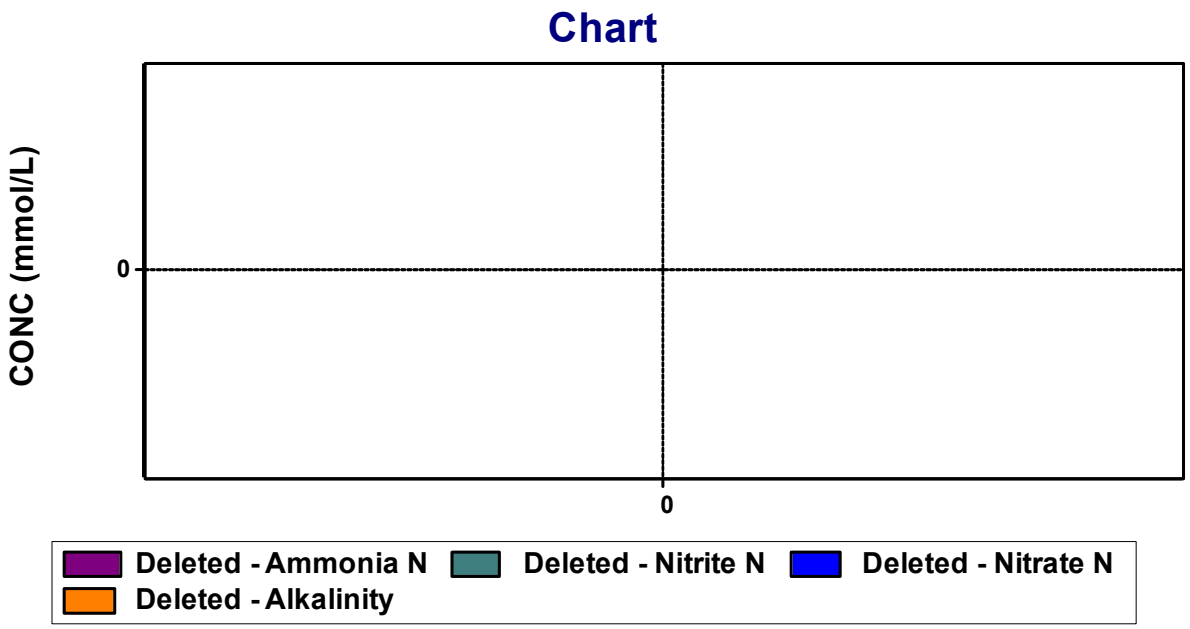

Album page - BOD_TSS

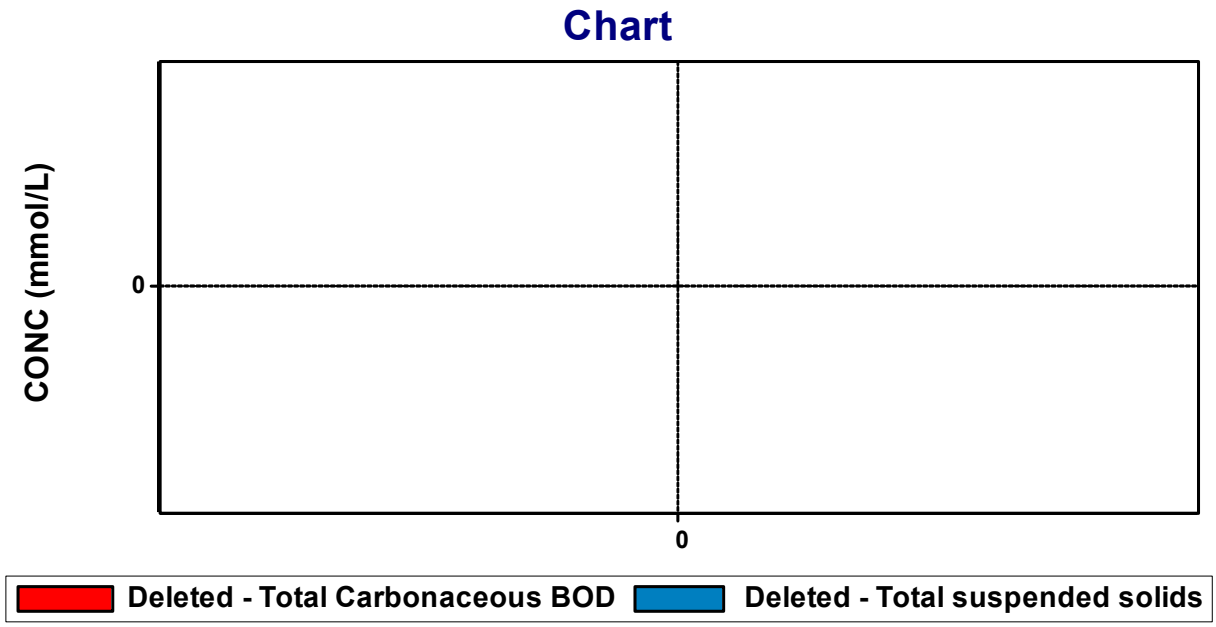

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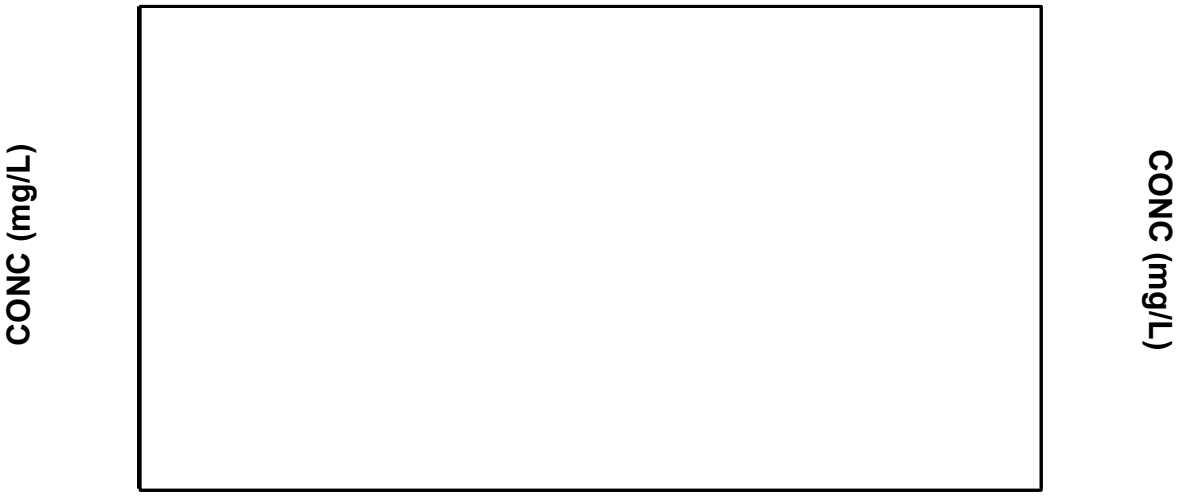
Chart



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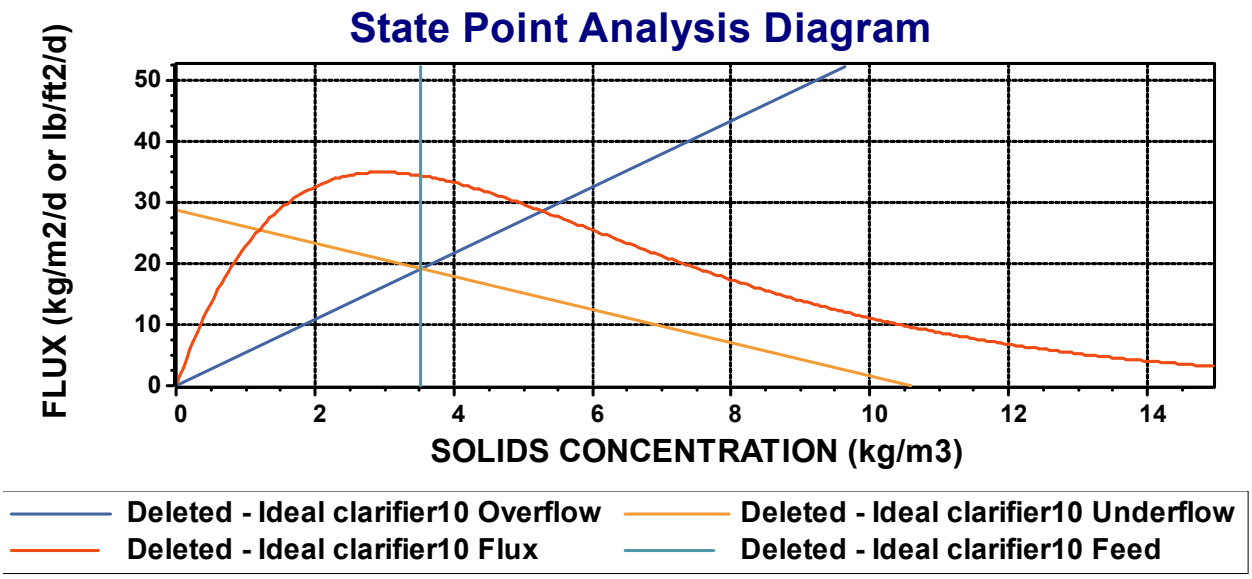

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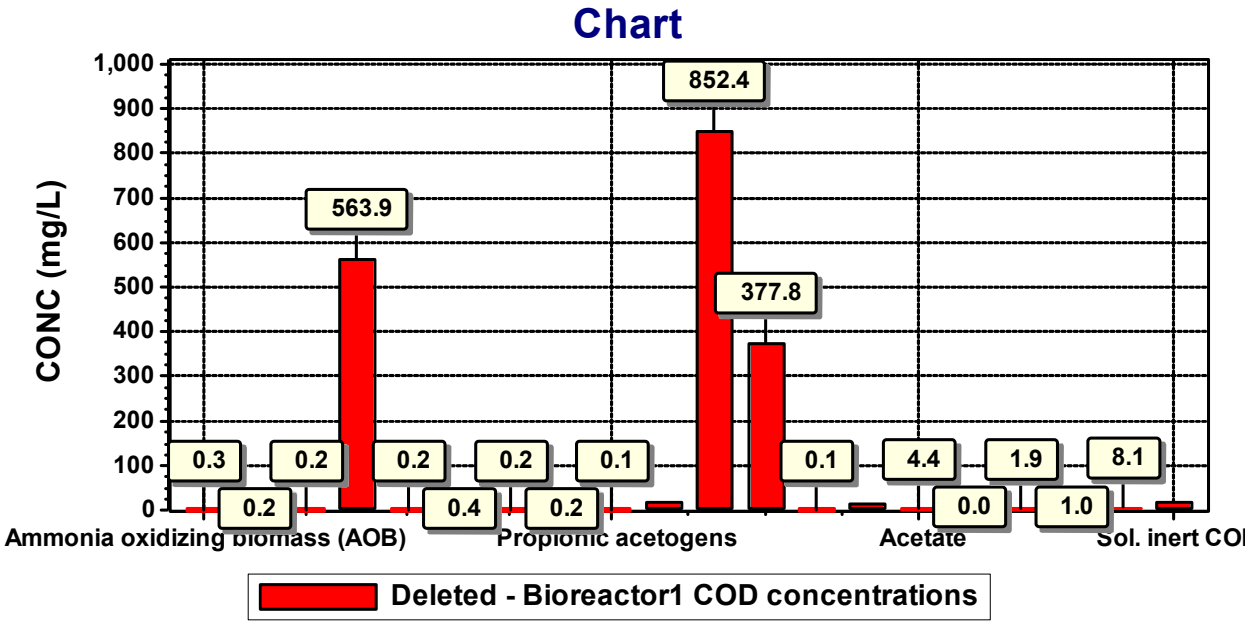

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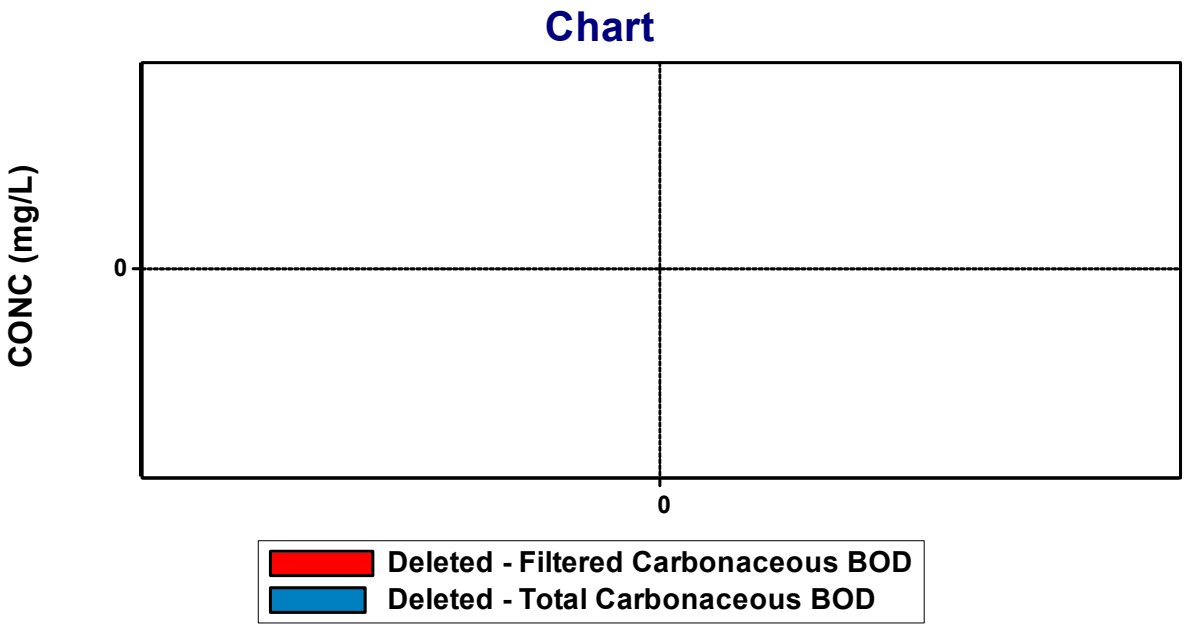

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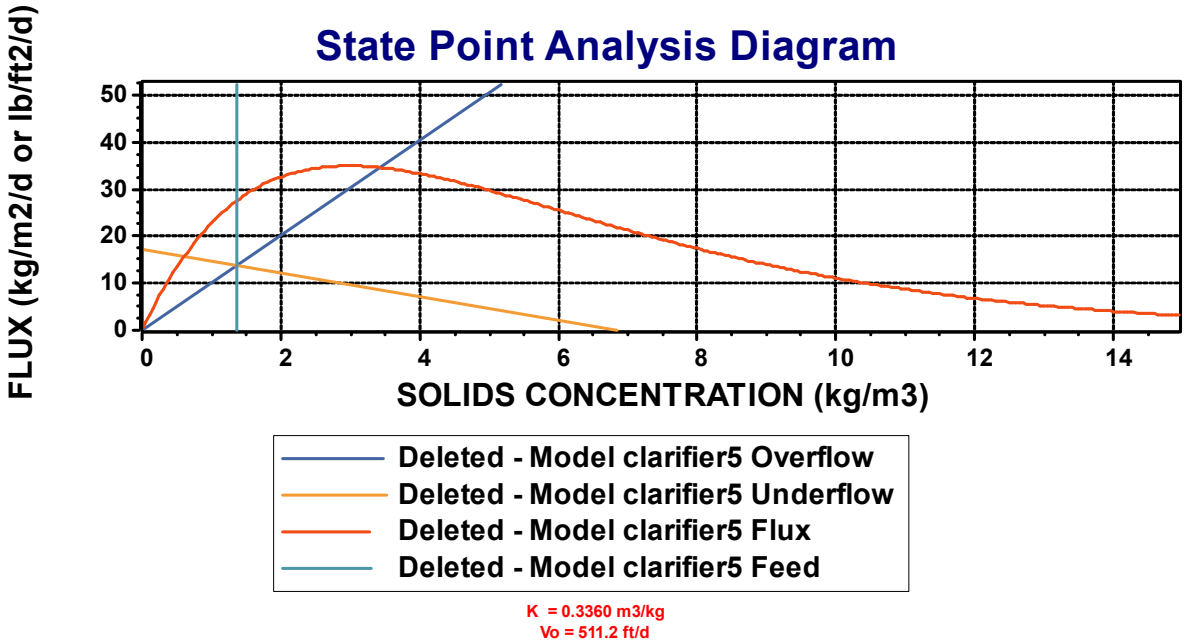

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Sludge90			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
Biomass - Acetoclastic methanogenic	0.27	0.03	
Biomass - Ammonia oxidizing	80.84	10.26	
Biomass - Anaerobic ammonia oxidizing	2.41	0.31	
Biomass - Endogenous products	2339.55	297.04	
Biomass - Hydrogenotrophic methanogenic	0.06	0.01	
Biomass - Methylotrophic	1.68	0.21	
Biomass - Nitrite oxidizing	49.65	6.30	
Biomass - Ordinary heterotrophic	3273.73	415.65	
Biomass - Phosphorus accumulating	1.26	0.16	
Biomass - Propionic acetogenic	0.31	0.04	
Biomass - Sulfur oxidizing	0	0	
Biomass - Sulfur reducing acetotrophic	0	0	
Biomass - Sulfur reducing hydrogenotrophic	0.00	0.00	
Biomass - Sulfur reducing propionic acetogenic	0	0	
CODp - Adsorbed hydrocarbon	0	0	
CODp - Degradable external organics	0	0	
CODp - Slowly degradable colloidal	0.02	0.00	
CODp - Slowly degradable particulate	177.40	22.52	
CODp - Stored PHA	0.00	0.00	
CODp - Undegradable cellulose	1872.26	237.71	
CODp - Undegradable non-cellulose	1872.26	237.71	
CODs - Acetate	0.00	0.00	
CODs - Complex readily degradable	1.44	0.18	
CODs - Degradable volatile ind. #1	0	0	
CODs - Degradable volatile ind. #2	0	0	
CODs - Degradable volatile ind. #3	0	0	
CODs - Methanol	0.00	0.00	
CODs - Propionate	0.00	0.00	
CODs - Soluble hydrocarbon	0	0	
CODs - Undegradable	47.47	6.03	
Gas - Dissolved hydrogen	0.01	0.00	

Gas - Dissolved methane	0.00	0.00	
Gas - Dissolved nitrogen	15.67	1.99	
Gas - Dissolved nitrous oxide	0	0	
Gas - Dissolved oxygen	2.00	0.25	
Gas - Dissolved total CO2	3.31	0.19	mmol/L and kmol/d
Gas - Dissolved total sulfides	0.00	0.00	
HAO - Aged	0	0	
HAO - High surface	0	0	
HAO - High with H2PO4- adsorbed	0	0	
HAO - Low surface	0	0	
HAO - Low with H2PO4- adsorbed	0	0	
HFO - Aged	0	0	
HFO - High surface	0	0	
HFO - High with H+ adsorbed	0	0	
HFO - High with H2PO4- adsorbed	0	0	
HFO - Low surface	0	0	
HFO - Low with H+ adsorbed	0	0	
HFO - Low with H2PO4- adsorbed	0	0	
Influent inorganic suspended solids	1315.40	167.01	
Metal soluble - Aluminum	0	0	
Metal soluble - Calcium	12.41	1.58	
Metal soluble - Ferric	0	0	
Metal soluble - Ferrous	0	0	
Metal soluble - Magnesium	2.94	0.37	
N - Ammonia	0.14	0.02	
N - Nitrate	11.31	1.44	
N - Nitrite	0.06	0.01	
N - Particulate degradable external organics	0	0	
N - Particulate degradable organic	8.13	1.03	
N - Particulate undegradable	131.06	16.64	
N - Soluble degradable organic	0.55	0.07	
N - Soluble undegradable organic	1.16	0.15	
Other Anions (strong acids)	4.98	0.29	meq/L and keq/d
Other Cations (strong bases)	7.31	0.42	meq/L and keq/d
P - Bound on aged HMO	0	0	

P - Particulate degradable external organics	0	0
P - Particulate degradable organic	2.63	0.33
P - Particulate undegradable	41.19	5.23
P - Releasable stored polyP	0.14	0.02
P - Soluble phosphate	2.04	0.26
P - Unreleasable stored polyP	0.01	0.00
Precipitate - Brushite	0	0
Precipitate - Ferrous sulfide	0	0
Precipitate - Hydroxy - apatite	0	0
Precipitate - Struvite	0	0
Precipitate - Vivianite	0	0
S - Particulate elemental sulfur	0	0
S - Soluble sulfate	0	0
User defined - UD1	0	0
User defined - UD2	0	0
User defined - UD3	0	0
User defined - UD4	0	0

Parameter	Value	Units
Cost (Sludge)	0	$/hour
Power	0	kW
Power cost (Excl. heating)	0	$/hour

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Elements	Flow [mgd]	Temperature [deg. C]	BOD - Total Carbonaceous [m	BOD - Filtered Carbonaceous [m	COD - Total [mg/L]	COD - Filtered [mg/L]	Total suspended solids [mg/L]	Volatile suspended solids [m	N - Total N [mgN/L]	N - Total Kjeldahl Nitrogen [m	N - Ammonia [mgN/L]	N - Nitrate [mgN/L]	N - Nitrite [mgN/L]	pH []	Alkalinity [mmol/L]	OUR - Carbonaceous [mgO	OUR - Nitrification [mgO/L/hr]	OUR - Total [mgO/L/hr]	SOTR [lb/hr]	Airflow rate [ft3/min (20C, 1at	Alpha [[]]

			g/L]	g/L]				g/L]		gN/L]						/L/hr]					m)]	
Influent - BOD14	0.60	22.00	349.96	159.83	730.36	302.19	338.00	302.00	580.00	580.00	42.65	0	0	7.20	4.00	-----	-----	-----	-----	-----	-----
Anoxic 1A	1.50	22.00	2042.07	6.61	9771.05	58.50	8652.73	6858.66	556.77	551.58	8.73	5.08	0.11	7.28	3.37	0	0	0	0	0	0.50
Aerobic 1A	1.50	22.00	2023.83	1.16	9743.45	49.19	8640.61	6845.78	555.06	544.95	1.65	9.12	0.99	6.75	2.53	49.71	57.91	107.62	193.80	904.20	0.22
Aerobic 2A	1.50	22.00	2008.81	1.03	9720.63	48.93	8625.08	6829.89	554.90	543.53	0.14	11.31	0.06	6.69	2.32	46.58	15.72	62.30	76.65	318.15	0.31
Anoxic 2A	1.50	22.00	2038.86	1.69	9766.66	50.58	8655.25	6861.15	555.23	551.58	8.94	3.54	0.12	7.29	3.50	0	0	0	0	0	0.50
MBRA	0.29	22.00	0.97	0.97	48.85	48.85	0	0	13.47	1.78	0.05	11.68	0.01	6.79	2.30	53.18	7.49	60.67	51.22	784.67	0.38
MBRA (U)	1.20	22.00	2477.66	0.97	12046.63	48.85	10705.23	8472.56	686.69	675.00	0.05	11.68	0.01	6.78	2.30	-----	-----	-----	-----	-----	-----
Effluent 1	0.58	22.00	0.97	0.97	48.85	48.85	0	0	13.47	1.78	0.05	11.68	0.01	6.78	2.30	-----	-----	-----	-----	-----	-----
Sludge90	0.02	22.00	2008.81	1.03	9720.63	48.93	8625.08	6829.89	554.90	543.53	0.14	11.31	0.06	6.69	2.32	-----	-----	-----	-----	-----	-----

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Sludge90

State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
Biomass - Acetoclastic methanogenic	0.27	0.03	
Biomass - Ammonia oxidizing	80.84	10.26	
Biomass - Anaerobic ammonia oxidizing	2.41	0.31	
Biomass - Endogenous products	2339.55	297.04	
Biomass - Hydrogenotrophic methanogenic	0.06	0.01	
Biomass - Methylotrophic	1.68	0.21	
Biomass - Nitrite oxidizing	49.65	6.30	
Biomass - Ordinary heterotrophic	3273.73	415.65	
Biomass - Phosphorus accumulating	1.26	0.16	
Biomass - Propionic acetogenic	0.31	0.04	
Biomass - Sulfur oxidizing	0	0	
Biomass - Sulfur reducing acetotrophic	0	0	
Biomass - Sulfur reducing hydrogenotrophic	0.00	0.00	
Biomass - Sulfur reducing propionic acetogenic	0	0	
CODp - Adsorbed hydrocarbon	0	0	
CODp - Degradable external organics	0	0	
CODp - Slowly degradable colloidal	0.02	0.00	
CODp - Slowly degradable particulate	177.40	22.52	
CODp - Stored PHA	0.00	0.00	
CODp - Undegradable cellulose	1872.26	237.71	
CODp - Undegradable non-cellulose	1872.26	237.71	
CODs - Acetate	0.00	0.00	
CODs - Complex readily degradable	1.44	0.18	
CODs - Degradable volatile ind. #1	0	0	
CODs - Degradable volatile ind. #2	0	0	
CODs - Degradable volatile ind. #3	0	0	
CODs - Methanol	0.00	0.00	
CODs - Propionate	0.00	0.00	
CODs - Soluble hydrocarbon	0	0	
CODs - Undegradable	47.47	6.03	
Gas - Dissolved hydrogen	0.01	0.00	
Gas - Dissolved methane	0.00	0.00	
Gas - Dissolved nitrogen	15.67	1.99	
Gas - Dissolved nitrous oxide	0	0	
Gas - Dissolved oxygen	2.00	0.25	

Gas - Dissolved total CO2	3.31	0.19	mmol/L and kmol/d
Gas - Dissolved total sulfides	0.00	0.00	
HAO - Aged	0	0	
HAO - High surface	0	0	
HAO - High with H2PO4- adsorbed	0	0	
HAO - Low surface	0	0	
HAO - Low with H2PO4- adsorbed	0	0	
HFO - Aged	0	0	
HFO - High surface	0	0	
HFO - High with H+ adsorbed	0	0	
HFO - High with H2PO4- adsorbed	0	0	
HFO - Low surface	0	0	
HFO - Low with H+ adsorbed	0	0	
HFO - Low with H2PO4- adsorbed	0	0	
Influent inorganic suspended solids	1315.40	167.01	
Metal soluble - Aluminum	0	0	
Metal soluble - Calcium	12.41	1.58	
Metal soluble - Ferric	0	0	
Metal soluble - Ferrous	0	0	
Metal soluble - Magnesium	2.94	0.37	
N - Ammonia	0.14	0.02	
N - Nitrate	11.31	1.44	
N - Nitrite	0.06	0.01	
N - Particulate degradable external organics	0	0	
N - Particulate degradable organic	8.13	1.03	
N - Particulate undegradable	131.06	16.64	
N - Soluble degradable organic	0.55	0.07	
N - Soluble undegradable organic	1.16	0.15	
Other Anions (strong acids)	4.98	0.29	meq/L and keq/d
Other Cations (strong bases)	7.31	0.42	meq/L and keq/d
P - Bound on aged HMO	0	0	
P - Particulate degradable external organics	0	0	
P - Particulate degradable organic	2.63	0.33	
P - Particulate undegradable	41.19	5.23	
P - Releasable stored polyP	0.14	0.02	

P - Soluble phosphate	2.04	0.26
P - Unreleasable stored polyP	0.01	0.00
Precipitate - Brushite	0	0
Precipitate - Ferrous sulfide	0	0
Precipitate - Hydroxy - apatite	0	0
Precipitate - Struvite	0	0
Precipitate - Vivianite	0	0
S - Particulate elemental sulfur	0	0
S - Soluble sulfate	0	0
User defined - UD1	0	0
User defined - UD2	0	0
User defined - UD3	0	0
User defined - UD4	0	0

Parameter	Value	Units
Cost (Sludge)	0	$/hour
Power	0	kW
Power cost (Excl. heating)	0	$/hour

Global Parameters

Common

Name	Default	Value	
Hydrolysis rate [1/d]	2.1000	2.1000	1.0290
Hydrolysis half sat. [-]	0.0600	0.0600	1.0000
External organics hydrolysis rate [1/d]	2.1000	2.1000	1.0290
External organics hydrolysis half sat. [-]	0.0600	0.0600	1.0000
Anoxic hydrolysis factor [-]	0.2800	0.2800	1.0000
Anaerobic hydrolysis factor (AS) [-]	0.0400	0.0400	1.0000
Anaerobic hydrolysis factor (AD) [-]	0.5000	0.5000	1.0000

Adsorption rate of colloids [L/(mgCOD d)]	0.1500	0.1500	1.0290
Ammonification rate [L/(mgCOD d)]	0.0800	0.0800	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.5000	0.5000	1.0000
Endogenous products decay rate [1/d]	0	0	1.0000

Ammonia oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9000	0.9000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.7000	0.7000	1.0000
Byproduct NH4 logistic slope [-]	50.0000	50.0000	1.0000
Byproduct NH4 inflection point [mgN/L]	1.4000	1.4000	1.0000
Denite DO half sat. [mg/L]	0.1000	0.1000	1.0000
Denite HNO2 half sat. [mgN/L]	5.000E-6	5.000E-6	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiHNO2 [mmol/L]	5.000E-3	5.000E-3	1.0000

Nitrite oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	0.7000	0.7000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.1000	0.1000	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiNH3 [mmol/L]	0.0750	0.0750	1.0000

Anaerobic ammonia oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	0.2000	0.2000	1.1000
Substrate (NH4) half sat. [mgN/L]	2.0000	2.0000	1.0000
Substrate (NO2) half sat. [mgN/L]	1.0000	1.0000	1.0000
Aerobic decay rate [1/d]	0.0190	0.0190	1.0290
Anoxic/anaerobic decay rate [1/d]	9.500E-3	9.500E-3	1.0290
Ki Nitrite [mgN/L]	1000.0000	1000.0000	1.0000
Nitrite sensitivity constant [L / (d mgN)]	0.0160	0.0160	1.0000

Ordinary heterotrophic

Name	Default	Value	
Max. spec. growth rate [1/d]	3.2000	3.2000	1.0290
Substrate half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Anoxic growth factor [-]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.6200	0.6200	1.0290
Anoxic decay rate [1/d]	0.2330	0.2330	1.0290
Anaerobic decay rate [1/d]	0.1310	0.1310	1.0290
Fermentation rate [1/d]	1.6000	1.6000	1.0290
Fermentation half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Fermentation growth factor (AS) [-]	0.2500	0.2500	1.0000
Free nitrous acid inhibition [mol/L]	1.000E-7	1.000E-7	1.0000

Heterotrophic on industrial COD

Name	Default	Value	
Maximum specific growth rate on Ind #1 COD [1/d]	4.3000	4.3000	1.0290
Substrate (Ind #1) half sat. [mgCOD/L]	1.0000	1.0000	1.0000
Inhibition coefficient for Ind #1 [mgCOD/L]	60.0000	60.0000	1.0000
Anaerobic growth factor for Ind #1 [mgCOD/L]	0.0500	0.0500	1.0000

Maximum specific growth rate on Ind #2 COD [1/d]	1.5000	1.5000	1.0290
Substrate (Ind #2) half sat. [mgCOD/L]	30.0000	30.0000	1.0000
Inhibition coefficient for Ind #2 [mgCOD/L]	3000.0000	3000.0000	1.0000
Anaerobic growth factor for Ind #2 [mgCOD/L]	0.0500	0.0500	1.0000
Maximum specific growth rate on Ind #3 COD [1/d]	4.3000	4.3000	1.0290
Substrate (Ind #3) half sat. [mgCOD/L]	1.0000	1.0000	1.0000
Inhibition coefficient for Ind #3 COD [mgCOD/L]	60.0000	60.0000	1.0000
Anaerobic growth factor for Ind #3 [mgCOD/L]	0.0500	0.0500	1.0000
Maximum specific growth rate on adsorbed hydrocarbon COD [1/d]	2.0000	2.0000	1.0290
Substrate (adsorbed hydrocarbon) half sat. [-]	0.1500	0.1500	1.0000
Anaerobic growth factor for adsorbed hydrocarbons [mgCOD/L]	0.0100	0.0100	1.0000
Adsorption rate of soluble hydrocarbons [l/(mgCOD d)]	0.2000	0.2000	1.0000

Methylotrophic

Name	Default	Value	
Max. spec. growth rate [1/d]	1.3000	1.3000	1.0720
Methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.0400	0.0400	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0300	0.0300	1.0290
Free nitrous acid inhibition [mmol/L]	1.000E-7	1.000E-7	1.0000

Phosphorus accumulating

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9500	0.9500	1.0000
Max. spec. growth rate, P-limited [1/d]	0.4200	0.4200	1.0000
Substrate half sat. [mgCOD(PHB)/mgCOD(Zbp)]	0.1000	0.1000	1.0000
Substrate half sat., P-limited [mgCOD(PHB)/mgCOD(Zbp)]	0.0500	0.0500	1.0000
Magnesium half sat. [mgMg/L]	0.1000	0.1000	1.0000

Cation half sat. [mmol/L]	0.1000	0.1000	1.0000
Calcium half sat. [mgCa/L]	0.1000	0.1000	1.0000
Aerobic/anoxic decay rate [1/d]	0.1000	0.1000	1.0000
Aerobic/anoxic maintenance rate [1/d]	0	0	1.0000
Anaerobic decay rate [1/d]	0.0400	0.0400	1.0000
Anaerobic maintenance rate [1/d]	0	0	1.0000
Sequestration rate [1/d]	4.5000	4.5000	1.0000
Anoxic growth factor [-]	0.3300	0.3300	1.0000

Propionic acetogenic

Name	Default	Value	
Max. spec. growth rate [1/d]	0.2500	0.2500	1.0290
Substrate half sat. [mgCOD/L]	10.0000	10.0000	1.0000
Acetate inhibition [mgCOD/L]	10000.0000	10000.0000	1.0000
Anaerobic decay rate [1/d]	0.0500	0.0500	1.0290
Aerobic/anoxic decay rate [1/d]	0.5200	0.5200	1.0290

Methanogenic

Name	Default	Value	
Acetoclastic max. spec. growth rate [1/d]	0.3000	0.3000	1.0290
H2-utilizing max. spec. growth rate [1/d]	1.4000	1.4000	1.0290
Acetoclastic substrate half sat. [mgCOD/L]	100.0000	100.0000	1.0000
Acetoclastic methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
H2-utilizing CO2 half sat. [mmol/L]	0.1000	0.1000	1.0000
H2-utilizing substrate half sat. [mgCOD/L]	1.0000	1.0000	1.0000
H2-utilizing methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
Acetoclastic propionic inhibition [mgCOD/L]	10000.0000	10000.0000	1.0000
Acetoclastic anaerobic decay rate [1/d]	0.1300	0.1300	1.0290
Acetoclastic aerobic/anoxic decay rate [1/d]	0.6000	0.6000	1.0290

H2-utilizing anaerobic decay rate [1/d]	0.1300	0.1300	1.0290
H2-utilizing aerobic/anoxic decay rate [1/d]	2.8000	2.8000	1.0290

Sulfur oxidizing

Name	Default	Value	
Maximum specific growth rate (sulfide) [1/d]	0.7500	0.7500	1.0290
Maximum specific growth rate (sulfur) [1/d]	0.1000	0.1000	1.0290
Substrate (H2S) half sat. [mgS/L]	1.0000	1.0000	1.0000
Substrate (sulfur) half sat. [mgS/L]	1.0000	1.0000	1.0000
Anoxic growth factor [-]	0.5000	0.5000	1.0000
Decay rate [1/d]	0.0400	0.0400	1.0290

Sulfur reducing

Name	Default	Value	
Propionic max. spec. growth rate [1/d]	0.5830	0.5830	1.0350
Propionic acid half sat. [mgCOD/L]	295.0000	295.0000	1.0000
Hydrogen sulfide inhibition coefficient [mgS/L]	185.0000	185.0000	1.0000
Sulfate (SO4=) half sat. [mgS/L]	2.4700	2.4700	1.0000
Decay rate [1/d]	0.0185	0.0185	1.0350
Acetotrophic max. spec. growth rate [1/d]	0.6120	0.6120	1.0350
Acetic acid half sat. [mgCOD/L]	24.0000	24.0000	1.0000
Hydrogen sulfide inhibition coefficient [mgS/L]	164.0000	164.0000	1.0000
Sulfate (SO4=) half sat. [mgS/L]	6.4100	6.4100	1.0000
Decay rate [1/d]	0.0275	0.0275	1.0350
Hydrogenotrophic max. spec. growth rate with SO4= [1/d]	2.8000	2.8000	1.0350
Hydrogenotrophic max. spec. growth rate with S [1/d]	0.1000	0.1000	1.0350
Hydrogen half sat. [mgCOD/L]	0.0700	0.0700	1.0000
Hydrogen sulfide inhibition coefficient [mgS/L]	550.0000	550.0000	1.0000
Sulfate (SO4=) half sat. [mgS/L]	6.4100	6.4100	1.0000

Sulfur (S) half sat. [mgS/L]	50.0000	50.0000	1.0000
Decay rate [1/d]	0.0600	0.0600	1.0350

pH

Name	Default	Value
Ordinary heterotrophic low pH limit [-]	4.0000	4.0000
Ordinary heterotrophic high pH limit [-]	10.0000	10.0000
Methylotrophic low pH limit [-]	4.0000	4.0000
Methylotrophic high pH limit [-]	10.0000	10.0000
Autotrophic low pH limit [-]	5.5000	5.5000
Autotrophic high pH limit [-]	9.5000	9.5000
Phosphorus accumulating low pH limit [-]	4.0000	4.0000
Phosphorus accumulating high pH limit [-]	10.0000	10.0000
Ordinary heterotrophic low pH limit (anaerobic) [-]	5.5000	5.5000
Ordinary heterotrophic high pH limit (anaerobic) [-]	8.5000	8.5000
Propionic acetogenic low pH limit [-]	4.0000	4.0000
Propionic acetogenic high pH limit [-]	10.0000	10.0000
Acetoclastic methanogenic low pH limit [-]	5.0000	5.0000
Acetoclastic methanogenic high pH limit [-]	9.0000	9.0000
H2-utilizing methanogenic low pH limit [-]	5.0000	5.0000
H2-utilizing methanogenic high pH limit [-]	9.0000	9.0000

Switches

Name	Default	Value
Ordinary heterotrophic DO half sat. [mgO2/L]	0.1500	0.0500
Phosphorus accumulating DO half sat. [mgO2/L]	0.0500	0.0500
Anoxic/anaerobic NOx half sat. [mgN/L]	0.1500	0.1500
Ammonia oxidizing DO half sat. [mgO2/L]	0.2500	0.2500
Nitrite oxidizing DO half sat. [mgO2/L]	0.5000	0.5000

Anaerobic ammonia oxidizing DO half sat. [mgO2/L]	0.0100	0.0100
Sulfur oxidizing sulfate pathway DO half sat. [mgO2/L]	0.2500	0.2500
Sulfur oxidizing sulfur pathway DO half sat. [mgO2/L]	0.0500	0.0500
Anoxic NO3(->NO2) half sat. [mgN/L]	0.1000	0.1000
Anoxic NO3(->N2) half sat. [mgN/L]	0.0500	0.0500
Anoxic NO2(->N2) half sat. (mgN/L)	0.0100	0.0100
NH3 nutrient half sat. [mgN/L]	5.000E-3	5.000E-3
PolyP half sat. [mgP/mgCOD]	0.0100	0.0100
VFA sequestration half sat. [mgCOD/L]	5.0000	5.0000
P uptake half sat. [mgP/L]	0.1500	0.1500
P nutrient half sat. [mgP/L]	1.000E-3	1.000E-3
Autotrophic CO2 half sat. [mmol/L]	0.1000	0.1000
H2 low/high half sat. [mgCOD/L]	1.0000	1.0000
Propionic acetogenic H2 inhibition [mgCOD/L]	5.0000	5.0000
Synthesis anion/cation half sat. [meq/L]	0.0100	0.0100

Common

Name	Default	Value
Biomass/Endog Ca content (gCa/gCOD)	3.912E-3	3.912E-3
Biomass/Endog Mg content (gMg/gCOD)	3.912E-3	3.912E-3
Biomass/Endog other cations content (mol/gCOD)	5.115E-4	5.115E-4
Biomass/Endog other Anions content (mol/gCOD)	1.410E-4	1.410E-4
N in endogenous residue [mgN/mgCOD]	0.0700	0.0700
P in endogenous residue [mgP/mgCOD]	0.0220	0.0220
Ca content of slowly biodegradabe (gCa/gCOD)	3.912E-3	3.912E-3
Mg content of slowly biodegradabe (gMg/gCOD)	3.700E-4	3.700E-4
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.6327	1.4200
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.4200
Cellulose COD:VSS ratio [mgCOD/mgVSS]	1.4000	1.4000
External organic COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6000
Molecular weight of other anions [mg/mmol]	35.5000	35.5000

Molecular weight of other cations [mg/mmol]	39.0983	39.1000

Ammonia oxidizing

Name	Default	Value
Yield [mgCOD/mgN]	0.1500	0.1500
Denite NO2 fraction as TEA [-]	0.5000	0.5000
Byproduct NH4 fraction to N2O [-]	2.500E-3	2.500E-3
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Nitrite oxidizing

Name	Default	Value
Yield [mgCOD/mgN]	0.0900	0.0900
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Anaerobic ammonia oxidizing

Name	Default	Value
Yield [mgCOD/mgN]	0.1140	0.1140
Nitrate production [mgN/mgBiomassCOD]	2.2800	2.2800
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220

Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Ordinary heterotrophic

Name	Default	Value
Yield (aerobic) [-]	0.6660	0.6660
Yield (fermentation, low H2) [-]	0.1000	0.1000
Yield (fermentation, high H2) [-]	0.1000	0.1000
H2 yield (fermentation low H2) [-]	0.3500	0.3500
H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.7000	0.7000
CO2 yield (fermentation, low H2) [-]	0.7000	0.7000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Endogenous fraction - aerobic [-]	0.0800	0.0800
Endogenous fraction - anoxic [-]	0.1030	0.1030
Endogenous fraction - anaerobic [-]	0.1840	0.1840
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield (anoxic) [-]	0.5400	0.5400
Yield propionic (aerobic) [-]	0.6400	0.6400
Yield propionic (anoxic) [-]	0.4600	0.4600
Yield acetic (aerobic) [-]	0.6000	0.6000
Yield acetic (anoxic) [-]	0.4300	0.4300
Yield methanol (aerobic) [-]	0.5000	0.5000
Adsorp. max. [-]	1.0000	1.0000
Max fraction to N2O at high FNA over nitrate [-]	0.0500	0.0500
Max fraction to N2O at high FNA over nitrite [-]	0.1000	0.1000

