.1535 | 3.5200e-003 | 0.3052 | 3.4400e-003 | 0.3087 | 0.0817 | 3.2300e-003 | 0.0850 | | 355.6612 | 355.6612 | 0.0145 | | 356.0225 |
| **Total** | **0.6786** | **0.5454** | **1.1809** | **3.6600e-003** | **0.3052** | **5.2400e-003** | **0.3105** | **0.0817** | **5.0300e-003** | **0.0868** | | **383.6448** | **383.6448** | **0.0150** | **5.1000e-004** | **384.1733** |

### Mitigated Operational

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Area | 0.5813 | 7.0000e-005 | 7.7600e-003 | 0.0000 | | 3.0000e-005 | 3.0000e-005 | | 3.0000e-005 | 3.0000e-005 | | 0.0167 | 0.0167 | 4.0000e-005 | | 0.0178 |
| Energy | 2.5600e-003 | 0.0233 | 0.0196 | 1.4000e-004 | | 1.7700e-003 | 1.7700e-003 | | 1.7700e-003 | 1.7700e-003 | | 27.9669 | 27.9669 | 5.4000e-004 | 5.1000e-004 | 28.1331 |
| Mobile | 0.0947 | 0.5220 | 1.1535 | 3.5200e-003 | 0.3052 | 3.4400e-003 | 0.3087 | 0.0817 | 3.2300e-003 | 0.0850 | | 355.6612 | 355.6612 | 0.0145 | | 356.0225 |
| **Total** | **0.6786** | **0.5454** | **1.1809** | **3.6600e-003** | **0.3052** | **5.2400e-003** | **0.3105** | **0.0817** | **5.0300e-003** | **0.0868** | | **383.6448** | **383.6448** | **0.0150** | **5.1000e-004** | **384.1733** |

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio-CO2 | Total CO2 | CH4 | N20 | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Percent Reduction** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |

## 3.0 Construction Detail

**Construction Phase**

| Phase Number | Phase Name | Phase Type | Start Date | End Date | Num Days Week | Num Days | Phase Description |
|---|---|---|---|---|---|---|---|
| 1 | Demolition | Demolition | 4/1/2024 | 4/12/2024 | 5 | 10 | |
| 2 | Site Preparation | Site Preparation | 4/12/2024 | 5/9/2024 | 5 | 20 | |
| 3 | Grading | Grading | 5/9/2024 | 6/19/2024 | 5 | 30 | |
| 4 | Building Construction | Building Construction | 7/29/2024 | 3/7/2025 | 5 | 160 | |
| 5 | Paving | Paving | 7/23/2024 | 7/29/2024 | 5 | 5 | |
| 6 | Architectural Coating | Architectural Coating | 3/7/2025 | 3/20/2025 | 5 | 10 | |
| 7 | Trenching | Trenching | 6/19/2024 | 7/23/2024 | 5 | 25 | |

**Acres of Grading (Site Preparation Phase): 2.1**

**Acres of Grading (Grading Phase): 3.9**

**Acres of Paving: 1.19**

**Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 37,080; Non-Residential Outdoor: 12,360; Striped Parking Area: 3,089 (Architectural Coating – sqft)**

**OffRoad Equipment**

Arcata Wastewater Treatment Facility Project (Phase 2) - Humboldt County, Summer

| Phase Name | Offroad Equipment Type | Amount | Usage Hours | Horse Power | Load Factor |
|---|---|---|---|---|---|
| Architectural Coating | Air Compressors | 1 | 6.00 | 78 | 0.48 |
| Paving | Cement and Mortar Mixers | 1 | 6.00 | 9 | 0.56 |
| Demolition | Concrete/Industrial Saws | 1 | 8.00 | 81 | 0.73 |
| Building Construction | Generator Sets | 1 | 8.00 | 84 | 0.74 |
| Building Construction | Cranes | 2 | 6.00 | 231 | 0.29 |
| Building Construction | Forklifts | 1 | 6.00 | 89 | 0.20 |
| Site Preparation | Graders | 1 | 8.00 | 187 | 0.41 |
| Paving | Pavers | 1 | 6.00 | 130 | 0.42 |
| Paving | Rollers | 1 | 7.00 | 80 | 0.38 |
| Demolition | Rubber Tired Dozers | 1 | 8.00 | 247 | 0.40 |
| Grading | Rubber Tired Dozers | 1 | 6.00 | 247 | 0.40 |
| Building Construction | Tractors/Loaders/Backhoes | 1 | 6.00 | 97 | 0.37 |
| Demolition | Tractors/Loaders/Backhoes | 3 | 8.00 | 97 | 0.37 |
| Grading | Tractors/Loaders/Backhoes | 1 | 7.00 | 97 | 0.37 |
| Paving | Tractors/Loaders/Backhoes | 1 | 8.00 | 97 | 0.37 |
| Site Preparation | Tractors/Loaders/Backhoes | 1 | 8.00 | 97 | 0.37 |
| Grading | Graders | 1 | 6.00 | 187 | 0.41 |
| Paving | Paving Equipment | 1 | 8.00 | 132 | 0.36 |
| Site Preparation | Rubber Tired Dozers | 1 | 7.00 | 247 | 0.40 |
| Building Construction | Welders | 3 | 8.00 | 46 | 0.45 |
| Building Construction | Bore/Drill Rigs | 1 | 6.00 | 221 | 0.50 |
| Trenching | Tractors/Loaders/Backhoes | 1 | 8.00 | 97 | 0.37 |
| Trenching | Excavators | 2 | 8.00 | 158 | 0.38 |

**Trips and VMT**

| Phase Name | Offroad Equipment Count | Worker Trip Number | Vendor Trip Number | Hauling Trip Number | Worker Trip Length | Vendor Trip Length | Hauling Trip Length | Worker Vehicle Class | Vendor Vehicle Class | Hauling Vehicle Class |
|---|---|---|---|---|---|---|---|---|---|---|
| Demolition | 5 | 13.00 | 0.00 | 8.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Site Preparation | 3 | 8.00 | 0.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Grading | 3 | 8.00 | 0.00 | 2,500.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Building Construction | 9 | 32.00 | 12.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Paving | 5 | 13.00 | 0.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Architectural Coating | 1 | 6.00 | 0.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Trenching | 3 | 8.00 | 0.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |

## 3.1 Mitigation Measures Construction

Water Exposed Area

## 3.2 Demolition - 2024

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Fugitive Dust | | | | | 0.1712 | 0.0000 | 0.1712 | 0.0259 | 0.0000 | 0.0259 | | | 0.0000 | | | 0.0000 |
| Off-Road | 1.4397 | 13.8867 | 13.4879 | 0.0241 | | 0.6311 | 0.6311 | | 0.5895 | 0.5895 | | 2,324.9459 | 2,324.9459 | 0.5884 | | 2,339.6562 |
| **Total** | **1.4397** | **13.8867** | **13.4879** | **0.0241** | **0.1712** | **0.6311** | **0.8023** | **0.0259** | **0.5895** | **0.6154** | | **2,324.9459** | **2,324.9459** | **0.5884** | | **2,339.6562** |

## 3.2 Demolition - 2024

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 4.4800e-003 | 0.1564 | 0.0300 | 6.1000e-004 | 0.0139 | 4.2000e-004 | 0.0143 | 3.8100e-003 | 4.0000e-004 | 4.2000e-003 | | 64.0472 | 64.0472 | 1.3300e-003 | | 64.0805 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.1143 | 0.0898 | 0.7354 | 1.4000e-003 | 0.1661 | 1.2300e-003 | 0.1673 | 0.0440 | 1.1400e-003 | 0.0452 | | 138.9431 | 138.9431 | 7.1100e-003 | | 139.1208 |
| **Total** | **0.1188** | **0.2462** | **0.7654** | **2.0100e-003** | **0.1800** | **1.6500e-003** | **0.1816** | **0.0478** | **1.5400e-003** | **0.0494** | | **202.9903** | **202.9903** | **8.4400e-003** | | **203.2013** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Fugitive Dust | | | | | 0.0770 | 0.0000 | 0.0770 | 0.0117 | 0.0000 | 0.0117 | | | 0.0000 | | | 0.0000 |
| Off-Road | 1.4397 | 13.8867 | 13.4879 | 0.0241 | | 0.6311 | 0.6311 | | 0.5895 | 0.5895 | 0.0000 | 2,324.9459 | 2,324.9459 | 0.5884 | | 2,339.6562 |
| **Total** | **1.4397** | **13.8867** | **13.4879** | **0.0241** | **0.0770** | **0.6311** | **0.7081** | **0.0117** | **0.5895** | **0.6011** | **0.0000** | **2,324.9459** | **2,324.9459** | **0.5884** | | **2,339.6562** |

## 3.2 Demolition - 2024

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 4.4800e-003 | 0.1564 | 0.0300 | 6.1000e-004 | 0.0139 | 4.2000e-004 | 0.0143 | 3.8100e-003 | 4.0000e-004 | 4.2000e-003 | | 64.0472 | 64.0472 | 1.3300e-003 | | 64.0805 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.1143 | 0.0898 | 0.7354 | 1.4000e-003 | 0.1661 | 1.2300e-003 | 0.1673 | 0.0440 | 1.1400e-003 | 0.0452 | | 138.9431 | 138.9431 | 7.1100e-003 | | 139.1208 |
| **Total** | **0.1188** | **0.2462** | **0.7654** | **2.0100e-003** | **0.1800** | **1.6500e-003** | **0.1816** | **0.0478** | **1.5400e-003** | **0.0494** | | **202.9903** | **202.9903** | **8.4400e-003** | | **203.2013** |

## 3.3 Site Preparation - 2024

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Fugitive Dust | | | | | 5.3807 | 0.0000 | 5.3807 | 2.9085 | 0.0000 | 2.9085 | | | 0.0000 | | | 0.0000 |
| Off-Road | 1.1067 | 11.8407 | 6.6317 | 0.0172 | | 0.4823 | 0.4823 | | 0.4437 | 0.4437 | | 1,665.8826 | 1,665.8826 | 0.5388 | | 1,679.3521 |
| **Total** | **1.1067** | **11.8407** | **6.6317** | **0.0172** | **5.3807** | **0.4823** | **5.8629** | **2.9085** | **0.4437** | **3.3521** | | **1,665.8826** | **1,665.8826** | **0.5388** | | **1,679.3521** |

## 3.3 Site Preparation - 2024

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.0703 | 0.0552 | 0.4526 | 8.6000e-004 | 0.1022 | 7.6000e-004 | 0.1029 | 0.0271 | 7.0000e-004 | 0.0278 | | 85.5034 | 85.5034 | 4.3700e-003 | | 85.6128 |
| **Total** | **0.0703** | **0.0552** | **0.4526** | **8.6000e-004** | **0.1022** | **7.6000e-004** | **0.1029** | **0.0271** | **7.0000e-004** | **0.0278** | | **85.5034** | **85.5034** | **4.3700e-003** | | **85.6128** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Fugitive Dust | | | | | 2.4213 | 0.0000 | 2.4213 | 1.3088 | 0.0000 | 1.3088 | | | 0.0000 | | | 0.0000 |
| Off-Road | 1.1067 | 11.8407 | 6.6317 | 0.0172 | | 0.4823 | 0.4823 | | 0.4437 | 0.4437 | 0.0000 | 1,665.8826 | 1,665.8826 | 0.5388 | | 1,679.3521 |
| **Total** | **1.1067** | **11.8407** | **6.6317** | **0.0172** | **2.4213** | **0.4823** | **2.9036** | **1.3088** | **0.4437** | **1.7525** | **0.0000** | **1,665.8826** | **1,665.8826** | **0.5388** | | **1,679.3521** |

## 3.3 Site Preparation - 2024

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.0703 | 0.0552 | 0.4526 | 8.6000e-004 | 0.1022 | 7.6000e-004 | 0.1029 | 0.0271 | 7.0000e-004 | 0.0278 | | 85.5034 | 85.5034 | 4.3700e-003 | | 85.6128 |
| **Total** | **0.0703** | **0.0552** | **0.4526** | **8.6000e-004** | **0.1022** | **7.6000e-004** | **0.1029** | **0.0271** | **7.0000e-004** | **0.0278** | | **85.5034** | **85.5034** | **4.3700e-003** | | **85.6128** |

## 3.4 Grading - 2024

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Fugitive Dust | | | | | 4.7425 | 0.0000 | 4.7425 | 2.5109 | 0.0000 | 2.5109 | | | 0.0000 | | | 0.0000 |
| Off-Road | 0.9132 | 9.7297 | 5.5468 | 0.0141 | | 0.4001 | 0.4001 | | 0.3681 | 0.3681 | | 1,364.6623 | 1,364.6623 | 0.4414 | | 1,375.6962 |
| **Total** | **0.9132** | **9.7297** | **5.5468** | **0.0141** | **4.7425** | **0.4001** | **5.1426** | **2.5109** | **0.3681** | **2.8790** | | **1,364.6623** | **1,364.6623** | **0.4414** | | **1,375.6962** |

## 3.4 Grading - 2024

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.4666 | 16.2955 | 3.1235 | 0.0637 | 1.4489 | 0.0433 | 1.4922 | 0.3964 | 0.0415 | 0.4379 | | 6,671.5878 | 6,671.5878 | 0.1385 | | 6,675.0490 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.0703 | 0.0552 | 0.4526 | 8.6000e-004 | 0.1022 | 7.6000e-004 | 0.1029 | 0.0271 | 7.0000e-004 | 0.0278 | | 85.5034 | 85.5034 | 4.3700e-003 | | 85.6128 |
| **Total** | **0.5369** | **16.3507** | **3.5761** | **0.0645** | **1.5511** | **0.0441** | **1.5952** | **0.4235** | **0.0422** | **0.4657** | | **6,757.0913** | **6,757.0913** | **0.1428** | | **6,760.6618** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Fugitive Dust | | | | | 2.1341 | 0.0000 | 2.1341 | 1.1299 | 0.0000 | 1.1299 | | | 0.0000 | | | 0.0000 |
| Off-Road | 0.9132 | 9.7297 | 5.5468 | 0.0141 | | 0.4001 | 0.4001 | | 0.3681 | 0.3681 | 0.0000 | 1,364.6623 | 1,364.6623 | 0.4414 | | 1,375.6962 |
| **Total** | **0.9132** | **9.7297** | **5.5468** | **0.0141** | **2.1341** | **0.4001** | **2.5342** | **1.1299** | **0.3681** | **1.4980** | **0.0000** | **1,364.6623** | **1,364.6623** | **0.4414** | | **1,375.6962** |

## 3.4 Grading - 2024

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.4666 | 16.2955 | 3.1235 | 0.0637 | 1.4489 | 0.0433 | 1.4922 | 0.3964 | 0.0415 | 0.4379 | | 6,671.5878 | 6,671.5878 | 0.1385 | | 6,675.0490 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.0703 | 0.0552 | 0.4526 | 8.6000e-004 | 0.1022 | 7.6000e-004 | 0.1029 | 0.0271 | 7.0000e-004 | 0.0278 | | 85.5034 | 85.5034 | 4.3700e-003 | | 85.6128 |
| **Total** | **0.5369** | **16.3507** | **3.5761** | **0.0645** | **1.5511** | **0.0441** | **1.5952** | **0.4235** | **0.0422** | **0.4657** | | **6,757.0913** | **6,757.0913** | **0.1428** | | **6,760.6618** |

## 3.5 Building Construction - 2024

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Off-Road | 1.8267 | 15.1178 | 15.3770 | 0.0335 | | 0.6069 | 0.6069 | | 0.5786 | 0.5786 | | 3,109.0494 | 3,109.0494 | 0.6915 | | 3,126.3360 |
| **Total** | **1.8267** | **15.1178** | **15.3770** | **0.0335** | | **0.6069** | **0.6069** | | **0.5786** | **0.5786** | | **3,109.0494** | **3,109.0494** | **0.6915** | | **3,126.3360** |

## 3.5 Building Construction - 2024

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0355 | 1.0482 | 0.2666 | 3.0400e-003 | 0.0733 | 1.7300e-003 | 0.0750 | 0.0211 | 1.6500e-003 | 0.0227 | | 317.2563 | 317.2563 | 0.0110 | | 317.5318 |
| Worker | 0.2814 | 0.2209 | 1.8103 | 3.4400e-003 | 0.4087 | 3.0300e-003 | 0.4118 | 0.1084 | 2.8000e-003 | 0.1112 | | 342.0138 | 342.0138 | 0.0175 | | 342.4512 |
| **Total** | **0.3169** | **1.2691** | **2.0769** | **6.4800e-003** | **0.4820** | **4.7600e-003** | **0.4868** | **0.1295** | **4.4500e-003** | **0.1339** | | **659.2700** | **659.2700** | **0.0285** | | **659.9830** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Off-Road | 1.8267 | 15.1178 | 15.3770 | 0.0335 | | 0.6069 | 0.6069 | | 0.5786 | 0.5786 | 0.0000 | 3,109.0494 | 3,109.0494 | 0.6915 | | 3,126.3359 |
| **Total** | **1.8267** | **15.1178** | **15.3770** | **0.0335** | | **0.6069** | **0.6069** | | **0.5786** | **0.5786** | **0.0000** | **3,109.0494** | **3,109.0494** | **0.6915** | | **3,126.3359** |

## 3.5 Building Construction - 2024

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0355 | 1.0482 | 0.2666 | 3.0400e-003 | 0.0733 | 1.7300e-003 | 0.0750 | 0.0211 | 1.6500e-003 | 0.0227 | | 317.2563 | 317.2563 | 0.0110 | | 317.5318 |
| Worker | 0.2814 | 0.2209 | 1.8103 | 3.4400e-003 | 0.4087 | 3.0300e-003 | 0.4118 | 0.1084 | 2.8000e-003 | 0.1112 | | 342.0138 | 342.0138 | 0.0175 | | 342.4512 |
| **Total** | **0.3169** | **1.2691** | **2.0769** | **6.4800e-003** | **0.4820** | **4.7600e-003** | **0.4868** | **0.1295** | **4.4500e-003** | **0.1339** | | **659.2700** | **659.2700** | **0.0285** | | **659.9830** |

## 3.5 Building Construction - 2025

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Off-Road | 1.7162 | 14.1878 | 15.2689 | 0.0335 | | 0.5394 | 0.5394 | | 0.5137 | 0.5137 | | 3,109.2098 | 3,109.2098 | 0.6849 | | 3,126.3332 |
| **Total** | **1.7162** | **14.1878** | **15.2689** | **0.0335** | | **0.5394** | **0.5394** | | **0.5137** | **0.5137** | | **3,109.2098** | **3,109.2098** | **0.6849** | | **3,126.3332** |

## 3.5 Building Construction - 2025

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0339 | 1.0265 | 0.2506 | 3.0200e-003 | 0.0733 | 1.6300e-003 | 0.0749 | 0.0211 | 1.5600e-003 | 0.0227 | | 315.3178 | 315.3178 | 0.0108 | | 315.5869 |
| Worker | 0.2673 | 0.2021 | 1.6712 | 3.3200e-003 | 0.4087 | 2.9100e-003 | 0.4117 | 0.1084 | 2.6800e-003 | 0.1111 | | 330.2773 | 330.2773 | 0.0159 | | 330.6742 |
| **Total** | **0.3013** | **1.2286** | **1.9218** | **6.3400e-003** | **0.4821** | **4.5400e-003** | **0.4866** | **0.1295** | **4.2400e-003** | **0.1337** | | **645.5952** | **645.5952** | **0.0266** | | **646.2611** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Off-Road | 1.7162 | 14.1878 | 15.2689 | 0.0335 | | 0.5394 | 0.5394 | | 0.5137 | 0.5137 | 0.0000 | 3,109.2098 | 3,109.2098 | 0.6849 | | 3,126.3332 |
| **Total** | **1.7162** | **14.1878** | **15.2689** | **0.0335** | | **0.5394** | **0.5394** | | **0.5137** | **0.5137** | **0.0000** | **3,109.2098** | **3,109.2098** | **0.6849** | | **3,126.3332** |

## 3.5 Building Construction - 2025

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0339 | 1.0265 | 0.2506 | 3.0200e-003 | 0.0733 | 1.6300e-003 | 0.0749 | 0.0211 | 1.5600e-003 | 0.0227 | | 315.3178 | 315.3178 | 0.0108 | | 315.5869 |
| Worker | 0.2673 | 0.2021 | 1.6712 | 3.3200e-003 | 0.4087 | 2.9100e-003 | 0.4117 | 0.1084 | 2.6800e-003 | 0.1111 | | 330.2773 | 330.2773 | 0.0159 | | 330.6742 |
| **Total** | **0.3013** | **1.2286** | **1.9218** | **6.3400e-003** | **0.4821** | **4.5400e-003** | **0.4866** | **0.1295** | **4.2400e-003** | **0.1337** | | **645.5952** | **645.5952** | **0.0266** | | **646.2611** |

## 3.6 Paving - 2024

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Off-Road | 0.6180 | 5.8607 | 8.8253 | 0.0136 | | 0.2810 | 0.2810 | | 0.2594 | 0.2594 | | 1,297.8688 | 1,297.8688 | 0.4114 | | 1,308.1547 |
| Paving | 0.5974 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | | 0.0000 | | | 0.0000 |
| **Total** | **1.2153** | **5.8607** | **8.8253** | **0.0136** | | **0.2810** | **0.2810** | | **0.2594** | **0.2594** | | **1,297.8688** | **1,297.8688** | **0.4114** | | **1,308.1547** |

## 3.6 Paving - 2024

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.1143 | 0.0898 | 0.7354 | 1.4000e-003 | 0.1661 | 1.2300e-003 | 0.1673 | 0.0440 | 1.1400e-003 | 0.0452 | | 138.9431 | 138.9431 | 7.1100e-003 | | 139.1208 |
| **Total** | **0.1143** | **0.0898** | **0.7354** | **1.4000e-003** | **0.1661** | **1.2300e-003** | **0.1673** | **0.0440** | **1.1400e-003** | **0.0452** | | **138.9431** | **138.9431** | **7.1100e-003** | | **139.1208** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Off-Road | 0.6180 | 5.8607 | 8.8253 | 0.0136 | | 0.2810 | 0.2810 | | 0.2594 | 0.2594 | 0.0000 | 1,297.8688 | 1,297.8688 | 0.4114 | | 1,308.1547 |
| Paving | 0.5974 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | | 0.0000 | | | 0.0000 |
| **Total** | **1.2153** | **5.8607** | **8.8253** | **0.0136** | | **0.2810** | **0.2810** | | **0.2594** | **0.2594** | **0.0000** | **1,297.8688** | **1,297.8688** | **0.4114** | | **1,308.1547** |

## 3.6 Paving - 2024

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.1143 | 0.0898 | 0.7354 | 1.4000e-003 | 0.1661 | 1.2300e-003 | 0.1673 | 0.0440 | 1.1400e-003 | 0.0452 | | 138.9431 | 138.9431 | 7.1100e-003 | | 139.1208 |
| **Total** | **0.1143** | **0.0898** | **0.7354** | **1.4000e-003** | **0.1661** | **1.2300e-003** | **0.1673** | **0.0440** | **1.1400e-003** | **0.0452** | | **138.9431** | **138.9431** | **7.1100e-003** | | **139.1208** |

## 3.7 Architectural Coating - 2025

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Archit. Coating | 12.1736 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | | 0.0000 | | | 0.0000 |
| Off-Road | 0.1709 | 1.1455 | 1.8091 | 2.9700e-003 | | 0.0515 | 0.0515 | | 0.0515 | 0.0515 | | 281.4481 | 281.4481 | 0.0154 | | 281.8319 |
| **Total** | **12.3445** | **1.1455** | **1.8091** | **2.9700e-003** | | **0.0515** | **0.0515** | | **0.0515** | **0.0515** | | **281.4481** | **281.4481** | **0.0154** | | **281.8319** |

## 3.7 Architectural Coating - 2025

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.0501 | 0.0379 | 0.3134 | 6.2000e-004 | 0.0766 | 5.5000e-004 | 0.0772 | 0.0203 | 5.0000e-004 | 0.0208 | | 61.9270 | 61.9270 | 2.9800e-003 | | 62.0014 |
| **Total** | **0.0501** | **0.0379** | **0.3134** | **6.2000e-004** | **0.0766** | **5.5000e-004** | **0.0772** | **0.0203** | **5.0000e-004** | **0.0208** | | **61.9270** | **61.9270** | **2.9800e-003** | | **62.0014** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Archit. Coating | 12.1736 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | | 0.0000 | | | 0.0000 |
| Off-Road | 0.1709 | 1.1455 | 1.8091 | 2.9700e-003 | | 0.0515 | 0.0515 | | 0.0515 | 0.0515 | 0.0000 | 281.4481 | 281.4481 | 0.0154 | | 281.8319 |
| **Total** | **12.3445** | **1.1455** | **1.8091** | **2.9700e-003** | | **0.0515** | **0.0515** | | **0.0515** | **0.0515** | **0.0000** | **281.4481** | **281.4481** | **0.0154** | | **281.8319** |

## 3.7 Architectural Coating - 2025

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.0501 | 0.0379 | 0.3134 | 6.2000e-004 | 0.0766 | 5.5000e-004 | 0.0772 | 0.0203 | 5.0000e-004 | 0.0208 | | 61.9270 | 61.9270 | 2.9800e-003 | | 62.0014 |
| **Total** | **0.0501** | **0.0379** | **0.3134** | **6.2000e-004** | **0.0766** | **5.5000e-004** | **0.0772** | **0.0203** | **5.0000e-004** | **0.0208** | | **61.9270** | **61.9270** | **2.9800e-003** | | **62.0014** |

## 3.8 Trenching - 2024

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Off-Road | 0.5056 | 4.2621 | 8.7893 | 0.0135 | | 0.2051 | 0.2051 | | 0.1887 | 0.1887 | | 1,306.0768 | 1,306.0768 | 0.4224 | | 1,316.6371 |
| **Total** | **0.5056** | **4.2621** | **8.7893** | **0.0135** | | **0.2051** | **0.2051** | | **0.1887** | **0.1887** | | **1,306.0768** | **1,306.0768** | **0.4224** | | **1,316.6371** |

## 3.8 Trenching - 2024

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.0703 | 0.0552 | 0.4526 | 8.6000e-004 | 0.1022 | 7.6000e-004 | 0.1029 | 0.0271 | 7.0000e-004 | 0.0278 | | 85.5034 | 85.5034 | 4.3700e-003 | | 85.6128 |
| **Total** | **0.0703** | **0.0552** | **0.4526** | **8.6000e-004** | **0.1022** | **7.6000e-004** | **0.1029** | **0.0271** | **7.0000e-004** | **0.0278** | | **85.5034** | **85.5034** | **4.3700e-003** | | **85.6128** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Off-Road | 0.5056 | 4.2621 | 8.7893 | 0.0135 | | 0.2051 | 0.2051 | | 0.1887 | 0.1887 | 0.0000 | 1,306.0768 | 1,306.0768 | 0.4224 | | 1,316.6371 |
| **Total** | **0.5056** | **4.2621** | **8.7893** | **0.0135** | | **0.2051** | **0.2051** | | **0.1887** | **0.1887** | **0.0000** | **1,306.0768** | **1,306.0768** | **0.4224** | | **1,316.6371** |

### 3.8 Trenching - 2024

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | | 0.0000 |
| Worker | 0.0703 | 0.0552 | 0.4526 | 8.6000e-004 | 0.1022 | 7.6000e-004 | 0.1029 | 0.0271 | 7.0000e-004 | 0.0278 | | 85.5034 | 85.5034 | 4.3700e-003 | | 85.6128 |
| **Total** | **0.0703** | **0.0552** | **0.4526** | **8.6000e-004** | **0.1022** | **7.6000e-004** | **0.1029** | **0.0271** | **7.0000e-004** | **0.0278** | | **85.5034** | **85.5034** | **4.3700e-003** | | **85.6128** |

## 4.0 Operational Detail - Mobile

### 4.1 Mitigation Measures Mobile

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Mitigated | 0.0947 | 0.5220 | 1.1535 | 3.5200e-003 | 0.3052 | 3.4400e-003 | 0.3087 | 0.0817 | 3.2300e-003 | 0.0850 | | 355.6612 | 355.6612 | 0.0145 | | 356.0225 |
| Unmitigated | 0.0947 | 0.5220 | 1.1535 | 3.5200e-003 | 0.3052 | 3.4400e-003 | 0.3087 | 0.0817 | 3.2300e-003 | 0.0850 | | 355.6612 | 355.6612 | 0.0145 | | 356.0225 |

