Centreville Wastewater Treatment Plant ENR Upgrade and Expansion Town of Centreville

Centreville, MD

December 2023

DRAFT Preliminary Engineering Report

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1 Executive Summary

The Town of Centreville Wastewater Treatment Plant (WWTP) is owned and operated by the Town of Centreville and treats flows from the entire town. The Centreville WWTP was most recently upgraded and expanded in 2003, including an upgrade of the facility to achieve biological nutrient removal (BNR) levels of treatment. The nutrient removal process at the Centreville WWTP consists of a two-tank sequencing batch reactor (SBR) with chemical addition for phosphorous precipitation and cloth media filtration. The WWTP is treating wastewater as designed and is meeting all the NPDES permit limits.

The facility has a permitted treatment capacity of 0.542 million gallons per day (MGD). The annual average daily flow (AAF) of the plant for the period 2014 through 2022 is 0.40 MGD. The most recent three calendar years, 2020-2022, averaged 0.45 MGD AAF, which is 83% of permitted capacity. The Town anticipates continued growth in the service area and may consider annexation of areas into the service area. Under the plant's current NPDES discharge permits, treated effluent is disposed into Gravel Run, a tributary to Corsica River, during the winter months and sprayed onto off-site irrigation fields during the warmer months.

The overall objective for this project is to expand the liquid and solids treatment and effluent disposal capacity to meet the needs of the anticipated growth, as well as meet enhanced nutrient removal (ENR) levels of treatment and continue compliance with the NPDES discharge permit. In concert with the treatment capacity expansion, the auxiliary systems, including the laboratory, office space, influent screening, and disinfection facilities will be upgraded and modernized. In addition, sludge handling, biosolids treatment and dewatering facilities will be included. A non-potable water system will be added to the facility to allow for the use of treated effluent for on-site uses.

The condition and performance of the existing facilities were evaluated. Almost all the facilities were found to be in good operating condition. The tertiary cloth media filter has been reported as having insufficient hydraulic throughput for wet weather flows. The cloth media was replaced, and the filter has been reviewed by a manufacturer's representative. In the evaluation of treatment alternatives, the cloth media filter would be replaced by a deep bed denitrifying (sand) filter that will both remove particulate as well as remove nitrogen.

This Preliminary Engineering Report (PER) considers three treatment alternatives to expand the design capacity of the WWTP to 1.0 MGD as well as meet ENR treatment levels:

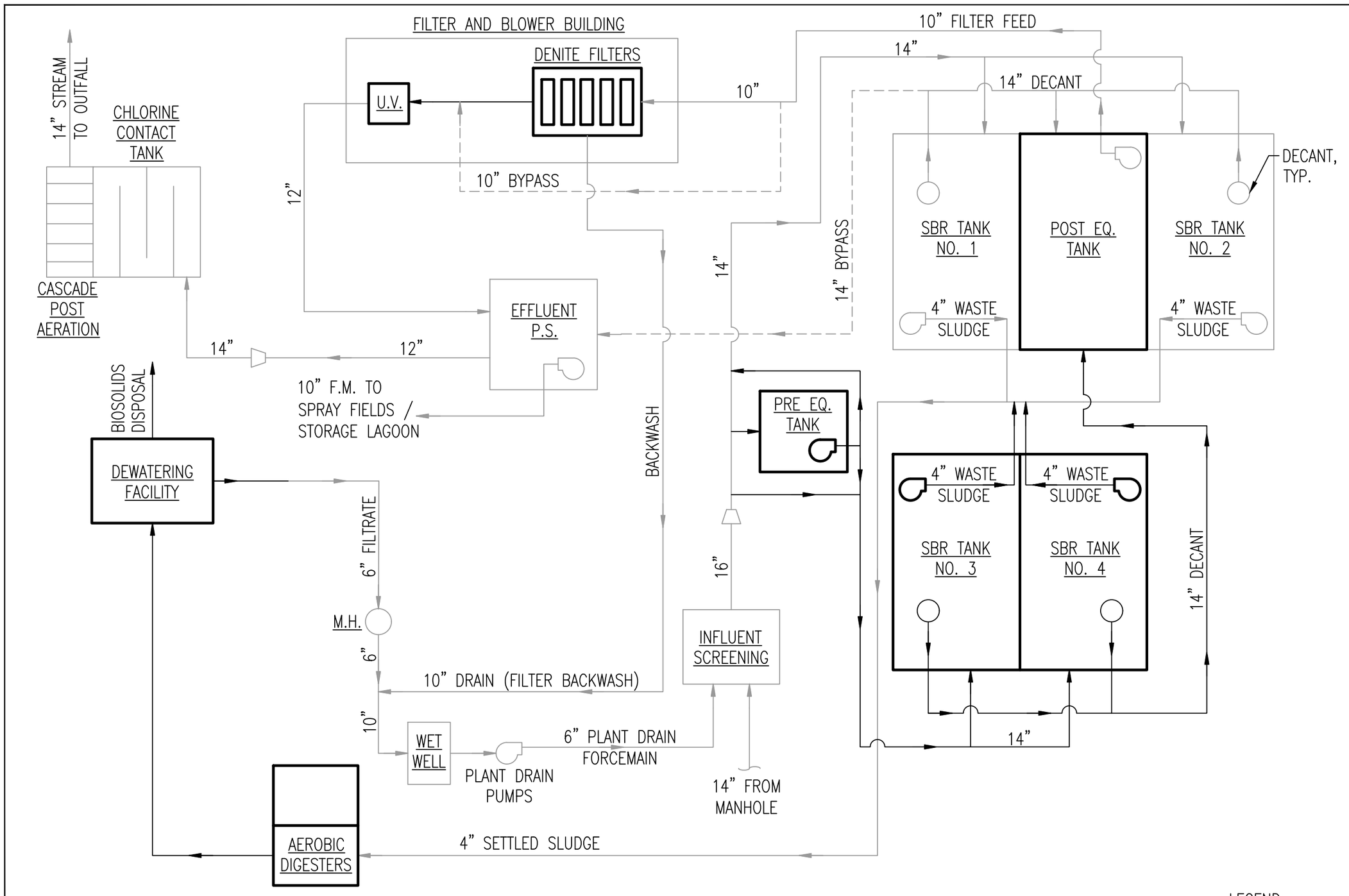
- Alternative 1 – SBR: Expand the existing SBR process, followed by tertiary denitrification filters,
- Alternative 2 – Conventional Activated Sludge: Replace the existing SBR system with a 5-stage ENR activated sludge process, followed by tertiary filters (with denitrification capability),
- Alternative 3 – MBR Activated Sludge: Replace the existing SBR system with a 5-stage ENR Membrane Bioreactor (MBR) activated sludge process.

Each alternative will require modifications to most of the existing treatment facilities, including sludge handling and expansion of the effluent disposal facilities. The expansion of the facilities capacity and upgrades to equipment will require enhancements to control and monitoring systems throughout the plant process areas. The addition of a centralized Plant Control System for monitoring and control will reduce overall operator and facilitate collection of process data. The identification and study of the effluent disposal expansion options will be conducted separately from this PER. **Table 1.1** provides a summary of the proposed modifications for Alternatives 1, 2, and 3. **Figures 1.1, 1.2, and 1.3** show the proposed process flow diagrams for Alternatives 1, 2, and 3, respectively.

Based on the evaluations in this PER, Alternative 3 – MBR Activated Sludge is recommended for the upgrade and expansion of the Centreville WWTP.

Table 1.1: Upgrade and Expansion of Facilities			
Facility	Alternative 1 – 4 SBRs	Alternative 2 – Conventional Activated Sludge	Alternative 3 – MBR Activated Sludge
Influent Screening	Replace existing mechanical screen with similar larger model rated at 4.0 MGD (peak hydraulic flow), modify existing concrete channel to accommodate.	Same as Alternative 1	Upgrade screening to mechanically cleaned bar rack followed by two (2) redundant 2-mm opening center feed band screens.
Influent Flow Equalization Tank	Not required for operation but requested by the Town. Construct a new 500,000-gallon working capacity flow equalization tank with surface aerator/mixers. Submersible pumps will pump flow from the influent flow equalization tank to the SBRs.	Not required for operation but requested by the Town. Convert the existing SBR process tanks to two (2) approximately 500,000-gallon working capacity each flow equalization tanks with surface aerator/mixers. Submersible pumps will pump flow from the influent flow equalization tank to the 5-stage activated sludge basins.	Same as Alternative 2 but required for operation.
SBR	Install two (2) additional SBR tanks. Install surface mixers, removable fine bubble diffusers and decant arms. Four (4) total 50 HP blowers added to Filter and Blower Building.	Not required. The existing SBR tanks will be converted into influent flow equalization tanks.	Same as Alternative 2.
Biological Reactors	Expand the existing SBR tanks with additional SBR tankage	Install 2 train, 5-stage conventional activated sludge process. Fine bubble diffusers to incorporate air from proposed high efficiency blowers. Anoxic and swing zones will be agitated with vertical mechanical mixers. Low head propeller pumps for internal recycle will be installed.	Install 2-train, 5-stage conventional activated sludge process with membranes to separate solids from treated effluent. Fine bubble diffusers to incorporate air from proposed high efficiency blowers. Anoxic and swing zones will be agitated with vertical mechanical mixers. Permeate pumps will draw effluent through membranes. Low head propeller pumps for internal recycle and return activated sludge will be installed. Waste sludge pumps will pull mixed liquor from the reactors and discharge into the aerobic digesters. Chemical cleaning facilities will be provided to clean the membranes.
Secondary Clarifiers	Not required	Two (2) rectangular clarifiers with chain and flight sludge collection and submersible return activated sludge (RAS) pumps installed in a sump. Sludge will be wasted from the RAS forcemain into the aerobic digesters.	Not required
Chemical Dosing	Provide double contained polyaluminum chloride (PACl) tank located in Filter and Blower Building for chemical phosphorus removal. Provide methanol storage and dosing facility for external carbon addition for enhanced denitrification.	Same as Alternative 1	Same as Alternative 1
Post Equalization Tank	Construct new 250,000-gallon post equalization tank with surface agitators.	Not required	Not required

Table 1.1: Upgrade and Expansion of Facilities			
Facility	Alternative 1 – 4 SBRs	Alternative 2 – Conventional Activated Sludge	Alternative 3 – MBR Activated Sludge
Effluent Filter	Replace the existing cloth media filter with a continuous backwash sand filter in concrete tanks, sized to provide denitrification with the addition of external carbon. House filter mechanical equipment and controls in a new building. Include maintenance space in building.	Same as Alternative 1	Not required
UV Disinfection	Install two UV disinfection units to replace existing.	Same as Alternative 1	Same as Alternative 1
Effluent Disposal	To be further evaluated. Options include: • Additional spray irrigation disposal with storage lagoon, • Relocation of the existing outfall and expand stream discharge to year round, and • Planning for future beneficial water reuse.	Same as Alternative 1	Same as Alternative 1
Non-Potable Water System	Install non-potable water system within the Filter and Blower Building that draws from the UV effluent and pumps to an on-site distribution system for applications such as spray water for influent screens, pump seal water, wash down, or yard hydrants throughout the WWTP.	Same as Alternative 1	Same as Alternative 1
Aerobic Digesters	Install new aerobic digesters with ability to thicken solids and decant liquid back to treatment process. Digester tank will have center wall to allow half of the tank offline. New blowers will supply air.	Retrofit existing SBR post equalization tank and sludge holding tank to two aerobic digesters with ability to thicken solids and decant liquid back to treatment process. Existing process blowers will supply air. Coarse air stainless steel diffusers will be mounted to the bottom slab.	Same as Alternative 2
Biosolids Dewatering System	Install new biosolids handling building for dewatering process. New covered sludge cake storage area for treated biosolids.	Same as Alternative 1	Same as Alternative 1
Plant Control System	Provide enhanced process controls with centralized monitoring and control workstation for operator interface. Provide capabilities to provide hub for Town wide SCADA system of utilities.	Same as Alternative 1	Same as Alternative 1
Laboratory/ Administration Space	Reconfigure the Laboratory/Administration Building to better utilize the space for the laboratory uses. Provide a dedicated space for locker rooms and offices.	Same as Alternative 1	Same as Alternative 1



ALTERNATIVE 1 PROCESS FLOW DIAGRAM: SBRs

SCALE: NONE

LEGEND:

EXISTING

PROPOSED

REVISIONS		

CLIENT INFORMATION

TOWN OF CENTREVILLE
CENTREVILLE, MD

WWTP UPGRADE

KEY PLAN

GRAPHIC SCALES

SIGNATURE

PRELIMINARY DESIGN
NOT FOR
CONSTRUCTION

PROFESSIONAL CERTIFICATION.
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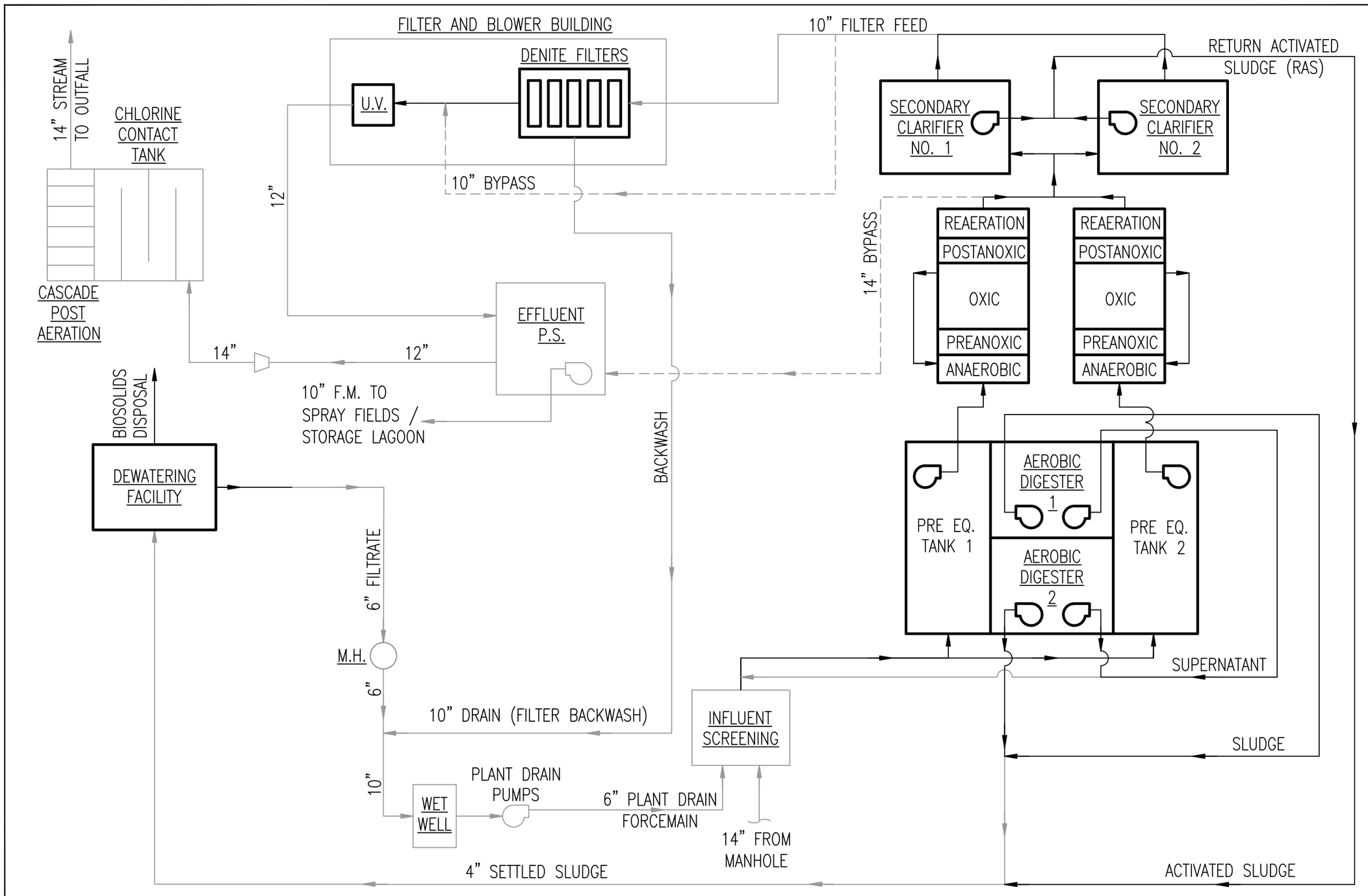
801 South Caroline Street, Baltimore, Maryland 21231

ALTERNATIVE 1 PROPOSED PROCESS FLOW DIAGRAM

FIGURE NO.