Ordinary heterotrophic on industrial COD

Name	Default	Value
Yield Ind #1 COD (Aerobic) [-]	0.5000	0.5000
Yield Ind #1 COD (Anoxic) [-]	0.4000	0.4000
Yield Ind #1 COD (Anaerobic) [-]	0.0400	0.0400
COD:Mole ratio - Ind #1 COD [gCOD/Mol]	224.0000	224.0000
Yield Ind #2 COD (Aerobic) [-]	0.5000	0.5000
Yield Ind #2 COD (Anoxic) [-]	0.4000	0.4000
Yield Ind #2 COD (Anaerobic) [-]	0.0500	0.0500
COD:Mole ratio - Ind #2 COD [gCOD/Mol]	240.0000	240.0000
Yield on Ind #3 COD (Aerobic) [-]	0.5000	0.5000
Yield on Ind #3 COD (Anoxic) [-]	0.4000	0.4000
Yield on Ind #3 COD (Anaerobic) [-]	0.0400	0.0400
COD:Mole ratio - Ind #3 COD [gCOD/Mol]	288.0000	288.0000
Yield enmeshed hydrocarbons (Aerobic) [-]	0.5000	0.5000
Yield enmeshed hydrocarbons (Anoxic) [-]	0.4000	0.4000
Yield enmeshed hydrocarbons (Anaerobic) [-]	0.0400	0.0400
COD:Mole ratio - Hydrocarbon COD [gCOD/Mol]	336.0000	336.0000
Hydrocarbon COD:VSS ratio [mgCOD/mgVSS]	3.2000	3.2000
Max. hydrocarbon adsorp. ratio [-]	1.0000	1.0000
Yield of Ind #1 on Ind #3 COD (Aerobic) [-]	0	0
Yield of Ind #1 on Ind #3 COD (Anoxic) [-]	0	0
Hydrocarbon Yield on Ind #3 COD (Aerobic) [-]	0	0
Hydrocarbon Yield on Ind #3 COD (Anoxic) [-]	0	0

Methylotrophic

Name	Default	Value
Yield (anoxic) [-]	0.4000	0.4000
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Max fraction to N2O at high FNA over nitrate [-]	0.1000	0.1000
Max fraction to N2O at high FNA over nitrite [-]	0.1500	0.1500

Phosphorus accumulating

Name	Default	Value
Yield (aerobic) [-]	0.6390	0.6390
Yield (anoxic) [-]	0.5200	0.5200
Aerobic P/PHA uptake [mgP/mgCOD]	0.9300	0.9300
Anoxic P/PHA uptake [mgP/mgCOD]	0.3500	0.3500
Yield of PHA on Ac sequestration [-]	0.8890	0.8890
N in biomass [mgN/mgCOD]	0.0700	0.0700
N in sol. inert [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous part. [-]	0.2500	0.2500
Inert fraction of endogenous sol. [-]	0.2000	0.2000
P/Ac release ratio [mgP/mgCOD]	0.5100	0.5100
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield of low PP [-]	0.9400	0.9400
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	0.3000	0.3000
Cation to P mole ratio in polyphosphate [meq/mmolP]	0.1500	0.1500
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	0.0500	0.0500

Propionic acetogenic

Name	Default	Value
Yield [-]	0.1000	0.1000
H2 yield [-]	0.4000	0.4000
CO2 yield [-]	1.0000	1.0000
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220

Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Methanogenic

Name	Default	Value
Acetoclastic yield [-]	0.1000	0.1000
Acetoclastic yield on methanol[-]	0.1000	0.1000
H2-utilizing yield [-]	0.1000	0.1000
H2-utilizing yield on methanol [-]	0.1000	0.1000
N in acetoclastic biomass [mgN/mgCOD]	0.0700	0.0700
N in H2-utilizing biomass [mgN/mgCOD]	0.0700	0.0700
P in acetoclastic biomass [mgP/mgCOD]	0.0220	0.0220
P in H2-utilizing biomass [mgP/mgCOD]	0.0220	0.0220
Acetoclastic fraction to endog. residue [-]	0.0800	0.0800
H2-utilizing fraction to endog. residue [-]	0.0800	0.0800
Acetoclastic COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
H2-utilizing COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Sulfur oxidizing

Name	Default	Value
Yield (aerobic) [mgCOD/mgS]	0.5000	0.5000
Yield (Anoxic) [mgCOD/mgS]	0.3500	0.3500
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Sulfur reducing

Name	Default	Value
Yield [mgCOD/mg H2 COD]	0.0712	0.0712
Yield [mgCOD/mg Ac COD]	0.0470	0.0470
Yield [mgCOD/mg Pr COD]	0.0384	0.0384
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

General

Name	Default	Value
Tank head loss per metre of length (from flow) [m/m]	2.500E-3	2.500E-3
BOD calculation rate constant for Xsc degradation [/d]	0.5000	0.5000
BOD calculation rate constant for Xsp (and hydrocarbon) degradation [/d]	0.5000	0.5000
BOD calculation rate constant for Xeo degradation [/d]	0.5000	0.5000

Heating fuel/Chemical Costs

Name	Default	Value
Methanol [$/gal]	1.6656	1.6656
Ferric chloride [$/lb Fe]	0.5307	0.5307
Ferric sulfate [$/lb Fe]	0.3583	0.3583
Ferrous chloride [$/lb Fe]	0.2767	0.2767
Ferrous sulfate [$/lb Fe]	1.0750	1.0750
Aluminum sulfate [$/lb Al]	0.7666	0.7666
Aluminum chloride [$/lb Al]	0.8981	0.8981
Poly Aluminum Chloride (PAC) [$/lb Al]	0.5307	0.5307
Natural gas [$/MMBTU]	3.1652	3.1652
Heating oil [$/gal]	1.8927	1.8927

Diesel [$/gal]	2.6498	2.6498
Custom fuel [$/gal]	3.7854	3.7854
Biogas sale price [$/MMBTU]	2.1101	2.1101

Anaerobic digester

Name	Default	Value
Bubble rise velocity (anaerobic digester) [cm/s]	23.9000	23.9000
Bubble Sauter mean diameter (anaerobic digester) [cm]	0.3500	0.3500
Anaerobic digester gas hold-up factor []	1.0000	1.0000

Combined Heat and Power (CHP) engine

Name	Default	Value
Methane heat of combustion [kJ/mole]	800.0000	800.0000
Hydrogen heat of combustion [kJ/mole]	240.0000	240.0000
CHP engine heat price [$/kWh]	0	0
CHP engine power price [$/kWh]	0.1500	0.1500

Calorific values of heating fuels

Name	Default	Value
Calorific value of natural gas [BTU/lb]	20636	20636
Calorific value of heating fuel oil [BTU/lb]	18057	18057
Calorific value of diesel [BTU/lb]	19776	19776
Calorific value of custom fuel [BTU/lb]	13758	13758

Density of liquid heating fuels

Name	Default	Value
Density of heating fuel oil [lb/ft3]	56	56
Density of diesel [lb/ft3]	55	55
Density of custom fuel [lb/ft3]	49	49

Mass transfer

Name	Default	Value	
Kl for H2 [m/d]	17.0000	17.0000	1.0240
Kl for CO2 [m/d]	10.0000	10.0000	1.0240
Kl for NH3 [m/d]	1.0000	1.0000	1.0240
Kl for CH4 [m/d]	8.0000	8.0000	1.0240
Kl for N2 [m/d]	15.0000	15.0000	1.0240
Kl for N2O [m/d]	8.0000	8.0000	1.0240
Kl for H2S [m/d]	1.0000	1.0000	1.0240
Kl for Ind #1 COD [m/d]	0	0	1.0240
Kl for Ind #2 COD [m/d]	0.5000	0.5000	1.0240
Kl for Ind #3 COD [m/d]	0	0	1.0240
Kl for O2 [m/d]	13.0000	13.0000	1.0240

Henry's law constants

Properties constants

Name	Default	Value

K in Viscosity = K e ^(Ea/RT) [Pa s]	6.849E-7	6.849E-7
Ea in Viscosity = K e ^(Ea/RT) [j/mol]	1.780E+4	1.780E+4
Y in ML Viscosity = H2O viscosity * (1+A*MLSS^Y) [-]	1.0000	1.0000
A in ML Viscosity = H2O viscosity * (1+A*MLSS^Y) [m3/g]	1.000E-7	1.000E-7
A in ML Density = H2O density + A*MLSS [(kg/m3)/(g/m3)]	3.248E-4	3.248E-4
A in Antoine equn. [T in K, P in Bar {NIST}]	5.2000	5.2039
B in Antoine equn. [T in K, P in Bar {NIST}]	1734.0000	1733.9260
C in Antoine equn. [T in K, P in Bar {NIST}]	-39.5000	-39.4800

Metal salt solution densities

BioWin user and configuration data

Project details

Project name: Unknown Project ref.: BW1

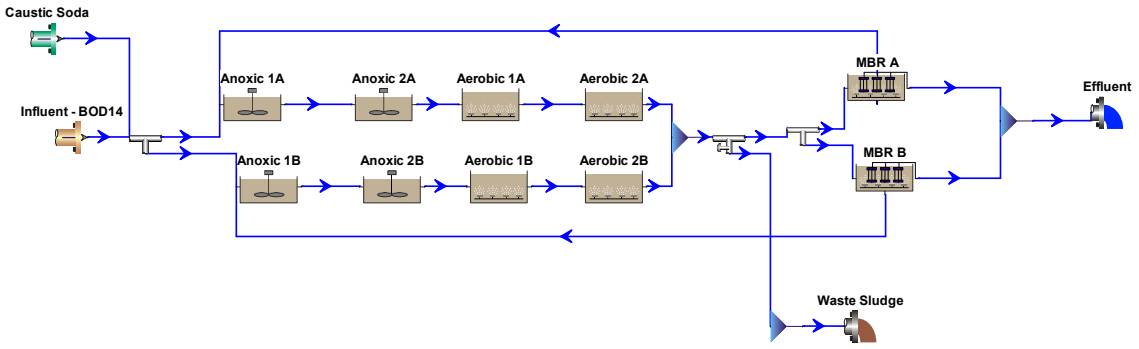
Plant name: Unknown User name: Jason.Flowers

Created: 5/18/2018 Saved: 10/3/2020

Steady state solution

Target SRT: 15.00 days SRT #0: 14.99 days

Temperature: 11.0°C



Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Anoxic 1A	0.0100	102.8312	13.000	Un-aerated
Aerobic 1A	0.0300	308.4936	13.000	70
Aerobic 2A	0.0300	308.4936	13.000	70
Anoxic 2A	0.0100	102.8312	13.000	Un-aerated
Anoxic 1B	0.0100	102.8312	13.000	Un-aerated
Aerobic 1B	0.0300	308.4936	13.000	70
Aerobic 2B	0.0300	308.4936	13.000	70
Anoxic 2B	0.0100	102.8312	13.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Anoxic 1A	0
Aerobic 1A	2.0
Aerobic 2A	2.0
Anoxic 2A	0
Anoxic 1B	0
Aerobic 1B	2.0
Aerobic 2B	2.0
Anoxic 2B	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^ 0.25 + k2	k2 in C = k1(PC)^ 0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	Diffuser mounting height	Min. air flow rate per diffuser ft3/min (20C, 1 atm)	Max. air flow rate per diffuser ft3/min (20C, 1 atm)	'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2
Anoxic 1A	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Aerobic 1A	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Aerobic 2A	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Anoxic 2A	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Anoxic 1B	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Aerobic 1B	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Aerobic 2B	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Anoxic 2B	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0

Configuration information for all Bioreactor - MBR units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers	# of cassettes	Displaced volume / cassette [ft3/cassette]	Membrane area / cassette [ft2/cassette]	Total displaced volume [Mil. Gal]	Membrane surface area [ft2]
MBR A	0.0300	308.4936	13.000	57	6.00	59.682	16320.03	0.00	97920.18
MBR B	0.0300	308.4936	13.000	57	6.00	59.682	16320.03	0.00	97920.18

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
MBR A	2.0
MBR B	2.0

Element name	Split method	Average Split specification
MBR A	Flow paced	200.00 %
MBR B	Flow paced	200.00 %

Aeration equipment parameters

Element name	k1 in C = k1(PC)^ 0.25 + k2	k2 in C = k1(PC)^ 0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	Diffuser mounting height	Min. air flow rate per diffuser ft3/min (20C, 1 atm)	Max. air flow rate per diffuser ft3/min (20C, 1 atm)	'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2
MBR A	0.0500	0.3800	1.0000	0.5382	0.2500	1.1772	29.4289	1.0000	0	0
MBR B	0.0500	0.3800	1.0000	0.5382	0.2500	1.1772	29.4289	1.0000	0	0

Element name	Surface pressure [kPa]	Fractional effective saturation depth (Fed) [-]
MBR A	101.3250	0.3000
MBR B	101.3250	0.3000

Element name	Supply gas CO2 content [vol. %]	Supply gas O2 [vol. %]	Off-gas CO2 [vol. %]	Off-gas O2 [vol. %]	Off-gas H2 [vol. %]	Off-gas NH3 [vol. %]	Off-gas CH4 [vol. %]	Off-gas N2O [vol. %]	Surface turbulence factor [-]
MBR A	0.0350	20.9500	1.2000	19.9000	0	0	0	0	2.0000
MBR B	0.0350	20.9500	1.2000	19.9000	0	0	0	0	2.0000

Configuration information for all Influent - BOD units

Operating data Average (flow/time weighted as required)

Element name	Influent - BOD14
Flow	1.14
BOD - Total Carbonaceous mgBOD/L	179.00
Volatile suspended solids mg/L	181.26
Total suspended solids mg/L	202.80
N - Total Kjeldahl Nitrogen mgN/L	30.90
P - Total P mgP/L	6.50
S - Total S mgS/L	0
N - Nitrate mgN/L	0
pH	7.10
Alkalinity mmol/L	2.00
Metal soluble - Calcium mg/L	80.00
Metal soluble - Magnesium mg/L	15.00
Gas - Dissolved oxygen mg/L	0

Element name	Influent - BOD14
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1410
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1418
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.8354
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0650
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.1300
Fcel - Cellulose fraction of unbiodegradable particulate [gCOD/gCOD]	0.5000
Fna - Ammonia [gNH3-N/gTKN]	0.7353
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0700
Fpo4 - Phosphate [gPO4-P/gTP]	0.4717

FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0220
Fsr - Reduced sulfur [H2S] [gS/gS]	0
FZbh - Ordinary heterotrophic COD fraction [gCOD/g of total COD]	0.0200
FZbm - Methylotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZao - Ammonia oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZno - Nitrite oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZaao - Anaerobic ammonia oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZppa - Phosphorus accumulating COD fraction [gCOD/g of total COD]	1.000E-4
FZpa - Propionic acetogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZam - Acetoclastic methanogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZhm - Hydrogenotrophic methanogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZso - Sulfur oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZsrpa - Sulfur reducing propionic acetogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZsra - Sulfur reducing acetotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZsrh - Sulfur reducing hydrogenotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZe - Endogenous products COD fraction [gCOD/g of total COD]	0

Configuration information for all Splitter units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Splitter66	Fraction	0.50
Splitter7	Flowrate [Side]	0.0152163268747883
Splitter8	Fraction	0.50

Configuration information for all Influent - State variable units

Operating data Average (flow/time weighted as required)

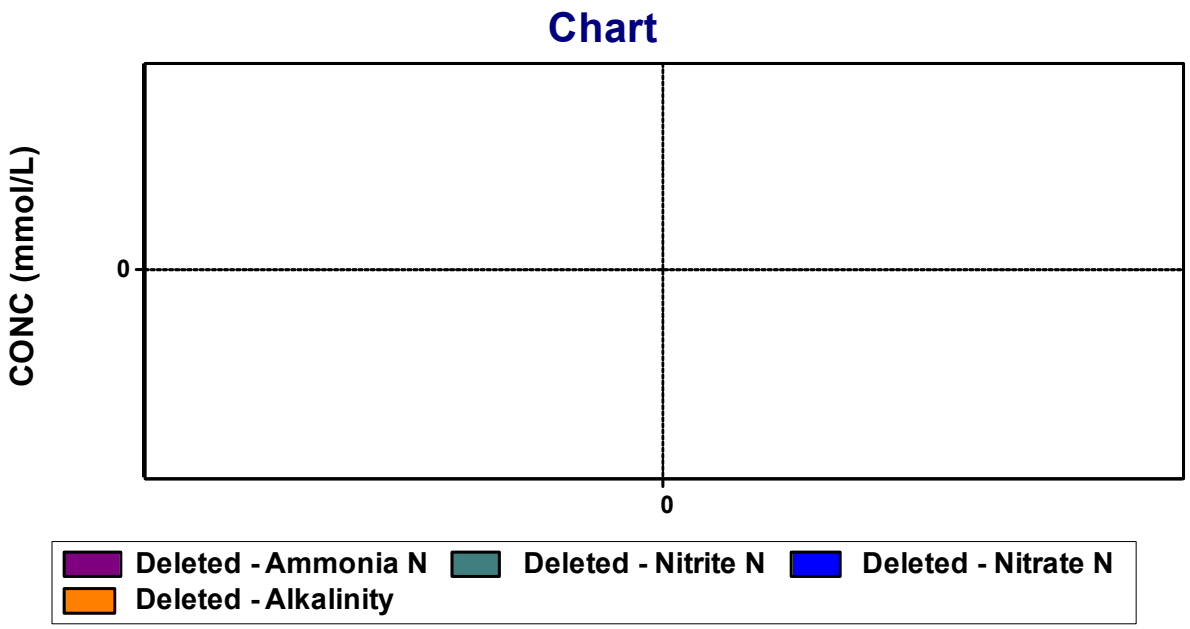
Element name	Caustic Soda
Biomass - Ordinary heterotrophic [mgCOD/L]	0
Biomass - Methylotrophic [mgCOD/L]	0
Biomass - Ammonia oxidizing [mgCOD/L]	0
Biomass - Nitrite oxidizing [mgCOD/L]	0
Biomass - Anaerobic ammonia oxidizing [mgCOD/L]	0
Biomass - Phosphorus accumulating [mgCOD/L]	0
Biomass - Propionic acetogenic [mgCOD/L]	0
Biomass - Acetoclastic methanogenic [mgCOD/L]	0
Biomass - Hydrogenotrophic methanogenic [mgCOD/L]	0
Biomass - Endogenous products [mgCOD/L]	0
CODp - Slowly degradable particulate [mgCOD/L]	0
CODp - Slowly degradable colloidal [mgCOD/L]	0
CODp - Degradable external organics [mgCOD/L]	0
CODp - Undegradable non-cellulose [mgCOD/L]	0
CODp - Undegradable cellulose [mgCOD/L]	0
N - Particulate degradable organic [mgN/L]	0
P - Particulate degradable organic [mgP/L]	0
N - Particulate degradable external organics [mgN/L]	0
P - Particulate degradable external organics [mgP/L]	0
N - Particulate undegradable [mgN/L]	0
P - Particulate undegradable [mgP/L]	0
CODp - Stored PHA [mgCOD/L]	0
P - Releasable stored polyP [mgP/L]	0
P - Unreleasable stored polyP [mgP/L]	0
CODs - Complex readily degradable [mgCOD/L]	0
CODs - Acetate [mgCOD/L]	0
CODs - Propionate [mgCOD/L]	0
CODs - Methanol [mgCOD/L]	0
Gas - Dissolved hydrogen [mgCOD/L]	0
Gas - Dissolved methane [mg/L]	0
N - Ammonia [mgN/L]	0
N - Soluble degradable organic [mgN/L]	0
Gas - Dissolved nitrous oxide [mgN/L]	0

N - Nitrite [mgN/L]	0
N - Nitrate [mgN/L]	0
Gas - Dissolved nitrogen [mgN/L]	0
P - Soluble phosphate [mgP/L]	0
CODs - Undegradable [mgCOD/L]	0
N - Soluble undegradable organic [mgN/L]	0
Influent inorganic suspended solids [mgISS/L]	0
Precipitate - Struvite [mgISS/L]	0
Precipitate - Brushite [mgISS/L]	0
Precipitate - Hydroxy - apatite [mgISS/L]	0
Precipitate - Vivianite [mgISS/L]	0
HFO - High surface [mg/L]	0
HFO - Low surface [mg/L]	0
HFO - High with H2PO4- adsorbed [mg/L]	0
HFO - Low with H2PO4- adsorbed [mg/L]	0
HFO - Aged [mg/L]	0
HFO - Low with H+ adsorbed [mg/L]	0
HFO - High with H+ adsorbed [mg/L]	0
HAO - High surface [mg/L]	0
HAO - Low surface [mg/L]	0
HAO - High with H2PO4- adsorbed [mg/L]	0
HAO - Low with H2PO4- adsorbed [mg/L]	0
HAO - Aged [mg/L]	0
P - Bound on aged HMO [mgP/L]	0
Metal soluble - Magnesium [mg/L]	0
Metal soluble - Calcium [mg/L]	0
Metal soluble - Ferric [mg/L]	0
Metal soluble - Ferrous [mg/L]	0
Metal soluble - Aluminum [mg/L]	0
Other Cations (strong bases) [meq/L]	12500.00
Other Anions (strong acids) [meq/L]	0
Gas - Dissolved total CO2 [mmol/L]	0
User defined - UD1 [mg/L]	0
User defined - UD2 [mg/L]	0
User defined - UD3 [mgVSS/L]	0

User defined - UD4 [mgISS/L]	0
Biomass - Sulfur oxidizing [mgCOD/L]	0
Biomass - Sulfur reducing propionic acetogenic [mgCOD/L]	0
Biomass - Sulfur reducing acetotrophic [mgCOD/L]	0
Biomass - Sulfur reducing hydrogenotrophic [mgCOD/L]	0
Gas - Dissolved total sulfides [mgS/L]	0
S - Soluble sulfate [mgS/L]	0
S - Particulate elemental sulfur [mgS/L]	0
Precipitate - Ferrous sulfide [mgISS/L]	0
CODp - Adsorbed hydrocarbon [mgCOD/L]	0
CODs - Degradable volatile ind. #1 [mgCOD/L]	0
CODs - Degradable volatile ind. #2 [mgCOD/L]	0
CODs - Degradable volatile ind. #3 [mgCOD/L]	0
CODs - Soluble hydrocarbon [mgCOD/L]	0
Gas - Dissolved oxygen [mg/L]	0
Flow	0.0001

BioWin Album

Album page - Nitrogen species



Album page - BOD_TSS

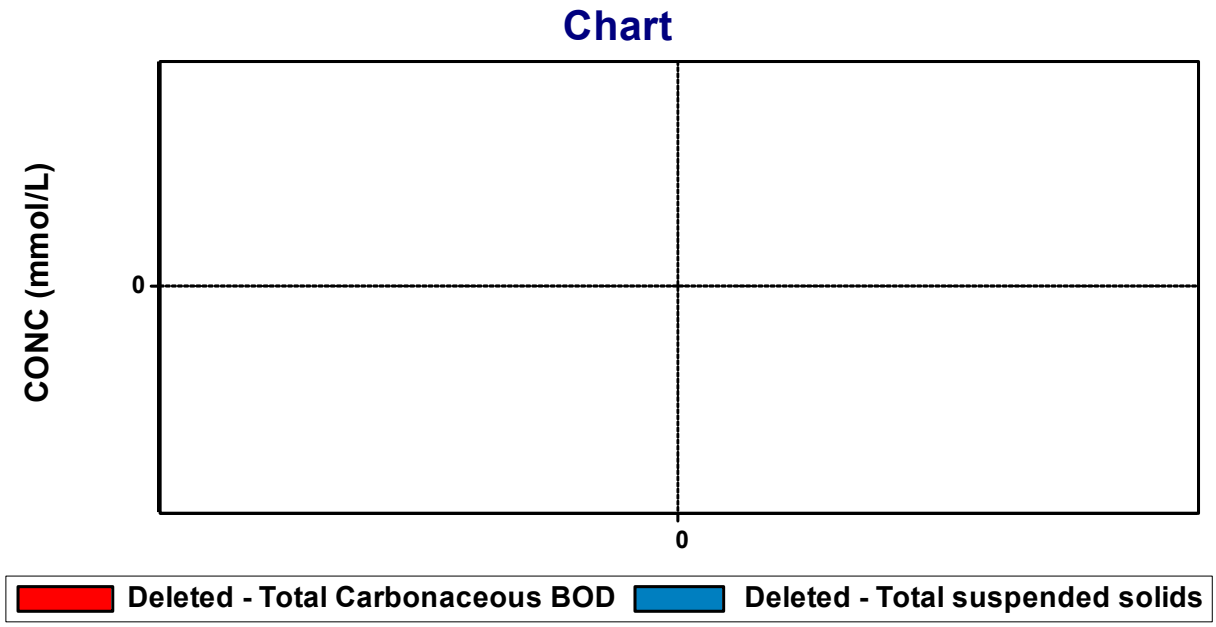


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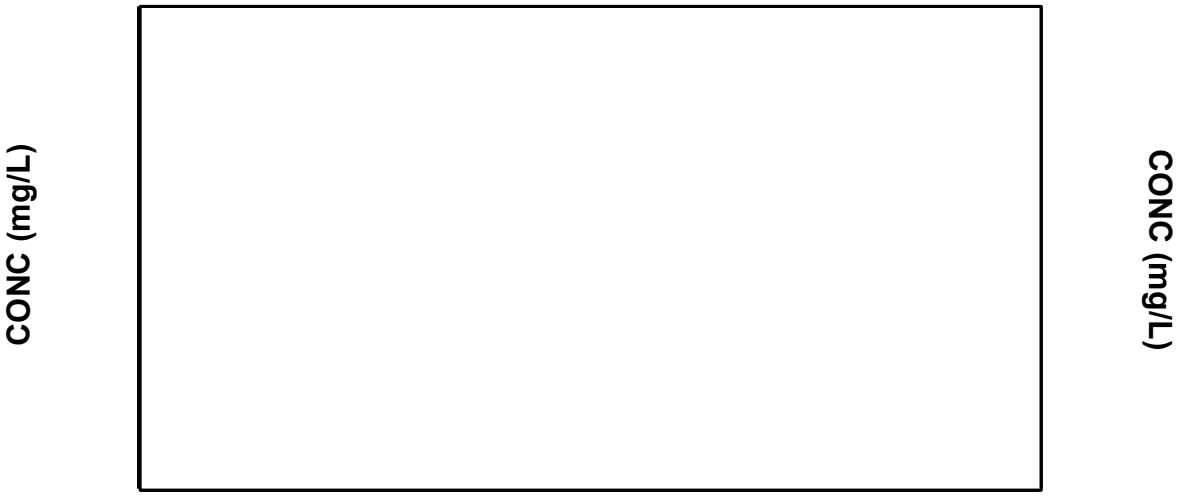
Chart



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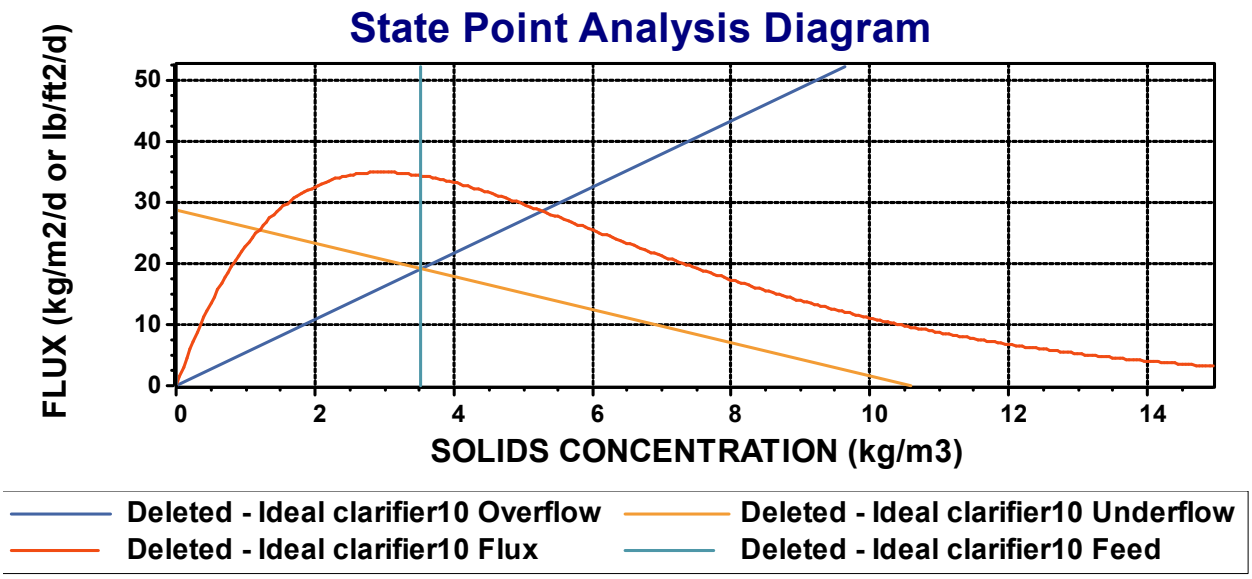

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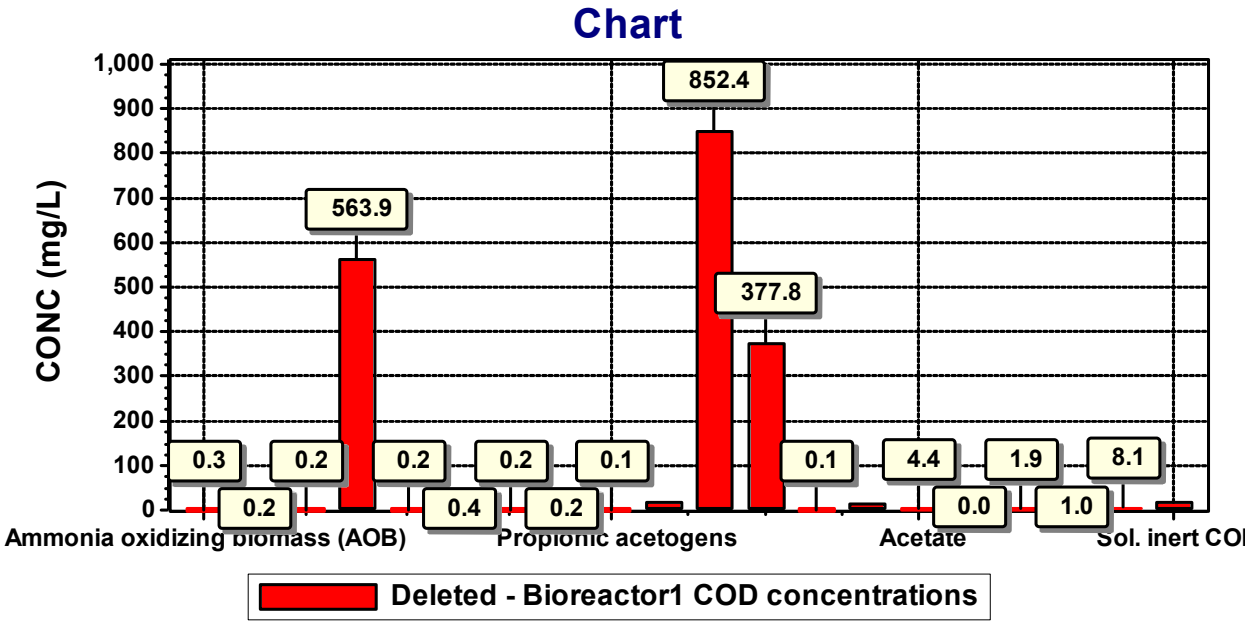

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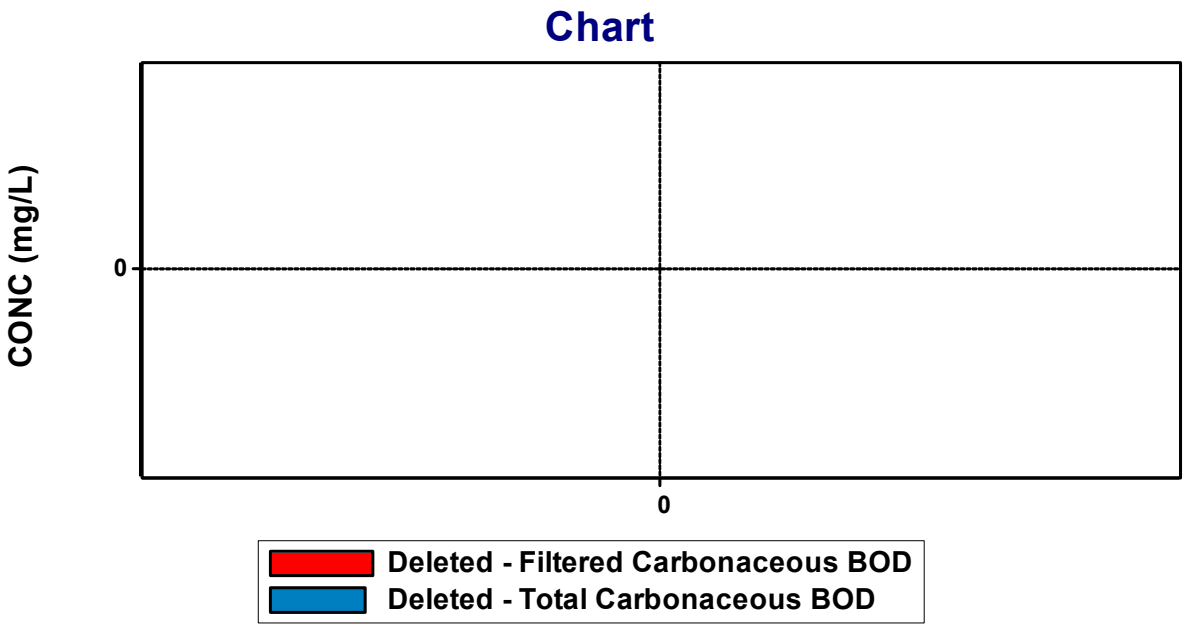

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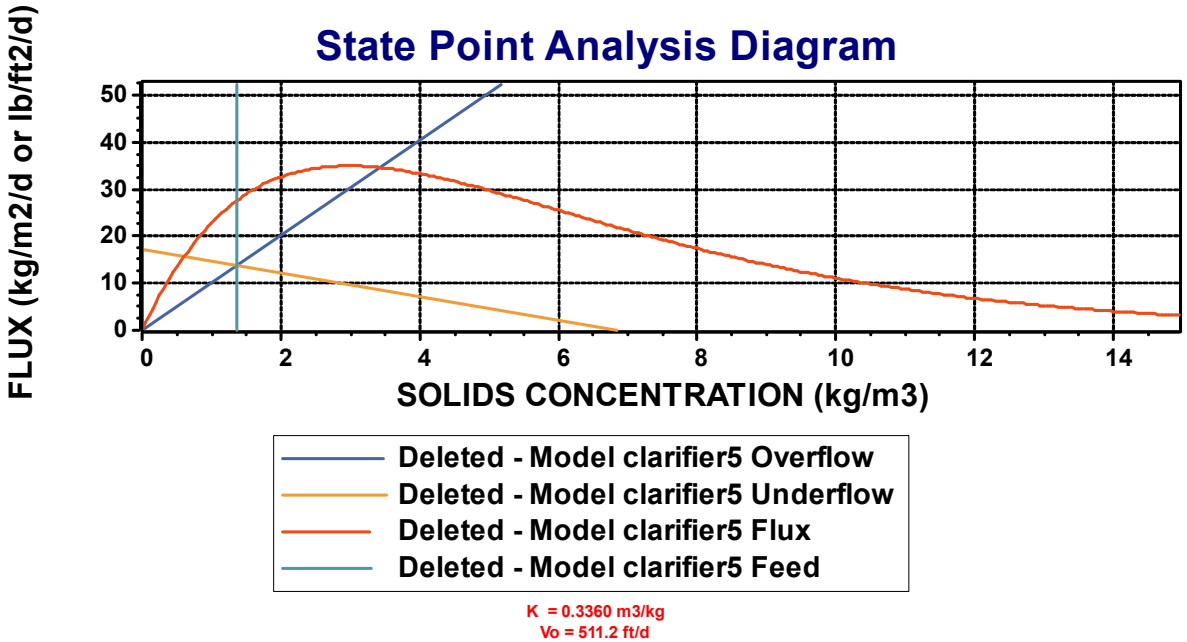

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Waste Sludge			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
Biomass - Acetoclastic methanogenic	0.35	0.04	
Biomass - Ammonia oxidizing	92.50	11.75	
Biomass - Anaerobic ammonia oxidizing	2.37	0.30	
Biomass - Endogenous products	2124.57	269.79	
Biomass - Hydrogenotrophic methanogenic	0.08	0.01	
Biomass - Methylotrophic	1.92	0.24	
Biomass - Nitrite oxidizing	56.85	7.22	
Biomass - Ordinary heterotrophic	4069.93	516.83	
Biomass - Phosphorus accumulating	1.23	0.16	
Biomass - Propionic acetogenic	0.40	0.05	
Biomass - Sulfur oxidizing	0.00	0.00	
Biomass - Sulfur reducing acetotrophic	0.00	0.00	
Biomass - Sulfur reducing hydrogenotrophic	0.00	0.00	
Biomass - Sulfur reducing propionic acetogenic	0	0	
CODp - Adsorbed hydrocarbon	0	0	
CODp - Degradable external organics	0.00	0.00	
CODp - Slowly degradable colloidal	0.04	0.01	
CODp - Slowly degradable particulate	233.60	29.66	
CODp - Stored PHA	0.00	0.00	
CODp - Undegradable cellulose	1818.98	230.99	
CODp - Undegradable non-cellulose	1818.98	230.99	
CODs - Acetate	0.00	0.00	
CODs - Complex readily degradable	1.38	0.17	
CODs - Degradable volatile ind. #1	0	0	
CODs - Degradable volatile ind. #2	0	0	
CODs - Degradable volatile ind. #3	0	0	
CODs - Methanol	0.00	0.00	
CODs - Propionate	0.00	0.00	
CODs - Soluble hydrocarbon	0	0	
CODs - Undegradable	24.28	3.08	
Gas - Dissolved hydrogen	0.01	0.00	

Gas - Dissolved methane	0.00	0.00	
Gas - Dissolved nitrogen	19.06	2.42	
Gas - Dissolved nitrous oxide	0	0	
Gas - Dissolved oxygen	2.00	0.25	
Gas - Dissolved total CO2	2.40	0.14	mmol/L and kmol/d
Gas - Dissolved total sulfides	0.00	0.00	
HAO - Aged	0	0	
HAO - High surface	0	0	
HAO - High with H2PO4- adsorbed	0	0	
HAO - Low surface	0	0	
HAO - Low with H2PO4- adsorbed	0	0	
HFO - Aged	0	0	
HFO - High surface	0	0	
HFO - High with H+ adsorbed	0	0	
HFO - High with H2PO4- adsorbed	0	0	
HFO - Low surface	0	0	
HFO - Low with H+ adsorbed	0	0	
HFO - Low with H2PO4- adsorbed	0	0	
Influent inorganic suspended solids	1500.15	190.50	
Metal soluble - Aluminum	0	0	
Metal soluble - Calcium	80.57	10.23	
Metal soluble - Ferric	0	0	
Metal soluble - Ferrous	0	0	
Metal soluble - Magnesium	14.79	1.88	
N - Ammonia	1.13	0.14	
N - Nitrate	5.47	0.69	
N - Nitrite	0.42	0.05	
N - Particulate degradable external organics	0.00	0.00	
N - Particulate degradable organic	10.44	1.33	
N - Particulate undegradable	127.33	16.17	
N - Soluble degradable organic	0.55	0.07	
N - Soluble undegradable organic	0.62	0.08	
Other Anions (strong acids)	9.69	0.56	meq/L and keq/d
Other Cations (strong bases)	6.06	0.35	meq/L and keq/d
P - Bound on aged HMO	0	0	

P - Particulate degradable external organics	0	0
P - Particulate degradable organic	4.07	0.52
P - Particulate undegradable	40.02	5.08
P - Releasable stored polyP	0.15	0.02
P - Soluble phosphate	3.93	0.50
P - Unreleasable stored polyP	0.01	0.00
Precipitate - Brushite	0	0
Precipitate - Ferrous sulfide	0	0
Precipitate - Hydroxy - apatite	0	0
Precipitate - Struvite	0	0
Precipitate - Vivianite	0	0
S - Particulate elemental sulfur	0.00	0.00
S - Soluble sulfate	0.00	0.00
User defined - UD1	0	0
User defined - UD2	0	0
User defined - UD3	0	0
User defined - UD4	0	0

Parameter	Value	Units
Cost (Sludge)	0	$/hour
Power	0	kW
Power cost (Excl. heating)	0	$/hour

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Elements	Flow [mgd]	Temperature [deg. C]	BOD - Total Carbonaceous [m	BOD - Filtered Carbonaceous [m	COD - Total [mg/L]	COD - Filtered [mg/L]	Total suspended solids [mg/L]	Volatile suspended solids [m	N - Total N [mgN/L]	N - Total Kjeldahl Nitrogen [m	N - Ammonia [mgN/L]	N - Nitrate [mgN/L]	N - Nitrite [mgN/L]	pH []	Alkalinity [mmol/L]	OUR - Carbonaceous [mgO	OUR - Nitrification [mgO/L/hr]	OUR - Total [mgO/L/hr]	SOTR [lb/hr]	Airflow rate [ft3/min (20C, 1at	Alpha [[]]

			g/L]	g/L]				g/L]		gN/L]						/L/hr]					m)]	
Influent - BOD14	1.14	11.00	178.98	60.00	373.52	116.48	202.80	181.26	30.90	30.90	22.72	0	0	7.10	2.00	-----	-----	-----	-----	-----	-----
Anoxic 1A	2.85	11.00	2512.94	3.90	1027 1.99	30.59	9260.14	7230.55	591.46	588.10	4.88	3.25	0.11	6.73	1.59	0	0	0	0	0	0.50
Aerobic 1A	2.85	11.00	2503.92	1.13	1025 8.41	25.98	9254.16	7224.24	590.55	586.09	2.76	3.99	0.47	6.47	1.36	44.27	32.95	77.22	117.77	516.02	0.27
Aerobic 2A	2.85	11.00	2496.73	1.00	1024 7.47	25.72	9246.89	7216.72	590.47	584.58	1.13	5.47	0.42	6.35	1.14	43.53	26.10	69.63	89.68	379.65	0.29
Anoxic 2A	2.85	11.00	2511.10	1.42	1026 9.62	26.82	9261.17	7231.54	590.63	588.10	5.03	2.42	0.11	6.75	1.66	0	0	0	0	0	0.50
MBRA	0.56	11.00	0.94	0.94	25.62	25.62	0	0	8.10	1.49	0.30	6.51	0.11	6.31	1.03	52.43	17.33	69.76	60.51	927.10	0.37
MBRA (U)	2.28	11.00	3102.32	0.95	1275 3.76	25.63	11517.51	8986.28	734.02	727.41	0.30	6.51	0.11	6.38	1.03	-----	-----	-----	-----	-----	-----
Effluent	1.12	11.00	0.94	0.94	25.62	25.62	0	0	8.10	1.49	0.30	6.51	0.11	6.38	1.03	-----	-----	-----	-----	-----	-----
Waste Sludge	0.02	11.00	2496.73	1.00	1024 7.47	25.72	9246.89	7216.72	590.47	584.58	1.13	5.47	0.42	6.35	1.14	-----	-----	-----	-----	-----	-----