## 4.2 Trip Summary Information

| | Average Daily Trip Rate | | | Unmitigated | Mitigated |
|---|---|---|---|---|---|
| Land Use | Weekday | Saturday | Sunday | Annual VMT | Annual VMT |
| General Heavy Industry | 37.08 | 37.08 | 37.08 | 143,257 | 143,257 |
| Other Asphalt Surfaces | 0.00 | 0.00 | 0.00 | | |
| Other Non-Asphalt Surfaces | 0.00 | 0.00 | 0.00 | | |
| Total | 37.08 | 37.08 | 37.08 | 143,257 | 143,257 |

## 4.3 Trip Type Information

| | Miles | | | Trip % | | | Trip Purpose % | | |
|---|---|---|---|---|---|---|---|---|---|
| Land Use | H-W or C-W | H-S or C-C | H-O or C-NW | H-W or C-W | H-S or C-C | H-O or C-NW | Primary | Diverted | Pass-by |
| General Heavy Industry | 14.70 | 6.60 | 6.60 | 59.00 | 28.00 | 13.00 | 92 | 5 | 3 |
| Other Asphalt Surfaces | 14.70 | 6.60 | 6.60 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| Other Non-Asphalt Surfaces | 14.70 | 6.60 | 6.60 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |

## 4.4 Fleet Mix

| Land Use | LDA | LDT1 | LDT2 | MDV | LHD1 | LHD2 | MHD | HHD | OBUS | UBUS | MCY | SBUS | MH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| General Heavy Industry | 0.513997 | 0.038291 | 0.211378 | 0.127840 | 0.030790 | 0.005245 | 0.013914 | 0.046462 | 0.003639 | 0.001308 | 0.005014 | 0.001472 | 0.000650 |
| Other Asphalt Surfaces | 0.513997 | 0.038291 | 0.211378 | 0.127840 | 0.030790 | 0.005245 | 0.013914 | 0.046462 | 0.003639 | 0.001308 | 0.005014 | 0.001472 | 0.000650 |
| Other Non-Asphalt Surfaces | 0.513997 | 0.038291 | 0.211378 | 0.127840 | 0.030790 | 0.005245 | 0.013914 | 0.046462 | 0.003639 | 0.001308 | 0.005014 | 0.001472 | 0.000650 |

## 5.0 Energy Detail

Historical Energy Use: N

### 5.1 Mitigation Measures Energy

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| NaturalGas Mitigated | 2.5600e-003 | 0.0233 | 0.0196 | 1.4000e-004 | | 1.7700e-003 | 1.7700e-003 | | 1.7700e-003 | 1.7700e-003 | | 27.9669 | 27.9669 | 5.4000e-004 | 5.1000e-004 | 28.1331 |
| NaturalGas Unmitigated | 2.5600e-003 | 0.0233 | 0.0196 | 1.4000e-004 | | 1.7700e-003 | 1.7700e-003 | | 1.7700e-003 | 1.7700e-003 | | 27.9669 | 27.9669 | 5.4000e-004 | 5.1000e-004 | 28.1331 |

## 5.2 Energy by Land Use - NaturalGas

### Unmitigated

| | NaturalGas Use | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land Use | kBTU/yr | lb/day | | | | | | | | | | lb/day | | | | | |
| General Heavy Industry | 237.718 | 2.5600e-003 | 0.0233 | 0.0196 | 1.4000e-004 | | 1.7700e-003 | 1.7700e-003 | | 1.7700e-003 | 1.7700e-003 | | 27.9669 | 27.9669 | 5.4000e-004 | 5.1000e-004 | 28.1331 |
| Other Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **2.5600e-003** | **0.0233** | **0.0196** | **1.4000e-004** | | **1.7700e-003** | **1.7700e-003** | | **1.7700e-003** | **1.7700e-003** | | **27.9669** | **27.9669** | **5.4000e-004** | **5.1000e-004** | **28.1331** |

### Mitigated

| | NaturalGas Use | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land Use | kBTU/yr | lb/day | | | | | | | | | | lb/day | | | | | |
| General Heavy Industry | 0.237718 | 2.5600e-003 | 0.0233 | 0.0196 | 1.4000e-004 | | 1.7700e-003 | 1.7700e-003 | | 1.7700e-003 | 1.7700e-003 | | 27.9669 | 27.9669 | 5.4000e-004 | 5.1000e-004 | 28.1331 |
| Other Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **2.5600e-003** | **0.0233** | **0.0196** | **1.4000e-004** | | **1.7700e-003** | **1.7700e-003** | | **1.7700e-003** | **1.7700e-003** | | **27.9669** | **27.9669** | **5.4000e-004** | **5.1000e-004** | **28.1331** |

## 6.0 Area Detail

## 6.1 Mitigation Measures Area

Use Low VOC Paint - Non-Residential Interior

Use Low VOC Paint - Non-Residential Exterior

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | lb/day | | | | | | | | | | lb/day | | | | | |
| Mitigated | 0.5813 | 7.0000e-005 | 7.7600e-003 | 0.0000 | | 3.0000e-005 | 3.0000e-005 | | 3.0000e-005 | 3.0000e-005 | | 0.0167 | 0.0167 | 4.0000e-005 | | 0.0178 |
| Unmitigated | 0.5813 | 7.0000e-005 | 7.7600e-003 | 0.0000 | | 3.0000e-005 | 3.0000e-005 | | 3.0000e-005 | 3.0000e-005 | | 0.0167 | 0.0167 | 4.0000e-005 | | 0.0178 |

## 6.2 Area by SubCategory

**Unmitigated**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SubCategory | lb/day | | | | | | | | | | lb/day | | | | | |
| Architectural Coating | 0.0334 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | | 0.0000 | | | 0.0000 |
| Consumer Products | 0.5472 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | | 0.0000 | | | 0.0000 |
| Landscaping | 7.1000e-004 | 7.0000e-005 | 7.7600e-003 | 0.0000 | | 3.0000e-005 | 3.0000e-005 | | 3.0000e-005 | 3.0000e-005 | | 0.0167 | 0.0167 | 4.0000e-005 | | 0.0178 |
| **Total** | **0.5813** | **7.0000e-005** | **7.7600e-003** | **0.0000** | | **3.0000e-005** | **3.0000e-005** | | **3.0000e-005** | **3.0000e-005** | | **0.0167** | **0.0167** | **4.0000e-005** | | **0.0178** |

**Mitigated**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SubCategory | lb/day | | | | | | | | | | lb/day | | | | | |
| Architectural Coating | 0.0334 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | | 0.0000 | | | 0.0000 |
| Consumer Products | 0.5472 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | | 0.0000 | | | 0.0000 |
| Landscaping | 7.1000e-004 | 7.0000e-005 | 7.7600e-003 | 0.0000 | | 3.0000e-005 | 3.0000e-005 | | 3.0000e-005 | 3.0000e-005 | | 0.0167 | 0.0167 | 4.0000e-005 | | 0.0178 |
| **Total** | **0.5813** | **7.0000e-005** | **7.7600e-003** | **0.0000** | | **3.0000e-005** | **3.0000e-005** | | **3.0000e-005** | **3.0000e-005** | | **0.0167** | **0.0167** | **4.0000e-005** | | **0.0178** |

## 7.0 Water Detail

### 7.1 Mitigation Measures Water

## 8.0 Waste Detail

### 8.1 Mitigation Measures Waste

## 9.0 Operational Offroad

| Equipment Type | Number | Hours/Day | Days/Year | Horse Power | Load Factor | Fuel Type |
|---|---|---|---|---|---|---|

## 10.0 Stationary Equipment

**Fire Pumps and Emergency Generators**

| Equipment Type | Number | Hours/Day | Hours/Year | Horse Power | Load Factor | Fuel Type |
|---|---|---|---|---|---|---|

**Boilers**

| Equipment Type | Number | Heat Input/Day | Heat Input/Year | Boiler Rating | Fuel Type |
|---|---|---|---|---|---|

**User Defined Equipment**

| Equipment Type | Number |
|---|---|

## 11.0 Vegetation

# Arcata Wastewater Treatment Facility Improvement Project (Phase 1)

**Humboldt County, Annual**

## 1.0 Project Characteristics

### 1.1 Land Usage

| Land Uses | Size | Metric | Lot Acreage | Floor Surface Area | Population |
|---|---|---|---|---|---|
| General Heavy Industry | 17.25 | 1000sqft | 0.40 | 17,250.00 | 0 |
| Other Asphalt Surfaces | 36.00 | 1000sqft | 0.83 | 36,000.00 | 0 |
| Other Non-Asphalt Surfaces | 12.00 | 1000sqft | 0.28 | 12,000.00 | 0 |

### 1.2 Other Project Characteristics

| | | | | | |
|---|---|---|---|---|---|
| **Urbanization** | Rural | **Wind Speed (m/s)** | 2.2 | **Precipitation Freq (Days)** | 103 |
| **Climate Zone** | 1 | | | **Operational Year** | 2022 |
| **Utility Company** | Pacific Gas & Electric Company | | | | |
| **CO2 Intensity (lb/MWhr)** | 641.35 | **CH4 Intensity (lb/MWhr)** | 0.029 | **N2O Intensity (lb/MWhr)** | 0.006 |

### 1.3 User Entered Comments & Non-Default Data

Arcata Wastewater Treatment Facility Improvement Project (Phase 1) - Humboldt County, Annual

Project Characteristics -

Land Use - "General Heavy Industry" was used for buildings and equipment. "Other Asphalt Surfaces" was used for paving of access roads. "Other Non-Asphalt Surfaces" was used for ductbank construction.

Construction Phase - Constructon schedule provided by project engineer.

Off-road Equipment - Equipment list supplemented by project engineer.

Off-road Equipment - Equipment list provided by project engineer.

Grading - It is assumed that the project site will be crossed over twice during grading and site preparation.

Demolition -

Off-road Equipment -

Architectural Coating - The project will use low VOC paint that is 50 g/L or less.

Area Coating - The project will use low VOC paint that is 50 g/L or less.

Area Mitigation - The project will use low VOC paint that is 50g/L or less.

| Table Name | Column Name | Default Value | New Value |
|---|---|---|---|
| tblArchitecturalCoating | EF_Nonresidential_Exterior | 250.00 | 50.00 |
| tblArchitecturalCoating | EF_Nonresidential_Interior | 250.00 | 50.00 |
| tblArchitecturalCoating | EF_Parking | 250.00 | 50.00 |
| tblAreaCoating | Area_EF_Nonresidential_Exterior | 250 | 50 |
| tblAreaCoating | Area_EF_Nonresidential_Interior | 250 | 50 |
| tblAreaCoating | Area_EF_Parking | 250 | 50 |
| tblAreaMitigation | UseLowVOCPaintParkingCheck | False | True |
| tblConstructionPhase | NumDays | 200.00 | 160.00 |
| tblConstructionPhase | NumDays | 20.00 | 32.00 |
| tblConstructionPhase | NumDays | 4.00 | 20.00 |
| tblConstructionPhase | NumDays | 10.00 | 5.00 |
| tblConstructionPhase | NumDays | 2.00 | 10.00 |
| tblConstructionPhase | PhaseEndDate | 3/10/2022 | 4/20/2022 |
| tblConstructionPhase | PhaseEndDate | 2/10/2022 | 4/7/2022 |

| | | | |
|---|---|---|---|
| tblConstructionPhase | PhaseEndDate | 4/28/2021 | 5/14/2021 |
| tblConstructionPhase | PhaseEndDate | 5/6/2021 | 6/23/2021 |
| tblConstructionPhase | PhaseEndDate | 2/24/2022 | 8/27/2021 |
| tblConstructionPhase | PhaseEndDate | 4/30/2021 | 5/27/2021 |
| tblConstructionPhase | PhaseStartDate | 2/25/2022 | 4/7/2022 |
| tblConstructionPhase | PhaseStartDate | 5/7/2021 | 8/27/2021 |
| tblConstructionPhase | PhaseStartDate | 5/1/2021 | 5/27/2021 |
| tblConstructionPhase | PhaseStartDate | 2/11/2022 | 8/23/2021 |
| tblConstructionPhase | PhaseStartDate | 4/29/2021 | 5/14/2021 |
| tblGrading | AcresOfGrading | 7.50 | 4.00 |
| tblGrading | AcresOfGrading | 5.00 | 2.05 |
| tblGrading | MaterialExported | 0.00 | 6,200.00 |
| tblGrading | MaterialImported | 0.00 | 880.00 |
| tblOffRoadEquipment | LoadFactor | 0.37 | 0.37 |
| tblOffRoadEquipment | LoadFactor | 0.38 | 0.38 |
| tblOffRoadEquipment | LoadFactor | 0.50 | 0.50 |
| tblOffRoadEquipment | OffRoadEquipmentType | | Tractors/Loaders/Backhoes |
| tblOffRoadEquipment | OffRoadEquipmentType | | Cranes |
| tblOffRoadEquipment | OffRoadEquipmentType | | Excavators |
| tblOffRoadEquipment | OffRoadEquipmentType | | Bore/Drill Rigs |
| tblProjectCharacteristics | UrbanizationLevel | Urban | Rural |

## 2.0 Emissions Summary

## 2.1 Overall Construction

### Unmitigated Construction

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | tons/yr | | | | | | | | | | MT/yr | | | | | |
| 2021 | 0.2008 | 1.7891 | 1.4495 | 3.1200e-003 | 0.1079 | 0.0770 | 0.1849 | 0.0483 | 0.0725 | 0.1208 | 0.0000 | 271.9166 | 271.9166 | 0.0567 | 0.0000 | 273.3343 |
| 2022 | 0.1285 | 0.6568 | 0.6293 | 1.3800e-003 | 0.0137 | 0.0274 | 0.0410 | 3.6900e-003 | 0.0262 | 0.0299 | 0.0000 | 117.6816 | 117.6816 | 0.0233 | 0.0000 | 118.2632 |
| **Maximum** | **0.2008** | **1.7891** | **1.4495** | **3.1200e-003** | **0.1079** | **0.0770** | **0.1849** | **0.0483** | **0.0725** | **0.1208** | **0.0000** | **271.9166** | **271.9166** | **0.0567** | **0.0000** | **273.3343** |

### Mitigated Construction

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | tons/yr | | | | | | | | | | MT/yr | | | | | |
| 2021 | 0.2008 | 1.7891 | 1.4495 | 3.1200e-003 | 0.1079 | 0.0770 | 0.1849 | 0.0483 | 0.0725 | 0.1208 | 0.0000 | 271.9163 | 271.9163 | 0.0567 | 0.0000 | 273.3341 |
| 2022 | 0.1285 | 0.6568 | 0.6293 | 1.3800e-003 | 0.0137 | 0.0274 | 0.0410 | 3.6900e-003 | 0.0262 | 0.0299 | 0.0000 | 117.6814 | 117.6814 | 0.0233 | 0.0000 | 118.2631 |
| **Maximum** | **0.2008** | **1.7891** | **1.4495** | **3.1200e-003** | **0.1079** | **0.0770** | **0.1849** | **0.0483** | **0.0725** | **0.1208** | **0.0000** | **271.9163** | **271.9163** | **0.0567** | **0.0000** | **273.3341** |

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio-CO2 | Total CO2 | CH4 | N20 | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Percent Reduction** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |

Arcata Wastewater Treatment Facility Improvement Project (Phase 1) - Humboldt County, Annual

| Quarter | Start Date | End Date | Maximum Unmitigated ROG + NOX (tons/quarter) | Maximum Mitigated ROG + NOX (tons/quarter) |
|---|---|---|---|---|
| 1 | 4-1-2021 | 6-30-2021 | 0.7427 | 0.7427 |
| 2 | 7-1-2021 | 9-30-2021 | 0.4485 | 0.4485 |
| 3 | 10-1-2021 | 12-31-2021 | 0.7841 | 0.7841 |
| 4 | 1-1-2022 | 3-31-2022 | 0.6857 | 0.6857 |
| 5 | 4-1-2022 | 6-30-2022 | 0.1049 | 0.1049 |
| | | Highest | 0.7841 | 0.7841 |

## 2.2 Overall Operational

### Unmitigated Operational

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Area | 0.0749 | 1.0000e-005 | 6.0000e-004 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 1.1700e-003 | 1.1700e-003 | 0.0000 | 0.0000 | 1.2400e-003 |
| Energy | 3.3000e-004 | 2.9700e-003 | 2.4900e-003 | 2.0000e-005 | | 2.3000e-004 | 2.3000e-004 | | 2.3000e-004 | 2.3000e-004 | 0.0000 | 24.7090 | 24.7090 | 1.0300e-003 | 2.6000e-004 | 24.8124 |
| Mobile | 0.0154 | 0.0939 | 0.1964 | 4.9000e-004 | 0.0365 | 6.5000e-004 | 0.0372 | 9.8400e-003 | 6.1000e-004 | 0.0105 | 0.0000 | 44.6886 | 44.6886 | 2.2800e-003 | 0.0000 | 44.7455 |
| Waste | | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 4.3420 | 0.0000 | 4.3420 | 0.2566 | 0.0000 | 10.7571 |
| Water | | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 1.2656 | 6.2793 | 7.5448 | 0.1303 | 3.1300e-003 | 11.7336 |
| **Total** | **0.0906** | **0.0969** | **0.1995** | **5.1000e-004** | **0.0365** | **8.8000e-004** | **0.0374** | **9.8400e-003** | **8.4000e-004** | **0.0107** | **5.6075** | **75.6780** | **81.2856** | **0.3902** | **3.3900e-003** | **92.0498** |

## 2.2 Overall Operational

**Mitigated Operational**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Area | 0.0749 | 1.0000e-005 | 6.0000e-004 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 1.1700e-003 | 1.1700e-003 | 0.0000 | 0.0000 | 1.2400e-003 |
| Energy | 3.3000e-004 | 2.9700e-003 | 2.4900e-003 | 2.0000e-005 | | 2.3000e-004 | 2.3000e-004 | | 2.3000e-004 | 2.3000e-004 | 0.0000 | 24.7090 | 24.7090 | 1.0300e-003 | 2.6000e-004 | 24.8124 |
| Mobile | 0.0154 | 0.0939 | 0.1964 | 4.9000e-004 | 0.0365 | 6.5000e-004 | 0.0372 | 9.8400e-003 | 6.1000e-004 | 0.0105 | 0.0000 | 44.6886 | 44.6886 | 2.2800e-003 | 0.0000 | 44.7455 |
| Waste | | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 4.3420 | 0.0000 | 4.3420 | 0.2566 | 0.0000 | 10.7571 |
| Water | | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 1.2656 | 6.2793 | 7.5448 | 0.1303 | 3.1300e-003 | 11.7336 |
| **Total** | **0.0906** | **0.0969** | **0.1995** | **5.1000e-004** | **0.0365** | **8.8000e-004** | **0.0374** | **9.8400e-003** | **8.4000e-004** | **0.0107** | **5.6075** | **75.6780** | **81.2856** | **0.3902** | **3.3900e-003** | **92.0498** |

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio-CO2 | Total CO2 | CH4 | N20 | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Percent Reduction** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |

## 3.0 Construction Detail

**Construction Phase**

Arcata Wastewater Treatment Facility Improvement Project (Phase 1) - Humboldt County, Annual

| Phase Number | Phase Name | Phase Type | Start Date | End Date | Num Days Week | Num Days | Phase Description |
|---|---|---|---|---|---|---|---|
| 1 | Demolition | Demolition | 4/1/2021 | 5/14/2021 | 5 | 32 | |
| 2 | Site Preparation | Site Preparation | 5/14/2021 | 5/27/2021 | 5 | 10 | |
| 3 | Grading | Grading | 5/27/2021 | 6/23/2021 | 5 | 20 | |
| 4 | Building Construction | Building Construction | 8/27/2021 | 4/7/2022 | 5 | 160 | |
| 5 | Paving | Paving | 8/23/2021 | 8/27/2021 | 5 | 5 | |
| 6 | Architectural Coating | Architectural Coating | 4/7/2022 | 4/20/2022 | 5 | 10 | |
| 7 | Trenching | Trenching | 6/23/2021 | 8/23/2021 | 5 | 44 | |

**Acres of Grading (Site Preparation Phase): 2.05**

**Acres of Grading (Grading Phase): 4**

**Acres of Paving: 1.11**

**Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 25,875; Non-Residential Outdoor: 8,625; Striped Parking Area: 2,880 (Architectural Coating – sqft)**

**OffRoad Equipment**

Arcata Wastewater Treatment Facility Improvement Project (Phase 1) - Humboldt County, Annual

| Phase Name | Offroad Equipment Type | Amount | Usage Hours | Horse Power | Load Factor |
|---|---|---|---|---|---|
| Architectural Coating | Air Compressors | 1 | 6.00 | 78 | 0.48 |
| Paving | Cement and Mortar Mixers | 1 | 6.00 | 9 | 0.56 |
| Demolition | Concrete/Industrial Saws | 1 | 8.00 | 81 | 0.73 |
| Building Construction | Generator Sets | 1 | 8.00 | 84 | 0.74 |
| Building Construction | Cranes | 1 | 6.00 | 231 | 0.29 |
| Building Construction | Forklifts | 1 | 6.00 | 89 | 0.20 |
| Site Preparation | Graders | 1 | 8.00 | 187 | 0.41 |
| Paving | Pavers | 1 | 6.00 | 130 | 0.42 |
| Paving | Rollers | 1 | 7.00 | 80 | 0.38 |
| Demolition | Rubber Tired Dozers | 1 | 8.00 | 247 | 0.40 |
| Grading | Rubber Tired Dozers | 1 | 6.00 | 247 | 0.40 |
| Building Construction | Tractors/Loaders/Backhoes | 1 | 6.00 | 97 | 0.37 |
| Demolition | Tractors/Loaders/Backhoes | 3 | 8.00 | 97 | 0.37 |
| Grading | Tractors/Loaders/Backhoes | 1 | 7.00 | 97 | 0.37 |
| Paving | Tractors/Loaders/Backhoes | 1 | 8.00 | 97 | 0.37 |
| Site Preparation | Tractors/Loaders/Backhoes | 1 | 8.00 | 97 | 0.37 |
| Grading | Graders | 1 | 6.00 | 187 | 0.41 |
| Paving | Paving Equipment | 1 | 8.00 | 132 | 0.36 |
| Site Preparation | Rubber Tired Dozers | 1 | 7.00 | 247 | 0.40 |
| Building Construction | Welders | 3 | 8.00 | 46 | 0.45 |
| Trenching | Tractors/Loaders/Backhoes | 1 | 8.00 | 97 | 0.37 |
| Building Construction | Cranes | 1 | 6.00 | 231 | 0.29 |
| Trenching | Excavators | 2 | 8.00 | 158 | 0.38 |
| Building Construction | Bore/Drill Rigs | 1 | 6.00 | 221 | 0.50 |

**Trips and VMT**

| Phase Name | Offroad Equipment Count | Worker Trip Number | Vendor Trip Number | Hauling Trip Number | Worker Trip Length | Vendor Trip Length | Hauling Trip Length | Worker Vehicle Class | Vendor Vehicle Class | Hauling Vehicle Class |
|---|---|---|---|---|---|---|---|---|---|---|
| Demolition | 5 | 13.00 | 0.00 | 20.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Site Preparation | 3 | 8.00 | 0.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Grading | 3 | 8.00 | 0.00 | 775.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Building Construction | 9 | 27.00 | 11.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Paving | 5 | 13.00 | 0.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Architectural Coating | 1 | 5.00 | 0.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Trenching | 3 | 8.00 | 0.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |

## 3.1 Mitigation Measures Construction

## 3.2 Demolition - 2021

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Fugitive Dust | | | | | 2.2000e-003 | 0.0000 | 2.2000e-003 | 3.3000e-004 | 0.0000 | 3.3000e-004 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Off-Road | 0.0319 | 0.3152 | 0.2319 | 3.9000e-004 | | 0.0167 | 0.0167 | | 0.0155 | 0.0155 | 0.0000 | 33.7141 | 33.7141 | 8.6200e-003 | 0.0000 | 33.9297 |
| **Total** | **0.0319** | **0.3152** | **0.2319** | **3.9000e-004** | **2.2000e-003** | **0.0167** | **0.0189** | **3.3000e-004** | **0.0155** | **0.0159** | **0.0000** | **33.7141** | **33.7141** | **8.6200e-003** | **0.0000** | **33.9297** |

## 3.2 Demolition - 2021

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 9.0000e-005 | 3.0500e-003 | 5.0000e-004 | 1.0000e-005 | 1.6000e-004 | 1.0000e-005 | 1.8000e-004 | 5.0000e-005 | 1.0000e-005 | 6.0000e-005 | 0.0000 | 0.7537 | 0.7537 | 2.0000e-005 | 0.0000 | 0.7542 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 2.3200e-003 | 2.0800e-003 | 0.0163 | 2.0000e-005 | 2.4900e-003 | 2.0000e-005 | 2.5200e-003 | 6.6000e-004 | 2.0000e-005 | 6.9000e-004 | 0.0000 | 2.2206 | 2.2206 | 1.4000e-004 | 0.0000 | 2.2242 |
| **Total** | **2.4100e-003** | **5.1300e-003** | **0.0168** | **3.0000e-005** | **2.6500e-003** | **3.0000e-005** | **2.7000e-003** | **7.1000e-004** | **3.0000e-005** | **7.5000e-004** | **0.0000** | **2.9743** | **2.9743** | **1.6000e-004** | **0.0000** | **2.9785** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Fugitive Dust | | | | | 2.2000e-003 | 0.0000 | 2.2000e-003 | 3.3000e-004 | 0.0000 | 3.3000e-004 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Off-Road | 0.0319 | 0.3152 | 0.2319 | 3.9000e-004 | | 0.0167 | 0.0167 | | 0.0155 | 0.0155 | 0.0000 | 33.7141 | 33.7141 | 8.6200e-003 | 0.0000 | 33.9296 |
| **Total** | **0.0319** | **0.3152** | **0.2319** | **3.9000e-004** | **2.2000e-003** | **0.0167** | **0.0189** | **3.3000e-004** | **0.0155** | **0.0159** | **0.0000** | **33.7141** | **33.7141** | **8.6200e-003** | **0.0000** | **33.9296** |

## 3.2 Demolition - 2021

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 9.0000e-005 | 3.0500e-003 | 5.0000e-004 | 1.0000e-005 | 1.6000e-004 | 1.0000e-005 | 1.8000e-004 | 5.0000e-005 | 1.0000e-005 | 6.0000e-005 | 0.0000 | 0.7537 | 0.7537 | 2.0000e-005 | 0.0000 | 0.7542 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 2.3200e-003 | 2.0800e-003 | 0.0163 | 2.0000e-005 | 2.4900e-003 | 2.0000e-005 | 2.5200e-003 | 6.6000e-004 | 2.0000e-005 | 6.9000e-004 | 0.0000 | 2.2206 | 2.2206 | 1.4000e-004 | 0.0000 | 2.2242 |
| **Total** | **2.4100e-003** | **5.1300e-003** | **0.0168** | **3.0000e-005** | **2.6500e-003** | **3.0000e-005** | **2.7000e-003** | **7.1000e-004** | **3.0000e-005** | **7.5000e-004** | **0.0000** | **2.9743** | **2.9743** | **1.6000e-004** | **0.0000** | **2.9785** |

## 3.3 Site Preparation - 2021

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Fugitive Dust | | | | | 0.0274 | 0.0000 | 0.0274 | 0.0146 | 0.0000 | 0.0146 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Off-Road | 7.7800e-003 | 0.0871 | 0.0378 | 9.0000e-005 | | 3.8300e-003 | 3.8300e-003 | | 3.5200e-003 | 3.5200e-003 | 0.0000 | 7.5592 | 7.5592 | 2.4400e-003 | 0.0000 | 7.6203 |
| **Total** | **7.7800e-003** | **0.0871** | **0.0378** | **9.0000e-005** | **0.0274** | **3.8300e-003** | **0.0313** | **0.0146** | **3.5200e-003** | **0.0181** | **0.0000** | **7.5592** | **7.5592** | **2.4400e-003** | **0.0000** | **7.6203** |

## 3.3 Site Preparation - 2021

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 4.5000e-004 | 4.0000e-004 | 3.1400e-003 | 0.0000 | 4.8000e-004 | 0.0000 | 4.8000e-004 | 1.3000e-004 | 0.0000 | 1.3000e-004 | 0.0000 | 0.4270 | 0.4270 | 3.0000e-005 | 0.0000 | 0.4277 |
| **Total** | **4.5000e-004** | **4.0000e-004** | **3.1400e-003** | **0.0000** | **4.8000e-004** | **0.0000** | **4.8000e-004** | **1.3000e-004** | **0.0000** | **1.3000e-004** | **0.0000** | **0.4270** | **0.4270** | **3.0000e-005** | **0.0000** | **0.4277** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Fugitive Dust | | | | | 0.0274 | 0.0000 | 0.0274 | 0.0146 | 0.0000 | 0.0146 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Off-Road | 7.7800e-003 | 0.0871 | 0.0378 | 9.0000e-005 | | 3.8300e-003 | 3.8300e-003 | | 3.5200e-003 | 3.5200e-003 | 0.0000 | 7.5592 | 7.5592 | 2.4400e-003 | 0.0000 | 7.6203 |
| **Total** | **7.7800e-003** | **0.0871** | **0.0378** | **9.0000e-005** | **0.0274** | **3.8300e-003** | **0.0313** | **0.0146** | **3.5200e-003** | **0.0181** | **0.0000** | **7.5592** | **7.5592** | **2.4400e-003** | **0.0000** | **7.6203** |