1.1

SCALE: NONE		
DATE: DECEMBER 2023	SHEET XX OF XX	
DES: LMA	DRAWN: LMA	CHECK: DRN



ALTERNATIVE 2 PROCESS FLOW DIAGRAM: CONVENTIONAL ACTIVATED SLUDGE

SCALE: NONE

LEGEND:

EXISTING

PROPOSED

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CENTREVILLE, MD

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ALTERNATIVE 2 PROPOSED PROCESS FLOW DIAGRAM

FIGURE NO.

1.2

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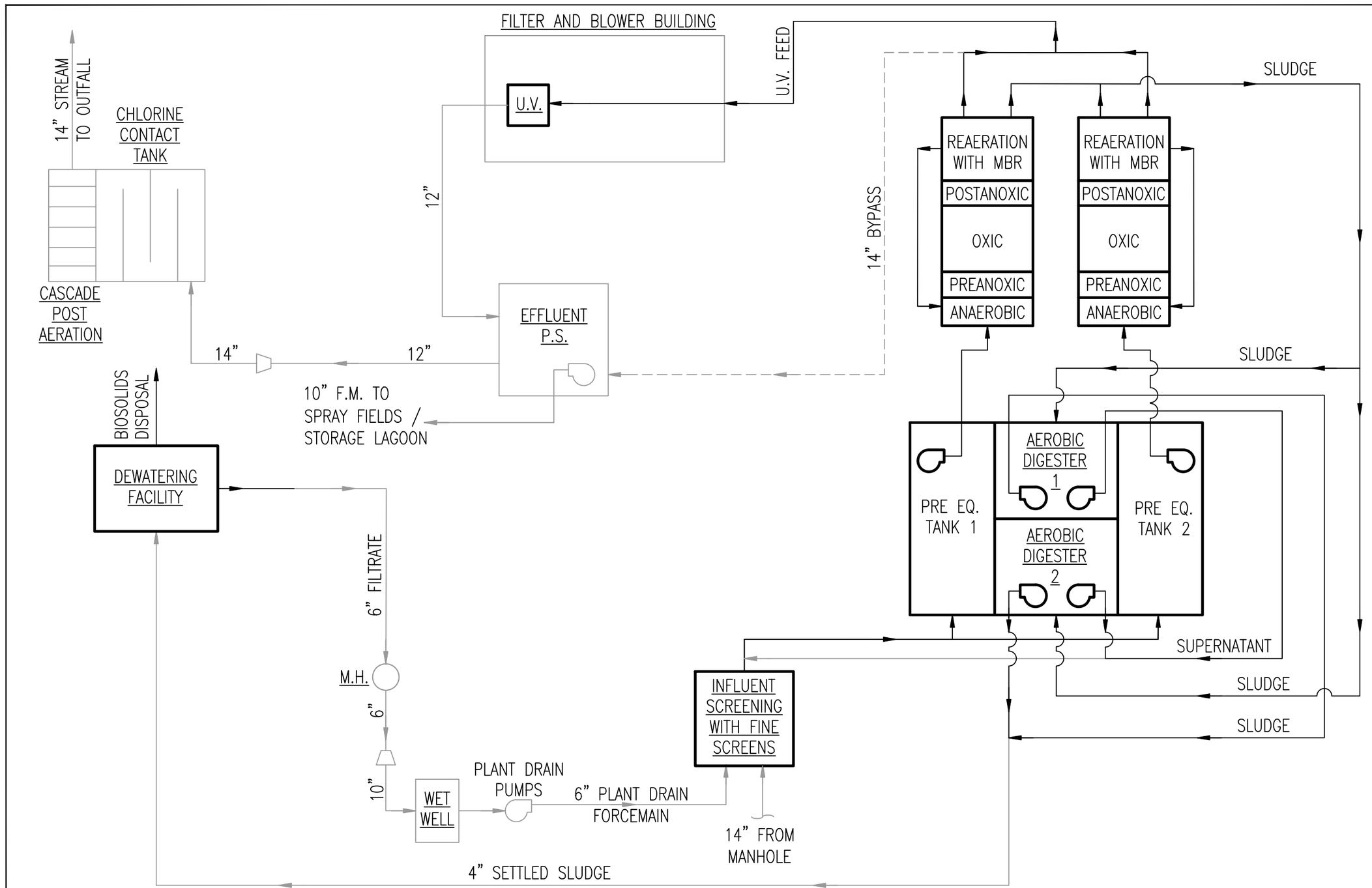

ALTERNATIVE 3 PROCESS FLOW DIAGRAM: MBR ACTIVATED SLUDGE

SCALE: NONE

LEGEND:

EXISTING

PROPOSED

REVISIONS		

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ALTERNATIVE 3 PROPOSED PROCESS FLOW DIAGRAM

FIGURE NO.

1.3

SCALE: NONE		
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1.1 Summary of Evaluations

To improve treatment to provide ENR level effluent water quality and to expand the treatment capacity for current and projected influent wastewater flows, three (3) alternatives were developed and evaluated. A “do nothing” alternative is not viable as the current average influent has exceeded 80% of the design treatment capacity and the effluent water quality has occasionally been adversely affected. Additionally, influent flows are projected to continue to increase in the future.

Preliminary sizing of the biological treatment process for each alternative to achieve the required effluent water quality was completed using the BioWin® process simulator (by EnviroSim).

Evaluation and comparison of each alternative is based on life cycle cost and non-monetary criteria:

- Life Cycle Cost Analysis (capital and O&M costs)
- Non-Monetary Comparison
- Energy and Water Efficiency
- Environmental Impacts

The capital costs of the three alternatives are within 3% from the least expensive Alternative 1 – SBR ($33.0 million), and the most expensive Alternative 2 – Conventional Activated Sludge ($33.9 million). The O&M costs were based on an assumed 20-year project life and resulted in life cycle costs of the three alternatives within 8% of each other, ranging from $47.9 million to $51.9 million.

Given the complexity of each alternative and the variability introduced in projecting operating and maintenance costs for a 20 year project life, the costs of the three alternatives are similar.

The non-monetary comparison indicated that Alternative 2 – Conventional Activated Sludge and Alternative 3 – MBR Activated Sludge were similar and both preferred to Alternative 1 – SBR. The ability to evolve with future regulations and technologies, and the use of the available space were key advantages for Alternatives 2 and 3, with Alternative 3 scoring higher than Alternative 2.

The treated effluent water quality of all three alternatives will be sufficient to meet off-site Class III and IV reclaimed water requirements for future consideration.

Given the smaller footprint of Alternative 3 – MBR Activated Sludge compared to the other two alternatives, the impact on the environment will be reduced. Alternative 3 will have greater flexibility to avoid the environmentally sensitive areas of the available site and have a reduced impact overall.

Alternative 3 – MBR Activated Sludge uses a permeable membrane to separate solids from the treated effluent compared to the other two alternatives using conventional sand media filter, and will produce the highest effluent quality in terms of suspended solids and turbidity.

Based on the evaluations, Alternative 3 – MBR Activated Sludge is recommended for the upgrade and expansion of the Centreville WWTP.

1.2 Summary of Improvements

A site plan of the locations of the facilities that will be affected by the ENR upgrade and expansion, and approximate location of proposed facilities for the recommended Alternative 3 – MBR is shown in **Figure 1.4**.

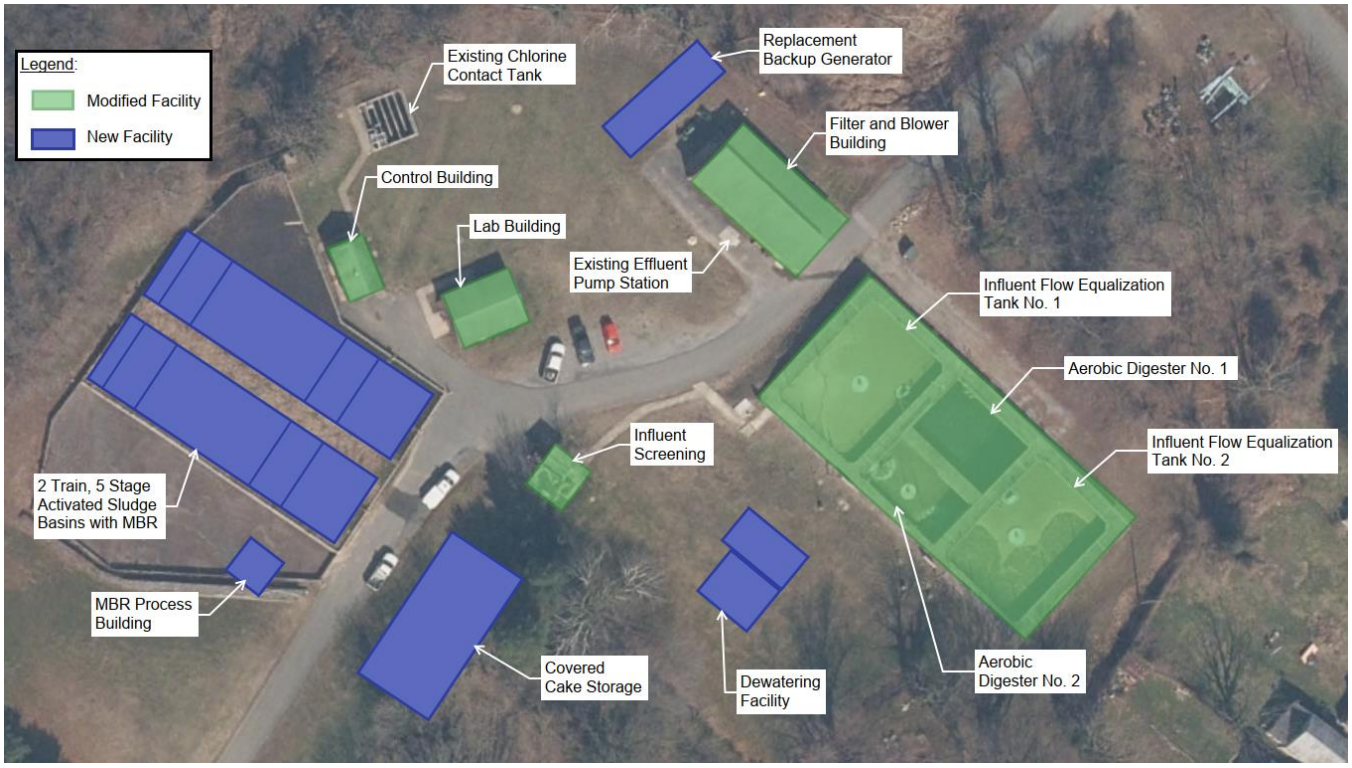


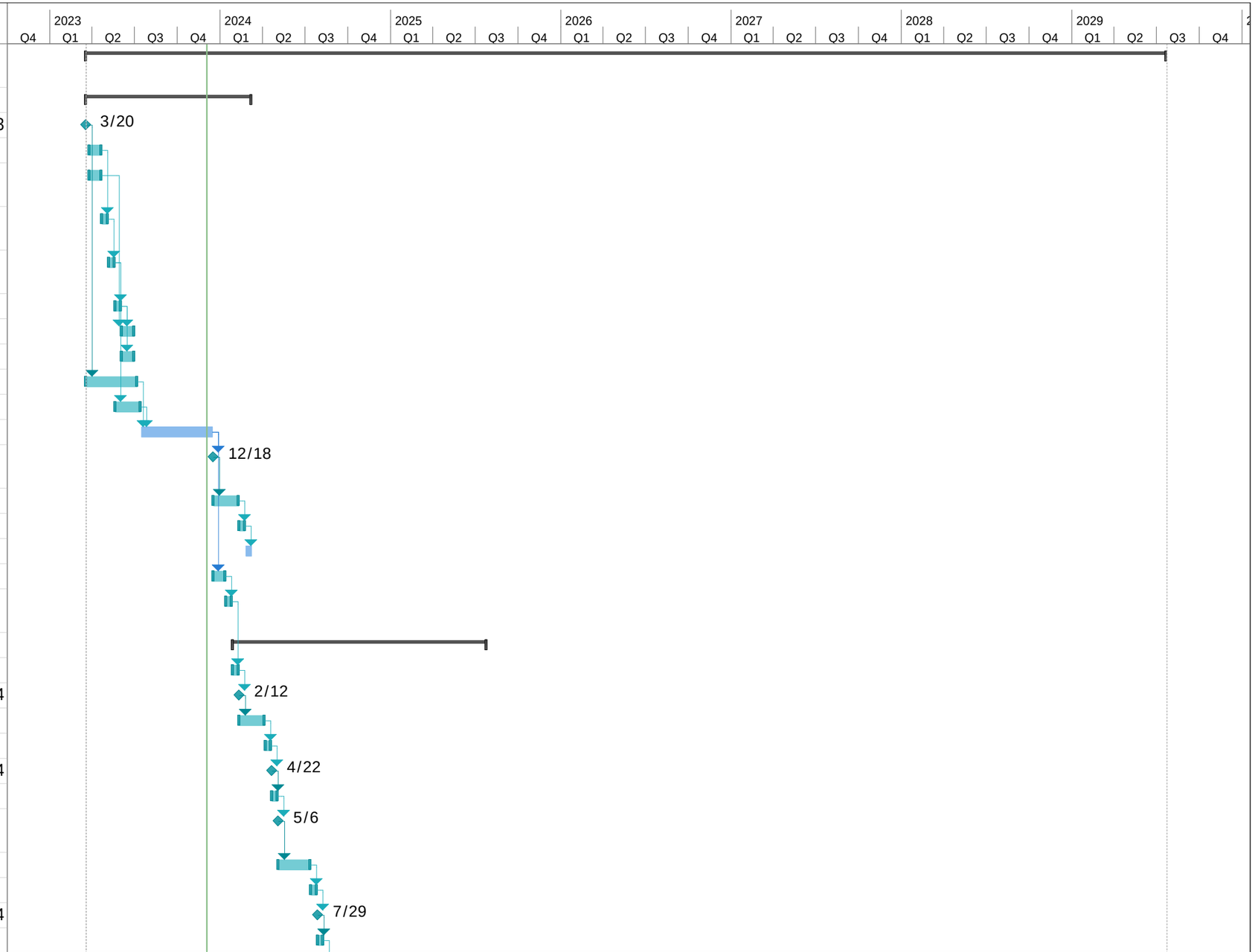
Figure 1.4: Site Plan of ENR Upgrades and Expansion – Alternative 3 MBR Activated Sludge

The key scope items and rough order of magnitude (ROM) construction cost estimate for each improvement is summarized in **Table 1.2**. Given the conceptual design stage, a minus 20 percent and a plus 50 percent cost contingency are added to the estimate. Additional cost breakdown for Alternative 3 – MBR Activated Sludge is included in **Appendix A**.

Table 1.2: Preliminary Construction Cost Estimate – Alternative 3 (MBR Activated Sludge)		
Item No.	Category	Cost
1	Interior Demolition (Lab, Control, and Filter and Blower Buildings)	$95,000
2	Influent Screening Expansion	$825,000
3	Converting Influent Flow Equalization Tanks, Aerated, with Pumping	$2,019,000
4	Methanol Facility	$618,000
5	UV Disinfection System	$642,000
6	Non-Potable Water System	$54,000
7	Dewatering Facility	$2,413,000
8	Covered Cake Storage Facility	$835,000
9	Lab, Control, and Filter and Blower Buildings Refurbishments	$617,000
10	Existing Tank Modifications	$643,000
11	Miscellaneous Process Piping and Equipment	$784,000
12	MBR Process Building, MBR Equipment and Controls	$5,789,000
13	Aerobic Digester Tank and Equipment	$78,000
14	Electrical	$4,169,000
15	Site Civil, including Yard Piping and Demolition (15% Items 1-12)	$2,312,000
16	Site SCADA (5% Items 1-12)	$771,000
	Subtotal	$22,664,000
	Design Contingency (30% of Subtotal)	$6,799,000
	Escalation to December 2026 (4%/year)	$3,678,000
	Total	**$33,141,000**
	Total (Low Range -20%)	*$26,513,000*
	Total (High Range +50%)	*$49,712,000*

The design and construction durations for the project were developed and presented in **Figure 1.5**.