Global Parameters

Common

Name	Default	Value	
Hydrolysis rate [1/d]	2.1000	2.1000	1.0290
Hydrolysis half sat. [-]	0.0600	0.0600	1.0000
External organics hydrolysis rate [1/d]	2.1000	2.1000	1.0290
External organics hydrolysis half sat. [-]	0.0600	0.0600	1.0000
Anoxic hydrolysis factor [-]	0.2800	0.2800	1.0000
Anaerobic hydrolysis factor (AS) [-]	0.0400	0.0400	1.0000
Anaerobic hydrolysis factor (AD) [-]	0.5000	0.5000	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.1500	0.1500	1.0290
Ammonification rate [L/(mgCOD d)]	0.0800	0.0800	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.5000	0.5000	1.0000
Endogenous products decay rate [1/d]	0	0	1.0000

Ammonia oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9000	0.9000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.7000	0.7000	1.0000
Byproduct NH4 logistic slope [-]	50.0000	50.0000	1.0000
Byproduct NH4 inflection point [mgN/L]	1.4000	1.4000	1.0000
Denite DO half sat. [mg/L]	0.1000	0.1000	1.0000
Denite HNO2 half sat. [mgN/L]	5.000E-6	5.000E-6	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiHNO2 [mmol/L]	5.000E-3	5.000E-3	1.0000

Nitrite oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	0.7000	0.7000	1.0600

Substrate (NO2) half sat. [mgN/L]	0.1000	0.1000	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiNH3 [mmol/L]	0.0750	0.0750	1.0000

Anaerobic ammonia oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	0.2000	0.2000	1.1000
Substrate (NH4) half sat. [mgN/L]	2.0000	2.0000	1.0000
Substrate (NO2) half sat. [mgN/L]	1.0000	1.0000	1.0000
Aerobic decay rate [1/d]	0.0190	0.0190	1.0290
Anoxic/anaerobic decay rate [1/d]	9.500E-3	9.500E-3	1.0290
Ki Nitrite [mgN/L]	1000.0000	1000.0000	1.0000
Nitrite sensitivity constant [L / (d mgN)]	0.0160	0.0160	1.0000

Ordinary heterotrophic

Name	Default	Value	
Max. spec. growth rate [1/d]	3.2000	3.2000	1.0290
Substrate half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Anoxic growth factor [-]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.6200	0.6200	1.0290
Anoxic decay rate [1/d]	0.2330	0.2330	1.0290
Anaerobic decay rate [1/d]	0.1310	0.1310	1.0290
Fermentation rate [1/d]	1.6000	1.6000	1.0290
Fermentation half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Fermentation growth factor (AS) [-]	0.2500	0.2500	1.0000
Free nitrous acid inhibition [mol/L]	1.000E-7	1.000E-7	1.0000

Heterotrophic on industrial COD

Name	Default	Value	
Maximum specific growth rate on Ind #1 COD [1/d]	4.3000	4.3000	1.0290
Substrate (Ind #1) half sat. [mgCOD/L]	1.0000	1.0000	1.0000
Inhibition coefficient for Ind #1 [mgCOD/L]	60.0000	60.0000	1.0000
Anaerobic growth factor for Ind #1 [mgCOD/L]	0.0500	0.0500	1.0000
Maximum specific growth rate on Ind #2 COD [1/d]	1.5000	1.5000	1.0290
Substrate (Ind #2) half sat. [mgCOD/L]	30.0000	30.0000	1.0000
Inhibition coefficient for Ind #2 [mgCOD/L]	3000.0000	3000.0000	1.0000
Anaerobic growth factor for Ind #2 [mgCOD/L]	0.0500	0.0500	1.0000
Maximum specific growth rate on Ind #3 COD [1/d]	4.3000	4.3000	1.0290
Substrate (Ind #3) half sat. [mgCOD/L]	1.0000	1.0000	1.0000
Inhibition coefficient for Ind #3 COD [mgCOD/L]	60.0000	60.0000	1.0000
Anaerobic growth factor for Ind #3 [mgCOD/L]	0.0500	0.0500	1.0000
Maximum specific growth rate on adsorbed hydrocarbon COD [1/d]	2.0000	2.0000	1.0290
Substrate (adsorbed hydrocarbon) half sat. [-]	0.1500	0.1500	1.0000
Anaerobic growth factor for adsorbed hydrocarbons [mgCOD/L]	0.0100	0.0100	1.0000
Adsorption rate of soluble hydrocarbons [l/(mgCOD d)]	0.2000	0.2000	1.0000

Methylotrophic

Name	Default	Value	
Max. spec. growth rate [1/d]	1.3000	1.3000	1.0720
Methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.0400	0.0400	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0300	0.0300	1.0290
Free nitrous acid inhibition [mmol/L]	1.000E-7	1.000E-7	1.0000

Phosphorus accumulating

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9500	0.9500	1.0000
Max. spec. growth rate, P-limited [1/d]	0.4200	0.4200	1.0000
Substrate half sat. [mgCOD(PHB)/mgCOD(Zbp)]	0.1000	0.1000	1.0000
Substrate half sat., P-limited [mgCOD(PHB)/mgCOD(Zbp)]	0.0500	0.0500	1.0000
Magnesium half sat. [mgMg/L]	0.1000	0.1000	1.0000
Cation half sat. [mmol/L]	0.1000	0.1000	1.0000
Calcium half sat. [mgCa/L]	0.1000	0.1000	1.0000
Aerobic/anoxic decay rate [1/d]	0.1000	0.1000	1.0000
Aerobic/anoxic maintenance rate [1/d]	0	0	1.0000
Anaerobic decay rate [1/d]	0.0400	0.0400	1.0000
Anaerobic maintenance rate [1/d]	0	0	1.0000
Sequestration rate [1/d]	4.5000	4.5000	1.0000
Anoxic growth factor [-]	0.3300	0.3300	1.0000

Propionic acetogenic

Name	Default	Value	
Max. spec. growth rate [1/d]	0.2500	0.2500	1.0290
Substrate half sat. [mgCOD/L]	10.0000	10.0000	1.0000
Acetate inhibition [mgCOD/L]	10000.0000	10000.0000	1.0000
Anaerobic decay rate [1/d]	0.0500	0.0500	1.0290
Aerobic/anoxic decay rate [1/d]	0.5200	0.5200	1.0290

Methanogenic

Name	Default	Value	
Acetoclastic max. spec. growth rate [1/d]	0.3000	0.3000	1.0290

H2-utilizing max. spec. growth rate [1/d]	1.4000	1.4000	1.0290
Acetoclastic substrate half sat. [mgCOD/L]	100.0000	100.0000	1.0000
Acetoclastic methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
H2-utilizing CO2 half sat. [mmol/L]	0.1000	0.1000	1.0000
H2-utilizing substrate half sat. [mgCOD/L]	1.0000	1.0000	1.0000
H2-utilizing methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
Acetoclastic propionic inhibition [mgCOD/L]	10000.0000	10000.0000	1.0000
Acetoclastic anaerobic decay rate [1/d]	0.1300	0.1300	1.0290
Acetoclastic aerobic/anoxic decay rate [1/d]	0.6000	0.6000	1.0290
H2-utilizing anaerobic decay rate [1/d]	0.1300	0.1300	1.0290
H2-utilizing aerobic/anoxic decay rate [1/d]	2.8000	2.8000	1.0290

Sulfur oxidizing

Name	Default	Value	
Maximum specific growth rate (sulfide) [1/d]	0.7500	0.7500	1.0290
Maximum specific growth rate (sulfur) [1/d]	0.1000	0.1000	1.0290
Substrate (H2S) half sat. [mgS/L]	1.0000	1.0000	1.0000
Substrate (sulfur) half sat. [mgS/L]	1.0000	1.0000	1.0000
Anoxic growth factor [-]	0.5000	0.5000	1.0000
Decay rate [1/d]	0.0400	0.0400	1.0290

Sulfur reducing

Name	Default	Value	
Propionic max. spec. growth rate [1/d]	0.5830	0.5830	1.0350
Propionic acid half sat. [mgCOD/L]	295.0000	295.0000	1.0000
Hydrogen sulfide inhibition coefficient [mgS/L]	185.0000	185.0000	1.0000
Sulfate (SO4=) half sat. [mgS/L]	2.4700	2.4700	1.0000
Decay rate [1/d]	0.0185	0.0185	1.0350
Acetotrophic max. spec. growth rate [1/d]	0.6120	0.6120	1.0350

Acetic acid half sat. [mgCOD/L]	24.0000	24.0000	1.0000
Hydrogen sulfide inhibition coefficient [mgS/L]	164.0000	164.0000	1.0000
Sulfate (SO4=) half sat. [mgS/L]	6.4100	6.4100	1.0000
Decay rate [1/d]	0.0275	0.0275	1.0350
Hydrogenotrophic max. spec. growth rate with SO4= [1/d]	2.8000	2.8000	1.0350
Hydrogenotrophic max. spec. growth rate with S [1/d]	0.1000	0.1000	1.0350
Hydrogen half sat. [mgCOD/L]	0.0700	0.0700	1.0000
Hydrogen sulfide inhibition coefficient [mgS/L]	550.0000	550.0000	1.0000
Sulfate (SO4=) half sat. [mgS/L]	6.4100	6.4100	1.0000
Sulfur (S) half sat. [mgS/L]	50.0000	50.0000	1.0000
Decay rate [1/d]	0.0600	0.0600	1.0350

pH

BioWin user and configuration data

Project details

Project name: Unknown Project ref.: BW1

Plant name: Unknown User name: Jason.Flowers

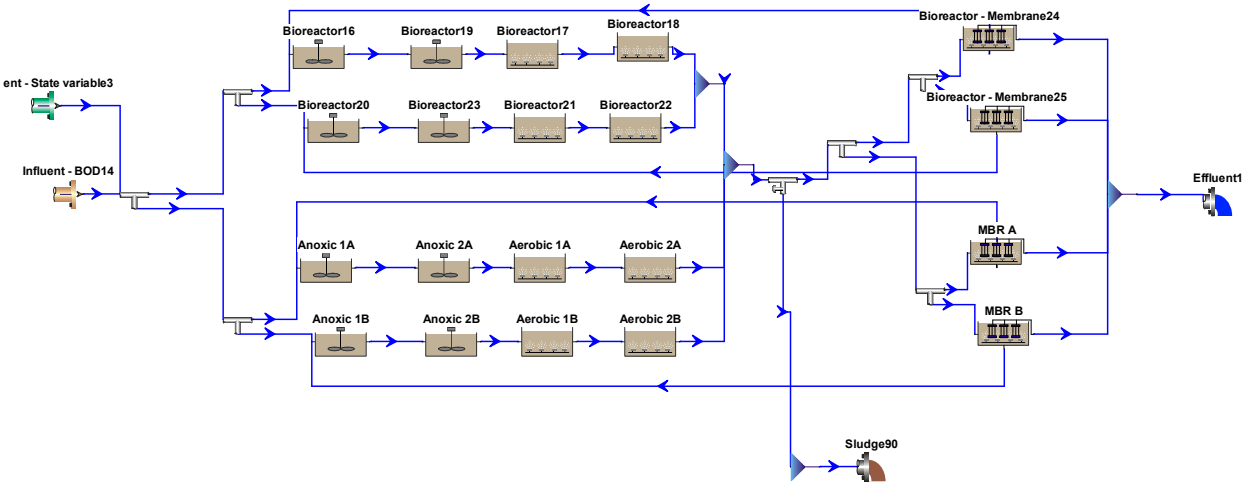
Created: 5/18/2018 Saved: 6/22/2020

Steady state solution

Target SRT: 15.00 days SRT #0: 15.00 days

Temperature: 22.0°C

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Anoxic 1A	0.0100	102.8312	13.000	Un-aerated
Aerobic 1A	0.0300	308.4936	13.000	70
Aerobic 2A	0.0300	308.4936	13.000	70
Anoxic 2A	0.0100	102.8312	13.000	Un-aerated
Anoxic 1B	0.0100	102.8312	13.000	Un-aerated
Aerobic 1B	0.0300	308.4936	13.000	70
Aerobic 2B	0.0300	308.4936	13.000	70
Anoxic 2B	0.0100	102.8312	13.000	Un-aerated
Bioreactor16	0.0100	102.8312	13.000	Un-aerated
Bioreactor17	0.0300	308.4936	13.000	70
Bioreactor18	0.0300	308.4936	13.000	70
Bioreactor19	0.0100	102.8312	13.000	Un-aerated
Bioreactor20	0.0100	102.8312	13.000	Un-aerated
Bioreactor21	0.0300	308.4936	13.000	70
Bioreactor22	0.0300	308.4936	13.000	70
Bioreactor23	0.0100	102.8312	13.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Anoxic 1A	0
Aerobic 1A	2.0
Aerobic 2A	2.0
Anoxic 2A	0
Anoxic 1B	0
Aerobic 1B	2.0
Aerobic 2B	2.0

Anoxic 2B	0
Bioreactor16	0
Bioreactor17	2.0
Bioreactor18	2.0
Bioreactor19	0
Bioreactor20	0
Bioreactor21	2.0
Bioreactor22	2.0
Bioreactor23	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^ 0.25 + k2	k2 in C = k1(PC)^ 0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	Diffuser mounting height	Min. air flow rate per diffuser ft3/min (20C, 1 atm)	Max. air flow rate per diffuser ft3/min (20C, 1 atm)	'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2
Anoxic 1A	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Aerobic 1A	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Aerobic 2A	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Anoxic 2A	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Anoxic 1B	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Aerobic 1B	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Aerobic 2B	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Anoxic 2B	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Bioreactor16	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Bioreactor17	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0

Bioreactor18	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Bioreactor19	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Bioreactor20	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Bioreactor21	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Bioreactor22	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Bioreactor23	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0

Configuration information for all Bioreactor - MBR units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers	# of cassettes	Displaced volume / cassette [ft3/cassette]	Membrane area / cassette [ft2/cassette]	Total displaced volume [Mil. Gal]	Membrane surface area [ft2]
MBR A	0.0300	308.4936	13.000	57	6.00	59.682	16320.03	0.00	97920.18
MBR B	0.0300	308.4936	13.000	57	6.00	59.682	16320.03	0.00	97920.18
Bioreactor - Membrane24	0.0300	308.4936	13.000	57	6.00	59.682	16320.03	0.00	97920.18
Bioreactor - Membrane25	0.0300	308.4936	13.000	57	6.00	59.682	16320.03	0.00	97920.18

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
MBR A	2.0

MBR B	2.0
Bioreactor - Membrane24	2.0
Bioreactor - Membrane25	2.0

Element name	Split method	Average Split specification
MBR A	Flow paced	200.00 %
MBR B	Flow paced	200.00 %
Bioreactor - Membrane24	Flow paced	200.00 %
Bioreactor - Membrane25	Flow paced	200.00 %

Aeration equipment parameters

Element name	k1 in C = k1(PC)^ 0.25 + k2	k2 in C = k1(PC)^ 0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	Diffuser mounting height	Min. air flow rate per diffuser ft3/min (20C, 1 atm)	Max. air flow rate per diffuser ft3/min (20C, 1 atm)	'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2
MBR A	0.0500	0.3800	1.0000	0.5382	0.2500	1.1772	29.4289	1.0000	0	0
MBR B	0.0500	0.3800	1.0000	0.5382	0.2500	1.1772	29.4289	1.0000	0	0
Bioreactor - Membrane24	0.0500	0.3800	1.0000	0.5382	0.2500	1.1772	29.4289	1.0000	0	0
Bioreactor - Membrane25	0.0500	0.3800	1.0000	0.5382	0.2500	1.1772	29.4289	1.0000	0	0

Element name	Surface pressure [kPa]	Fractional effective saturation depth (Fed) [-]
MBR A	101.3250	0.3000
MBR B	101.3250	0.3000
Bioreactor - Membrane24	101.3250	0.3000

Bioreactor - Membrane25	101.3250	0.3000

Element name	Supply gas CO2 content [vol. %]	Supply gas O2 [vol. %]	Off-gas CO2 [vol. %]	Off-gas O2 [vol. %]	Off-gas H2 [vol. %]	Off-gas NH3 [vol. %]	Off-gas CH4 [vol. %]	Off-gas N2O [vol. %]	Surface turbulence factor [-]
MBR A	0.0350	20.9500	1.2000	19.9000	0	0	0	0	2.0000
MBR B	0.0350	20.9500	1.2000	19.9000	0	0	0	0	2.0000
Bioreactor - Membrane24	0.0350	20.9500	1.2000	19.9000	0	0	0	0	2.0000
Bioreactor - Membrane25	0.0350	20.9500	1.2000	19.9000	0	0	0	0	2.0000

Configuration information for all Influent - BOD units

Operating data Average (flow/time weighted as required)

Element name	Influent - BOD14
Flow	1.21
BOD - Total Carbonaceous mgBOD/L	339.00
Volatile suspended solids mg/L	303.00
Total suspended solids mg/L	327.00
N - Total Kjeldahl Nitrogen mgN/L	56.00
P - Total P mgP/L	6.50
S - Total S mgS/L	0
N - Nitrate mgN/L	0
pH	7.10
Alkalinity mmol/L	4.00
Metal soluble - Calcium mg/L	80.00
Metal soluble - Magnesium mg/L	15.00
Gas - Dissolved oxygen mg/L	0

Element name	Influent - BOD14
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1410
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1418
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.7097
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0650
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.1300
Fcel - Cellulose fraction of unbiodegradable particulate [gCOD/gCOD]	0.5000
Fna - Ammonia [gNH3-N/gTKN]	0.7353
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0700
Fpo4 - Phosphate [gPO4-P/gTP]	0.4717
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0220
Fsr - Reduced sulfur [H2S] [gS/gS]	0
FZbh - Ordinary heterotrophic COD fraction [gCOD/g of total COD]	0.0200
FZbm - Methylotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZao - Ammonia oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZno - Nitrite oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZaao - Anaerobic ammonia oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZppa - Phosphorus accumulating COD fraction [gCOD/g of total COD]	1.000E-4
FZpa - Propionic acetogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZam - Acetoclastic methanogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZhm - Hydrogenotrophic methanogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZso - Sulfur oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZsrpa - Sulfur reducing propionic acetogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZsra - Sulfur reducing acetotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZsrh - Sulfur reducing hydrogenotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZe - Endogenous products COD fraction [gCOD/g of total COD]	0

Configuration information for all Splitter units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Splitter66	Fraction	0.50
Splitter7	Flowrate [Side]	0.0295245821878847
Splitter8	Fraction	0.50
Splitter28	Fraction	0.50
Splitter29	Fraction	0.50
Splitter30	Fraction	0.50
Splitter37	Fraction	0.50

Configuration information for all Influent - State variable units

Operating data Average (flow/time weighted as required)

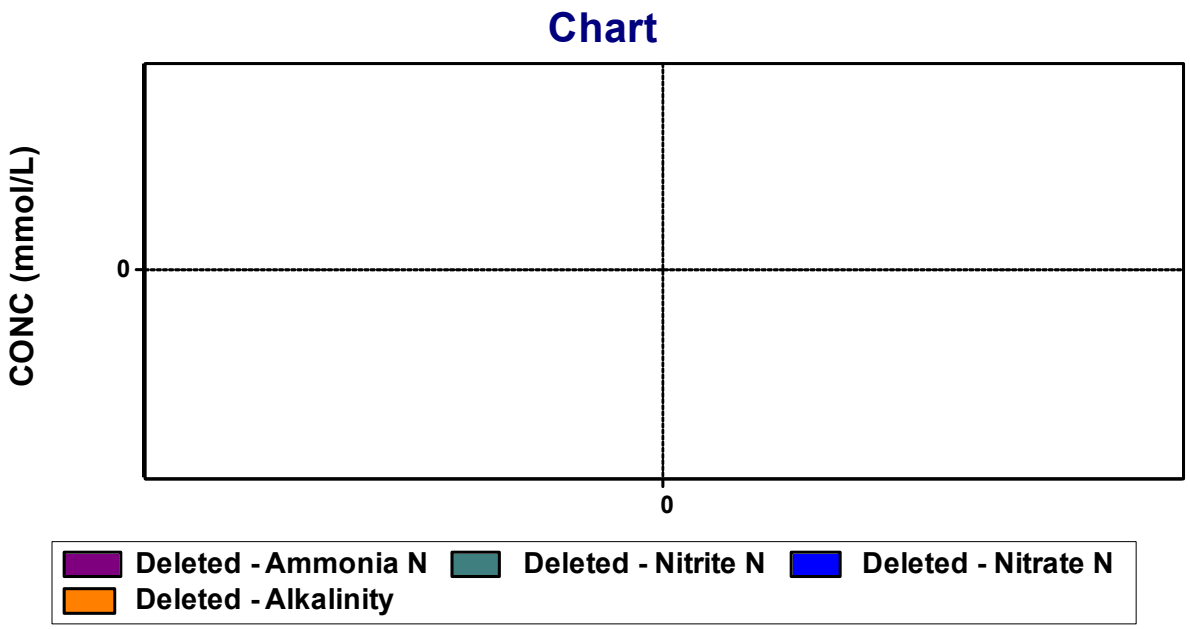
Element name	Influent - State variable3
Biomass - Ordinary heterotrophic [mgCOD/L]	0
Biomass - Methylotrophic [mgCOD/L]	0
Biomass - Ammonia oxidizing [mgCOD/L]	0
Biomass - Nitrite oxidizing [mgCOD/L]	0
Biomass - Anaerobic ammonia oxidizing [mgCOD/L]	0
Biomass - Phosphorus accumulating [mgCOD/L]	0
Biomass - Propionic acetogenic [mgCOD/L]	0
Biomass - Acetoclastic methanogenic [mgCOD/L]	0
Biomass - Hydrogenotrophic methanogenic [mgCOD/L]	0
Biomass - Endogenous products [mgCOD/L]	0
CODp - Slowly degradable particulate [mgCOD/L]	0
CODp - Slowly degradable colloidal [mgCOD/L]	0
CODp - Degradable external organics [mgCOD/L]	0
CODp - Undegradable non-cellulose [mgCOD/L]	0
CODp - Undegradable cellulose [mgCOD/L]	0

N - Particulate degradable organic [mgN/L]	0
P - Particulate degradable organic [mgP/L]	0
N - Particulate degradable external organics [mgN/L]	0
P - Particulate degradable external organics [mgP/L]	0
N - Particulate undegradable [mgN/L]	0
P - Particulate undegradable [mgP/L]	0
CODp - Stored PHA [mgCOD/L]	0
P - Releasable stored polyP [mgP/L]	0
P - Unreleasable stored polyP [mgP/L]	0
CODs - Complex readily degradable [mgCOD/L]	0
CODs - Acetate [mgCOD/L]	0
CODs - Propionate [mgCOD/L]	0
CODs - Methanol [mgCOD/L]	0
Gas - Dissolved hydrogen [mgCOD/L]	0
Gas - Dissolved methane [mg/L]	0
N - Ammonia [mgN/L]	0
N - Soluble degradable organic [mgN/L]	0
Gas - Dissolved nitrous oxide [mgN/L]	0
N - Nitrite [mgN/L]	0
N - Nitrate [mgN/L]	0
Gas - Dissolved nitrogen [mgN/L]	0
P - Soluble phosphate [mgP/L]	0
CODs - Undegradable [mgCOD/L]	0
N - Soluble undegradable organic [mgN/L]	0
Influent inorganic suspended solids [mgISS/L]	0
Precipitate - Struvite [mgISS/L]	0
Precipitate - Brushite [mgISS/L]	0
Precipitate - Hydroxy - apatite [mgISS/L]	0
Precipitate - Vivianite [mgISS/L]	0
HFO - High surface [mg/L]	0
HFO - Low surface [mg/L]	0
HFO - High with H2PO4- adsorbed [mg/L]	0
HFO - Low with H2PO4- adsorbed [mg/L]	0
HFO - Aged [mg/L]	0
HFO - Low with H+ adsorbed [mg/L]	0

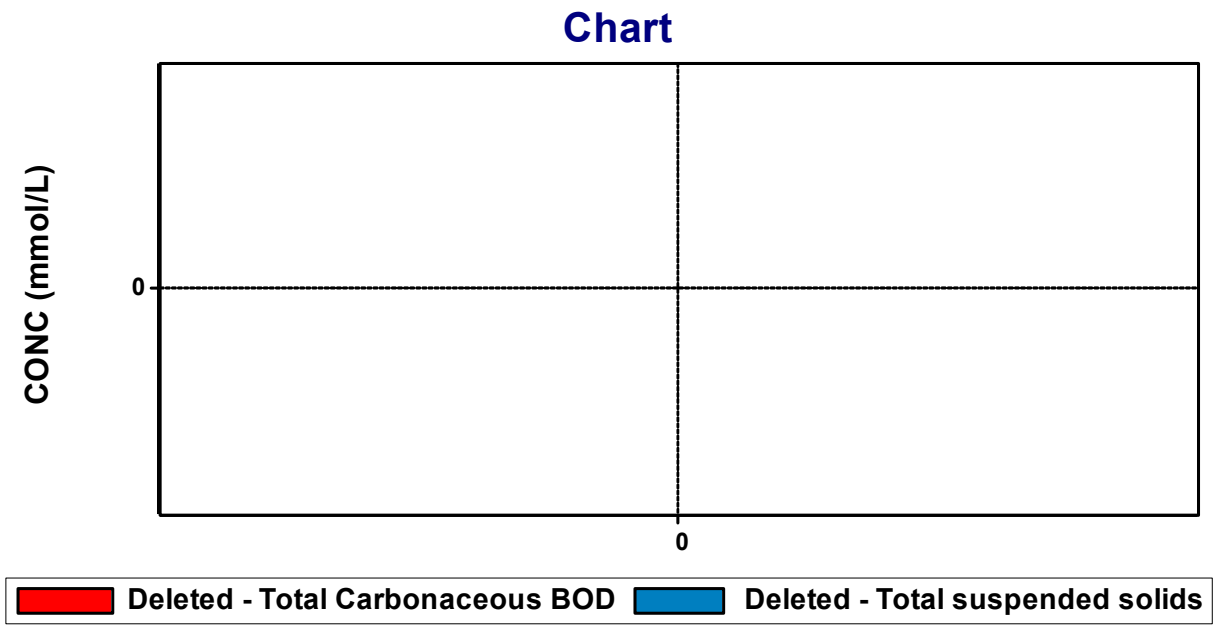
HFO - High with H+ adsorbed [mg/L]	0
HAO - High surface [mg/L]	0
HAO - Low surface [mg/L]	0
HAO - High with H2PO4- adsorbed [mg/L]	0
HAO - Low with H2PO4- adsorbed [mg/L]	0
HAO - Aged [mg/L]	0
P - Bound on aged HMO [mgP/L]	0
Metal soluble - Magnesium [mg/L]	0
Metal soluble - Calcium [mg/L]	0
Metal soluble - Ferric [mg/L]	0
Metal soluble - Ferrous [mg/L]	0
Metal soluble - Aluminum [mg/L]	0
Other Cations (strong bases) [meq/L]	12500.00
Other Anions (strong acids) [meq/L]	0
Gas - Dissolved total CO2 [mmol/L]	0
User defined - UD1 [mg/L]	0
User defined - UD2 [mg/L]	0
User defined - UD3 [mgVSS/L]	0
User defined - UD4 [mgISS/L]	0
Biomass - Sulfur oxidizing [mgCOD/L]	0
Biomass - Sulfur reducing propionic acetogenic [mgCOD/L]	0
Biomass - Sulfur reducing acetotrophic [mgCOD/L]	0
Biomass - Sulfur reducing hydrogenotrophic [mgCOD/L]	0
Gas - Dissolved total sulfides [mgS/L]	0
S - Soluble sulfate [mgS/L]	0
S - Particulate elemental sulfur [mgS/L]	0
Precipitate - Ferrous sulfide [mgISS/L]	0
CODp - Adsorbed hydrocarbon [mgCOD/L]	0
CODs - Degradable volatile ind. #1 [mgCOD/L]	0
CODs - Degradable volatile ind. #2 [mgCOD/L]	0
CODs - Degradable volatile ind. #3 [mgCOD/L]	0
CODs - Soluble hydrocarbon [mgCOD/L]	0
Gas - Dissolved oxygen [mg/L]	0
Flow	0.0001

BioWin Album

Album page - Nitrogen species



Album page - BOD_TSS



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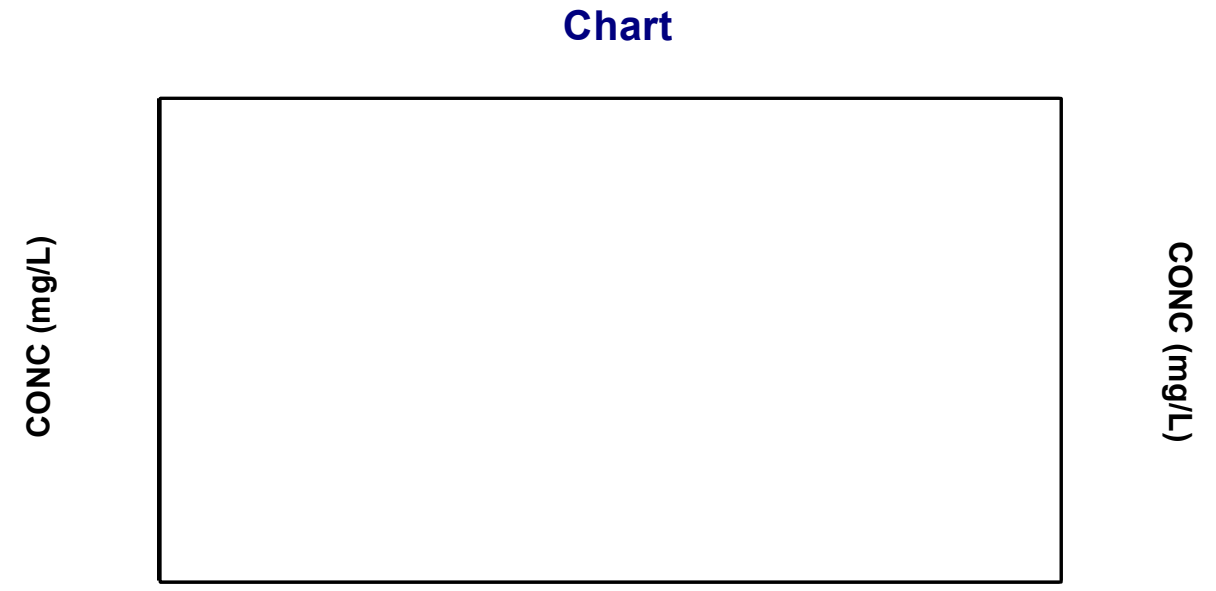
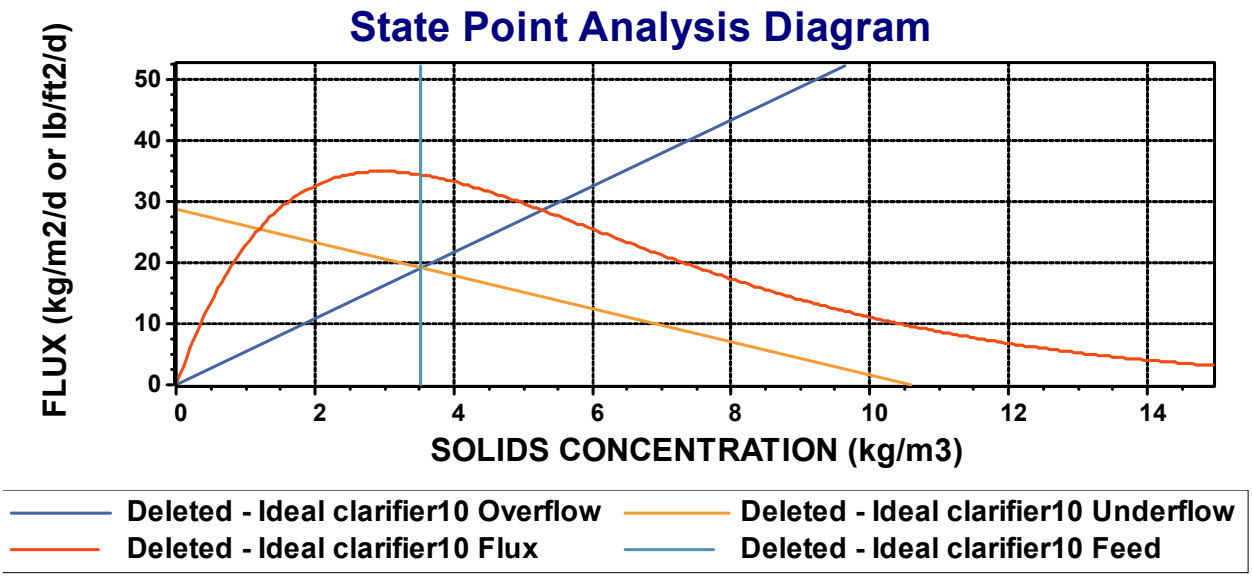


Album page - Page 4

Album page - Page 5



K = 0.3362 m3/kg
Vo = 511.2 ft/d

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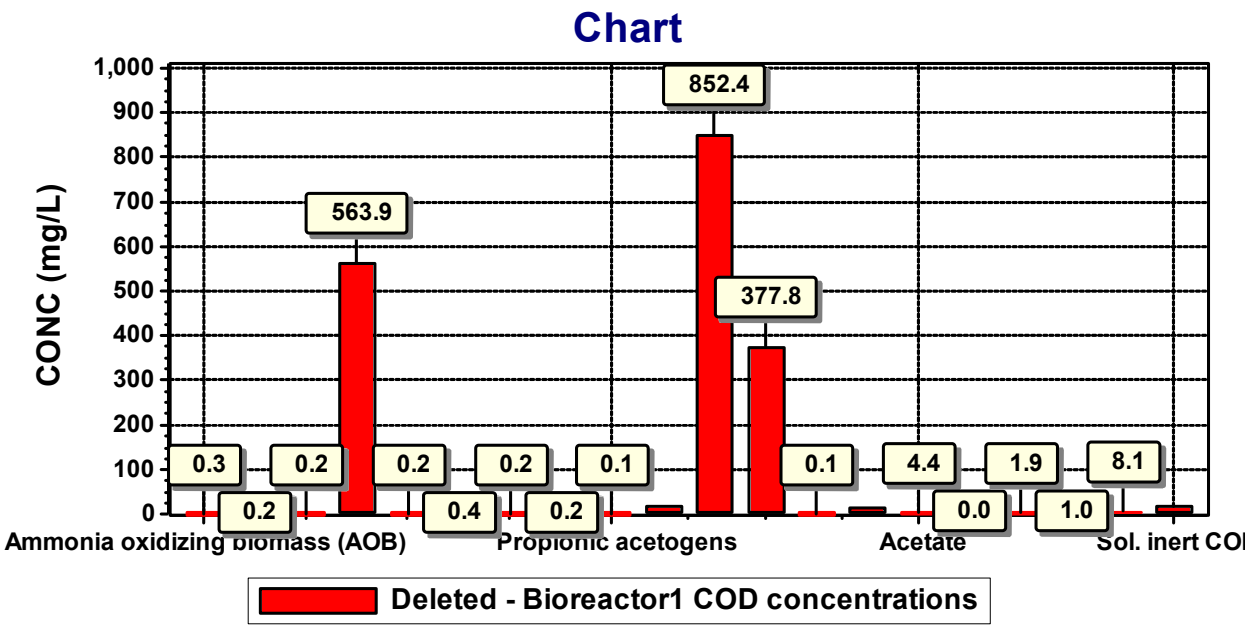

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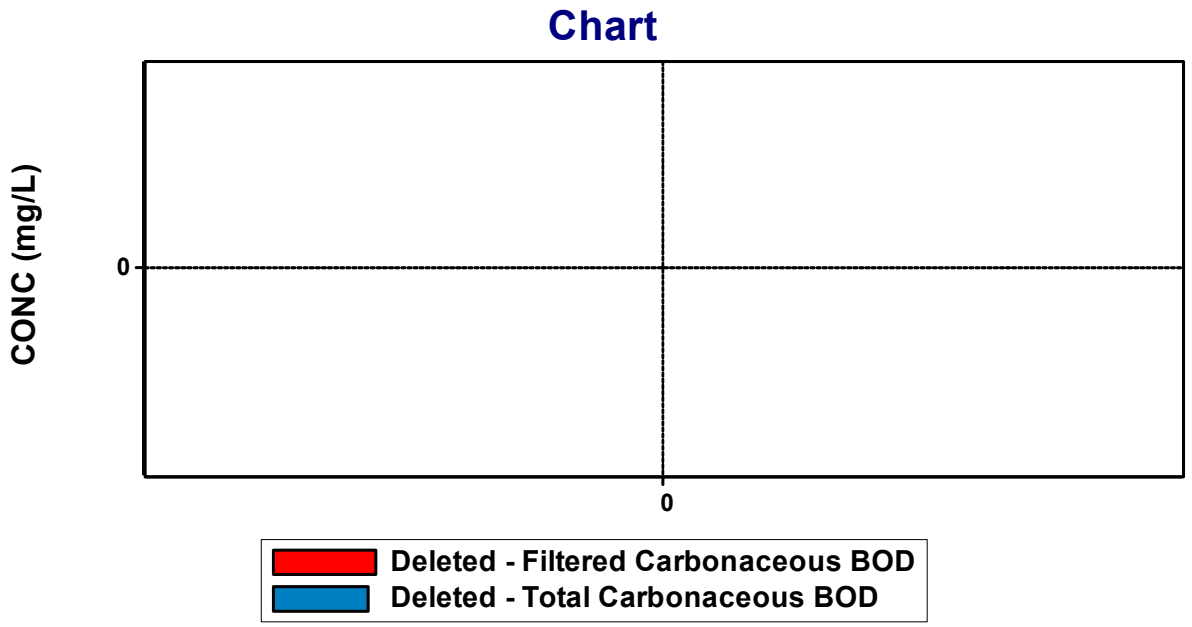

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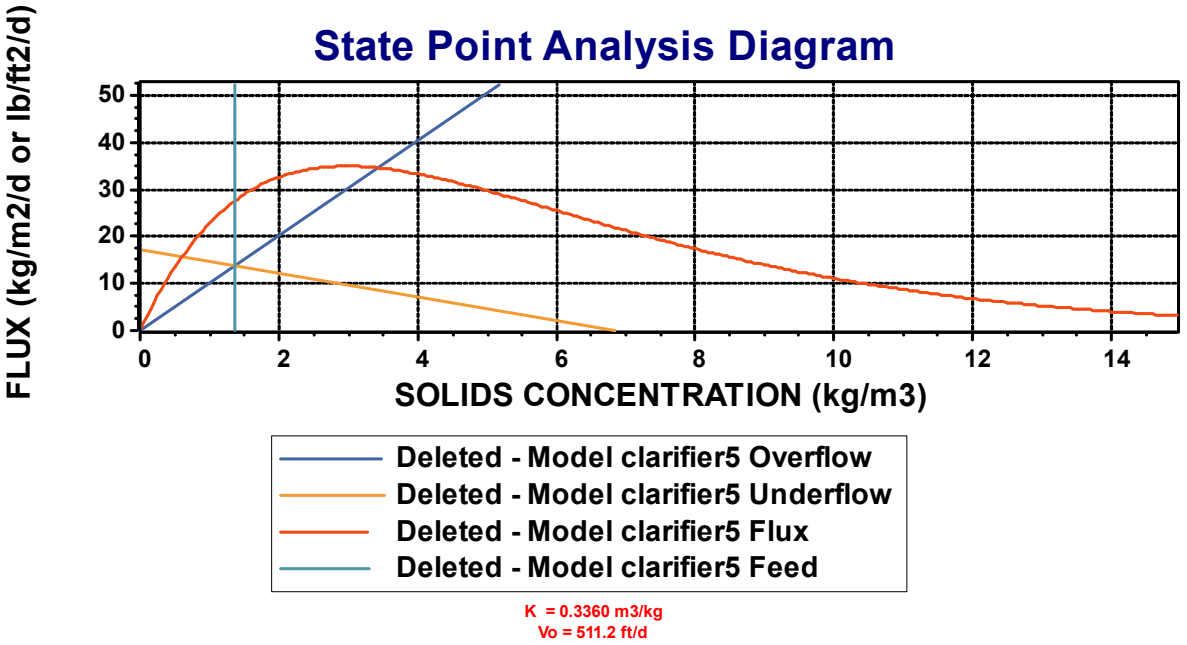

Album page - Page 9

Sludge90			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
Biomass - Acetoclastic methanogenic	0.28	0.07	
Biomass - Ammonia oxidizing	80.42	19.81	
Biomass - Anaerobic ammonia oxidizing	2.46	0.61	
Biomass - Endogenous products	2363.52	582.36	
Biomass - Hydrogenotrophic methanogenic	0.06	0.02	
Biomass - Methylotrophic	1.71	0.42	
Biomass - Nitrite oxidizing	50.03	12.33	
Biomass - Ordinary heterotrophic	3314.44	816.66	
Biomass - Phosphorus accumulating	1.25	0.31	
Biomass - Propionic acetogenic	0.31	0.08	
Biomass - Sulfur oxidizing	0.00	0.00	
Biomass - Sulfur reducing acetotrophic	0	0	
Biomass - Sulfur reducing hydrogenotrophic	0	0	
Biomass - Sulfur reducing propionic acetogenic	0	0	

CODp - Adsorbed hydrocarbon	0	0	
CODp - Degradable external organics	0.00	0.00	
CODp - Slowly degradable colloidal	0.05	0.01	
CODp - Slowly degradable particulate	179.02	44.11	
CODp - Stored PHA	0.00	0.00	
CODp - Undegradable cellulose	1884.43	464.31	
CODp - Undegradable non-cellulose	1884.43	464.31	
CODs - Acetate	0.00	0.00	
CODs - Complex readily degradable	1.36	0.33	
CODs - Degradable volatile ind. #1	0	0	
CODs - Degradable volatile ind. #2	0	0	
CODs - Degradable volatile ind. #3	0	0	
CODs - Methanol	0.00	0.00	
CODs - Propionate	0.00	0.00	
CODs - Soluble hydrocarbon	0	0	
CODs - Undegradable	45.98	11.33	
Gas - Dissolved hydrogen	0.01	0.00	
Gas - Dissolved methane	0.00	0.00	
Gas - Dissolved nitrogen	15.71	3.87	
Gas - Dissolved nitrous oxide	0	0	
Gas - Dissolved oxygen	2.00	0.49	
Gas - Dissolved total CO2	2.40	0.27	mmol/L and kmol/d
Gas - Dissolved total sulfides	0.00	0.00	
HAO - Aged	0	0	
HAO - High surface	0	0	
HAO - High with H2PO4- adsorbed	0	0	
HAO - Low surface	0	0	
HAO - Low with H2PO4- adsorbed	0	0	
HFO - Aged	0	0	
HFO - High surface	0	0	
HFO - High with H+ adsorbed	0	0	
HFO - High with H2PO4- adsorbed	0	0	
HFO - Low surface	0	0	
HFO - Low with H+ adsorbed	0	0	
HFO - Low with H2PO4- adsorbed	0	0	

