Memorandum

Date: August 30, 2022

To: Mr. Barti Oumarou, Basin Engineer, Wisconsin Department of Natural Resources

From: Mike Gerbitz, Ryan Holzem, Christine Wood - Donohue

Re: **Capacity Re-Rate Request**
Heart of the Valley Metropolitan Sewerage District, Kaukauna, WI
Donohue Project Number 14649

The Heart of the Valley Metropolitan Sewerage District (HOVMSD) owns and operates an advanced water reclamation (WRRF or Facility). This Memorandum asks the Department to increase the Facility's 5-day biochemical oxygen demand (BOD) and ammonia (NH3) capacities. Although the WRRF possesses more total suspended solids (TSS) and total phosphorus (TP) capacity, this submittal does not request more capacity for these parameters.

Current Rated Capacities

Table 1 shows the original maximum month WDNR-approved flow and loading capacities for the WRRF. The design calculations that arrived at these values are provided in Appendix A.

Table 1: Current Flow and Loading Capacities

Parameter	Maximum Month
Flow (mgd)	11.9
BOD (ppd)	14,651
TSS (ppd)	16,278
Ammonia (ppd)	1,920
TP (ppd)	407

Liquid Train Configuration

The forward flow consists of screening, grit removal, sand-ballasted primary settling (Actiflo), fixed-film biological treatment, and chlorine disinfection. The biological treatment process is a biological aerated filter (BAF or, its specific trade name, Biostyr). Figure 1 shows a simple liquid train flow schematic.

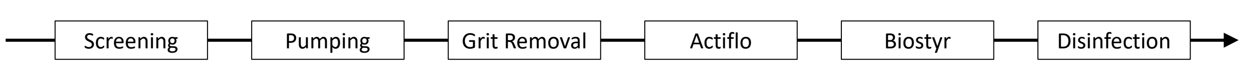

Figure 1. Liquid Treatment Train Schematic.

The most recent WPDES Permit regulating the Facility includes total maximum daily load (TMDL) limits for TSS and TP. An active construction project is adding tertiary effluent filtration. The filtration system will enhance TSS and TP removal and enhance the Facility's ability to comply with these TMDL limits. Figure 2 shows the liquid train with tertiary filtration.

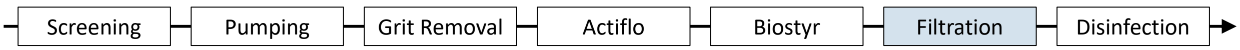

Figure 2. Liquid Treatment Train Schematic with Effluent Filtration.

Solids Train Configuration

Solids stabilization consists of gravity thickening (GT), dissolved air flotation thickening (DAFT), autothermal aerobic digestion (ATAD) with post-ATAD nitrification, and liquid solids storage. Figure 3 shows a simple solids train schematic. Overflow and underflow sidestreams from the thickening processes (GT and DAFT) return to the liquid treatment train upstream of primary settling (Actiflo).

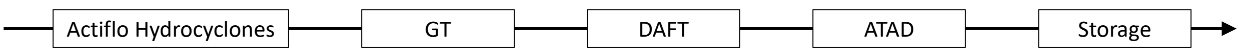

Figure 3. Solids Stabilization Schematic.

BOD and NH3 Removal Processes

Two existing unit processes remove BOD and NH3 from the forward flow: Actiflo and Biostyr. In the future, tertiary filtration will remove secondary effluent TSS and the BOD associated with those solids. Figure 4 highlights the processes that remove BOD and NH3.

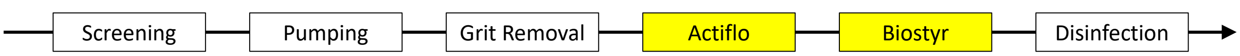

Figure 4. BOD- and NH3-Removing Processes

Original BOD and NH3 Design Assumptions

The Biostry process includes eight separate treatment cells. The media in these eight cells occupies 86,480 cubic feet (Figure 5).

Biostyr Volume

Parameter	Units	Value
Area per Cell	sf	940
Cell Height	ft	11.5
Number of Cells	#	8
Total Volume	cf	86,480
	kcf	86.48

Figure 5. Biostry Media Volume

The original design basis made several assumptions that defined the Facility's BOD and NH3 treatment capacities: [1] Actiflo would remove 50% of the influent BOD, [2] Actiflo would remove 0% of the influent NH3, [3] Biostyr's eight cells could treat 84.71 pounds per day (ppd) of BOD per 1000 cubic feet (kcf) of media volume , [4] Biostyr's eight cells could treat 24.42 ppd-NH3/kcf, and [5] sidestream loadings would increase Biostyr loadings by 10%. The original design only considered sidestream loadings for ammonia. The calculations below show how these assumptions defined the present-day BOD and NH3 loading capacities.

BOD Removal

Equation 1 represents the total forward flow BOD treatment capacity for the WRRF.

$$BOD_{WRRF} = BOD_{Actiflo} + BOD_{Biostyr} \quad (1)$$

where

BOD_{WRRF}	BOD design capacity of WRRF
$BOD_{Actiflo}$	BOD removal from Actiflo at WRRF design capacity
$BOD_{Biostyr}$	BOD removal from Biostyr at WRRF design capacity

Equation 2 represents the total BOD capacity for Actiflo. Equation 3 represents the total BOD capacity for Biostyr based on unit volume loadings.

$$BOD_{Actiflo} = \%Removal \times BOD_{WRRF} \quad (2)$$

$$BOD_{Biostyr} = BOD_{kcf} \times V_{kcf} \quad (3)$$

where

BOD_{kcf}	Design BOD loading on a unit volume basis
V_{kcf}	Media volume

The above equations can be arranged to provide Equation 4.

$$BOD_{WRRF} = (BOD_{kcf} \times V_{kcf}) / (1 - \%Removal) \quad (4)$$

Assuming Actiflo will remove 50% of the influent BOD and the eight Biostyr cells will treat 84.71 ppd-BOD/kcf, Equation 4 yields a BOD capacity of 14,651 ppd-BOD.

$$BOD_{WRRF} = (84.71 \text{ ppd-BOD/kcf} \times 86.58 \text{ kcf}) / (0.5) = 14{,}651 \text{ ppd-BOD} \quad (5)$$

Ammonia Removal

Equation 6 represents the total forward flow NH3 treatment capacity for the WRRF.

$$BOD_{WRRF} = NH3_{Actiflo} + NH3_{Biostyr} \quad (6)$$

where

$NH3_{WRRF}$	NH3 design capacity of WRRF
$NH3_{Actiflo}$	NH3 removal from Actiflo at WRRF design capacity
$NH3_{Biostyr}$	NH3 removal from Biostyr at WRRF design capacity

Equation 7 represents the total NH3 capacity for Actiflo. Equation 8 represents the total NH3 capacity for Biostyr based on unit volume loadings.

$$NH3_{Actiflo} = \%Removal \times NH3_{WRRF} \quad (7)$$

$$NH3_{Biostyr} = NH3_{kcf} \times V_{kcf} \quad (8)$$

where

$NH3_{kcf}$	Design NH3 loading on a unit volume basis
V_{kcf}	Media volume

The above equations can be arranged to provide Equation 9.

$$NH3_{WRRF} = (NH3_{kcf} \times V_{kcf}) / (1 - \%Removal) \quad (9)$$

Assuming Actiflo will remove 0% of the influent NH3, the eight Biostyr cells will treat 24.42 ppd-NH3/kcf, and 10% of the ammonia loading to Biostyr is attributed to an internal sidestream, Equation 9 yields a NH3 capacity of 1,902 ppd-NH3.

$$NH3_{WRRF} = (24.42 \text{ ppd-BOD/kcf} \times 86.58 \text{ kcf}) \times 90\% = 1{,}902 \text{ ppd-NH3} \quad (5)$$

Full-Scale Stress Test

A full-scale, cold-weather stress test was conducted between February 7 and May 16, 2022. The purpose of the stress test was to investigate the true BOD and NH3 treatment capacity of the liquid train when influent wastewater is cold and treatment kinetics are the slowest.