ID	Task Name	Duration	Start	Finish
1	Centreville WWTP ENR Upgrade and Expansion	1655 days	Mon 3/20/23	Mon 7/23/29
2	PER Development	255 days	Mon 3/20/23	Fri 3/8/24
3	Start PER Update	0 days	Mon 3/20/23	Mon 3/20/23
4	Advertise for M/WBE	4 wks	Mon 3/27/23	Fri 4/21/23
5	Town Assembles Requested Information	4 wks	Mon 3/27/23	Fri 4/21/23
6	Develop ENR PER Amendment	2 wks	Mon 4/24/23	Fri 5/5/23
7	Town Review PER Amendment	2 wks	Mon 5/8/23	Fri 5/19/23
8	Sub Agreements	2 wks	Mon 5/22/23	Fri 6/2/23
9	Develop Draft PER	4 wks	Mon 6/5/23	Fri 6/30/23
10	Topo Survey	4 wks	Mon 6/5/23	Fri 6/30/23
11	Develop Alternatives	16 wks	Mon 3/20/23	Fri 7/7/23
12	Subconsultant Field Worl	8 wks	Mon 5/22/23	Fri 7/14/23
13	Develop PER	22 wks	Mon 7/17/23	Fri 12/15/23
14	Draft PER to Town and MDE	0 days	Mon 12/18/23	Mon 12/18/23
15	Review Draft PER	8 wks	Mon 12/18/2	Fri 2/9/24
16	Incorporate Comments	2 wks	Mon 2/12/24	Fri 2/23/24
17	Finalize PER	2 wks	Mon 2/26/24	Fri 3/8/24
18	Develop Design Proposal	4 wks	Mon 12/18/2	Fri 1/12/24
19	Town Reviews Design Proposal	2 wks	Mon 1/15/24	Fri 1/26/24
20	ENR Upgrade Design	390 days	Mon 1/29/24	Fri 7/25/25
21	Project Set Up	2 wks	Mon 1/29/24	Fri 2/9/24
22	Design Kick Off w Town	0 days	Mon 2/12/24	Mon 2/12/24
23	30% Design	8 wks	Mon 2/12/24	Fri 4/5/24
24	30% Design Internal QA	2 wks	Mon 4/8/24	Fri 4/19/24
25	30% Design to Town	0 days	Mon 4/22/24	Mon 4/22/24
26	Town Reviews 30% Desig	2 wks	Mon 4/22/24	Fri 5/3/24
27	30% Design Comment Review Meeting	0 days	Mon 5/6/24	Mon 5/6/24
28	60% Design	10 wks	Mon 5/6/24	Fri 7/12/24
29	60% Design Internal QA	2 wks	Mon 7/15/24	Fri 7/26/24
30	60% Design to Town	0 days	Mon 7/29/24	Mon 7/29/24
31	Town Reviews 60% Desig	2 wks	Mon 7/29/24	Fri 8/9/24

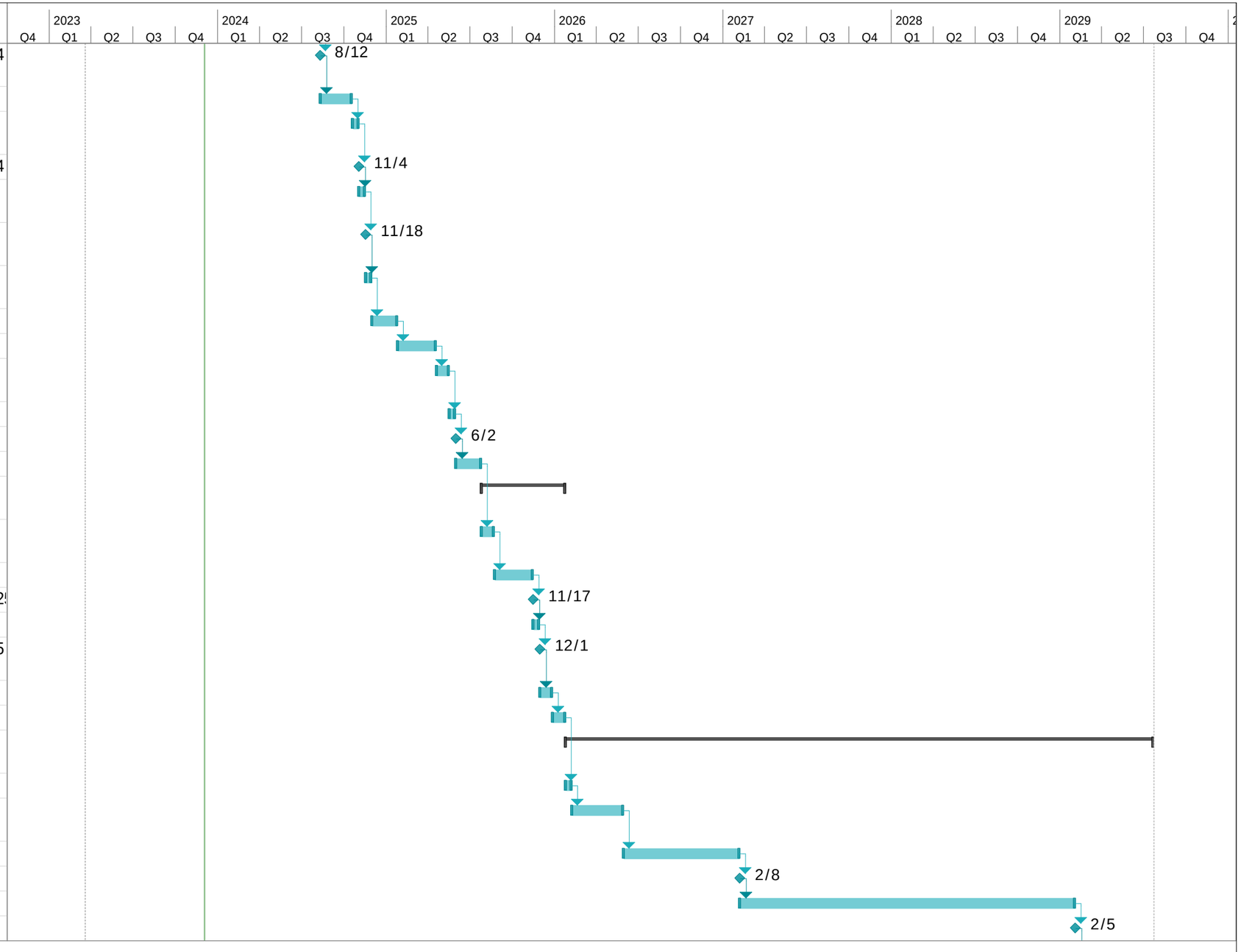


Project: Centreville WWTP ENR
Date: Mon 12/4/23

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone

Figure 1.5: Upgrade and Expansion Schedule

ID	Task Name	Duration	Start	Finish
32	60% Design Comment Review Meeting	0 days	Mon 8/12/24	Mon 8/12/24
33	Pre-Final Design	10 wks	Mon 8/12/24	Fri 10/18/24
34	Pre-Final Design Internal QA	2 wks	Mon 10/21/24	Fri 11/1/24
35	Pre-Final Design to Town	0 days	Mon 11/4/24	Mon 11/4/24
36	Town Reviews Pre-Final Design	2 wks	Mon 11/4/24	Fri 11/15/24
37	Pre-Final Design Comment Review	0 days	Mon 11/18/24	Mon 11/18/24
38	Design Review Meeting with MDE	2 wks	Mon 11/18/24	Fri 11/29/24
39	MDE Review	8 wks	Mon 12/2/24	Fri 1/24/25
40	Permitting	12 wks	Mon 1/27/25	Fri 4/18/25
41	Develop Bid Ready Documents	4 wks	Mon 4/21/25	Fri 5/16/25
42	Bid Ready Doc Internal Q	2 wks	Mon 5/19/25	Fri 5/30/25
43	Bid Ready Docs to Town	0 days	Mon 6/2/25	Mon 6/2/25
44	Town Finalizes Funding	8 wks	Mon 6/2/25	Fri 7/25/25
45	ENR Upgrade and Expansion Bidding	130 days	Mon 7/28/25	Fri 1/23/26
46	Town Prepares for Advertisement	4 wks	Mon 7/28/25	Fri 8/22/25
47	Advertise	12 wks	Mon 8/25/25	Fri 11/14/25
48	Open Bids	0 days	Mon 11/17/25	Mon 11/17/25
49	Bid Review	2 wks	Mon 11/17/25	Fri 11/28/25
50	Bid Recommendation to MDE	0 days	Mon 12/1/25	Mon 12/1/25
51	MDE Bid Review	4 wks	Mon 12/1/25	Fri 12/26/25
52	Construction NTP	4 wks	Mon 12/29/25	Fri 1/23/26
53	ENR Upgrade and Exp Construction	910 days	Mon 1/26/26	Mon 7/23/29
54	Issue PO's	2 wks	Mon 1/26/26	Fri 2/6/26
55	Shop Drawing Submittals and Review	16 wks	Mon 2/9/26	Fri 5/29/26
56	Major Equipment Deliver	36 wks	Mon 6/1/26	Fri 2/5/27
57	Mobilize Site	0 days	Mon 2/8/27	Mon 2/8/27
58	Construction	104 wks	Mon 2/8/27	Fri 2/2/29
59	Substantial Completion	0 days	Mon 2/5/29	Mon 2/5/29

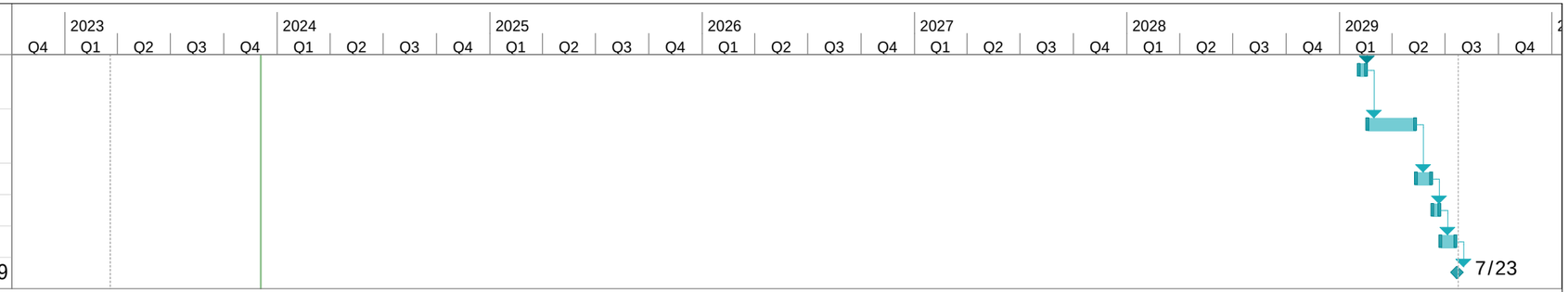


Project: Centreville WWTP ENR
Date: Mon 12/4/23

Task	Project Summary	Manual Task	Start-only	Deadline			
Split	Inactive Task	Duration-only	Finish-only	Progress			
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress			
Summary	Inactive Summary	Manual Summary	External Milestone				

Figure 1.5: Upgrade and Expansion Schedule

ID	Task Name	Duration	Start	Finish
60	Operations Process Training	2 wks	Mon 2/5/29	Fri 2/16/29
61	Commissioning and Start Up	12 wks	Mon 2/19/29	Fri 5/11/29
62	Process Testing	4 wks	Mon 5/14/29	Fri 6/8/29
63	Develop Punchlist	2 wks	Mon 6/11/29	Fri 6/22/29
64	Project Closeout	4 wks	Mon 6/25/29	Fri 7/20/29
65	Final Completion	0 days	Mon 7/23/29	Mon 7/23/29



Project: Centreville WWTP ENR
Date: Mon 12/4/23

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone	

Figure 1.5: Upgrade and Expansion Schedule

2 Background

2.1 Introduction

The Town of Centreville, established in 1782, is the county seat of Queen Anne's County and is the County's largest incorporated municipality with an estimated 2020 population of about 4,700 people. The Town, located on Corsica River is situated in the center of Queen Anne's County and is geographically positioned in the middle of Maryland's Eastern Shore.

The Town of Centreville Board of Commissioners owns the Centreville WWTP located at 116 Johnstown Lane, Centreville, MD. The Centreville WWTP has a surface water discharge permit, state number 20-DP-0116 and NPDES discharge permit number MD0020834, and a groundwater discharge permit, state number 20-DP-3323 and NPDES discharge permit number MD3323R05. Each permit allows 0.542 MGD annual average flow to be discharged. The Centreville WWTP has had an average daily flow of 0.40 MGD for the calendar years 2014 through 2022. The Town has experienced steady growth over the past several years and has been approached by multiple developers with plans to develop in the growth areas surrounding the current Town limits.

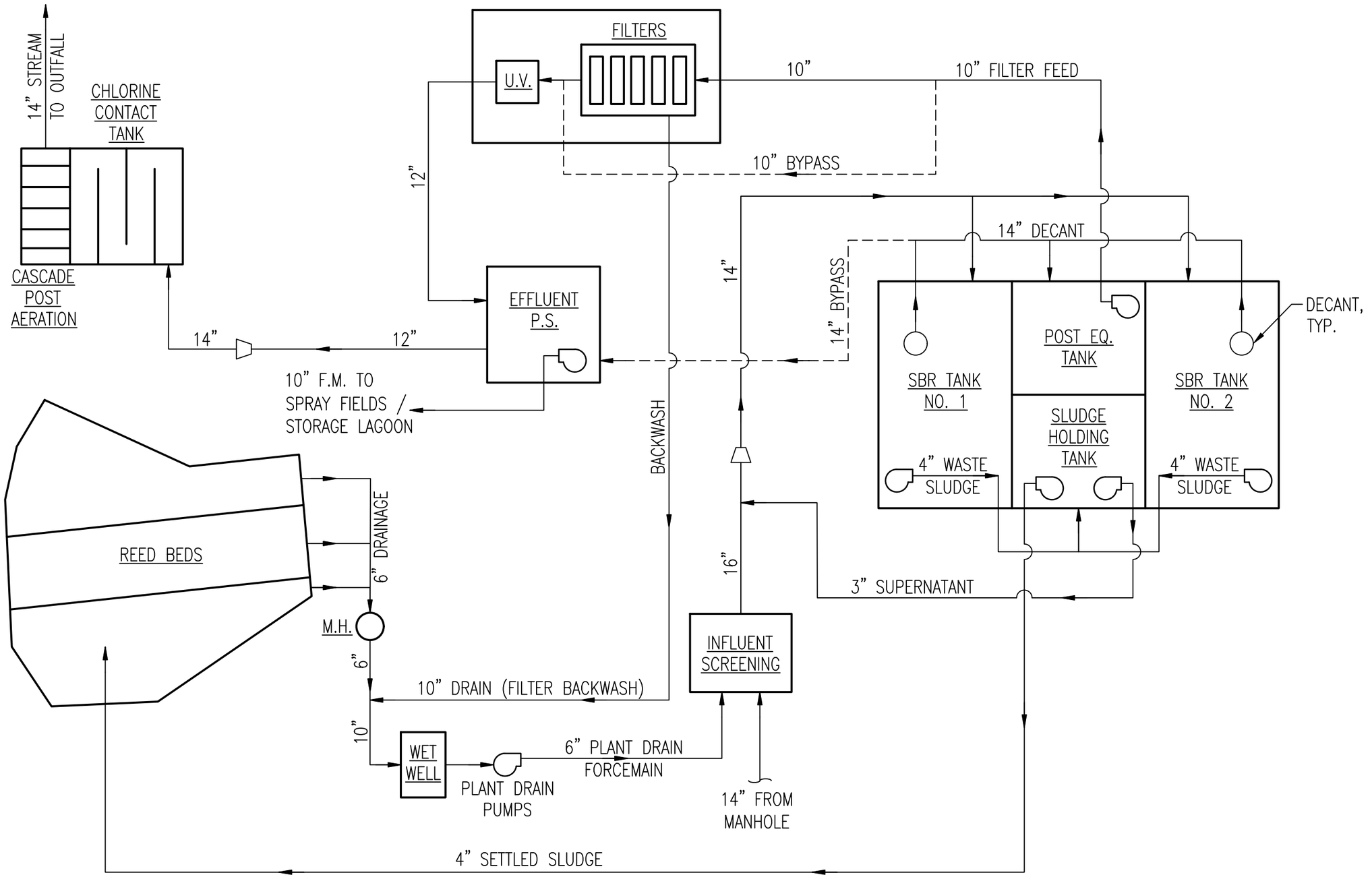
The Centreville WWTP was originally constructed in 1963, with a major upgrades and expansion that was completed in 2003. The 2003 modifications included an upgrade of the facility to achieve BNR levels of treatment. The nutrient removal process at the Centreville WWTP consists of a two-tank SBR with chemical addition for phosphorous precipitation and cloth media filtration, as can be seen in **Figure 2.1**. The facility effluent total nitrogen and total phosphorus monthly average permit concentrations when discharging to surface waters are 5.5 and 1.0 mg/L, respectively.

Figure 2.1: Centreville WWTP SBR

2.2 Existing Facilities

The facility provides preliminary treatment, with an activated sludge process for secondary biological nutrient removal, tertiary particulate filtration, followed by effluent disinfection with ultraviolet (UV) light, and final post aeration. Final effluent from the plant can be discharged to the Gravel Run stream December 1 to March 31, and groundwater application via spray irrigation from March 1 through December 15. A 20 million gallon (MG) working volume effluent storage lagoon is located adjacent to the spray irrigation fields. Sludge generated in the treatment process is stored in an aerated storage tank and applied and dried in reed beds. Periodically, the reed beds are removed an disposed of by land application.