## 3.3 Site Preparation - 2021

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 4.5000e-004 | 4.0000e-004 | 3.1400e-003 | 0.0000 | 4.8000e-004 | 0.0000 | 4.8000e-004 | 1.3000e-004 | 0.0000 | 1.3000e-004 | 0.0000 | 0.4270 | 0.4270 | 3.0000e-005 | 0.0000 | 0.4277 |
| **Total** | **4.5000e-004** | **4.0000e-004** | **3.1400e-003** | **0.0000** | **4.8000e-004** | **0.0000** | **4.8000e-004** | **1.3000e-004** | **0.0000** | **1.3000e-004** | **0.0000** | **0.4270** | **0.4270** | **3.0000e-005** | **0.0000** | **0.4277** |

## 3.4 Grading - 2021

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Fugitive Dust | | | | | 0.0477 | 0.0000 | 0.0477 | 0.0251 | 0.0000 | 0.0251 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Off-Road | 0.0129 | 0.1433 | 0.0633 | 1.4000e-004 | | 6.3800e-003 | 6.3800e-003 | | 5.8700e-003 | 5.8700e-003 | 0.0000 | 12.3837 | 12.3837 | 4.0100e-003 | 0.0000 | 12.4838 |
| **Total** | **0.0129** | **0.1433** | **0.0633** | **1.4000e-004** | **0.0477** | **6.3800e-003** | **0.0541** | **0.0251** | **5.8700e-003** | **0.0310** | **0.0000** | **12.3837** | **12.3837** | **4.0100e-003** | **0.0000** | **12.4838** |

## 3.4 Grading - 2021

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 3.4600e-003 | 0.1182 | 0.0193 | 3.1000e-004 | 6.3700e-003 | 5.4000e-004 | 6.9100e-003 | 1.7500e-003 | 5.2000e-004 | 2.2700e-003 | 0.0000 | 29.2045 | 29.2045 | 8.9000e-004 | 0.0000 | 29.2268 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 8.9000e-004 | 8.0000e-004 | 6.2800e-003 | 1.0000e-005 | 9.6000e-004 | 1.0000e-005 | 9.7000e-004 | 2.6000e-004 | 1.0000e-005 | 2.6000e-004 | 0.0000 | 0.8541 | 0.8541 | 6.0000e-005 | 0.0000 | 0.8555 |
| **Total** | **4.3500e-003** | **0.1190** | **0.0255** | **3.2000e-004** | **7.3300e-003** | **5.5000e-004** | **7.8800e-003** | **2.0100e-003** | **5.3000e-004** | **2.5300e-003** | **0.0000** | **30.0586** | **30.0586** | **9.5000e-004** | **0.0000** | **30.0822** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Fugitive Dust | | | | | 0.0477 | 0.0000 | 0.0477 | 0.0251 | 0.0000 | 0.0251 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Off-Road | 0.0129 | 0.1433 | 0.0633 | 1.4000e-004 | | 6.3800e-003 | 6.3800e-003 | | 5.8700e-003 | 5.8700e-003 | 0.0000 | 12.3836 | 12.3836 | 4.0100e-003 | 0.0000 | 12.4838 |
| **Total** | **0.0129** | **0.1433** | **0.0633** | **1.4000e-004** | **0.0477** | **6.3800e-003** | **0.0541** | **0.0251** | **5.8700e-003** | **0.0310** | **0.0000** | **12.3836** | **12.3836** | **4.0100e-003** | **0.0000** | **12.4838** |

## 3.4 Grading - 2021

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 3.4600e-003 | 0.1182 | 0.0193 | 3.1000e-004 | 6.3700e-003 | 5.4000e-004 | 6.9100e-003 | 1.7500e-003 | 5.2000e-004 | 2.2700e-003 | 0.0000 | 29.2045 | 29.2045 | 8.9000e-004 | 0.0000 | 29.2268 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 8.9000e-004 | 8.0000e-004 | 6.2800e-003 | 1.0000e-005 | 9.6000e-004 | 1.0000e-005 | 9.7000e-004 | 2.6000e-004 | 1.0000e-005 | 2.6000e-004 | 0.0000 | 0.8541 | 0.8541 | 6.0000e-005 | 0.0000 | 0.8555 |
| **Total** | **4.3500e-003** | **0.1190** | **0.0255** | **3.2000e-004** | **7.3300e-003** | **5.5000e-004** | **7.8800e-003** | **2.0100e-003** | **5.3000e-004** | **2.5300e-003** | **0.0000** | **30.0586** | **30.0586** | **9.5000e-004** | **0.0000** | **30.0822** |

## 3.5 Building Construction - 2021

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Off-Road | 0.1054 | 0.8896 | 0.7257 | 1.5200e-003 | | 0.0410 | 0.0410 | | 0.0391 | 0.0391 | 0.0000 | 128.2779 | 128.2779 | 0.0295 | 0.0000 | 129.0159 |
| **Total** | **0.1054** | **0.8896** | **0.7257** | **1.5200e-003** | | **0.0410** | **0.0410** | | **0.0391** | **0.0391** | **0.0000** | **128.2779** | **128.2779** | **0.0295** | **0.0000** | **129.0159** |

## 3.5 Building Construction - 2021

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 2.3100e-003 | 0.0589 | 0.0160 | 1.3000e-004 | 2.9000e-003 | 2.4000e-004 | 3.1400e-003 | 8.4000e-004 | 2.3000e-004 | 1.0700e-003 | 0.0000 | 12.1925 | 12.1925 | 6.3000e-004 | 0.0000 | 12.2082 |
| Worker | 0.0137 | 0.0123 | 0.0965 | 1.5000e-004 | 0.0147 | 1.4000e-004 | 0.0149 | 3.9300e-003 | 1.3000e-004 | 4.0500e-003 | 0.0000 | 13.1155 | 13.1155 | 8.5000e-004 | 0.0000 | 13.1368 |
| **Total** | **0.0160** | **0.0712** | **0.1125** | **2.8000e-004** | **0.0176** | **3.8000e-004** | **0.0180** | **4.7700e-003** | **3.6000e-004** | **5.1200e-003** | **0.0000** | **25.3080** | **25.3080** | **1.4800e-003** | **0.0000** | **25.3450** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Off-Road | 0.1054 | 0.8896 | 0.7257 | 1.5200e-003 | | 0.0410 | 0.0410 | | 0.0391 | 0.0391 | 0.0000 | 128.2778 | 128.2778 | 0.0295 | 0.0000 | 129.0158 |
| **Total** | **0.1054** | **0.8896** | **0.7257** | **1.5200e-003** | | **0.0410** | **0.0410** | | **0.0391** | **0.0391** | **0.0000** | **128.2778** | **128.2778** | **0.0295** | **0.0000** | **129.0158** |

## 3.5 Building Construction - 2021

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 2.3100e-003 | 0.0589 | 0.0160 | 1.3000e-004 | 2.9000e-003 | 2.4000e-004 | 3.1400e-003 | 8.4000e-004 | 2.3000e-004 | 1.0700e-003 | 0.0000 | 12.1925 | 12.1925 | 6.3000e-004 | 0.0000 | 12.2082 |
| Worker | 0.0137 | 0.0123 | 0.0965 | 1.5000e-004 | 0.0147 | 1.4000e-004 | 0.0149 | 3.9300e-003 | 1.3000e-004 | 4.0500e-003 | 0.0000 | 13.1155 | 13.1155 | 8.5000e-004 | 0.0000 | 13.1368 |
| **Total** | **0.0160** | **0.0712** | **0.1125** | **2.8000e-004** | **0.0176** | **3.8000e-004** | **0.0180** | **4.7700e-003** | **3.6000e-004** | **5.1200e-003** | **0.0000** | **25.3080** | **25.3080** | **1.4800e-003** | **0.0000** | **25.3450** |

## 3.5 Building Construction - 2022

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Off-Road | 0.0724 | 0.5986 | 0.5411 | 1.1600e-003 | | 0.0267 | 0.0267 | | 0.0255 | 0.0255 | 0.0000 | 97.3133 | 97.3133 | 0.0221 | 0.0000 | 97.8664 |
| **Total** | **0.0724** | **0.5986** | **0.5411** | **1.1600e-003** | | **0.0267** | **0.0267** | | **0.0255** | **0.0255** | **0.0000** | **97.3133** | **97.3133** | **0.0221** | **0.0000** | **97.8664** |

## 3.5 Building Construction - 2022

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 1.6300e-003 | 0.0425 | 0.0111 | 1.0000e-004 | 2.2000e-003 | 1.6000e-004 | 2.3600e-003 | 6.4000e-004 | 1.6000e-004 | 7.9000e-004 | 0.0000 | 9.1818 | 9.1818 | 4.6000e-004 | 0.0000 | 9.1934 |
| Worker | 9.9400e-003 | 8.4700e-003 | 0.0662 | 1.1000e-004 | 0.0112 | 1.0000e-004 | 0.0113 | 2.9800e-003 | 9.0000e-005 | 3.0700e-003 | 0.0000 | 9.6508 | 9.6508 | 5.8000e-004 | 0.0000 | 9.6653 |
| **Total** | **0.0116** | **0.0510** | **0.0773** | **2.1000e-004** | **0.0134** | **2.6000e-004** | **0.0136** | **3.6200e-003** | **2.5000e-004** | **3.8600e-003** | **0.0000** | **18.8326** | **18.8326** | **1.0400e-003** | **0.0000** | **18.8587** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Off-Road | 0.0724 | 0.5986 | 0.5411 | 1.1600e-003 | | 0.0267 | 0.0267 | | 0.0255 | 0.0255 | 0.0000 | 97.3132 | 97.3132 | 0.0221 | 0.0000 | 97.8663 |
| **Total** | **0.0724** | **0.5986** | **0.5411** | **1.1600e-003** | | **0.0267** | **0.0267** | | **0.0255** | **0.0255** | **0.0000** | **97.3132** | **97.3132** | **0.0221** | **0.0000** | **97.8663** |

## 3.5 Building Construction - 2022

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 1.6300e-003 | 0.0425 | 0.0111 | 1.0000e-004 | 2.2000e-003 | 1.6000e-004 | 2.3600e-003 | 6.4000e-004 | 1.6000e-004 | 7.9000e-004 | 0.0000 | 9.1818 | 9.1818 | 4.6000e-004 | 0.0000 | 9.1934 |
| Worker | 9.9400e-003 | 8.4700e-003 | 0.0662 | 1.1000e-004 | 0.0112 | 1.0000e-004 | 0.0113 | 2.9800e-003 | 9.0000e-005 | 3.0700e-003 | 0.0000 | 9.6508 | 9.6508 | 5.8000e-004 | 0.0000 | 9.6653 |
| **Total** | **0.0116** | **0.0510** | **0.0773** | **2.1000e-004** | **0.0134** | **2.6000e-004** | **0.0136** | **3.6200e-003** | **2.5000e-004** | **3.8600e-003** | **0.0000** | **18.8326** | **18.8326** | **1.0400e-003** | **0.0000** | **18.8587** |

## 3.6 Paving - 2021

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Off-Road | 1.9300e-003 | 0.0194 | 0.0221 | 3.0000e-005 | | 1.0400e-003 | 1.0400e-003 | | 9.6000e-004 | 9.6000e-004 | 0.0000 | 2.9412 | 2.9412 | 9.3000e-004 | 0.0000 | 2.9646 |
| Paving | 1.0900e-003 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | **3.0200e-003** | **0.0194** | **0.0221** | **3.0000e-005** | | **1.0400e-003** | **1.0400e-003** | | **9.6000e-004** | **9.6000e-004** | **0.0000** | **2.9412** | **2.9412** | **9.3000e-004** | **0.0000** | **2.9646** |

## 3.6 Paving - 2021

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 3.6000e-004 | 3.2000e-004 | 2.5500e-003 | 0.0000 | 3.9000e-004 | 0.0000 | 3.9000e-004 | 1.0000e-004 | 0.0000 | 1.1000e-004 | 0.0000 | 0.3470 | 0.3470 | 2.0000e-005 | 0.0000 | 0.3475 |
| **Total** | **3.6000e-004** | **3.2000e-004** | **2.5500e-003** | **0.0000** | **3.9000e-004** | **0.0000** | **3.9000e-004** | **1.0000e-004** | **0.0000** | **1.1000e-004** | **0.0000** | **0.3470** | **0.3470** | **2.0000e-005** | **0.0000** | **0.3475** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Off-Road | 1.9300e-003 | 0.0194 | 0.0221 | 3.0000e-005 | | 1.0400e-003 | 1.0400e-003 | | 9.6000e-004 | 9.6000e-004 | 0.0000 | 2.9412 | 2.9412 | 9.3000e-004 | 0.0000 | 2.9646 |
| Paving | 1.0900e-003 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | **3.0200e-003** | **0.0194** | **0.0221** | **3.0000e-005** | | **1.0400e-003** | **1.0400e-003** | | **9.6000e-004** | **9.6000e-004** | **0.0000** | **2.9412** | **2.9412** | **9.3000e-004** | **0.0000** | **2.9646** |

## 3.6 Paving - 2021

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 3.6000e-004 | 3.2000e-004 | 2.5500e-003 | 0.0000 | 3.9000e-004 | 0.0000 | 3.9000e-004 | 1.0000e-004 | 0.0000 | 1.1000e-004 | 0.0000 | 0.3470 | 0.3470 | 2.0000e-005 | 0.0000 | 0.3475 |
| **Total** | **3.6000e-004** | **3.2000e-004** | **2.5500e-003** | **0.0000** | **3.9000e-004** | **0.0000** | **3.9000e-004** | **1.0000e-004** | **0.0000** | **1.1000e-004** | **0.0000** | **0.3470** | **0.3470** | **2.0000e-005** | **0.0000** | **0.3475** |

## 3.7 Architectural Coating - 2022

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Archit. Coating | 0.0433 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Off-Road | 1.0200e-003 | 7.0400e-003 | 9.0700e-003 | 1.0000e-005 | | 4.1000e-004 | 4.1000e-004 | | 4.1000e-004 | 4.1000e-004 | 0.0000 | 1.2766 | 1.2766 | 8.0000e-005 | 0.0000 | 1.2787 |
| **Total** | **0.0443** | **7.0400e-003** | **9.0700e-003** | **1.0000e-005** | | **4.1000e-004** | **4.1000e-004** | | **4.1000e-004** | **4.1000e-004** | **0.0000** | **1.2766** | **1.2766** | **8.0000e-005** | **0.0000** | **1.2787** |

## 3.7 Architectural Coating - 2022

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 2.7000e-004 | 2.3000e-004 | 1.7800e-003 | 0.0000 | 3.0000e-004 | 0.0000 | 3.0000e-004 | 8.0000e-005 | 0.0000 | 8.0000e-005 | 0.0000 | 0.2590 | 0.2590 | 2.0000e-005 | 0.0000 | 0.2594 |
| **Total** | **2.7000e-004** | **2.3000e-004** | **1.7800e-003** | **0.0000** | **3.0000e-004** | **0.0000** | **3.0000e-004** | **8.0000e-005** | **0.0000** | **8.0000e-005** | **0.0000** | **0.2590** | **0.2590** | **2.0000e-005** | **0.0000** | **0.2594** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Archit. Coating | 0.0433 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Off-Road | 1.0200e-003 | 7.0400e-003 | 9.0700e-003 | 1.0000e-005 | | 4.1000e-004 | 4.1000e-004 | | 4.1000e-004 | 4.1000e-004 | 0.0000 | 1.2766 | 1.2766 | 8.0000e-005 | 0.0000 | 1.2787 |
| **Total** | **0.0443** | **7.0400e-003** | **9.0700e-003** | **1.0000e-005** | | **4.1000e-004** | **4.1000e-004** | | **4.1000e-004** | **4.1000e-004** | **0.0000** | **1.2766** | **1.2766** | **8.0000e-005** | **0.0000** | **1.2787** |

## 3.7 Architectural Coating - 2022

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 2.7000e-004 | 2.3000e-004 | 1.7800e-003 | 0.0000 | 3.0000e-004 | 0.0000 | 3.0000e-004 | 8.0000e-005 | 0.0000 | 8.0000e-005 | 0.0000 | 0.2590 | 0.2590 | 2.0000e-005 | 0.0000 | 0.2594 |
| **Total** | **2.7000e-004** | **2.3000e-004** | **1.7800e-003** | **0.0000** | **3.0000e-004** | **0.0000** | **3.0000e-004** | **8.0000e-005** | **0.0000** | **8.0000e-005** | **0.0000** | **0.2590** | **0.2590** | **2.0000e-005** | **0.0000** | **0.2594** |

## 3.8 Trenching - 2021

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Off-Road | 0.0142 | 0.1368 | 0.1942 | 3.0000e-004 | | 7.0700e-003 | 7.0700e-003 | | 6.5000e-003 | 6.5000e-003 | 0.0000 | 26.0466 | 26.0466 | 8.4200e-003 | 0.0000 | 26.2572 |
| **Total** | **0.0142** | **0.1368** | **0.1942** | **3.0000e-004** | | **7.0700e-003** | **7.0700e-003** | | **6.5000e-003** | **6.5000e-003** | **0.0000** | **26.0466** | **26.0466** | **8.4200e-003** | **0.0000** | **26.2572** |

## 3.8 Trenching - 2021

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 1.9600e-003 | 1.7600e-003 | 0.0138 | 2.0000e-005 | 2.1100e-003 | 2.0000e-005 | 2.1300e-003 | 5.6000e-004 | 2.0000e-005 | 5.8000e-004 | 0.0000 | 1.8790 | 1.8790 | 1.2000e-004 | 0.0000 | 1.8820 |
| **Total** | **1.9600e-003** | **1.7600e-003** | **0.0138** | **2.0000e-005** | **2.1100e-003** | **2.0000e-005** | **2.1300e-003** | **5.6000e-004** | **2.0000e-005** | **5.8000e-004** | **0.0000** | **1.8790** | **1.8790** | **1.2000e-004** | **0.0000** | **1.8820** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Off-Road | 0.0142 | 0.1368 | 0.1942 | 3.0000e-004 | | 7.0700e-003 | 7.0700e-003 | | 6.5000e-003 | 6.5000e-003 | 0.0000 | 26.0466 | 26.0466 | 8.4200e-003 | 0.0000 | 26.2572 |
| **Total** | **0.0142** | **0.1368** | **0.1942** | **3.0000e-004** | | **7.0700e-003** | **7.0700e-003** | | **6.5000e-003** | **6.5000e-003** | **0.0000** | **26.0466** | **26.0466** | **8.4200e-003** | **0.0000** | **26.2572** |

### 3.8 Trenching - 2021

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 1.9600e-003 | 1.7600e-003 | 0.0138 | 2.0000e-005 | 2.1100e-003 | 2.0000e-005 | 2.1300e-003 | 5.6000e-004 | 2.0000e-005 | 5.8000e-004 | 0.0000 | 1.8790 | 1.8790 | 1.2000e-004 | 0.0000 | 1.8820 |
| **Total** | **1.9600e-003** | **1.7600e-003** | **0.0138** | **2.0000e-005** | **2.1100e-003** | **2.0000e-005** | **2.1300e-003** | **5.6000e-004** | **2.0000e-005** | **5.8000e-004** | **0.0000** | **1.8790** | **1.8790** | **1.2000e-004** | **0.0000** | **1.8820** |

## 4.0 Operational Detail - Mobile

### 4.1 Mitigation Measures Mobile

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Mitigated | 0.0154 | 0.0939 | 0.1964 | 4.9000e-004 | 0.0365 | 6.5000e-004 | 0.0372 | 9.8400e-003 | 6.1000e-004 | 0.0105 | 0.0000 | 44.6886 | 44.6886 | 2.2800e-003 | 0.0000 | 44.7455 |
| Unmitigated | 0.0154 | 0.0939 | 0.1964 | 4.9000e-004 | 0.0365 | 6.5000e-004 | 0.0372 | 9.8400e-003 | 6.1000e-004 | 0.0105 | 0.0000 | 44.6886 | 44.6886 | 2.2800e-003 | 0.0000 | 44.7455 |

## 4.2 Trip Summary Information

| | Average Daily Trip Rate | | | Unmitigated | Mitigated |
|---|---|---|---|---|---|
| Land Use | Weekday | Saturday | Sunday | Annual VMT | Annual VMT |
| General Heavy Industry | 25.88 | 25.88 | 25.88 | 99,967 | 99,967 |
| Other Asphalt Surfaces | 0.00 | 0.00 | 0.00 | | |
| Other Non-Asphalt Surfaces | 0.00 | 0.00 | 0.00 | | |
| Total | 25.88 | 25.88 | 25.88 | 99,967 | 99,967 |

## 4.3 Trip Type Information

| | Miles | | | Trip % | | | Trip Purpose % | | |
|---|---|---|---|---|---|---|---|---|---|
| Land Use | H-W or C-W | H-S or C-C | H-O or C-NW | H-W or C-W | H-S or C-C | H-O or C-NW | Primary | Diverted | Pass-by |
| General Heavy Industry | 14.70 | 6.60 | 6.60 | 59.00 | 28.00 | 13.00 | 92 | 5 | 3 |
| Other Asphalt Surfaces | 14.70 | 6.60 | 6.60 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| Other Non-Asphalt Surfaces | 14.70 | 6.60 | 6.60 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |

## 4.4 Fleet Mix

| Land Use | LDA | LDT1 | LDT2 | MDV | LHD1 | LHD2 | MHD | HHD | OBUS | UBUS | MCY | SBUS | MH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| General Heavy Industry | 0.489041 | 0.045286 | 0.209606 | 0.134980 | 0.040724 | 0.006674 | 0.014654 | 0.046205 | 0.003398 | 0.001529 | 0.005553 | 0.001505 | 0.000846 |
| Other Asphalt Surfaces | 0.489041 | 0.045286 | 0.209606 | 0.134980 | 0.040724 | 0.006674 | 0.014654 | 0.046205 | 0.003398 | 0.001529 | 0.005553 | 0.001505 | 0.000846 |
| Other Non-Asphalt Surfaces | 0.489041 | 0.045286 | 0.209606 | 0.134980 | 0.040724 | 0.006674 | 0.014654 | 0.046205 | 0.003398 | 0.001529 | 0.005553 | 0.001505 | 0.000846 |

## 5.0 Energy Detail

Historical Energy Use: N

### 5.1 Mitigation Measures Energy

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Electricity Mitigated | | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 21.4780 | 21.4780 | 9.7000e-004 | 2.0000e-004 | 21.5622 |
| Electricity Unmitigated | | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 21.4780 | 21.4780 | 9.7000e-004 | 2.0000e-004 | 21.5622 |
| NaturalGas Mitigated | 3.3000e-004 | 2.9700e-003 | 2.4900e-003 | 2.0000e-005 | | 2.3000e-004 | 2.3000e-004 | | 2.3000e-004 | 2.3000e-004 | 0.0000 | 3.2311 | 3.2311 | 6.0000e-005 | 6.0000e-005 | 3.2503 |
| NaturalGas Unmitigated | 3.3000e-004 | 2.9700e-003 | 2.4900e-003 | 2.0000e-005 | | 2.3000e-004 | 2.3000e-004 | | 2.3000e-004 | 2.3000e-004 | 0.0000 | 3.2311 | 3.2311 | 6.0000e-005 | 6.0000e-005 | 3.2503 |

## 5.2 Energy by Land Use - NaturalGas

### Unmitigated

| | NaturalGas Use | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land Use | kBTU/yr | tons/yr | | | | | | | | | | MT/yr | | | | | |
| General Heavy Industry | 60547.5 | 3.3000e-004 | 2.9700e-003 | 2.4900e-003 | 2.0000e-005 | | 2.3000e-004 | 2.3000e-004 | | 2.3000e-004 | 2.3000e-004 | 0.0000 | 3.2311 | 3.2311 | 6.0000e-005 | 6.0000e-005 | 3.2503 |
| Other Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **3.3000e-004** | **2.9700e-003** | **2.4900e-003** | **2.0000e-005** | | **2.3000e-004** | **2.3000e-004** | | **2.3000e-004** | **2.3000e-004** | **0.0000** | **3.2311** | **3.2311** | **6.0000e-005** | **6.0000e-005** | **3.2503** |

### Mitigated

| | NaturalGas Use | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land Use | kBTU/yr | tons/yr | | | | | | | | | | MT/yr | | | | | |
| General Heavy Industry | 60547.5 | 3.3000e-004 | 2.9700e-003 | 2.4900e-003 | 2.0000e-005 | | 2.3000e-004 | 2.3000e-004 | | 2.3000e-004 | 2.3000e-004 | 0.0000 | 3.2311 | 3.2311 | 6.0000e-005 | 6.0000e-005 | 3.2503 |
| Other Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **3.3000e-004** | **2.9700e-003** | **2.4900e-003** | **2.0000e-005** | | **2.3000e-004** | **2.3000e-004** | | **2.3000e-004** | **2.3000e-004** | **0.0000** | **3.2311** | **3.2311** | **6.0000e-005** | **6.0000e-005** | **3.2503** |

## 5.3 Energy by Land Use - Electricity

**Unmitigated**

| | Electricity Use | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|
| Land Use | kWh/yr | MT/yr | | | |
| General Heavy Industry | 73830 | 21.4780 | 9.7000e-004 | 2.0000e-004 | 21.5622 |
| Other Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **21.4780** | **9.7000e-004** | **2.0000e-004** | **21.5622** |

**Mitigated**

| | Electricity Use | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|
| Land Use | kWh/yr | MT/yr | | | |
| General Heavy Industry | 73830 | 21.4780 | 9.7000e-004 | 2.0000e-004 | 21.5622 |
| Other Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **21.4780** | **9.7000e-004** | **2.0000e-004** | **21.5622** |

## 6.0 Area Detail

## 6.1 Mitigation Measures Area

Use Low VOC Paint - Non-Residential Interior

Use Low VOC Paint - Non-Residential Exterior

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Mitigated | 0.0749 | 1.0000e-005 | 6.0000e-004 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 1.1700e-003 | 1.1700e-003 | 0.0000 | 0.0000 | 1.2400e-003 |
| Unmitigated | 0.0749 | 1.0000e-005 | 6.0000e-004 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 1.1700e-003 | 1.1700e-003 | 0.0000 | 0.0000 | 1.2400e-003 |

## 6.2 Area by SubCategory

**Unmitigated**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SubCategory | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Architectural Coating | 4.3300e-003 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Consumer Products | 0.0705 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Landscaping | 6.0000e-005 | 1.0000e-005 | 6.0000e-004 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 1.1700e-003 | 1.1700e-003 | 0.0000 | 0.0000 | 1.2400e-003 |
| **Total** | **0.0749** | **1.0000e-005** | **6.0000e-004** | **0.0000** | | **0.0000** | **0.0000** | | **0.0000** | **0.0000** | **0.0000** | **1.1700e-003** | **1.1700e-003** | **0.0000** | **0.0000** | **1.2400e-003** |

**Mitigated**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SubCategory | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Architectural Coating | 4.3300e-003 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Consumer Products | 0.0705 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Landscaping | 6.0000e-005 | 1.0000e-005 | 6.0000e-004 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 1.1700e-003 | 1.1700e-003 | 0.0000 | 0.0000 | 1.2400e-003 |
| **Total** | **0.0749** | **1.0000e-005** | **6.0000e-004** | **0.0000** | | **0.0000** | **0.0000** | | **0.0000** | **0.0000** | **0.0000** | **1.1700e-003** | **1.1700e-003** | **0.0000** | **0.0000** | **1.2400e-003** |

## 7.0 Water Detail

## 7.1 Mitigation Measures Water

| | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|
| Category | MT/yr | | | |
| Mitigated | 7.5448 | 0.1303 | 3.1300e-003 | 11.7336 |
| Unmitigated | 7.5448 | 0.1303 | 3.1300e-003 | 11.7336 |

## 7.2 Water by Land Use

**Unmitigated**

| | Indoor/Outdoor Use | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|
| Land Use | Mgal | MT/yr | | | |
| General Heavy Industry | 3.98906 / 0 | 7.5448 | 0.1303 | 3.1300e-003 | 11.7336 |
| Other Asphalt Surfaces | 0 / 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 / 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **7.5448** | **0.1303** | **3.1300e-003** | **11.7336** |

### 7.2 Water by Land Use

**Mitigated**

| | Indoor/Outdoor Use | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|
| Land Use | Mgal | MT/yr | | | |
| General Heavy Industry | 3.98906 / 0 | 7.5448 | 0.1303 | 3.1300e-003 | 11.7336 |
| Other Asphalt Surfaces | 0 / 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 / 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **7.5448** | **0.1303** | **3.1300e-003** | **11.7336** |

## 8.0 Waste Detail

### 8.1 Mitigation Measures Waste

**Category/Year**

| | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|
| | MT/yr | | | |
| Mitigated | 4.3420 | 0.2566 | 0.0000 | 10.7571 |
| Unmitigated | 4.3420 | 0.2566 | 0.0000 | 10.7571 |

## 8.2 Waste by Land Use

**Unmitigated**

| | Waste Disposed | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|
| Land Use | tons | MT/yr | | | |
| General Heavy Industry | 21.39 | 4.3420 | 0.2566 | 0.0000 | 10.7571 |
| Other Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **4.3420** | **0.2566** | **0.0000** | **10.7571** |

## 8.2 Waste by Land Use

**Mitigated**

| | Waste Disposed | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|
| Land Use | tons | MT/yr | | | |
| General Heavy Industry | 21.39 | 4.3420 | 0.2566 | 0.0000 | 10.7571 |
| Other Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **4.3420** | **0.2566** | **0.0000** | **10.7571** |

## 9.0 Operational Offroad

| Equipment Type | Number | Hours/Day | Days/Year | Horse Power | Load Factor | Fuel Type |
|---|---|---|---|---|---|---|

## 10.0 Stationary Equipment

**Fire Pumps and Emergency Generators**

| Equipment Type | Number | Hours/Day | Hours/Year | Horse Power | Load Factor | Fuel Type |
|---|---|---|---|---|---|---|

**Boilers**

| Equipment Type | Number | Heat Input/Day | Heat Input/Year | Boiler Rating | Fuel Type |
|---|---|---|---|---|---|

**User Defined Equipment**

| Equipment Type | Number |
|---|---|

## 11.0 Vegetation

# Arcata Wastewater Treatment Facility Project (Phase 2)

**Humboldt County, Annual**

## 1.0 Project Characteristics

### 1.1 Land Usage

| Land Uses | Size | Metric | Lot Acreage | Floor Surface Area | Population |
|---|---|---|---|---|---|
| General Heavy Industry | 24.72 | 1000sqft | 0.57 | 24,720.00 | 0 |
| Other Asphalt Surfaces | 49.50 | 1000sqft | 1.14 | 49,500.00 | 0 |
| Other Non-Asphalt Surfaces | 1.98 | 1000sqft | 0.05 | 1,980.00 | 0 |

### 1.2 Other Project Characteristics

| | | | | | |
|---|---|---|---|---|---|
| **Urbanization** | Rural | **Wind Speed (m/s)** | 2.2 | **Precipitation Freq (Days)** | 103 |
| **Climate Zone** | 1 | | | **Operational Year** | 2025 |
| **Utility Company** | Pacific Gas & Electric Company | | | | |
| **CO2 Intensity (lb/MWhr)** | 641.35 | **CH4 Intensity (lb/MWhr)** | 0.029 | **N2O Intensity (lb/MWhr)** | 0.006 |

### 1.3 User Entered Comments & Non-Default Data

Arcata Wastewater Treatment Facility Project (Phase 2) - Humboldt County, Annual

Project Characteristics -

Land Use - "General Heavy Industry" was used for buildings and equipment. "Other Asphalt Surfaces" was used for paving of access roads. "Other Non-Asphalt Surfaces" was used for ductbank construction.