Figure 5 shows where samples were collected. Samples collected upstream and downstream of Actiflo (Locations 2 and 3) revealed Actiflo’s effective BOD and NH3 removal performance. Volumetric BOD and NH3 loadings to Biostyr were artificially increased by reducing the number of Biostyr cells in service. Samples collected at Locations 1 and 4 show the treatment performance of the Actiflo-Biostyr system with Biostyr operating at artificially elevated loadings.

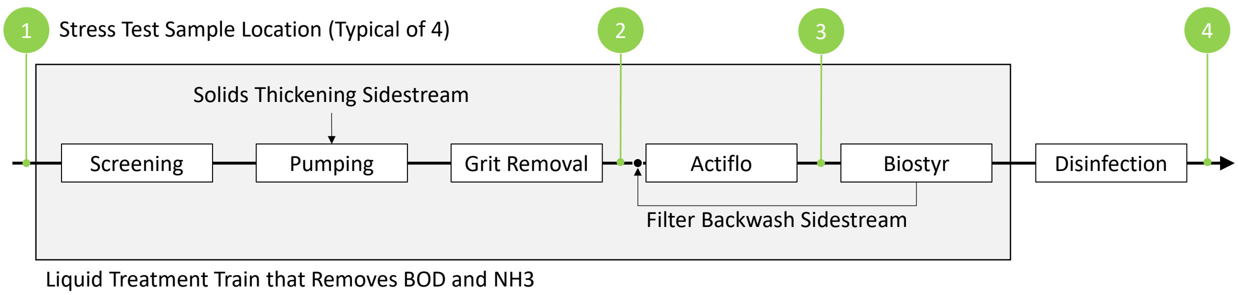

Figure 5. Stress Test Sample Locations

Temperature

Influent wastewater temperatures were cold, ranging from 49 – 55°F. Elevated loadings occurred during some of the coldest temperatures.

Actiflo

Figure 6 shows the measured BOD removal efficiencies. BOD removal exceeded that assumed in the original design, averaging 63%. The original design assumed 50%. All but one measurement exceeded the assumed design value.

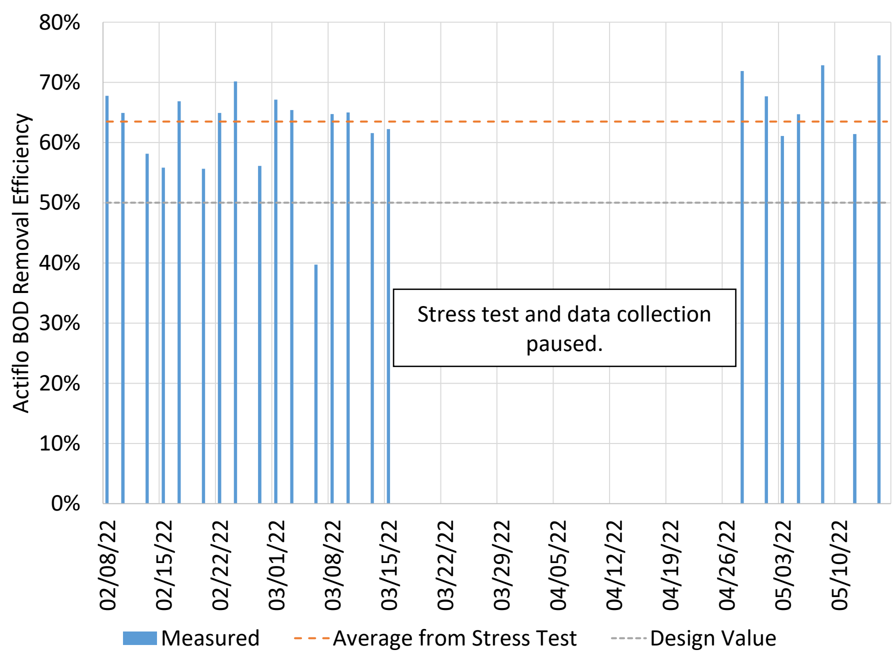

Figure 6. Measured Actiflo BOD Removal Efficiencies

Figure 7 shows the measured total Kjeldahl nitrogen (TKN) removal efficiencies. TKN is comprised of ammonia and organic nitrogen, representing the total nitrogen load that must be nitrified in the Biostyr process. Actiflow removal efficiencies were minimal and highly variable. Some of the values were less than zero, likely revealing effects of internal sidestreams. The original design assumed 0%. The average was 10%. Despite some good removal performance, the stress test confirmed that Actiflo is not a reliable TKN (ammonia) process.

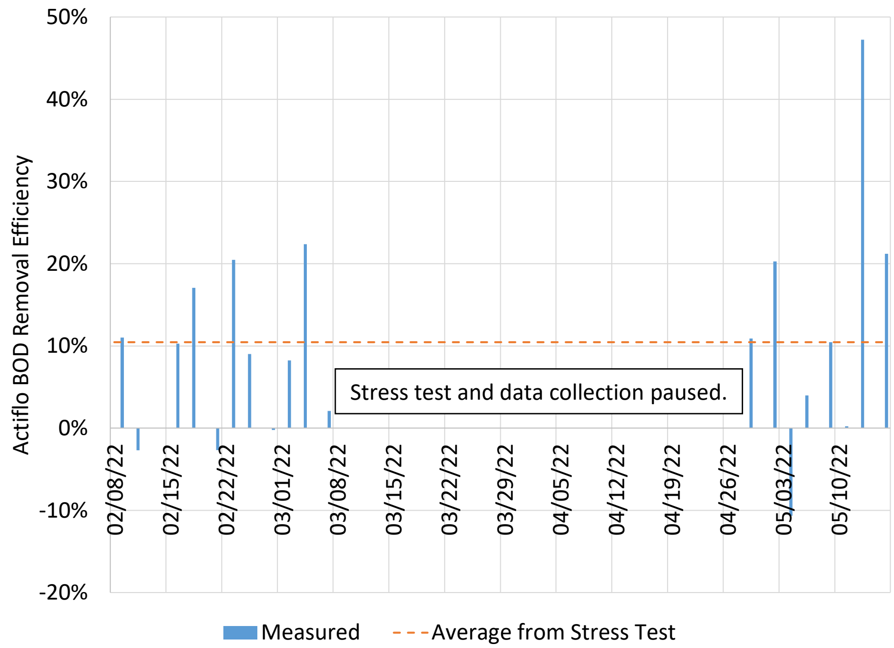

Figure 7. Measured Actiflo TKN (NH3) Removal Efficiencies

Actiflo-Biostyr System

The original design assumed Actiflo would remove 50% of influent BOD and Biostyr would treat 84.71 ppd-BOD/kcf. In other words, the original design assumed the Actiflo-Biostyr process would treat a raw wastewater BOD loading of 169.42 ppd-BOD/kcf. Figure 8 shows raw wastewater BOD loadings per unit volume of Biostyr media in service versus final effluent BOD concentrations. Unit volume loadings far exceeded the design value (169.42 ppd-BOD/kcf) and, with only one exception, effluent BOD concentrations were well below the monthly average effluent limit.

The original design assumed Actiflo would remove 0% of influent NH3, internal sidestreams would contribute 10% of the Biostyr ammonia loading, and Biostyr would treat 24.42 ppd-NH3/kcf. In other words, the original design assumed the Actiflo-Biostyr process would treat a raw wastewater NH3 loading of 21.98 ppd-NH3/kcf. Figure 9 shows raw wastewater NH3 loadings per unit volume of Biostyr media in service versus final effluent NH3 concentrations. Unit volume loadings far exceeded the design value (21.92 ppd-NH3/kcf) and effluent NH3 was well below the most stringent ammonia effluent limit that occurs during the warmest months: June - September.