Influent inorganic suspended solids	875.92	215.82	
Metal soluble - Aluminum	0	0	
Metal soluble - Calcium	81.21	20.01	
Metal soluble - Ferric	0	0	
Metal soluble - Ferrous	0	0	
Metal soluble - Magnesium	14.67	3.61	
N - Ammonia	0.20	0.05	
N - Nitrate	10.81	2.66	
N - Nitrite	0.07	0.02	
N - Particulate degradable external organics	0.00	0.00	
N - Particulate degradable organic	8.18	2.02	
N - Particulate undegradable	131.91	32.50	
N - Soluble degradable organic	0.54	0.13	
N - Soluble undegradable organic	1.12	0.28	
Other Anions (strong acids)	8.98	1.00	meq/L and keq/d
Other Cations (strong bases)	5.97	0.67	meq/L and keq/d
P - Bound on aged HMO	0	0	
P - Particulate degradable external organics	0.00	0.00	
P - Particulate degradable organic	2.67	0.66	
P - Particulate undegradable	41.46	10.21	
P - Releasable stored polyP	0.14	0.03	
P - Soluble phosphate	2.25	0.55	
P - Unreleasable stored polyP	0.01	0.00	
Precipitate - Brushite	0	0	
Precipitate - Ferrous sulfide	0	0	
Precipitate - Hydroxy - apatite	0	0	
Precipitate - Struvite	0	0	
Precipitate - Vivianite	0	0	
S - Particulate elemental sulfur	0	0	
S - Soluble sulfate	0.00	0.00	
User defined - UD1	0	0	
User defined - UD2	0	0	
User defined - UD3	0	0	
User defined - UD4	0	0	

Parameter	Value	Units
Cost (Sludge)	0	$/hour
Power	0	kW
Power cost (Excl. heating)	0	$/hour

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Elements	Flow [mgd]	Temperature [deg. C]	BOD - Total Carbonaceous [mg/L]	BOD - Filtered Carbonaceous [mg/L]	COD - Total [mg/L]	COD - Filtered [mg/L]	Total suspended solids [mg/L]	Volatile suspended solids [mg/L]	N - Total N [mgN/L]	N - Total Kjeldahl Nitrogen [mgN/L]	N - Ammonia [mgN/L]	N - Nitrate [mgN/L]	N - Nitrite [mgN/L]	pH []	Alkalinity [mmol/L]	OUR - Carbonaceous [mgO/L/hr]	OUR - Nitrification [mgO/L/hr]	OUR - Total [mgO/L/hr]	SOTR [lb/hr]	Airflow rate [ft3/min (20C, 1atm)]	Alpha [[]]
Influent - BOD14	1.21	22.00	338.96	146.30	707.40	277.80	327.00	303.00	56.00	56.00	41.18	0	0	7.10	4.00	----	----	----	----	----	----
Anoxic 1A	2.72	22.00	2050.86	5.05	9837.48	54.26	8269.08	6908.55	560.95	553.28	4.73	7.57	0.09	6.75	1.96	0	0	0	0	0	0.50
Aerobic 1A	2.72	22.00	2040.77	1.15	9822.36	47.70	8263.40	6902.52	559.94	550.02	1.32	9.45	0.47	6.53	1.56	48.50	52.11	100.61	137.09	612.26	0.30
Aerobic 2A	2.72	22.00	2032.48	0.99	9809.78	47.40	8254.96	6893.87	559.86	548.97	0.20	10.81	0.07	6.46	1.41	47.05	19.31	66.36	79.81	332.95	0.32
Anoxic 2A	2.72	22.00	2048.90	1.78	9834.86	49.03	8270.95	6910.39	560.04	553.28	4.90	6.64	0.11	6.77	2.04	0	0	0	0	0	0.50

MBRA	0.30	22.00	0.97	0.97	47.37	47.37	0	0	12.79	1.74	0.06	11.03	0.01	6.54	1.39	50.47	7.00	57.47	50.74	777.35	0.37
MBRA (U)	2.42	22.00	2270.70	0.98	10985.87	47.37	9251.60	7724.44	626.50	615.45	0.06	11.03	0.01	6.53	1.39	----	----	----	----	----	----
Effluent 1	1.18	22.00	0.97	0.97	47.37	47.37	0	0	12.79	1.74	0.06	11.03	0.01	6.53	1.39	----	----	----	----	----	----
Sludge 90	0.03	22.00	2032.48	0.99	9809.78	47.40	8254.96	6893.87	559.86	548.97	0.20	10.81	0.07	6.46	1.41	----	----	----	----	----	----

Global Parameters

Common

Name	Default	Value	
Hydrolysis rate [1/d]	2.1000	2.1000	1.0290
Hydrolysis half sat. [-]	0.0600	0.0600	1.0000
External organics hydrolysis rate [1/d]	2.1000	2.1000	1.0290
External organics hydrolysis half sat. [-]	0.0600	0.0600	1.0000
Anoxic hydrolysis factor [-]	0.2800	0.2800	1.0000
Anaerobic hydrolysis factor (AS) [-]	0.0400	0.0400	1.0000
Anaerobic hydrolysis factor (AD) [-]	0.5000	0.5000	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.1500	0.1500	1.0290
Ammonification rate [L/(mgCOD d)]	0.0800	0.0800	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.5000	0.5000	1.0000
Endogenous products decay rate [1/d]	0	0	1.0000

Ammonia oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9000	0.9000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.7000	0.7000	1.0000
Byproduct NH4 logistic slope [-]	50.0000	50.0000	1.0000
Byproduct NH4 inflection point [mgN/L]	1.4000	1.4000	1.0000
Denite DO half sat. [mg/L]	0.1000	0.1000	1.0000
Denite HNO2 half sat. [mgN/L]	5.000E-6	5.000E-6	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiHNO2 [mmol/L]	5.000E-3	5.000E-3	1.0000

Nitrite oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	0.7000	0.7000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.1000	0.1000	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiNH3 [mmol/L]	0.0750	0.0750	1.0000

Anaerobic ammonia oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	0.2000	0.2000	1.1000
Substrate (NH4) half sat. [mgN/L]	2.0000	2.0000	1.0000
Substrate (NO2) half sat. [mgN/L]	1.0000	1.0000	1.0000
Aerobic decay rate [1/d]	0.0190	0.0190	1.0290
Anoxic/anaerobic decay rate [1/d]	9.500E-3	9.500E-3	1.0290
Ki Nitrite [mgN/L]	1000.0000	1000.0000	1.0000
Nitrite sensitivity constant [L / (d mgN)]	0.0160	0.0160	1.0000

Ordinary heterotrophic

Name	Default	Value	
Max. spec. growth rate [1/d]	3.2000	3.2000	1.0290
Substrate half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Anoxic growth factor [-]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.6200	0.6200	1.0290
Anoxic decay rate [1/d]	0.2330	0.2330	1.0290
Anaerobic decay rate [1/d]	0.1310	0.1310	1.0290
Fermentation rate [1/d]	1.6000	1.6000	1.0290
Fermentation half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Fermentation growth factor (AS) [-]	0.2500	0.2500	1.0000
Free nitrous acid inhibition [mol/L]	1.000E-7	1.000E-7	1.0000

Heterotrophic on industrial COD

Name	Default	Value	
Maximum specific growth rate on Ind #1 COD [1/d]	4.3000	4.3000	1.0290
Substrate (Ind #1) half sat. [mgCOD/L]	1.0000	1.0000	1.0000
Inhibition coefficient for Ind #1 [mgCOD/L]	60.0000	60.0000	1.0000
Anaerobic growth factor for Ind #1 [mgCOD/L]	0.0500	0.0500	1.0000
Maximum specific growth rate on Ind #2 COD [1/d]	1.5000	1.5000	1.0290
Substrate (Ind #2) half sat. [mgCOD/L]	30.0000	30.0000	1.0000
Inhibition coefficient for Ind #2 [mgCOD/L]	3000.0000	3000.0000	1.0000
Anaerobic growth factor for Ind #2 [mgCOD/L]	0.0500	0.0500	1.0000
Maximum specific growth rate on Ind #3 COD [1/d]	4.3000	4.3000	1.0290
Substrate (Ind #3) half sat. [mgCOD/L]	1.0000	1.0000	1.0000
Inhibition coefficient for Ind #3 COD [mgCOD/L]	60.0000	60.0000	1.0000
Anaerobic growth factor for Ind #3 [mgCOD/L]	0.0500	0.0500	1.0000

Maximum specific growth rate on adsorbed hydrocarbon COD [1/d]	2.0000	2.0000	1.0290
Substrate (adsorbed hydrocarbon) half sat. [-]	0.1500	0.1500	1.0000
Anaerobic growth factor for adsorbed hydrocarbons [mgCOD/L]	0.0100	0.0100	1.0000
Adsorption rate of soluble hydrocarbons [l/(mgCOD d)]	0.2000	0.2000	1.0000

Methylotrophic

Name	Default	Value	
Max. spec. growth rate [1/d]	1.3000	1.3000	1.0720
Methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.0400	0.0400	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0300	0.0300	1.0290
Free nitrous acid inhibition [mmol/L]	1.000E-7	1.000E-7	1.0000

Phosphorus accumulating

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9500	0.9500	1.0000
Max. spec. growth rate, P-limited [1/d]	0.4200	0.4200	1.0000
Substrate half sat. [mgCOD(PHB)/mgCOD(Zbp)]	0.1000	0.1000	1.0000
Substrate half sat., P-limited [mgCOD(PHB)/mgCOD(Zbp)]	0.0500	0.0500	1.0000
Magnesium half sat. [mgMg/L]	0.1000	0.1000	1.0000
Cation half sat. [mmol/L]	0.1000	0.1000	1.0000
Calcium half sat. [mgCa/L]	0.1000	0.1000	1.0000
Aerobic/anoxic decay rate [1/d]	0.1000	0.1000	1.0000
Aerobic/anoxic maintenance rate [1/d]	0	0	1.0000
Anaerobic decay rate [1/d]	0.0400	0.0400	1.0000
Anaerobic maintenance rate [1/d]	0	0	1.0000
Sequestration rate [1/d]	4.5000	4.5000	1.0000
Anoxic growth factor [-]	0.3300	0.3300	1.0000

Propionic acetogenic

Name	Default	Value	
Max. spec. growth rate [1/d]	0.2500	0.2500	1.0290
Substrate half sat. [mgCOD/L]	10.0000	10.0000	1.0000
Acetate inhibition [mgCOD/L]	10000.0000	10000.0000	1.0000
Anaerobic decay rate [1/d]	0.0500	0.0500	1.0290
Aerobic/anoxic decay rate [1/d]	0.5200	0.5200	1.0290

Methanogenic

Name	Default	Value	
Acetoclastic max. spec. growth rate [1/d]	0.3000	0.3000	1.0290
H2-utilizing max. spec. growth rate [1/d]	1.4000	1.4000	1.0290
Acetoclastic substrate half sat. [mgCOD/L]	100.0000	100.0000	1.0000
Acetoclastic methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
H2-utilizing CO2 half sat. [mmol/L]	0.1000	0.1000	1.0000
H2-utilizing substrate half sat. [mgCOD/L]	1.0000	1.0000	1.0000
H2-utilizing methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
Acetoclastic propionic inhibition [mgCOD/L]	10000.0000	10000.0000	1.0000
Acetoclastic anaerobic decay rate [1/d]	0.1300	0.1300	1.0290
Acetoclastic aerobic/anoxic decay rate [1/d]	0.6000	0.6000	1.0290
H2-utilizing anaerobic decay rate [1/d]	0.1300	0.1300	1.0290
H2-utilizing aerobic/anoxic decay rate [1/d]	2.8000	2.8000	1.0290

Sulfur oxidizing

Name	Default	Value

Maximum specific growth rate (sulfide) [1/d]	0.7500	0.7500	1.0290
Maximum specific growth rate (sulfur) [1/d]	0.1000	0.1000	1.0290
Substrate (H2S) half sat. [mgS/L]	1.0000	1.0000	1.0000
Substrate (sulfur) half sat. [mgS/L]	1.0000	1.0000	1.0000
Anoxic growth factor [-]	0.5000	0.5000	1.0000
Decay rate [1/d]	0.0400	0.0400	1.0290

Sulfur reducing

Name	Default	Value	
Propionic max. spec. growth rate [1/d]	0.5830	0.5830	1.0350
Propionic acid half sat. [mgCOD/L]	295.0000	295.0000	1.0000
Hydrogen sulfide inhibition coefficient [mgS/L]	185.0000	185.0000	1.0000
Sulfate (SO4=) half sat. [mgS/L]	2.4700	2.4700	1.0000
Decay rate [1/d]	0.0185	0.0185	1.0350
Acetotrophic max. spec. growth rate [1/d]	0.6120	0.6120	1.0350
Acetic acid half sat. [mgCOD/L]	24.0000	24.0000	1.0000
Hydrogen sulfide inhibition coefficient [mgS/L]	164.0000	164.0000	1.0000
Sulfate (SO4=) half sat. [mgS/L]	6.4100	6.4100	1.0000
Decay rate [1/d]	0.0275	0.0275	1.0350
Hydrogenotrophic max. spec. growth rate with SO4= [1/d]	2.8000	2.8000	1.0350
Hydrogenotrophic max. spec. growth rate with S [1/d]	0.1000	0.1000	1.0350
Hydrogen half sat. [mgCOD/L]	0.0700	0.0700	1.0000
Hydrogen sulfide inhibition coefficient [mgS/L]	550.0000	550.0000	1.0000
Sulfate (SO4=) half sat. [mgS/L]	6.4100	6.4100	1.0000
Sulfur (S) half sat. [mgS/L]	50.0000	50.0000	1.0000
Decay rate [1/d]	0.0600	0.0600	1.0350

pH

Name	Default	Value

Ordinary heterotrophic low pH limit [-]	4.0000	4.0000
Ordinary heterotrophic high pH limit [-]	10.0000	10.0000
Methylotrophic low pH limit [-]	4.0000	4.0000
Methylotrophic high pH limit [-]	10.0000	10.0000
Autotrophic low pH limit [-]	5.5000	5.5000
Autotrophic high pH limit [-]	9.5000	9.5000
Phosphorus accumulating low pH limit [-]	4.0000	4.0000
Phosphorus accumulating high pH limit [-]	10.0000	10.0000
Ordinary heterotrophic low pH limit (anaerobic) [-]	5.5000	5.5000
Ordinary heterotrophic high pH limit (anaerobic) [-]	8.5000	8.5000
Propionic acetogenic low pH limit [-]	4.0000	4.0000
Propionic acetogenic high pH limit [-]	10.0000	10.0000
Acetoclastic methanogenic low pH limit [-]	5.0000	5.0000
Acetoclastic methanogenic high pH limit [-]	9.0000	9.0000
H2-utilizing methanogenic low pH limit [-]	5.0000	5.0000
H2-utilizing methanogenic high pH limit [-]	9.0000	9.0000

Switches

Name	Default	Value
Ordinary heterotrophic DO half sat. [mgO2/L]	0.1500	0.0500
Phosphorus accumulating DO half sat. [mgO2/L]	0.0500	0.0500
Anoxic/anaerobic NOx half sat. [mgN/L]	0.1500	0.1500
Ammonia oxidizing DO half sat. [mgO2/L]	0.2500	0.2500
Nitrite oxidizing DO half sat. [mgO2/L]	0.5000	0.5000
Anaerobic ammonia oxidizing DO half sat. [mgO2/L]	0.0100	0.0100
Sulfur oxidizing sulfate pathway DO half sat. [mgO2/L]	0.2500	0.2500
Sulfur oxidizing sulfur pathway DO half sat. [mgO2/L]	0.0500	0.0500
Anoxic NO3(->NO2) half sat. [mgN/L]	0.1000	0.1000
Anoxic NO3(->N2) half sat. [mgN/L]	0.0500	0.0500
Anoxic NO2(->N2) half sat. (mgN/L)	0.0100	0.0100
NH3 nutrient half sat. [mgN/L]	5.000E-3	5.000E-3
PolyP half sat. [mgP/mgCOD]	0.0100	0.0100

VFA sequestration half sat. [mgCOD/L]	5.0000	5.0000
P uptake half sat. [mgP/L]	0.1500	0.1500
P nutrient half sat. [mgP/L]	1.000E-3	1.000E-3
Autotrophic CO2 half sat. [mmol/L]	0.1000	0.1000
H2 low/high half sat. [mgCOD/L]	1.0000	1.0000
Propionic acetogenic H2 inhibition [mgCOD/L]	5.0000	5.0000
Synthesis anion/cation half sat. [meq/L]	0.0100	0.0100

Common

Name	Default	Value
Biomass/Endog Ca content (gCa/gCOD)	3.912E-3	3.912E-3
Biomass/Endog Mg content (gMg/gCOD)	3.912E-3	3.912E-3
Biomass/Endog other cations content (mol/gCOD)	5.115E-4	5.115E-4
Biomass/Endog other Anions content (mol/gCOD)	1.410E-4	1.410E-4
N in endogenous residue [mgN/mgCOD]	0.0700	0.0700
P in endogenous residue [mgP/mgCOD]	0.0220	0.0220
Ca content of slowly biodegradabe (gCa/gCOD)	3.912E-3	3.912E-3
Mg content of slowly biodegradabe (gMg/gCOD)	3.700E-4	3.700E-4
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.6327	1.4200
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.4200
Cellulose COD:VSS ratio [mgCOD/mgVSS]	1.4000	1.4000
External organic COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6000
Molecular weight of other anions [mg/mmol]	35.5000	35.5000
Molecular weight of other cations [mg/mmol]	39.0983	39.1000

Ammonia oxidizing

Name	Default	Value
Yield [mgCOD/mgN]	0.1500	0.1500

Denite NO2 fraction as TEA [-]	0.5000	0.5000
Byproduct NH4 fraction to N2O [-]	2.500E-3	2.500E-3
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Nitrite oxidizing

Name	Default	Value
Yield [mgCOD/mgN]	0.0900	0.0900
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Anaerobic ammonia oxidizing

Name	Default	Value
Yield [mgCOD/mgN]	0.1140	0.1140
Nitrate production [mgN/mgBiomassCOD]	2.2800	2.2800
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Ordinary heterotrophic

Name	Default	Value

Yield (aerobic) [-]	0.6660	0.6660
Yield (fermentation, low H2) [-]	0.1000	0.1000
Yield (fermentation, high H2) [-]	0.1000	0.1000
H2 yield (fermentation low H2) [-]	0.3500	0.3500
H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.7000	0.7000
CO2 yield (fermentation, low H2) [-]	0.7000	0.7000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Endogenous fraction - aerobic [-]	0.0800	0.0800
Endogenous fraction - anoxic [-]	0.1030	0.1030
Endogenous fraction - anaerobic [-]	0.1840	0.1840
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield (anoxic) [-]	0.5400	0.5400
Yield propionic (aerobic) [-]	0.6400	0.6400
Yield propionic (anoxic) [-]	0.4600	0.4600
Yield acetic (aerobic) [-]	0.6000	0.6000
Yield acetic (anoxic) [-]	0.4300	0.4300
Yield methanol (aerobic) [-]	0.5000	0.5000
Adsorp. max. [-]	1.0000	1.0000
Max fraction to N2O at high FNA over nitrate [-]	0.0500	0.0500
Max fraction to N2O at high FNA over nitrite [-]	0.1000	0.1000

Ordinary heterotrophic on industrial COD

Methylotrophic

Name	Default	Value

Yield (anoxic) [-]	0.4000	0.4000
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Max fraction to N2O at high FNA over nitrate [-]	0.1000	0.1000
Max fraction to N2O at high FNA over nitrite [-]	0.1500	0.1500

Phosphorus accumulating

Name	Default	Value
Yield (aerobic) [-]	0.6390	0.6390
Yield (anoxic) [-]	0.5200	0.5200
Aerobic P/PHA uptake [mgP/mgCOD]	0.9300	0.9300
Anoxic P/PHA uptake [mgP/mgCOD]	0.3500	0.3500
Yield of PHA on Ac sequestration [-]	0.8890	0.8890
N in biomass [mgN/mgCOD]	0.0700	0.0700
N in sol. inert [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous part. [-]	0.2500	0.2500
Inert fraction of endogenous sol. [-]	0.2000	0.2000
P/Ac release ratio [mgP/mgCOD]	0.5100	0.5100
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield of low PP [-]	0.9400	0.9400
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	0.3000	0.3000
Cation to P mole ratio in polyphosphate [meq/mmolP]	0.1500	0.1500
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	0.0500	0.0500

Propionic acetogenic

Name	Default	Value

Yield [-]	0.1000	0.1000
H2 yield [-]	0.4000	0.4000
CO2 yield [-]	1.0000	1.0000
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Methanogenic

Name	Default	Value
Acetoclastic yield [-]	0.1000	0.1000
Acetoclastic yield on methanol[-]	0.1000	0.1000
H2-utilizing yield [-]	0.1000	0.1000
H2-utilizing yield on methanol [-]	0.1000	0.1000
N in acetoclastic biomass [mgN/mgCOD]	0.0700	0.0700
N in H2-utilizing biomass [mgN/mgCOD]	0.0700	0.0700
P in acetoclastic biomass [mgP/mgCOD]	0.0220	0.0220
P in H2-utilizing biomass [mgP/mgCOD]	0.0220	0.0220
Acetoclastic fraction to endog. residue [-]	0.0800	0.0800
H2-utilizing fraction to endog. residue [-]	0.0800	0.0800
Acetoclastic COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
H2-utilizing COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Sulfur oxidizing

Name	Default	Value
Yield (aerobic) [mgCOD/mgS]	0.5000	0.5000
Yield (Anoxic) [mgCOD/mgS]	0.3500	0.3500
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220

Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Sulfur reducing

Name	Default	Value
Yield [mgCOD/mg H2 COD]	0.0712	0.0712
Yield [mgCOD/mg Ac COD]	0.0470	0.0470
Yield [mgCOD/mg Pr COD]	0.0384	0.0384
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

General

Name	Default	Value
Tank head loss per metre of length (from flow) [m/m]	2.500E-3	2.500E-3
BOD calculation rate constant for Xsc degradation [/d]	0.5000	0.5000
BOD calculation rate constant for Xsp (and hydrocarbon) degradation [/d]	0.5000	0.5000
BOD calculation rate constant for Xeo degradation [/d]	0.5000	0.5000

Heating fuel/Chemical Costs

Name	Default	Value
Methanol [$/gal]	1.6656	1.6656
Ferric chloride [$/lb Fe]	0.5307	0.5307
Ferric sulfate [$/lb Fe]	0.3583	0.3583
Ferrous chloride [$/lb Fe]	0.2767	0.2767

Ferrous sulfate [$/lb Fe]	1.0750	1.0750
Aluminum sulfate [$/lb Al]	0.7666	0.7666
Aluminum chloride [$/lb Al]	0.8981	0.8981
Poly Aluminum Chloride (PAC) [$/lb Al]	0.5307	0.5307
Natural gas [$/MMBTU]	3.1652	3.1652
Heating oil [$/gal]	1.8927	1.8927
Diesel [$/gal]	2.6498	2.6498
Custom fuel [$/gal]	3.7854	3.7854
Biogas sale price [$/MMBTU]	2.1101	2.1101

Anaerobic digester

Name	Default	Value
Bubble rise velocity (anaerobic digester) [cm/s]	23.9000	23.9000
Bubble Sauter mean diameter (anaerobic digester) [cm]	0.3500	0.3500
Anaerobic digester gas hold-up factor []	1.0000	1.0000

Combined Heat and Power (CHP) engine

Name	Default	Value
Methane heat of combustion [kJ/mole]	800.0000	800.0000
Hydrogen heat of combustion [kJ/mole]	240.0000	240.0000
CHP engine heat price [$/kWh]	0	0
CHP engine power price [$/kWh]	0.1500	0.1500

Calorific values of heating fuels

Name	Default	Value
Calorific value of natural gas [BTU/lb]	20636	20636

Calorific value of heating fuel oil [BTU/lb]	18057	18057
Calorific value of diesel [BTU/lb]	19776	19776
Calorific value of custom fuel [BTU/lb]	13758	13758

Density of liquid heating fuels

Name	Default	Value
Density of heating fuel oil [lb/ft3]	56	56
Density of diesel [lb/ft3]	55	55
Density of custom fuel [lb/ft3]	49	49

Mass transfer

Name	Default	Value	
Kl for H2 [m/d]	17.0000	17.0000	1.0240
Kl for CO2 [m/d]	10.0000	10.0000	1.0240
Kl for NH3 [m/d]	1.0000	1.0000	1.0240
Kl for CH4 [m/d]	8.0000	8.0000	1.0240
Kl for N2 [m/d]	15.0000	15.0000	1.0240
Kl for N2O [m/d]	8.0000	8.0000	1.0240
Kl for H2S [m/d]	1.0000	1.0000	1.0240
Kl for Ind #1 COD [m/d]	0	0	1.0240
Kl for Ind #2 COD [m/d]	0.5000	0.5000	1.0240
Kl for Ind #3 COD [m/d]	0	0	1.0240
Kl for O2 [m/d]	13.0000	13.0000	1.0240

Henry's law constants

Name	Default	Value

CO2 [M/atm]	3.4000E-2	3.4000E-2	2400.0000
O2 [M/atm]	1.3000E-3	1.3000E-3	1500.0000
N2 [M/atm]	6.5000E-4	6.5000E-4	1300.0000
N2O [M/atm]	2.5000E-2	2.5000E-2	2600.0000
NH3 [M/atm]	5.8000E+1	5.8000E+1	4100.0000
CH4 [M/atm]	1.4000E-3	1.4000E-3	1600.0000
H2 [M/atm]	7.8000E-4	7.8000E-4	500.0000
H2S [M/Atm]	1.0000E-1	1.0000E-1	2200.0000
Ind 1 [M/Atm]	1.9000E+3	1.9000E+3	7300.0000
Ind 2 [M/Atm]	1.8000E-1	1.8000E-1	2200.0000
Ind 3 [M/Atm]	1.5000E-1	1.5000E-1	1900.0000

Properties constants

Name	Default	Value
K in Viscosity = K e ^(Ea/RT) [Pa s]	6.849E-7	6.849E-7
Ea in Viscosity = K e ^(Ea/RT) [j/mol]	1.780E+4	1.780E+4
Y in ML Viscosity = H2O viscosity * (1+A*MLSS^Y) [-]	1.0000	1.0000
A in ML Viscosity = H2O viscosity * (1+A*MLSS^Y) [m3/g]	1.000E-7	1.000E-7
A in ML Density = H2O density + A*MLSS [(kg/m3)/(g/m3)]	3.248E-4	3.248E-4
A in Antoine equn. [T in K, P in Bar {NIST}]	5.2000	5.2039
B in Antoine equn. [T in K, P in Bar {NIST}]	1734.0000	1733.9260
C in Antoine equn. [T in K, P in Bar {NIST}]	-39.5000	-39.4800

Metal salt solution densities

Name	Default	Value
Ferric chloride solution density [kg/m3]	3820.0000	3820.0000
Ferric sulfate solution density [kg/m3]	4800.0000	4800.0000
Ferrous chloride solution density [kg/m3]	3160.0000	3160.0000
Ferrous sulfate solution density [kg/m3]	1150.0000	1150.0000

Aluminum sulfate solution density [kg/m3]	1950.0000	1950.0000
Aluminum chloride solution density [kg/m3]	2480.0000	2480.0000

Mineral precipitation rates

Name	Default	Value	
Vivianite precipitation rate [L/(mol d)]	1.000E+5	1.000E+5	1.0240
Vivianite redissolution rate [L/(mol d)]	1.000E+5	1.000E+5	1.0240
Vivianite half sat. [mgTSS/L]	0.0100	0.0100	1.0000
FeS precipitation rate [L/(mol d)]	1000.0000	1000.0000	1.0240
FeS redissolution rate [L/(mol d)]	10.0000	10.0000	1.0240
FeS half sat. [mgTSS/L]	0.1000	0.1000	1.0000
Struvite precipitation rate [L^2/(mol^2 d)]	3.000E+10	3.000E+10	1.0240
Struvite redissolution rate [L^2/(mol^2 d)]	3.000E+11	3.000E+11	1.0240
Struvite half sat. [mgTSS/L]	1.0000	1.0000	1.0000
Brushite precipitation rate [L/(mol d)]	1.000E+6	1.000E+6	1.0000
Brushite redissolution rate [L/(mol d)]	10000.0000	10000.0000	1.0000
Brushite half sat. [mgTSS/L]	1.0000	1.0000	1.0000
HAP precipitation rate [g/d]	5.000E-4	5.000E-4	1.0000

Mineral precipitation constants

Name	Default	Value
Vivianite solubility product [mol/L]^5	1.710E-36	1.710E-36
FeS solubility product [mol/L]^2	4.258E-4	4.258E-4
Struvite solubility product [mol/L]^3	6.918E-14	6.918E-14
Brushite solubility product [mol/L]^2	2.490E-7	2.490E-7

Fe rates

Name	Default	Value	
A in aging rate = A * exp(-G/B) [1/d)]	16.1550	16.1550	1.0000
B in aging rate = A * exp(-G/B) [1/s)]	57.3000	57.3000	1.0000
HFO(L) aging rate factor	2.500E-4	2.500E-4	1.0000
HFO(H) with H2PO4- bound aging factor []	1.000E-5	1.000E-5	1.0000
HFO(L) with H2PO4- bound aging factor []	0.4000	0.4000	1.0000
H2PO4- coprecipitation rate [mol/(L d)]	1.500E-9	1.500E-9	1.0000
H2PO4- Adsorption rate [mol /(L d)]	2.000E-11	2.000E-11	1.0000
H+ competition for HFO(H) protonation sites [L/(mmol . d)]	1000.0000	1000.0000	1.0000
H+ competition for HFO(L) protonation sites [L/(mmol . d)]	100.0000	100.0000	1.0000

Fe constants

Name	Default	Value
Ferric active site factor(high) [{mol Sites}/{mol HFO(H)}]	4.0000	2.0000
Ferric active site factor(low) [{mol Sites}/{mol HFO(L)}]	2.4000	1.2000
H+ competition level for Fe(OH)3 [mol/L]	7.000E-7	7.000E-7
Equilibrium constant for FeOH3-H2PO4- [{mf HFO(H).H2PO4}/({mol H2PO4-}{mf HFO(H)}^2)]	2.000E-9	2.000E-9
Colloidal COD removed with Ferric [gCOD/Fe active site]	80.0000	130.0000
Minimum residual P level with iron addition [mgP/L]	0.0150	0.0150
HFO(H) with H2PO4- P release factor	10000.0000	10000.0000
HFO(L) with H2PO4- P release factor	10000.0000	10000.0000

Fe RedOx rates

Name	Default	Value	
Iron reduction using acetic acid	1.000E-7	1.000E-7	1.0000
Half Sat. acetic acid	0.5000	0.5000	1.0000
Iron reduction using propionic acid	1.000E-7	1.000E-7	1.0000
Half Sat. propionic acid	0.5000	0.5000	1.0000

Iron reduction using dissolved hydrogen gas	1.000E-7	1.000E-7	1.0000
Half Sat. dissolved hydrogen gas	0.5000	0.5000	1.0000
Iron reduction using hydrogen sulfide	5.000E-5	5.000E-5	1.0000
Half Sat. hydrogen sulfide	0.5000	0.5000	1.0000
Iron oxidation rate (aerobic)	1.000E-3	1.000E-3	1.0000
Abiotic iron reduction using acetic acid	2.000E-5	2.000E-5	1.0000
Abiotic iron reduction using propionic acid	2.000E-5	2.000E-5	1.0000
Abiotic iron reduction using dissolved hydrogen gas	2.000E-5	2.000E-5	1.0000
Abiotic iron reduction using hydrogen sulfide	2.000E-5	2.000E-5	1.0000
Abiotic iron oxidation rate (aerobic)	1.0000	1.0000	1.0000

CEPT rates

Name	Default	Value	
HFO colloidal adsorption rate	1.0000	1.0000	1.0000
Residual Xsc for adsorption to HFO	5.0000	5.0000	1.0000
Slope for Xsc residual	1.0000	1.0000	1.0000
HAO colloidal adsorption rate	1.0000	1.0000	1.0000
Residual Xsc for adsorption to HAO	5.0000	5.0000	1.0000
Slope for Xsc residual	1.0000	1.0000	1.0000

AI rates

Name	Default	Value	
A in aging rate = A * exp(-G/B) [1/d)]	16.1550	16.1550	1.0000
B in aging rate = A * exp(-G/B) [1/s)]	57.3000	57.3000	1.0000
HAO(L) aging rate factor	2.500E-4	2.500E-4	1.0000
HAO(H) with H2PO4- bound aging factor []	1.000E-5	1.000E-5	1.0000
HAO(L) with H2PO4- bound aging factor []	0.4000	0.4000	1.0000
H2PO4- coprecipitation rate [mol/(L d)]	1.500E-9	1.500E-9	1.0000
H2PO4- Adsorption rate [mol /(L d)]	1.000E-9	1.000E-9	1.0000

Al constants

Name	Default	Value
Al active site factor(high) [{mol Sites}/{mol HAO(H)}]	3.0000	3.0000
Al active site factor(low) [{mol Sites}/{mol HAO(L)}]	1.5000	1.5000
Equilibrium constant for AlOH3-H2PO4- [{mf HAO(H).H2PO4}/({mol H2PO4-}{mf HAO(H)}^2)]	8.000E-10	8.000E-10
Colloidal COD removed with Al [gCOD/Al active site]	30.0000	30.0000
Minimum residual P level with Al addition [mgP/L]	0.0150	0.0150
HAO(H) with H2PO4- P release factor	10000.0000	10000.0000
HAO(L) with H2PO4- P release factor	10000.0000	10000.0000

Pipe and pump parameters

Name	Default	Value
Static head [ft]	0.8202	0.8202
Pipe length (headloss calc.s) [ft]	164.0420	164.0420
Pipe inside diameter [in]	19.68504	19.68504
K(fittings) - Total minor losses K	5.0000	5.0000
Pipe roughness [in]	0.00787	0.00787
'A' in overall pump efficiency = A + B*Q + C*(Q^2)[-]	0.8500	0.8500
'B' in overall pump efficiency = A + B*Q + C*(Q^2)[-]/(mgd)]	0	0
'C' in overall pump efficiency = A + B*Q + C*(Q^2)[-]/(mgd)^2]	0	0

Fittings and loss coefficients ('K' values)

Name	Default	Value
Pipe entrance (bellmouth)	0.0500	1.0000
90° bend	0.7500	5.0000

45° bend	0.3000	2.0000
Butterfly value (open)	0.3000	1.0000
Non-return value	1.0000	0
Outlet (bellmouth)	0.2000	1.0000

Aeration

Name	Default	Value
Surface pressure [kPa]	101.3250	101.3250
Fractional effective saturation depth (Fed) [-]	0.3250	0.3250
Supply gas CO2 content [vol. %]	0.0400	0.0350
Supply gas O2 [vol. %]	20.9500	20.9500
Off-gas CO2 [vol. %]	2.0000	2.0000
Off-gas O2 [vol. %]	18.8000	18.8000
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Off-gas N2O [vol. %]	0	0
Surface turbulence factor [-]	2.0000	2.0000
Set point controller gain []	1.0000	1.0000

MABR Membrane effective diffusivities

Name	Default	Value	
O2 [m2/s]	2.500E-9	2.500E-9	1.0000
N2 [m2/s]	1.900E-9	1.900E-9	1.0000
CO2 [m2/s]	1.960E-9	1.960E-9	1.0000
H2 [m2/s]	5.850E-9	5.850E-9	1.0000
CH4 [m2/s]	1.963E-9	1.963E-9	1.0000
NH3 [m2/s]	2.000E-9	2.000E-9	1.0000
N2O [m2/s]	1.607E-9	1.607E-9	1.0000

H2S [m2/s]	1.530E-9	1.530E-9	1.0000
Ind 1 [m2/s]	7.240E-10	7.240E-10	1.0000
Ind 2 [m2/s]	8.900E-10	8.900E-10	1.0000
Ind 3 [m2/s]	7.960E-10	7.960E-10	1.0000

MABR Membrane transfer factors

Name	Default	Value	
O2 []	1.0000	1.0000	1.0000
N2 []	1.0000	1.0000	1.0000
CO2 []	1.0000	1.0000	1.0000
H2 []	1.0000	1.0000	1.0000
CH4 []	1.0000	1.0000	1.0000
NH3 []	1.0000	1.0000	1.0000
N2O []	1.0000	1.0000	1.0000
H2S []	1.0000	1.0000	1.0000
Ind 1 []	1.0000	1.0000	1.0000
Ind 2 []	1.0000	1.0000	1.0000
Ind 3 []	1.0000	1.0000	1.0000

Blower

Name	Default	Value
Intake filter pressure drop [psi]	0.5076	0.5076
Pressure drop through distribution system (piping/valves) [psi]	0.4351	0.4351
Adiabatic/polytropic compression exponent (1.4 for adiabatic)	1.4000	1.4000
'A' in blower efficiency = A + B*Qa + C*(Qa^2)[-]	0.7500	0.7500
'B' in blower efficiency = A + B*Qa + C*(Qa^2)[[-]/(ft3/min (20C, 1 atm))]	0	0
'C' in blower efficiency = A + B*Qa + C*(Qa^2)[[-]/(ft3/min (20C, 1 atm))^2]	0	0

Diffuser

Name	Default	Value
k1 in C = k1(PC)^0.25 + k2	1.2400	1.2400
k2 in C = k1(PC)^0.25 + k2	0.8960	0.8960
Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	0.8880	0.8880
Area of one diffuser [ft2]	0.4413	0.4413
Diffuser mounting height [ft]	0.8202	0.8202
Min. air flow rate per diffuser ft3/min (20C, 1 atm)	0.2943	0.2943
Max. air flow rate per diffuser ft3/min (20C, 1 atm)	5.8858	5.8858
'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2 [psi]	0.4351	0.4351
'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[psi/(ft3/min (20C, 1 atm))]	0	0
'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2[psi/(ft3/min (20C, 1 atm))^2]	0	0

Surface aerators

Name	Default	Value
Surface aerator Std. oxygen transfer rate [lb O /(hp hr)]	2.46697	2.46697

Modified Vesilind

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.387	0.355
Vesilind hindered zone settling parameter (K) [L/g]	0.370	0.336
Clarification switching function [mg/L]	100.000	100.000
Specified TSS conc.for height calc. [mg/L]	2500.000	2500.000
Maximum compactability constant [mg/L]	15000.000	15000.000
Maximum compactability slope [L/mg]	0.010	0.010

Double exponential

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.934	0.934
Maximum (practical) settling velocity (Vo') [ft/min]	0.615	0.615
Hindered zone settling parameter (Kh) [L/g]	0.400	0.400
Flocculent zone settling parameter (Kf) [L/g]	2.500	2.500
Maximum non-settleable TSS [mg/L]	20.0000	20.0000
Non-settleable fraction [-]	1.000E-3	1.000E-3
Specified TSS conc. for height calc. [mg/L]	2500.0000	2500.0000

Emission factors

Name	Default	Value
Carbon dioxide equivalence of nitrous oxide	296.0000	296.0000
Carbon dioxide equivalence of methane	23.0000	23.0000

Biofilm general

Name	Default	Value	
Attachment rate [g / (m2 d)]	8.0000	80.0000	1.0000
Attachment TSS half sat. [mg/L]	100.0000	100.0000	1.0000
Detachment rate [g/(m3 d)]	8000.0000	8.000E+4	1.0000
Solids movement factor []	10.0000	10.0000	1.0000
Diffusion neta []	0.8000	0.8000	1.0000
Thin film limit [mm]	0.5000	0.5000	1.0000
Thick film limit [mm]	3.0000	3.0000	1.0000
Assumed Film thickness for tank volume correction (temp independent) [mm]	1.2500	0.7500	1.0000
Film surface area to media area ratio - Max.[ ]	1.0000	1.0000	1.0000
Minimum biofilm conc. for streamer formation [gTSS/m2]	4.0000	4.0000	1.0000

Maximum biofilm concentrations [mg/L]

Name	Default	Value	
Biomass - Ordinary heterotrophic	5.000E+4	5.000E+4	1.0000
Biomass - Methylotrophic	5.000E+4	5.000E+4	1.0000
Biomass - Ammonia oxidizing	1.000E+5	1.000E+5	1.0000
Biomass - Nitrite oxidizing	1.000E+5	1.000E+5	1.0000
Biomass - Anaerobic ammonia oxidizing	5.000E+4	5.000E+4	1.0000
Biomass - Phosphorus accumulating	5.000E+4	5.000E+4	1.0000
Biomass - Propionic acetogenic	5.000E+4	5.000E+4	1.0000
Biomass - Acetoclastic methanogenic	5.000E+4	5.000E+4	1.0000
Biomass - Hydrogenotrophic methanogenic	5.000E+4	5.000E+4	1.0000
Biomass - Endogenous products	3.000E+4	3.000E+4	1.0000
CODp - Slowly degradable particulate	5000.0000	5000.0000	1.0000
CODp - Slowly degradable colloidal	4000.0000	4000.0000	1.0000
CODp - Degradable external organics	5000.0000	5000.0000	1.0000
CODp - Undegradable non-cellulose	5000.0000	5000.0000	1.0000
CODp - Undegradable cellulose	5000.0000	5000.0000	1.0000
N - Particulate degradable organic	0	0	1.0000
P - Particulate degradable organic	0	0	1.0000
N - Particulate degradable external organics	0	0	1.0000
P - Particulate degradable external organics	0	0	1.0000
N - Particulate undegradable	0	0	1.0000
P - Particulate undegradable	0	0	1.0000
CODp - Stored PHA	5000.0000	5000.0000	1.0000
P - Releasable stored polyP	1.150E+6	1.150E+6	1.0000
P - Unreleasable stored polyP	1.150E+6	1.150E+6	1.0000
CODs - Complex readily degradable	0	0	1.0000
CODs - Acetate	0	0	1.0000
CODs - Propionate	0	0	1.0000
CODs - Methanol	0	0	1.0000
Gas - Dissolved hydrogen	0	0	1.0000
Gas - Dissolved methane	0	0	1.0000
N - Ammonia	0	0	1.0000