Figure 2.2 provides the existing process flow diagram (PFD).



EXISTING PROCESS FLOW DIAGRAM

SCALE: NONE

REVISIONS		

CLIENT INFORMATION

TOWN OF CENTREVILLE
CENTREVILLE, MD

WWTP UPGRADE

KEY PLAN

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CENTREVILLE WWTP EXISTING PROCESS FLOW DIAGRAM

FIGURE NO.

2.2

SCALE: NONE		
DATE: DECEMBER 2023	SHEET XX OF XX	
DES: LMA	DRAWN: LMA	CHECK: DRN

Figure 2.3 provides an overview of the existing treatment process facilities at the Centreville WWTP.

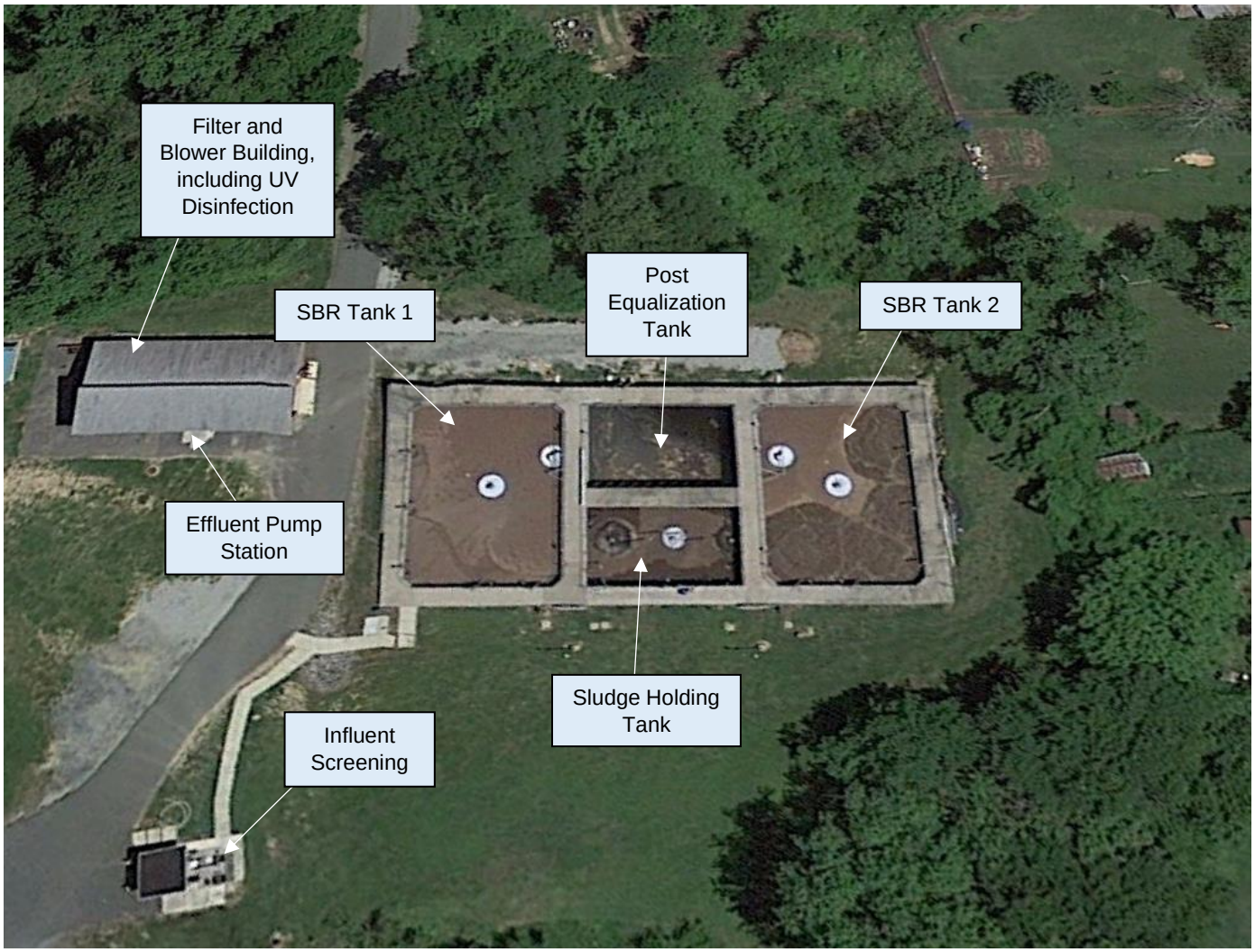


Figure 2.3: Existing Treatment Facilities (Credit: Google Earth)

Figure 2.4 provides an overview of the existing sludge reed drying beds, chlorine contact tank, Laboratory and Administration Building, and the influent screening.

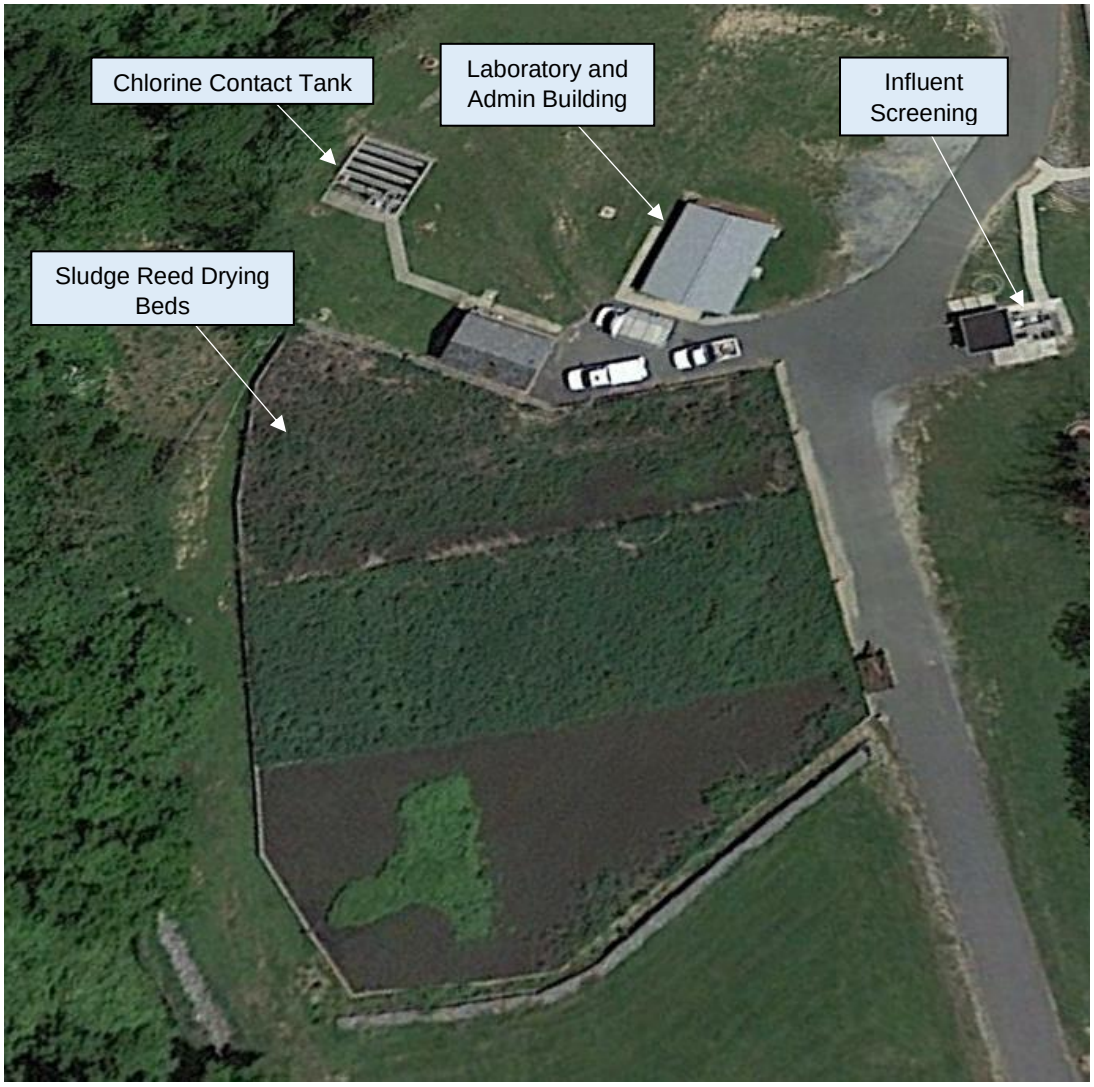


Figure 2.4: Further Existing Facilities (Credit: Google Earth)

2.3 Objective

The overall objective for the project is to expand the liquid and solids treatment and treated effluent disposal capacity to both meet the needs of the anticipated growth within the service area, as well as meet ENR level treatment and continue compliance with the NPDES discharge permit(s). In concert with the upgrade, the supporting facilities, including the laboratory, office space, and backup power system, will be upgraded. An on-site non-potable water system will be added to allow for the use of treated effluent for a variety of applications, which will increase the efficiency of the plant.

2.3.1 Treatment Quality Goals

Under the plant's current NPDES discharge permits, treated effluent is disposed into Gravel Run, a tributary to Corsica River, during the period between December 1 through March 31. No stream discharge is permitted from April 1 through November 30 and during this period effluent up to the permitted capacity is disposed of by offsite spray irrigation to ground waters through a separate permit (both the stream permit and the ground water permit are included in **Appendix B**).

With the proposed treatment capacity expansion, the effluent disposal capacity will need to be expanded as well and the Town envisions a combination of spray irrigation and year-round stream discharge. However, year-round stream discharge will require a relocation of the current Gravel Run outfall to a new outfall location further downstream and directly into Corsica River as identified in MDE's Nutrient TMDL for Corsica River. As such, with the capacity expansion, the Town intends to replace the current BNR treatment process with enhanced nutrient removal (ENR) technology to meet TN and TP effluent levels of 3.0 mg/L and 0.3 mg/L, respectively.

3 Project Planning

3.1 Cost and Effectiveness Analysis

The development of viable treatment alternatives considers and weights monetary and non-monetary factors to deliver a project that meets the treatment objectives, is resilient, preserves natural resources, and is cost effective. The Town of Centreville WWTP ENR Upgrade and Expansion project is similar to other WWTP upgrade projects in Maryland that have implemented enhanced nutrient removal, and the alternatives propose to utilize equipment and treatment processes that have been proven successful and cost effective elsewhere.

Components that do preserve natural resources and are cost effective are incorporated into the project wherever practical. Examples include the inclusion of a treated effluent supplied non-potable water system for onsite process water uses in place of potable water, and the use of slow speed sludge dewatering equipment that draws less power than high rotational speed centrifuges.

Throughout the design process, there will be opportunities to select equipment that provides energy and water efficiency. Examples include:

1.) Selecting influent screens that require less wash water,
2.) Specifying the latest generation of UV light disinfection equipment,
3.) Utilizing high efficiency process blowers,
4.) Incorporating process controls and instrumentation that automatically maintains the treatment process and reduces energy use.

The alternatives selected will all meet the treatment goals. The non-monetary evaluation incorporates components for considering the following:

1.) Reuse of existing assets,
2.) Compatibility with future upgrades to meet ever more stringent regulations,
3.) Water reuse and,
4.) Long term project maintainability.

The Town is interested in water reuse, including treated effluent water use onsite for processes where currently potable water is used and non-potable water can be used instead, consideration for future Class III or IV reclaimed water use off-site, and planning for potential future direct or indirect potable water reuse.

3.2 Environmental Resources

A desktop analysis was conducted to identify environmental resources within the project study area. These resources include the United States Fish and Wildlife Service (USFWS) National Wetland Inventory, the Maryland Department of Natural Resources (MDNR) Wetlands, Maryland Department of the Environment (MDE) Wetlands of State Special Concern (WSSC), Federal Emergency Management Agency (FEMA) Floodplain data, MDE Tier II (High Quality) Waters, Chesapeake Bay Critical Areas (CBCA), Forest Interior Dwelling Species (FIDS) Habitat, MDNR Sensitive Species Project Review Areas (SSPRA), and Maryland Bird Conservation Partnership's bald eagle nest locations.

In addition to the desktop analysis, Coastal Resources, Inc. (CRI) conducted a site visit in July – August 2023 to conduct a waters of the U.S. (including wetlands) delineation and to map forest resources and other habitats. Wetlands were assessed in accordance with the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic Gulf and Coastal Plain Region, Version 2.0* (USACE 2010). All identified waters of the U.S., including wetlands, were classified according to *A Classification of Wetland and Deep-Water Habitats in the United States* (USFWS 1979).

Terrestrial habitats within the study area were broadly assessed to document their general physical condition and quality. Forest stands were characterized by successional stage, dominant and codominant species, size class, common understory and herbaceous species, percent canopy closure, prevalence of downed woody debris, presence of invasive species, and basal area. CRI also identified specimen trees with a 30-inch diameter at breast height (DBH) or higher, or that have a diameter which is 75% of the State Champion of that species, including the location, species, size, and health of each specimen tree. A summary of the results of the site visit is included below.

3.2.1 Desktop Analysis

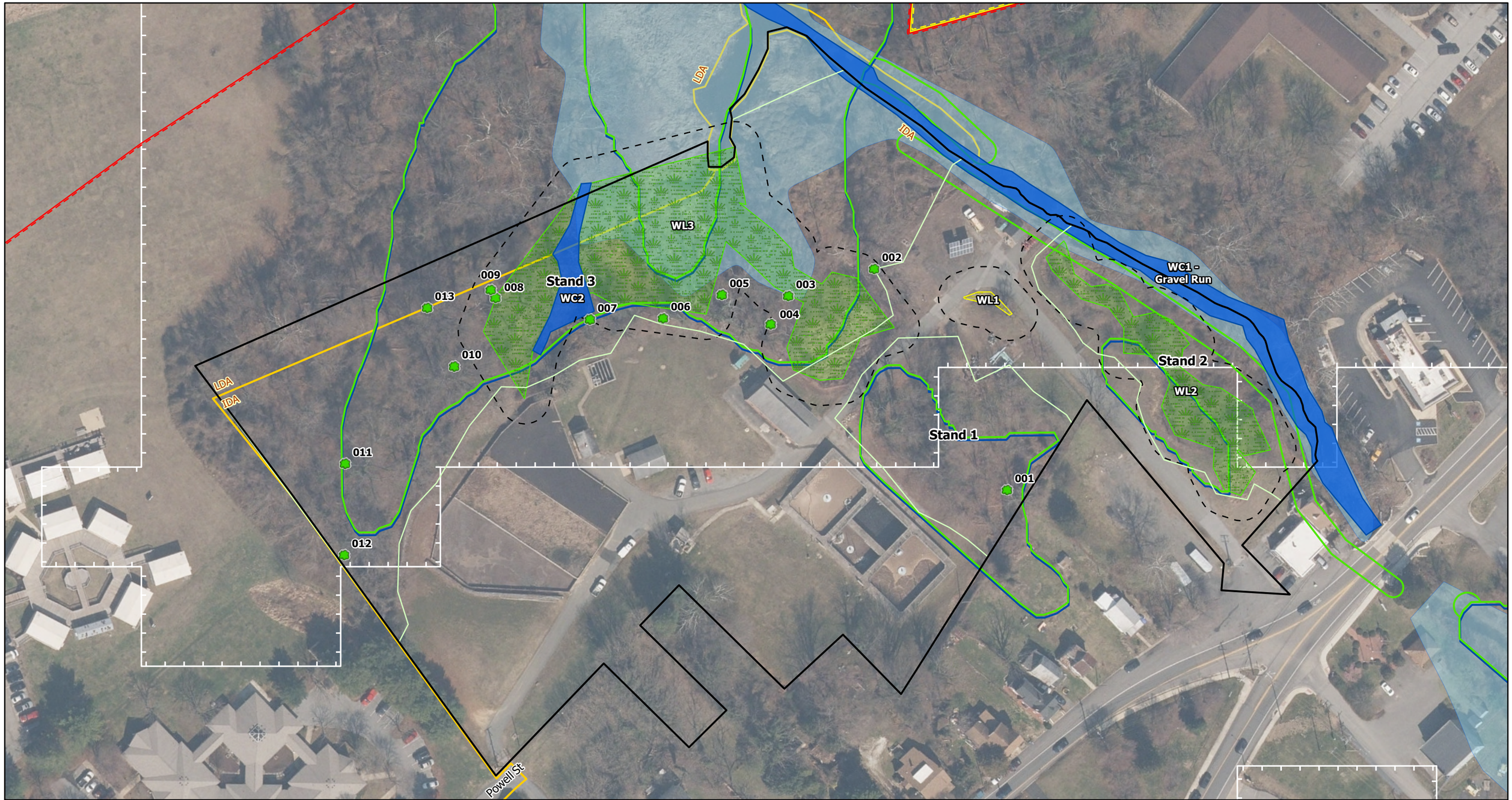
Based on the desktop analysis, several environmental resources are present within the study area, including CBCA, FIDS habitat, MDE Tier II (High Quality) Waters, 100-year floodplains, and wetlands mapped by the NWI and DNR. No WSSC, SPRA, or bald eagle nests are mapped within the project study area. Mapped resources are depicted in **Figure 3.1**. The CBCA is located throughout the project study area and classified as an Intensely Developed Area (IDA). FIDS habitats are mapped in the forest areas surrounding the WWTP property. The entire project study area is within the Gravel Run 1 Tier II (High Quality) catchment. A 100-year floodplain is present on the northern portion of the study area associated with Gravel Run. A palustrine emergent (PEM) wetland was mapped by the NWI on the northern portion of the project area. In addition to NWI, DNR mapped palustrine forested (PFO) and estuarine intertidal emergent (E2EM) wetlands in the forested areas just north of the WWTP site.