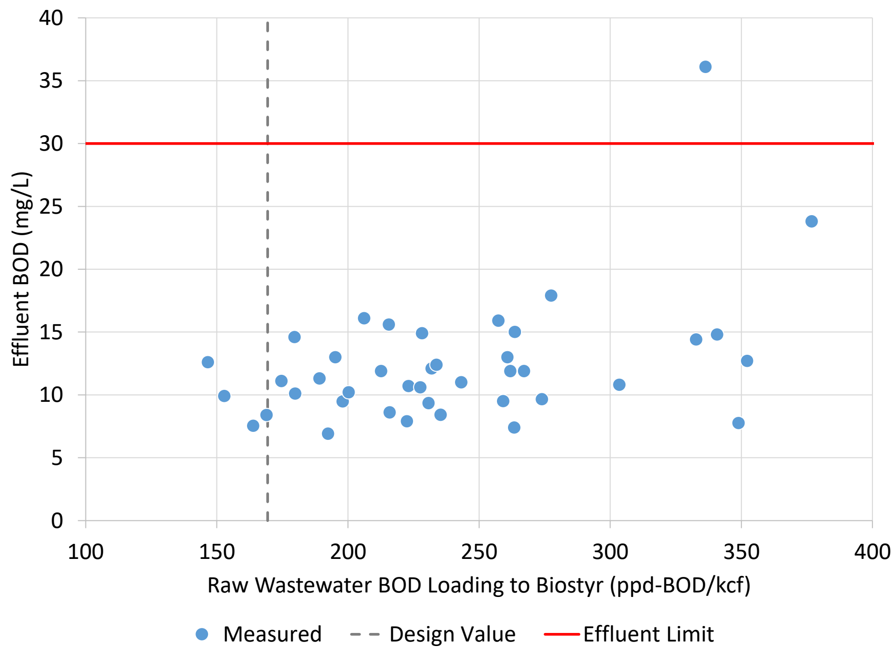

Figure 8. Raw Wastewater BOD Loadings to Biostyr and Effluent Quality

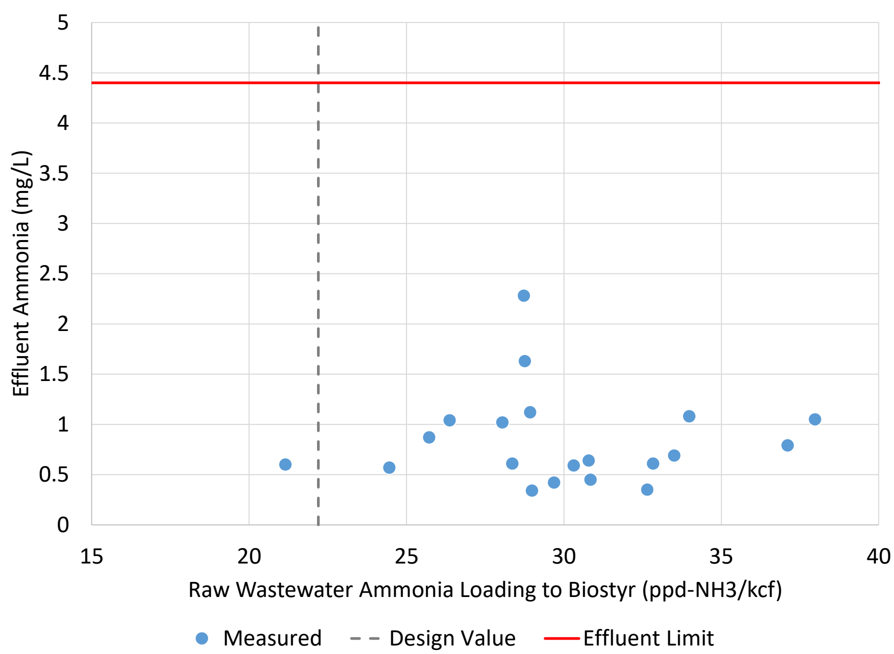

Figure 9. Raw Wastewater NH3 Loadings to Biostyr and Effluent Quality

Proposed Rated Capacity

Based on the excellent cold-weather BOD removal performance of the Actiflo-Biostyr system, the Heart of the Valley Metropolitan Sewerage District requests the WRRF capacity be increased to an influent BOD loading that corresponds to 250 ppd-BOD/kcf of active Biostyr media. Assuming one of the Biostyr cells will be off line for backwashing, this volumetric loading would increase the BOD capacity from 14,651 ppd-BOD to 18,918 ppd, a 29% increase. See Figure 10.

Based on the excellent cold-weather NH3 removal performance of the Actiflo-Biostyr system, the Heart of the Valley Metropolitan Sewerage District requests the WRRF capacity be increased to an influent NH3 loading that corresponds to 30 ppd-BOD/kcf of active Biostyr media. Assuming one of the Biostyr cells will be offline for backwashing, this volumetric loading would increase the NH3 capacity from 1,920 ppd-BOD to 2,270 ppd, an 18% increase. See Figure 10.

Active Biostyr Volume

Parameter	Units	Value
Area per Cell	sf	940
Cell Height	ft	11.5
Number of Cells	#	7
Total Volume	cf	75,670
	kcf	75.67

WRRF Capacity / Maximum Month Condition

Raw Wastewater Parameter	Units	Value	Proposed Biostyr Volumetric Loading (ppd/kcf)	% Increase from Original Design
Flow	mgd	11.9		
BOD	ppd	18,918	250	129%
TSS	ppd	16,278		
NH3	ppd	2,270	30	118%
TP	ppd	407		

Figure 10. Proposed BOD and NH3 Capacity Ratings

Solids Train Analysis

The requested revised capacity increases the maximum month BOD and NH3 loadings by 29% and 18%, respectively. This section confirms that the existing solids processes can accommodate those increased loadings.

Maximum Month Solids Production and Solids-Handling Capacity Analysis

The proposed higher maximum month BOD and NH3 loadings to the Actiflo-Biostyr process will produce more biological solids. Figure 11 shows [1] maximum month Biostyr solids will increase 29%, [2] maximum month total solids production will increase 8%, and all solids-handling processes are adequately sized for these increases.

Process and Parameter		Original Design Rating	Proposed Rating	Comments	
Maximum Month Pre-Digestion Solids					
Actiflo Solids	ppd	17,092	17,092	No Change	
Biostyr Solids	ppd	6,593	8,513	129%	
Total Solids	ppd	23,685	25,605	108%	
Total Solids Concentration	%	0.30%	0.30%	Hydrocyclone underflow	
Total Solids	gpd	946,643	1,023,381	108%	
Gravity Thickener					
Surface Area	sf	3,600	3,600		
SOR	gpd/sf	263	284	M+E: 380 - 760 gpd/sf	OK
Total Thickened Solids Concentration	%	3.00%	3.00%		
Total Solids	ppd	23,685	25,605		
Total Solids	gpd	94,664	102,338		
Dissolved Air Flotation					
Surface Area	sf	1,536	1,536		
Solids Loading	pph/sf	0.64	0.69	M+E: 0.83 - 1.25 pph/sf	OK
Total Thickened Solids Concentration	%	5.00%	5.00%		
Total Solids	ppd	23,685	25,605		
Total Solids	gpd	56,799	61,403		
Total Volatile Solids	ppd	17,898	19,626	70% VS Actiflo, 90% VS BAF	
ATAD					
Volume	Mgal	0.639	0.639		
HRT	d	11	10	M+E: 6 - 8 d	OK
VS Loading	ppd/kcf	210	230	M+E: 200 - 260 ppd/kcf	OK
Maximum Month Post-Digestion Solids					
VS Destruction in ATAD	%	65%	65%		
Total Solids	ppd	12,051	12,848	107%	

Figure 11. Maximum Month Solids Capacity Analysis

Annual Average Biosolids Production and Storage Analysis

The proposed higher BOD and NH3 loadings to the Actiflo-Biostyr process will produce more biological solids and, in turn, might increase annual average biosolids quantities. Historical biosolids production values and concentrations are shown in Figure 12. The historical weighted average concentration of land applied biosolids is 7.36%.