N - Soluble degradable organic	0	0	1.0000
Gas - Dissolved nitrous oxide	0	0	1.0000
N - Nitrite	0	0	1.0000
N - Nitrate	0	0	1.0000
Gas - Dissolved nitrogen	0	0	1.0000
P - Soluble phosphate	0	0	1.0000
CODs - Undegradable	0	0	1.0000
N - Soluble undegradable organic	0	0	1.0000
Influent inorganic suspended solids	1.300E+6	1.300E+6	1.0000
Precipitate - Struvite	8.500E+5	8.500E+5	1.0000
Precipitate - Brushite	1.165E+6	1.165E+6	1.0000
Precipitate - Hydroxy - apatite	1.600E+6	1.600E+6	1.0000
Precipitate - Vivianite	1.340E+6	1.340E+6	1.0000
HFO - High surface	5.000E+4	5.000E+4	1.0000
HFO - Low surface	5.000E+4	5.000E+4	1.0000
HFO - High with H2PO4- adsorbed	5.000E+4	5.000E+4	1.0000
HFO - Low with H2PO4- adsorbed	5.000E+4	5.000E+4	1.0000
HFO - Aged	5.000E+4	5.000E+4	1.0000
HFO - Low with H+ adsorbed	5.000E+4	5.000E+4	1.0000
HFO - High with H+ adsorbed	5.000E+4	5.000E+4	1.0000
HAO - High surface	5.000E+4	5.000E+4	1.0000
HAO - Low surface	5.000E+4	5.000E+4	1.0000
HAO - High with H2PO4- adsorbed	5.000E+4	5.000E+4	1.0000
HAO - Low with H2PO4- adsorbed	5.000E+4	5.000E+4	1.0000
HAO - Aged	5.000E+4	5.000E+4	1.0000
P - Bound on aged HMO	5.000E+4	5.000E+4	1.0000
Metal soluble - Magnesium	0	0	1.0000
Metal soluble - Calcium	0	0	1.0000
Metal soluble - Ferric	0	0	1.0000
Metal soluble - Ferrous	0	0	1.0000
Metal soluble - Aluminum	0	0	1.0000
Other Cations (strong bases)	0	0	1.0000
Other Anions (strong acids)	0	0	1.0000
Gas - Dissolved total CO2	0	0	1.0000
User defined - UD1	0	0	1.0000

User defined - UD2	0	0	1.0000
User defined - UD3	5.000E+4	5.000E+4	1.0000
User defined - UD4	5.000E+4	5.000E+4	1.0000
Biomass - Sulfur oxidizing	1.000E+5	1.000E+5	1.0000
Biomass - Sulfur reducing propionic acetogenic	5.000E+4	5.000E+4	1.0000
Biomass - Sulfur reducing acetotrophic	5.000E+4	5.000E+4	1.0000
Biomass - Sulfur reducing hydrogenotrophic	1.000E+5	1.000E+5	1.0000
Gas - Dissolved total sulfides	0	0	1.0000
S - Soluble sulfate	0	0	1.0000
S - Particulate elemental sulfur	5.000E+4	5.000E+4	1.0000
Precipitate - Ferrous sulfide	5.000E+4	5.000E+4	1.0000
CODp - Adsorbed hydrocarbon	5.000E+4	5.000E+4	1.0000
CODs - Degradable volatile ind. #1	0	0	1.0000
CODs - Degradable volatile ind. #2	0	0	1.0000
CODs - Degradable volatile ind. #3	0	0	1.0000
CODs - Soluble hydrocarbon	0	0	1.0000
Gas - Dissolved oxygen	0	0	1.0000

Effective diffusivities [m2/s]

Name	Default	Value	
Biomass - Ordinary heterotrophic	5.000E-14	5.000E-14	1.0290
Biomass - Methylotrophic	5.000E-14	5.000E-14	1.0290
Biomass - Ammonia oxidizing	5.000E-14	5.000E-14	1.0290
Biomass - Nitrite oxidizing	5.000E-14	5.000E-14	1.0290
Biomass - Anaerobic ammonia oxidizing	5.000E-14	5.000E-14	1.0290
Biomass - Phosphorus accumulating	5.000E-14	5.000E-14	1.0290
Biomass - Propionic acetogenic	5.000E-14	5.000E-14	1.0290
Biomass - Acetoclastic methanogenic	5.000E-14	5.000E-14	1.0290
Biomass - Hydrogenotrophic methanogenic	5.000E-14	5.000E-14	1.0290
Biomass - Endogenous products	5.000E-14	5.000E-14	1.0290
CODp - Slowly degradable particulate	5.000E-14	5.000E-14	1.0290
CODp - Slowly degradable colloidal	5.000E-10	5.000E-10	1.0290

CODp - Degradable external organics	5.000E-14	5.000E-14	1.0290
CODp - Undegradable non-cellulose	5.000E-14	5.000E-14	1.0290
CODp - Undegradable cellulose	5.000E-14	5.000E-14	1.0290
N - Particulate degradable organic	5.000E-14	5.000E-14	1.0290
P - Particulate degradable organic	5.000E-14	5.000E-14	1.0290
N - Particulate degradable external organics	5.000E-14	5.000E-14	1.0290
P - Particulate degradable external organics	5.000E-14	5.000E-14	1.0290
N - Particulate undegradable	5.000E-14	5.000E-14	1.0290
P - Particulate undegradable	5.000E-14	5.000E-14	1.0290
CODp - Stored PHA	5.000E-14	5.000E-14	1.0290
P - Releasable stored polyP	5.000E-14	5.000E-14	1.0290
P - Unreleasable stored polyP	5.000E-14	5.000E-14	1.0290
CODs - Complex readily degradable	6.900E-10	6.900E-10	1.0290
CODs - Acetate	1.240E-9	1.240E-9	1.0290
CODs - Propionate	8.300E-10	8.300E-10	1.0290
CODs - Methanol	1.600E-9	1.600E-9	1.0290
Gas - Dissolved hydrogen	5.850E-9	5.850E-9	1.0290
Gas - Dissolved methane	1.963E-9	1.963E-9	1.0290
N - Ammonia	2.000E-9	2.000E-9	1.0290
N - Soluble degradable organic	1.370E-9	1.370E-9	1.0290
Gas - Dissolved nitrous oxide	1.607E-9	1.607E-9	1.0290
N - Nitrite	2.980E-9	2.980E-9	1.0290
N - Nitrate	2.980E-9	2.980E-9	1.0290
Gas - Dissolved nitrogen	1.900E-9	1.900E-9	1.0290
P - Soluble phosphate	2.000E-9	2.000E-9	1.0290
CODs - Undegradable	6.900E-10	6.900E-10	1.0290
N - Soluble undegradable organic	6.850E-10	6.850E-10	1.0290
Influent inorganic suspended solids	5.000E-14	5.000E-14	1.0290
Precipitate - Struvite	5.000E-14	5.000E-14	1.0290
Precipitate - Brushite	5.000E-14	5.000E-14	1.0290
Precipitate - Hydroxy - apatite	5.000E-14	5.000E-14	1.0290
Precipitate - Vivianite	5.000E-14	5.000E-14	1.0290
HFO - High surface	5.000E-14	5.000E-14	1.0290
HFO - Low surface	5.000E-14	5.000E-14	1.0290
HFO - High with H2PO4- adsorbed	5.000E-14	5.000E-14	1.0290

HFO - Low with H2PO4- adsorbed	5.000E-14	5.000E-14	1.0290
HFO - Aged	5.000E-14	5.000E-14	1.0290
HFO - Low with H+ adsorbed	5.000E-14	5.000E-14	1.0290
HFO - High with H+ adsorbed	5.000E-14	5.000E-14	1.0290
HAO - High surface	5.000E-14	5.000E-14	1.0290
HAO - Low surface	5.000E-14	5.000E-14	1.0290
HAO - High with H2PO4- adsorbed	5.000E-14	5.000E-14	1.0290
HAO - Low with H2PO4- adsorbed	5.000E-14	5.000E-14	1.0290
HAO - Aged	5.000E-14	5.000E-14	1.0290
P - Bound on aged HMO	5.000E-14	5.000E-14	1.0290
Metal soluble - Magnesium	7.200E-10	7.200E-10	1.0290
Metal soluble - Calcium	7.200E-10	7.200E-10	1.0290
Metal soluble - Ferric	4.800E-10	4.800E-10	1.0290
Metal soluble - Ferrous	4.800E-10	4.800E-10	1.0290
Metal soluble - Aluminum	4.800E-10	4.800E-10	1.0290
Other Cations (strong bases)	1.440E-9	1.440E-9	1.0290
Other Anions (strong acids)	1.440E-9	1.440E-9	1.0290
Gas - Dissolved total CO2	1.960E-9	1.960E-9	1.0290
User defined - UD1	6.900E-10	6.900E-10	1.0290
User defined - UD2	6.900E-10	6.900E-10	1.0290
User defined - UD3	5.000E-14	5.000E-14	1.0290
User defined - UD4	5.000E-14	5.000E-14	1.0290
Biomass - Sulfur oxidizing	5.000E-14	5.000E-14	1.0290
Biomass - Sulfur reducing propionic acetogenic	5.000E-14	5.000E-14	1.0290
Biomass - Sulfur reducing acetotrophic	5.000E-14	5.000E-14	1.0290
Biomass - Sulfur reducing hydrogenotrophic	5.000E-14	5.000E-14	1.0290
Gas - Dissolved total sulfides	1.530E-9	1.530E-9	1.0290
S - Soluble sulfate	2.130E-10	2.130E-10	1.0290
S - Particulate elemental sulfur	5.000E-14	5.000E-14	1.0290
Precipitate - Ferrous sulfide	5.000E-14	5.000E-14	1.0290
CODp - Adsorbed hydrocarbon	5.000E-14	5.000E-14	1.0290
CODs - Degradable volatile ind. #1	7.240E-10	7.240E-10	1.0290
CODs - Degradable volatile ind. #2	8.900E-10	8.900E-10	1.0290
CODs - Degradable volatile ind. #3	7.960E-10	7.960E-10	1.0290
CODs - Soluble hydrocarbon	7.120E-10	7.120E-10	1.0290

Gas - Dissolved oxygen	2.500E-9	2.500E-9	1.0290

EPS Strength coefficients [ ]

Name	Default	Value	
Biomass - Ordinary heterotrophic	1.0000	1.0000	1.0000
Biomass - Methylotrophic	1.0000	1.0000	1.0000
Biomass - Ammonia oxidizing	5.0000	5.0000	1.0000
Biomass - Nitrite oxidizing	25.0000	25.0000	1.0000
Biomass - Anaerobic ammonia oxidizing	10.0000	10.0000	1.0000
Biomass - Phosphorus accumulating	1.0000	1.0000	1.0000
Biomass - Propionic acetogenic	1.0000	1.0000	1.0000
Biomass - Acetoclastic methanogenic	1.0000	1.0000	1.0000
Biomass - Hydrogenotrophic methanogenic	1.0000	1.0000	1.0000
Biomass - Endogenous products	1.0000	1.0000	1.0000
CODp - Slowly degradable particulate	1.0000	1.0000	1.0000
CODp - Slowly degradable colloidal	1.0000	1.0000	1.0000
CODp - Degradable external organics	1.0000	1.0000	1.0000
CODp - Undegradable non-cellulose	1.0000	1.0000	1.0000
CODp - Undegradable cellulose	1.0000	1.0000	1.0000
N - Particulate degradable organic	1.0000	1.0000	1.0000
P - Particulate degradable organic	1.0000	1.0000	1.0000
N - Particulate degradable external organics	1.0000	1.0000	1.0000
P - Particulate degradable external organics	1.0000	1.0000	1.0000
N - Particulate undegradable	1.0000	1.0000	1.0000
P - Particulate undegradable	1.0000	1.0000	1.0000
CODp - Stored PHA	1.0000	1.0000	1.0000
P - Releasable stored polyP	1.0000	1.0000	1.0000
P - Unreleasable stored polyP	1.0000	1.0000	1.0000
CODs - Complex readily degradable	0	0	1.0000
CODs - Acetate	0	0	1.0000
CODs - Propionate	0	0	1.0000
CODs - Methanol	0	0	1.0000

Gas - Dissolved hydrogen	0	0	1.0000
Gas - Dissolved methane	0	0	1.0000
N - Ammonia	0	0	1.0000
N - Soluble degradable organic	0	0	1.0000
Gas - Dissolved nitrous oxide	0	0	1.0000
N - Nitrite	0	0	1.0000
N - Nitrate	0	0	1.0000
Gas - Dissolved nitrogen	0	0	1.0000
P - Soluble phosphate	0	0	1.0000
CODs - Undegradable	0	0	1.0000
N - Soluble undegradable organic	0	0	1.0000
Influent inorganic suspended solids	0.3300	0.3300	1.0000
Precipitate - Struvite	1.0000	1.0000	1.0000
Precipitate - Brushite	1.0000	1.0000	1.0000
Precipitate - Hydroxy - apatite	1.0000	1.0000	1.0000
Precipitate - Vivianite	1.0000	1.0000	1.0000
HFO - High surface	1.0000	1.0000	1.0000
HFO - Low surface	1.0000	1.0000	1.0000
HFO - High with H2PO4- adsorbed	1.0000	1.0000	1.0000
HFO - Low with H2PO4- adsorbed	1.0000	1.0000	1.0000
HFO - Aged	1.0000	1.0000	1.0000
HFO - Low with H+ adsorbed	1.0000	1.0000	1.0000
HFO - High with H+ adsorbed	1.0000	1.0000	1.0000
HAO - High surface	1.0000	1.0000	1.0000
HAO - Low surface	1.0000	1.0000	1.0000
HAO - High with H2PO4- adsorbed	1.0000	1.0000	1.0000
HAO - Low with H2PO4- adsorbed	1.0000	1.0000	1.0000
HAO - Aged	1.0000	1.0000	1.0000
P - Bound on aged HMO	1.0000	1.0000	1.0000
Metal soluble - Magnesium	0	0	1.0000
Metal soluble - Calcium	0	0	1.0000
Metal soluble - Ferric	0	0	1.0000
Metal soluble - Ferrous	0	0	1.0000
Metal soluble - Aluminum	0	0	1.0000
Other Cations (strong bases)	0	0	1.0000

Other Anions (strong acids)	0	0	1.0000
Gas - Dissolved total CO2	0	0	1.0000
User defined - UD1	0	0	1.0000
User defined - UD2	0	0	1.0000
User defined - UD3	1.0000	1.0000	1.0000
User defined - UD4	1.0000	1.0000	1.0000
Biomass - Sulfur oxidizing	1.0000	1.0000	1.0000
Biomass - Sulfur reducing propionic acetogenic	1.0000	1.0000	1.0000
Biomass - Sulfur reducing acetotrophic	1.0000	1.0000	1.0000
Biomass - Sulfur reducing hydrogenotrophic	1.0000	1.0000	1.0000
Gas - Dissolved total sulfides	0	0	1.0000
S - Soluble sulfate	0	0	1.0000
S - Particulate elemental sulfur	1.0000	1.0000	1.0000
Precipitate - Ferrous sulfide	1.0000	1.0000	1.0000
CODp - Adsorbed hydrocarbon	1.0000	1.0000	1.0000
CODs - Degradable volatile ind. #1	0	0	1.0000
CODs - Degradable volatile ind. #2	0	0	1.0000
CODs - Degradable volatile ind. #3	0	0	1.0000
CODs - Soluble hydrocarbon	0	0	1.0000
Gas - Dissolved oxygen	0	0	1.0000

BioWin user and configuration data

Project details

Project name: Unknown Project ref.: BW1

Plant name: Unknown User name: Jason.Flowers

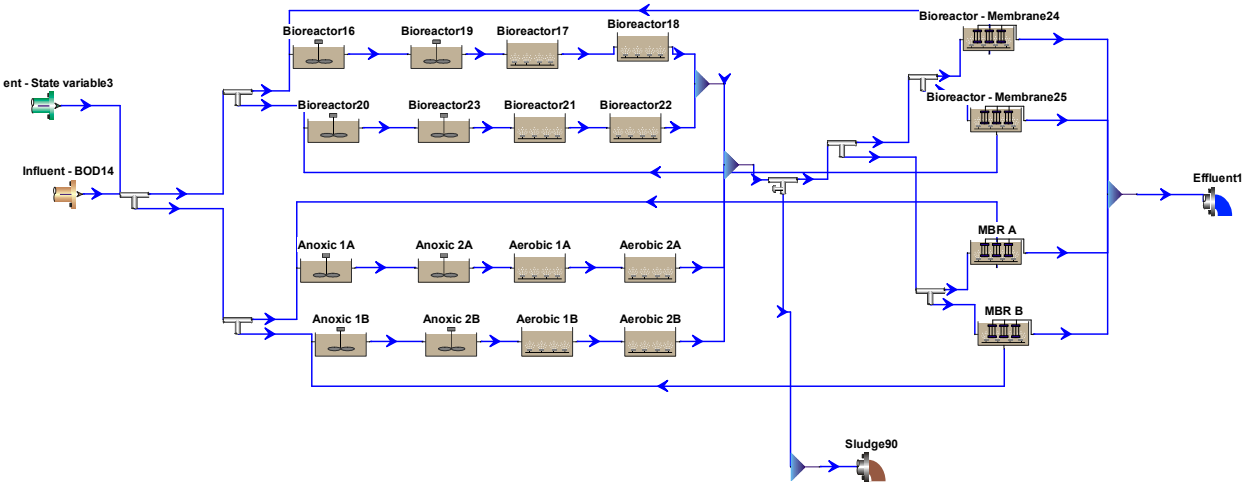
Created: 5/18/2018 Saved: 6/22/2020

Steady state solution

Target SRT: 15.00 days SRT #0: 15.00 days

Temperature: 11.0°C

Flowsheet



Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
Anoxic 1A	0.0100	102.8312	13.000	Un-aerated
Aerobic 1A	0.0300	308.4936	13.000	70
Aerobic 2A	0.0300	308.4936	13.000	70
Anoxic 2A	0.0100	102.8312	13.000	Un-aerated
Anoxic 1B	0.0100	102.8312	13.000	Un-aerated
Aerobic 1B	0.0300	308.4936	13.000	70
Aerobic 2B	0.0300	308.4936	13.000	70
Anoxic 2B	0.0100	102.8312	13.000	Un-aerated
Bioreactor16	0.0100	102.8312	13.000	Un-aerated
Bioreactor17	0.0300	308.4936	13.000	70
Bioreactor18	0.0300	308.4936	13.000	70
Bioreactor19	0.0100	102.8312	13.000	Un-aerated
Bioreactor20	0.0100	102.8312	13.000	Un-aerated
Bioreactor21	0.0300	308.4936	13.000	70
Bioreactor22	0.0300	308.4936	13.000	70
Bioreactor23	0.0100	102.8312	13.000	Un-aerated

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
Anoxic 1A	0
Aerobic 1A	2.0
Aerobic 2A	2.0
Anoxic 2A	0
Anoxic 1B	0
Aerobic 1B	2.0
Aerobic 2B	2.0

Anoxic 2B	0
Bioreactor16	0
Bioreactor17	2.0
Bioreactor18	2.0
Bioreactor19	0
Bioreactor20	0
Bioreactor21	2.0
Bioreactor22	2.0
Bioreactor23	0

Aeration equipment parameters

Element name	k1 in C = k1(PC)^ 0.25 + k2	k2 in C = k1(PC)^ 0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	Diffuser mounting height	Min. air flow rate per diffuser ft3/min (20C, 1 atm)	Max. air flow rate per diffuser ft3/min (20C, 1 atm)	'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2
Anoxic 1A	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Aerobic 1A	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Aerobic 2A	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Anoxic 2A	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Anoxic 1B	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Aerobic 1B	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Aerobic 2B	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Anoxic 2B	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Bioreactor16	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Bioreactor17	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0

Bioreactor18	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Bioreactor19	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Bioreactor20	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Bioreactor21	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Bioreactor22	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0
Bioreactor23	1.2400	0.8960	0.8880	0.4413	0.2500	0.2943	5.8858	3.0000	0	0

Configuration information for all Bioreactor - MBR units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers	# of cassettes	Displaced volume / cassette [ft3/cassette]	Membrane area / cassette [ft2/cassette]	Total displaced volume [Mil. Gal]	Membrane surface area [ft2]
MBR A	0.0300	308.4936	13.000	57	6.00	59.682	16320.03	0.00	97920.18
MBR B	0.0300	308.4936	13.000	57	6.00	59.682	16320.03	0.00	97920.18
Bioreactor - Membrane24	0.0300	308.4936	13.000	57	6.00	59.682	16320.03	0.00	97920.18
Bioreactor - Membrane25	0.0300	308.4936	13.000	57	6.00	59.682	16320.03	0.00	97920.18

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
MBR A	2.0

MBR B	2.0
Bioreactor - Membrane24	2.0
Bioreactor - Membrane25	2.0

Element name	Split method	Average Split specification
MBR A	Flow paced	200.00 %
MBR B	Flow paced	200.00 %
Bioreactor - Membrane24	Flow paced	200.00 %
Bioreactor - Membrane25	Flow paced	200.00 %

Aeration equipment parameters

Element name	k1 in C = k1(PC)^ 0.25 + k2	k2 in C = k1(PC)^ 0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	Diffuser mounting height	Min. air flow rate per diffuser ft3/min (20C, 1 atm)	Max. air flow rate per diffuser ft3/min (20C, 1 atm)	'A' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'B' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2	'C' in diffuser pressure drop = A + B*(Qa/Diff) + C*(Qa/Diff)^2
MBR A	0.0500	0.3800	1.0000	0.5382	0.2500	1.1772	29.4289	1.0000	0	0
MBR B	0.0500	0.3800	1.0000	0.5382	0.2500	1.1772	29.4289	1.0000	0	0
Bioreactor - Membrane24	0.0500	0.3800	1.0000	0.5382	0.2500	1.1772	29.4289	1.0000	0	0
Bioreactor - Membrane25	0.0500	0.3800	1.0000	0.5382	0.2500	1.1772	29.4289	1.0000	0	0

Element name	Surface pressure [kPa]	Fractional effective saturation depth (Fed) [-]
MBR A	101.3250	0.3000
MBR B	101.3250	0.3000
Bioreactor - Membrane24	101.3250	0.3000

Bioreactor - Membrane25	101.3250	0.3000

Element name	Supply gas CO2 content [vol. %]	Supply gas O2 [vol. %]	Off-gas CO2 [vol. %]	Off-gas O2 [vol. %]	Off-gas H2 [vol. %]	Off-gas NH3 [vol. %]	Off-gas CH4 [vol. %]	Off-gas N2O [vol. %]	Surface turbulence factor [-]
MBR A	0.0350	20.9500	1.2000	19.9000	0	0	0	0	2.0000
MBR B	0.0350	20.9500	1.2000	19.9000	0	0	0	0	2.0000
Bioreactor - Membrane24	0.0350	20.9500	1.2000	19.9000	0	0	0	0	2.0000
Bioreactor - Membrane25	0.0350	20.9500	1.2000	19.9000	0	0	0	0	2.0000

Configuration information for all Influent - BOD units

Operating data Average (flow/time weighted as required)

Element name	Influent - BOD14
Flow	2.27
BOD - Total Carbonaceous mgBOD/L	173.00
Volatile suspended solids mg/L	182.00
Total suspended solids mg/L	196.00
N - Total Kjeldahl Nitrogen mgN/L	30.90
P - Total P mgP/L	6.50
S - Total S mgS/L	0
N - Nitrate mgN/L	0
pH	7.10
Alkalinity mmol/L	2.00
Metal soluble - Calcium mg/L	80.00
Metal soluble - Magnesium mg/L	15.00
Gas - Dissolved oxygen mg/L	0

Element name	Influent - BOD14
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1410
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1418
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.8771
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0650
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.1300
Fcel - Cellulose fraction of unbiodegradable particulate [gCOD/gCOD]	0.5000
Fna - Ammonia [gNH3-N/gTKN]	0.7353
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0700
Fpo4 - Phosphate [gPO4-P/gTP]	0.4717
FupP - P:COD ratio for unbiodegradable part. COD [gP/gCOD]	0.0220
Fsr - Reduced sulfur [H2S] [gS/gS]	0
FZbh - Ordinary heterotrophic COD fraction [gCOD/g of total COD]	0.0200
FZbm - Methylotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZao - Ammonia oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZno - Nitrite oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZaao - Anaerobic ammonia oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZppa - Phosphorus accumulating COD fraction [gCOD/g of total COD]	1.000E-4
FZpa - Propionic acetogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZam - Acetoclastic methanogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZhm - Hydrogenotrophic methanogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZso - Sulfur oxidizing COD fraction [gCOD/g of total COD]	1.000E-4
FZsrpa - Sulfur reducing propionic acetogenic COD fraction [gCOD/g of total COD]	1.000E-4
FZsra - Sulfur reducing acetotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZsrh - Sulfur reducing hydrogenotrophic COD fraction [gCOD/g of total COD]	1.000E-4
FZe - Endogenous products COD fraction [gCOD/g of total COD]	0

Configuration information for all Splitter units

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Splitter66	Fraction	0.50
Splitter7	Flowrate [Side]	0.0295267746789225
Splitter8	Fraction	0.50
Splitter28	Fraction	0.50
Splitter29	Fraction	0.50
Splitter30	Fraction	0.50
Splitter37	Fraction	0.50

Configuration information for all Influent - State variable units

Operating data Average (flow/time weighted as required)

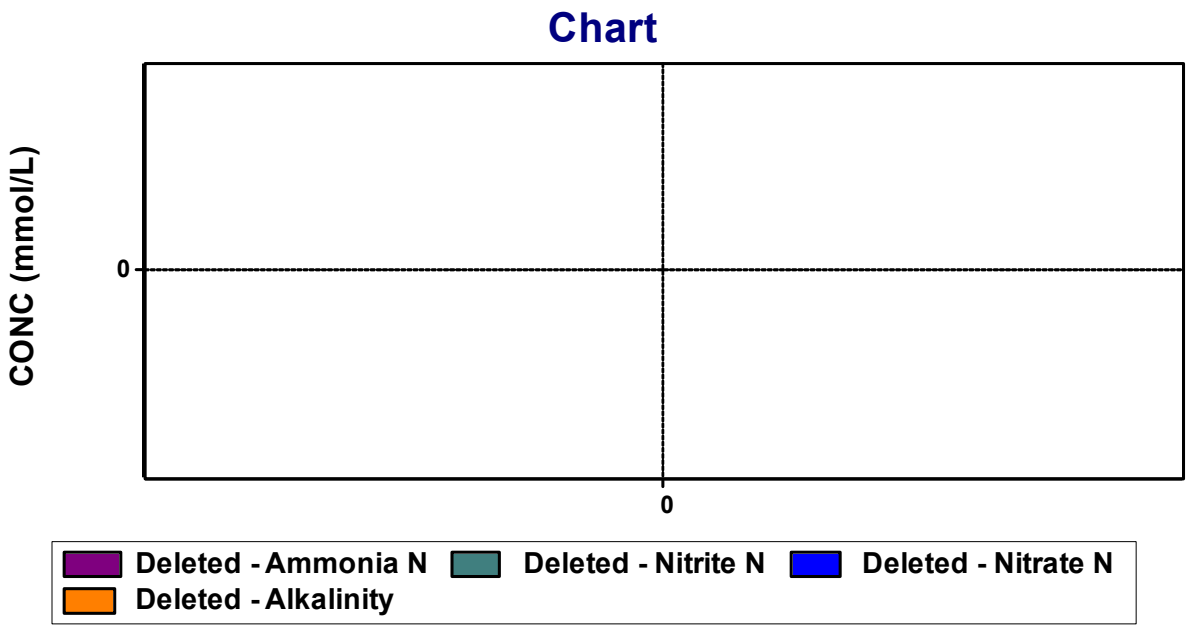
Element name	Influent - State variable3
Biomass - Ordinary heterotrophic [mgCOD/L]	0
Biomass - Methylotrophic [mgCOD/L]	0
Biomass - Ammonia oxidizing [mgCOD/L]	0
Biomass - Nitrite oxidizing [mgCOD/L]	0
Biomass - Anaerobic ammonia oxidizing [mgCOD/L]	0
Biomass - Phosphorus accumulating [mgCOD/L]	0
Biomass - Propionic acetogenic [mgCOD/L]	0
Biomass - Acetoclastic methanogenic [mgCOD/L]	0
Biomass - Hydrogenotrophic methanogenic [mgCOD/L]	0
Biomass - Endogenous products [mgCOD/L]	0
CODp - Slowly degradable particulate [mgCOD/L]	0
CODp - Slowly degradable colloidal [mgCOD/L]	0
CODp - Degradable external organics [mgCOD/L]	0
CODp - Undegradable non-cellulose [mgCOD/L]	0
CODp - Undegradable cellulose [mgCOD/L]	0

N - Particulate degradable organic [mgN/L]	0
P - Particulate degradable organic [mgP/L]	0
N - Particulate degradable external organics [mgN/L]	0
P - Particulate degradable external organics [mgP/L]	0
N - Particulate undegradable [mgN/L]	0
P - Particulate undegradable [mgP/L]	0
CODp - Stored PHA [mgCOD/L]	0
P - Releasable stored polyP [mgP/L]	0
P - Unreleasable stored polyP [mgP/L]	0
CODs - Complex readily degradable [mgCOD/L]	0
CODs - Acetate [mgCOD/L]	0
CODs - Propionate [mgCOD/L]	0
CODs - Methanol [mgCOD/L]	0
Gas - Dissolved hydrogen [mgCOD/L]	0
Gas - Dissolved methane [mg/L]	0
N - Ammonia [mgN/L]	0
N - Soluble degradable organic [mgN/L]	0
Gas - Dissolved nitrous oxide [mgN/L]	0
N - Nitrite [mgN/L]	0
N - Nitrate [mgN/L]	0
Gas - Dissolved nitrogen [mgN/L]	0
P - Soluble phosphate [mgP/L]	0
CODs - Undegradable [mgCOD/L]	0
N - Soluble undegradable organic [mgN/L]	0
Influent inorganic suspended solids [mgISS/L]	0
Precipitate - Struvite [mgISS/L]	0
Precipitate - Brushite [mgISS/L]	0
Precipitate - Hydroxy - apatite [mgISS/L]	0
Precipitate - Vivianite [mgISS/L]	0
HFO - High surface [mg/L]	0
HFO - Low surface [mg/L]	0
HFO - High with H2PO4- adsorbed [mg/L]	0
HFO - Low with H2PO4- adsorbed [mg/L]	0
HFO - Aged [mg/L]	0
HFO - Low with H+ adsorbed [mg/L]	0

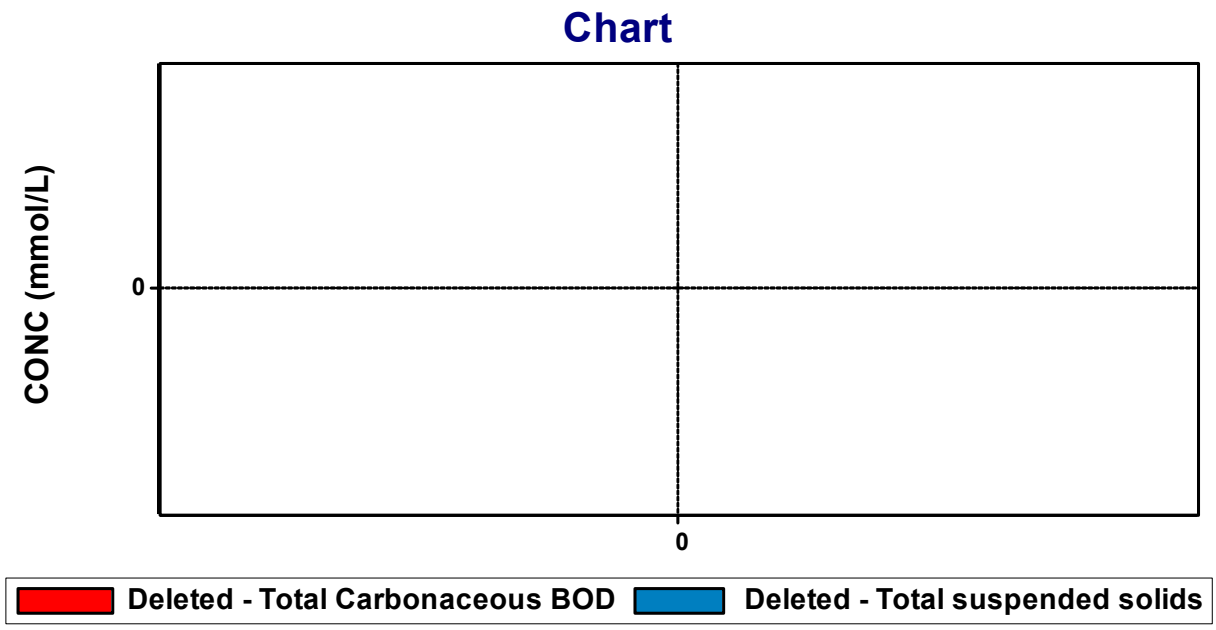
HFO - High with H+ adsorbed [mg/L]	0
HAO - High surface [mg/L]	0
HAO - Low surface [mg/L]	0
HAO - High with H2PO4- adsorbed [mg/L]	0
HAO - Low with H2PO4- adsorbed [mg/L]	0
HAO - Aged [mg/L]	0
P - Bound on aged HMO [mgP/L]	0
Metal soluble - Magnesium [mg/L]	0
Metal soluble - Calcium [mg/L]	0
Metal soluble - Ferric [mg/L]	0
Metal soluble - Ferrous [mg/L]	0
Metal soluble - Aluminum [mg/L]	0
Other Cations (strong bases) [meq/L]	12500.00
Other Anions (strong acids) [meq/L]	0
Gas - Dissolved total CO2 [mmol/L]	0
User defined - UD1 [mg/L]	0
User defined - UD2 [mg/L]	0
User defined - UD3 [mgVSS/L]	0
User defined - UD4 [mgISS/L]	0
Biomass - Sulfur oxidizing [mgCOD/L]	0
Biomass - Sulfur reducing propionic acetogenic [mgCOD/L]	0
Biomass - Sulfur reducing acetotrophic [mgCOD/L]	0
Biomass - Sulfur reducing hydrogenotrophic [mgCOD/L]	0
Gas - Dissolved total sulfides [mgS/L]	0
S - Soluble sulfate [mgS/L]	0
S - Particulate elemental sulfur [mgS/L]	0
Precipitate - Ferrous sulfide [mgISS/L]	0
CODp - Adsorbed hydrocarbon [mgCOD/L]	0
CODs - Degradable volatile ind. #1 [mgCOD/L]	0
CODs - Degradable volatile ind. #2 [mgCOD/L]	0
CODs - Degradable volatile ind. #3 [mgCOD/L]	0
CODs - Soluble hydrocarbon [mgCOD/L]	0
Gas - Dissolved oxygen [mg/L]	0
Flow	0.0001

BioWin Album

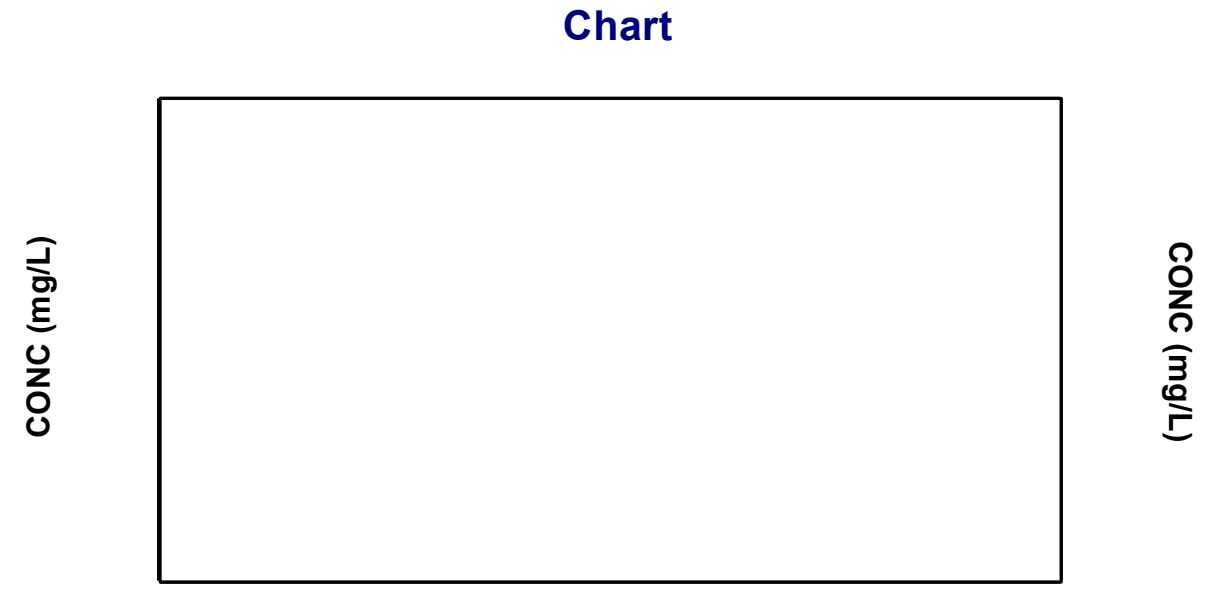
Album page - Nitrogen species



Album page - BOD_TSS

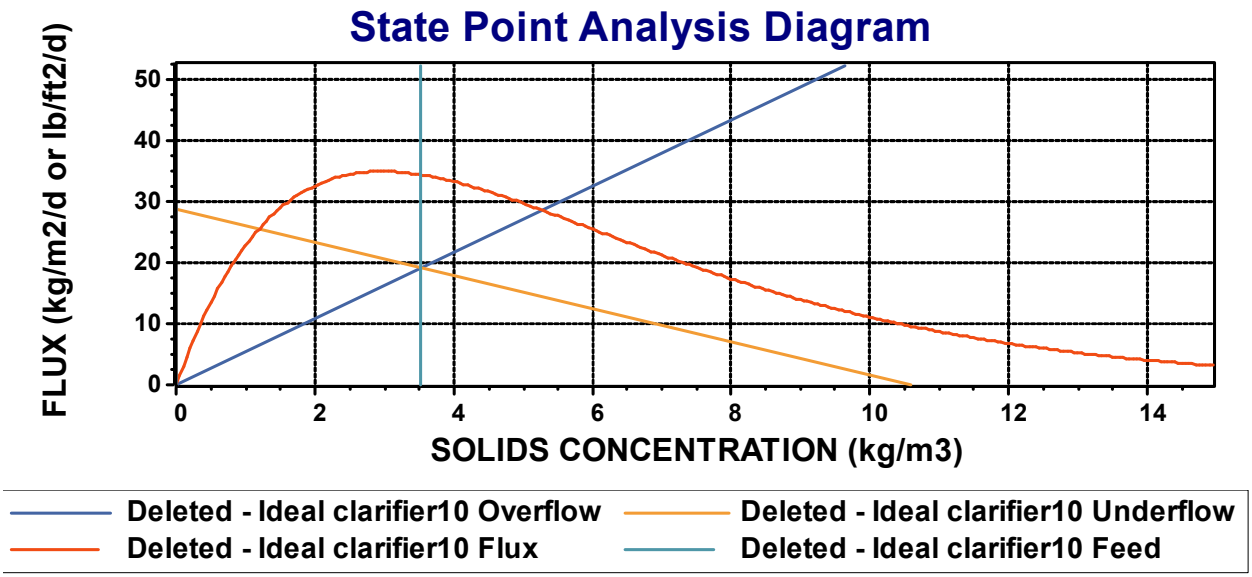


Album page - Page 3



Album page - Page 4

Album page - Page 5



K = 0.3362 m3/kg
Vo = 511.2 ft/d

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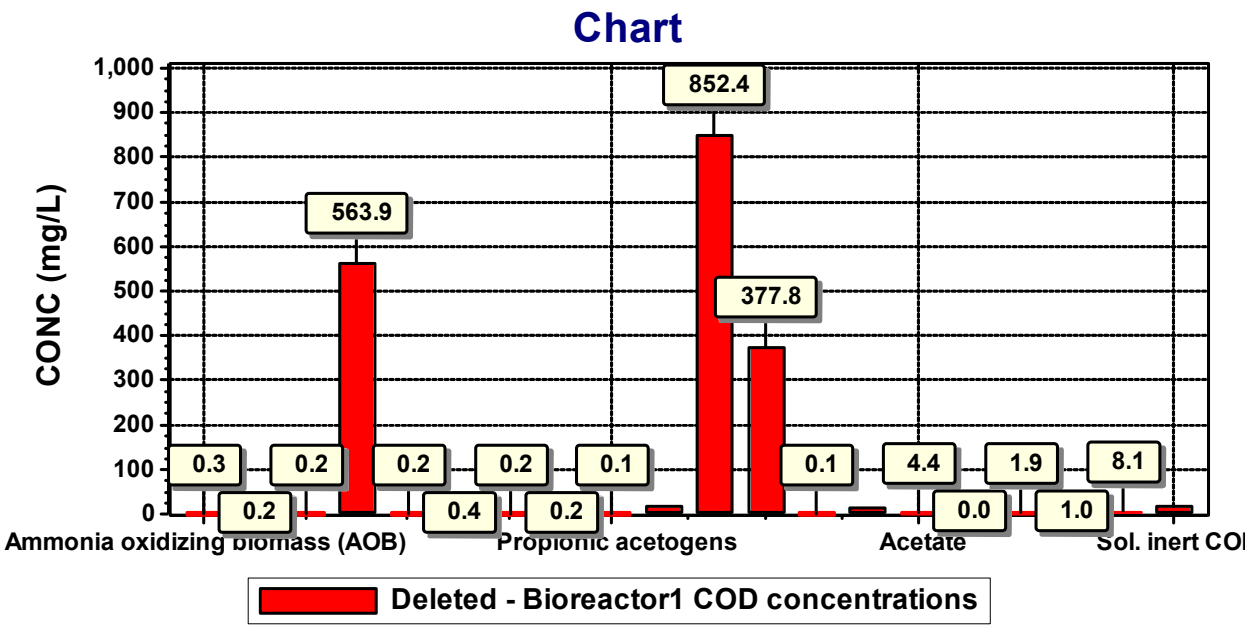

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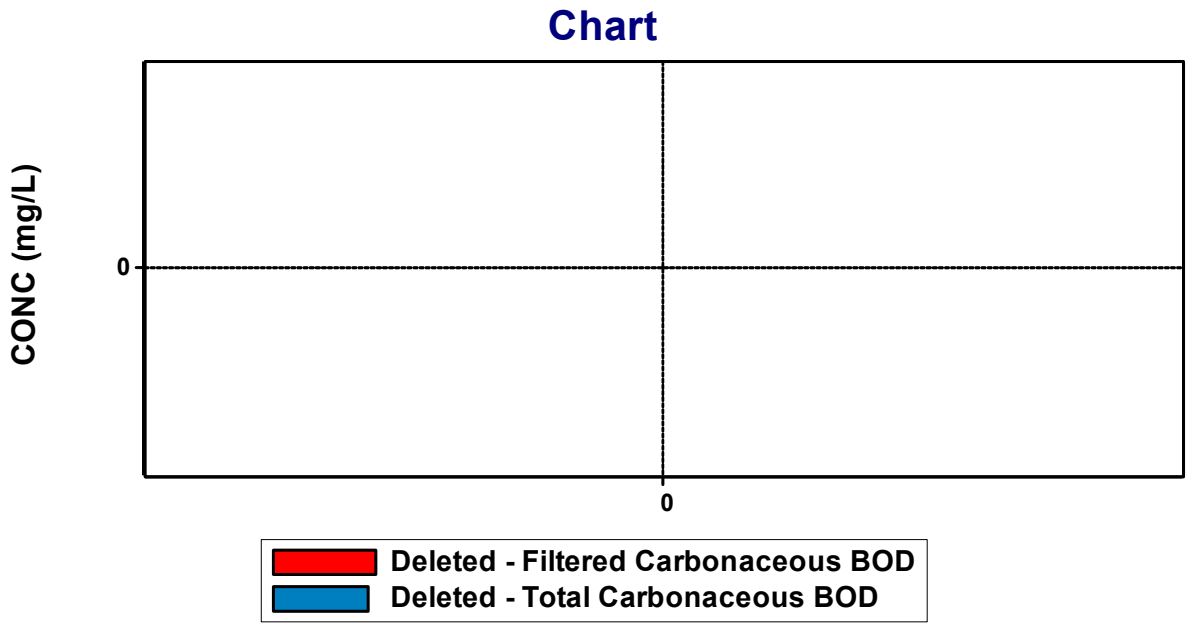