Construction Phase - Construction schedule provided project engineer.

Off-road Equipment - Default equipment list for building construction supplemented by project engineer.

Off-road Equipment - Equipment list for trenching provided by project engineer.

Grading - It is assumed that the project site will be crossed over twice during grading and site preparation.

Demolition - Estimate of demolition debris provided by project engineer.

Architectural Coating - The project will use low VOC paint that is 50 g/L or less.

Area Coating - The project will use low VOC paint that is 50 g/L or less.

Construction Off-road Equipment Mitigation -

Area Mitigation -

| Table Name | Column Name | Default Value | New Value |
|---|---|---|---|
| tblArchitecturalCoating | EF_Nonresidential_Exterior | 250.00 | 50.00 |
| tblArchitecturalCoating | EF_Nonresidential_Interior | 250.00 | 50.00 |
| tblArchitecturalCoating | EF_Parking | 250.00 | 50.00 |
| tblAreaCoating | Area_EF_Nonresidential_Exterior | 250 | 50 |
| tblAreaCoating | Area_EF_Nonresidential_Interior | 250 | 50 |
| tblAreaCoating | Area_EF_Parking | 250 | 50 |
| tblAreaMitigation | UseLowVOCPaintParkingCheck | False | True |
| tblConstructionPhase | NumDays | 200.00 | 160.00 |
| tblConstructionPhase | NumDays | 20.00 | 10.00 |
| tblConstructionPhase | NumDays | 4.00 | 30.00 |
| tblConstructionPhase | NumDays | 10.00 | 5.00 |
| tblConstructionPhase | NumDays | 2.00 | 20.00 |
| tblConstructionPhase | PhaseEndDate | 3/10/2025 | 3/20/2025 |
| tblConstructionPhase | PhaseEndDate | 2/10/2025 | 3/7/2025 |

| | | | |
|---|---|---|---|
| tblConstructionPhase | PhaseEndDate | 4/26/2024 | 4/12/2024 |
| tblConstructionPhase | PhaseEndDate | 5/6/2024 | 6/19/2024 |
| tblConstructionPhase | PhaseEndDate | 2/24/2025 | 7/29/2024 |
| tblConstructionPhase | PhaseEndDate | 4/30/2024 | 5/9/2024 |
| tblConstructionPhase | PhaseStartDate | 2/25/2025 | 3/7/2025 |
| tblConstructionPhase | PhaseStartDate | 5/7/2024 | 7/29/2024 |
| tblConstructionPhase | PhaseStartDate | 5/1/2024 | 5/9/2024 |
| tblConstructionPhase | PhaseStartDate | 2/11/2025 | 7/23/2024 |
| tblConstructionPhase | PhaseStartDate | 4/27/2024 | 4/12/2024 |
| tblGrading | AcresOfGrading | 11.25 | 3.90 |
| tblGrading | AcresOfGrading | 10.00 | 2.10 |
| tblGrading | MaterialExported | 0.00 | 20,000.00 |
| tblGrading | MaterialImported | 0.00 | 3,350.00 |
| tblOffRoadEquipment | LoadFactor | 0.37 | 0.37 |
| tblOffRoadEquipment | LoadFactor | 0.38 | 0.38 |
| tblOffRoadEquipment | OffRoadEquipmentType | | Bore/Drill Rigs |
| tblOffRoadEquipment | OffRoadEquipmentType | | Tractors/Loaders/Backhoes |
| tblOffRoadEquipment | OffRoadEquipmentType | | Excavators |
| tblOffRoadEquipment | OffRoadEquipmentUnitAmount | 1.00 | 2.00 |
| tblProjectCharacteristics | UrbanizationLevel | Urban | Rural |

## 2.0 Emissions Summary

## 2.1 Overall Construction

### Unmitigated Construction

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | tons/yr | | | | | | | | | | MT/yr | | | | | |
| 2024 | 0.1740 | 1.5686 | 1.4016 | 3.9400e-003 | 0.1766 | 0.0522 | 0.2288 | 0.0807 | 0.0492 | 0.1299 | 0.0000 | 347.4122 | 347.4122 | 0.0581 | 0.0000 | 348.8638 |
| 2025 | 0.1111 | 0.3763 | 0.4246 | 9.7000e-004 | 0.0112 | 0.0133 | 0.0246 | 3.0300e-003 | 0.0127 | 0.0157 | 0.0000 | 83.2254 | 83.2254 | 0.0156 | 0.0000 | 83.6151 |
| **Maximum** | **0.1740** | **1.5686** | **1.4016** | **3.9400e-003** | **0.1766** | **0.0522** | **0.2288** | **0.0807** | **0.0492** | **0.1299** | **0.0000** | **347.4122** | **347.4122** | **0.0581** | **0.0000** | **348.8638** |

### Mitigated Construction

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | tons/yr | | | | | | | | | | MT/yr | | | | | |
| 2024 | 0.1740 | 1.5686 | 1.4016 | 3.9400e-003 | 0.1074 | 0.0522 | 0.1596 | 0.0439 | 0.0492 | 0.0931 | 0.0000 | 347.4119 | 347.4119 | 0.0581 | 0.0000 | 348.8636 |
| 2025 | 0.1111 | 0.3763 | 0.4246 | 9.7000e-004 | 0.0112 | 0.0133 | 0.0246 | 3.0300e-003 | 0.0127 | 0.0157 | 0.0000 | 83.2253 | 83.2253 | 0.0156 | 0.0000 | 83.6150 |
| **Maximum** | **0.1740** | **1.5686** | **1.4016** | **3.9400e-003** | **0.1074** | **0.0522** | **0.1596** | **0.0439** | **0.0492** | **0.0931** | **0.0000** | **347.4119** | **347.4119** | **0.0581** | **0.0000** | **348.8636** |

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio-CO2 | Total CO2 | CH4 | N20 | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Percent Reduction** | **0.00** | **0.00** | **0.00** | **0.00** | **36.84** | **0.00** | **27.31** | **43.94** | **0.00** | **25.25** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |

| Quarter | Start Date | End Date | Maximum Unmitigated ROG + NOX (tons/quarter) | Maximum Mitigated ROG + NOX (tons/quarter) |
|---|---|---|---|---|
| 1 | 4-1-2024 | 6-30-2024 | 0.6319 | 0.6319 |
| 2 | 7-1-2024 | 9-30-2024 | 0.4819 | 0.4819 |
| 3 | 10-1-2024 | 12-31-2024 | 0.6128 | 0.6128 |
| 4 | 1-1-2025 | 3-31-2025 | 0.4816 | 0.4816 |
| | | Highest | 0.6319 | 0.6319 |

## 2.2 Overall Operational

### Unmitigated Operational

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Area | 0.1060 | 1.0000e-005 | 7.0000e-004 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 1.3600e-003 | 1.3600e-003 | 0.0000 | 0.0000 | 1.4500e-003 |
| Energy | 4.7000e-004 | 4.2500e-003 | 3.5700e-003 | 3.0000e-005 | | 3.2000e-004 | 3.2000e-004 | | 3.2000e-004 | 3.2000e-004 | 0.0000 | 35.4091 | 35.4091 | 1.4800e-003 | 3.7000e-004 | 35.5572 |
| Mobile | 0.0172 | 0.0969 | 0.2170 | 6.4000e-004 | 0.0522 | 6.3000e-004 | 0.0528 | 0.0141 | 5.9000e-004 | 0.0146 | 0.0000 | 58.4856 | 58.4856 | 2.4200e-003 | 0.0000 | 58.5460 |
| Waste | | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 6.2217 | 0.0000 | 6.2217 | 0.3677 | 0.0000 | 15.4139 |
| Water | | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 1.8136 | 8.9985 | 10.8121 | 0.1867 | 4.4800e-003 | 16.8148 |
| **Total** | **0.1237** | **0.1012** | **0.2213** | **6.7000e-004** | **0.0522** | **9.5000e-004** | **0.0532** | **0.0141** | **9.1000e-004** | **0.0150** | **8.0353** | **102.8945** | **110.9298** | **0.5583** | **4.8500e-003** | **126.3335** |

## 2.2 Overall Operational

**Mitigated Operational**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Area | 0.1060 | 1.0000e-005 | 7.0000e-004 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 1.3600e-003 | 1.3600e-003 | 0.0000 | 0.0000 | 1.4500e-003 |
| Energy | 4.7000e-004 | 4.2500e-003 | 3.5700e-003 | 3.0000e-005 | | 3.2000e-004 | 3.2000e-004 | | 3.2000e-004 | 3.2000e-004 | 0.0000 | 35.4091 | 35.4091 | 1.4800e-003 | 3.7000e-004 | 35.5572 |
| Mobile | 0.0172 | 0.0969 | 0.2170 | 6.4000e-004 | 0.0522 | 6.3000e-004 | 0.0528 | 0.0141 | 5.9000e-004 | 0.0146 | 0.0000 | 58.4856 | 58.4856 | 2.4200e-003 | 0.0000 | 58.5460 |
| Waste | | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 6.2217 | 0.0000 | 6.2217 | 0.3677 | 0.0000 | 15.4139 |
| Water | | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 1.8136 | 8.9985 | 10.8121 | 0.1867 | 4.4800e-003 | 16.8148 |
| **Total** | **0.1237** | **0.1012** | **0.2213** | **6.7000e-004** | **0.0522** | **9.5000e-004** | **0.0532** | **0.0141** | **9.1000e-004** | **0.0150** | **8.0353** | **102.8945** | **110.9298** | **0.5583** | **4.8500e-003** | **126.3335** |

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio-CO2 | Total CO2 | CH4 | N20 | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Percent Reduction** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |

## 3.0 Construction Detail

**Construction Phase**

Arcata Wastewater Treatment Facility Project (Phase 2) - Humboldt County, Annual

| Phase Number | Phase Name | Phase Type | Start Date | End Date | Num Days Week | Num Days | Phase Description |
|---|---|---|---|---|---|---|---|
| 1 | Demolition | Demolition | 4/1/2024 | 4/12/2024 | 5 | 10 | |
| 2 | Site Preparation | Site Preparation | 4/12/2024 | 5/9/2024 | 5 | 20 | |
| 3 | Grading | Grading | 5/9/2024 | 6/19/2024 | 5 | 30 | |
| 4 | Building Construction | Building Construction | 7/29/2024 | 3/7/2025 | 5 | 160 | |
| 5 | Paving | Paving | 7/23/2024 | 7/29/2024 | 5 | 5 | |
| 6 | Architectural Coating | Architectural Coating | 3/7/2025 | 3/20/2025 | 5 | 10 | |
| 7 | Trenching | Trenching | 6/19/2024 | 7/23/2024 | 5 | 25 | |

**Acres of Grading (Site Preparation Phase): 2.1**

**Acres of Grading (Grading Phase): 3.9**

**Acres of Paving: 1.19**

**Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 37,080; Non-Residential Outdoor: 12,360; Striped Parking Area: 3,089 (Architectural Coating – sqft)**

**OffRoad Equipment**

Arcata Wastewater Treatment Facility Project (Phase 2) - Humboldt County, Annual

| Phase Name | Offroad Equipment Type | Amount | Usage Hours | Horse Power | Load Factor |
|---|---|---|---|---|---|
| Architectural Coating | Air Compressors | 1 | 6.00 | 78 | 0.48 |
| Paving | Cement and Mortar Mixers | 1 | 6.00 | 9 | 0.56 |
| Demolition | Concrete/Industrial Saws | 1 | 8.00 | 81 | 0.73 |
| Building Construction | Generator Sets | 1 | 8.00 | 84 | 0.74 |
| Building Construction | Cranes | 2 | 6.00 | 231 | 0.29 |
| Building Construction | Forklifts | 1 | 6.00 | 89 | 0.20 |
| Site Preparation | Graders | 1 | 8.00 | 187 | 0.41 |
| Paving | Pavers | 1 | 6.00 | 130 | 0.42 |
| Paving | Rollers | 1 | 7.00 | 80 | 0.38 |
| Demolition | Rubber Tired Dozers | 1 | 8.00 | 247 | 0.40 |
| Grading | Rubber Tired Dozers | 1 | 6.00 | 247 | 0.40 |
| Building Construction | Tractors/Loaders/Backhoes | 1 | 6.00 | 97 | 0.37 |
| Demolition | Tractors/Loaders/Backhoes | 3 | 8.00 | 97 | 0.37 |
| Grading | Tractors/Loaders/Backhoes | 1 | 7.00 | 97 | 0.37 |
| Paving | Tractors/Loaders/Backhoes | 1 | 8.00 | 97 | 0.37 |
| Site Preparation | Tractors/Loaders/Backhoes | 1 | 8.00 | 97 | 0.37 |
| Grading | Graders | 1 | 6.00 | 187 | 0.41 |
| Paving | Paving Equipment | 1 | 8.00 | 132 | 0.36 |
| Site Preparation | Rubber Tired Dozers | 1 | 7.00 | 247 | 0.40 |
| Building Construction | Welders | 3 | 8.00 | 46 | 0.45 |
| Building Construction | Bore/Drill Rigs | 1 | 6.00 | 221 | 0.50 |
| Trenching | Tractors/Loaders/Backhoes | 1 | 8.00 | 97 | 0.37 |
| Trenching | Excavators | 2 | 8.00 | 158 | 0.38 |

**Trips and VMT**

| Phase Name | Offroad Equipment Count | Worker Trip Number | Vendor Trip Number | Hauling Trip Number | Worker Trip Length | Vendor Trip Length | Hauling Trip Length | Worker Vehicle Class | Vendor Vehicle Class | Hauling Vehicle Class |
|---|---|---|---|---|---|---|---|---|---|---|
| Demolition | 5 | 13.00 | 0.00 | 8.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Site Preparation | 3 | 8.00 | 0.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Grading | 3 | 8.00 | 0.00 | 2,500.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Building Construction | 9 | 32.00 | 12.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Paving | 5 | 13.00 | 0.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Architectural Coating | 1 | 6.00 | 0.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |
| Trenching | 3 | 8.00 | 0.00 | 0.00 | 16.80 | 6.60 | 20.00 | LD_Mix | HDT_Mix | HHDT |

## 3.1 Mitigation Measures Construction

Water Exposed Area

## 3.2 Demolition - 2024

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Fugitive Dust | | | | | 8.6000e-004 | 0.0000 | 8.6000e-004 | 1.3000e-004 | 0.0000 | 1.3000e-004 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Off-Road | 7.2000e-003 | 0.0694 | 0.0674 | 1.2000e-004 | | 3.1600e-003 | 3.1600e-003 | | 2.9500e-003 | 2.9500e-003 | 0.0000 | 10.5458 | 10.5458 | 2.6700e-003 | 0.0000 | 10.6125 |
| **Total** | **7.2000e-003** | **0.0694** | **0.0674** | **1.2000e-004** | **8.6000e-004** | **3.1600e-003** | **4.0200e-003** | **1.3000e-004** | **2.9500e-003** | **3.0800e-003** | **0.0000** | **10.5458** | **10.5458** | **2.6700e-003** | **0.0000** | **10.6125** |

## 3.2 Demolition - 2024

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 2.0000e-005 | 7.8000e-004 | 1.6000e-004 | 0.0000 | 7.0000e-005 | 0.0000 | 7.0000e-005 | 2.0000e-005 | 0.0000 | 2.0000e-005 | 0.0000 | 0.2881 | 0.2881 | 1.0000e-005 | 0.0000 | 0.2883 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 6.3000e-004 | 4.9000e-004 | 3.7700e-003 | 1.0000e-005 | 7.8000e-004 | 1.0000e-005 | 7.9000e-004 | 2.1000e-004 | 1.0000e-005 | 2.1000e-004 | 0.0000 | 0.6306 | 0.6306 | 3.0000e-005 | 0.0000 | 0.6314 |
| **Total** | **6.5000e-004** | **1.2700e-003** | **3.9300e-003** | **1.0000e-005** | **8.5000e-004** | **1.0000e-005** | **8.6000e-004** | **2.3000e-004** | **1.0000e-005** | **2.3000e-004** | **0.0000** | **0.9187** | **0.9187** | **4.0000e-005** | **0.0000** | **0.9197** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Fugitive Dust | | | | | 3.9000e-004 | 0.0000 | 3.9000e-004 | 6.0000e-005 | 0.0000 | 6.0000e-005 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Off-Road | 7.2000e-003 | 0.0694 | 0.0674 | 1.2000e-004 | | 3.1600e-003 | 3.1600e-003 | | 2.9500e-003 | 2.9500e-003 | 0.0000 | 10.5458 | 10.5458 | 2.6700e-003 | 0.0000 | 10.6125 |
| **Total** | **7.2000e-003** | **0.0694** | **0.0674** | **1.2000e-004** | **3.9000e-004** | **3.1600e-003** | **3.5500e-003** | **6.0000e-005** | **2.9500e-003** | **3.0100e-003** | **0.0000** | **10.5458** | **10.5458** | **2.6700e-003** | **0.0000** | **10.6125** |

## 3.2 Demolition - 2024

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 2.0000e-005 | 7.8000e-004 | 1.6000e-004 | 0.0000 | 7.0000e-005 | 0.0000 | 7.0000e-005 | 2.0000e-005 | 0.0000 | 2.0000e-005 | 0.0000 | 0.2881 | 0.2881 | 1.0000e-005 | 0.0000 | 0.2883 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 6.3000e-004 | 4.9000e-004 | 3.7700e-003 | 1.0000e-005 | 7.8000e-004 | 1.0000e-005 | 7.9000e-004 | 2.1000e-004 | 1.0000e-005 | 2.1000e-004 | 0.0000 | 0.6306 | 0.6306 | 3.0000e-005 | 0.0000 | 0.6314 |
| **Total** | **6.5000e-004** | **1.2700e-003** | **3.9300e-003** | **1.0000e-005** | **8.5000e-004** | **1.0000e-005** | **8.6000e-004** | **2.3000e-004** | **1.0000e-005** | **2.3000e-004** | **0.0000** | **0.9187** | **0.9187** | **4.0000e-005** | **0.0000** | **0.9197** |

## 3.3 Site Preparation - 2024

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Fugitive Dust | | | | | 0.0538 | 0.0000 | 0.0538 | 0.0291 | 0.0000 | 0.0291 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Off-Road | 0.0111 | 0.1184 | 0.0663 | 1.7000e-004 | | 4.8200e-003 | 4.8200e-003 | | 4.4400e-003 | 4.4400e-003 | 0.0000 | 15.1126 | 15.1126 | 4.8900e-003 | 0.0000 | 15.2348 |
| **Total** | **0.0111** | **0.1184** | **0.0663** | **1.7000e-004** | **0.0538** | **4.8200e-003** | **0.0586** | **0.0291** | **4.4400e-003** | **0.0335** | **0.0000** | **15.1126** | **15.1126** | **4.8900e-003** | **0.0000** | **15.2348** |

## 3.3 Site Preparation - 2024

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 7.8000e-004 | 6.0000e-004 | 4.6400e-003 | 1.0000e-005 | 9.6000e-004 | 1.0000e-005 | 9.7000e-004 | 2.6000e-004 | 1.0000e-005 | 2.6000e-004 | 0.0000 | 0.7761 | 0.7761 | 4.0000e-005 | 0.0000 | 0.7771 |
| **Total** | **7.8000e-004** | **6.0000e-004** | **4.6400e-003** | **1.0000e-005** | **9.6000e-004** | **1.0000e-005** | **9.7000e-004** | **2.6000e-004** | **1.0000e-005** | **2.6000e-004** | **0.0000** | **0.7761** | **0.7761** | **4.0000e-005** | **0.0000** | **0.7771** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Fugitive Dust | | | | | 0.0242 | 0.0000 | 0.0242 | 0.0131 | 0.0000 | 0.0131 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Off-Road | 0.0111 | 0.1184 | 0.0663 | 1.7000e-004 | | 4.8200e-003 | 4.8200e-003 | | 4.4400e-003 | 4.4400e-003 | 0.0000 | 15.1126 | 15.1126 | 4.8900e-003 | 0.0000 | 15.2348 |
| **Total** | **0.0111** | **0.1184** | **0.0663** | **1.7000e-004** | **0.0242** | **4.8200e-003** | **0.0290** | **0.0131** | **4.4400e-003** | **0.0175** | **0.0000** | **15.1126** | **15.1126** | **4.8900e-003** | **0.0000** | **15.2348** |

## 3.3 Site Preparation - 2024

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 7.8000e-004 | 6.0000e-004 | 4.6400e-003 | 1.0000e-005 | 9.6000e-004 | 1.0000e-005 | 9.7000e-004 | 2.6000e-004 | 1.0000e-005 | 2.6000e-004 | 0.0000 | 0.7761 | 0.7761 | 4.0000e-005 | 0.0000 | 0.7771 |
| **Total** | **7.8000e-004** | **6.0000e-004** | **4.6400e-003** | **1.0000e-005** | **9.6000e-004** | **1.0000e-005** | **9.7000e-004** | **2.6000e-004** | **1.0000e-005** | **2.6000e-004** | **0.0000** | **0.7761** | **0.7761** | **4.0000e-005** | **0.0000** | **0.7771** |

## 3.4 Grading - 2024

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Fugitive Dust | | | | | 0.0711 | 0.0000 | 0.0711 | 0.0377 | 0.0000 | 0.0377 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Off-Road | 0.0137 | 0.1460 | 0.0832 | 2.1000e-004 | | 6.0000e-003 | 6.0000e-003 | | 5.5200e-003 | 5.5200e-003 | 0.0000 | 18.5700 | 18.5700 | 6.0100e-003 | 0.0000 | 18.7202 |
| **Total** | **0.0137** | **0.1460** | **0.0832** | **2.1000e-004** | **0.0711** | **6.0000e-003** | **0.0771** | **0.0377** | **5.5200e-003** | **0.0432** | **0.0000** | **18.5700** | **18.5700** | **6.0100e-003** | **0.0000** | **18.7202** |

## 3.4 Grading - 2024

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 7.1000e-003 | 0.2446 | 0.0486 | 9.5000e-004 | 0.0206 | 6.5000e-004 | 0.0212 | 5.6600e-003 | 6.3000e-004 | 6.2900e-003 | 0.0000 | 90.0422 | 90.0422 | 1.9700e-003 | 0.0000 | 90.0915 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 1.1600e-003 | 9.0000e-004 | 6.9600e-003 | 1.0000e-005 | 1.4400e-003 | 1.0000e-005 | 1.4500e-003 | 3.8000e-004 | 1.0000e-005 | 3.9000e-004 | 0.0000 | 1.1642 | 1.1642 | 6.0000e-005 | 0.0000 | 1.1657 |
| **Total** | **8.2600e-003** | **0.2455** | **0.0555** | **9.6000e-004** | **0.0220** | **6.6000e-004** | **0.0227** | **6.0400e-003** | **6.4000e-004** | **6.6800e-003** | **0.0000** | **91.2064** | **91.2064** | **2.0300e-003** | **0.0000** | **91.2571** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Fugitive Dust | | | | | 0.0320 | 0.0000 | 0.0320 | 0.0170 | 0.0000 | 0.0170 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Off-Road | 0.0137 | 0.1460 | 0.0832 | 2.1000e-004 | | 6.0000e-003 | 6.0000e-003 | | 5.5200e-003 | 5.5200e-003 | 0.0000 | 18.5700 | 18.5700 | 6.0100e-003 | 0.0000 | 18.7201 |
| **Total** | **0.0137** | **0.1460** | **0.0832** | **2.1000e-004** | **0.0320** | **6.0000e-003** | **0.0380** | **0.0170** | **5.5200e-003** | **0.0225** | **0.0000** | **18.5700** | **18.5700** | **6.0100e-003** | **0.0000** | **18.7201** |

## 3.4 Grading - 2024

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 7.1000e-003 | 0.2446 | 0.0486 | 9.5000e-004 | 0.0206 | 6.5000e-004 | 0.0212 | 5.6600e-003 | 6.3000e-004 | 6.2900e-003 | 0.0000 | 90.0422 | 90.0422 | 1.9700e-003 | 0.0000 | 90.0915 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 1.1600e-003 | 9.0000e-004 | 6.9600e-003 | 1.0000e-005 | 1.4400e-003 | 1.0000e-005 | 1.4500e-003 | 3.8000e-004 | 1.0000e-005 | 3.9000e-004 | 0.0000 | 1.1642 | 1.1642 | 6.0000e-005 | 0.0000 | 1.1657 |
| **Total** | **8.2600e-003** | **0.2455** | **0.0555** | **9.6000e-004** | **0.0220** | **6.6000e-004** | **0.0227** | **6.0400e-003** | **6.4000e-004** | **6.6800e-003** | **0.0000** | **91.2064** | **91.2064** | **2.0300e-003** | **0.0000** | **91.2571** |

## 3.5 Building Construction - 2024

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Off-Road | 0.1023 | 0.8466 | 0.8611 | 1.8800e-003 | | 0.0340 | 0.0340 | | 0.0324 | 0.0324 | 0.0000 | 157.9470 | 157.9470 | 0.0351 | 0.0000 | 158.8252 |
| **Total** | **0.1023** | **0.8466** | **0.8611** | **1.8800e-003** | | **0.0340** | **0.0340** | | **0.0324** | **0.0324** | **0.0000** | **157.9470** | **157.9470** | **0.0351** | **0.0000** | **158.8252** |