Year	Land Applied Volume (gallons)	Land Applied Mass (1000 kg)	Land Applied Mass (lbs)	Solids Concentration (%)
2019	1,118,751	217	478,485	5.13%
2020	4,529,804	1,425	3,142,125	8.32%
2021	3,185,717	743	1,638,315	6.17%
Weighted Average				7.36%

Figure 12. Historical Average Biosolids Quanties and Concentrations

Figure 13 shows the existing biosolids storage volume is adequate assuming, conservatively, that annual average biosolids quantities will increase at the same rate as the maximum month quantities.

Process and Parameter		Original Design Rating	Proposed Rating	Comments	
Average Month Post-Digestion Solids					
Total Solids	ppd	9,780	10,427	107%	
Total Solids Concentration	%	7.36%	7.36%	Historical data	
Total Solids	gpd	15,933	16,986		
180-Day Volume Required	Mgal	2.87	3.06	Actual = 4.2 Mgal	OK

Figure 13. Annual Average Biosolids Production Quantities and Storage Requirement

<u>Summary</u>

<u>The preceding analysis demonstrates the existing WRRF serving the HOVMSD possess adequate liquid and solids train capacities to produce permit-compliant effluent and biosolids if the Department increases its maximum month BOD and NH3 capacities to 18,918 ppd and 2,270 ppd, respectively. The HOVMSD requests the Department of Natural Resources to adjust the rated-capacity accordingly</u>. The Figures that follow show how recent historical flows and loadings compare to current and requested (BOD and NH3) capacities.