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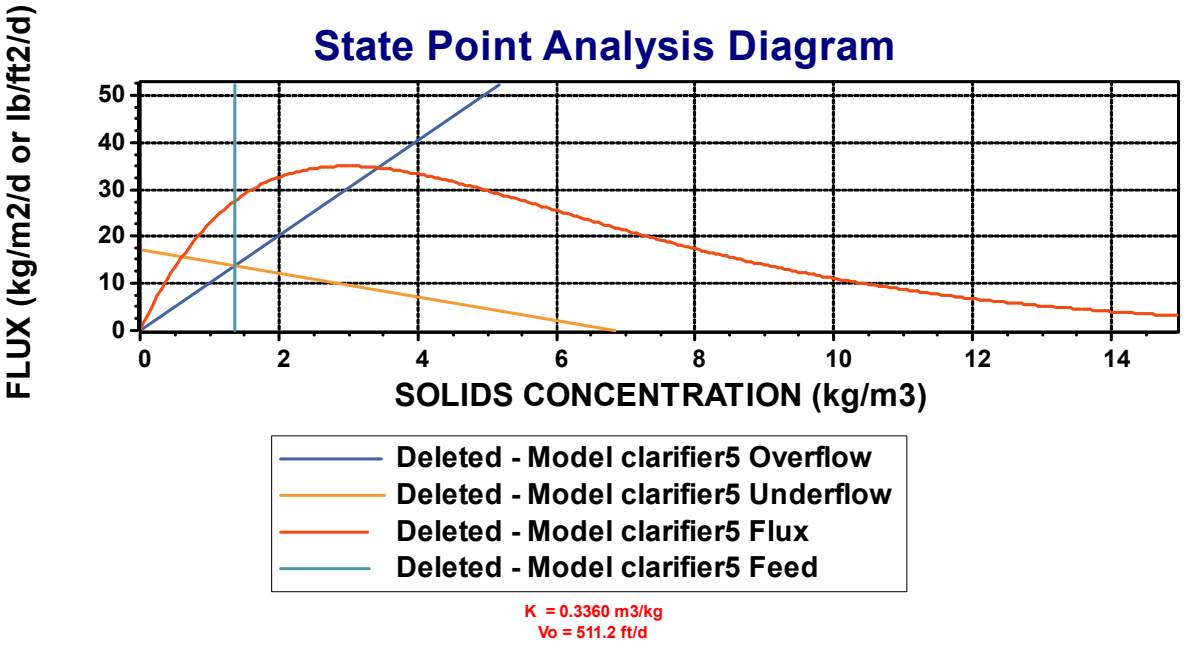

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Sludge90			
State variable	Conc. (mg/L)	Mass rate (lb/d)	Notes
Biomass - Acetoclastic methanogenic	0.35	0.09	
Biomass - Ammonia oxidizing	94.04	23.17	
Biomass - Anaerobic ammonia oxidizing	2.33	0.57	
Biomass - Endogenous products	2111.28	520.25	
Biomass - Hydrogenotrophic methanogenic	0.08	0.02	
Biomass - Methylotrophic	1.91	0.47	
Biomass - Nitrite oxidizing	56.51	13.92	
Biomass - Ordinary heterotrophic	4054.91	999.18	
Biomass - Phosphorus accumulating	1.20	0.30	
Biomass - Propionic acetogenic	0.40	0.10	
Biomass - Sulfur oxidizing	0	0	
Biomass - Sulfur reducing acetotrophic	0.00	0.00	
Biomass - Sulfur reducing hydrogenotrophic	0	0	
Biomass - Sulfur reducing propionic acetogenic	0	0	

CODp - Adsorbed hydrocarbon	0	0	
CODp - Degradable external organics	0.00	0.00	
CODp - Slowly degradable colloidal	0.08	0.02	
CODp - Slowly degradable particulate	232.18	57.21	
CODp - Stored PHA	0.00	0.00	
CODp - Undegradable cellulose	1804.00	444.53	
CODp - Undegradable non-cellulose	1804.00	444.53	
CODs - Acetate	0.00	0.00	
CODs - Complex readily degradable	1.38	0.34	
CODs - Degradable volatile ind. #1	0	0	
CODs - Degradable volatile ind. #2	0	0	
CODs - Degradable volatile ind. #3	0	0	
CODs - Methanol	0.00	0.00	
CODs - Propionate	0.00	0.00	
CODs - Soluble hydrocarbon	0	0	
CODs - Undegradable	23.47	5.78	
Gas - Dissolved hydrogen	0.01	0.00	
Gas - Dissolved methane	0.00	0.00	
Gas - Dissolved nitrogen	19.09	4.70	
Gas - Dissolved nitrous oxide	0	0	
Gas - Dissolved oxygen	2.00	0.49	
Gas - Dissolved total CO2	1.84	0.21	mmol/L and kmol/d
Gas - Dissolved total sulfides	0.00	0.00	
HAO - Aged	0	0	
HAO - High surface	0	0	
HAO - High with H2PO4- adsorbed	0	0	
HAO - Low surface	0	0	
HAO - Low with H2PO4- adsorbed	0	0	
HFO - Aged	0	0	
HFO - High surface	0	0	
HFO - High with H+ adsorbed	0	0	
HFO - High with H2PO4- adsorbed	0	0	
HFO - Low surface	0	0	
HFO - Low with H+ adsorbed	0	0	
HFO - Low with H2PO4- adsorbed	0	0	

Influent inorganic suspended solids	960.44	236.67	
Metal soluble - Aluminum	0	0	
Metal soluble - Calcium	80.58	19.86	
Metal soluble - Ferric	0	0	
Metal soluble - Ferrous	0	0	
Metal soluble - Magnesium	14.80	3.65	
N - Ammonia	1.30	0.32	
N - Nitrate	5.61	1.38	
N - Nitrite	0.43	0.11	
N - Particulate degradable external organics	0	0	
N - Particulate degradable organic	10.44	2.57	
N - Particulate undegradable	126.28	31.12	
N - Soluble degradable organic	0.55	0.13	
N - Soluble undegradable organic	0.62	0.15	
Other Anions (strong acids)	9.69	1.08	meq/L and keq/d
Other Cations (strong bases)	5.51	0.62	meq/L and keq/d
P - Bound on aged HMO	0	0	
P - Particulate degradable external organics	0	0	
P - Particulate degradable organic	4.10	1.01	
P - Particulate undegradable	39.69	9.78	
P - Releasable stored polyP	0.14	0.03	
P - Soluble phosphate	4.06	1.00	
P - Unreleasable stored polyP	0.01	0.00	
Precipitate - Brushite	0	0	
Precipitate - Ferrous sulfide	0	0	
Precipitate - Hydroxy - apatite	0	0	
Precipitate - Struvite	0	0	
Precipitate - Vivianite	0	0	
S - Particulate elemental sulfur	0	0	
S - Soluble sulfate	0.00	0.00	
User defined - UD1	0	0	
User defined - UD2	0	0	
User defined - UD3	0	0	
User defined - UD4	0	0	

Parameter	Value	Units
Cost (Sludge)	0	$/hour
Power	0	kW
Power cost (Excl. heating)	0	$/hour

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Elements	Flow [mgd]	Temperature [deg.C]	BOD - Total Carbonaceous [mg/L]	BOD - Filtered Carbonaceous [mg/L]	COD - Total [mg/L]	COD - Filtered [mg/L]	Total suspended solids [mg/L]	Volatile suspended solids [mg/L]	N - Total N [mgN/L]	N - Total Kjeldahl Nitrogen [mgN/L]	N - Ammonia [mgN/L]	N - Nitrate [mgN/L]	N - Nitrite [mgN/L]	pH []	Alkalinity [mmol/L]	OUR - Carbonaceous [mgO/L/hr]	OUR - Nitrification [mgO/L/hr]	OUR - Total [mgO/L/hr]	SOTR [lb/hr]	Airflow rate [ft3/min (20C, 1atm)]	Alpha [[]]
Influent - BOD14	2.27	11.00	172.98	52.46	361.00	102.90	196.00	182.00	30.90	30.90	22.72	0	0	7.10	2.00	----	----	----	----	----	----
Anoxic 1A	5.11	11.00	2497.28	2.81	10201.81	27.84	8670.77	7182.91	588.45	583.58	3.18	4.62	0.25	6.32	0.81	0	0	0	0	0	0.50
Aerobic 1A	5.11	11.00	2492.17	1.13	10194.21	25.16	8667.49	7179.45	587.88	582.59	2.17	4.88	0.41	6.18	0.71	43.41	29.05	72.45	107.52	465.73	0.30
Aerobic 2A	5.11	11.00	2488.18	1.02	10188.13	24.94	8663.50	7175.33	587.84	581.79	1.30	5.61	0.43	6.07	0.59	43.29	24.55	67.84	79.90	333.37	0.32
Anoxic 2A	5.11	11.00	2496.12	1.33	10200.32	25.64	8671.31	7183.42	587.93	583.58	3.28	4.11	0.24	6.34	0.85	0	0	0	0	0	0.50

MBRA	0.56	11.00	0.96	0.96	24.83	24.83	0	0	8.44	1.84	0.66	6.30	0.30	5.98	0.50	47.83	21.66	69.49	60.28	923.52	0.37
MBRA (U)	4.54	11.00	2790.49	0.97	1143.516	24.85	9727.73	8055.81	659.27	652.67	0.66	6.30	0.30	6.06	0.50	-----	-----	-----	-----	-----	-----
Effluent 1	2.24	11.00	0.96	0.96	24.83	24.83	0	0	8.44	1.84	0.66	6.30	0.30	6.06	0.50	-----	-----	-----	-----	-----	-----
Sludge 90	0.03	11.00	2488.18	1.02	1018 8.13	24.94	8663.50	7175.33	587.84	581.79	1.30	5.61	0.43	6.07	0.59	-----	-----	-----	-----	-----	-----

Global Parameters

Common

Name	Default	Value	
Hydrolysis rate [1/d]	2.1000	2.1000	1.0290
Hydrolysis half sat. [-]	0.0600	0.0600	1.0000
External organics hydrolysis rate [1/d]	2.1000	2.1000	1.0290
External organics hydrolysis half sat. [-]	0.0600	0.0600	1.0000
Anoxic hydrolysis factor [-]	0.2800	0.2800	1.0000
Anaerobic hydrolysis factor (AS) [-]	0.0400	0.0400	1.0000
Anaerobic hydrolysis factor (AD) [-]	0.5000	0.5000	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.1500	0.1500	1.0290
Ammonification rate [L/(mgCOD d)]	0.0800	0.0800	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.5000	0.5000	1.0000
Endogenous products decay rate [1/d]	0	0	1.0000

Ammonia oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9000	0.9000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.7000	0.7000	1.0000
Byproduct NH4 logistic slope [-]	50.0000	50.0000	1.0000
Byproduct NH4 inflection point [mgN/L]	1.4000	1.4000	1.0000
Denite DO half sat. [mg/L]	0.1000	0.1000	1.0000
Denite HNO2 half sat. [mgN/L]	5.000E-6	5.000E-6	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiHNO2 [mmol/L]	5.000E-3	5.000E-3	1.0000

Nitrite oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	0.7000	0.7000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.1000	0.1000	1.0000
Aerobic decay rate [1/d]	0.1700	0.1700	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0800	0.0800	1.0290
KiNH3 [mmol/L]	0.0750	0.0750	1.0000

Anaerobic ammonia oxidizing

Name	Default	Value	
Max. spec. growth rate [1/d]	0.2000	0.2000	1.1000
Substrate (NH4) half sat. [mgN/L]	2.0000	2.0000	1.0000
Substrate (NO2) half sat. [mgN/L]	1.0000	1.0000	1.0000
Aerobic decay rate [1/d]	0.0190	0.0190	1.0290
Anoxic/anaerobic decay rate [1/d]	9.500E-3	9.500E-3	1.0290
Ki Nitrite [mgN/L]	1000.0000	1000.0000	1.0000
Nitrite sensitivity constant [L / (d mgN)]	0.0160	0.0160	1.0000

Ordinary heterotrophic

Name	Default	Value	
Max. spec. growth rate [1/d]	3.2000	3.2000	1.0290
Substrate half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Anoxic growth factor [-]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.6200	0.6200	1.0290
Anoxic decay rate [1/d]	0.2330	0.2330	1.0290
Anaerobic decay rate [1/d]	0.1310	0.1310	1.0290
Fermentation rate [1/d]	1.6000	1.6000	1.0290
Fermentation half sat. [mgCOD/L]	5.0000	5.0000	1.0000
Fermentation growth factor (AS) [-]	0.2500	0.2500	1.0000
Free nitrous acid inhibition [mol/L]	1.000E-7	1.000E-7	1.0000

Heterotrophic on industrial COD

Name	Default	Value	
Maximum specific growth rate on Ind #1 COD [1/d]	4.3000	4.3000	1.0290
Substrate (Ind #1) half sat. [mgCOD/L]	1.0000	1.0000	1.0000
Inhibition coefficient for Ind #1 [mgCOD/L]	60.0000	60.0000	1.0000
Anaerobic growth factor for Ind #1 [mgCOD/L]	0.0500	0.0500	1.0000
Maximum specific growth rate on Ind #2 COD [1/d]	1.5000	1.5000	1.0290
Substrate (Ind #2) half sat. [mgCOD/L]	30.0000	30.0000	1.0000
Inhibition coefficient for Ind #2 [mgCOD/L]	3000.0000	3000.0000	1.0000
Anaerobic growth factor for Ind #2 [mgCOD/L]	0.0500	0.0500	1.0000
Maximum specific growth rate on Ind #3 COD [1/d]	4.3000	4.3000	1.0290
Substrate (Ind #3) half sat. [mgCOD/L]	1.0000	1.0000	1.0000
Inhibition coefficient for Ind #3 COD [mgCOD/L]	60.0000	60.0000	1.0000
Anaerobic growth factor for Ind #3 [mgCOD/L]	0.0500	0.0500	1.0000

Maximum specific growth rate on adsorbed hydrocarbon COD [1/d]	2.0000	2.0000	1.0290
Substrate (adsorbed hydrocarbon) half sat. [-]	0.1500	0.1500	1.0000
Anaerobic growth factor for adsorbed hydrocarbons [mgCOD/L]	0.0100	0.0100	1.0000
Adsorption rate of soluble hydrocarbons [l/(mgCOD d)]	0.2000	0.2000	1.0000

Methylotrophic

Name	Default	Value	
Max. spec. growth rate [1/d]	1.3000	1.3000	1.0720
Methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
Denite N2 producers (NO3 or NO2) [-]	0.5000	0.5000	1.0000
Aerobic decay rate [1/d]	0.0400	0.0400	1.0290
Anoxic/anaerobic decay rate [1/d]	0.0300	0.0300	1.0290
Free nitrous acid inhibition [mmol/L]	1.000E-7	1.000E-7	1.0000

Phosphorus accumulating

Name	Default	Value	
Max. spec. growth rate [1/d]	0.9500	0.9500	1.0000
Max. spec. growth rate, P-limited [1/d]	0.4200	0.4200	1.0000
Substrate half sat. [mgCOD(PHB)/mgCOD(Zbp)]	0.1000	0.1000	1.0000
Substrate half sat., P-limited [mgCOD(PHB)/mgCOD(Zbp)]	0.0500	0.0500	1.0000
Magnesium half sat. [mgMg/L]	0.1000	0.1000	1.0000
Cation half sat. [mmol/L]	0.1000	0.1000	1.0000
Calcium half sat. [mgCa/L]	0.1000	0.1000	1.0000
Aerobic/anoxic decay rate [1/d]	0.1000	0.1000	1.0000
Aerobic/anoxic maintenance rate [1/d]	0	0	1.0000
Anaerobic decay rate [1/d]	0.0400	0.0400	1.0000
Anaerobic maintenance rate [1/d]	0	0	1.0000
Sequestration rate [1/d]	4.5000	4.5000	1.0000
Anoxic growth factor [-]	0.3300	0.3300	1.0000

Propionic acetogenic

Name	Default	Value	
Max. spec. growth rate [1/d]	0.2500	0.2500	1.0290
Substrate half sat. [mgCOD/L]	10.0000	10.0000	1.0000
Acetate inhibition [mgCOD/L]	10000.0000	10000.0000	1.0000
Anaerobic decay rate [1/d]	0.0500	0.0500	1.0290
Aerobic/anoxic decay rate [1/d]	0.5200	0.5200	1.0290

Methanogenic

Name	Default	Value	
Acetoclastic max. spec. growth rate [1/d]	0.3000	0.3000	1.0290
H2-utilizing max. spec. growth rate [1/d]	1.4000	1.4000	1.0290
Acetoclastic substrate half sat. [mgCOD/L]	100.0000	100.0000	1.0000
Acetoclastic methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
H2-utilizing CO2 half sat. [mmol/L]	0.1000	0.1000	1.0000
H2-utilizing substrate half sat. [mgCOD/L]	1.0000	1.0000	1.0000
H2-utilizing methanol half sat. [mgCOD/L]	0.5000	0.5000	1.0000
Acetoclastic propionic inhibition [mgCOD/L]	10000.0000	10000.0000	1.0000
Acetoclastic anaerobic decay rate [1/d]	0.1300	0.1300	1.0290
Acetoclastic aerobic/anoxic decay rate [1/d]	0.6000	0.6000	1.0290
H2-utilizing anaerobic decay rate [1/d]	0.1300	0.1300	1.0290
H2-utilizing aerobic/anoxic decay rate [1/d]	2.8000	2.8000	1.0290

Sulfur oxidizing

Name	Default	Value

Maximum specific growth rate (sulfide) [1/d]	0.7500	0.7500	1.0290
Maximum specific growth rate (sulfur) [1/d]	0.1000	0.1000	1.0290
Substrate (H2S) half sat. [mgS/L]	1.0000	1.0000	1.0000
Substrate (sulfur) half sat. [mgS/L]	1.0000	1.0000	1.0000
Anoxic growth factor [-]	0.5000	0.5000	1.0000
Decay rate [1/d]	0.0400	0.0400	1.0290

Sulfur reducing

Name	Default	Value	
Propionic max. spec. growth rate [1/d]	0.5830	0.5830	1.0350
Propionic acid half sat. [mgCOD/L]	295.0000	295.0000	1.0000
Hydrogen sulfide inhibition coefficient [mgS/L]	185.0000	185.0000	1.0000
Sulfate (SO4=) half sat. [mgS/L]	2.4700	2.4700	1.0000
Decay rate [1/d]	0.0185	0.0185	1.0350
Acetotrophic max. spec. growth rate [1/d]	0.6120	0.6120	1.0350
Acetic acid half sat. [mgCOD/L]	24.0000	24.0000	1.0000
Hydrogen sulfide inhibition coefficient [mgS/L]	164.0000	164.0000	1.0000
Sulfate (SO4=) half sat. [mgS/L]	6.4100	6.4100	1.0000
Decay rate [1/d]	0.0275	0.0275	1.0350
Hydrogenotrophic max. spec. growth rate with SO4= [1/d]	2.8000	2.8000	1.0350
Hydrogenotrophic max. spec. growth rate with S [1/d]	0.1000	0.1000	1.0350
Hydrogen half sat. [mgCOD/L]	0.0700	0.0700	1.0000
Hydrogen sulfide inhibition coefficient [mgS/L]	550.0000	550.0000	1.0000
Sulfate (SO4=) half sat. [mgS/L]	6.4100	6.4100	1.0000
Sulfur (S) half sat. [mgS/L]	50.0000	50.0000	1.0000
Decay rate [1/d]	0.0600	0.0600	1.0350

pH

Name	Default	Value

Ordinary heterotrophic low pH limit [-]	4.0000	4.0000
Ordinary heterotrophic high pH limit [-]	10.0000	10.0000
Methylotrophic low pH limit [-]	4.0000	4.0000
Methylotrophic high pH limit [-]	10.0000	10.0000
Autotrophic low pH limit [-]	5.5000	5.5000
Autotrophic high pH limit [-]	9.5000	9.5000
Phosphorus accumulating low pH limit [-]	4.0000	4.0000
Phosphorus accumulating high pH limit [-]	10.0000	10.0000
Ordinary heterotrophic low pH limit (anaerobic) [-]	5.5000	5.5000
Ordinary heterotrophic high pH limit (anaerobic) [-]	8.5000	8.5000
Propionic acetogenic low pH limit [-]	4.0000	4.0000
Propionic acetogenic high pH limit [-]	10.0000	10.0000
Acetoclastic methanogenic low pH limit [-]	5.0000	5.0000
Acetoclastic methanogenic high pH limit [-]	9.0000	9.0000
H2-utilizing methanogenic low pH limit [-]	5.0000	5.0000
H2-utilizing methanogenic high pH limit [-]	9.0000	9.0000

Switches

Name	Default	Value
Ordinary heterotrophic DO half sat. [mgO2/L]	0.1500	0.0500
Phosphorus accumulating DO half sat. [mgO2/L]	0.0500	0.0500
Anoxic/anaerobic NOx half sat. [mgN/L]	0.1500	0.1500
Ammonia oxidizing DO half sat. [mgO2/L]	0.2500	0.2500
Nitrite oxidizing DO half sat. [mgO2/L]	0.5000	0.5000
Anaerobic ammonia oxidizing DO half sat. [mgO2/L]	0.0100	0.0100
Sulfur oxidizing sulfate pathway DO half sat. [mgO2/L]	0.2500	0.2500
Sulfur oxidizing sulfur pathway DO half sat. [mgO2/L]	0.0500	0.0500
Anoxic NO3(->NO2) half sat. [mgN/L]	0.1000	0.1000
Anoxic NO3(->N2) half sat. [mgN/L]	0.0500	0.0500
Anoxic NO2(->N2) half sat. (mgN/L)	0.0100	0.0100
NH3 nutrient half sat. [mgN/L]	5.000E-3	5.000E-3
PolyP half sat. [mgP/mgCOD]	0.0100	0.0100

VFA sequestration half sat. [mgCOD/L]	5.0000	5.0000
P uptake half sat. [mgP/L]	0.1500	0.1500
P nutrient half sat. [mgP/L]	1.000E-3	1.000E-3
Autotrophic CO2 half sat. [mmol/L]	0.1000	0.1000
H2 low/high half sat. [mgCOD/L]	1.0000	1.0000
Propionic acetogenic H2 inhibition [mgCOD/L]	5.0000	5.0000
Synthesis anion/cation half sat. [meq/L]	0.0100	0.0100

Common

Name	Default	Value
Biomass/Endog Ca content (gCa/gCOD)	3.912E-3	3.912E-3
Biomass/Endog Mg content (gMg/gCOD)	3.912E-3	3.912E-3
Biomass/Endog other cations content (mol/gCOD)	5.115E-4	5.115E-4
Biomass/Endog other Anions content (mol/gCOD)	1.410E-4	1.410E-4
N in endogenous residue [mgN/mgCOD]	0.0700	0.0700
P in endogenous residue [mgP/mgCOD]	0.0220	0.0220
Ca content of slowly biodegradabe (gCa/gCOD)	3.912E-3	3.912E-3
Mg content of slowly biodegradabe (gMg/gCOD)	3.700E-4	3.700E-4
Endogenous residue COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.6327	1.4200
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.4200
Cellulose COD:VSS ratio [mgCOD/mgVSS]	1.4000	1.4000
External organic COD:VSS ratio [mgCOD/mgVSS]	1.6000	1.6000
Molecular weight of other anions [mg/mmol]	35.5000	35.5000
Molecular weight of other cations [mg/mmol]	39.0983	39.1000

Ammonia oxidizing

Name	Default	Value
Yield [mgCOD/mgN]	0.1500	0.1500

Denite NO2 fraction as TEA [-]	0.5000	0.5000
Byproduct NH4 fraction to N2O [-]	2.500E-3	2.500E-3
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Nitrite oxidizing

Name	Default	Value
Yield [mgCOD/mgN]	0.0900	0.0900
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Anaerobic ammonia oxidizing

Name	Default	Value
Yield [mgCOD/mgN]	0.1140	0.1140
Nitrate production [mgN/mgBiomassCOD]	2.2800	2.2800
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Ordinary heterotrophic

Name	Default	Value

Yield (aerobic) [-]	0.6660	0.6660
Yield (fermentation, low H2) [-]	0.1000	0.1000
Yield (fermentation, high H2) [-]	0.1000	0.1000
H2 yield (fermentation low H2) [-]	0.3500	0.3500
H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.7000	0.7000
CO2 yield (fermentation, low H2) [-]	0.7000	0.7000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Endogenous fraction - aerobic [-]	0.0800	0.0800
Endogenous fraction - anoxic [-]	0.1030	0.1030
Endogenous fraction - anaerobic [-]	0.1840	0.1840
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield (anoxic) [-]	0.5400	0.5400
Yield propionic (aerobic) [-]	0.6400	0.6400
Yield propionic (anoxic) [-]	0.4600	0.4600
Yield acetic (aerobic) [-]	0.6000	0.6000
Yield acetic (anoxic) [-]	0.4300	0.4300
Yield methanol (aerobic) [-]	0.5000	0.5000
Adsorp. max. [-]	1.0000	1.0000
Max fraction to N2O at high FNA over nitrate [-]	0.0500	0.0500
Max fraction to N2O at high FNA over nitrite [-]	0.1000	0.1000

Ordinary heterotrophic on industrial COD

Name	Default	Value
Yield Ind #1 COD (Aerobic) [-]	0.5000	0.5000
Yield Ind #1 COD (Anoxic) [-]	0.4000	0.4000
Yield Ind #1 COD (Anaerobic) [-]	0.0400	0.0400
COD:Mole ratio - Ind #1 COD [gCOD/Mol]	224.0000	224.0000
Yield Ind #2 COD (Aerobic) [-]	0.5000	0.5000

Yield Ind #2 COD (Anoxic) [-]	0.4000	0.4000
Yield Ind #2 COD (Anaerobic) [-]	0.0500	0.0500
COD:Mole ratio - Ind #2 COD [gCOD/Mol]	240.0000	240.0000
Yield on Ind #3 COD (Aerobic) [-]	0.5000	0.5000
Yield on Ind #3 COD (Anoxic) [-]	0.4000	0.4000
Yield on Ind #3 COD (Anaerobic) [-]	0.0400	0.0400
COD:Mole ratio - Ind #3 COD [gCOD/Mol]	288.0000	288.0000
Yield enmeshed hydrocarbons (Aerobic) [-]	0.5000	0.5000
Yield enmeshed hydrocarbons (Anoxic) [-]	0.4000	0.4000
Yield enmeshed hydrocarbons (Anaerobic) [-]	0.0400	0.0400
COD:Mole ratio - Hydrocarbon COD [gCOD/Mol]	336.0000	336.0000
Hydrocarbon COD:VSS ratio [mgCOD/mgVSS]	3.2000	3.2000
Max. hydrocarbon adsorp. ratio [-]	1.0000	1.0000
Yield of Ind #1 on Ind #3 COD (Aerobic) [-]	0	0
Yield of Ind #1 on Ind #3 COD (Anoxic) [-]	0	0
Hydrocarbon Yield on Ind #3 COD (Aerobic) [-]	0	0
Hydrocarbon Yield on Ind #3 COD (Anoxic) [-]	0	0

Methylotrophic

Name	Default	Value
Yield (anoxic) [-]	0.4000	0.4000
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Max fraction to N2O at high FNA over nitrate [-]	0.1000	0.1000
Max fraction to N2O at high FNA over nitrite [-]	0.1500	0.1500

Phosphorus accumulating

Name	Default	Value
Yield (aerobic) [-]	0.6390	0.6390
Yield (anoxic) [-]	0.5200	0.5200
Aerobic P/PHA uptake [mgP/mgCOD]	0.9300	0.9300
Anoxic P/PHA uptake [mgP/mgCOD]	0.3500	0.3500
Yield of PHA on Ac sequestration [-]	0.8890	0.8890
N in biomass [mgN/mgCOD]	0.0700	0.0700
N in sol. inert [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous part. [-]	0.2500	0.2500
Inert fraction of endogenous sol. [-]	0.2000	0.2000
P/Ac release ratio [mgP/mgCOD]	0.5100	0.5100
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
Yield of low PP [-]	0.9400	0.9400
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	0.3000	0.3000
Cation to P mole ratio in polyphosphate [meq/mmolP]	0.1500	0.1500
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	0.0500	0.0500

Propionic acetogenic

Name	Default	Value
Yield [-]	0.1000	0.1000
H2 yield [-]	0.4000	0.4000
CO2 yield [-]	1.0000	1.0000
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Methanogenic

Name	Default	Value
Acetoclastic yield [-]	0.1000	0.1000
Acetoclastic yield on methanol[-]	0.1000	0.1000
H2-utilizing yield [-]	0.1000	0.1000
H2-utilizing yield on methanol [-]	0.1000	0.1000
N in acetoclastic biomass [mgN/mgCOD]	0.0700	0.0700
N in H2-utilizing biomass [mgN/mgCOD]	0.0700	0.0700
P in acetoclastic biomass [mgP/mgCOD]	0.0220	0.0220
P in H2-utilizing biomass [mgP/mgCOD]	0.0220	0.0220
Acetoclastic fraction to endog. residue [-]	0.0800	0.0800
H2-utilizing fraction to endog. residue [-]	0.0800	0.0800
Acetoclastic COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200
H2-utilizing COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Sulfur oxidizing

Name	Default	Value
Yield (aerobic) [mgCOD/mgS]	0.5000	0.5000
Yield (Anoxic) [mgCOD/mgS]	0.3500	0.3500
N in biomass [mgN/mgCOD]	0.0700	0.0700
P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

Sulfur reducing

Name	Default	Value
Yield [mgCOD/mg H2 COD]	0.0712	0.0712
Yield [mgCOD/mg Ac COD]	0.0470	0.0470
Yield [mgCOD/mg Pr COD]	0.0384	0.0384
N in biomass [mgN/mgCOD]	0.0700	0.0700

P in biomass [mgP/mgCOD]	0.0220	0.0220
Fraction to endogenous residue [-]	0.0800	0.0800
COD:VSS ratio [mgCOD/mgVSS]	1.4200	1.4200

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Technical Memorandum 5

Date: April 22, 2021

Project: City of Sandy – Detailed Discharge Alternative Evaluation

To: Jordan Wheeler, City Manager
Mike Walker, Public Works Director
City of Sandy, Oregon

From: Matt Hickey, PE
Ken Vigil, PE
Katie Husk, PE
Murraysmith

Re: Technical Memorandum 5 – Sandy River Temperature Compliance Evaluation
Technical Memorandum Update

Introduction

Technical Memorandum 5 is a deliverable under Task 4.2 of the Detailed Discharge Alternative Evaluation (DDAE) program. This memo includes a review of potential impacts to temperature on the Sandy River due to effluent discharges from the proposed, new membrane bioreactor facility.

Furthermore, Technical Memorandum 5 is an update to the memo prepared on May 22, 2019 as part of the WSFP Continuing Planning Services project (see attached).

This update provides the opportunity to review this topic with additional temperature data collected on the Sandy River, and updated estimates of river flows, effluent flows, and effluent temperatures.

Sandy River Temperature Data

In the May 2019 memo, temperature data for the Sandy River was not available. The mixing analysis that was done in that memo was completed using regulatory temperature criteria.

As part of the DDAE program, Waterways Consulting installed temperature probes in four locations on the Sandy River and collected temperature data. The locations of the installed temperature probes are shown in **Figure 1**. Descriptions of each of the probe locations are shown in **Table 1**.

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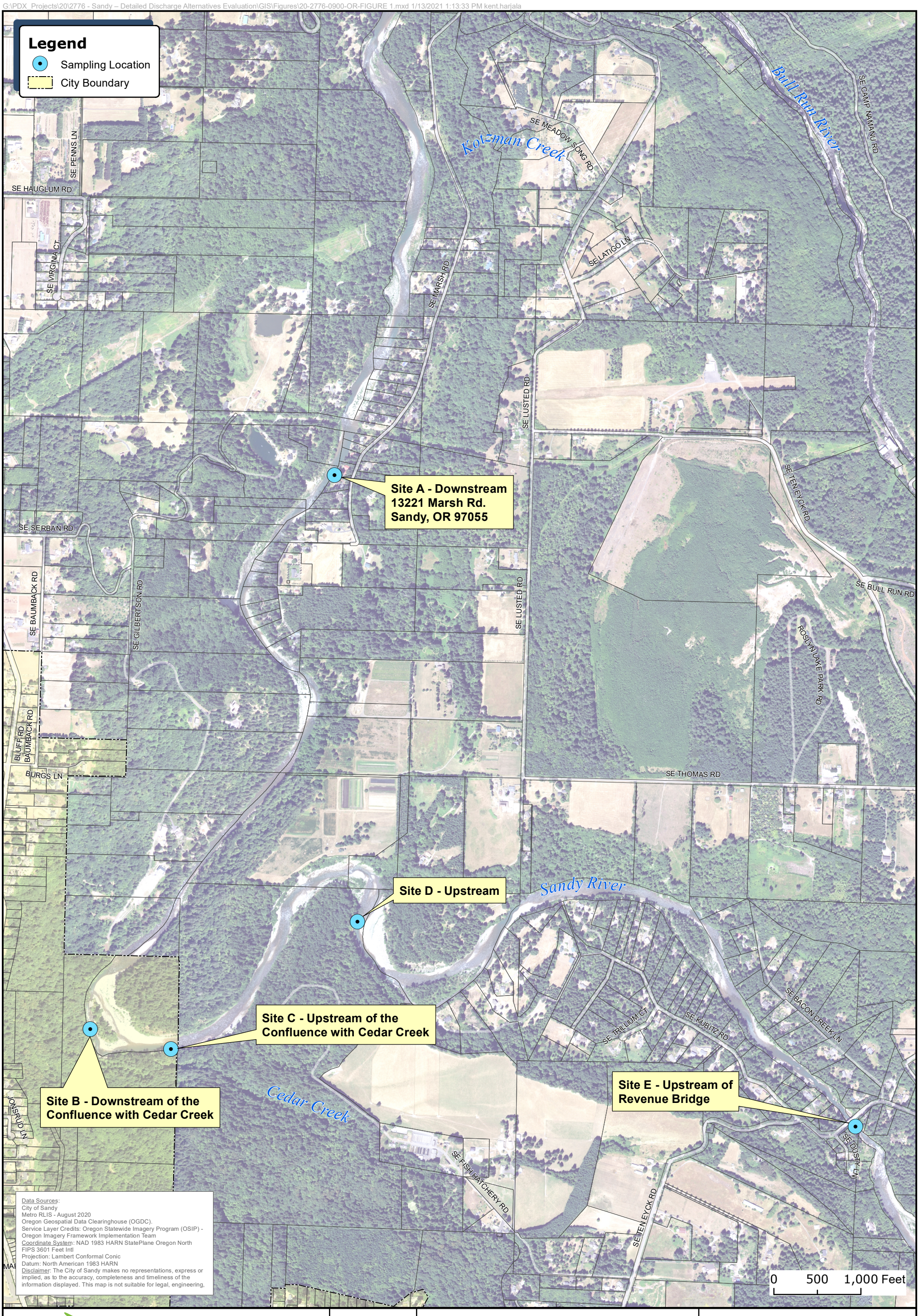

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SANDY
WHERE INNOVATION MEETS ELEVATION

N W E S

City of Sandy, Oregon
Wastewater System Facility Plan

Figure 1
Sampling Locations

January 2021

20-2776.0900

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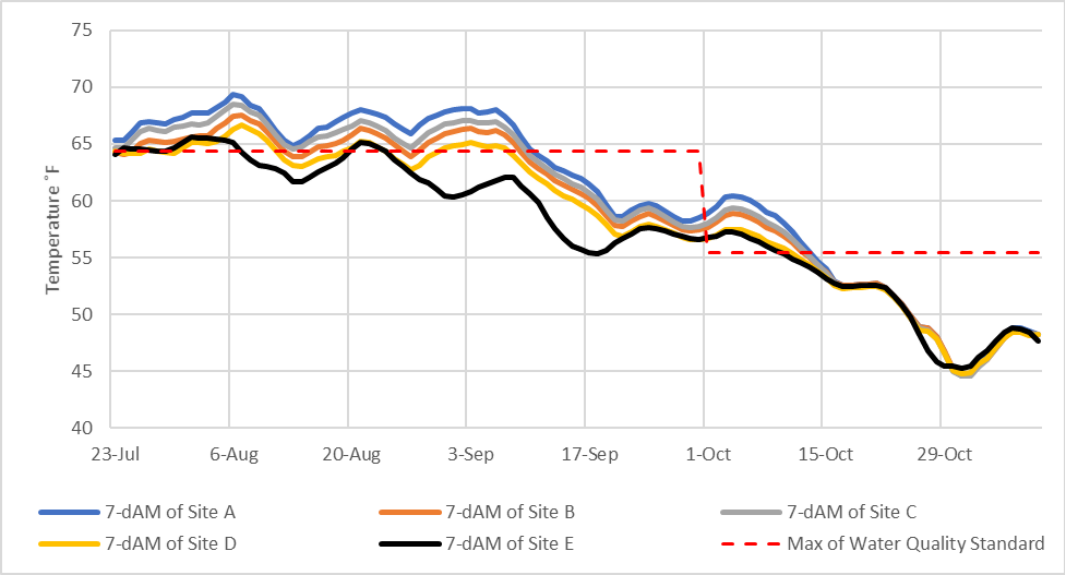
Table 1 | Water Quality Sample Locations

Site ID	Site Description	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
A	Downstream Most Site; Approximately 8,900 feet Downstream of Cedar Creek Confluence; Upstream of SE Lusted Rd. Bridge Crossing at 13221 Marsh Rd. Sandy, OR 97055; River Right	45.427673	-122.258792
B	Approximately 800 feet Downstream of Cedar Creek Confluence; River Left	45.410051	-122.269181
C	Approximately 300 feet Upstream of Cedar Creek Confluence; River Left	45.409476	-122.265549
D	Approximately 4,200 feet Upstream of Cedar Creek Confluence; River Left	45.413616	-122.257325
E	Upstream Most Site; Approximately 12,000 feet Upstream of Cedar Creek Confluence; Upstream of Revenue Bridge (SE Ten Eyck Rd.); River Left	45.407508	-122.234845

Temperature loggers were initially deployed at Sites A, B, C, and D, on July 10, 2019. An additional temperature logger was deployed at a location less than a mile downstream of Site E (Revenue Bridge Site) on July 17, 2020. On October 2, 2020, the temperature probe was moved to Site E. The temperature probes collected data at 15-minute intervals from July to October 2020. The graph below (**Figure 2**) shows the rolling 7-day average of the maximum temperature observed each day (7-dAM). The temperature was generally observed to be warmer at the more downstream sites, with Site E showing the coldest temperatures on average.

Figure 2 | 7-dAM of Temperature Probe (15-min intervals)



Sandy River Flow Data

The project team has conducted additional analysis since the May 2019 memo which has resulted in more accurate estimates of the Sandy River flow rates at the proposed outfall location. Previous analysis utilized a gauge station located upstream of the proposed outfall location, which means that a portion of the drainage basin was not considered. Additionally, the new flows have been updated to reflect more current data.

A multi-faceted approach was developed by Murraysmith and Waterways for reviewing flow rates on the Sandy River, whereby a series of flow rate measurements would be taken over the course of five years. Waterways Consulting took the first flow measurement in 2019 as a wading sample, where measurements were taken at approximately 20 points across a single cross section using a Price AA Flow Meter. Four additional wading measurements were conducted by Waterways near the Oxbow location in the summer and fall of 2019. These flow measurements were used as a calibration measure for reviewing the accuracy of data being recorded by the U. S. Geological Survey (USGS).

The closest long-term USGS river gauge is located approximately 5.5 miles downstream of the proposed outfall site at Ten Eyck Road. Additional flows from the Bull Run River enter the Sandy River between the project site and the gauging station. The USGS and the City of Portland monitor these flows, so reliable flow data is available. The Bull Run River gauging station is also located upstream of the Little Sandy River confluence, which is also monitored by USGS. The project engineers subtracted the flow rates from the Bull Run River and the Little Sandy River gauging stations to estimate the discharge rates for the Sandy River upstream of the Bull Run confluence (where the proposed outfall would be located). Table 2 summarizes the recorded 7Q10 flow rates (the lowest 7-day average flow that occurs once every 10 years) in the Sandy River, calculated for each month. The river flow values from the 2019 memo are provided here as well for comparison.

Table 2 | Estimated 7Q10 Flows in Sandy River at Proposed Outfall

Month	River Flow (CFS)	River Flow[1] (MGD, Current Estimate)	River Flow[2] (MGD, 2019 Memo Estimate)	Difference (MGD, Current - 2019)
January	940	607	532	75
February	899	581	496	85
March	655	423	525	-102
April	1177	760	738	22
May 1 – May 15	765	494	400	94
May 16 – May 31	730	471	400	71
June	415	268	294	-26
July	331	214	207	7
August	269	174	170	4
September	245	158	146	12
Oct 1 – Oct 14	236	152	147	5
Oct 15 – Oct 31	245	158	147	11
November	381	246	354	-108
December	442	285	399	-114

Notes:

1. 7Q10 flow at downstream of USGS gauging station, calculated for approximately 10-year time period from 2010-2019 (Bull Run River and Little Sandy River flows subtracted).
2. 7Q10 flow at upstream of USGS gauging station, calculated for approximately 10-year time period from 2008-2018. River flows include 5 cfs (3 MGD) for the assumed Cedar Creek flow into the Sandy.

As shown in **Table 2**, the flow rates estimated in 2019 were relatively close to the latest flow estimates. While there is some variation in the values, ranging from 75 MGD higher to 114 MGD lower than the previous estimate for a single month, the conclusions that can be drawn from the data are largely the same. Those conclusions are discussed in greater detail in the following sections.

Effluent Flows/Temperature

The current and projected flow rates associated with the total City of Sandy wastewater flows (along with the flow rates that will be diverted to the MBR facility) are included in **Table 3.** The project team has updated these effluent flow estimates based on recent analysis from those estimated in the 2019 memo. In earlier stages of this project, it was assumed that the proposed diversion pump would direct higher flow rates to the new MBR treatment plant. The design has since been updated to a more realistic phased approach, wherein a larger amount of the flow will continue to be sent to the existing wastewater treatment facility. This change was largely due to the City's decision to update the existing Tickle Creek Plant.