3.2.2 Waters of the U.S. (Including Wetlands) Delineation

The results of the wetland delineation indicate that there are three vegetated wetlands and two perennial streams within the project study area (see **Figure 3.1**). Wetland 1 (WL1) is a small, isolated PEM wetland located in drainage swale adjacent to the WWTP entrance road. Wetland 2 is a PFO floodplain depressions on the eastern portion of the project study area associated with Gravel Run (WC1). Wetland 3 is also a PFO floodplain depression associated with an and an unnamed tributary to Gravel Run (WC2). Watercourse 1 (WC1) is Gravel Run, a lower perennial stream that flows northwest along the eastern boundary of the project study area. Watercourse 2 (WC2) is an unnamed lower perennial tributary to Gravel Run on the north-central portion of the project area that receives water from the treatment plant discharge.

3.2.3 Terrestrial Habitat

Terrestrial habitats include three forest stands on the northern portion of the study area (see **Figure 3.1**). Stand 1 consists of an early-mid succession ash-leaf maple (*Acer negundo*) – black locust (*Robinia pseudoacacia*) forest with abundant downed woody debris, high invasive plant cover, and fair structure. One specimen tree was identified in Stand 1. This stand was considered poor due to high invasive cover, fair structure, and an abundance of trash/rubble. Stand 2 consists of an early succession black willow (*Salix nigra*) – American elm (*Ulmus americana*) wetland forest. Downed woody debris was abundant in this stand, with moderate invasive plant cover, and poor structure. No specimen trees were identified in Stand 2. This stand was considered fair due to moderate invasive cover, presence of trash, and poor structure. Stand 3 consists of a mid-late succession tulip tree (*Liriodendron tulipifera*) – silver maple (*A. saccharinum*) forest with abundant downed woody debris and a total of 12 specimen trees. Due to the high invasive plant cover, abundance of dead/dying trees, and presence of trash/rubble, this stand was considered poor.



Centreville Wastewater Treatment Plant Expansion Project

Figure 3.1: Environmental Resources Map

Queen Anne's County, Maryland
November 2023

COASTAL RESOURCES INC.

- Study Area
- NWI Wetland
- DNR Wetland
- 100 Year Floodplain (1% Chance)
- Forest Interior Dwelling Species
- Chesapeake Bay Critical Area

Tier II Catchments 2021

- Assimilative Capacity Remaining
- No Assimilative Capacity Remaining

Delineated Wetlands & Waters

- 25' Wetland Buffer
- Palustrine Emergent Wetland
- Palustrine Forested Wetland
- Perennial Stream

Delineated Forest & Trees

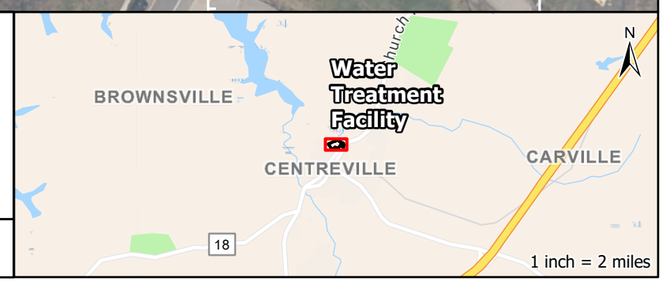
- Specimen Tree
- Forest Stand

N
W E
S

0 40 80
feet

1 inch = 90 feet

Map Center, NAD83
39.0486°, -76.0644°



Source: Large-scale map: Maryland iMAP, DoIT. Imagery flown in 2022 (Eastern Shore) and 2020 (Western Shore). Received November 2023. Small-scale map: Esri, HERE, Garmin, FAO, NOAA, USGS, OpenStreetMap contributors, and the GIS user community. Received November 2023.

3.3 Location

The project is located on Johnstown Lane within the town limits of the Town of Centreville which is the county seat of Queen Anne's County on the eastern shore of Maryland. The project will be on parcels currently owned by the Town Council of Centreville.

3.4 Population Trends

Population in the Town has grown from 2,018 in the 1980 census to 4,949 in the 2020 census, see **Table 3.1** and are expected to grow for at least several more years.

Table 3.1: Centreville Population Data

Year	1980	1990	2000	2010	2020
Population[1]	2,018	2,097	1,970	4,285	4,949
Growth Rate	8.9%	3.9%	-6.1%	117.5%	1.5%

https://www.census.gov/programs-surveys/popest/technical-documentation/research/evaluation-estimates/2020-evaluation-estimates/2010s-cities-and-towns-total.html

The data from **Table 3.1** is also depicted in **Figure 3.2**.

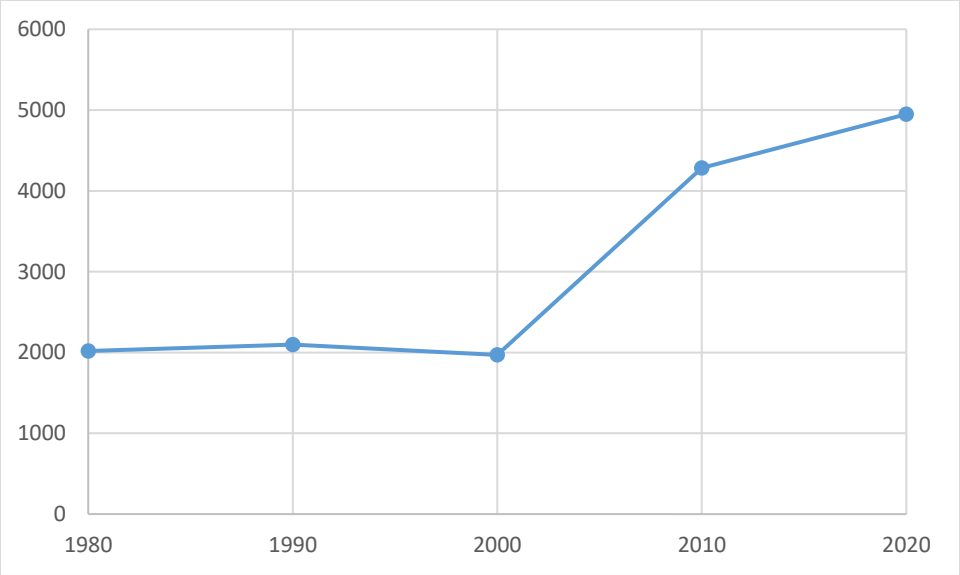


Figure 3.2: Centreville Population

According to the Queen Anne's County 2011 Comprehensive Water and Sewerage Plan:

> "The Growth Areas generally include parcels of land contiguous to the east and west sides of the current Town boundaries. It is anticipated that growth pressures will occur, for the most part, on the Route 301 side of Centreville, due to the multiple road connections. Present growth patterns in and near the Town support this premise. The Town anticipates a phased approach to annexation."

The Town of Centreville Community Plan, 2009, estimated total future wastewater demand of 1.62 MGD.

4 Existing Performance, Facilities, and Conditions

4.1 Location Map

The Centreville WWTP is located within a residential area of the town. **Figure 4.1** provides a location map to show the relative distance between Centreville WWTP and the irrigation spray fields.

Figure 4.1: Location Map (Credit: Google Earth)

4.2 History

The original portions of the Town's sewer collection system were installed in 1934. A primary wastewater treatment facility was constructed in the 1960's. A major upgrade was completed in 2005 that installed influent screening, a two (2) tank SBR, cloth media particulate tertiary filters, UV light disinfection, effluent pumping, treated effluent storage lagoons, spray irrigation fields, and reed drying beds. The treatment was designed to provide treatment for 0.542 MGD of annual average flow with an effluent total nitrogen of 5.5 mg/L.

The receiving stream, Gravel Run, is a tributary of the Corsica River. At the time of the planning and design of the 2005 upgrade and expansion, the total maximum daily loads for the Corsica River were being developed. To accommodate the planned flows, the Town decided to forgo year-round discharge to Gravel Run and developed a spray irrigation disposal system to provide 0.542 MGD of disposal capacity. Discharge to Gravel Run was restricted to cold weather months.

4.3 Financial Status

As described in **Section 3.4**, the Town has been experiencing growth within the existing water and sewer service areas. As the largest town in Queen Anne's County, it's central location on the eastern shore, and its designation as a Smart Growth area, the population is expected to continue to grow significantly for many years. The Queen Anne's County Comprehensive Water and Sewer Plan indicates future build out flows will reach 1.75 MGD of sanitary flow.

The Town has invested significant funds into upgrading its water distribution and sanitary collection systems to improve their integrity and position them for future flows.

The Town's recent and budgeted water and sewer income and expenses are summarized in **Tables 4.1 and 4.2.**

Table 4.1: Recent Water and Sewer Income and Expenses

	Water		Sewer	
Fiscal Year (FY)	Income	Expenses	Income	Expenses
FY20	$844,402	$1,115,148	$891,258	$1,156,565
FY21	$1,029,299	$1,122,767	$1,135,004	$1,073,320
FY22	$1,343,266	$1,298,048	$1,366,296	$1,206,366
FY23 (Through 3/28/2023)	$604,136	$543,029	$591,252	$850,908

Table 4.2: Budgeted Water and Sewer Income and Expenses

	Water		Sewer	
Fiscal Year (FY)	Income	Expenses	Income	Expenses
FY24	$1,414,928	$1,616,603	$1,531,427	$1,510,483
FY25	$1,485,675	$1,697,433	$1,607,998	$1,586,007
FY26	$1,574,816	$1,782,305	$1,704,478	$1,665,307
FY27	$1,685,053	$1,871,420	$1,826,791	$1,781,878
FY28	$1,819,857	$1,964,991	$1,972,694	$1,870,972

The existing debt service held by the Town for the water and wastewater systems are summarized in **Table 4.3**.

Table 4.3: Existing Debt Service

Area	Existing Debt (as of March 2023)
Water	$5,075,189
Sewer	$4,960,400

4.4 Current Influent Conditions

Influent conditions are not measured on a regular basis at the Centreville WWTP. Operators are able to gather composite samples of the influent when required. Composite influent sampling data from September/October 2017 and March 2023 was provided by the Town of Centreville for evaluations in this PER. **Table 4.4** lists the existing estimated average and maximum monthly influent conditions, based on the available sampling data. **Appendix C** includes all data from influent sampling.

Table 4.4: Existing Influent Conditions at Centreville WWTP

Condition	Flow	Wastewater Temperature	Biochemical Oxygen Demand (BOD)	Volatile Suspended Solids (VSS)	Total Suspended Solids (TSS)	Total Kjeldahl Nitrogen (TKN)	Total Phosphorus (TP)
	(MGD)	(Deg C)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Average	1.0	20	130	116	145	35	8
Maximum Monthly	1.2	12	156	139	174	42	8

4.5 Existing Plant Performance

Operations collects samples for analysis at the plant effluent for annual quality reporting. The effluent quality data from the monthly operating reports (MORs) that is relevant to the ENR upgrades was reviewed. The annual average, maximum monthly, and peak daily effluent flows from both stream discharge and spray discharge are summarized in **Table 4.5**.

Table 4.5: Centreville WWTP Stream and Spray Effluent Flows

	Stream Effluent Flow (MGD)			Spray Effluent Flow (MGD)		
Year	Annual Average	Maximum Monthly Average	Peak Day Flow	Annual Average	Maximum Monthly Average	Peak Day Flow
2014	0.34	0.36	0.54	0.25	0.57	2.09
2015	0.38	0.44	0.90	0.25	0.62	2.44
2016	0.45	0.47	0.60	0.25	0.51	1.88
2017	0.38	0.39	0.71	0.21	0.56	2.17
2018	0.49	0.66	0.93	0.36	0.64	2.05
2019	0.59	0.66	0.87	0.37	0.66	1.97
2020	0.51	0.71	0.93	0.37	0.52	1.72
2021	0.59	0.70	1.02	0.45	0.57	0.68
2022	0.46	0.49	0.68	0.39	0.42	0.69

The annual average and maximum monthly average for calendar years 2014 through 2022 for the total effluent flow, biochemical oxygen demand (BOD) concentration, total suspended solids (TSS) concentration, total kjeldahl nitrogen (TKN) concentration, ammonia (NH_3) concentration, nitrate + nitrite (NO_2 + NO_3) concentration, total nitrogen (TN) concentration, total phosphorus (TP) concentration, and E. coli concentration are included in **Tables 4.6 through 4.9**. **Tables 4.6 and 4.7** summarize the effluent quality of the stream discharge, which occurs during the winter months (December to March). **Tables 4.8 and 4.9** summarize the effluent quality of the spray discharge, which occurs throughout the warmer months of the year (April to November). **Appendix C** includes all available weekly average data for these categories.

Table 4.6: Centreville WWTP Stream Effluent BOD, TSS, TKN, and Ammonia Concentrations								
	Effluent BOD (mg/L)		Effluent TSS (mg/L)		Effluent TKN (mg/L)		Effluent Ammonia (mg/L)	
Year	Annual Average	Maximum Monthly Average	Annual Average	Maximum Monthly Average	Annual Average	Maximum Monthly Average	Annual Average	Maximum Monthly Average
2014	4.19	5.75	3.53	4.38	1.20	1.93	0.50	1.07
2015	3.15	4.05	1.31	2.19	0.71	1.07	0.14	0.17
2016	2.15	2.62	1.21	1.38	0.45	0.55	0.17	0.21
2017	2.50	3.03	1.77	2.60	0.85	0.97	0.20	0.32
2018	3.44	4.21	2.80	3.83	1.13	1.49	0.37	0.62
2019	2.02	2.78	0.99	1.13	0.72	0.88	0.28	0.35
2020	1.87	2.43	0.79	1.00	1.34	3.38	0.41	0.52
2021	1.63	1.87	2.84	7.83	1.86	2.07	0.54	0.90
2022	2.40	3.89	2.08	3.00	1.74	2.21	0.63	0.81
Overall Average	**2.76**		**1.77**		**0.91**		**0.29**	

Table 4.7: Centreville WWTP Stream Effluent Total NO_2 + NO_3, TN, TP, and E. Coli Concentrations								
	Effluent Total NO_2 + NO_3 (mg/L)		Effluent TN (mg/L)		Effluent TP (mg/L)		Effluent E. Coli (MPN/100 mL)	
Year	Annual Average	Maximum Monthly Average	Annual Average	Maximum Monthly Average	Annual Average	Maximum Monthly Average	Annual Average	Maximum Monthly Average
2014	2.09	2.60	3.29	4.20	0.25	0.75	1.28	1.90
2015	1.89	2.24	2.61	2.88	0.18	0.26	4.52	12.4
2016	2.32	2.98	2.76	3.39	0.21	0.25	4.80	41.2
2017	1.46	1.70	2.32	2.67	0.46	0.64	1.22	9.98
2018	1.72	2.06	2.91	3.38	0.45	0.78	20.6	42.9
2019	1.83	2.65	2.55	3.39	0.66	1.12	31.3	91.6
2020	1.21	1.48	2.55	4.87	0.88	1.05	118	185
2021	1.63	2.54	3.15	3.55	0.68	0.95	461	1148
2022	1.39	2.42	2.82	3.31	1.16	2.14	2.40	538
Overall Average	**1.79**		**2.71**		**0.44**		**25.93**	

Table 4.8: Centreville WWTP Spray Effluent BOD, TSS, TKN, and Ammonia Concentrations								
	Effluent BOD (mg/L)		Effluent TSS (mg/L)		Effluent TKN (mg/L)		Effluent Ammonia (mg/L)	
Year	Annual Average	Maximum Monthly Average	Annual Average	Maximum Monthly Average	Annual Average	Maximum Monthly Average	Annual Average	Maximum Monthly Average
2014	2.72	3.88	4.22	4.50	0.82	1.09	0.22	0.27
2015	3.87	6.26	3.03	6.08	0.85	1.20	0.18	0.27
2016	3.44	5.22	1.57	3.22	0.81	1.36	0.23	0.64
2017	3.17	4.08	1.52	3.00	0.90	1.30	0.16	0.30
2018	2.76	4.63	1.17	1.63	1.09	1.77	0.19	0.75
2019	1.27	1.64	0.67	0.94	0.98	1.14	0.18	0.28
2020	1.76	2.69	0.86	1.44	1.00	1.95	0.40	1.03
2021	2.41	3.70	1.89	3.00	1.96	3.48	0.57	2.22
2022	2.06	2.75	2.35	4.50	1.37	1.67	0.37	0.60
Overall Average	**2.71**		**1.86**		**0.92**		**0.22**	

Table 4.9: Centreville WWTP Spray Effluent Total NO_2 + NO_3, TN, TP, and E. Coli Concentrations								
	Effluent Total NO_2 + NO_3 (mg/L)		Effluent TN (mg/L)		Effluent TP (mg/L)		Effluent E. Coli (MPN/100 mL)	
Year	Annual Average	Annual Average	Annual Average	Maximum Monthly Average	Annual Average	Maximum Monthly Average	Annual Average	Maximum Monthly Average
2014	2.28	2.28	3.10	3.46	0.79	1.18	3.54	11.5
2015	1.62	1.62	2.31	2.71	1.13	1.86	2.72	6.67
2016	1.58	1.58	2.39	2.88	2.02	3.15	2.57	6.37
2017	1.42	1.42	2.30	2.96	1.82	2.54	5.99	14.6
2018	1.58	1.58	2.63	3.17	1.68	2.56	3.69	7.59
2019	1.58	1.58	2.56	2.93	1.67	2.54	5.22	23.3
2020	1.50	1.50	2.46	3.16	1.84	2.63	7.64	30.2
2021	2.03	2.03	3.77	5.09	1.58	2.41	236.15	908
2022	1.83	3.47	2.71	4.54	2.43	3.64	234.03	1223
Overall Average	**1.65**		**2.54**		**1.57**		**4.48**	

Since January 2014, Centreville WWTP has had an average stream effluent total flow of 0.45 MGD and an average spray effluent flow of 0.29 MGD. **Figures 4.2 and 4.3** show the monthly average stream and spray effluent flows from January 2014 to December 2022.