## 3.5 Building Construction - 2024

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 2.0600e-003 | 0.0586 | 0.0159 | 1.7000e-004 | 3.9000e-003 | 1.0000e-004 | 4.0000e-003 | 1.1300e-003 | 9.0000e-005 | 1.2200e-003 | 0.0000 | 15.9111 | 15.9111 | 5.9000e-004 | 0.0000 | 15.9257 |
| Worker | 0.0174 | 0.0134 | 0.1039 | 1.9000e-004 | 0.0215 | 1.7000e-004 | 0.0217 | 5.7300e-003 | 1.6000e-004 | 5.8800e-003 | 0.0000 | 17.3849 | 17.3849 | 8.9000e-004 | 0.0000 | 17.4071 |
| **Total** | **0.0194** | **0.0720** | **0.1198** | **3.6000e-004** | **0.0254** | **2.7000e-004** | **0.0257** | **6.8600e-003** | **2.5000e-004** | **7.1000e-003** | **0.0000** | **33.2960** | **33.2960** | **1.4800e-003** | **0.0000** | **33.3329** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Off-Road | 0.1023 | 0.8466 | 0.8611 | 1.8800e-003 | | 0.0340 | 0.0340 | | 0.0324 | 0.0324 | 0.0000 | 157.9468 | 157.9468 | 0.0351 | 0.0000 | 158.8250 |
| **Total** | **0.1023** | **0.8466** | **0.8611** | **1.8800e-003** | | **0.0340** | **0.0340** | | **0.0324** | **0.0324** | **0.0000** | **157.9468** | **157.9468** | **0.0351** | **0.0000** | **158.8250** |

## 3.5 Building Construction - 2024

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 2.0600e-003 | 0.0586 | 0.0159 | 1.7000e-004 | 3.9000e-003 | 1.0000e-004 | 4.0000e-003 | 1.1300e-003 | 9.0000e-005 | 1.2200e-003 | 0.0000 | 15.9111 | 15.9111 | 5.9000e-004 | 0.0000 | 15.9257 |
| Worker | 0.0174 | 0.0134 | 0.1039 | 1.9000e-004 | 0.0215 | 1.7000e-004 | 0.0217 | 5.7300e-003 | 1.6000e-004 | 5.8800e-003 | 0.0000 | 17.3849 | 17.3849 | 8.9000e-004 | 0.0000 | 17.4071 |
| **Total** | **0.0194** | **0.0720** | **0.1198** | **3.6000e-004** | **0.0254** | **2.7000e-004** | **0.0257** | **6.8600e-003** | **2.5000e-004** | **7.1000e-003** | **0.0000** | **33.2960** | **33.2960** | **1.4800e-003** | **0.0000** | **33.3329** |

## 3.5 Building Construction - 2025

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Off-Road | 0.0412 | 0.3405 | 0.3665 | 8.0000e-004 | | 0.0130 | 0.0130 | | 0.0123 | 0.0123 | 0.0000 | 67.6951 | 67.6951 | 0.0149 | 0.0000 | 68.0679 |
| **Total** | **0.0412** | **0.3405** | **0.3665** | **8.0000e-004** | | **0.0130** | **0.0130** | | **0.0123** | **0.0123** | **0.0000** | **67.6951** | **67.6951** | **0.0149** | **0.0000** | **68.0679** |

## 3.5 Building Construction - 2025

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 8.4000e-004 | 0.0246 | 6.4100e-003 | 7.0000e-005 | 1.6700e-003 | 4.0000e-005 | 1.7100e-003 | 4.8000e-004 | 4.0000e-005 | 5.2000e-004 | 0.0000 | 6.7777 | 6.7777 | 2.5000e-004 | 0.0000 | 6.7838 |
| Worker | 7.0800e-003 | 5.2500e-003 | 0.0411 | 8.0000e-005 | 9.2100e-003 | 7.0000e-005 | 9.2800e-003 | 2.4500e-003 | 6.0000e-005 | 2.5200e-003 | 0.0000 | 7.1950 | 7.1950 | 3.5000e-004 | 0.0000 | 7.2036 |
| **Total** | **7.9200e-003** | **0.0298** | **0.0475** | **1.5000e-004** | **0.0109** | **1.1000e-004** | **0.0110** | **2.9300e-003** | **1.0000e-004** | **3.0400e-003** | **0.0000** | **13.9727** | **13.9727** | **6.0000e-004** | **0.0000** | **13.9874** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Off-Road | 0.0412 | 0.3405 | 0.3665 | 8.0000e-004 | | 0.0130 | 0.0130 | | 0.0123 | 0.0123 | 0.0000 | 67.6950 | 67.6950 | 0.0149 | 0.0000 | 68.0678 |
| **Total** | **0.0412** | **0.3405** | **0.3665** | **8.0000e-004** | | **0.0130** | **0.0130** | | **0.0123** | **0.0123** | **0.0000** | **67.6950** | **67.6950** | **0.0149** | **0.0000** | **68.0678** |

## 3.5 Building Construction - 2025

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 8.4000e-004 | 0.0246 | 6.4100e-003 | 7.0000e-005 | 1.6700e-003 | 4.0000e-005 | 1.7100e-003 | 4.8000e-004 | 4.0000e-005 | 5.2000e-004 | 0.0000 | 6.7777 | 6.7777 | 2.5000e-004 | 0.0000 | 6.7838 |
| Worker | 7.0800e-003 | 5.2500e-003 | 0.0411 | 8.0000e-005 | 9.2100e-003 | 7.0000e-005 | 9.2800e-003 | 2.4500e-003 | 6.0000e-005 | 2.5200e-003 | 0.0000 | 7.1950 | 7.1950 | 3.5000e-004 | 0.0000 | 7.2036 |
| **Total** | **7.9200e-003** | **0.0298** | **0.0475** | **1.5000e-004** | **0.0109** | **1.1000e-004** | **0.0110** | **2.9300e-003** | **1.0000e-004** | **3.0400e-003** | **0.0000** | **13.9727** | **13.9727** | **6.0000e-004** | **0.0000** | **13.9874** |

## 3.6 Paving - 2024

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Off-Road | 1.5400e-003 | 0.0147 | 0.0221 | 3.0000e-005 | | 7.0000e-004 | 7.0000e-004 | | 6.5000e-004 | 6.5000e-004 | 0.0000 | 2.9435 | 2.9435 | 9.3000e-004 | 0.0000 | 2.9669 |
| Paving | 1.4900e-003 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | **3.0300e-003** | **0.0147** | **0.0221** | **3.0000e-005** | | **7.0000e-004** | **7.0000e-004** | | **6.5000e-004** | **6.5000e-004** | **0.0000** | **2.9435** | **2.9435** | **9.3000e-004** | **0.0000** | **2.9669** |

## 3.6 Paving - 2024

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 3.1000e-004 | 2.4000e-004 | 1.8800e-003 | 0.0000 | 3.9000e-004 | 0.0000 | 3.9000e-004 | 1.0000e-004 | 0.0000 | 1.1000e-004 | 0.0000 | 0.3153 | 0.3153 | 2.0000e-005 | 0.0000 | 0.3157 |
| **Total** | **3.1000e-004** | **2.4000e-004** | **1.8800e-003** | **0.0000** | **3.9000e-004** | **0.0000** | **3.9000e-004** | **1.0000e-004** | **0.0000** | **1.1000e-004** | **0.0000** | **0.3153** | **0.3153** | **2.0000e-005** | **0.0000** | **0.3157** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Off-Road | 1.5400e-003 | 0.0147 | 0.0221 | 3.0000e-005 | | 7.0000e-004 | 7.0000e-004 | | 6.5000e-004 | 6.5000e-004 | 0.0000 | 2.9435 | 2.9435 | 9.3000e-004 | 0.0000 | 2.9668 |
| Paving | 1.4900e-003 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | **3.0300e-003** | **0.0147** | **0.0221** | **3.0000e-005** | | **7.0000e-004** | **7.0000e-004** | | **6.5000e-004** | **6.5000e-004** | **0.0000** | **2.9435** | **2.9435** | **9.3000e-004** | **0.0000** | **2.9668** |

## 3.6 Paving - 2024

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 3.1000e-004 | 2.4000e-004 | 1.8800e-003 | 0.0000 | 3.9000e-004 | 0.0000 | 3.9000e-004 | 1.0000e-004 | 0.0000 | 1.1000e-004 | 0.0000 | 0.3153 | 0.3153 | 2.0000e-005 | 0.0000 | 0.3157 |
| **Total** | **3.1000e-004** | **2.4000e-004** | **1.8800e-003** | **0.0000** | **3.9000e-004** | **0.0000** | **3.9000e-004** | **1.0000e-004** | **0.0000** | **1.1000e-004** | **0.0000** | **0.3153** | **0.3153** | **2.0000e-005** | **0.0000** | **0.3157** |

## 3.7 Architectural Coating - 2025

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Archit. Coating | 0.0609 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Off-Road | 8.5000e-004 | 5.7300e-003 | 9.0500e-003 | 1.0000e-005 | | 2.6000e-004 | 2.6000e-004 | | 2.6000e-004 | 2.6000e-004 | 0.0000 | 1.2766 | 1.2766 | 7.0000e-005 | 0.0000 | 1.2784 |
| **Total** | **0.0617** | **5.7300e-003** | **9.0500e-003** | **1.0000e-005** | | **2.6000e-004** | **2.6000e-004** | | **2.6000e-004** | **2.6000e-004** | **0.0000** | **1.2766** | **1.2766** | **7.0000e-005** | **0.0000** | **1.2784** |

## 3.7 Architectural Coating - 2025

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 2.8000e-004 | 2.1000e-004 | 1.6000e-003 | 0.0000 | 3.6000e-004 | 0.0000 | 3.6000e-004 | 1.0000e-004 | 0.0000 | 1.0000e-004 | 0.0000 | 0.2811 | 0.2811 | 1.0000e-005 | 0.0000 | 0.2814 |
| **Total** | **2.8000e-004** | **2.1000e-004** | **1.6000e-003** | **0.0000** | **3.6000e-004** | **0.0000** | **3.6000e-004** | **1.0000e-004** | **0.0000** | **1.0000e-004** | **0.0000** | **0.2811** | **0.2811** | **1.0000e-005** | **0.0000** | **0.2814** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Archit. Coating | 0.0609 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Off-Road | 8.5000e-004 | 5.7300e-003 | 9.0500e-003 | 1.0000e-005 | | 2.6000e-004 | 2.6000e-004 | | 2.6000e-004 | 2.6000e-004 | 0.0000 | 1.2766 | 1.2766 | 7.0000e-005 | 0.0000 | 1.2784 |
| **Total** | **0.0617** | **5.7300e-003** | **9.0500e-003** | **1.0000e-005** | | **2.6000e-004** | **2.6000e-004** | | **2.6000e-004** | **2.6000e-004** | **0.0000** | **1.2766** | **1.2766** | **7.0000e-005** | **0.0000** | **1.2784** |

## 3.7 Architectural Coating - 2025

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 2.8000e-004 | 2.1000e-004 | 1.6000e-003 | 0.0000 | 3.6000e-004 | 0.0000 | 3.6000e-004 | 1.0000e-004 | 0.0000 | 1.0000e-004 | 0.0000 | 0.2811 | 0.2811 | 1.0000e-005 | 0.0000 | 0.2814 |
| **Total** | **2.8000e-004** | **2.1000e-004** | **1.6000e-003** | **0.0000** | **3.6000e-004** | **0.0000** | **3.6000e-004** | **1.0000e-004** | **0.0000** | **1.0000e-004** | **0.0000** | **0.2811** | **0.2811** | **1.0000e-005** | **0.0000** | **0.2814** |

## 3.8 Trenching - 2024

**Unmitigated Construction On-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Off-Road | 6.3200e-003 | 0.0533 | 0.1099 | 1.7000e-004 | | 2.5600e-003 | 2.5600e-003 | | 2.3600e-003 | 2.3600e-003 | 0.0000 | 14.8107 | 14.8107 | 4.7900e-003 | 0.0000 | 14.9304 |
| **Total** | **6.3200e-003** | **0.0533** | **0.1099** | **1.7000e-004** | | **2.5600e-003** | **2.5600e-003** | | **2.3600e-003** | **2.3600e-003** | **0.0000** | **14.8107** | **14.8107** | **4.7900e-003** | **0.0000** | **14.9304** |

## 3.8 Trenching - 2024

### Unmitigated Construction Off-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 9.7000e-004 | 7.5000e-004 | 5.8000e-003 | 1.0000e-005 | 1.2000e-003 | 1.0000e-005 | 1.2100e-003 | 3.2000e-004 | 1.0000e-005 | 3.3000e-004 | 0.0000 | 0.9701 | 0.9701 | 5.0000e-005 | 0.0000 | 0.9714 |
| **Total** | **9.7000e-004** | **7.5000e-004** | **5.8000e-003** | **1.0000e-005** | **1.2000e-003** | **1.0000e-005** | **1.2100e-003** | **3.2000e-004** | **1.0000e-005** | **3.3000e-004** | **0.0000** | **0.9701** | **0.9701** | **5.0000e-005** | **0.0000** | **0.9714** |

### Mitigated Construction On-Site

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Off-Road | 6.3200e-003 | 0.0533 | 0.1099 | 1.7000e-004 | | 2.5600e-003 | 2.5600e-003 | | 2.3600e-003 | 2.3600e-003 | 0.0000 | 14.8106 | 14.8106 | 4.7900e-003 | 0.0000 | 14.9304 |
| **Total** | **6.3200e-003** | **0.0533** | **0.1099** | **1.7000e-004** | | **2.5600e-003** | **2.5600e-003** | | **2.3600e-003** | **2.3600e-003** | **0.0000** | **14.8106** | **14.8106** | **4.7900e-003** | **0.0000** | **14.9304** |

### 3.8 Trenching - 2024

**Mitigated Construction Off-Site**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Hauling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Vendor | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Worker | 9.7000e-004 | 7.5000e-004 | 5.8000e-003 | 1.0000e-005 | 1.2000e-003 | 1.0000e-005 | 1.2100e-003 | 3.2000e-004 | 1.0000e-005 | 3.3000e-004 | 0.0000 | 0.9701 | 0.9701 | 5.0000e-005 | 0.0000 | 0.9714 |
| **Total** | **9.7000e-004** | **7.5000e-004** | **5.8000e-003** | **1.0000e-005** | **1.2000e-003** | **1.0000e-005** | **1.2100e-003** | **3.2000e-004** | **1.0000e-005** | **3.3000e-004** | **0.0000** | **0.9701** | **0.9701** | **5.0000e-005** | **0.0000** | **0.9714** |

## 4.0 Operational Detail - Mobile

### 4.1 Mitigation Measures Mobile

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Mitigated | 0.0172 | 0.0969 | 0.2170 | 6.4000e-004 | 0.0522 | 6.3000e-004 | 0.0528 | 0.0141 | 5.9000e-004 | 0.0146 | 0.0000 | 58.4856 | 58.4856 | 2.4200e-003 | 0.0000 | 58.5460 |
| Unmitigated | 0.0172 | 0.0969 | 0.2170 | 6.4000e-004 | 0.0522 | 6.3000e-004 | 0.0528 | 0.0141 | 5.9000e-004 | 0.0146 | 0.0000 | 58.4856 | 58.4856 | 2.4200e-003 | 0.0000 | 58.5460 |

## 4.2 Trip Summary Information

| | Average Daily Trip Rate | | | Unmitigated | Mitigated |
|---|---|---|---|---|---|
| Land Use | Weekday | Saturday | Sunday | Annual VMT | Annual VMT |
| General Heavy Industry | 37.08 | 37.08 | 37.08 | 143,257 | 143,257 |
| Other Asphalt Surfaces | 0.00 | 0.00 | 0.00 | | |
| Other Non-Asphalt Surfaces | 0.00 | 0.00 | 0.00 | | |
| Total | 37.08 | 37.08 | 37.08 | 143,257 | 143,257 |

## 4.3 Trip Type Information

| | Miles | | | Trip % | | | Trip Purpose % | | |
|---|---|---|---|---|---|---|---|---|---|
| Land Use | H-W or C-W | H-S or C-C | H-O or C-NW | H-W or C-W | H-S or C-C | H-O or C-NW | Primary | Diverted | Pass-by |
| General Heavy Industry | 14.70 | 6.60 | 6.60 | 59.00 | 28.00 | 13.00 | 92 | 5 | 3 |
| Other Asphalt Surfaces | 14.70 | 6.60 | 6.60 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| Other Non-Asphalt Surfaces | 14.70 | 6.60 | 6.60 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |

## 4.4 Fleet Mix

| Land Use | LDA | LDT1 | LDT2 | MDV | LHD1 | LHD2 | MHD | HHD | OBUS | UBUS | MCY | SBUS | MH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| General Heavy Industry | 0.513997 | 0.038291 | 0.211378 | 0.127840 | 0.030790 | 0.005245 | 0.013914 | 0.046462 | 0.003639 | 0.001308 | 0.005014 | 0.001472 | 0.000650 |
| Other Asphalt Surfaces | 0.513997 | 0.038291 | 0.211378 | 0.127840 | 0.030790 | 0.005245 | 0.013914 | 0.046462 | 0.003639 | 0.001308 | 0.005014 | 0.001472 | 0.000650 |
| Other Non-Asphalt Surfaces | 0.513997 | 0.038291 | 0.211378 | 0.127840 | 0.030790 | 0.005245 | 0.013914 | 0.046462 | 0.003639 | 0.001308 | 0.005014 | 0.001472 | 0.000650 |

## 5.0 Energy Detail

Historical Energy Use: N

### 5.1 Mitigation Measures Energy

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Electricity Mitigated | | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 30.7789 | 30.7789 | 1.3900e-003 | 2.9000e-004 | 30.8995 |
| Electricity Unmitigated | | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 30.7789 | 30.7789 | 1.3900e-003 | 2.9000e-004 | 30.8995 |
| NaturalGas Mitigated | 4.7000e-004 | 4.2500e-003 | 3.5700e-003 | 3.0000e-005 | | 3.2000e-004 | 3.2000e-004 | | 3.2000e-004 | 3.2000e-004 | 0.0000 | 4.6302 | 4.6302 | 9.0000e-005 | 8.0000e-005 | 4.6577 |
| NaturalGas Unmitigated | 4.7000e-004 | 4.2500e-003 | 3.5700e-003 | 3.0000e-005 | | 3.2000e-004 | 3.2000e-004 | | 3.2000e-004 | 3.2000e-004 | 0.0000 | 4.6302 | 4.6302 | 9.0000e-005 | 8.0000e-005 | 4.6577 |

## 5.2 Energy by Land Use - NaturalGas

### Unmitigated

| | NaturalGas Use | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land Use | kBTU/yr | tons/yr | | | | | | | | | | MT/yr | | | | | |
| General Heavy Industry | 86767.2 | 4.7000e-004 | 4.2500e-003 | 3.5700e-003 | 3.0000e-005 | | 3.2000e-004 | 3.2000e-004 | | 3.2000e-004 | 3.2000e-004 | 0.0000 | 4.6302 | 4.6302 | 9.0000e-005 | 8.0000e-005 | 4.6577 |
| Other Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **4.7000e-004** | **4.2500e-003** | **3.5700e-003** | **3.0000e-005** | | **3.2000e-004** | **3.2000e-004** | | **3.2000e-004** | **3.2000e-004** | **0.0000** | **4.6302** | **4.6302** | **9.0000e-005** | **8.0000e-005** | **4.6577** |

### Mitigated

| | NaturalGas Use | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land Use | kBTU/yr | tons/yr | | | | | | | | | | MT/yr | | | | | |
| General Heavy Industry | 86767.2 | 4.7000e-004 | 4.2500e-003 | 3.5700e-003 | 3.0000e-005 | | 3.2000e-004 | 3.2000e-004 | | 3.2000e-004 | 3.2000e-004 | 0.0000 | 4.6302 | 4.6302 | 9.0000e-005 | 8.0000e-005 | 4.6577 |
| Other Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **4.7000e-004** | **4.2500e-003** | **3.5700e-003** | **3.0000e-005** | | **3.2000e-004** | **3.2000e-004** | | **3.2000e-004** | **3.2000e-004** | **0.0000** | **4.6302** | **4.6302** | **9.0000e-005** | **8.0000e-005** | **4.6577** |

## 5.3 Energy by Land Use - Electricity

**Unmitigated**

| | Electricity Use | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|
| Land Use | kWh/yr | MT/yr | | | |
| General Heavy Industry | 105802 | 30.7789 | 1.3900e-003 | 2.9000e-004 | 30.8995 |
| Other Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **30.7789** | **1.3900e-003** | **2.9000e-004** | **30.8995** |

**Mitigated**

| | Electricity Use | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|
| Land Use | kWh/yr | MT/yr | | | |
| General Heavy Industry | 105802 | 30.7789 | 1.3900e-003 | 2.9000e-004 | 30.8995 |
| Other Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **30.7789** | **1.3900e-003** | **2.9000e-004** | **30.8995** |

## 6.0 Area Detail

## 6.1 Mitigation Measures Area

Use Low VOC Paint - Non-Residential Interior

Use Low VOC Paint - Non-Residential Exterior

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Mitigated | 0.1060 | 1.0000e-005 | 7.0000e-004 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 1.3600e-003 | 1.3600e-003 | 0.0000 | 0.0000 | 1.4500e-003 |
| Unmitigated | 0.1060 | 1.0000e-005 | 7.0000e-004 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 1.3600e-003 | 1.3600e-003 | 0.0000 | 0.0000 | 1.4500e-003 |

## 6.2 Area by SubCategory

**Unmitigated**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SubCategory | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Architectural Coating | 6.0900e-003 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Consumer Products | 0.0999 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Landscaping | 6.0000e-005 | 1.0000e-005 | 7.0000e-004 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 1.3600e-003 | 1.3600e-003 | 0.0000 | 0.0000 | 1.4500e-003 |
| **Total** | **0.1060** | **1.0000e-005** | **7.0000e-004** | **0.0000** | | **0.0000** | **0.0000** | | **0.0000** | **0.0000** | **0.0000** | **1.3600e-003** | **1.3600e-003** | **0.0000** | **0.0000** | **1.4500e-003** |

**Mitigated**

| | ROG | NOx | CO | SO2 | Fugitive PM10 | Exhaust PM10 | PM10 Total | Fugitive PM2.5 | Exhaust PM2.5 | PM2.5 Total | Bio- CO2 | NBio- CO2 | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SubCategory | tons/yr | | | | | | | | | | MT/yr | | | | | |
| Architectural Coating | 6.0900e-003 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Consumer Products | 0.0999 | | | | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Landscaping | 6.0000e-005 | 1.0000e-005 | 7.0000e-004 | 0.0000 | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 1.3600e-003 | 1.3600e-003 | 0.0000 | 0.0000 | 1.4500e-003 |
| **Total** | **0.1060** | **1.0000e-005** | **7.0000e-004** | **0.0000** | | **0.0000** | **0.0000** | | **0.0000** | **0.0000** | **0.0000** | **1.3600e-003** | **1.3600e-003** | **0.0000** | **0.0000** | **1.4500e-003** |

## 7.0 Water Detail

## 7.1 Mitigation Measures Water

| | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|
| Category | MT/yr | | | |
| Mitigated | 10.8121 | 0.1867 | 4.4800e-003 | 16.8148 |
| Unmitigated | 10.8121 | 0.1867 | 4.4800e-003 | 16.8148 |

## 7.2 Water by Land Use

**Unmitigated**

| | Indoor/Outdoor Use | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|
| Land Use | Mgal | MT/yr | | | |
| General Heavy Industry | 5.7165 / 0 | 10.8121 | 0.1867 | 4.4800e-003 | 16.8148 |
| Other Asphalt Surfaces | 0 / 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 / 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **10.8121** | **0.1867** | **4.4800e-003** | **16.8148** |

### 7.2 Water by Land Use

**Mitigated**

| | Indoor/Outdoor Use | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|
| Land Use | Mgal | MT/yr | | | |
| General Heavy Industry | 5.7165 / 0 | 10.8121 | 0.1867 | 4.4800e-003 | 16.8148 |
| Other Asphalt Surfaces | 0 / 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 / 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **10.8121** | **0.1867** | **4.4800e-003** | **16.8148** |

## 8.0 Waste Detail

### 8.1 Mitigation Measures Waste

**Category/Year**

| | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|
| | MT/yr | | | |
| Mitigated | 6.2217 | 0.3677 | 0.0000 | 15.4139 |
| Unmitigated | 6.2217 | 0.3677 | 0.0000 | 15.4139 |

## 8.2 Waste by Land Use

**Unmitigated**

| | Waste Disposed | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|
| Land Use | tons | MT/yr | | | |
| General Heavy Industry | 30.65 | 6.2217 | 0.3677 | 0.0000 | 15.4139 |
| Other Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **6.2217** | **0.3677** | **0.0000** | **15.4139** |

## 8.2 Waste by Land Use

**Mitigated**

| | Waste Disposed | Total CO2 | CH4 | N2O | CO2e |
|---|---|---|---|---|---|
| Land Use | tons | MT/yr | | | |
| General Heavy Industry | 30.65 | 6.2217 | 0.3677 | 0.0000 | 15.4139 |
| Other Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Other Non-Asphalt Surfaces | 0 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Total** | | **6.2217** | **0.3677** | **0.0000** | **15.4139** |

## 9.0 Operational Offroad

| Equipment Type | Number | Hours/Day | Days/Year | Horse Power | Load Factor | Fuel Type |
|---|---|---|---|---|---|---|

## 10.0 Stationary Equipment

**Fire Pumps and Emergency Generators**

| Equipment Type | Number | Hours/Day | Hours/Year | Horse Power | Load Factor | Fuel Type |
|---|---|---|---|---|---|---|

**Boilers**

| Equipment Type | Number | Heat Input/Day | Heat Input/Year | Boiler Rating | Fuel Type |
|---|---|---|---|---|---|

**User Defined Equipment**

| Equipment Type | Number |
|---|---|

## 11.0 Vegetation

# ATTACHMENT 35

*North Coast Unified Air Quality Management District (NCUAQMD). 2020. Website – Air Quality Planning & CEQA. Available at: www.ncuaqmd.org/index.php?page=aqplanning.ceqa#T1. Accessed on: 9/15/20.*




DISTRICT INFORMATION
DISTRICT BOARDS
PUBLIC NOTICES
NEWS & ADVISORIES
RULES & REGULATIONS
AIR QUALITY
WILDFIRE SMOKE
BURN PERMITS
FORMS & APPLICATIONS
GRANTS & INCENTIVES
PLANNING & CEQA
PERMITTED SOURCES
MOBILE SOURCES & VEHICLES
REGISTRATIONS
COMPLIANCE & ENFORCEMENT
ASBESTOS REGULATIONS
COMMUNITY RESOURCES



**North Coast Unified Air Quality Management District**
707 L Street

# Air Quality Planning & CEQA

- NCUAQMD Criteria Pollutant Attainment Status
- Transportation, Land Use & CEQA
- Environmental Review Guidelines
- Greenhouse Gases (GHG) & Climate Change
- AQ Models & Meteorological Data

### NCUAQMD Criteria Pollutant Attainment Status

The North Coast Air Basin is comprised of three air districts, the North Coast Unified AQMD, the Mendocino County AQMD, and the Northern Sonoma County APCD. The North Coast AQMD includes Del Norte, Humboldt, and Trinity Counties; the Mendocino County AQMD consists of Mendocino County; and the Northern Sonoma County APCD comprises the northern portion of Sonoma County.

The District is listed as "attainment" or "unclassified" for all the federal and state ambient air quality standards with the exception of the state 24-hour particulate ($PM_{10}$) standard in Humboldt County only. The District has not exceeded the federal annual standard for particulate matter during the last five year period. Primary sources of particulate matter in the Eureka area are on-road vehicles (engine exhaust and dust from paved and unpaved roads), open burning of vegetation (both residential and commerical), residential wood stoves, and stationary industrial sources (factories).

In an effort to achieve the state air quality standard, an understanding of the causes of high $PM_{10}$ levels is necessary. In 1995, the District provided a study to identify the major contributors of $PM_{10}$, which is summarized in a NCUAQMD Paticulate Matter $PM_{10}$ Attainment Plan draft report. This report should be used cautiously as it is not a document that is required in order for the District to come into

**Current Information for All 3 Zones**

Today:
Tuesday September 15th

For burn day status call
**1-866-287-6329**

## Did You Know?

Pre-1990 trucks can emit two and a half times as much NOx and five times as much particulates as trucks meeting the current on-road heavy-duty engine exhaust emission standards.

**Helpful Links & Additional Information**

- Air Resources Board
- CA Air Districts
- EPA Compliance Center
- EPA Region 9
- Humboldt County
- Trinity County
- Del Norte County
- CAL FIRE
- CAL FIRE Humboldt-Del Norte
- Guide to the Clean Air Act
- Fire Adapted Communities

**Connect with us on Facebook**

Eureka, CA 95501

Office (707) 443-3093
Fax (707) 443-3099

*Office Hours:*
*Modified Office hours until further notice due to COVID-19 impacts*
Open: Tuesday-Thursday
10am-Noon, 1pm - 3pm

*Burn Day Information*
(707) 443-7665 or
(866) BURN-DAY
[866-287-6329]

*Complaint Hotline*
(707) 444-2233

attainment for the state standard, however the District is planning to update the document.