Table 3 | City of Sandy Wastewater Flow Rates

Month	Est. WWTP[1] Temp. (°C)	Present (2020)		Future (2040)	
		Overall City of Sandy Wastewater Flow[2] (MGD)	Flow to MBR[3] (MGD)	Overall City of Sandy Wastewater Flow[2] (MGD)	Flow to MBR[2] (MGD)
January	15.4	1.58	0.79	3.28	1.64
February	16.2	1.45	0.73	3.07	1.54
March	15.7	1.61	0.81	3.33	1.67
April	16.4	1.43	0.72	3.2	1.6
May 1 – May 15	17.4	1.4	0.7	2.99	1.5
May 16 – May 31	17.9	1.4	0.7	2.99	1.5
June	20.9	1.1	0.55	2.61	1.31
July	21.9	0.76	0.38	2.19	1.1
August	22.8	0.69	0.35	2.08	1.04
September	22.4	0.73	0.37	2.14	1.07
Oct 1 – Oct 14	21.2	1.41	0.71	3.13	1.57
Oct 15 – Oct 31	20.5	1.41	0.71	3.13	1.57
November	20	1.75	0.88	3.99	2
December	16.7	1.66	0.83	3.63	1.82

Notes:

1. Maximum of the 7-day average daily maximum (7 DADM) temps from existing WWTP DMRs.
2. Estimated wastewater system average monthly flows using Murraysmith hydraulic model.
3. Estimated flows to MBR facility, approximately ½ of overall wastewater flow.

Monthly Temperature Impact Reviews

Several different regulatory thresholds and methodologies exist for reviewing temperature impacts. For example, the Sandy River Total Maximum Daily Load (TMDL) study lists an allowable temperature increase from point source discharges of 0.54°F (0.3°C). The TMDL study assumes 25 percent of the Sandy River 7Q10 flows would mix with point source effluent at the edge of the regulatory mixing zone. The TMDL also states, however, that under some circumstances it may be appropriate to consider 100 percent of the 7Q10 effluent flows for mixing.

Oregon Department of Environmental Quality's (DEQ) Antidegradation Internal Management Directive (IMD) for new discharges to receiving streams (such as proposed for the Sandy River) lists a lower regulatory threshold of 0.25°F (0.14°C) at the edge of the mixing zone.

For planning purposes, and to be conservative, Murraysmith engineers have reviewed impacts against the lower antidegradation threshold of 0.25°F and assumed that 25 percent of the Sandy River 7Q10 flows would mix with effluent. Tables 4 and 5 include the results of this temperature review, using mass balance to estimate resulting temperatures after the effluent has mixed with the river.

Table 4 | Temperature Evaluation Based on Present Conditions

Month	WWTP Flow[1] (MGD)	WWTP Temp[2] (°C)	River Flow[3] (MGD)	River Temp[4] (°C)	Delta T at EMZ[5] (°C)	Delta T at EMZ (°F)
JAN	0.79	15.40	607	13.00	0.01	0.02
FEB	0.73	16.20	581	13.00	0.02	0.03
MAR	0.81	15.70	423	13.00	0.02	0.04
APR	0.72	16.40	760	13.00	0.01	0.02
MAY 1-14	0.70	17.40	494	13.00	0.02	0.04
MAY 15-31	0.70	17.90	471	18.00	0.00	0.00
JUN	0.55	20.90	268	18.00	0.02	0.04
JUL	0.38	21.90	214	18.00	0.03	0.05
AUG	0.35	22.80	174	18.00	0.04	0.07
SEP	0.37	22.40	158	18.00	0.04	0.07
OCT 1-14	0.71	21.20	152	18.00	0.06	0.10
OCT 15-31	0.71	20.50	158	13.00	0.13	0.24
NOV	0.88	20.00	246	13.00	0.10	0.18
DEC	0.83	16.70	285	13.00	0.04	0.08

Notes:

1. Estimated wastewater system flow diversion using Murraysmith hydraulic model.
2. Maximum of the 7-day average daily maximum (7 DADM) temps from existing WWTP DMRs.
3. 7Q10 flow at discharge location (USGS data for Sandy River, with Bull Run River and Little Sandy River flows subtracted).
4. Biological temperature criteria used for river temperature.
5. Estimated temperature increase based on 25% of river flow at edge of assumed mixing zone (EMZ).

Table 5 | Temperature Evaluation: Based on Future Conditions

Month	WWTP Flow[1] (MGD)	WWTP Temp[2] (°C)	River Flow[3] (MGD)	River Temp[4] (°C)	Delta T at EMZ[5] (°C)	Delta T at EMZ (°F)
JAN	1.64	15.40	607	13.00	0.03	0.05
FEB	1.54	16.20	581	13.00	0.03	0.06
MAR	1.67	15.70	423	13.00	0.04	0.08
APR	1.60	16.40	760	13.00	0.03	0.05
MAY 1-14	1.50	17.40	494	13.00	0.05	0.09
MAY 15-31	1.50	17.90	471	18.00	0.00	0.00
JUN	1.31	20.90	268	18.00	0.06	0.10
JUL	1.10	21.90	214	18.00	0.08	0.14
AUG	1.04	22.80	174	18.00	0.11	0.20
SEP	1.07	22.40	158	18.00	0.12	0.21
OCT 1-14	1.57	21.20	152	18.00	0.13	0.23
OCT 15-31	1.57	20.50	158	13.00	0.29	0.51
NOV	2.00	20.00	246	13.00	0.22	0.40
DEC	1.82	16.70	285	13.00	0.09	0.17

Notes:

1. Estimated wastewater system flow diversion using Murraysmith hydraulic model.
2. Maximum of the 7-day average daily maximum (7 DADM) temps from existing WWTP DMRs.
3. 7Q10 flow at discharge location (USGS data for Sandy River, with Bull Run River and Little Sandy River flows subtracted).
4. Biological temperature criteria used for river temperature.
5. Estimated temperature increase based on 25% of river flow at EMZ.

As shown in **Tables 4** and **5**, the increase in temperature associated with the City's proposed discharge into the Sandy River would be minimal during the winter and spring months for both existing and future conditions. Greater impacts could occur during the summer and fall months for future conditions. Discharges to the Sandy River during the fall could result in exceedances of the 0.25°F antidegradation policy threshold for future conditions as effluent flows from the MBR plant increase (see numbers in red in **Table 5**). Therefore, the City needs to consider reducing effluent discharges into the Sandy River during the summer and fall months to mitigate future temperature impacts. For more information on potential discharge alternatives, refer to Murraysmith's Technical Memorandum 9 & 10 – Indirect Discharge and Roslyn Lake Alternatives Site Review.

In the previous 2019 memo, the engineers reviewed biological criteria, acute impairment, and thermal shock. They concluded that temperature would not be a major concern for these categories of impairment, but that additional mitigation might be needed in the future. The latest antidegradation study supports the conclusions drawn in the 2019 memo. However, this more recent review also considers the more stringent antidegradation threshold and confirms the need to have temperature management as a key part of the design and permitting process moving forward.

Summary and Conclusions

This memorandum, (Technical Memorandum 5 of the Detailed Discharge Alternative Evaluation study) is an update to the earlier temperature review conducted by Murraysmith in 2019.

The project team has used new and updated data to review potential temperature impacts to the Sandy River from the proposed new MBR satellite treatment facility. Results from this new review are consistent with those from 2019: the planned effluent discharge into the Sandy River will need thoughtful temperature design and management to meet regulatory temperature thresholds as the community grows. In addition, the project team evaluated these temperatures under the more stringent anti-degradation requirements, which had not been considered in the previous memo. This updated temperature review results in the following conclusions.

- With population growth at the City and climate change, temperatures and heat load from the treated wastewater effluent will increase, resulting in greater need for temperature management.

- Summer and fall discharges to the Sandy river (especially in the future) are at the highest risk of violating current regulatory temperature thresholds if temperature is not managed appropriately.

- These temperature impacts may be managed by strategically reducing the effluent flow into the Sandy River.

- The DDAE planning study has identified and recommended the Roslyn Lake site for discharging portions of the effluent (into constructed wetlands) during summer and fall periods to help eliminate/minimize temperature impacts to the Sandy River now and into the future.

- The City will want to continue to work closely with DEQ to better understand which regulatory thresholds will govern final design and permitting. There are currently several thresholds listed in the TMDL study and in the Antidegradation IMD.

- Likewise, the City will want to coordinate closely with DEQ on methodology for temperature reviews. For planning purposes, we have assumed 1/4 of the Sandy 7Q10 River flows would mix with effluent (consistent with DEQ's point source temperature reviews in the Sandy River TMDL). Other methodology could assume 100 percent of 7Q10 river flows for mixing and different temperature thresholds.

- Final NPDES permitting reviews of temperature will require outfall design, dilution modeling, and related mixing zone studies to better estimate mixing and dilution of effluent when it enters the Sandy River. The regulatory temperature thresholds would need to be met after the effluent mixes and travels to the defined regulatory mixing zone boundary.

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Technical Memorandum

Date: May 22, 2019

Project: 19-2424
Sandy WSFP Continuing Planning Services

To: Mike Walker, Director of Public Works
Thomas Fisher, Engineering Technician
City of Sandy, Oregon

From: Preston Van Meter, PE
Bernadel Garstecki, EIT
Jessica Cawley, EIT

Review: Matt Hickey, PE
Jason Flowers, PE, PhD

Re: New Sandy River Outfall Preliminary Temperature Evaluation

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The following sections are included in this TM:

- Introduction and Background: Overview of the proposed outfall as well as the Oregon Administrative Rules for temperature criteria.
- Methodology: Description of the process used for the preliminary temperature evaluation, and an overview of the data used for the analysis.
- Analysis: Results of the temperature evaluation for the two scenarios
- Conclusions, Recommendations, and Next Steps: Summary of the results and potential mitigation efforts for near-term and long-term effects.

1. Introduction and Background

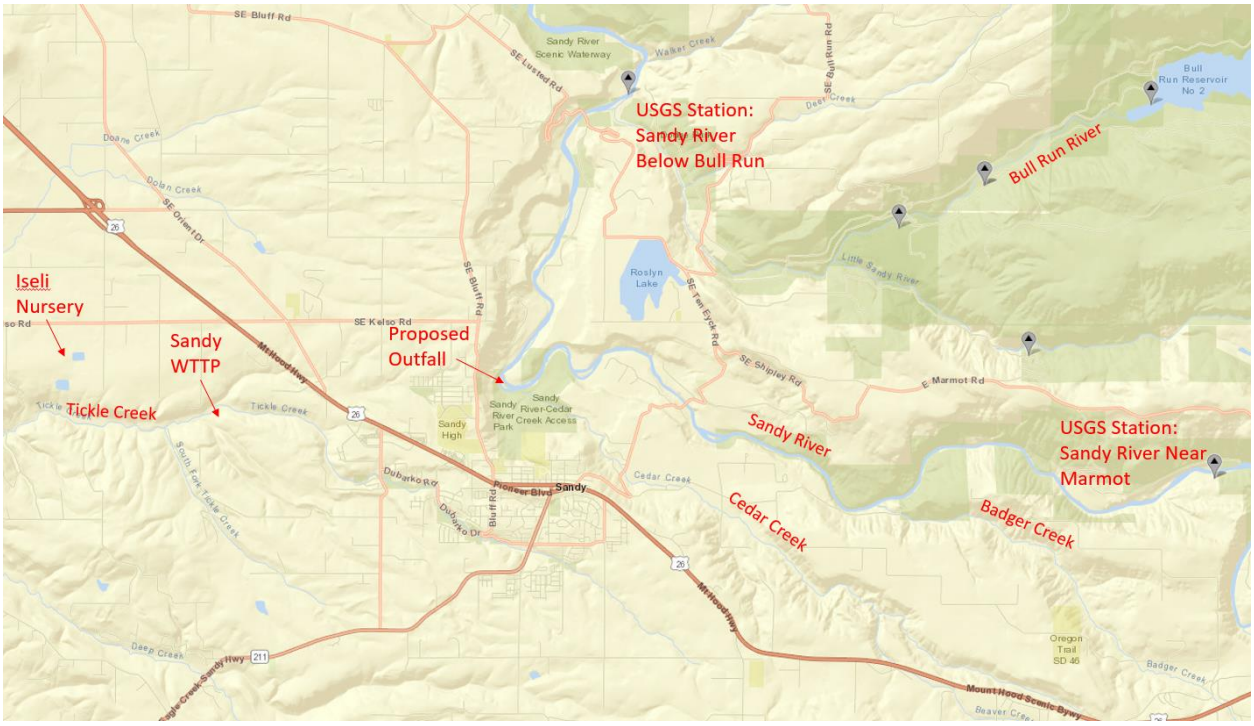
The purpose of this TM is to provide a preliminary temperature evaluation of the proposed outfall to the Sandy River for the effluent from the City of Sandy east side treatment facility. This report reviews the regulatory environment surrounding temperature compliance in regard to the Oregon water quality standards for the Sandy River and analyzes the specific flows of the Sandy River and projected flows from the east side treatment facility to evaluate any significant source of warming to the Sandy River. Two scenarios, existing conditions and future conditions, were analyzed to determine the impact of the outfall on the river. The scenarios were created using a hydraulic model of the collection system. Evaluation of the existing system considers sending the maximum

flows that can be diverted from the proposed diversion structure to a new outfall. Evaluation of the future system (2040) considers sending the entire projected wastewater flows to a new outfall. These two scenarios were analyzed for the following temperature regulations: human use allowance, acute impairment, thermal shock, and migration blockage.

The existing Sandy WWTP is located northwest of the city via Jarl Road. Between November 1st and April 30th, the effluent is discharged to Tickle Creek, a tributary of the Clackamas River. Between May 1st and October 31st, the effluent is used by Iseli Nursery to supplement their water demand for irrigation purposes. The ponds are nearing their capacity and the expected increase in wastewater over the next 20 years will exceed the capacity of Tickle Creek. The east side treatment facility will not be able to discharge to the existing outfall and so a new outfall is proposed. The proposed outfall is located on the Sandy River at approximately river mile 23 from the mouth of the river, near Sandy River Park. While recycle water will continue to be sent to Iseli Nursery for irrigation in the summer, the proposed outfall will have the capacity for any summer flows above the capacity of the nursery in addition to entire winter season flows.

A Total Maximum Daily Load (TMDL) report was prepared by the Oregon Department of Environmental Quality in 2005 for the Sandy River Basin which outlines the temperature Human Use Allowance for the river as well as other factors that might impact the quality of the river. This report cited information obtained from USGS stream gauges located upstream (near Marmot dam) and downstream (near the mouth of the Bull Run River) of the proposed outfall. These gauges stations do not exactly measure flow at the proposed outfall location, so it is recommended that temperature and flow are recorded at the proposed outfall location. The locations of the existing WTTP, proposed outfall, and USGS gauge stations are shown below in Figure 1.

Figure 1 – Vicinity Map



1.1 Temperature Criteria

Table 1 on the following page summarizes the regulations and criteria from the Oregon Administrative Rules (OAR) for Water Quality Standards (OAR 340-041-0028).

Table 1 - Oregon Administrative Rules – Water Quality Standards for the Sandy River Outfall

Regulations	Description	Season	Criteria
Biological Criteria OAR 340-041-0028 (4) (c) Figure 286A	Salmon and Trout Rearing & Migration	Year round	7dAM mixed stream temperature may not exceed **Allowable** **7dAM T = 18.0°C (64.4°F)**
Biological Criteria OAR 340-041-0028 (4) (a) Figure 286B	Designated Salmon and Steelhead Spawning Use	Winter (spawning) Oct. 15 – May 15	7dAM mixed stream temperature may not exceed **Allowable** **7dAM T = 13.0°C (55.4°F)**
Human Use Allowance OAR 340-041-0028 (12) (b) (B)	An "insignificant" addition of thermal load anthropogenic activities	When waters exceed the applicable temperature criteria	According to the 2005 Sandy TMDL: **Singe point source:** **allowable ΔT = 0.3°C (0.54°F)** **in 25% of stream flow** Or **All point sources combined:** **allowable ΔT = 0.2°C (0.36°F)** **in 100% of stream flow**
Acute Impairment OAR 340-041-0053 (2) (d) (B)	Instantaneous lethality	Year round	**Allowable Effluent T < 32.0°C (89.6°F)**
Thermal Shock OAR 340-041-0053 (2) (d) (C)		Year round	**Allowable Mixture T < 25.0°C (77.0°F)** **with 5% of stream flow**
Migration Blockage OAR 340-041-0053 (2) (d) (D)		Year round	**Allowable Mixture T < 21.0°C (69.8°F)** **with 25% of stream flow**
Exceptions OAR 340-041-0028 (12) (c) & (d)	A water body that only exceeds the criteria set out in this rule when the exceedance is attributed to daily maximum air temperatures that exceed the 90th percentile value of annual maximum seven-day average maximum air temperatures calculated using at least 10 years of air temperature data, will not be listed on the section 303(d) list of impaired waters and sources will not be considered in violation of this rule. An exceedance of the biologically-based numeric criteria will not be considered a permit violation during stream flows that are less than the 7Q10 low flow condition for that water body.		

As of August 8, 2013, the Environmental Protection Agency disapproved rule of section 8 (Natural Conditions Criteria) of OAR 340-041-0028. This section is described below:

> *"(8) Natural Conditions Criteria. Where the department determines that the natural thermal potential of all or a portion of a water body exceeds the biologically-based criteria in section (4) of this rule, the natural thermal potential temperatures supersede the biologically-based criteria, and are deemed to be the applicable temperature criteria for that water body." – OAR 340-041-0028*

According to this change, if the river temperatures exceed the biological criteria, the allowable change in temperature will be calculated using the biological criteria as the river temperature.

Anti-degradation laws prohibit the further degradation of water quality limited waters and does not allow for new discharges to water quality waters unless a TMDL has been established with wasteload allocations, load allocations, and reserve capacity in order to assimilate the increased load. A TMDL was established for the Sandy River and includes a reserve allocation of 0.2 degrees Celsius for point source discharges.

1.2 Definitions

Seven-day-average maximum (7dAM): The average of the maximum daily temperature of seven consecutive days as reported on the 7th day.

7Q10: Seven-day averaged flow condition that occurs on a ten-year return period. This flow has a 10 percent probability of occurring every year during the specified month.

2. Methodology

Preliminary temperature evaluations for human use allowance, acute impairment, thermal shock, and migration blockage, as stated in the OARs and TMDL, were conducted for the proposed outfall. The two scenarios, existing conditions and future conditions, were analyzed to determine the impact of the outfall on the river. Evaluation of the existing system considers sending the maximum flows that can be diverted from the proposed diversion structure to a new outfall. Evaluation of the future system (2040) considers sending the entire projected wastewater flows to a new outfall.

Completion of the temperature evaluation required flow and temperature data for the WWTP and Sandy River. As noted previously, the temperature data on the Sandy River is limited and flow data used in the preliminary evaluations is from a gauge station upstream of the proposed outfall. The gauge station is at approximately river mile 30 or seven river miles upstream of the proposed outfall.

Current and projected monthly average flows for the existing Sandy Treatment Plant were calculated using a hydraulic model developed of the collection system and rainfall events with a two-year return interval. For the existing conditions, the proposed diversion structure would have the capacity to divert approximately 70 percent of the wastewater system flow up to a maximum flow of 3.5 MGD. The capacity of the proposed eastside treatment facility is 3.5 MGD after phase 1 of the proposed wastewater facilities plan, to be expanded to 7.0 MGD by 2040. The wastewater

treatment plant temperatures used in the analysis were calculated for each month using the DMR reports from 2013 – 2017 to find the maximum 7dAM effluent temperatures from the existing treatment plant.

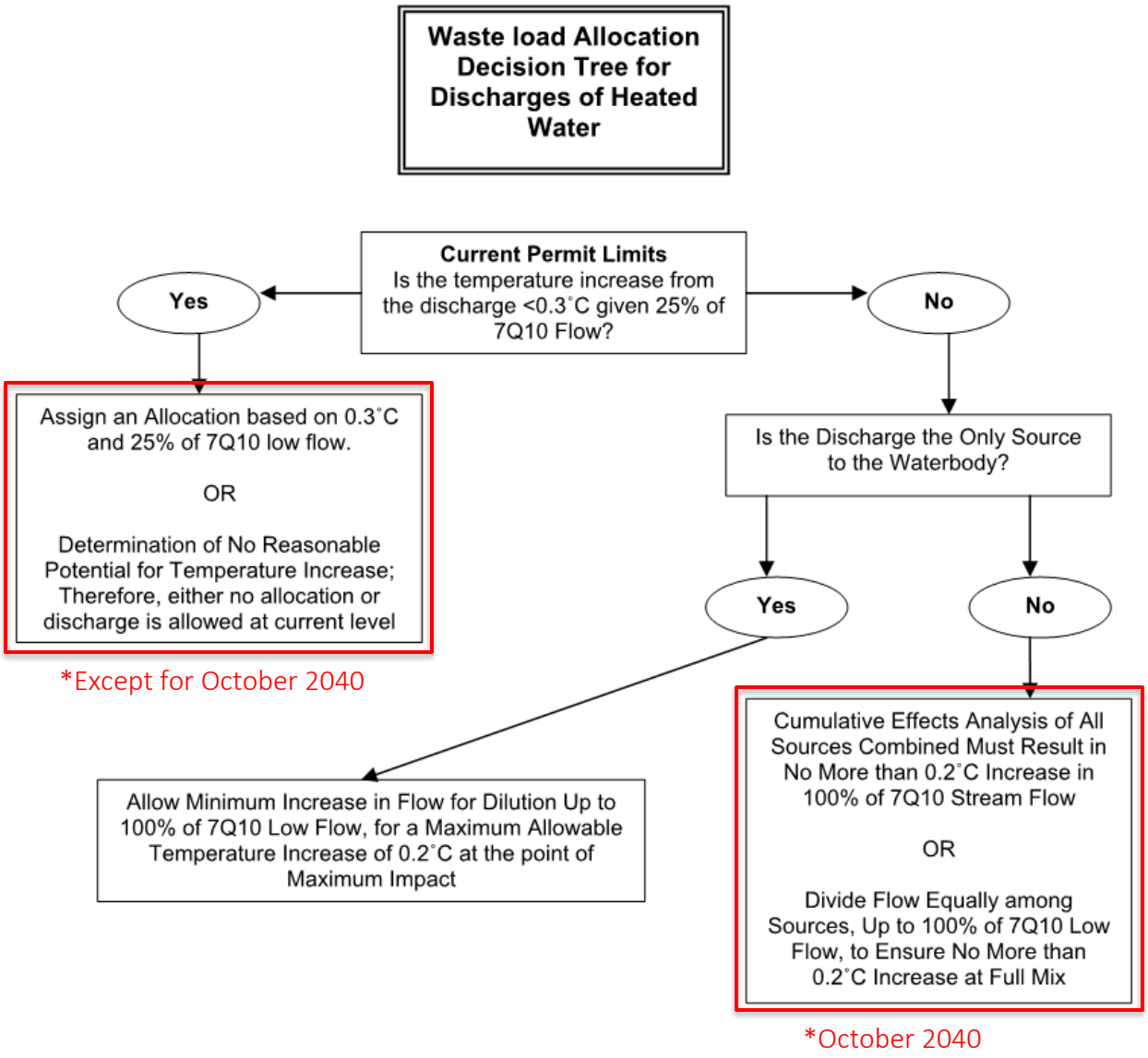
River flow data was obtained from 2008 – 2018 from the USGS gauge station: 14137000, Sandy River Near Marmot. This gauge station is located approximately eight river miles upstream of the proposed outfall. There are two small creeks, Badger Creek and Cedar Creek, that flow into the Sandy between the proposed outfall and the gauge station. The TMDL estimated the 7Q10 low flow of Cedar Creek to be 5 cfs (3 MGD). The monthly river 7Q10 low flow values were calculated from flow data from 2008 – 2018 using a Log Pearson Type III approach and then 5 cfs was added to each month to account for the flow from Cedar Creek. The flow values used in the analysis will still be lower than the actual flows the since Badger Creek flows have not been included, but this will provide a more conservative estimate.

Yearly river temperature data was not available at the proposed outfall location. The Sandy TMDL showed summer maximum river temperatures at the proposed outfall location of approximately 20 degrees Celsius which are above the summer biological criteria of 18 degrees Celsius. Winter temperature data was not provided in the TMDL. The summer and winter biological criteria were used in the data analysis in place of actual river temperatures. The biological criteria for cold-water protection is 18 degrees Celsius from May 16 to October 14, and 13 degrees Celsius from October 15 to May 15.

2.1 Human Use Allowance (HUA)

The Sandy River Basin TMDL methodology for allocating waste loads to point sources was used to determine the human use allowance for the proposed outfall. The discharge from the proposed outfall is first analyzed to determine whether the temperature increase is less than 0.3 degrees Celsius given 25 percent of the 7Q10 low flow. If the discharge passes these criteria, then a waste load allocation can be assigned based on these limits. If the anticipated temperature increase to the Sandy River does not meet this criterion, the Sandy River TMDL gives an alternative allocation methodology. Since the proposed outfall would not be the only source of discharge to the waterbody, all the discharge sources combined must result in no more than 0.2 degrees Celsius increase in 100 percent of the 7Q10 low flow. The following flow chart (Figure 2) from the Sandy River Basin TMDL summarizes this methodology.

Figure 2 – Point Source Methodology Flow Chart (from Sandy TMDL)



The estimated ETL from the proposed outfall was calculated for current flows and projected flows using **Equation 1** (DEQ). The estimated change in river temperature due to the outfall was calculated using **Equation 2** (DEQ).

$$Estimated\ ETL = Q_E * (T_E - T_C) * C_F \qquad \textit{(Equation 1)}$$

$$\Delta T = \frac{Q_E}{(Q_E + Q_R)} * (T_E - T_C) \qquad \textit{(Equation 2)}$$

Where,

$$ETL = the\ excess\ thermal\ load\ \left(\frac{kcal}{day}\right)$$
$$\Delta T = Temperature\ increase\ above\ applicable\ criteria$$
$$Q_E = Point\ source\ effluent\ flow\ (CFS)$$
$$Q_R = 25\%\ of\ the\ 7Q10\ river\ flow\ (CFS)$$
$$C_F = conversion\ factor = 2{,}446{,}664\ kcal \cdot \frac{s}{°C} \cdot ft^3 \cdot day$$
$$T_E = Point\ source\ effluent\ temperature\ (°C)\ as\ 7dAM$$
$$T_C = Applicable\ temperature\ criterion\ (°C)$$
$$\Delta T = Actual\ change\ in\ river\ temperature\ (°C)$$

2.2 Acute Impairment, Thermal Shock, Migration Blockage

A monthly analysis of possible acute impairment, thermal shock, and migration blockage was conducted for the existing system diverted flows and 2040 total system flows using the criteria outlined in the OAR.

2.3 Data Used for Analysis

2.3.1 WWTP Flow and Temperature

Table 2 below shows the average monthly treatment plant flows and temperatures for the existing and future conditions.

Table 2 – Monthly Treatment Plant Flow and Temperature

Month	WWTP Flow (MGD)			WWTP Temp (°C)[1]
	Existing All System	Existing Diverted	2040 All System	
January	2.20	1.58	3.28	15.4
February	2.01	1.45	3.07	16.2
March	2.25	1.61	3.33	15.7
April	1.98	1.43	3.20	16.4
May 1 - May 15	1.94	1.40	2.99	17.4
May 16 - May 31	1.94	1.40	2.99	17.9
June	1.59	1.10	2.61	20.9
July	1.19	0.76	2.19	21.9
August	1.10	0.69	2.08	22.8
September	1.15	0.73	2.14	22.4
Oct 1 - Oct 14	2.04	1.41	3.13	21.2
Oct 15 - Oct 31	2.04	1.41	3.13	20.5
November	2.44	1.75	3.99	20.0
December	2.32	1.66	3.63	16.7

1. WWTP temperatures were calculated using the maximum 7dAM effluent temperatures as reported on the DMRs from 2013 to 2017

2.3.2 Sandy River Flow and Temperature Data Used for Analysis

Table 3 below shows the monthly river flows and temperatures used in the analysis.

Table 3 – Monthly River Flow and Temperature

Month	7Q10 River Flow (MGD)[1]	Biological Criteria (°C)[2]
January	532	13.0
February	496	13.0
March	525	13.0
April	738	13.0
May 1 - May 15	400	13.0
May 16 - May 31	400	18.0
June	294	18.0
July	207	18.0
August	170	18.0
September	146	18.0
Oct 1 - Oct 14	147	18.0
Oct 15 - Oct 31	147	13.0
November	354	13.0
December	399	13.0

1. River flows include 5 cfs (3 MGD) for the assumed Cedar Creek flow into the Sandy.
2. Biological criteria was used in the data analysis because no actual river temperature data was available for the proposed outfall location.

3. Analysis

Results for the two scenarios are included below. The first scenario considers current conditions with a split flow to the proposed outfall, and the second scenario considers future conditions with the full treatment plant discharge to the proposed outfall on the Sandy River. There are no temperature exceedances for the existing condition scenario and there was only one exceedance calculated for the future conditions. Table 4 below shows the estimated excess thermal loads (ETLs) and estimated increases in river temperature each month resulting from the two scenarios.

Table 4 – ETLs and ΔT

Month	Existing (diverted flows)		2040 (all system)	
	Estimated ETL (MMkcal/day)	Estimated ΔT (°C)	Estimated ETL (MMkcal/day)	Estimated ΔT (°C)
January	15	0.03	30	0.06
February	17	0.04	37	0.08
March	16	0.03	33	0.07
April	18	0.03	41	0.06
May 1 - May 15	23	0.06	50	0.13
May 16 - May 31	-1	0.00	-1	0.00
June	12	0.04	29	0.10
July	11	0.06	32	0.16
August	13	0.08	38	0.22
September	12	0.09	36	0.24
Oct 1 - Oct 14	17	0.12	38	0.25
Oct 15 - Oct 31	40	0.28	89	0.59
November	46	0.13	105	0.30
December	23	0.06	51	0.13

Acute Impairment, Thermal Shock, Migration Blockage

A monthly analysis of possible acute impairment, thermal shock, and migration blockage was conducted for the existing system diverted flows and the 2040 total system flows. Table 5 shows the river mixture temperatures for each month.

Table 5 – River Mixture Temperatures

Month	Acute Impairment T Effluent (°C) < 32 °C		Thermal Shock (5% River Flow) T Mix (°C) < 25 °C		Migration Blockage (25% River Flow) T Mix (°C) < 21 °C	
	Existing	2040	Existing	2040	Existing	2040
January	15.4	15.4	13.1	13.3	13.0	13.1
February	16.2	16.2	13.2	13.3	13.0	13.1
March	15.7	15.7	13.2	13.3	13.0	13.1
April	16.4	16.4	13.1	13.3	13.0	13.1
May 1 - May 15	17.4	17.4	13.3	13.6	13.1	13.1
May 16 - May 31	17.9	17.9	18.0	18.0	18.0	18.0
June	20.9	20.9	18.2	18.4	18.0	18.1
July	21.9	21.9	18.3	18.7	18.1	18.2
August	22.8	22.8	18.4	18.9	18.1	18.2
September	22.4	22.4	18.4	19.0	18.1	18.2
Oct 1 - Oct 14	21.2	21.2	18.5	19.0	18.1	18.3
Oct 15 - Oct 31	20.5	20.5	14.2	15.2	13.3	13.6
November	20.0	20.0	13.6	14.3	13.1	13.3
December	16.7	16.7	13.3	13.6	13.1	13.1

Conclusions, Recommendations, and Next Steps

Based on the temperature analysis and excess thermal load limits, there does not appear to be a significant potential for the wastewater effluent to violate the temperature criteria for either scenario, existing split flows or future all system flows. The river flow is much greater than the expected effluent flow, and so it is difficult for the effluent to significantly impact the river temperatures.

The only month that exceeds the 0.3-degree Celsius limit is the second half of October in 2040. November in 2040 does not exceed the limit but it is on the edge of being an exceedance. The long-term analysis shows that there is slightly more impact of the effluent on the river so it is recommended that the city plan for additional mitigation in the future. It is also recommended that the city install a thermistor and flow gauge at the location of the proposed outfall to correlate river flow data from the existing USGS gauge stations to the location of the proposed outfall. This will provide a more complete understanding of the existing river conditions and a way to very this preliminary temperature analysis.

There are no exceedances of the criteria for acute impairment, thermal shock, and migration blockage for either scenario, existing or future.

The Sandy River is considered a water quality limited water for temperature. According to DEQ's IMD for Antidegradation, a facility renewing a permit proposing an effluent increase or change in discharge location is subject to an antidegradation review. This review will be conducted by DEQ.

References

Oregon Department of Environmental Quality (DEQ). 2001. Antidegradation Policy Implementation Internal Management Directive.

Oregon Department of Environmental Quality (DEQ). 2005. Sandy River Basin Total Maximum Daily Load (TMDL).

Oregon Department of Environmental Quality (DEQ). 2008. Temperature Water Quality Standard Implementation Internal Management Directive.

Oregon Secretary of State. Oregon Administrative Rule 340-041-0028 Water Quality Standards for Temperature. Accessed 4/10/2018 via internet at https://secure.sos.state.or.us/oard/viewSingleRule.action?ruleVrsnRsn=244176

Oregon Secretary of State. Oregon Administrative Rule 340-041-0053 Water Quality Standards for Mixing Zones. Accessed 4/10/2018 via internet at https://secure.sos.state.or.us/oard/viewSingleRule.action?ruleVrsnRsn=68770

U.S. Geological Survey (USGS). Gauge station information accessed 4/10/2018 via internet at https://waterdata.usgs.gov/nwis/inventory

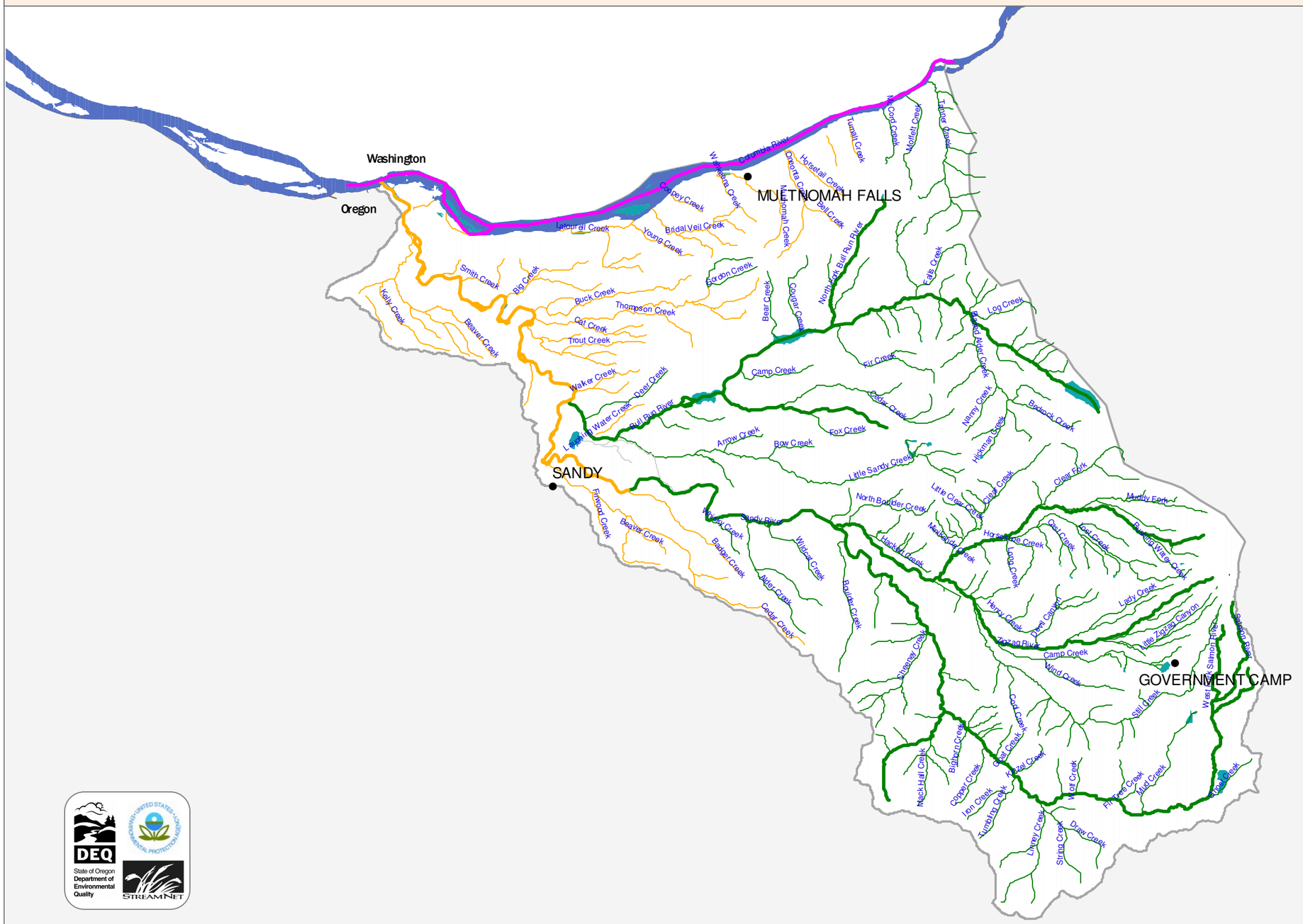
Attachments

1. Figure 286A: Fish Use Designations, Sandy Basin, Oregon
2. Figure 286B: Salmon and Steelhead Spawning Use Designations, Sandy Basin, Oregon

XXX:xxx

Cc: Name, Agency

Figure 286A: Fish Use Designations Sandy Basin, Oregon*



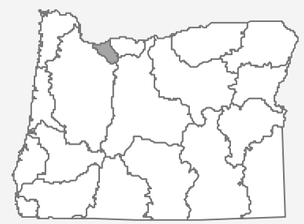
Legend

Designated Fish Use*:

- Core Cold-Water Habitat
- Salmon & Trout** Rearing & Migration
- Salmon & Steelhead Migration Corridors
- No salmonid use

Subbasins

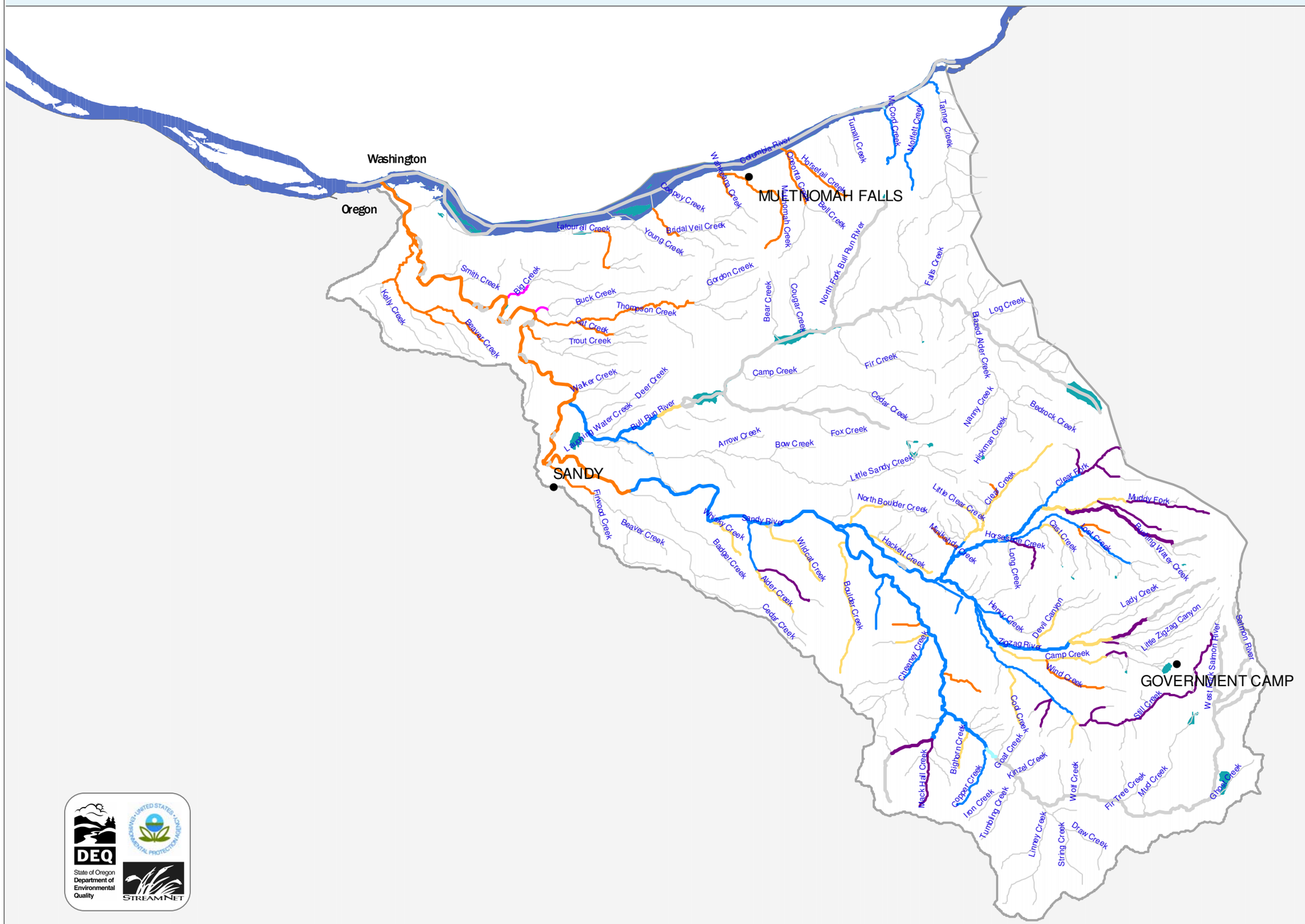
NOTES:
*Please see Figure 286B for Spawning Use Designations.
**Includes all salmon species, steelhead, rainbow, and cutthroat trout.
Major rivers shown in bolder lines.
Map produced November, 2003



DEQ State of Oregon Department of Environmental Quality

STREAMNET

Figure 286B: Salmon and Steelhead Spawning Use Designations Sandy Basin, Oregon*



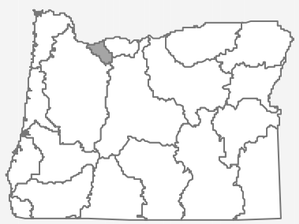
Legend

Designated Salmon and Steelhead Spawning Use*:

- August 15-May 15
- August 15-June 15
- October 15-May 15
- October 15-June 15
- January 1-May 15
- January 1-June 15
- No Spawning Use

Subbasins

NOTES:
*Please see Figure 286A for Fish Use Designations.
Major rivers shown in bolder lines.
Map produced November, 2003



State of Oregon Department of Environmental Quality

STREAMNET

Technical Memorandum 6

Date:	March 10, 2021
Project:	City of Sandy – Detailed Discharge Alternative Evaluation
To:	Jordan Wheeler, Mike Walker, Director of Public Works Thomas Fisher, Engineering Technician City of Sandy, Oregon
From:	Matt Hickey, PE Jessica Cawley, PE Murraysmith
Re:	Sandy River Water Quality Sampling and Testing Program Compilation

Introduction

This memo contains a summary of 2019-2020 Sandy River water quality data collected in proximity to alternatives for the outfall location of the proposed Eastside Satellite Treatment Facility. The City of Sandy (City) and the Oregon Department of Environmental Quality (DEQ) hope to determine compliance with anti-degradation laws set forth in the Oregon Administrative Rules (OAR) regulated by the DEQ in the National Pollutant Discharge Elimination System (NPDES) permitting process.