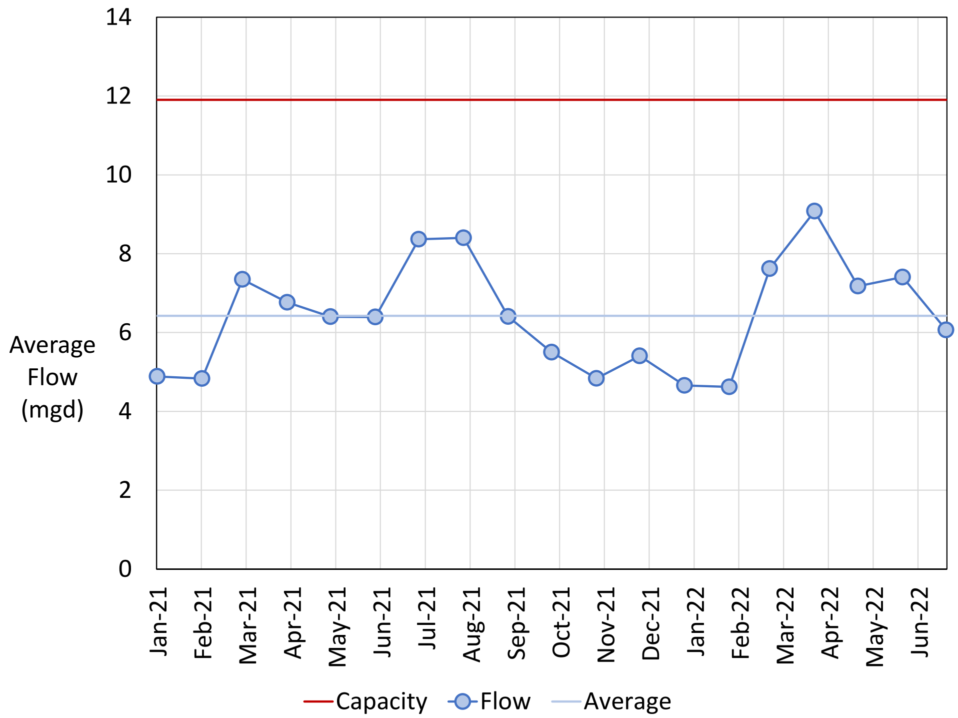

Figure 14. Rated Flow Capacity and Recent Historical Monthly Average Flows

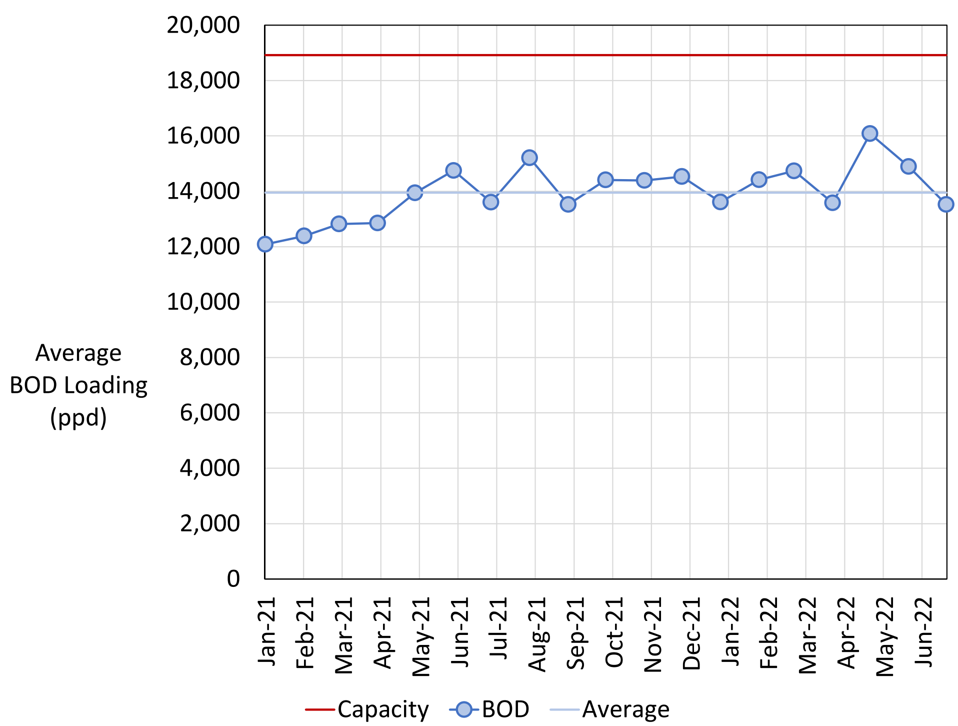

Figure 15. Requested BOD Capacity and Recent Historical Monthly Average Loadings

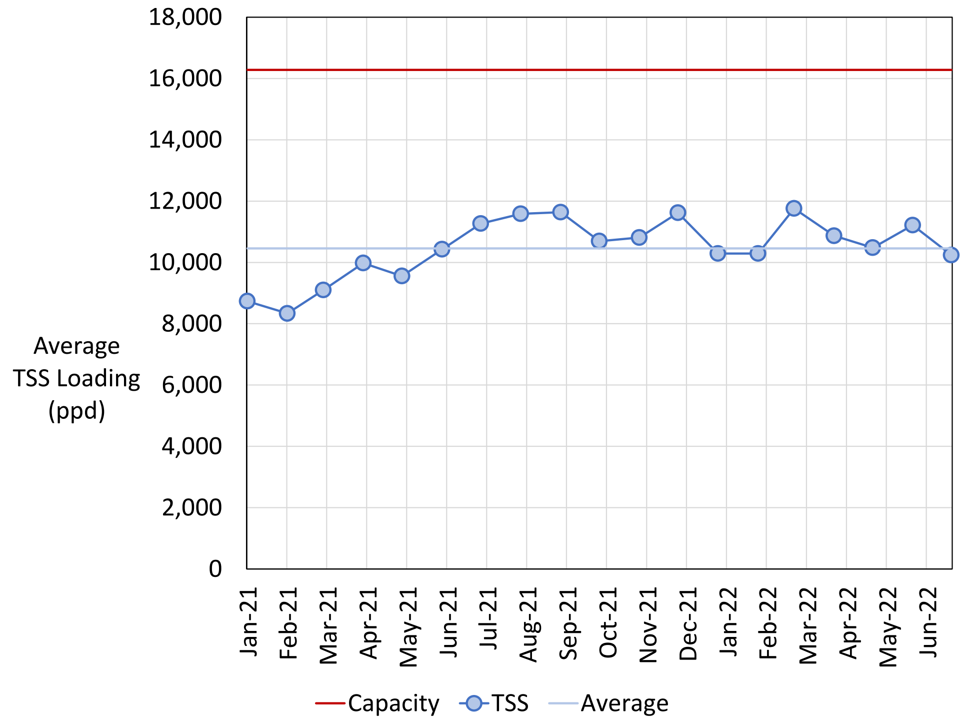

Figure 15. Rated TSS Capacity and Recent Historical Monthly Average Loadings

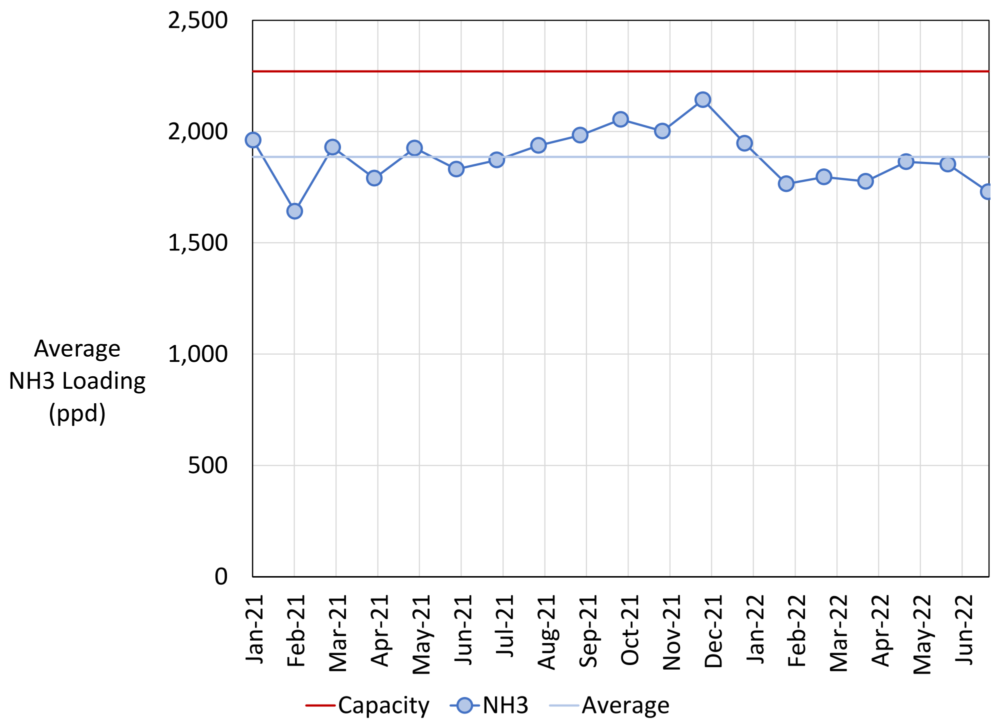

Figure 15. Requested NH3 Capacity and Recent Historical Monthly Average Loadings

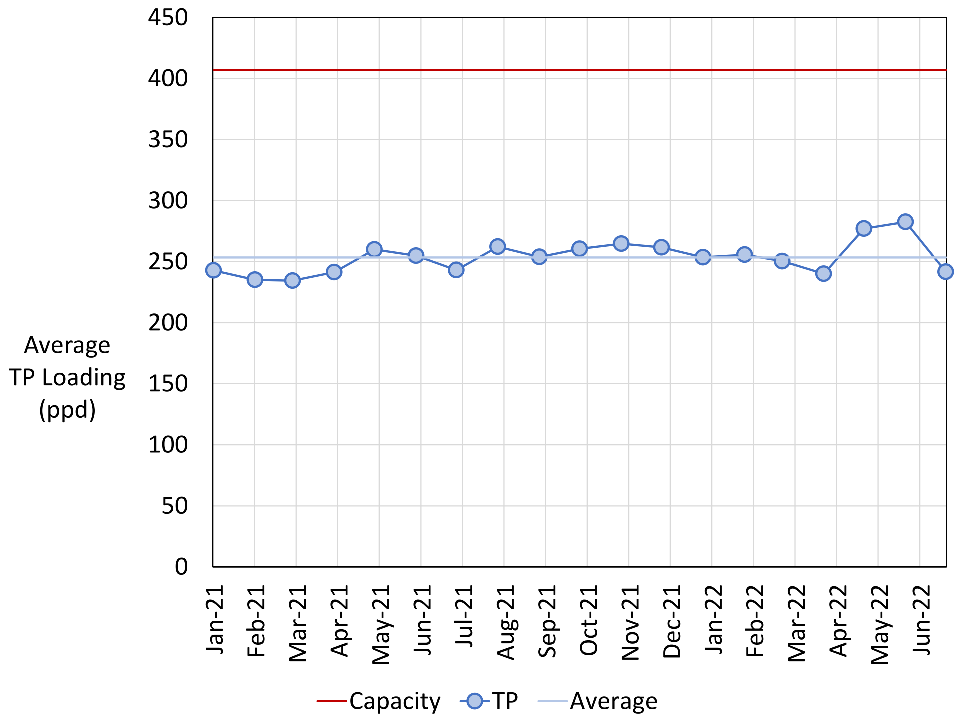

Figure 15. Rated TP Capacity and Recent Historical Monthly Average Loadings

Appendix A

Original Design Basis

III. DESIGN CRITERIA

Parameter Design Year	Design Parameter **2028**
DESIGN YEAR POPULATION	67,827
DESIGN YEAR FLOW, mgd	
■ Average	8.5
■ Maximum 30-Day (1.4:1)	11.9
■ Normal Maximum Day (3.1:1)	26.4
■ Maximum day, 100-year storm	35
■ Peak Hour, 100-year storm	60
■ Average 5-Day/Week Flow	9.2
■ Average Weekend Flow	7.7
■ Peak Daily Diurnal	13.7
■ Average Dry Weather Flow	5.7
■ Minimum Flow	3.9
RECYCLE FLOWS	
■ Actiflo Underflow To New Gravity Thickener, Overflow To Peak Flow Pump Station	Forward Flow / Recycle Flow: 0 to 15 mgd — 352 gpm, 0.127 mgd 15 to 20 mgd — 704 gpm, 1 mgd 20 to 30 mgd — 1,056 gpm, 1.5 mgd 30 to 40 mgd — 1,408 gpm, 2 mgd 40 to 50 mgd — 1,760 gpm, 2.5 mgd 50 to 60 mgd — 2,112 gpm, 3 mgd
■ BAF Backwash Pumped To Actiflo	
◆ Average (backwash every 48-hours)	0.80 mgd 8x.8 mgd
◆ Maximum (backwash every 24-hours)	1,683 gpm, 1.6 mgd
■ DAF Subnatant to Headworks	
◆ Average	28,053 gpd 19.5 gpm
◆ Maximum 30-Day	33,665 gpd
■ Sludge Storage Decant To Peak Flow Wet Well	
◆ Average	21,904 gpd 15.2 gpm
◆ Maximum 30-Day	26,285 gpd
BOD, lbs./day	
■ Average	12,209
■ Maximum 30-Day (1.2:1)	14,651
■ Maximum Day (2.4:1)	29,302
TSS, lbs./day	
■ Average	13,565
■ Maximum 30-Day (1.2:1)	16,278
■ Maximum Day (2.4:1)	32,556
PHOSPHORUS	
■ Average	339
■ Maximum 30-Day (1.2:1)	407
■ Maximum Day (3:1)	1,017
AMMONIA N, lbs./day (based upon 16 mg/l)	
■ Average	1,600
■ Maximum 30-Day (1.2:1)	1,920
■ Maximum Day (2.5:1)	3,005