**Transportation, Land Use & CEQA**

Cars and trucks and other vehicles are considered a source of particulate matter within the North Coast Unified Air Quality Management District (District). Fugitive emissions as a result of vehicular traffic on unpaved roadways is the largest source of particulate matter emissions within the District. Its control and mitigation plays a key role in the District's attainment strategy. Land use decisions often involve transporation.

Land use decisions are the general name for how a community uses its land, and land use decisions can affect air quality. Air pollution may result from a specific project, such as the construction of a new business that will emit air pollution, or may be related to the growth and transporation patterns of many new projects over a long period of time.

In order to provide consistency to lead agencies, project proponents, and the general public throughout the state, the California Air Pollution Control Officers Association (CAPCOA) prepared a guidance document, entitled "Health Risk Assessments for Proposed Land Use Project", to assist lead agencies with the requirements of the California Environmental Quality Act (CEQA) when projects may involve exposure to toxic air contaminants. This document focuses on the acute, chronic, and cancer impacts of sources that may undergo CEQA review. It also outlines the recommended procedures to identify when a project should undergo further risk evaluation, how to conduct the health risk assessment (HRA), how to engage the public, what to do with the results from the HRA, and what mitigation measures may be appropriate for various land use projects.

**Environmental Review Guidelines**

The California Environmental Quality Act (CEQA) is the state law that requires state and local agencies to identify the significant environmental impacts of projects and to avoid or mitigate those impacts, if feasible. Most proposals for physical development in California are subject to the provisions of CEQA, as are many governmental decisions which do not immediately result in physical development (such as adoption of a general or community plan). Every development project which requires a discretionary governmental approval will require at least some environmental review pursuant to CEQA, unless an exemption applies.

The District's Planning Division staff participate in the preparation and review of environmental documents prepared by Humboldt County, Del Norte County, Trinity County, local cities, and other public agencies to determine potential adverse air quality impacts from projects, and identify measures to mitigate those impacts. The District is

typically not the lead agency for projects, given the fact that other state, county, or city government agencies are usually considered the lead for most projects. When applicable, the District follows environmental review procedures and guidelines as outlined in the NCUAQMD Rules & Regulations, Appendix A, Procedures for Environmental Impact Review.

In determining whether a project has significant air quality impacts on the environment, planners typically apply their local air district's thresholds of significance to projects in the review process. However, the District has not formally adopted significance thresholds, but rather utilizes the Best Available Control Technology (BACT) emission rates for stationary sources as defined and listed in the NCUAQMD Rule and Regulations, Rule 110 - New Source Review (NSR) And Prevention of Significant Deterioration (PSD), Section 5.1 - BACT (pages 8-9). The District does not currently have any thresholds for toxics, but recommends the use of the latest version of the CAPCOA's "Health Risk Assessments for Proposed Land Use Project" as mentioned above, to evaluate and reduce air pollution impacts from new development.

The District strongly encourages planners, project applicants, and/or consultants, to contact the District's Permits & Planning Division to discuss projects and their impacts. District staff can be contacted at (707) 443-3093 or support@ncuaqmd.org.

**Greenhouse Gases (GHGs) & Climate Change**

Greenhouse Gases (GHGs) and Climate Change are a constantly evolving policy, especially in light of the passage of the Global Warming Solutions Act of 2006 (AB-32). As the California Air Resources Board and other state agencies and offices develop policies and regulations to address GHG emissions, the interface between the CEQA and these other programs may change.

As a result of revisions to the CEQA Guidelines that became effective in March 2010, lead agencies are obligated to determine whether a project's GHG emissions significantly affect the environment and to impose feasible mitigation to eliminate or substantially lessen any such significant effects.

In 2011, the NCUAQMD adopted Rule 111 (Federal Permitting Requirements for Sources of Greenhouse Gases) into the District rules, to establish a threshold above which New Source Review (NSR) and federal Title V permitting applies, and to establish federally enforceable limits on potential to emit greenhouse gases for stationary sources. These are considered requirements for stationary sources and should not be used as a threshold of significance for stationary source projects.

The District strongly encourages planners, project applicants, and/or consultants, to contact the District's

Permits & Planning Division to discuss any questions related to GHG project impacts. Staff can be contacted at (707) 443-3093 or support@ncuaqmd.org.

The California Air Pollution Control Officers Association (CAPCOA) has also released a resource guide in January 2008, entitled "CEQA & Climate Change" to address GHG emissions from projects subject to the CEQA. This resource guide was prepared to support local governments as they develop their programs and policies around climate change issues. It is not a guidance document, and is not intended to dictate or direct how any agency chooses to address GHG emissions. Rather, it is intended to provide a common platform of information about key elements of CEQA as they pertain to GHG, including an analysis of different approaches to setting significance thresholds. The resource guide also contains an organized review of available tools and models for evaluating GHG emissions, and an overview of strategies for mitigating potentially significant GHG emissions from projects.

CAPCOA has also prepared a report entitled "Quantifying Greenhouse Gas Mitigation Measures". It is primarily focused on the quantification of project-level mitigation of greenhouse gas emissions associated with land use, transportation, energy use, and other related project areas. The report provides a discussion of background information on programs and other circumstances in which quantification of greenhouse gas emissions is important. This includes voluntary emission reduction efforts, project-level emission reduction efforts, reductions for regulatory compliance, and reductions for some form of credit. The information provided covers basic terms and concepts and does not endorse or provide guidance on any policy position.

**AQ Models and Meteorological Data**

Models are commonly used to calculate and predict project air emissions. The District requires that all CEQA, NEPA and other modeling use the most recent ARB approved modeling protocol or alternatives as approved by the District's Air Pollution Control Officer. District historical meteorological data files are also available for air dispersion or land use project modeling.

Historically URBEMIS was widely used to calculate project air emissions, however a new air emissions model, the California Emissions Estimator Model (CalEEMod) is now being used. This model calculates both criteria pollutant and greenhouse gas emissions from projects.

The District strongly encourages planners, project applicants, and/or consultants, to contact the District's Permits & Planning Division to discuss any questions. District staff can be contacted at (707) 443-3093 or support@ncuaqmd.org.

# ATTACHMENT 36

U.S. Environmental Protection Agency (EPA) Website. 2020. Current Nonattainment Counties for All Criteria Pollutants. Available at: www.epa.gov/airquality/greenbook/ancl.html. Accessed on: 10/9/20.

# Current Nonattainment Counties for All Criteria Pollutants

Data is current as of September 30, 2020

The 8-hour Ozone (1997) standard was revoked on April 6, 2015 and the 1-hour Ozone (1979) standard was revoked on June 15, 2005.
The asterisk (*) indicates only a portion of the county is included in the designated nonattainment area (NA).

Download National Dataset of all designated areas (currently nonattainment, maintenance, revoked):
dbf | xls | Data dictionary (PDF)

---

Listed by State, County, NAAQS (Classification, if applicable) * Part County NA NA Area Name

---

**ALASKA**

Fairbanks North Star Borough

| | |
|---|---|
| *PM-2.5 (2006)* | *Fairbanks, AK - (Serious) |

**ARIZONA**

Cochise County

| | |
|---|---|
| *PM-10 (1987)* | *Paul Spur/Douglas (Cochise County), AZ - (Moderate) |

Gila County

| | |
|---|---|
| *Lead (2008)* | *Hayden, AZ |
| *PM-10 (1987)* | *Hayden, AZ - (Moderate) |
| *PM-10 (1987)* | *Miami, AZ - (Moderate) |
| *Sulfur Dioxide (2010)* | *Hayden, AZ |
| *Sulfur Dioxide (2010)* | *Miami, AZ |
| *8-Hour Ozone (2015)* | *Phoenix-Mesa, AZ - (Marginal) |

Maricopa County

| | |
|---|---|
| *PM-10 (1987)* | *Phoenix, AZ - (Serious) |
| *8-Hour Ozone (2008)* | *Phoenix-Mesa, AZ - (Moderate) |
| *8-Hour Ozone (2015)* | *Phoenix-Mesa, AZ - (Marginal) |

Pima County

| | |
|---|---|
| *PM-10 (1987)* | *Rillito, AZ - (Moderate) |

Pinal County

| | |
|---|---|
| *Lead (2008)* | *Hayden, AZ |
| *PM-10 (1987)* | *Hayden, AZ - (Moderate) |
| *PM-10 (1987)* | *Miami, AZ - (Moderate) |
| *PM-10 (1987)* | *Phoenix, AZ - (Serious) |
| *PM-10 (1987)* | *West Pinal, AZ - (Serious) |
| *PM-2.5 (2006)* | *West Central Pinal, AZ - (Moderate) |
| *Sulfur Dioxide (1971)* | *Hayden (Pinal County), AZ |
| *Sulfur Dioxide (2010)* | *Hayden, AZ |
| *8-Hour Ozone (2008)* | *Phoenix-Mesa, AZ - (Moderate) |
| *8-Hour Ozone (2015)* | *Phoenix-Mesa, AZ - (Marginal) |

Santa Cruz County

| | |
|---|---|
| *PM-10 (1987)* | *Nogales, AZ - (Moderate) |

*PM-2.5 (2006)* *Nogales, AZ - (Moderate)
Yuma County
*PM-10 (1987)* *Yuma, AZ - (Moderate)
*8-Hour Ozone (2015)* *Yuma, AZ - (Marginal)

**CALIFORNIA**

Alameda County
*PM-2.5 (2006)* San Francisco Bay Area, CA - (Moderate)
*8-Hour Ozone (2008)* San Francisco Bay Area, CA - (Marginal)
*8-Hour Ozone (2015)* San Francisco Bay Area, CA - (Marginal)
Amador County
*8-Hour Ozone (2015)* Amador County, CA - (Marginal)
Butte County
*8-Hour Ozone (2008)* Chico (Butte County), CA - (Marginal)
*8-Hour Ozone (2015)* Butte County, CA - (Marginal)
Calaveras County
*8-Hour Ozone (2008)* Calaveras County, CA - (Marginal)
*8-Hour Ozone (2015)* Calaveras County, CA - (Marginal)
Contra Costa County
*PM-2.5 (2006)* San Francisco Bay Area, CA - (Moderate)
*8-Hour Ozone (2008)* San Francisco Bay Area, CA - (Marginal)
*8-Hour Ozone (2015)* San Francisco Bay Area, CA - (Marginal)
El Dorado County
*PM-2.5 (2006)* *Sacramento, CA - (Moderate)
*8-Hour Ozone (2008)* *Sacramento Metro, CA - (Severe 15)
*8-Hour Ozone (2015)* *Sacramento Metro, CA - (Moderate)
Fresno County
*PM-2.5 (1997)* San Joaquin Valley, CA - (Serious)
*PM-2.5 (2006)* San Joaquin Valley, CA - (Serious)
*PM-2.5 (2012)* San Joaquin Valley, CA - (Moderate)
*8-Hour Ozone (2008)* San Joaquin Valley, CA - (Extreme)
*8-Hour Ozone (2015)* San Joaquin Valley, CA - (Extreme)
Imperial County
*PM-10 (1987)* *Imperial Valley, CA - (Serious)
*PM-2.5 (2006)* *Imperial Co, CA - (Moderate)
*PM-2.5 (2012)* *Imperial County, CA - (Moderate)
*8-Hour Ozone (2008)* Imperial County, CA - (Moderate)
*8-Hour Ozone (2015)* Imperial County, CA - (Marginal)
Inyo County
*PM-10 (1987)* *Owens Valley, CA - (Serious)
Kern County
*PM-10 (1987)* *East Kern Co, CA - (Serious)
*PM-2.5 (1997)* *San Joaquin Valley, CA - (Serious)
*PM-2.5 (2006)* *San Joaquin Valley, CA - (Serious)
*PM-2.5 (2012)* *San Joaquin Valley, CA - (Moderate)
*8-Hour Ozone (2008)* *Kern Co (Eastern Kern), CA - (Serious)
*8-Hour Ozone (2008)* *San Joaquin Valley, CA - (Extreme)
*8-Hour Ozone (2015)* *Kern County (Eastern Kern), CA - (Moderate)
*8-Hour Ozone (2015)* *San Joaquin Valley, CA - (Extreme)
Kings County
*PM-2.5 (1997)* San Joaquin Valley, CA - (Serious)
*PM-2.5 (2006)* San Joaquin Valley, CA - (Serious)
*PM-2.5 (2012)* San Joaquin Valley, CA - (Moderate)
*8-Hour Ozone (2008)* San Joaquin Valley, CA - (Extreme)
*8-Hour Ozone (2015)* San Joaquin Valley, CA - (Extreme)
Los Angeles County
*Lead (2008)* *Los Angeles County-South Coast Air Basin, CA
*PM-2.5 (1997)* *Los Angeles-South Coast Air Basin, CA - (Moderate)
*PM-2.5 (2006)* *Los Angeles-South Coast Air Basin, CA - (Serious)

| | |
|---|---|
| *PM-2.5 (2012)* | *Los Angeles-South Coast Air Basin, CA - (Moderate) |
| *8-Hour Ozone (2008)* | *Los Angeles-San Bernardino Counties (West Mojave Desert), CA - (Severe 15) |
| *8-Hour Ozone (2008)* | *Los Angeles-South Coast Air Basin, CA - (Extreme) |
| *8-Hour Ozone (2015)* | *Los Angeles-San Bernardino Counties (West Mojave Desert), CA - (Severe 15) |
| *8-Hour Ozone (2015)* | *Los Angeles-South Coast Air Basin, CA - (Extreme) |
| Madera County | |
| *PM-2.5 (1997)* | San Joaquin Valley, CA - (Serious) |
| *PM-2.5 (2006)* | San Joaquin Valley, CA - (Serious) |
| *PM-2.5 (2012)* | San Joaquin Valley, CA - (Moderate) |
| *8-Hour Ozone (2008)* | San Joaquin Valley, CA - (Extreme) |
| *8-Hour Ozone (2015)* | San Joaquin Valley, CA - (Extreme) |
| Marin County | |
| *PM-2.5 (2006)* | San Francisco Bay Area, CA - (Moderate) |
| *8-Hour Ozone (2008)* | San Francisco Bay Area, CA - (Marginal) |
| *8-Hour Ozone (2015)* | San Francisco Bay Area, CA - (Marginal) |
| Mariposa County | |
| *8-Hour Ozone (2008)* | Mariposa County, CA - (Moderate) |
| *8-Hour Ozone (2015)* | Mariposa County, CA - (Marginal) |
| Merced County | |
| *PM-2.5 (1997)* | San Joaquin Valley, CA - (Serious) |
| *PM-2.5 (2006)* | San Joaquin Valley, CA - (Serious) |
| *PM-2.5 (2012)* | San Joaquin Valley, CA - (Moderate) |
| *8-Hour Ozone (2008)* | San Joaquin Valley, CA - (Extreme) |
| *8-Hour Ozone (2015)* | San Joaquin Valley, CA - (Extreme) |
| Mono County | |
| *PM-10 (1987)* | *Mono Basin, CA - (Moderate) |
| Napa County | |
| *PM-2.5 (2006)* | San Francisco Bay Area, CA - (Moderate) |
| *8-Hour Ozone (2008)* | San Francisco Bay Area, CA - (Marginal) |
| *8-Hour Ozone (2015)* | San Francisco Bay Area, CA - (Marginal) |
| Nevada County | |
| *8-Hour Ozone (2008)* | *Nevada Co. (Western part), CA - (Serious) |
| *8-Hour Ozone (2015)* | *Nevada County (Western part), CA - (Moderate) |
| Orange County | |
| *PM-2.5 (1997)* | Los Angeles-South Coast Air Basin, CA - (Moderate) |
| *PM-2.5 (2006)* | Los Angeles-South Coast Air Basin, CA - (Serious) |
| *PM-2.5 (2012)* | Los Angeles-South Coast Air Basin, CA - (Moderate) |
| *8-Hour Ozone (2008)* | Los Angeles-South Coast Air Basin, CA - (Extreme) |
| *8-Hour Ozone (2015)* | Los Angeles-South Coast Air Basin, CA - (Extreme) |
| Placer County | |
| *PM-2.5 (2006)* | *Sacramento, CA - (Moderate) |
| *8-Hour Ozone (2008)* | *Sacramento Metro, CA - (Severe 15) |
| *8-Hour Ozone (2015)* | *Sacramento Metro, CA - (Moderate) |
| Plumas County | |
| *PM-2.5 (2012)* | *Plumas County, CA - (Moderate) |
| Riverside County | |
| *PM-10 (1987)* | *Coachella Valley, CA - (Serious) |
| *PM-2.5 (1997)* | *Los Angeles-South Coast Air Basin, CA - (Moderate) |
| *PM-2.5 (2006)* | *Los Angeles-South Coast Air Basin, CA - (Serious) |

| | |
|---|---|
| *PM-2.5 (2012)* | *Los Angeles-South Coast Air Basin, CA - (Moderate) |
| *8-Hour Ozone (2008)* | *Los Angeles-South Coast Air Basin, CA - (Extreme) |
| *8-Hour Ozone (2008)* | *Morongo Band of Mission Indians - (Serious) |
| *8-Hour Ozone (2008)* | *Pechanga Band of Luiseno Mission Indians of the Pechanga Reservation - (Moderate) |
| *8-Hour Ozone (2008)* | *Riverside Co, (Coachella Valley), CA - (Severe 15) |
| *8-Hour Ozone (2015)* | *Los Angeles-South Coast Air Basin, CA - (Extreme) |
| *8-Hour Ozone (2015)* | *Morongo Band of Mission Indians, CA - (Serious) |
| *8-Hour Ozone (2015)* | *Pechanga Band of Luiseno Mission Indians of the Pechanga Reservation, CA - (Marginal) |
| *8-Hour Ozone (2015)* | *Riverside County (Coachella Valley), CA - (Severe 15) |
| Sacramento County | |
| *PM-2.5 (2006)* | Sacramento, CA - (Moderate) |
| *8-Hour Ozone (2008)* | Sacramento Metro, CA - (Severe 15) |
| *8-Hour Ozone (2015)* | Sacramento Metro, CA - (Moderate) |
| San Bernardino County | |
| *PM-10 (1987)* | *San Bernardino Co, CA - (Moderate) |
| *PM-10 (1987)* | *Trona, CA - (Moderate) |
| *PM-2.5 (1997)* | *Los Angeles-South Coast Air Basin, CA - (Moderate) |
| *PM-2.5 (2006)* | *Los Angeles-South Coast Air Basin, CA - (Serious) |
| *PM-2.5 (2012)* | *Los Angeles-South Coast Air Basin, CA - (Moderate) |
| *8-Hour Ozone (2008)* | *Los Angeles-San Bernardino Counties (West Mojave Desert), CA - (Severe 15) |
| *8-Hour Ozone (2008)* | *Los Angeles-South Coast Air Basin, CA - (Extreme) |
| *8-Hour Ozone (2015)* | *Los Angeles-San Bernardino Counties (West Mojave Desert), CA - (Severe 15) |
| *8-Hour Ozone (2015)* | *Los Angeles-South Coast Air Basin, CA - (Extreme) |
| San Diego County | |
| *8-Hour Ozone (2008)* | *Pechanga Band of Luiseno Mission Indians of the Pechanga Reservation - (Moderate) |
| *8-Hour Ozone (2008)* | *San Diego County, CA - (Serious) |
| *8-Hour Ozone (2015)* | *Pechanga Band of Luiseno Mission Indians of the Pechanga Reservation, CA - (Marginal) |
| *8-Hour Ozone (2015)* | *San Diego County, CA - (Moderate) |
| San Francisco County | |
| *PM-2.5 (2006)* | San Francisco Bay Area, CA - (Moderate) |
| *8-Hour Ozone (2008)* | San Francisco Bay Area, CA - (Marginal) |
| *8-Hour Ozone (2015)* | San Francisco Bay Area, CA - (Marginal) |
| San Joaquin County | |
| *PM-2.5 (1997)* | San Joaquin Valley, CA - (Serious) |
| *PM-2.5 (2006)* | San Joaquin Valley, CA - (Serious) |
| *PM-2.5 (2012)* | San Joaquin Valley, CA - (Moderate) |
| *8-Hour Ozone (2008)* | San Joaquin Valley, CA - (Extreme) |
| *8-Hour Ozone (2015)* | San Joaquin Valley, CA - (Extreme) |
| San Luis Obispo County | |
| *8-Hour Ozone (2008)* | *San Luis Obispo (Eastern San Luis Obispo), CA - (Marginal) |
| *8-Hour Ozone (2015)* | *San Luis Obispo (Eastern part), CA - (Marginal) |
| San Mateo County | |
| *PM-2.5 (2006)* | San Francisco Bay Area, CA - (Moderate) |

*8-Hour Ozone (2008)* San Francisco Bay Area, CA - (Marginal)
*8-Hour Ozone (2015)* San Francisco Bay Area, CA - (Marginal)

Santa Clara County
*PM-2.5 (2006)* San Francisco Bay Area, CA - (Moderate)
*8-Hour Ozone (2008)* San Francisco Bay Area, CA - (Marginal)
*8-Hour Ozone (2015)* San Francisco Bay Area, CA - (Marginal)

Solano County
*PM-2.5 (2006)* *Sacramento, CA - (Moderate)
*PM-2.5 (2006)* *San Francisco Bay Area, CA - (Moderate)
*8-Hour Ozone (2008)* *Sacramento Metro, CA - (Severe 15)
*8-Hour Ozone (2008)* *San Francisco Bay Area, CA - (Marginal)
*8-Hour Ozone (2015)* *Sacramento Metro, CA - (Moderate)
*8-Hour Ozone (2015)* *San Francisco Bay Area, CA - (Marginal)

Sonoma County
*PM-2.5 (2006)* *San Francisco Bay Area, CA - (Moderate)
*8-Hour Ozone (2008)* *San Francisco Bay Area, CA - (Marginal)
*8-Hour Ozone (2015)* *San Francisco Bay Area, CA - (Marginal)

Stanislaus County
*PM-2.5 (1997)* San Joaquin Valley, CA - (Serious)
*PM-2.5 (2006)* San Joaquin Valley, CA - (Serious)
*PM-2.5 (2012)* San Joaquin Valley, CA - (Moderate)
*8-Hour Ozone (2008)* San Joaquin Valley, CA - (Extreme)
*8-Hour Ozone (2015)* San Joaquin Valley, CA - (Extreme)

Sutter County
*8-Hour Ozone (2008)* *Sacramento Metro, CA - (Severe 15)
*8-Hour Ozone (2015)* *Sacramento Metro, CA - (Moderate)
*8-Hour Ozone (2015)* *Sutter Buttes, CA - (Marginal)

Tehama County
*8-Hour Ozone (2008)* *Tuscan Buttes, CA - (Marginal)
*8-Hour Ozone (2015)* *Tuscan Buttes, CA - (Marginal (Rural Transport))

Tulare County
*PM-2.5 (1997)* San Joaquin Valley, CA - (Serious)
*PM-2.5 (2006)* San Joaquin Valley, CA - (Serious)
*PM-2.5 (2012)* San Joaquin Valley, CA - (Moderate)
*8-Hour Ozone (2008)* San Joaquin Valley, CA - (Extreme)
*8-Hour Ozone (2015)* San Joaquin Valley, CA - (Extreme)

Tuolumne County
*8-Hour Ozone (2015)* Tuolumne County, CA - (Marginal)

Ventura County
*8-Hour Ozone (2008)* *Ventura County, CA - (Serious)
*8-Hour Ozone (2015)* *Ventura County, CA - (Serious)

Yolo County
*PM-2.5 (2006)* *Sacramento, CA - (Moderate)
*8-Hour Ozone (2008)* Sacramento Metro, CA - (Severe 15)
*8-Hour Ozone (2015)* Sacramento Metro, CA - (Moderate)

**COLORADO**

Adams County
*8-Hour Ozone (2008)* Denver-Boulder-Greeley-Ft. Collins-Loveland, CO - (Serious)
*8-Hour Ozone (2015)* Denver Metro/North Front Range, CO - (Marginal)

Arapahoe County
*8-Hour Ozone (2008)* Denver-Boulder-Greeley-Ft. Collins-Loveland, CO - (Serious)
*8-Hour Ozone (2015)* Denver Metro/North Front Range, CO - (Marginal)

Boulder County
*8-Hour Ozone (2008)* Denver-Boulder-Greeley-Ft. Collins-Loveland, CO - (Serious)
*8-Hour Ozone (2015)* Denver Metro/North Front Range, CO - (Marginal)

Broomfield County
*8-Hour Ozone (2008)* Denver-Boulder-Greeley-Ft. Collins-Loveland, CO - (Serious)
*8-Hour Ozone (2015)* Denver Metro/North Front Range, CO - (Marginal)
Denver County
*8-Hour Ozone (2008)* Denver-Boulder-Greeley-Ft. Collins-Loveland, CO - (Serious)
*8-Hour Ozone (2015)* Denver Metro/North Front Range, CO - (Marginal)
Douglas County
*8-Hour Ozone (2008)* Denver-Boulder-Greeley-Ft. Collins-Loveland, CO - (Serious)
*8-Hour Ozone (2015)* Denver Metro/North Front Range, CO - (Marginal)
Jefferson County
*8-Hour Ozone (2008)* Denver-Boulder-Greeley-Ft. Collins-Loveland, CO - (Serious)
*8-Hour Ozone (2015)* Denver Metro/North Front Range, CO - (Marginal)
Larimer County
*8-Hour Ozone (2008)* * Denver-Boulder-Greeley-Ft. Collins-Loveland, CO - (Serious)
*8-Hour Ozone (2015)* * Denver Metro/North Front Range, CO - (Marginal)
Weld County
*8-Hour Ozone (2008)* * Denver-Boulder-Greeley-Ft. Collins-Loveland, CO - (Serious)
*8-Hour Ozone (2015)* * Denver Metro/North Front Range, CO - (Marginal)

**CONNECTICUT**
Fairfield County
*8-Hour Ozone (2008)* New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious)
*8-Hour Ozone (2015)* New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate)
Hartford County
*8-Hour Ozone (2008)* Greater Connecticut, CT - (Serious)
*8-Hour Ozone (2015)* Greater Connecticut, CT - (Marginal)
Litchfield County
*8-Hour Ozone (2008)* Greater Connecticut, CT - (Serious)
*8-Hour Ozone (2015)* Greater Connecticut, CT - (Marginal)
Middlesex County
*8-Hour Ozone (2008)* New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious)
*8-Hour Ozone (2015)* New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate)
New Haven County
*8-Hour Ozone (2008)* New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious)
*8-Hour Ozone (2015)* New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate)
New London County
*8-Hour Ozone (2008)* Greater Connecticut, CT - (Serious)
*8-Hour Ozone (2015)* Greater Connecticut, CT - (Marginal)
Tolland County
*8-Hour Ozone (2008)* Greater Connecticut, CT - (Serious)
*8-Hour Ozone (2015)* Greater Connecticut, CT - (Marginal)
Windham County
*8-Hour Ozone (2008)* Greater Connecticut, CT - (Serious)
*8-Hour Ozone (2015)* Greater Connecticut, CT - (Marginal)

**DELAWARE**
New Castle County
*8-Hour Ozone (2008)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
*8-Hour Ozone (2015)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
Sussex County
*8-Hour Ozone (2008)* Seaford, DE - (Marginal)

**DISTRICT OF COLUMBIA**
District of Columbia
*8-Hour Ozone (2015)* Washington, DC-MD-VA - (Marginal)

**GEORGIA**
Bartow County
*8-Hour Ozone (2015)* Atlanta, GA - (Marginal)
Clayton County
*8-Hour Ozone (2015)* Atlanta, GA - (Marginal)
Cobb County
*8-Hour Ozone (2015)* Atlanta, GA - (Marginal)
DeKalb County
*8-Hour Ozone (2015)* Atlanta, GA - (Marginal)
Fulton County
*8-Hour Ozone (2015)* Atlanta, GA - (Marginal)
Gwinnett County
*8-Hour Ozone (2015)* Atlanta, GA - (Marginal)
Henry County
*8-Hour Ozone (2015)* Atlanta, GA - (Marginal)

**GUAM**
Guam
*Sulfur Dioxide (1971)* *Piti, GU
*Sulfur Dioxide (1971)* *Tanguisson, GU
*Sulfur Dioxide (2010)* *Piti-Cabras, GU