Murraysmith collected grab samples and Alexin Analytical Laboratories, Inc in Tigard, Oregon analyzed the samples in accordance with the Sampling and Testing Plan prepared August 7, 2019. Waterways Consulting, Inc installed temperature probes which recorded measurements on a 15-minute interval from July through October in 2019 and 2020. River discharge was estimated using instantaneous data from USGS Gages.

The purpose of this memorandum is to report the water quality data from the Sandy River as recorded. Further conclusions and findings will be discussed in other technical memorandums for this project.

Scope

The goal of this investigation was to provide ambient water quality data on the Sandy River in support of the preparation of a new NPDES permit for the proposed Eastside Satellite Treatment Facility. The scope of this study included once per month sampling for three months in the fall of 2019 (August, September, and October) during low flows to establish a strong baseline of water quality data; as well as samples collected in the spring and fall (June and November) of 2020. It is recommended to continue this sampling program with quarterly samples through 2021.

Sandy River Sampling

Sandy River Sampling Overview

Sampling was initiated in August 2019. Murraysmith collected grab samples on the following dates.

- August 16, 2019
- September 23, 2019
- October 31, 2019
- June 18, 2020
- November 3, 2020

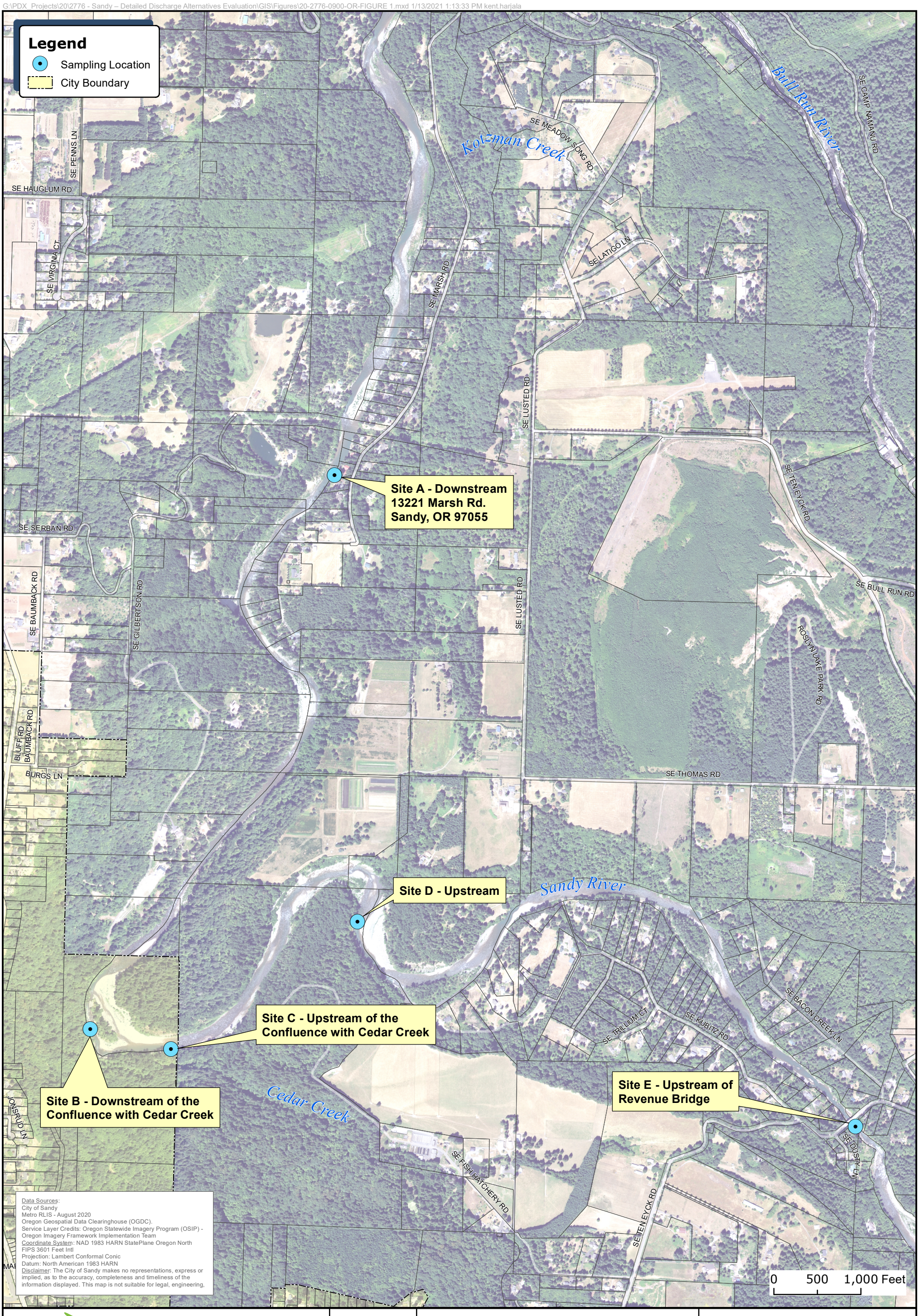
Grab samples were collected at three sites on the Sandy River (**Figure 1**). The grab sample sites include Site B, Site C, and Site E. The original scope of water quality sample focused on the Oxbow near Site B and Site C. Subsequent development of the Revenue Bridge discharge location led the City and team to replace Site B with Site E for the November 2020 sampling event. Geographic coordinates and descriptions of sample locations are included below (**Table 1**).

Table 1
Water Quality Sample Locations

Site ID	Site Description	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
A	Downstream Most Site; Approximately 8,900 feet Downstream of Cedar Creek Confluence; Upstream of SE Lusted Rd. Bridge Crossing at 13221 Marsh Rd. Sandy, OR 97055; River Right	45.427673	-122.258792
B	Approximately 800 feet Downstream of Cedar Creek Confluence; River Left	45.410051	-122.269181
C	Approximately 300 feet Upstream of Cedar Creek Confluence; River Left	45.409476	-122.265549
D	Approximately 4,200 feet Upstream of Cedar Creek Confluence; River Left	45.413616	-122.257325
E	Upstream Most Site; Approximately 12,000 feet Upstream of Cedar Creek Confluence; Upstream of Revenue Bridge (SE Ten Eyck Rd.); River Left	45.407508	-122.234845

Temperature was also sampled at Sites A, B, C, and D.

G:\PDX_Projects\20\2776 - Sandy – Detailed Discharge Alternatives Evaluation\GIS\Figures\20-2776-0900-OR-FIGURE 1.mxd 1/13/2021 1:13:33 PM kent.harjala



murraysmith

SANDY
WHERE INNOVATION MEETS ELEVATION

N W E S

City of Sandy, Oregon
Wastewater System Facility Plan

Figure 1
Sampling Locations

January 2021

20-2776.0900

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Table 2 shows the list of analytes analyzed for the grab samples collected at Sites B, C, and E).

Table 2
Water Quality Sampling Parameters

Alkalinity as CaCO3	Ammonia, as N	Arsenic
Bacteria - E. Coli	Bacteria - Enterococci	Bacteria - Fecal Coliform
Biochemical oxygen demand (BOD5)	Cadmium	Chemical oxygen demand (COD)
Chlorophyll-a	Chromium, total	Copper
Hardness	Iron (Total)	Kjeldahl nitrogen (TKN), as N
Lead	Manganese	Mercury
Nickel	Nitrate, as N	Nitrite, as N
Orthophosphate, as P	pH	Phaeophytin
Phosphorus (Total), as P	Total dissolved solids (TDS)	Total Suspended Solids (TSS)
Total Organic Carbon (TOC) as CaCO3		

Sandy River Sampling Results

Grab samples were collected following procedures outlined in the Sampling and Testing Plan prepared August 7, 2019. All procedures were analyzed by Alexin Analytical, an accredited analytical laboratory, in accordance with procedures established by the U.S. Environmental Protection Agency (US EPA) and National Environmental Accreditation Conference (NELAC) certification. Alexin Analytical is accredited under US EPA Accreditation Number #OR100013. Several samples produced results below the minimum reporting limits and therefore recorded as non-detect (ND). A table of all observed values and the associated minimum reporting limits (MRL) are summarized in Appendix A. The original laboratory results are included in Appendix B.

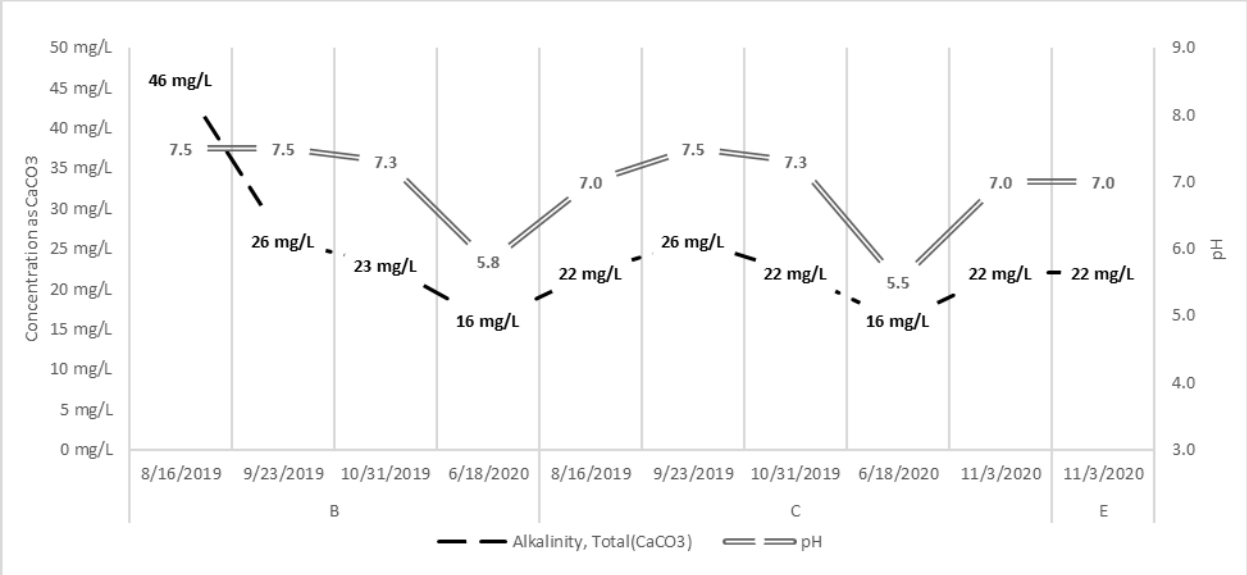
pH and Alkalinity

Standard: [1] pH between 6.5 to 8.5

The pH values ranged between 5.5 and 7.5 between the sites. Aside from the June 2020 sampling event, pH was relatively consistent between sampling locations. The June 2020 sampling event showed an acidic pH below the limit of the water quality standard; June 2020 was also the highest observed river discharge that coincided with a sampling event. All other samples observed pH within the bounds of state water quality standards.

Alkalinity values ranged from 16 mg/L to 46 mg/L between the sites. In general, the alkalinity was relatively consistent between sampling points with one sample observably higher (46 mg/L) than the rest at the furthest downstream sampling location.

Figure 2
pH and Alkalinity Grab Samples



[1] OAR 340-041-0290 Basin-Specific Criteria (Sandy Basin): Water Quality Standards and Policies for this Basin

Bacteria

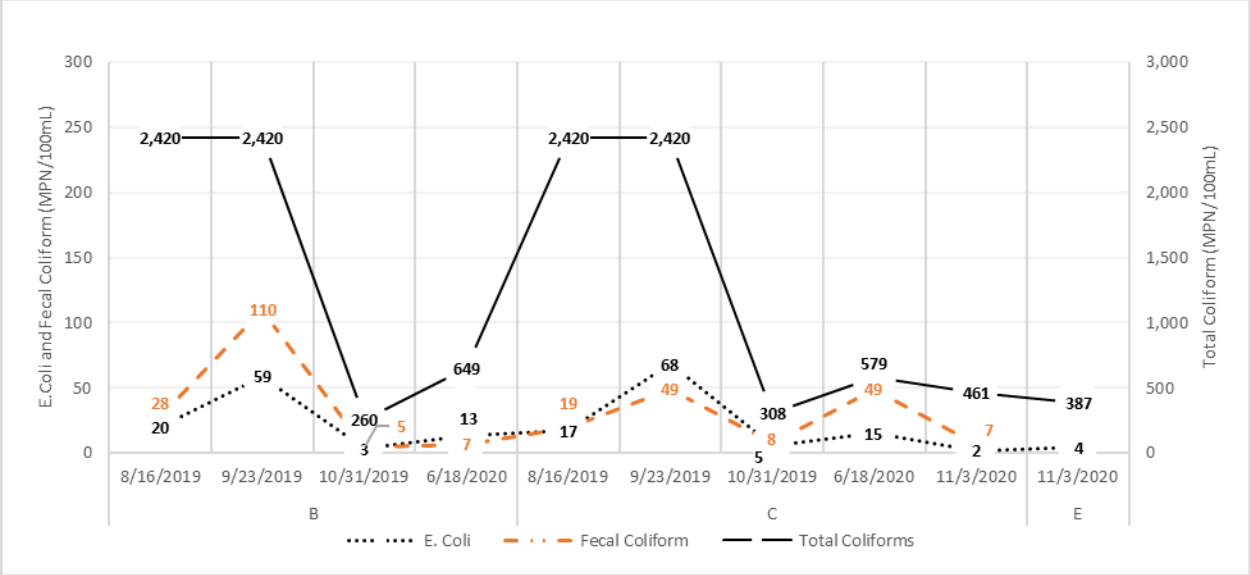
Standard: none currently specified for Sandy Basin

E. Coli values ranged from 2 MPN per 100 mL to 68 MPN per 100 mL. These values peaked in the September samples but all samples fell within Oregon Water Quality Standards. There is no TMDL on bacteria at this location on the Sandy River. The waste load allocation for point sources is limited to 126 E. Coli coliform forming units (CFU) per 100 mL of samples, which all sample results fell below.

Fecal coliform samples ranged between 5 MPN per 100 mL to 110 MPN per 100 mL. Total coliform samples ranged between 260 MPN per 100 mL to over 2,420 MPN per 100 mL. The highest total coliform values were observed in August and September.

Figure 3 below is a graph of the findings.

Figure 3
Bacteria Grab Samples

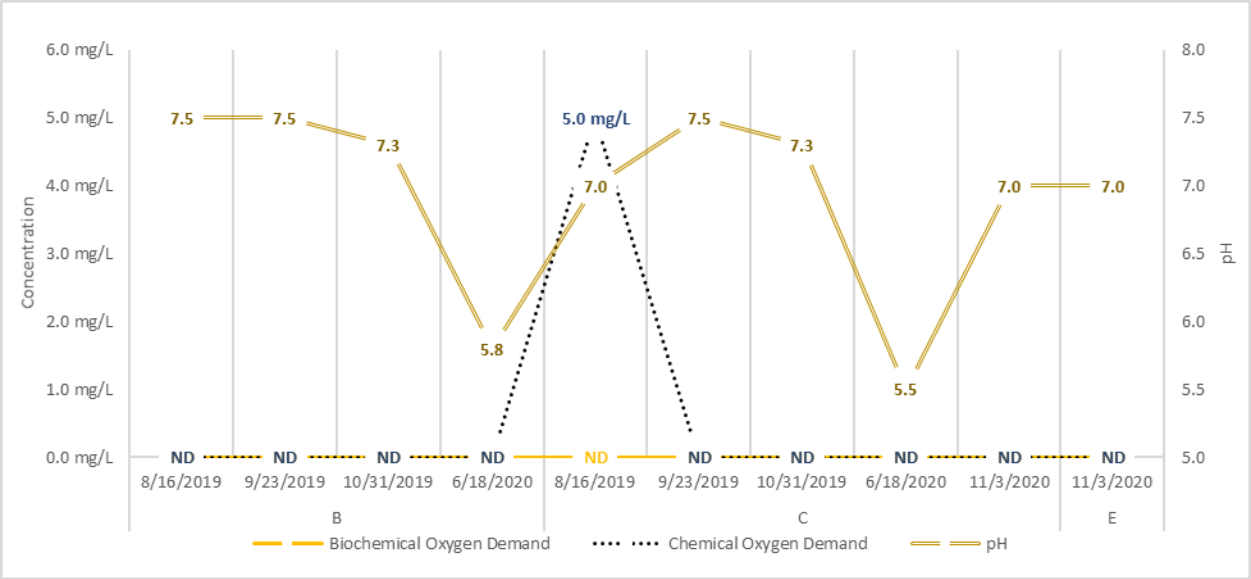


Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)

Standard: none currently specified for Sandy Basin

All BOD samples observed concentrations below the detectable limit (ND) of 2 mg/L. One COD sample in August 2019 observed a concentration of 5.0 mg/L.

Figure 4
BOD and COD Grab Samples

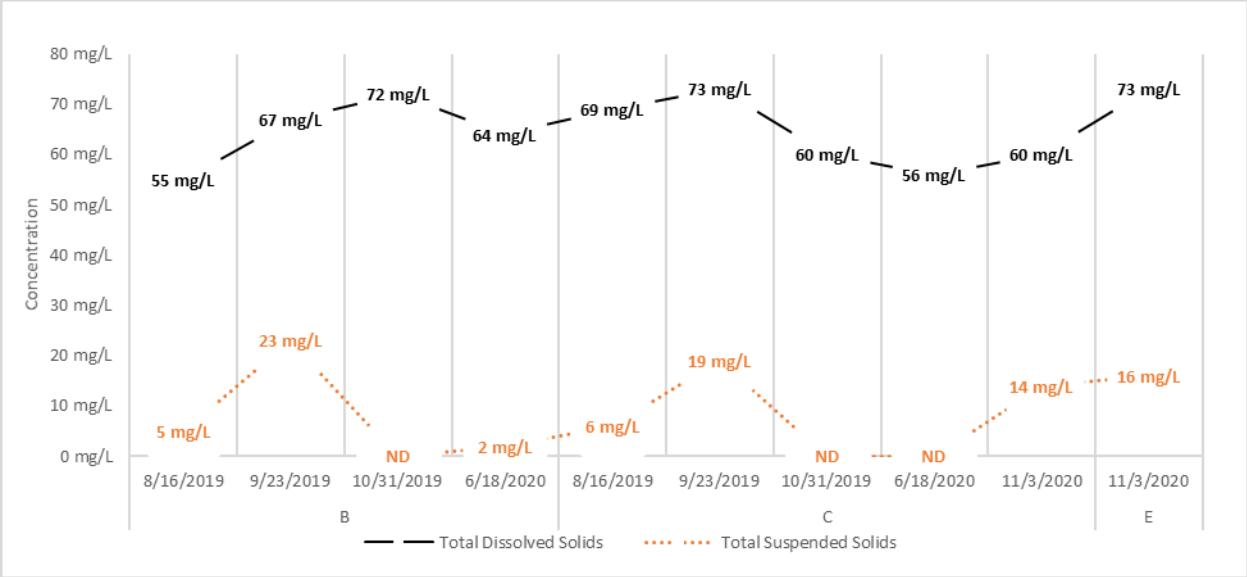


Total Suspended Solids (TSS) and Total Dissolved Solids (TDS)

Standard: none currently specified for Sandy Basin

Values for TSS ranged between below the detectable limit of 2 mg/L and 23 mg/L. September 2019 and November 2020 grab sample data showed notable peaks. TDS values ranged between 55 mg/L and 73 mg/L.

Figure 5
TSS and TDS Grab Samples



Total Kjeldahl Nitrogen (TKN), Ammonia, Nitrate, and Nitrite

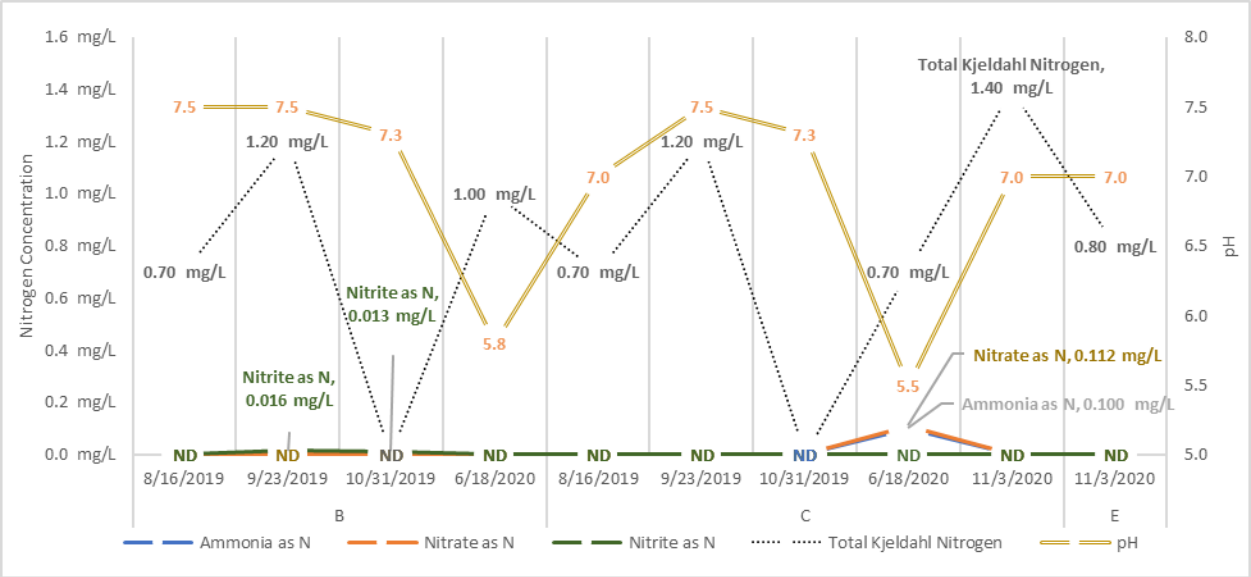
Standard: none currently specified for Sandy Basin

TKN values range between below the Not Detected (ND) limit of 0.5 mg/L and 1.4 mg/L. It is assumed this TKN is comprised of mostly Organic Nitrogen since all Ammonia concentrations were ND except for the June 2020 sampling event at site C where Ammonia was recorded at 0.100 mg/L; June 2020 was also the highest observed river discharge that coincided with a sampling event.

A Nitrate concentration of 0.112 mg/L was observed in the June 2020 sample at Site C; and this was the only sample within this study with a concentration of Nitrate above the detectable limit of 0.1 mg/L.

Nitrite concentrations between 0.013 mg/L and 0.016 mg/L were observed in October 2019 and September 2019, respectively. All other samples were below the detectable limit of 0.01 mg/L.

Figure 6
Nitrogen Grab Samples

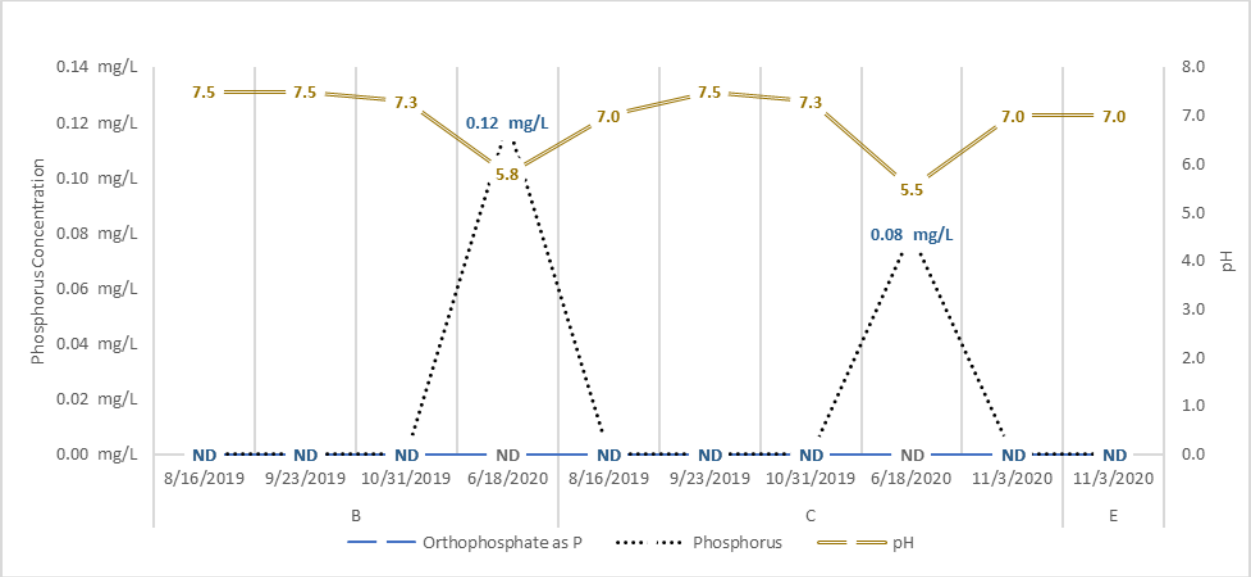


Phosphorus

Standard: none currently specified for Sandy Basin

Total phosphorus values range between 0.08 mg/L and 0.12 mg/L, observed at sites C and B, respectively, on the June 2020 sampling event. All other samples were below the detectable limit of 0.05 mg/L.

Figure 7
Phosphorus Grab Samples

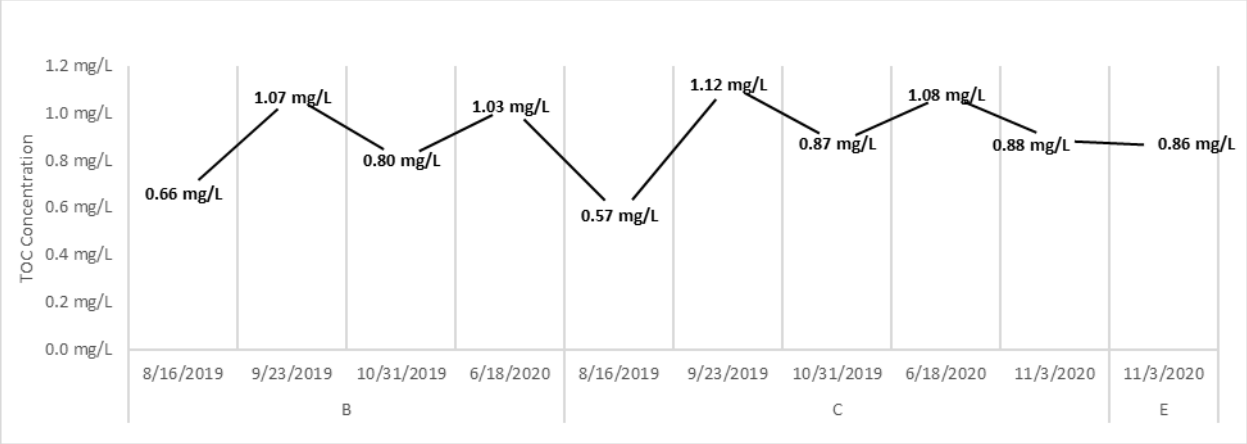


Total Organic Carbon (TOC)

Standard: none currently specified for Sandy Basin

TOC concentrations ranged between 0.57 mg/L and 1.12 mg/L. Sample values seem to exhibit slight variability but no strong correlation to location or time of year.

Figure 8
Total Organic Carbon Grab Samples

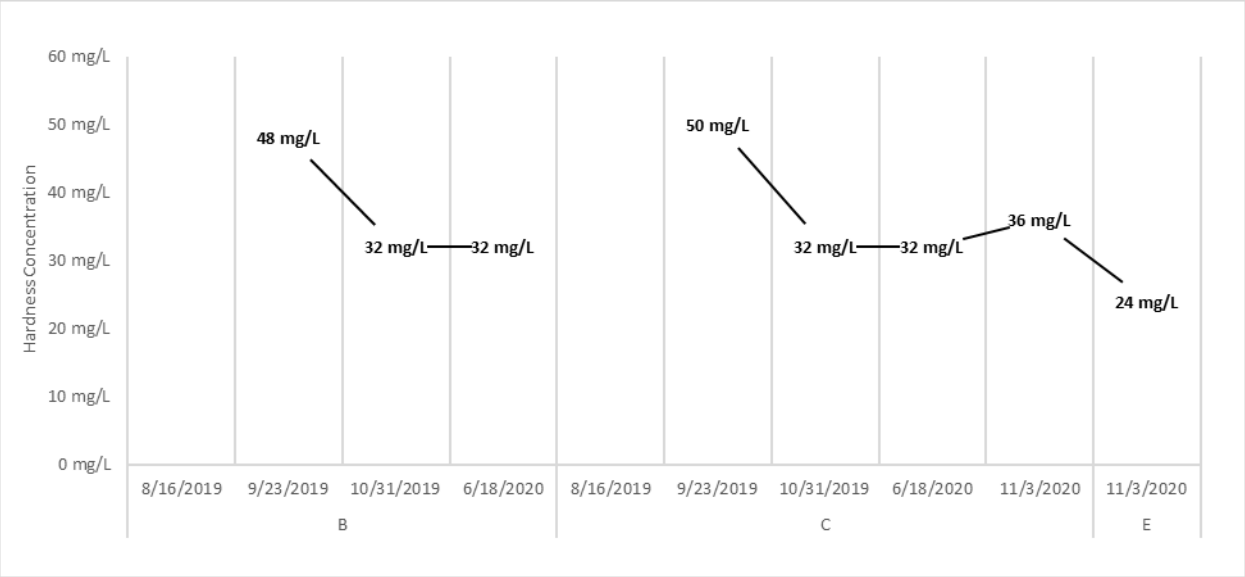


Hardness

Standard: none currently specified for Sandy Basin

Samples were not measured for hardness during the first sampling event in August 2019. Sample values ranged between 24 mg/L and 50 mg/L. The freshwater toxicity criterion is a function of hardness for toxic pollutants such as Cadmium, Chromium III, Lead, Nickle, Silver, and Zinc.

Figure 9
Hardness Concentration

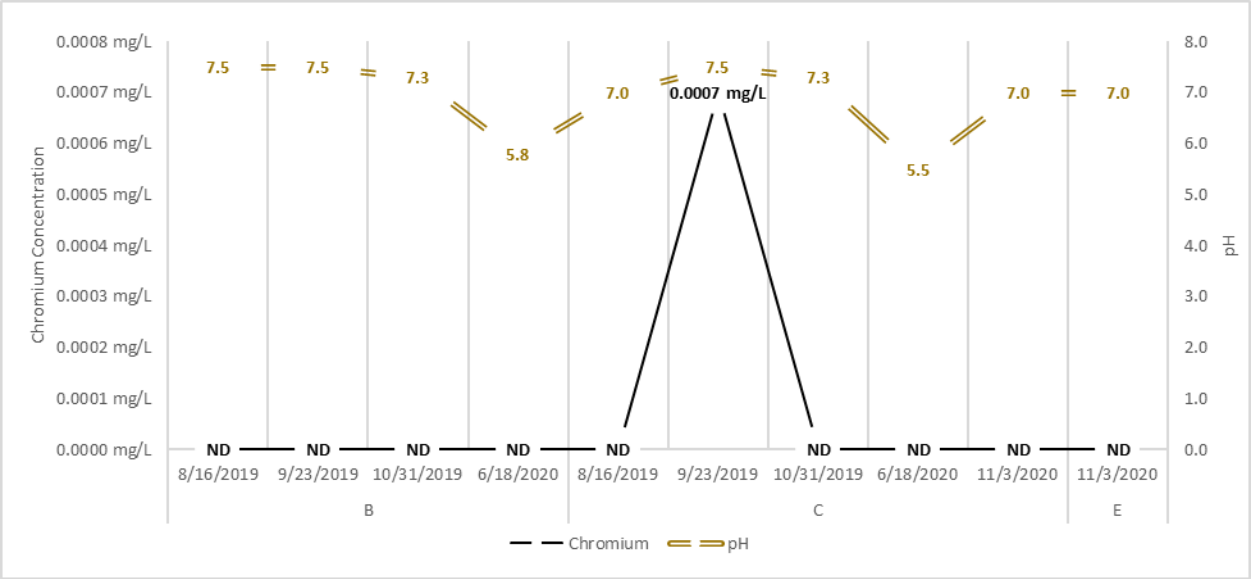


Chromium

Standard[2]:
Chromium VI: Acute Toxicity 0.016 mg/L
Chromium VI: Chronic Toxicity 0.011 mg/L

Chromium concentrations ranged below the detectable limit of 0.0004 mg/L and 0.0007 mg/L. The one sample above the detectable limit was observed in the September 2019 sample.

Figure 10
Chromium Grab Samples



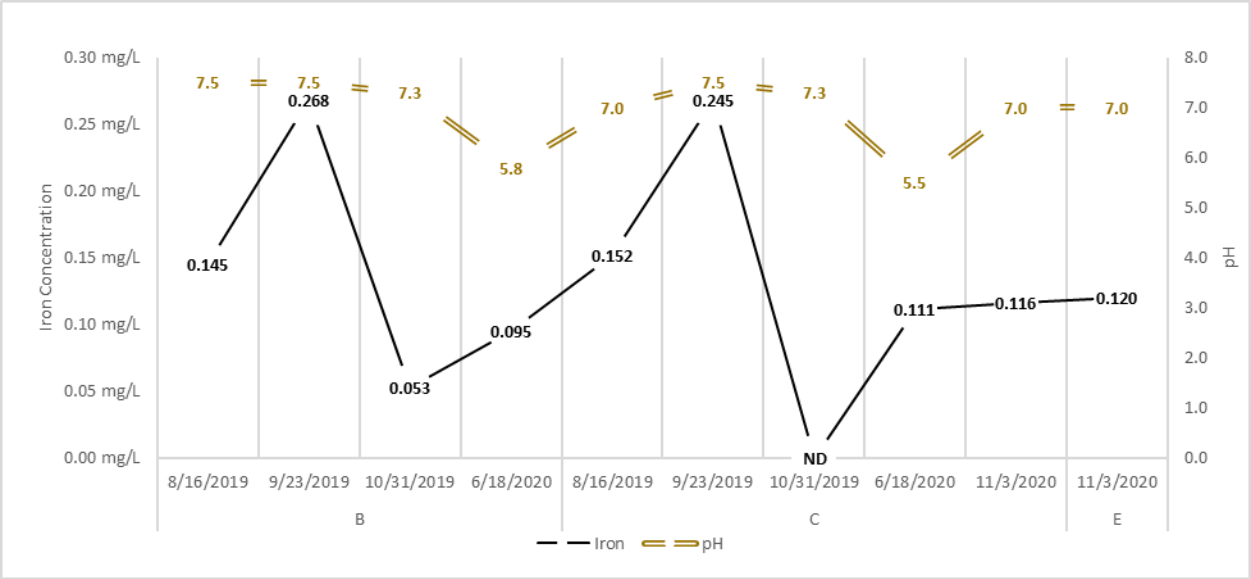
[2] OAR 340-041-8033 Aquatic Life Water Quality Criteria for Toxic Pollutants Table 30

Iron

Standard[3]: Chronic Toxicity 1.0 mg/L

Iron concentrations ranged between below the detectable limit of 0.050 mg/L and 0.268 mg/L. The peaks were observed in the September 2019 sampling event.

Figure 11
Iron Concentrations



[3] OAR 340-041-8033 Aquatic Life Water Quality Criteria for Toxic Pollutants Table 30

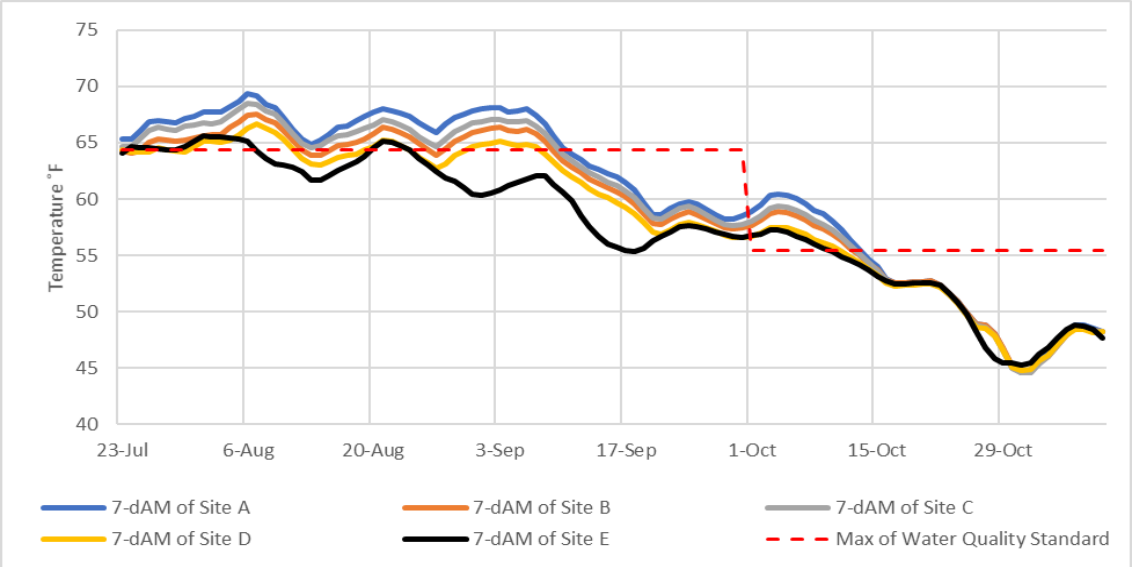
Temperature

Standard[4]:
October 15th – May 15th Salmon and Steelhead Spawning Use Designation
7-day average maximum temperature 55.4°F (13.0°C)

Salmon & Trout* * Rearing and Migration
7-day average maximum temperature 64.4°F (18.0°C)

A temperature logger was deployed Sites A, B, C, and D, on July 10, 2019. An additional temperature logger was deployed at a location less than a mile downstream of Site E (Revenue Bridge Site) on July 17, 2020. On October 2, 2020 the temperature probe was moved to Site E. The temperature probes collected data at 15-minute intervals from July to October. The graph below (**Figure 12**) shows the rolling 7-day average of the maximum temperature observed each day (7-dAM). The temperature was generally observed to be warmer at the more downstream sites, with Site E showing the coldest temperatures on average. This data was used to aid in the selection of an outfall location, as discussed further in Technical Memorandum 7.1 – Outfall Siting Study, and the Antidegradation Review .

Figure 12
7-dAM of Temperature Probe (15-min intervals)



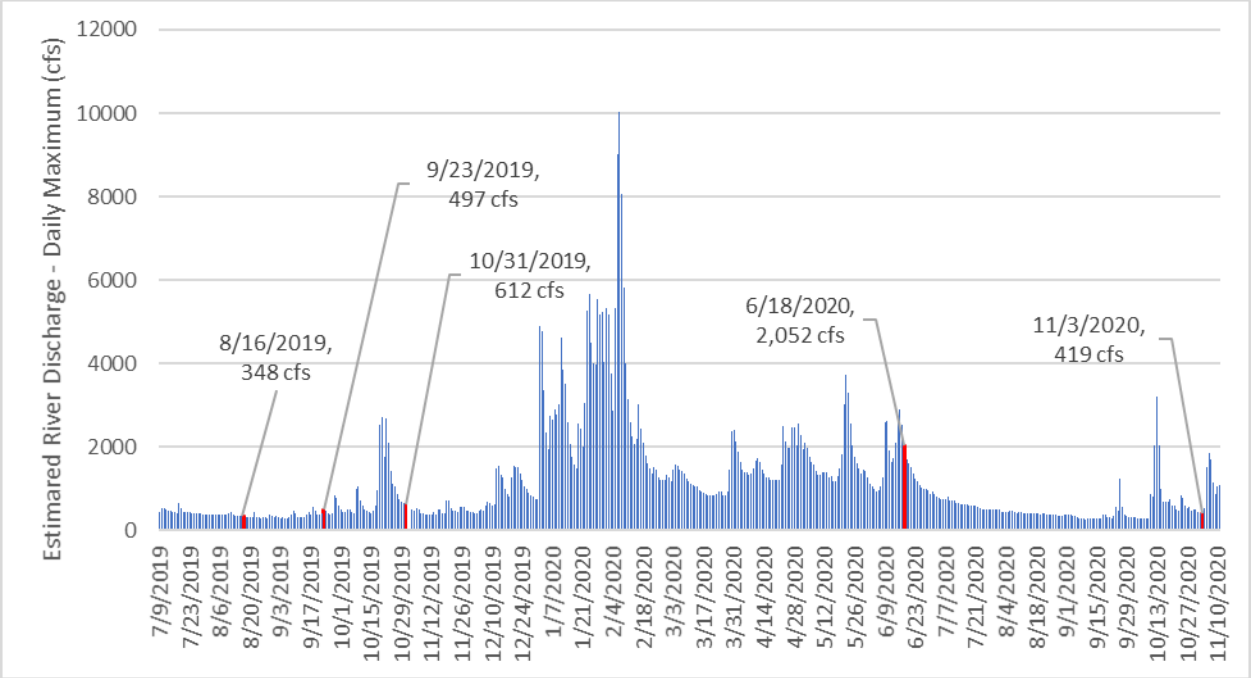
Flow

River discharge for the sampling locations is approximated by the summation of reported instantaneous river discharge from USGS Gages: Sandy River Below Bull Run (14142500) - (Bull

4
OAR 340-041-0028 Water Quality Standards: Beneficial Uses, Policies, and Criterion for Oregon (all basins)
OAR 340-041-0286 Figure 286A Fish Use Designations* - Sandy Basin, Oregon
OAR 340-041-0286 Figure 286B Salmon and Steelhead Spawning Use Designations* - Sandy Basin, Oregon

Run River (14140000) - Little Sandy River (14141500)). A graph of the estimated instantaneous discharge at the sampling locations is approximated in **Figure 13** below. The sampling dates in this study are identified with June 18, 2020 being the most notable high flow event captured in the samples.

Figure 13
Estimated Instantaneous River Discharge – Daily Maximum (cfs) During Sampling Events



Conclusion

This report summarizes the water quality data collected on the Sandy River, in the proximity of the City's proposed outfall locations. This ambient water quality data has been used to inform design proposals, such as outfall site selection as described in Technical Memorandum 7.1. The data will be used as the project moves forward to better understand the water quality characteristics of the Sandy River. Murraysmith recommends continued water quality sampling on a quarterly basis to provide a robust dataset for these evaluations.

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