Parameter Design Year	Design Parameter 2028
HAULED WASTE RECEIVING STATION (Conversion Of Existing Gravity Thickener) ■ Number Of Units ■ Volume @ High Water Level ■ Number Of Pumps ■ Type ◆ Capacity Each Pump, gpm ◆ TDH, each ◆ Horsepower, each	 1 49,800 gallons 2 Submersible Grinder 56 32 2.7
INFLUENT FLOW MONITORING ■ Number ■ Type ■ Size	 Parshall Flume 2 (1 normal flow, 1 peak flow) 36-inch
FINE SCREENS ■ Normal Flow ◆ Number Of Units ◆ Type ◆ Opening Size, mm ◆ Horsepower, screens ◆ Horsepower, washer compactor ■ Peak Flow ◆ Number Of Units ◆ Type ◆ Opening Size, mm ◆ Horsepower, screen ◆ Horsepower, washer compactor	 3 (2 screens, 1 washer compactor) Mechanical Step Screens 10 3 2.3 2 (1 screen, 1 washer compactor) Mechanical Rake Bar Screens 6 2 5
ACTIFLO INFLUENT PUMP STATION ■ To Actiflo Firm Capacity Of 25 mgd ◆ Number Of Pumps ◆ Type ◆ Capacity, Each, gpm ◆ TDH, feet ◆ Horsepower, each ◆ VFD's	 3 Vertical Turbine Solids Handling 10,000 / 8,700 / 4,200 49/ 48 / 44 150 Yes
MODIFIED PE PUMPS - PEAK FLOW PUMP STATION ■ To Actiflo & Disinfection ◆ Number Of Pumps ◆ Type ◆ Capacity, Each, gpm ◆ TDH, feet ◆ Horsepower, each ◆ VFD's	 4 + 1-future Vertical Intermediate Shaft Centrifuge Pump 8,133 59 150 Yes
NORMAL RECYCLE FLOWS - PROCESS RETURN FLOW PUMPS ■ To Actiflo (former RAS Pumps) ◆ Number Of Pumps ◆ Type ◆ Capacity, each, gpm (@ pump start) ◆ TDH, feet ◆ Horsepower, each ◆ VFD's	 3 Vertical Dry Pit Centrifuge 675 43 25 Yes

Parameter Design Year	Design Parameter 2028
GRIT REMOVAL	
■ Number Of Units	2
■ Type	Vortex
■ Capacity, each unit, mgd	30
■ Horsepower	2
GRIT WASHER	
■ Type	Coanda
■ Horsepower, stirrer	1
■ Horsepower, screw conveyor	1.5
ACTIFLO HIGH RATE CLARIFICATION SYSTEM	
■ Total Design Flow, mgd	60
■ Peak Hydraulic Capacity, mgd	70
■ Number Of Trains	2
■ Capacity Per Train, mgd	30
COAGULATION TANK DESIGN (@ 30 mgd per train)	
■ HRT, minute	1
■ Number Of Tanks Per Train	1
■ Length, feet	12
■ Width, feet	12
■ Sidewater Depth, feet = 21542 gallons × 2 = 43,085 gallons	20
■ Mixer	
◆ rpm	37
◆ Horsepower	10
◆ VFD's	No
INJECTION TANK DESIGN (@ 30 mgd per train)	
■ HRT, minute	1
■ Number Of Tanks Per Train	1
■ Length, feet	12
■ Width, feet	12
■ Sidewater Depth, feet	20
■ Mixer	
◆ rpm	37 Max.
◆ Horsepower	10
◆ VFD's	Yes
MATURATION TANK DESIGN (@ 30 mgd per train)	
■ HRT, minute	3
■ Number Of Tanks Per Train	1
■ Length, feet	18.1
■ Width, feet	25.3
■ Sidewater Depth, feet	20
■ Mixer	
◆ rpm	20 Max.
◆ Horsepower	15
◆ VFD's	Yes

Parameter Design Year	Design Parameter 2028
SETTLING TANK DESIGN	
■ Number Of Tanks Per Train	1
■ Length, feet	25.3
■ Width, feet	25.3
■ Sidewater Depth, feet	20
■ Plan View Settling Area, sq.ft.	417
■ Overflow Rate @ 30 mgd Per Train, gpm/sq.ft.	50
■ Overflow Rate @ 35 mgd Per Train, gpm/sq.ft.	58.3
■ Scraper Mechanism	
◆ rpm	0.25 Max.
◆ Horsepower	5
◆ VFD's	Yes
SAND RECIRCULATION CIRCUIT DESIGN	
■ Number Of Pumps Per Train	2 duty + 1 standby
■ Type	Centrifugal Slurry Pumps
■ Total Dynamic Head, psi	45
■ Pump Capacity, gpm	440
■ Horsepower	25
■ VFD's	No
■ Number of Hydrocyclones Per Pump	1
■ Capacity, gpm	440
■ Estimated Sludge Concentration, % solids	0.1 to 0.5
■ Sludge Discharge Per Train @ Design Flow, gpm	704
■ Capacity Each Train, wo/sand @ 13 gpm/sq.ft., mgd	7.8
■ Capacity Each Train, w/sand @ 70 gpm/sq.ft., mgd	42
BALLASTED SEDIMENTATION PERFORMANCE	
■ CBOD Removal	50%
■ TSS Removal	70%
■ NH3N Removal	0%
■ Phosphorus Removal	75%
■ Chemical Used	$Fe_2(SO_4)_3$
■ Chemical Dose	50 to 150 mg/l
■ Polymer Dose	1 to 2.5 mg/l

Parameter Design Year	Design Parameter 2028
POLYMER CHEMICAL FEED SYSTEM (continued)	
■ Polymer Metering Pumps	
◆ Number Of Pumps Per Train	2 + 1 standby
◆ Type	Progressive Cavity
◆ Capacity Each, gpd	1,440 to 28,800
◆ Horsepower	2
LOADINGS TO BIOSTYR BIOLOGICAL AERATED FILTER	
■ Flow	
◆ Maximum Daily Flow, mgd	26.4
■ CBOD, lbs./day	
◆ Average	6,105
◆ Maximum, 30-day	7,326
◆ Maximum Day	14,651
■ CBOD, mg/l	
◆ Average (8.5 mgd)	86 mg/l
◆ Maximum, 30-day (11.9 mgd)	74 mg/l
◆ Maximum Day (26.4 mgd)	67 mg/l
◆ @ Dry Weather Flow (5.7 mgd)	128 mg/l
■ TSS, lbs./day	
◆ Average	4,070
◆ Maximum, 30-day	4,883
◆ Maximum Day	9,767
■ TSS, mg/l	
◆ Average (8.5 mgd)	57 mg/l
◆ Maximum, 30-day (11.9 mgd)	49 mg/l
◆ Maximum Day (26.4 mgd)	44 mg/l
◆ @ Dry Weather Flow (5.7 mgd)	86 mg/l
■ Ammonia, lbs./day [1]	
◆ Average	1,720 (24.3 mg/l)
◆ Maximum, 30-day	2,100 (29.6 mg/l)
◆ Maximum Day	3,306
◆ Peak Daily Diurnal Ammonia Load, lbs./day	3,710
◆ @ 13.9 mgd and 32 mg/l NH3N	
[1] Ammonia loadings include 10% safety factor due to recycle flows and hauled in wastes.	
■ Ammonia, mg/l	
◆ Average (8.5 mgd)	24.3 mg/l
◆ Maximum, 30-day (8.5 mgd)	29.6 mg/l
◆ Maximum Day (26.4 mgd)	15 mg/l
◆ @ Average Dry Weather (5.7 mgd)	36 mg/l