**IDAHO**
Bannock County
*PM-10 (1987)* *Fort Hall Indian Reservation - (Moderate)
Franklin County
*PM-2.5 (2006)* *Logan, UT-ID - (Moderate)
Power County
*PM-10 (1987)* *Fort Hall Indian Reservation - (Moderate)
Shoshone County
*PM-2.5 (2012)* *West Silver Valley, ID - (Moderate)

**ILLINOIS**
Cook County
*8-Hour Ozone (2008)* Chicago-Naperville, IL-IN-WI - (Serious)
*8-Hour Ozone (2015)* Chicago, IL-IN-WI - (Marginal)
DuPage County
*8-Hour Ozone (2008)* Chicago-Naperville, IL-IN-WI - (Serious)
*8-Hour Ozone (2015)* Chicago, IL-IN-WI - (Marginal)
Grundy County
*8-Hour Ozone (2008)* *Chicago-Naperville, IL-IN-WI - (Serious)
*8-Hour Ozone (2015)* *Chicago, IL-IN-WI - (Marginal)
Kane County
*8-Hour Ozone (2008)* Chicago-Naperville, IL-IN-WI - (Serious)
*8-Hour Ozone (2015)* Chicago, IL-IN-WI - (Marginal)
Kendall County
*8-Hour Ozone (2008)* *Chicago-Naperville, IL-IN-WI - (Serious)
*8-Hour Ozone (2015)* *Chicago, IL-IN-WI - (Marginal)
Lake County
*8-Hour Ozone (2008)* Chicago-Naperville, IL-IN-WI - (Serious)
*8-Hour Ozone (2015)* Chicago, IL-IN-WI - (Marginal)
Madison County
*Sulfur Dioxide (2010)* *Alton Township, IL

*8-Hour Ozone (2015)* St. Louis, MO-IL - (Marginal)
McHenry County
*8-Hour Ozone (2008)* Chicago-Naperville, IL-IN-WI - (Serious)
St. Clair County
*8-Hour Ozone (2015)* St. Louis, MO-IL - (Marginal)
Will County
*8-Hour Ozone (2008)* Chicago-Naperville, IL-IN-WI - (Serious)
*8-Hour Ozone (2015)* Chicago, IL-IN-WI - (Marginal)

**INDIANA**
Clark County
*8-Hour Ozone (2015)* Louisville, KY-IN - (Marginal)
Daviess County
*Sulfur Dioxide (2010)* *Southwest Indiana, IN
Floyd County
*8-Hour Ozone (2015)* Louisville, KY-IN - (Marginal)
Huntington County
*Sulfur Dioxide (2010)* *Huntington, IN
Lake County
*8-Hour Ozone (2008)* Chicago-Naperville, IL-IN-WI - (Serious)
*8-Hour Ozone (2015)* *Chicago, IL-IN-WI - (Marginal)
Pike County
*Sulfur Dioxide (2010)* *Southwest Indiana, IN
Porter County
*8-Hour Ozone (2008)* Chicago-Naperville, IL-IN-WI - (Serious)

**IOWA**
Muscatine County
*Sulfur Dioxide (2010)* *Muscatine, IA

**KANSAS**
Saline County
*Lead (2008)* *Saline County, KS

**KENTUCKY**
Boone County
*8-Hour Ozone (2015)* *Cincinnati, OH-KY - (Marginal)
Bullitt County
*8-Hour Ozone (2015)* Louisville, KY-IN - (Marginal)
Campbell County
*8-Hour Ozone (2015)* *Cincinnati, OH-KY - (Marginal)
Jefferson County
*8-Hour Ozone (2015)* Louisville, KY-IN - (Marginal)
Kenton County
*8-Hour Ozone (2015)* *Cincinnati, OH-KY - (Marginal)
Oldham County
*8-Hour Ozone (2015)* Louisville, KY-IN - (Marginal)

**LOUISIANA**
Evangeline Parish
*Sulfur Dioxide (2010)* *Evangeline Parish (Partial), LA
St. Bernard Parish
*Sulfur Dioxide (2010)* St. Bernard Parish, LA

**MARYLAND**
Anne Arundel County
*Sulfur Dioxide (2010)* *Anne Arundel County and Baltimore County, MD
*8-Hour Ozone (2008)* Baltimore, MD - (Moderate)
*8-Hour Ozone (2015)* Baltimore, MD - (Marginal)
Baltimore County
*Sulfur Dioxide (2010)* *Anne Arundel County and Baltimore County, MD
*8-Hour Ozone (2008)* Baltimore, MD - (Moderate)
*8-Hour Ozone (2015)* Baltimore, MD - (Marginal)
Baltimore city
*8-Hour Ozone (2008)* Baltimore, MD - (Moderate)
*8-Hour Ozone (2015)* Baltimore, MD - (Marginal)
Calvert County

*8-Hour Ozone (2015)* Washington, DC-MD-VA - (Marginal)
Carroll County
*8-Hour Ozone (2008)* Baltimore, MD - (Moderate)
*8-Hour Ozone (2015)* Baltimore, MD - (Marginal)
Cecil County
*8-Hour Ozone (2008)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
*8-Hour Ozone (2015)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
Charles County
*8-Hour Ozone (2015)* Washington, DC-MD-VA - (Marginal)
Frederick County
*8-Hour Ozone (2015)* Washington, DC-MD-VA - (Marginal)
Harford County
*8-Hour Ozone (2008)* Baltimore, MD - (Moderate)
*8-Hour Ozone (2015)* Baltimore, MD - (Marginal)
Howard County
*8-Hour Ozone (2008)* Baltimore, MD - (Moderate)
*8-Hour Ozone (2015)* Baltimore, MD - (Marginal)
Montgomery County
*8-Hour Ozone (2015)* Washington, DC-MD-VA - (Marginal)
Prince George's County
*8-Hour Ozone (2015)* Washington, DC-MD-VA - (Marginal)

**MASSACHUSETTS**
Dukes County
*8-Hour Ozone (2008)* Dukes County, MA - (Marginal)

**MICHIGAN**
Allegan County
*8-Hour Ozone (2015)* *Allegan County, MI - (Marginal)
Berrien County
*8-Hour Ozone (2015)* Berrien County, MI - (Marginal)
Livingston County
*8-Hour Ozone (2015)* Detroit, MI - (Marginal)
Macomb County
*8-Hour Ozone (2015)* Detroit, MI - (Marginal)
Monroe County
*8-Hour Ozone (2015)* Detroit, MI - (Marginal)
Muskegon County
*8-Hour Ozone (2015)* *Muskegon County, MI - (Marginal)
Oakland County
*8-Hour Ozone (2015)* Detroit, MI - (Marginal)
St. Clair County
*Sulfur Dioxide (2010)* *St. Clair, MI
*8-Hour Ozone (2015)* Detroit, MI - (Marginal)
Washtenaw County
*8-Hour Ozone (2015)* Detroit, MI - (Marginal)
Wayne County
*Sulfur Dioxide (2010)* *Detroit, MI
*8-Hour Ozone (2015)* Detroit, MI - (Marginal)

**MINNESOTA**
Dakota County
*Lead (2008)* *Eagan, MN

**MISSOURI**
Dent County
*Lead (2008)* *Iron, Dent, and Reynolds Counties, MO
Franklin County
*8-Hour Ozone (2015)* *St. Louis, MO-IL - (Marginal)
Iron County
*Lead (2008)* *Iron, Dent, and Reynolds Counties, MO
Jackson County
*Sulfur Dioxide (2010)* *Jackson County, MO

Jefferson County
*Lead (1978)* *Jefferson County (part); Herculaneum, MO
*Lead (2008)* *Jefferson County, MO
*Sulfur Dioxide (2010)* *Jefferson County, MO
Reynolds County
*Lead (2008)* *Iron, Dent, and Reynolds Counties, MO
St. Charles County
*8-Hour Ozone (2015)* St. Louis, MO-IL - (Marginal)
St. Louis County
*8-Hour Ozone (2015)* St. Louis, MO-IL - (Marginal)
St. Louis city
*8-Hour Ozone (2015)* St. Louis, MO-IL - (Marginal)

**MONTANA**

Flathead County
*PM-10 (1987)* *Flathead County; Whitefish and vicinity, MT - (Moderate)
Lake County
*PM-10 (1987)* *Polson, MT - (Moderate)
*PM-10 (1987)* *Ronan, MT - (Moderate)
Lincoln County
*PM-2.5 (1997)* *Libby, MT - (Moderate)
Rosebud County
*PM-10 (1987)* *Lame Deer, MT - (Moderate)
Sanders County
*PM-10 (1987)* *Sanders County (part); Thompson Falls and vicinity, MT - (Moderate)
Silver Bow County
*PM-10 (1987)* *Butte, MT - (Moderate)
Yellowstone County
*Sulfur Dioxide (1971)* *Laurel Area (Yellowstone County), MT

**NEVADA**

Clark County
*8-Hour Ozone (2015)* *Las Vegas, NV - (Marginal)

**NEW JERSEY**

Atlantic County
*8-Hour Ozone (2008)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
*8-Hour Ozone (2015)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
Bergen County
*8-Hour Ozone (2008)* New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious)
*8-Hour Ozone (2015)* New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate)
Burlington County
*8-Hour Ozone (2008)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
*8-Hour Ozone (2015)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
Camden County
*8-Hour Ozone (2008)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
*8-Hour Ozone (2015)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
Cape May County
*8-Hour Ozone (2008)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
*8-Hour Ozone (2015)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
Cumberland County

*8-Hour Ozone (2008)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
*8-Hour Ozone (2015)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)

Essex County
*8-Hour Ozone (2008)* New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious)
*8-Hour Ozone (2015)* New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate)

Gloucester County
*8-Hour Ozone (2008)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
*8-Hour Ozone (2015)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)

Hudson County
*8-Hour Ozone (2008)* New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious)
*8-Hour Ozone (2015)* New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate)

Hunterdon County
*8-Hour Ozone (2008)* New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious)
*8-Hour Ozone (2015)* New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate)

Mercer County
*8-Hour Ozone (2008)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
*8-Hour Ozone (2015)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)

Middlesex County
*8-Hour Ozone (2008)* New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious)
*8-Hour Ozone (2015)* New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate)

Monmouth County
*8-Hour Ozone (2008)* New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious)
*8-Hour Ozone (2015)* New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate)

Morris County
*8-Hour Ozone (2008)* New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious)
*8-Hour Ozone (2015)* New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate)

Ocean County
*8-Hour Ozone (2008)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
*8-Hour Ozone (2015)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)

Passaic County
*8-Hour Ozone (2008)* New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious)
*8-Hour Ozone (2015)* New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate)

Salem County
*8-Hour Ozone (2008)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
*8-Hour Ozone (2015)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)

Somerset County

| | |
|---|---|
| *8-Hour Ozone (2008)* | New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious) |
| *8-Hour Ozone (2015)* | New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate) |
| Sussex County | |
| *8-Hour Ozone (2008)* | New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious) |
| *8-Hour Ozone (2015)* | New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate) |
| Union County | |
| *8-Hour Ozone (2008)* | New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious) |
| *8-Hour Ozone (2015)* | New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate) |
| Warren County | |
| *Sulfur Dioxide (1971)* | *Warren Co, NJ |
| *8-Hour Ozone (2008)* | New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious) |
| *8-Hour Ozone (2015)* | New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate) |
| **NEW MEXICO** | |
| Dona Ana County | |
| *PM-10 (1987)* | *Anthony, NM - (Moderate) |
| *8-Hour Ozone (2015)* | *Dona Ana County (Sunland Park Area), NM - (Marginal) |
| **NEW YORK** | |
| Bronx County | |
| *8-Hour Ozone (2008)* | New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious) |
| *8-Hour Ozone (2015)* | New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate) |
| Chautauqua County | |
| *8-Hour Ozone (2008)* | Jamestown, NY - (Marginal) |
| Kings County | |
| *8-Hour Ozone (2008)* | New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious) |
| *8-Hour Ozone (2015)* | New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate) |
| Nassau County | |
| *8-Hour Ozone (2008)* | New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious) |
| *8-Hour Ozone (2015)* | New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate) |
| New York County | |
| *PM-10 (1987)* | New York Co, NY - (Moderate) |
| *8-Hour Ozone (2008)* | New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious) |
| *8-Hour Ozone (2015)* | New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate) |
| Queens County | |
| *8-Hour Ozone (2008)* | New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious) |
| *8-Hour Ozone (2015)* | New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate) |
| Richmond County | |
| *8-Hour Ozone (2008)* | New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious) |
| *8-Hour Ozone (2015)* | New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate) |
| Rockland County | |

*8-Hour Ozone (2008)* New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious)
*8-Hour Ozone (2015)* New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate)

Suffolk County
*8-Hour Ozone (2008)* New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious)
*8-Hour Ozone (2015)* New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate)

Westchester County
*8-Hour Ozone (2008)* New York-N. New Jersey-Long Island, NY-NJ-CT - (Serious)
*8-Hour Ozone (2015)* New York-Northern New Jersey-Long Island, NY-NJ-CT - (Moderate)

**OHIO**

Butler County
*8-Hour Ozone (2015)* Cincinnati, OH-KY - (Marginal)

Clermont County
*8-Hour Ozone (2015)* Cincinnati, OH-KY - (Marginal)

Cuyahoga County
*8-Hour Ozone (2015)* Cleveland, OH - (Marginal)

Geauga County
*8-Hour Ozone (2015)* Cleveland, OH - (Marginal)

Hamilton County
*8-Hour Ozone (2015)* Cincinnati, OH-KY - (Marginal)

Lake County
*8-Hour Ozone (2015)* Cleveland, OH - (Marginal)

Lorain County
*8-Hour Ozone (2015)* Cleveland, OH - (Marginal)

Medina County
*8-Hour Ozone (2015)* Cleveland, OH - (Marginal)

Morgan County
*Sulfur Dioxide (2010)* *Muskingum River, OH

Portage County
*8-Hour Ozone (2015)* Cleveland, OH - (Marginal)

Summit County
*8-Hour Ozone (2015)* Cleveland, OH - (Marginal)

Warren County
*8-Hour Ozone (2015)* Cincinnati, OH-KY - (Marginal)

Washington County
*Sulfur Dioxide (2010)* *Muskingum River, OH

**OREGON**

Klamath County
*PM-2.5 (2006)* *Klamath Falls, OR - (Moderate)

Lane County
*PM-10 (1987)* *Lane Co, OR - (Moderate)
*PM-2.5 (2006)* *Oakridge, OR - (Moderate)

**PENNSYLVANIA**

Allegheny County
*PM-2.5 (1997)* *Liberty-Clairton, PA - (Moderate)
*PM-2.5 (2006)* *Liberty-Clairton, PA - (Moderate)
*PM-2.5 (2012)* Allegheny County, PA - (Moderate)
*Sulfur Dioxide (2010)* *Allegheny, PA
*8-Hour Ozone (2008)* Pittsburgh-Beaver Valley, PA - (Marginal)

Armstrong County
*Sulfur Dioxide (1971)* *Armstrong Co, PA
*Sulfur Dioxide (2010)* *Indiana, PA
*8-Hour Ozone (2008)* Pittsburgh-Beaver Valley, PA - (Marginal)

Beaver County
*Lead (2008)* *Lower Beaver Valley, PA
*Sulfur Dioxide (2010)* *Beaver, PA

*8-Hour Ozone (2008)* Pittsburgh-Beaver Valley, PA - (Marginal)
Berks County
*Lead (2008)* *Lyons, PA
*Lead (2008)* *North Reading, PA
*8-Hour Ozone (2008)* Reading, PA - (Marginal)
Bucks County
*8-Hour Ozone (2008)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
*8-Hour Ozone (2015)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
Butler County
*8-Hour Ozone (2008)* Pittsburgh-Beaver Valley, PA - (Marginal)
Carbon County
*8-Hour Ozone (2008)* Allentown-Bethlehem-Easton, PA - (Marginal)
Chester County
*8-Hour Ozone (2008)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
*8-Hour Ozone (2015)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
Delaware County
*8-Hour Ozone (2008)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
*8-Hour Ozone (2015)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
Fayette County
*8-Hour Ozone (2008)* Pittsburgh-Beaver Valley, PA - (Marginal)
Indiana County
*Sulfur Dioxide (2010)* Indiana, PA
Lancaster County
*8-Hour Ozone (2008)* Lancaster, PA - (Marginal)
Lehigh County
*8-Hour Ozone (2008)* Allentown-Bethlehem-Easton, PA - (Marginal)
Montgomery County
*8-Hour Ozone (2008)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
*8-Hour Ozone (2015)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
Northampton County
*8-Hour Ozone (2008)* Allentown-Bethlehem-Easton, PA - (Marginal)
Philadelphia County
*8-Hour Ozone (2008)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
*8-Hour Ozone (2015)* Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE - (Marginal)
Warren County
*Sulfur Dioxide (2010)* *Warren, PA
Washington County
*8-Hour Ozone (2008)* Pittsburgh-Beaver Valley, PA - (Marginal)
Westmoreland County
*8-Hour Ozone (2008)* Pittsburgh-Beaver Valley, PA - (Marginal)

**PUERTO RICO**

Arecibo Municipio
*Lead (2008)* *Arecibo, PR
Bayamon Municipio
*Sulfur Dioxide (2010)* *San Juan, PR
Catano Municipio
*Sulfur Dioxide (2010)* San Juan, PR
Guaynabo Municipio
*Sulfur Dioxide (2010)* *San Juan, PR
Salinas Municipio
*Sulfur Dioxide (2010)* *Guayama-Salinas, PR

San Juan Municipio
*Sulfur Dioxide (2010)* *San Juan, PR
Toa Baja Municipio
*Sulfur Dioxide (2010)* *San Juan, PR

**TENNESSEE**

Sullivan County
*Sulfur Dioxide (2010)* *Sullivan County, TN

**TEXAS**

Anderson County
*Sulfur Dioxide (2010)* *Freestone and Anderson Counties, TX
Bexar County
*8-Hour Ozone (2015)* San Antonio, TX - (Marginal)
Brazoria County
*8-Hour Ozone (2008)* Houston-Galveston-Brazoria, TX - (Serious)
*8-Hour Ozone (2015)* Houston-Galveston-Brazoria, TX - (Marginal)
Chambers County
*8-Hour Ozone (2008)* Houston-Galveston-Brazoria, TX - (Serious)
*8-Hour Ozone (2015)* Houston-Galveston-Brazoria, TX - (Marginal)
Collin County
*8-Hour Ozone (2008)* Dallas-Fort Worth, TX - (Serious)
*8-Hour Ozone (2015)* Dallas-Fort Worth, TX - (Marginal)
Dallas County
*8-Hour Ozone (2008)* Dallas-Fort Worth, TX - (Serious)
*8-Hour Ozone (2015)* Dallas-Fort Worth, TX - (Marginal)
Denton County
*8-Hour Ozone (2008)* Dallas-Fort Worth, TX - (Serious)
*8-Hour Ozone (2015)* Dallas-Fort Worth, TX - (Marginal)
El Paso County
*PM-10 (1987)* *El Paso Co, TX - (Moderate)
Ellis County
*8-Hour Ozone (2008)* Dallas-Fort Worth, TX - (Serious)
*8-Hour Ozone (2015)* Dallas-Fort Worth, TX - (Marginal)
Fort Bend County
*8-Hour Ozone (2008)* Houston-Galveston-Brazoria, TX - (Serious)
*8-Hour Ozone (2015)* Houston-Galveston-Brazoria, TX - (Marginal)
Freestone County
*Sulfur Dioxide (2010)* *Freestone and Anderson Counties, TX
Galveston County
*8-Hour Ozone (2008)* Houston-Galveston-Brazoria, TX - (Serious)
*8-Hour Ozone (2015)* Houston-Galveston-Brazoria, TX - (Marginal)
Harris County
*8-Hour Ozone (2008)* Houston-Galveston-Brazoria, TX - (Serious)
*8-Hour Ozone (2015)* Houston-Galveston-Brazoria, TX - (Marginal)
Johnson County
*8-Hour Ozone (2008)* Dallas-Fort Worth, TX - (Serious)
*8-Hour Ozone (2015)* Dallas-Fort Worth, TX - (Marginal)
Kaufman County
*8-Hour Ozone (2008)* Dallas-Fort Worth, TX - (Serious)
*8-Hour Ozone (2015)* Dallas-Fort Worth, TX - (Marginal)
Liberty County
*8-Hour Ozone (2008)* Houston-Galveston-Brazoria, TX - (Serious)
Montgomery County
*8-Hour Ozone (2008)* Houston-Galveston-Brazoria, TX - (Serious)
*8-Hour Ozone (2015)* Houston-Galveston-Brazoria, TX - (Marginal)
Panola County
*Sulfur Dioxide (2010)* *Rusk and Panola Counties, TX
Parker County
*8-Hour Ozone (2008)* Dallas-Fort Worth, TX - (Serious)
*8-Hour Ozone (2015)* Dallas-Fort Worth, TX - (Marginal)
Rockwall County
*8-Hour Ozone (2008)* Dallas-Fort Worth, TX - (Serious)

Rusk County
*Sulfur Dioxide (2010)* *Rusk and Panola Counties, TX
Tarrant County
*8-Hour Ozone (2008)* Dallas-Fort Worth, TX - (Serious)
*8-Hour Ozone (2015)* Dallas-Fort Worth, TX - (Marginal)
Titus County
*Sulfur Dioxide (2010)* *Titus County, TX
Waller County
*8-Hour Ozone (2008)* Houston-Galveston-Brazoria, TX - (Serious)
Wise County
*8-Hour Ozone (2008)* Dallas-Fort Worth, TX - (Serious)
*8-Hour Ozone (2015)* Dallas-Fort Worth, TX - (Marginal)

**UTAH**

Box Elder County
*PM-2.5 (2006)* *Salt Lake City, UT - (Serious)
Cache County
*PM-2.5 (2006)* *Logan, UT-ID - (Moderate)
Davis County
*PM-2.5 (2006)* Salt Lake City, UT - (Serious)
*8-Hour Ozone (2015)* Northern Wasatch Front, UT - (Marginal)
Duchesne County
*8-Hour Ozone (2015)* *Uinta Basin, UT - (Marginal)
Salt Lake County
*PM-2.5 (2006)* Salt Lake City, UT - (Serious)
*Sulfur Dioxide (1971)* Salt Lake Co, UT
*8-Hour Ozone (2015)* Northern Wasatch Front, UT - (Marginal)
Tooele County
*PM-2.5 (2006)* *Salt Lake City, UT - (Serious)
*Sulfur Dioxide (1971)* *Tooele Co, UT
*8-Hour Ozone (2015)* *Northern Wasatch Front, UT - (Marginal)
Uintah County
*8-Hour Ozone (2015)* *Uinta Basin, UT - (Marginal)
Utah County
*PM-2.5 (2006)* *Provo, UT - (Serious)
*8-Hour Ozone (2015)* *Southern Wasatch Front, UT - (Marginal)
Weber County
*PM-2.5 (2006)* *Salt Lake City, UT - (Serious)
*8-Hour Ozone (2015)* *Northern Wasatch Front, UT - (Marginal)

**VIRGINIA**

Alexandria city
*8-Hour Ozone (2015)* Washington, DC-MD-VA - (Marginal)
Arlington County
*8-Hour Ozone (2015)* Washington, DC-MD-VA - (Marginal)
Fairfax County
*8-Hour Ozone (2015)* Washington, DC-MD-VA - (Marginal)
Fairfax city
*8-Hour Ozone (2015)* Washington, DC-MD-VA - (Marginal)
Falls Church city
*8-Hour Ozone (2015)* Washington, DC-MD-VA - (Marginal)
Loudoun County
*8-Hour Ozone (2015)* Washington, DC-MD-VA - (Marginal)
Manassas Park city
*8-Hour Ozone (2015)* Washington, DC-MD-VA - (Marginal)
Manassas city
*8-Hour Ozone (2015)* Washington, DC-MD-VA - (Marginal)
Prince William County
*8-Hour Ozone (2015)* Washington, DC-MD-VA - (Marginal)

**WEST VIRGINIA**

Marshall County
*Sulfur Dioxide (2010)* *Marshall, WV

**WISCONSIN**

Kenosha County
*8-Hour Ozone (2008)* *Chicago-Naperville, IL-IN-WI - (Serious)
*8-Hour Ozone (2015)* *Chicago, IL-IN-WI - (Marginal)
Manitowoc County
*8-Hour Ozone (2015)* *Manitowoc County, WI - (Marginal)
Milwaukee County
*8-Hour Ozone (2015)* *Northern Milwaukee/Ozaukee Shoreline, WI - (Marginal)
Oneida County
*Sulfur Dioxide (2010)* *Rhinelander, WI
Ozaukee County
*8-Hour Ozone (2015)* *Northern Milwaukee/Ozaukee Shoreline, WI - (Marginal)
Sheboygan County
*8-Hour Ozone (2015)* *Sheboygan County, WI - (Marginal)

**WYOMING**

Lincoln County
*8-Hour Ozone (2008)* *Upper Green River Basin Area, WY - (Marginal)
Sublette County
*8-Hour Ozone (2008)* Upper Green River Basin Area, WY - (Marginal)
Sweetwater County
*8-Hour Ozone (2008)* *Upper Green River Basin Area, WY - (Marginal)

**Discover.**
**Connect.**
**Ask.**

**Follow.**

**2020-09-30**

# ATTACHMENT 37

*U.S. Environmental Protection Agency (EPA) Website. 2020. General Conformity - De Minimis Tables. Available at: https://www.epa.gov/general-conformity/de-minimis-tables. Accessed on: 9/30/20.*

An official website of the United States government.

Close

Due to a sitewide outage, some EPA content may not be available at this time. We are working to resolve the issue.

Close

We've made some changes to EPA.gov. If the information you are looking for is not here, you may be able to find it on the EPA Web Archive or the January 19, 2017 Web Snapshot.

# De Minimis Tables

| 40 CFR 93.153(b)(1) - For purposes of paragraph (b) of this section the following rates apply in nonattainment areas (NAA's): | |
|---|---|
| | **Tons/year** |
| Ozone (VOC's or NOx): | |
| Serious NAA's | 50 |
| Severe NAA's | 25 |
| Extreme NAAs | 10 |
| Other ozone NAA's outside an ozone transport region: | 100 |
| Other ozone NAA's inside an ozone transport region: | |
| VOC | 50 |
| NOx | 100 |
| Carbon Monoxide: All maintenance areas | 100 |
| $SO_2$ or $NO_2$: All NAA's | 100 |
| $PM_{10}$: | |
| Moderate NAA's | 100 |
| Serious NAA's | 70 |
| $PM_{2.5}$ (direct emissions, $SO_2$, NOx, VOC, and Ammonia): | |
| Moderate NAA's | 100 |
| Serious NAA's | 70 |
| Pb: All NAA's | 25 |

| 40 CFR 93.153(b)(2) - For purposes of paragraph (b) of this section the following rates apply in maintenance areas: | |
|---|---|
| | **Tons/year** |
| Ozone (NOx), $SO_2$ or $NO_2$: | |
| All maintenance areas | 100 |
| Ozone (VOC's) | |
| Maintenance areas inside an ozone transport region | 50 |
| Maintenance areas outside an ozone transport region | 100 |
| Carbon monoxide: All maintenance areas | 100 |
| $PM_{10}$: All maintenance areas | 100 |
| $PM_{2.5}$ (direct emissions, SO2, NOx, VOC, and Ammonia) | 100 |
| All maintenance areas | 100 |
| Pb: All maintenance areas | 25 |

LAST UPDATED ON MAY 27, 2020

# ATTACHMENT 38

North Coast Regional Water Quality Control Board. *Email Correspondence with City of Arcata and California State Water Quality Control Board Site Closure.* October 19, 2020.

October 19, 2020

Mark Andre
City of Arcata
Director of Environmental Services
736 F Street
Arcata, CA 95521
mandre@cityofarcata.org

Dear Mr. Andre:

Site: City of Arcata Corporation Yard, 600 G Street, Arcata, CA 95521
Case Number 1NHU767

Subject: Eligible for Closure

SHN Consulting requested case closure for this site in their August 2018 "Groundwater Monitoring Report and Low Threat Closure Evaluation." Additional information was required including current groundwater data from monitoring well MW-2. In February 2019, SHN collected groundwater samples from a temporary well point near MW-2 because the monitoring well was compromised and could not be accessed. SHN submitted a report and closure request in April 2019. A summary memo for the site is attached to this letter. Regional Water Board staff concurs with closing this case.

Due to the presence of soil and groundwater impacts at the site, a land use covenant (LUC) must be recorded with the County of Humboldt prior to closure. We will send you a draft of the LUC for review. The LUC will need to include the legal description of the property when it is finalized. Please provide this agency with a copy of the legal description of the property.