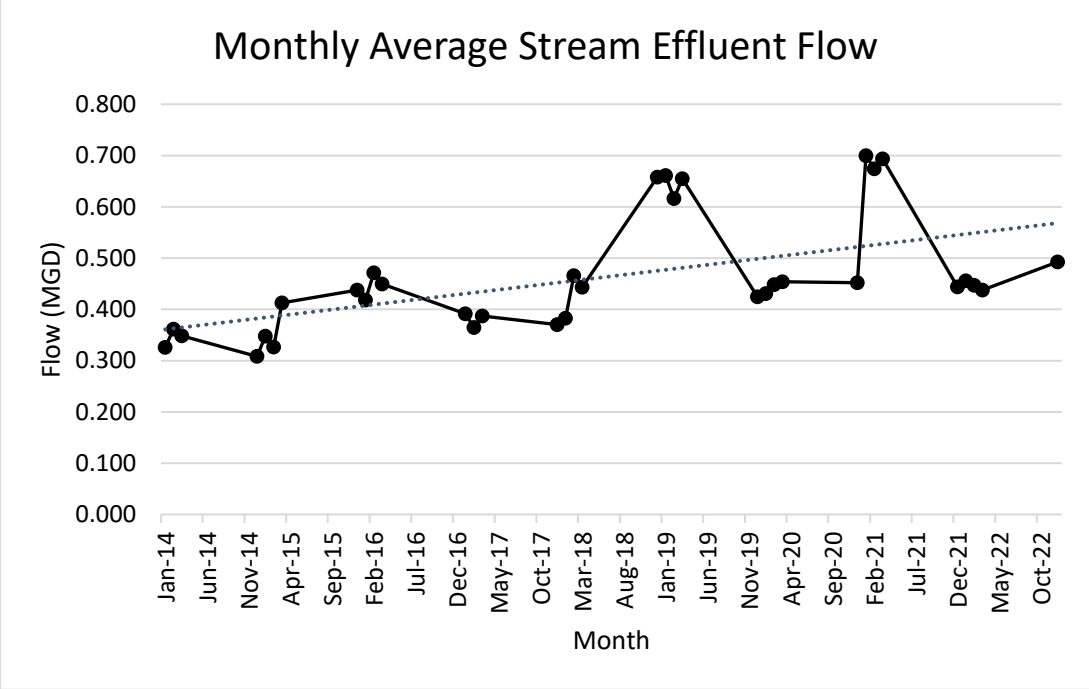


Figure 4.2: Stream Effluent Total Flow

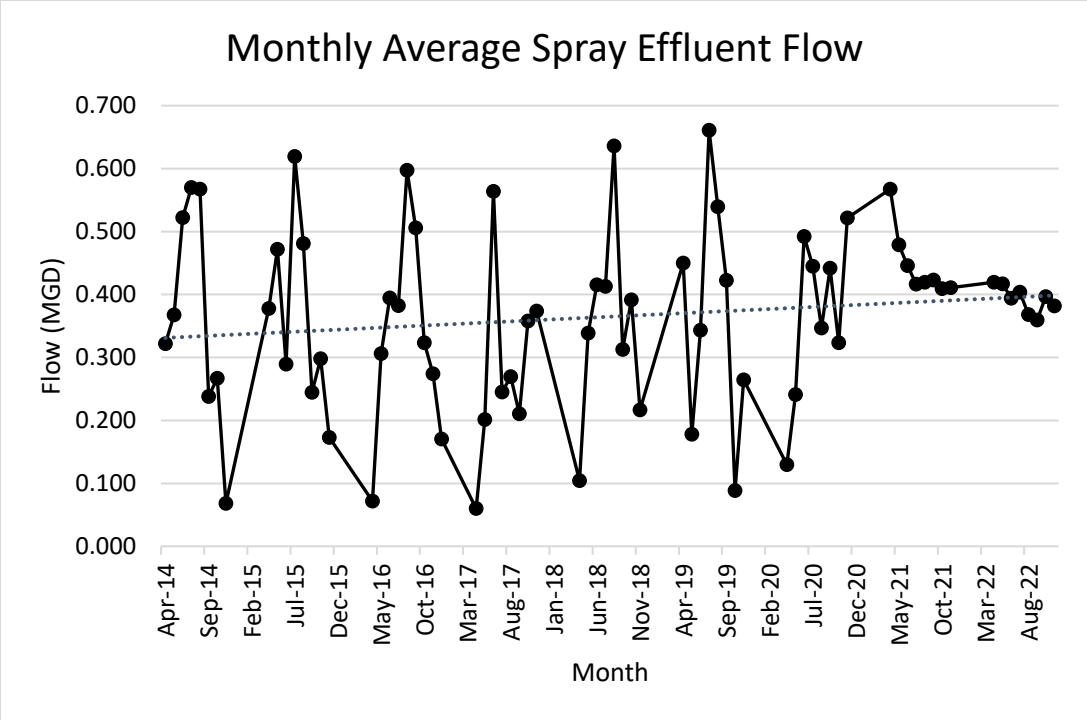


Figure 4.3: Spray Effluent Total Flow

Figures 4.4 and 4.5 show the monthly averages of effluent BOD concentrations from January 2014 to December 2022. Since January 2014, the average stream effluent BOD concentration is 2.76 mg/L, and the average spray effluent BOD concentration is 2.71 mg/L.

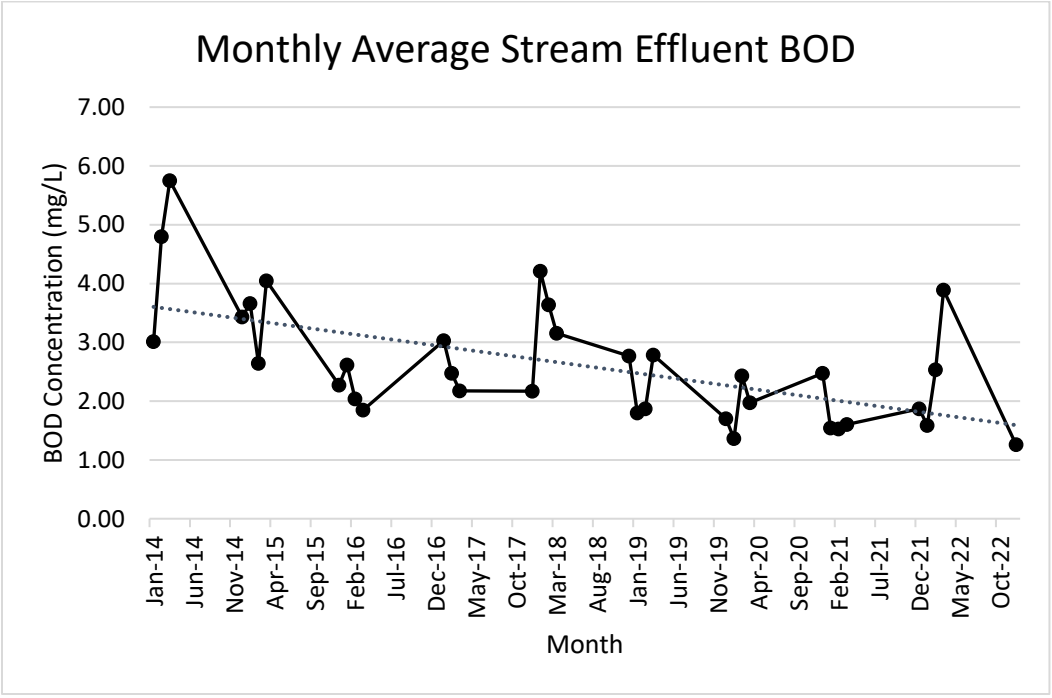


Figure 4.4: Stream Effluent BOD Concentration

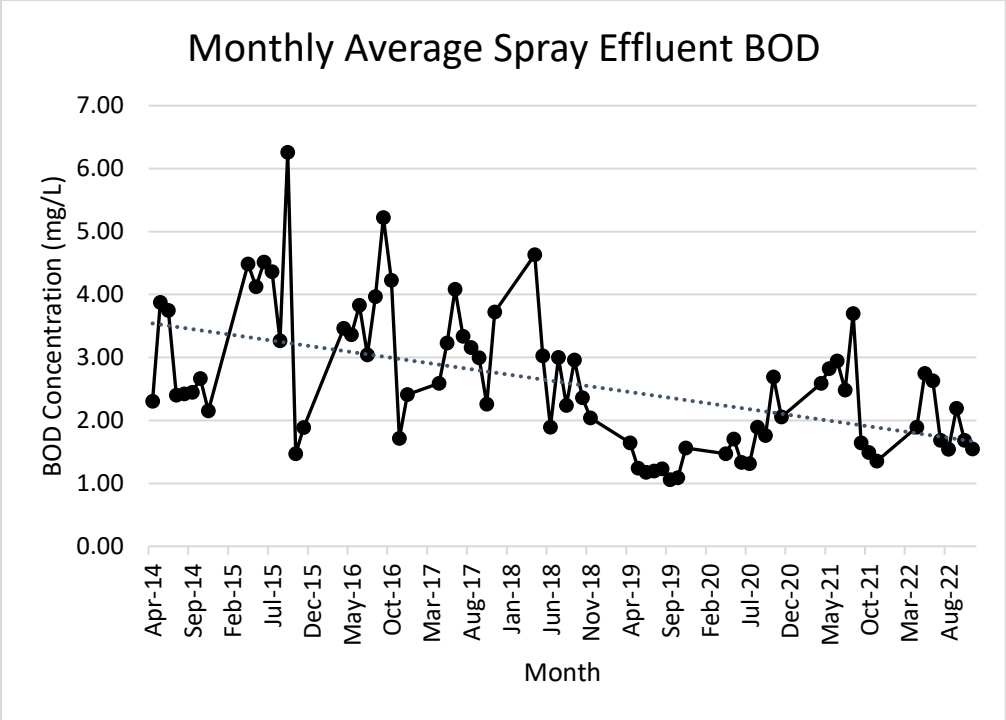


Figure 4.5: Spray Effluent BOD Concentration

Since January 2014, the average stream and spray effluent TSS concentrations are 1.77 mg/L and 1.86 mg/L, respectively. **Figures 4.6 and 4.7** show the monthly averages of effluent TSS concentrations from January 2014 to December 2022.

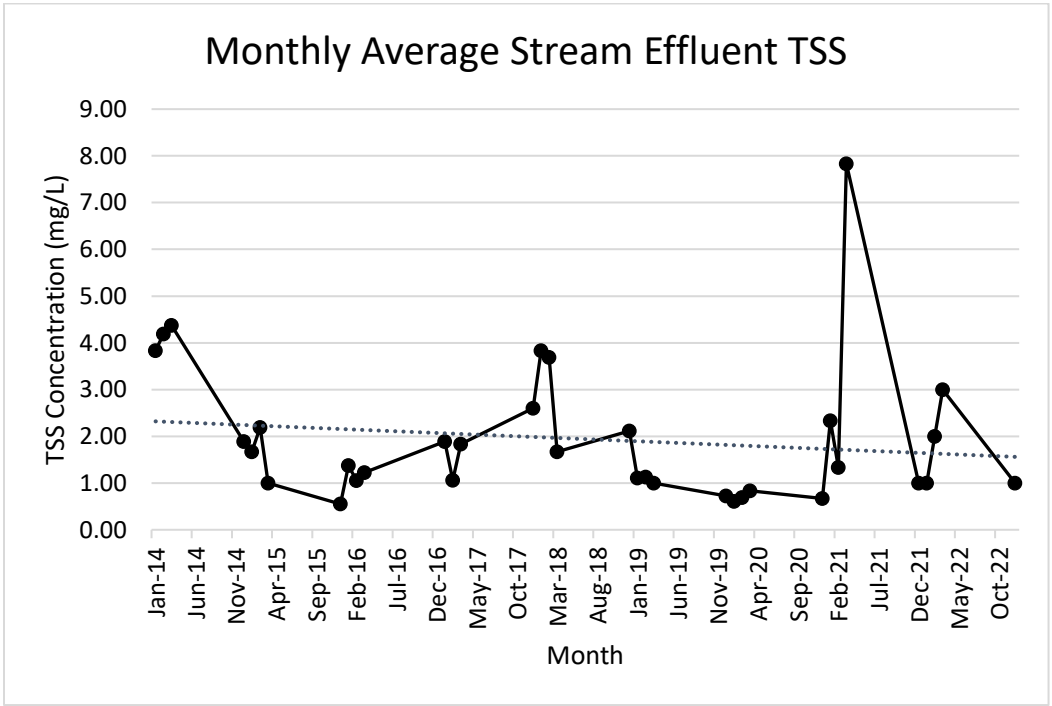


Figure 4.6: Stream Effluent TSS Concentration

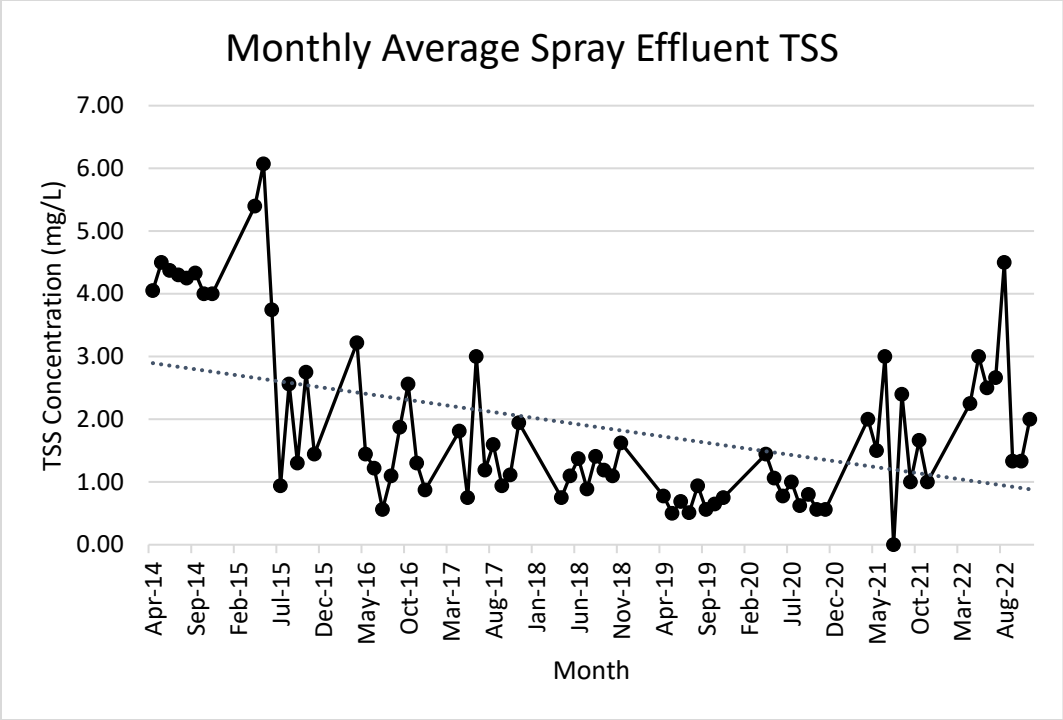


Figure 4.7: Spray Effluent TSS Concentration

Figures 4.8 and 4.9 show the monthly average stream and spray effluent TKN since January 2014. From January 2014 to December 2022, the average stream effluent TKN is 0.91 mg/L, and the average spray effluent TKN is 0.92 mg/L.