Parameter Design Year	Design Parameter 2028
LOADINGS TO BIOSTYR BIOLOGICAL AERATED FILTER (cont.)	
■ Effluent Requirements, mg/l, monthly average	
◆ CBOD, average	15 mg/l
◆ CBOD, maximum month	25 mg/l
◆ TSS, average	20 mg/l
◆ TSS, maximum month	25 mg/l
◆ NH3N, Average June-September	3.6 mg/l
◆ NH3N, Average January-March	10 mg/l
◆ NH3N, Average April-May	11 mg/l
◆ NH3N, Average October-December	18 mg/l
◆ NH3N, daily maximum	20 mg/l
◆ Phosphorus, average	1 mg/l
■ Minimum Waste Temperature	7°C
■ Flow, mgd, maximum day	26
BIOSTYR SYSTEM	
■ Number Of Filters	8
■ Size, each cell, sq.ft.	940
■ Media Size, mm	4.0
■ Total Filter Area, sq.ft.	7,520
■ Filtration Rate, maximum, gpm/sq.ft.	3.08
■ BAF Backwash, mgd	1
■ Height Of Media, feet	11.5
■ Process Air/Cell, scfm	
◆ Average	258
◆ Maximum Month	310
◆ Peak Day	735
■ Backwash Air/Cell, scfm	735
■ Average Air Requirement, scfm	2,800 (w/backwash air)
■ Maximum Month Air Requirement, scfm	3,215 (w/backwash air)
■ Peak Day Air Demand, scfm	6,615
■ Blowers	
◆ Number Of Units	8 + 1 Standby
◆ Size, each unit, scfm	726
◆ Discharge Pressure	14.04 psig
◆ Horsepower, each	75
■ Backwashing	
◆ Frequency	1/day/cell
◆ Backwash Volume/Cell, gpd	202,000
◆ Backwash Volume, Daily, mgd	1.62
■ Spent Backwash Tanks	
◆ Number Of Tanks (3 existing Unox tanks)	3
◆ Total Volume @ Water Surface 611.78, gallons	250,000
■ Spent Backwash Return Pumps	
◆ Number	2
◆ Type	Dry Pit Submersible
◆ Capacity, each, gpm	1,683
◆ TDM, feet	51.2
◆ Horsepower	40

Parameter Design Year	Design Parameter 2028
DISINFECTION	
■ Existing Chlorine Contact Tanks	
◆ Number Of Rectangular Tanks	1
◆ Volume, gal	334,955
◆ HRT @ 8.5 mgd, mins.	57
■ Secondary Clarifier Tanks Converted To Peak Flow Chlorine Tank	
◆ Number Of Tanks	2
◆ Volume, two tanks, gal	646,272
◆ HRT @ 35 mgd, mins.	26.6
■ Chlorination System	
◆ Chlorine Demand, mg/l	1.5
◆ Chlorine Demand, lbs./day	
- @ 8.5 mgd	107
- @ 11.9 mgd	149
◆ @ 60 mgd	757
◆ Total Hypochlorite Demand, gpd	
- @ 8.5 mgd	107
- @ 11.9 mgd	149
- @ 60 mgd	757
◆ Hypochlorite Demand @ Existing Contact Tanks	
- @ 8.5 mgd, gpd	214
- @ 11.9 mgd, gpd	298
- @ 26.4 mgd, gpd	672
◆ Peak Hypo Demand @ Each Peak Contact Tank, gpd	552
■ Hypochlorite Storage Tanks	
◆ Number Of Tanks	1
◆ Volume, each, gal	12,000
◆ HRT @ 50% Dilution, days/tank	
- @ 8.5 mgd	56
- @ 11.9 mgd	40
■ Hypochlorite Transfer Pump	
◆ Number Of Units	1
◆ Type	Air Diaphragm
◆ Capacity, gpm	49 max.
■ Existing Cl_2 Contact Tank	
◆ Hypochlorite Feed Pumps	
- Number Of Pumps	2 + 1 spare
- Type	Diaphragm Metering
- Capacity, each, gpd	29 - 576
- Horsepower	½
■ Peak Flow Cl2 Contact, each tank	
◆ Number Of Pumps	1
◆ Type	Diaphragm Metering
◆ Capacity, each, gpd	29 - 576
◆ Horsepower	½
■ Sodium Bisulfite	
◆ Equivalent Dose To SO_2	
. lbs. Bisulfite/gal @ 38% Solution	1.5
- gpd of Bisulfite Needed	3.17
@ 8.6 mgd	
@ 26.4 mgd	34
@ 60 mgd	10636

Parameter Design Year	Design Parameter 2028	
DISINFECTION (continued)		
■ Sodium Bisulfite Storage Tank		
◆ Number Of Tanks	1	
◆ Volume Of Tank, gallons	2,000	
◆ HRT, days		
- @ 8.5 mgd	59	
- @ 11.9 mgd	49	
◆ Sodium Bisulfite Feed Pumps, gpd		
- Type	10.8 to 216	
- 2 Pumps @	Diaphragm Metering	
- 1 Pump @	6 to 120	
- Horsepower	1/2	
SLUDGE PRODUCTION	Start-Up	2028
■ Primary Sludge		
◆ BOD Removal, %	50	50
◆ TSS Removal, %	70	70
◆ Phosphorus Removal, %	75	75
◆ NH3N Removal, %	0	0
■ Total Suspended Solids Removed, lbs./day		
◆ Average	7,093	9,496
◆ Maximum, 30-day	8,546	11,395
◆ Maximum Day (x 2.4)	17,092	22,789
■ Total Actiflo Sludge Production, lbs./lb. TSS Removed (1)		
◆ Fe2(SO4)3 Dose of 90 mg/l	1.6	
◆ Fe2(SO4)3 Dose of 60 mg/l	1.5	
◆ Fe2(SO4)3 Dose Of 50 mg/l	1.4	
[1] Based upon mass balance during pilot testing.		
■ Total Actiflo Sludge, lbs./day @ 60 mg/l Dose		
◆ Average	10,640	14,244
◆ Maximum Month	12,820	17,093
◆ Maximum Day	25,638	34,184
■ % Volatiles - Actiflo Sludge	70	70
■ Volatiles, lbs./day		
◆ Average	7,448	9,971
◆ Maximum Month	8,974	11,965
◆ Maximum Day	17,947	23,929
■ BAF Sludge, lbs./day to Actiflo		
◆ Yield, lbs./lb. CBOD Removed	0.9	0.9
◆ Average	3,915	5,495
◆ Maximum, 30-day (x 1.2)	4,698	6,593
◆ Maximum Day (x 2.5)	9,788	13,186
■ Total Sludge, lbs./day [@ 60 mg/l $Fe_2(SO_4)_3$]		
◆ Average	14,555	19,739
◆ Maximum, 30-day	17,518	23,686
◆ Maximum Day	35,426	47,350
■ Volatiles, %		
◆ Actiflo Sludge	70%	70%
◆ BAF Sludge	90%	90%
■ BAF Volatile Sludge, lbs./day		
◆ Average	3,524	5,351
◆ Maximum Month	4,228	5,934
◆ Maximum Day	8,809	11,867