A 60-day public comment period is required prior to case closure. The notification will be sent to:

1) Municipal and county water districts, water replenishment districts, special act districts with groundwater management authority,
2) Agencies with authority to issue building permits for land affected by the petroleum release, and
3) Owners and occupants of the property impacted by the petroleum release, and the owners and occupants of all parcels adjacent to the site.

A copy of this letter and the public notice (Notice) has been sent to the Humboldt County Environmental Health Department and adjacent property owners. Please post the Notice at the site and distribute copies to the occupants of the site building and adjacent buildings.

Before case closure can be completed, a LUC must be recorded, and the monitoring wells installed as part of this investigation will need to be decommissioned in accordance with the California Department of Water Resources Well Standards (DWR Bulletins 74-81 and 74-90). Please submit to this office a brief workplan (e.g., letter plan) for the destruction of the wells. You will also need to obtain the proper permit from Humboldt County Environmental Health. In addition, all investigative and remedial wastes need to be removed from the site and properly disposed. A report of well destruction and waste disposal needs to be submitted to this office before final case closure. Do not proceed with the well decommissioning until the public notice period has ended on December 21, 2020, and you receive concurrence with the workplan from Regional Water Board staff.

Please do not hesitate to contact me at Paul.Nelson@waterboards.ca.gov or (707) 576-2686 if you have any questions.

Sincerely,

Paul Nelson, P.G., C.Hg.
Engineering Geologist

201019_PBN_mc_ArcataCorpYard_ClosureLetter

Attachments: Review of Closure Evaluation and Recommendation for No Further Action

cc: SHN Consulting Engineers and Geologists, enielsen@shn-engr.com
Humboldt County Environmental Health, Norm Crawford, ncrawford@co.humboldt.ca.us
City of Arcata Building and Engineering Department, Engineering@cityofarcata.org
Property owner and occupant, 700 South G Street, Arcata, CA 95521
California State Parks District Office, P.O. Box 2006 Eureka, CA 95502

TO: Heidi Bauer/ File

FROM: Paul Nelson

Digitally signed by Paul Nelson
Date: 2020.10.19 08:24:14 -07'00'

DATE: October 19, 2020

Site: Arcata City Corporation Yard, 600 G Street, Arcata, 1NHU767

Subject: Review of Closure Evaluation and Recommendation for No Further Action

## Summary

The Arcata City Corporation Yard is located on G Street, west of Highway 101, adjacent to Humboldt Bay and the City of Arcata wastewater treatment plant. In 2000, the City of Arcata (City) encountered contamination during a site upgrade. Several investigations and remediation activities have occurred at the site. Current conditions indicate that the past remediation has been successful in removing source material from the site and groundwater impacts have been declining. I recommend closing this site with no further action required.

## Background

Fueling activities commenced at the corporation yard in 1962. The corporation yard was historically tidal marsh with drainage channels that were filled in over time. Prior to the City locating the corporation yard to this site, the land near the former fueling island was used by the City for the disposal of soil generated from various construction and repair activities.

In 2000, the City of Arcata began upgrading its corporation yard. During the initial phase of the facility upgrade, contamination was encountered when a trench for a channel drain was being constructed. Free product and contaminated soils were noted in the portion of the trench located in the vicinity of the fuel island dispensers. A pressure test was conducted by W. N. Tetrault & Co. of Eureka, California on May 11, 2000 which determined that the diesel line and the unleaded fuel line were leaking. Following the results of the pressure test, the fuel island was immediately taken out of service by the City of Arcata (SHN, May 2000).

## Geology and Hydrogeology

The geology at the site generally consists of fill material to depths of between one and eight feet below ground surface. The fill is underlain by clay with silt and organic matter (bay mud). The site is generally flat and groundwater flow has been calculated to be towards the north. Groundwater levels are typically shallow and have been measured between about 0.3 to six feet above mean sea level.

A sensitive receptor survey was performed for the site in 2008. The survey did not find any water supply well within 1,500 feet of the site. The survey did identify several buried utilities and the tidal marsh and draining channels adjacent to the site.

## Environmental Investigations

- In June 2000, ten soil borings (B-1 through B-10) were drilled and sampled at the site. Soil and groundwater samples were analyzed for total petroleum hydrocarbons as gasoline (TPH-g), diesel (TPH-d), benzene, toluene, ethylbenzene, and xylenes, (BTEX), fuel oxygenates, and lead. Elevated concentrations of diesel, gasoline, and BTEX were present in the soil and groundwater samples that were collected near the fueling island.

- In August 2000, nine exploratory soil borings and temporary well points (WP-101 through WP-109) were drilled and sampled at the site. The investigation confirmed the presence of elevated concentrations of TPH-g, TPH-d, and BTEX in soil in the area of the fueling island, and in groundwater near the source area.

- In October 2000, approximately 550 gallons of gasoline was released at a temporary fueling area. Excavation was performed in this area in October 2001.

- In September 2002, monitoring wells MW-1 through MW-6 were installed at the site. Groundwater monitoring and reporting occurred at the site on a quarterly basis from September 2002 to October 2009.

- In May 2018, a confirmation groundwater monitoring event was performed at the site. Monitoring well MW-2 could not be located during this event.

- In February 2019 a groundwater grab sample was collected from a temporary soil boring that was drilled near MW-2.

## Environmental Remediation

Remedial measures performed include the excavation of an estimated 240 cubic yards (cy) of petroleum hydrocarbon-contaminated soils in November 2000 to mitigate the effect of the October 2000 spill. In October 2001, an additional 500 cy of soil was excavated from the source areas and stockpiled on site. A recovery sump was operated as an interim remedial action for dissolved phase hydrocarbons at the source while the

extent of the dissolved phase hydrocarbon contamination was being investigated. The groundwater recovered from the recovery sump was pumped into an oil/water separator and then discharged to the City of Arcata wastewater treatment plant. (WWTP)

In September 2003 a biopile was constructed of the 740 cy of stockpiled soil at the site. The biopile remediation process involved stimulating aerobic microbial activity through active aeration with a blower. Inorganic fertilizers were added to supplement available nutrients, and air was supplied into the soil piles to stimulate existing bacteria in the soils, which degraded the petroleum hydrocarbons. In a letter dated April 13, 2006, the Regional Water Board indicated that the soil was suitable for relocation and the treated material was moved to the area west of Marsh #3.

A groundwater pump-and-treat system was installed in May 2004 to extract groundwater from MW-3. The pump-and-treat system had minimal effect on decreasing petroleum hydrocarbon concentrations in the groundwater and was taken off-line in March 2005. Approximately 96,000 gallons of groundwater was extracted and treated and subsequently discharged to the City of Arcata WWTP.

In April 2006, an air sparge treatment system was operated at the site to enhance bioremediation of the groundwater. The system injected compressed air into four sparge wells located within the excavation area. The sparge system was shut down in November 2008 and was effective in reducing petroleum hydrocarbon concentrations in groundwater.

**Asphalt Dumping Area**

The site was also the subject of an investigation and cleanup of an asphalt emulsion dumping area. The asphalt investigation overlapped the AST and spill investigation. The excavation that took place in November 2000 for the gasoline spill also encompassed the asphalt emulsion dumping area and included the removal of impacted material followed by confirmation sampling. The excavation appears to have remediated the asphalt dumping area along with the impacts from the AST spill.

**Results of Remedial Efforts**

The excavations appeared to have been successful in removing impacted soil from both the spill and AST/dispenser areas. The confirmation samples were mostly favorable but three locations (samples 60, 54 and S17) contained gasoline and/or diesel above the screening levels for a commercial property[1]. Soil boring WP-8 also exhibited elevated concentrations of petroleum hydrocarbons. The excavation area is currently paved.

The air sparging efforts appear to have helped reduce the concentrations of petroleum hydrocarbons in groundwater. Although residual concentrations remain in groundwater, the levels have declined over time and appear to be attenuating.

[1] United States Environmental Protection Agency Region 9, Regional Screening Levels, April, 2019

Please refer to SHN's August 2018 Groundwater Monitoring Report and Low Threat Closure Evaluation and April 2019 Addendum 1 to Low Threat Closure Evaluation for details regarding the site including tabulated analytical data of soil and groundwater samples.

**Closure Discussion**

The petroleum hydrocarbon plume that exceeds water quality objectives (MTBE and TBA) is less than 250 feet long and Humboldt Bay and adjacent wetlands are approximately 200 to 300 feet from the plume boundary. However, the groundwater concentrations have been declining which indicates that natural attenuation is occurring at the site.

Step-out groundwater grab samples collected in August 2000 defined the distal plume to below water quality objectives and the May 2018 monitoring well data indicates concentrations of MTBE and TBA from 0.50 micrograms per liter (µg/L) to 20 µg/L, and 11 µg/L to 48 µg/L, respectively. MW-2 was damaged by heavy equipment and could not be sampled during the May 2018 sampling event. However, a temporary sampling point was installed next to MW-2 in February 2019. Results from this sampling did not indicate the presence of MTBE above the reporting limit (5 µg/L). No other petroleum hydrocarbons were detected above the reporting limit. These data indicate a decline in MTBE concentrations in the area of MW-2 compared with the 2009 results (12 µg/L of MTBE in MW-2). With respect to TBA, the results indicate a typical degradation pathway from MTBE to TBA followed by declining trends. These conditions are expected to continue because the source has been removed and the dissolved phase concentrations are degrading and diluting.

Soil impacts in the vicinity of the former AST and the historical spill were generally removed from the site. However, impacted soil remains at the AST and excavation locations as well as in the area of WP-8 but the remaining concentrations do not appear to be a direct contact or outdoor air exposure risk. The highest concentration of benzene in soil was 5.6 mg/kg in WP-8 at a depth of 3.5 to 4.5 feet below ground surface which is above the San Francisco Bay Regional Water Quality Control Board Environmental direct exposure screening level (ESL) for shallow soil in a commercial setting. The WP-8 soil sample is also above the USEPA Regional Screening Level (RSL) for benzene in industrial soil (5.1 mg/kg).

The concentrations of total petroleum hydrocarbons as diesel in shallow soil are above the direct exposure ESL in the WP-8 soil sample (1,700 mg/kg compared with the 1,100 mg/kg ESL). The remaining soil samples are below the direct exposure ESLs for TPH as gasoline, and diesel.

**Conclusions**

Based on the information contained in the file, groundwater pollution appears to be adequately defined at the site. Although petroleum hydrocarbon concentrations at the site remain over the water quality objectives in some monitoring wells, the data

indicates declining concentrations and attenuation. The nearest sensitive receptor corresponds to the tidal flats of Humboldt Bay and Klopp Lake which are located 200 to 600 feet from the plume boundary.

The Arcata City Corporation Yard is located adjacent to the City of Arcata wastewater treatment facility. There are wastewater treatment oxidation ponds south of the site and parklands to the north and west. The site is likely to remain the City Corporation Yard for the foreseeable future.

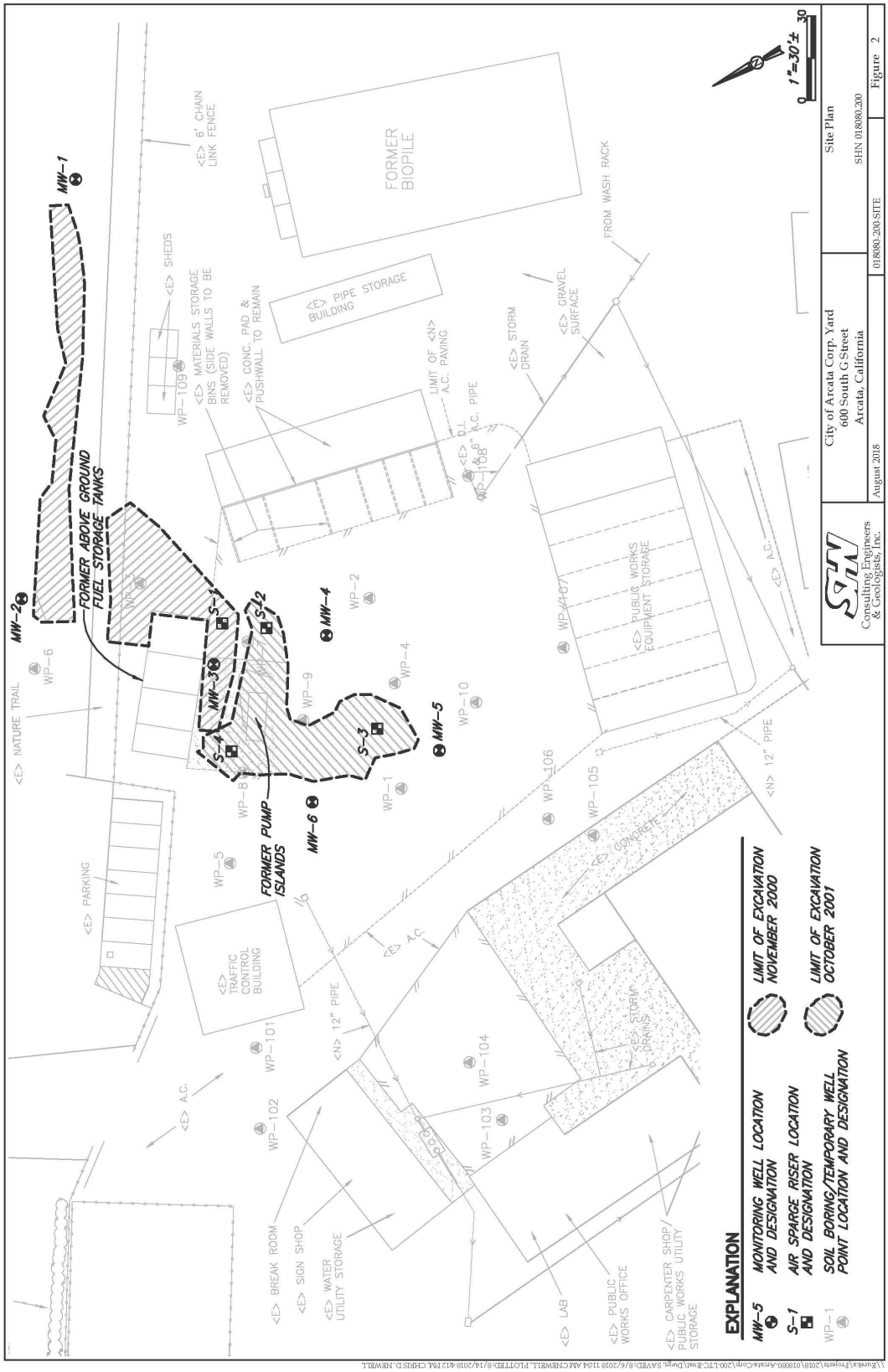
The remaining diesel and benzene impacts in soil are over the screening levels for direct exposure in an industrial setting. However, the impacts are limited in areal extent. A soil management plan has been submitted for the site that identifies the former AST location and excavation as areas of concern and addresses the remaining soil impacts (Soil and Groundwater Management Contingency Plan) . The plan adequately defines procedure for handling and disposing of petroleum hydrocarbon impacted soil and groundwater if encountered at the site.

Recording a land use covenant (LUC) is warranted based on the remaining soil impacts in the former AST location. The LUC should identify the area of impacts and require proper handling and disposal of soil that is exposed or excavated from the site.

**Recommendations**

I recommend closing the case with no further remedial action. An LUC that addresses the remaining soil impacts and includes the soil and groundwater management plan should be recorded prior to closure.

201019_PBN_mc_ArcataCorpYard_SummaryMemo


FORMER ABOVE GROUND FUEL STORAGE TANKS
FORMER PUMP ISLANDS
FORMER BIOPILE
MW-1
MW-2
MW-3
MW-4
MW-5
MW-6
S-1
S-2
S-3
S-4
WP-1
WP-2
WP-3
WP-4
WP-5
WP-6
WP-7
WP-8
WP-9
WP-10
WP-101
WP-102
WP-103
WP-104
WP-105
WP-106
WP-107
WP-108
WP-109
<E> NATURE TRAIL
<E> PARKING
<E> TRAFFIC CONTROL BUILDING
<E> BREAK ROOM
<E> SIGN SHOP
<E> WATER UTILITY STORAGE
<E> A.C.
<N> 12" PIPE
<E> STORM DRAINS
<E> LAB
<E> PUBLIC WORKS OFFICE
<E> CARPENTER SHOP/ PUBLIC WORKS UTILITY STORAGE
<E> CONCRETE
<E> PUBLIC WORKS EQUIPMENT STORAGE
<E> PIPE STORAGE BUILDING
<E> SHEDS
<E> MATERIALS STORAGE BINS (SIDE WALLS TO BE REMOVED)
<E> CONC. PAD & PUSHWALL TO REMAIN
<E> 6" CHAIN LINK FENCE
LIMIT OF <N> A.C. PAVING
<E> D.I.
<E> STORM DRAIN
<E> GRAVEL SURFACE
FROM WASH RACK
EXPLANATION
MW-5 MONITORING WELL LOCATION AND DESIGNATION
S-1 AIR SPARGE RISER LOCATION AND DESIGNATION
WP-1 SOIL BORING/TEMPORARY WELL POINT LOCATION AND DESIGNATION
LIMIT OF EXCAVATION NOVEMBER 2000
LIMIT OF EXCAVATION OCTOBER 2001
1"=30'±
SHN
Consulting Engineers & Geologists, Inc.
City of Arcata Corp. Yard
600 South G Street
Arcata, California
Site Plan
SHN 018080.200
August 2018
018080-200-SITE
Figure 2

**Notice of Proposed No Further Action**

for

City of Arcata Corporation Yard
600 G Street, Arcata, California

Case Number 1NHU767

Humboldt County

**Notice Posting Date: October 19, 2020**

**End of Comment Period: December 21, 2020**

Soil and groundwater investigations were conducted at the above-referenced site and releases of petroleum hydrocarbons were documented. Although some contamination remains, this site meets the conditions for closure. Regional Water Board staff proposes that no further work be required. The purpose of this notice is to inform interested parties, including owners of nearby land, that the case is being considered for closure, and to invite public comment on this proposed decision.

**Problem Description**
Previous aboveground storage tank fuel systems, removed/upgraded in 2000, released petroleum hydrocarbon diesel and gasoline to soil and groundwater at this site. Soil and groundwater at and around the release areas have been investigated. Historical sampling at the site indicated contamination in soil and groundwater in the immediate vicinity of the release. However, recent sampling has indicated impacts remaining in groundwater are confined to the site and are degrading. No water supply wells were impacted by this contamination.

**Proposed Action**
Case closure is proposed once the land use covenant is recorded.

Unless significant comments are received or new information is presented regarding this site, Regional Water Board staff plans to proceed with the closure process upon conclusion of the comment period. Please contact Paul Nelson at (707) 576-2686 or Paul.Nelson@waterboards.ca.gov with any questions or comments. Written comments may also be submitted to:

North Coast Regional Water Quality Control Board
Attention: Paul Nelson
5550 Skylane Blvd, Suite A
Santa Rosa, CA 95403

Regional Water Board site records comprise both a paper file and an electronic file. Beginning in 2005, select file material was uploaded to the State Water Resources Control Board's GeoTracker website and not necessarily included in the paper file. All new file material after 2014 is retained only electronically. The GeoTracker records are available at:
https://geotracker.waterboards.ca.gov/profile_report.asp?global_id=T0602393537

The paper file (“Arcata, City Corporation Yard”, Case No. 1NHU767) may be reviewed at the North Coast Regional Water Quality Control Board office from 8:00 a.m. to 5:00 p.m. Monday through Friday. Appointments are recommended and can be arranged by calling (707) 576-2220.

# ATTACHMENT 39

City of Arcata. September 2020. *Final Notice and Public Explanation of a Proposed Activity in a Wetland.* Published 09/16/20.

**Final Notice and Public Explanation of a Proposed Activity in a Wetland**

To: All interested Agencies, Groups and Individuals:

This is to give notice that the City of Arcata has conducted an evaluation as required by Executive Orders 11988 and 11990, and as implemented by U.S. Department of Housing and Urban (HUD) Regulations found at 24 CFR 55.20, to determine the potential effect that its activity in the floodplain and wetland will have on the human environment, for the proposed Arcata Wastewater Treatment Facility Upgrades Project under contract number 17-CDBG-12017. HUD has allocated Community Development Block Grant funds for the acquisition and installation of UV equipment, which would be dispersed through the City of Arcata as the Responsible Entity for the proposed project; therefore, the City of Arcata is the Lead Agency for National Environmental Policy Act (NEPA) review.

There are three primary purposes for this notice. First, people who may be affected by activities in wetlands and those who have an interest in the protection of the natural environment should be given an opportunity to express their concerns and provide information about these areas. Second, an adequate public notice program can be an important public educational tool. The dissemination of information about wetlands can facilitate and enhance Federal efforts to reduce the risks associated with the occupancy and modification of these special areas. Third, as a matter of fairness, when the Federal government determines it will participate in actions taking place in wetlands, it must inform those who may be put at greater or continued risk.

The Proposed Project will rehabilitate the City's existing wastewater treatment facility located at 601 G Street in Arcata, Humboldt County, California. Arcata's Wastewater Treatment Facility (Facility) is located within the Arcata Marsh and Wildlife Sanctuary, and utilizes innovative treatment methods using treatment ponds within the marsh area. The City of Arcata is proposing to replace a portion of existing Facility infrastructure and upgrade several components as part of the Arcata Wastewater Treatment Facility Improvement Project. The work includes installation of buried pipe for the flow reconfiguration of disinfected enhancement wetlands effluent, installing a discharge pipe into a constructed brackish marsh at the north end of the Arcata Bay section of Humboldt Bay (future outfall discharge point), relocation of the electrical equipment building in the Facility to allow for improved road access for fire and emergency services (requiring installation of a new utility service line), installing a new ultraviolet light disinfection system, and constructing a mitigation wetland area. For a full description of proposed activities, visit the City's Facility Upgrades page at: https://www.cityofarcata.org/856/Wastewater-Treatment-Facilities-Improvem

The Facility is located in the "AE" Flood zone, which has an annual 1% probability of flooding. Additionally, the project scope includes the installation of a new discharge pipe for treated effluent into an existing Brackish Marsh, which was constructed as part of the McDaniel Slough Restoration Project with the express intent of treating discharged wastewater. The Final Wetland Delineation identified the Outfall area as containing 0.23 acres of freshwater emergent wetland, a portion of which may be permanently impacted by the project (Stillwater Sciences Final Delineation of Waters and Wetlands, August 2020). This wetland area is subject to Section 404 of the Clean Water Act and thus under USACE-

jurisdiction as well as State- and LCP-jurisdiction. The Early Notice and Public Review of Proposed Activities in 100-Year Floodplain and Mapped Wetland Area, published July 8, 2020, shared the current available data at the time, which assumed 0.1 acres of wetland in the area of the Brackish Marsh may be affected (Stillwater Sciences Preliminary Delineation of Waters and Wetlands, April 2020). The final 8-Step Analysis and assumptions noted herein reviewed project effects and alternatives using the final calculated wetlands acreage of 0.23 acres.

The City of Arcata has considered the following alternatives and mitigation measures to be taken to minimize adverse impacts and to restore and preserve natural and beneficial values:

**Locate the Project Outside of the Floodplain and Wetland (Offsite Alternative)**: The project's intent is to rehabilitate and improve the existing system, and a full relocation would not fit these parameters. This objective is based on both the logistic and economic and time constrained infeasibility of a full relocation of the facility. Arcata is a small community of less than 20,000 inhabitants, roughly half of which are students; the cost of a full relocation has been estimated at up to $150 million by the City engineer. There are only a handful of parcels within City limits that could house such a large facility, and the majority of them are already developed. In addition, many of the suitable industrially-zoned parcels in the northern portion of the City are subject to inundation in the case of a catastrophic failure of Matthew's Dam at Ruth Lake. Suitably large parcels in the southern or eastern portion of Arcata would likely require conversion of prime agricultural lands, and would remain located in the Coastal Zone with similar impacts and permit processes.

**No Action Alternative:** The project purpose and need would not be met with the No Action alternative. The No Action alternative assumes that no new upgrades to the existing facility would occur. In the absence of these upgrades, the Facility will remain out of compliance with the requirements of the NPDES permit and the quality of treated effluent discharged into Humboldt Bay will not be addressed, which has the potential to result in a variety of negative effects to humans and wildlife. The City's continued ability to utilize the Treatment Facility relies on undertaking the improvements discussed in this environmental assessment.

**Onsite configuration Alternatives (includes Preferred Alternative):** Four alternatives augmenting the existing facility treatment system were developed in the prepared Facility Plan (Carollo Engineers, 2017) to address improvements needed for the AWTF. The four alternatives included common improvements, including actions to reduce flood risk, vegetation maintenance, and ultraviolet disinfection, among others. A full list of common improvements can be found in the 8-Step Analysis, which can be viewed at City Hall or online at the link listed at the end of this Notice.

Alternatives were conceived through a collaboration between City staff, LACO Associates, Carollo Engineers, and the community through public discussions in a series of public workshops. The City and consultants (LACO Associates and Carollo Engineers) determined the five criteria that were important for the project and ranked each project. The five criteria were: meets permit requirements; ease of operation and maintenance; constructability; reliability; and ammonia removal.

Alternative 1 was the least expensive alternative, however it received the lowest scores for meeting permit requirements, constructability, reliability and ammonia removal. Alternative 2 provides an additional secondary treatment system that will provide BOD treatment and meet ammonia and nitrogen limits. Alternative 2 is the second most expensive alternative and received

low ranking regarding the non-economic criteria. The low ranking was due to Alternative 2 requiring the most project elements. This would increase the difficulty of operating and maintaining the treatment processes and facilities. Alternative 3 constructs an additional secondary treatment system with a larger capacity than Alternative 2 because less treatment will occur in the natural system, Alternative 3 requires less construction and maintenance than Alternative 2. Alternative 3 was the highest scoring alternative for the non-economic criteria. It achieved high rankings in reliability and ammonia removal due to the larger treatment capacity of the oxidation ditches compared to Alternative 2.

Alternative 4 (Preferred Alternative) was developed after the first three alternatives were presented to the Regional Water Quality Control Board (Water Board). The Water Board found that these three alternatives would not achieve the requirements of the permit. Alternatives 1, 2 and 3 did not provide the peak wet weather flow capacity (5.9 mgd) to pass through the Enhancement Wetlands. This is not in compliance with the Enclosed Bays and Estuaries Policy. Alternative 4 allows a peak pumped flow of 5.9 mgd at Outfall-003 to utilize the Enhancement Wetlands for additional treatment and meet the discharge requirements.

It has been determined that the Preferred Alternative would provide improved water treatment for the existing City population, and would address rehabilitation needs of critical city infrastructure. While the Preferred Alternative would change the elevation of the floodplain in the vicinity of the proposed project, it would not change the occupancy of the floodplain and would not have effects on flood velocities upstream or downstream. Once implemented, the improved levee system will be designed to withstand storm surge velocities and wave action for the 100-year-storm event. The Preferred Alternative would therefore minimize the potential effects that could be expected to occur within the floodplain and further mitigation or compliance measures will not be required. While there would be adverse effects to regulated wetlands resulting from construction of the proposed project, the Preferred Alternative would not significantly adversely affect wetland resources in the area and all permanently affect wetlands will be mitigated onsite at a minimum 1:1 ratio, in compliance with state and local wetland protection procedures. Furthermore, the project area is already developed and the treatment facility is pre-existing; implementation of the Preferred Alternative would not encourage further new development within the floodplain or wetlands in the proposed project area.

The City of Arcata has reevaluated the alternatives to building in the wetland and has determined that it has no practicable alternative. Therefore, the City determines that the proposed project complies with EOs 11988 and 11990, and 44 CFR 60.3. Environmental files that document compliance with steps 3 through 6 of EO 11988 are available for public review with the Community Development Department, located at Arcata City Hall at 736 F Street, Arcata CA, (707) 822-5955, and may be examined or copied on weekdays between 11:00 AM and 5:00 PM. The documents may also be found at:
https://www.cityofarcata.org/856/Wastewater-Treatment-Facilities-Improvem

PUBLIC COMMENTS

Pursuant to 24 CFR Part 55, an Early Notice and Public Review of a Proposed Activity in a 100-Year Floodplain and Wetland, was published on July 8, 2020. Publication of this notice was followed by a 28 day comment period, in which one public comment was received. The comment was from a partner agency and did not substantively address the proposed use of federal funds to support the construction of the proposed project in a floodplain and / or

wetland, but primarily requested further information related to project impacts to fish and wildlife, which will be further analyzed in the project's Environmental Assessment. These comments will be included as an appendix to the Final Environmental Assessment.

All interested persons, groups and agencies are invited to submit written comments to the Community Development Department of the City of Arcata regarding the proposed use of federal funds to support the construction of the proposed project in a floodplain and / or wetland, at the following email address: comdev@cityofarcata.org or the address listed above. The Community Development Department will consider all comments received by close of business on September 24, 2020.