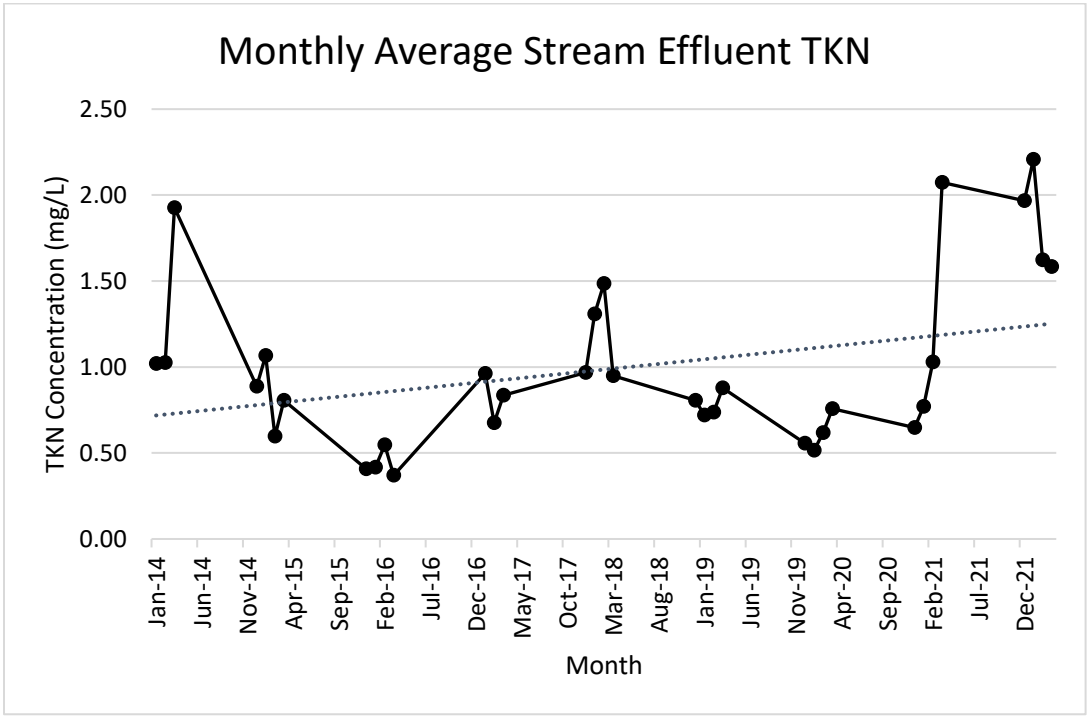


Figure 4.8: Stream Effluent TKN Concentration

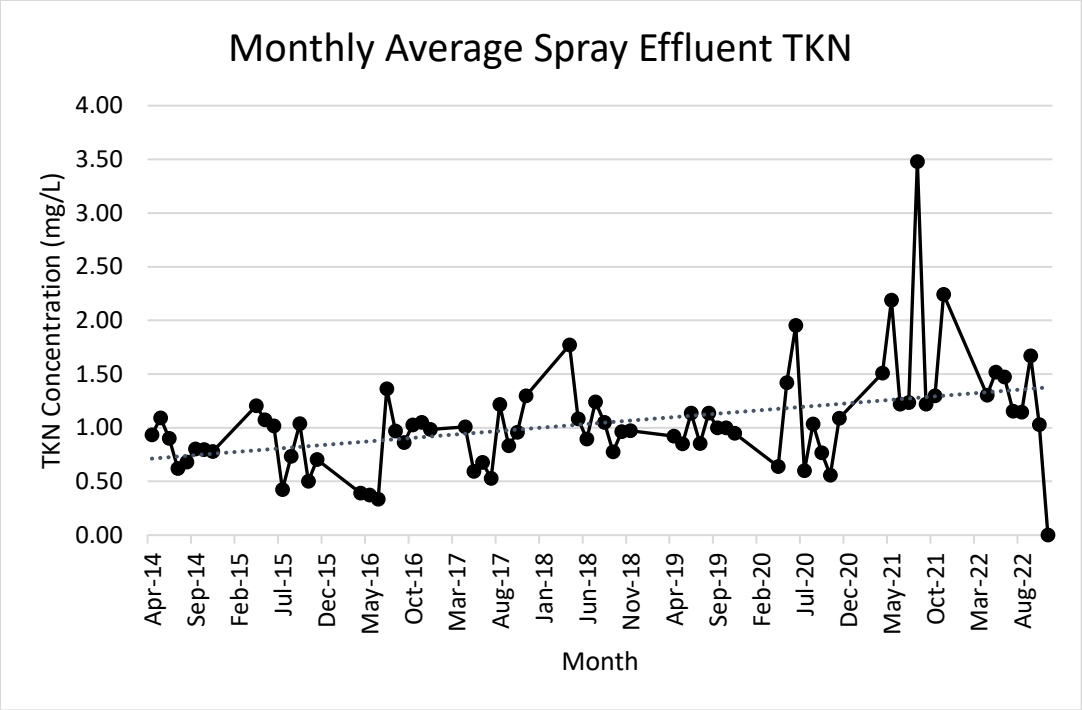


Figure 4.9: Spray Effluent TKN Concentration

Figures 4.10 and 4.11 show the monthly average stream and spray effluent ammonia since January 2014. Since January 2014, the average stream and spray effluent ammonia concentrations are 0.29 mg/L and 0.22 mg/L, respectively.

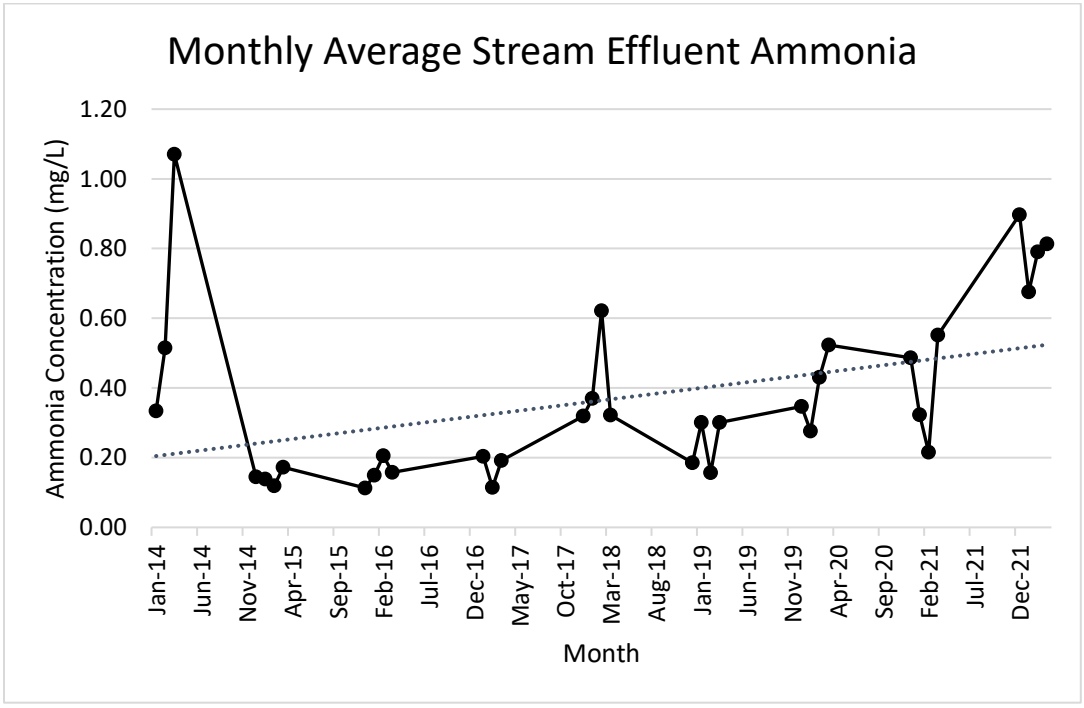


Figure 4.10: Stream Effluent Ammonia Concentration

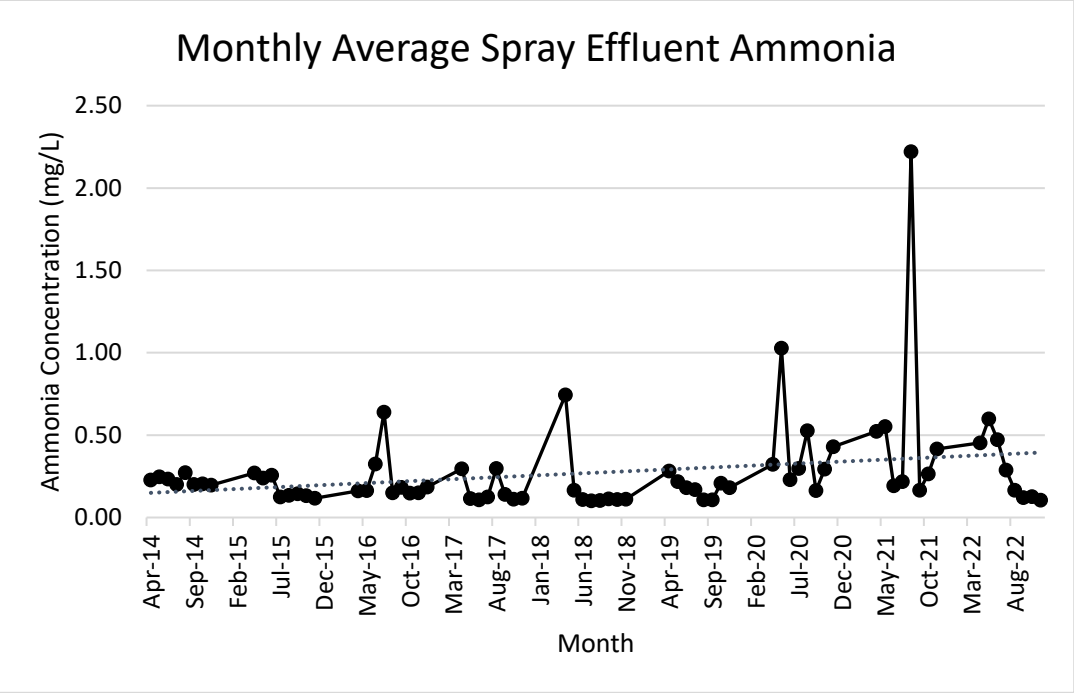


Figure 4.11: Spray Effluent Ammonia Concentration

Figures 4.12 and 4.13 show the monthly average nitrate plus nitrate (NO_3 + NO_2) concentrations in the stream and spray effluent from January 2014 to December 2022. On average, the NO_3 + NO_2 concentrations in the stream and spray effluent have been 1.79 mg/L and 1.65 mg/L, respectively, since January 2014.

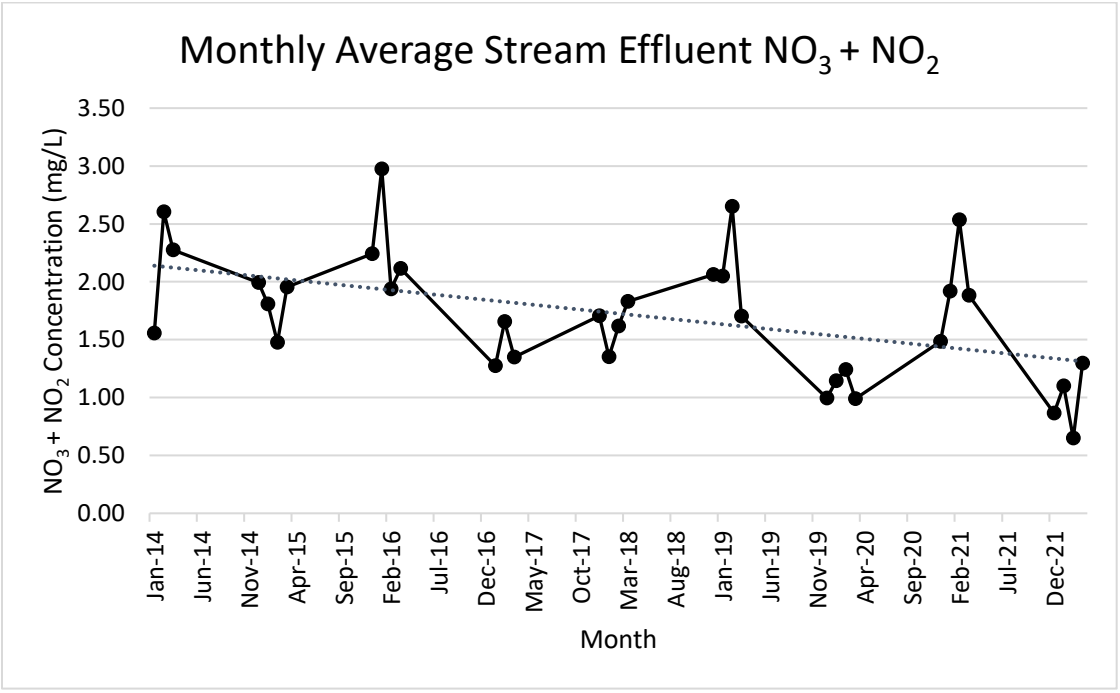


Figure 4.12: Stream Effluent NO_3 + NO_2 Concentration

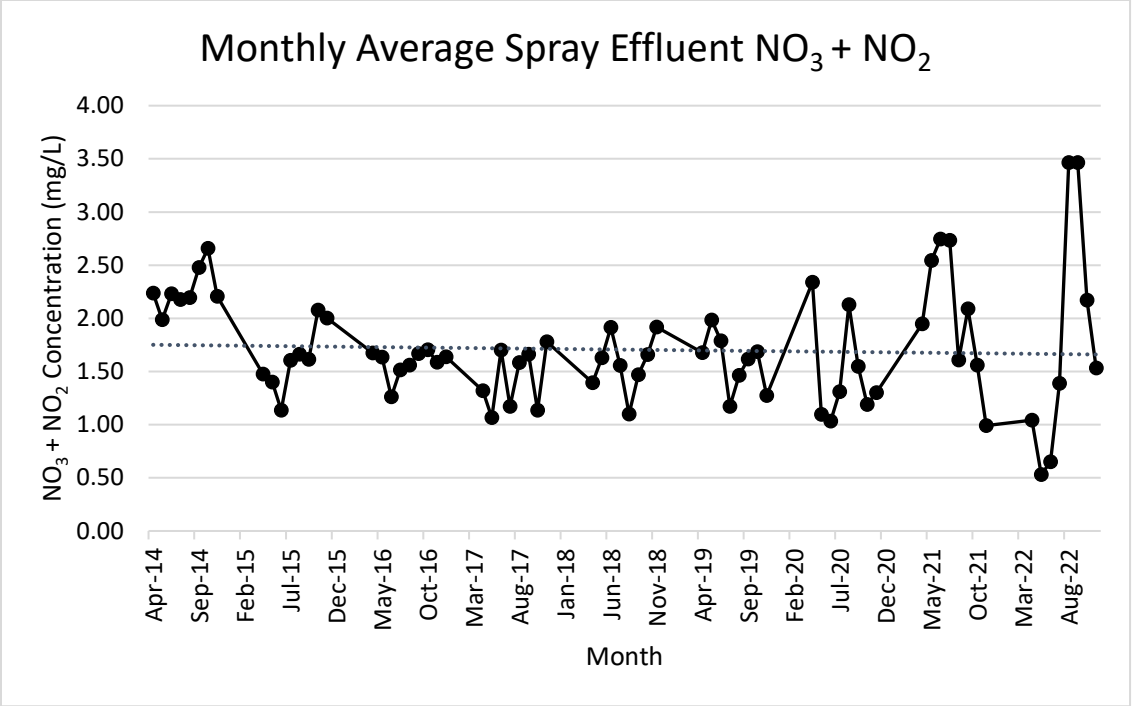


Figure 4.13: Spray Effluent NO_3 + NO_2 Concentration

The monthly average TN concentrations in the stream and spray effluent from January 2014 to December 2022 are shown in **Figures 4.14 and 4.15**. The average TN concentration in the stream effluent is 2.71 mg/L, and the average total nitrogen concentration in the spray effluent is 2.54 mg/L.