Parameter Design Year	Design Parameter 2028	
SLUDGE PRODUCTION (continued)	Start-Up	2028
■ Total Volatiles, lbs./day		
◆ Average	10,972	15,322
◆ Maximum 30-day	13,202	17,899
◆ Maximum Day	26,756	35,796
■ ATAD Performance VSS Destruction, %	65	65
■ VSS Destroyed, lbs./day		
◆ Average	7,132	9,959
◆ Maximum, 30-day	8,581	11,634
◆ Maximum Day	17,391	23,267
■ Sludge To Storage, lbs./day		
◆ Average	7,423	9,780
◆ Maximum, 30-day	8,937	12,052
◆ Maximum Day	18,035	24,083
■ Sludge From Storage, gpd @ 5%		
◆ Average	17,801	23,453
■ Sludge Storage Decant, gpd	17,103	23,883
■ Ammonia Concentration, mg/l	200	200
■ Ammonia Sidestream, lbs./day	29	40
SLUDGE GRAVITY THICKENER		
■ Number Of Units	1 (existing Primary Clarifier 4) + 1 spare (Primary Clarifier 3)	
■ Length, feet	60	
■ Width, feet	60	
■ Sidewater Depth, feet	10	
■ SOR, gpd/sq.ft.		
◆ Maximum @ 4.4 mgd	1,222	
■ Solids Load, lbs./sq.ft.		
◆ Average	5.1	
◆ Maximum Month	6.1	
■ % Solids To DAF	3	
■ Volume To Sludge To DAF, gpd		
◆ Average	78,893	
◆ Maximum Month	94,668	
◆ Maximum Day	189,249	
THICKENED SLUDGE TRANSFER PUMPS		
■ Number Of Units	1 new & 2 existing	
■ Type (new)	Rotary lobe	
■ Capacity (new), gpm	250	
■ Total Dynamic Head (new), psig	20	
■ Horsepower (new)	7.5	
■ VFD	Yes	
ACTIFLO SCUM PUMPS		
■ Number Of Units	2	
■ Type	Vertical Pedestal Chopper	
■ Capacity, gpm	310	
■ Total Dynamic Head, feet	73	
■ Horsepower	5	
■ VFD	No	

Parameter Design Year	Design Parameter **2028**
DISSOLVED AIR FLOTATION THICKENERS (existing)	
■ Number Of Units	2
■ Dimensions, each unit, feet	
◆ Length	48
◆ Width	16
◆ Surface Area, sq.ft., each	768
■ Surface Area, sq.ft., total	1,536
■ Solids Loading/Day, lbs./day/sq.ft.	
◆ Average	12.9
◆ Maximum Month	15.4
◆ Maximum Day	30.8
■ Volume From DAF @ 5.0%, gpd	
◆ Average	47,333
◆ Maximum Month	56,801
THICKENED SLUDGE DAY TANK	
■ Number Of Units	1
■ Area Above Feet, sq.ft.	530.9
■ Maximum Sidewater Depth, feet	27
■ Maximum Volume, gallons	95,000
■ Mixer	
◆ Number Of Units	1
◆ Type	Submersible
◆ Capacity	11,729
◆ Horsepower	15.4
◆ VFD	No
ATAD FEED PUMPS	
■ Number Of Units	2
■ Type	Rotary Lobe
■ Capacity, each, gpm	322
■ Total Dynamic Head, psig	40
■ Horsepower	20
■ VFD's	Yes
ATAD	
■ Tank Diameter, feet	65
■ Total Tank Volume, gal	721,894
■ Volume Used, gal	638,700
■ HRT, days	
◆ Average	13.5
◆ Maximum Month	11.2
■ ATAD Recirculation Pumps	
◆ Number Of Units	2
◆ Type	Centrifugal Open Impeller
◆ Horsepower, each	125
◆ Capacity, gpm (each)	11,000
◆ Total Design Head, feet	31
◆ VFD's	Yes

Parameter Design Year	Design Parameter 2028
ATAD (continued)	
■ ATAD Foam Suppression / Transfer Pumps	
◆ Number Of Pumps	2
◆ Type	Centrifugal Open Impeller
◆ Capacity, each, gpd	1,500
◆ Total Design Head, feet	85
◆ Horsepower	40
◆ VFD's	
■ ATAD Blowers	
◆ Number Of Blowers	2 + 1 standby
◆ Capacity, each, gpd	1,175
◆ Total Design Head, feet	10.75
◆ Horsepower	100
POST-ATAD NITRIFICATION	
■ Existing Digestion Converted To Post-ATAD Tanks	
◆ Number Of Tanks	2
◆ Tank Diameter, feet	40
◆ Volume, each, gallons	200,000
■ Total Post-ATAD HRT, days	
◆ Average	8.5
◆ Maximum Month	7.0
■ Post ATAD Recirculation Pumps	
◆ Number Of Pumps	2
◆ Type	Centrifugal Open Impeller
◆ Capacity, each, gpm	4,500
◆ Total Design Head, feet	22.5
◆ Horsepower	40
◆ VFD's	Yes
■ Post ATAD Blowers	
◆ Number Of Blowers	2 + 1 spare
◆ Capacity, each, scfm	400
◆ Design Pressure, psig	8.15
◆ Horsepower	25
◆ VFD's	Yes
ATAD ODOR CONTROL BIOFILTER	
■ Biofilter	
◆ Number Of Units	1
◆ Media Type	Lava Rock / Wood Chip
◆ Media Area, sq.ft.	800
◆ Lava Rock Depth, feet	3
◆ Wood Chip Depth, feet	3
■ Biofilter Ammonia Scrubber	
◆ Number Of Units	1
◆ Diameter, feet	7
◆ Height, feet	10
■ Biofilter Fan	
◆ Number Of Units	1
◆ Capacity, acfm	5,000
◆ Design Pressure, inches, w.c.	9
◆ Horsepower	10
◆ VFD	Yes

Parameter Design Year	Design Parameter 2028
ATAD ODOR CONTROL BIOFILTER (continued)	
■ Anticipated System Performance	
◆ Ammonia Removal, %	95
◆ Methyl Mercaptans Removal, %	95
◆ Dimethyl Sulfide Removal, %	95
SLUDGE STORAGE	
■ Start-Up Sludge Volume @ 5% Solids, gpd	17,801
■ Design Sludge Volume @ 5% Solids, gpd	23,453
■ Sludge Storage Volume Needed, mg	
◆ Startup	3.2
◆ Design	4.2
■ Existing Tank Volume, mg	2.4
■ Existing Digesters Storage, mg	0.2
■ New Sludge Storage Tank	
◆ Diameter	81
◆ Sidewater Depth	42
◆ Volume, mg	1.6
SECONDARY EFFLUENT PUMPS	
■ Number Of Units	4 existing
■ Capacity Each Unit, gpm	3,819
TERTIARY FILTERS **(Removed From Service)**	
■ Number Of Units	6 existing
■ Dimensions Each Unit, feet	
◆ Length	20
◆ Width	20
■ Total Surface Area, feet	2,400
■ Type Of Media	Anthracite
■ Size Of Media, mm	1.8 to 2.0
■ Filtration Rate, gpm/square foot	
◆ @ 9 mgd	2.6
◆ @ 16.5 mgd	4.8
◆ @ 25 mgd	7.2
■ Waste Backwash Pumps	
◆ Number Of Units	2 existing
◆ Capacity, Each, gpm	850
■ Filter Backwash Pumps	
◆ Number Of Units	3 existing
◆ Capacity, Each, gpm	4,000
■ Filter Air Scour Blowers	
◆ Number Of Units	3 existing
◆ Capacity, Each, scfm	950

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