Pumping Energy Requirements from New AWTF to RMTII

Pipeline Length	50000 ft	
Average Dry Weather Flow	2.3 MGD	3.558629 cfs
Average Wet Weather Flow	5 MGD	7.73615 cfs
peak Wet Weather Flow	5.9 MGD	9.128657 cfs
Peak Instantaneous Flow	16.5 MGD	25.5293 cfs

MGD to CFS	1.54723
MGD to GPM	694.44
HW C value (PVC)	130

1 psi		2.31 head (ft)
pump eff	n	0.7
Specific Gravity	SG	1
1 hp		0.7457 kW

flow (MGD)	flow (cfs)	flow (gpm	actual ID (	Area (ft^2)	Velocity (ft/s)	headloss per 100 ft (ft/100ft)	headloss full pipe (ft)	TDH (assumed 50% increase to headloss for minor losses)	power required (hp)	power required (kW)	kWh/year
0	0.0	0	24	3.1	0	0.00	0	23	0.0	0.0	0
2.3	3.6	1597	24	3.1	1	0.02	11	38	22.1	16.5	144333
5	7.7	3472	24	3.1	2	0.09	45	89	111.8	83.4	730351
5.9	9.1	4097	24	3.1	3	0.12	60	113	167.3	124.8	1093026
16.5	25.5	11458	24	3.1	8	0.81	406	632	2611.4	1947.3	17058497

Hazen Williams Equation

$h_{100ft} = 0.2083\ (100 / c)^{1.852}\ q^{1.852} / d_h^{4.8655}$ (1)

where

h_{100ft} = friction head loss in feet of water per 100 feet of pipe (ft_{h2O}/100 ft pipe)

c = Hazen-Williams roughness constant

q = volume flow (gal/min)

d_h = inside hydraulic diameter (inches)

Water Power Equation

Or - alternatively

$P_{h(hp)} = q_{gpm}\ h_{ft}\ SG / (3960\ \eta)$ (2b)

where

q_{gpm} = flow (gpm)

h_{ft} = differential head (ft)

SG = Specific Gravity (1 for water)

η = pump efficiency

dry months energy use (kWh)		60139
wet months energy use (kWh)		426038
yearly use (kWh):		486177
cost per kWh	$	0.30
Yearly Energy Cost	**$**	**146,000**

Pumping Energy Requirments from Ex AWTF to New AWTF Location

Pipeline Length	19300 ft		MGD to CFS	1.54723	
Average Dry Weather Flow	2.3 mgd	3.558629 cfs	MGD to GPM	694.44	
Average Wet Weather Flow	5 mgd	7.73615 cfs	HW C value (P	130	
peak Wet Weather Flow	5.9 mgd	9.128657 cfs	1 psi	=	2.31 head (ft)
Peak Instantaneuos Flow	16.5 mgd	25.5293 cfs	pump eff	n	0.7
			Specific Gravit	SG	1
			1 hp		0.7457 kW

flow (mgd)	flow (cfs)	flow (gpm)	actual ID (	Area (ft^2)	Velocity (ft/s)	headloss per 100 ft (ft/100ft)	headloss full pipe (ft)	TDH (assumed 30% increase to headloss for minor losses)	power required (hp)	power required (kW)	kWh/year
0	0.0	0	24	3.1	0	0.00	0	20	0.0	0.0	0
2.3	3.6	1597	24	3.1	1	0.02	4	25	14.3	10.7	93349
5	7.7	3472	24	3.1	2	0.09	17	42	52.4	39.1	342294
5.9	9.1	4097	24	3.1	3	0.12	23	50	73.7	54.9	481255
16.5	25.5	11458	24	3.1	8	0.81	157	223	923.1	688.3	6029929

Hazen Williams Equation

$h_{100ft} = 0.2083\ (100 / c)^{1.852}\ q^{1.852} / d_h^{4.8655}$ (1)

where

h_{100ft} = friction head loss in feet of water per 100 feet of pipe (ft_{h2O}/100 ft pipe)

c = Hazen-Williams roughness constant

q = volume flow (gal/min)

d_h = inside hydraulic diameter (inches)

Water Power Equation

Or - alternatively

$P_{h(hp)} = q_{gpm}\ h_{ft}\ SG / (3960\ \eta)$ (2b)

where

q_{gpm} = flow (gpm)

h_{ft} = differential head (ft)

SG = Specific Gravity (1 for water)

η = pump efficiency

dry months energy use (		38896
wet months energy use (		199672
yearly use (kWh):		238567
cost per kWh	$	0.30
Yearly Energy Cost	**$**	**72,000**