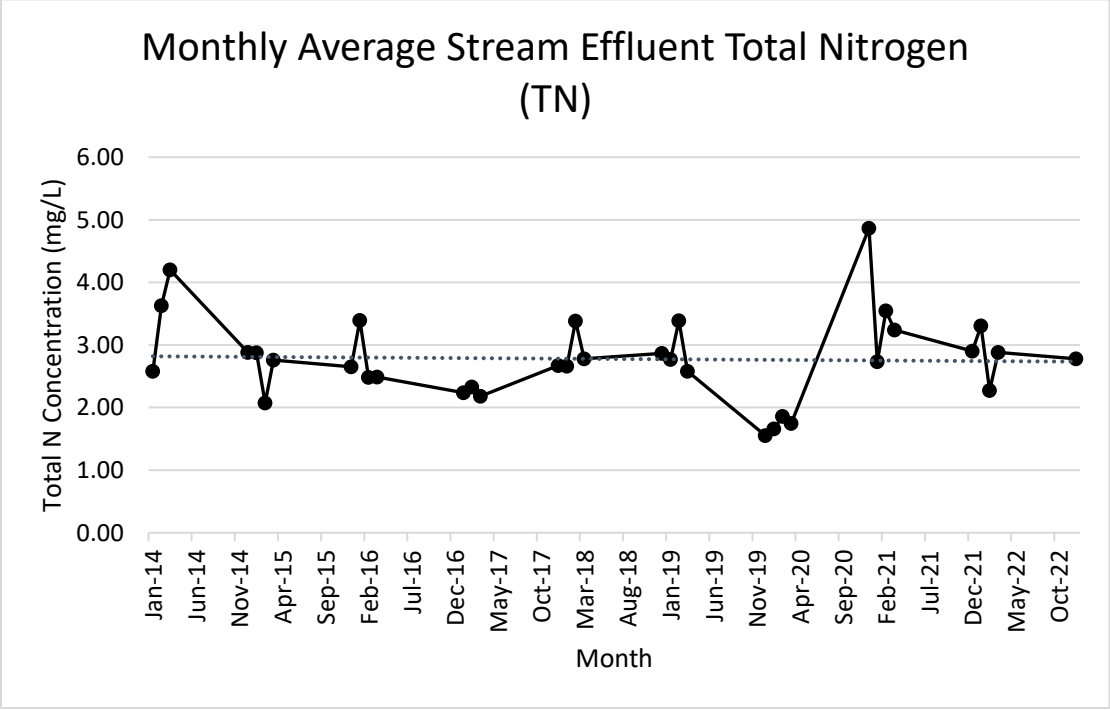


Figure 4.14: Stream Effluent Total Nitrogen Concentration

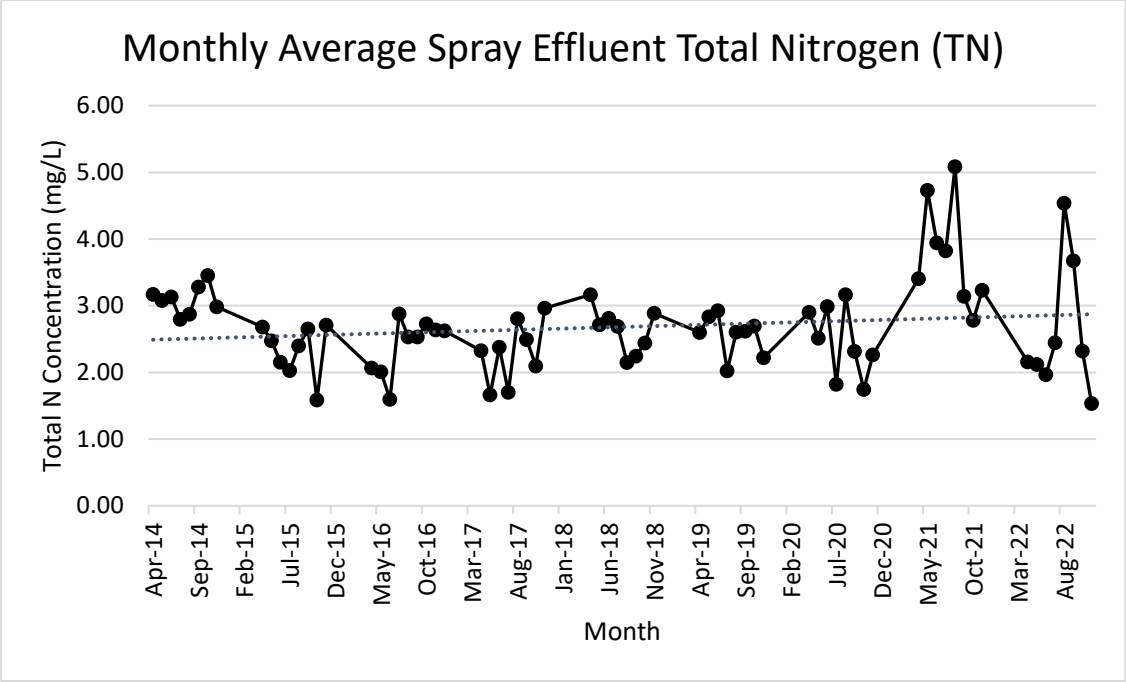


Figure 4.15: Spray Effluent Total Nitrogen Concentration

Figures 4.16 and 4.17 show the monthly average TP concentrations in the stream and spray effluent from January 2014 to December 2022. The overall average TP concentration in the stream effluent is 0.44 mg/L, and the overall average TP concentration in the spray effluent is 1.57 mg/L. The monthly average TP concentrations have increased over the recent years, which is likely due to the increased flow through the WWTP.

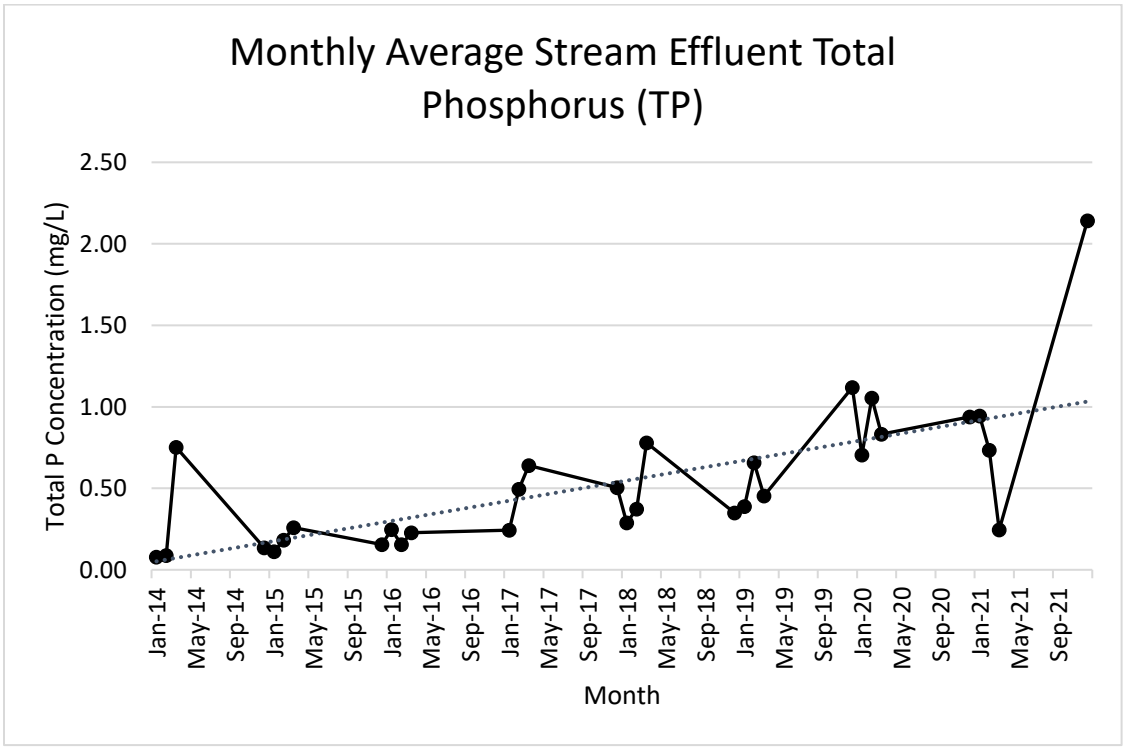


Figure 4.16: Stream Effluent Total Phosphorus Concentration

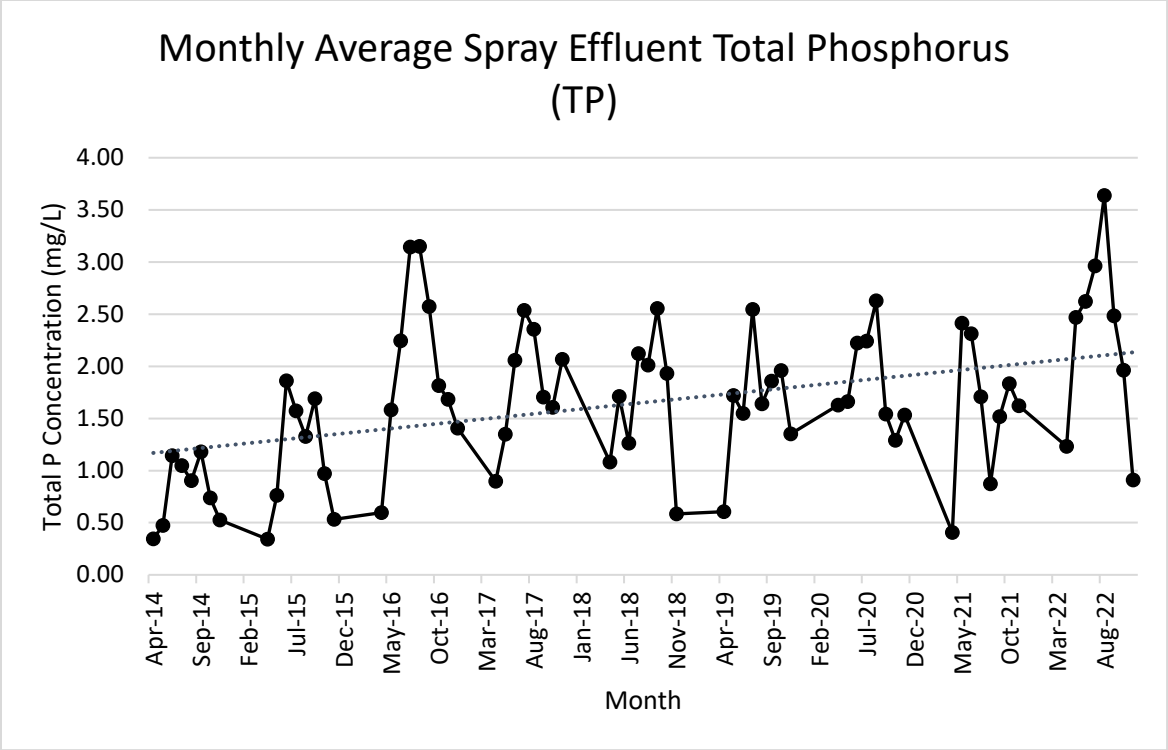


Figure 4.17: Spray Effluent Total Phosphorus Concentration

Since January 2014, Centreville WWTP has had an average stream effluent E. coli concentration of 25.9 MPN/100 mL and an average spray effluent E. coli concentration of 4.48 MPN/100 mL. **Figure 4.18 and Figure 4.19** show the monthly average stream and spray effluent E. coli concentrations from January 2014 to December 2022. E. coli concentrations have increased in the effluent in recent years due to the WWTP operating closer to its design capacity.

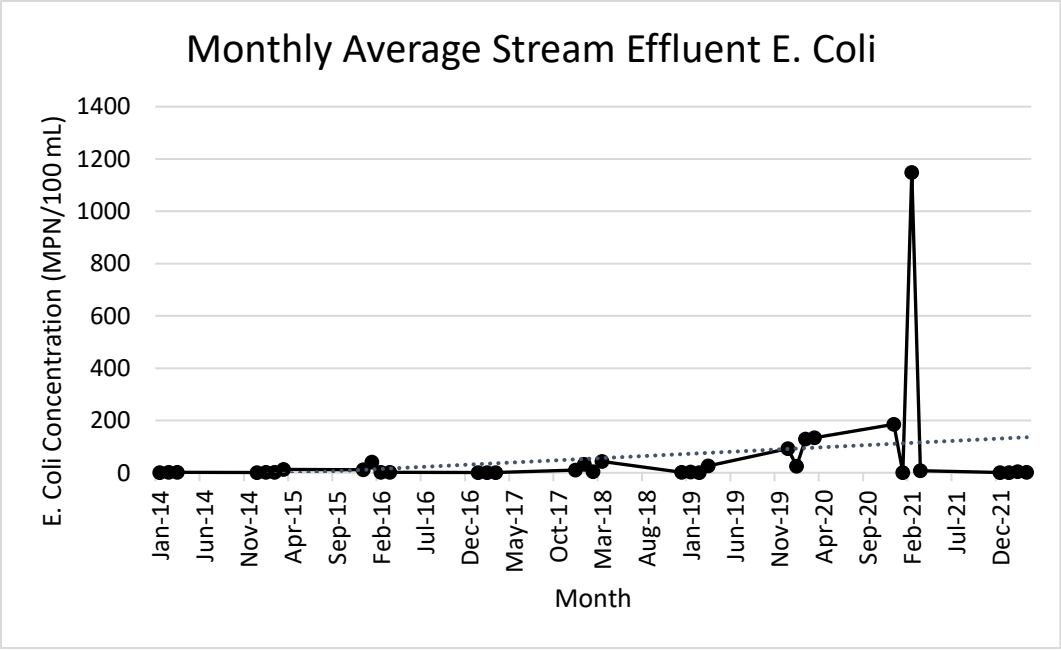


Figure 4.18: Stream Effluent Geomean E. Coli Concentration

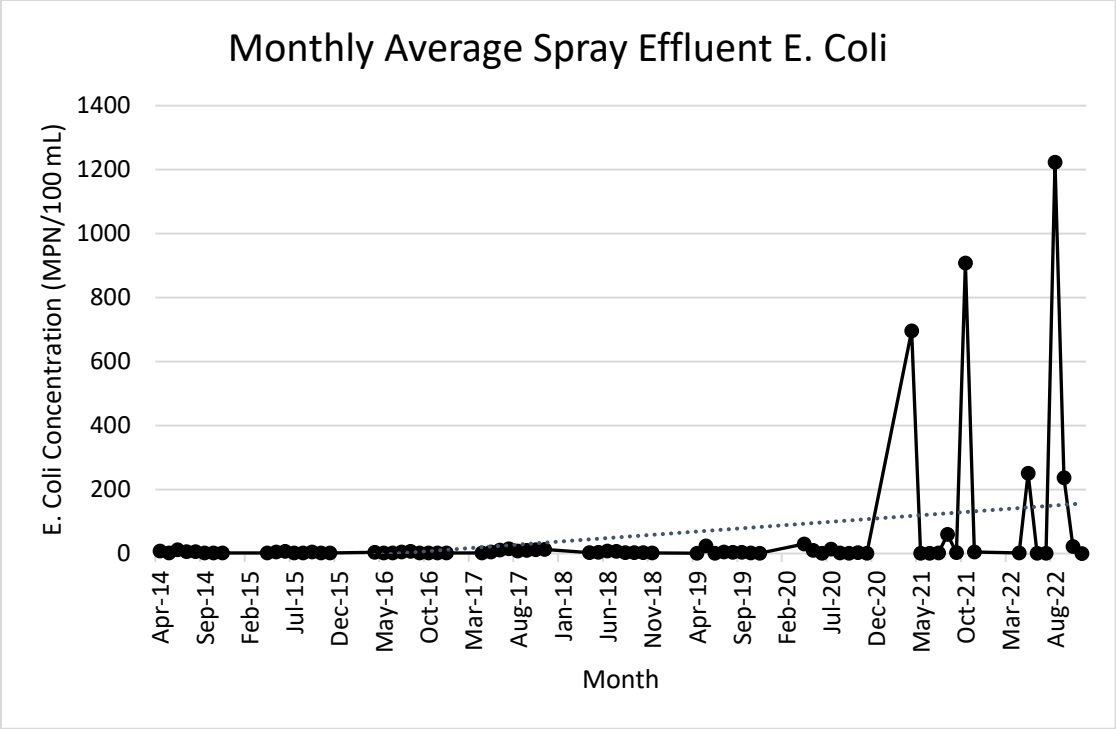


Figure 4.19: Spray Effluent Geomean E. Coli Concentration

4.6 Condition of Existing Facilities

The Centreville WWTP is generally operating as intended without excessive maintenance and repair costs. The WWTP was most recently upgraded in 2003; therefore, most of the equipment is approximately 20 years old. Most mechanical equipment has a planned 20-year expected life.

4.6.1 Treatment Process Overview

The wastewater enters the WWTP via mostly force main, and some gravity pipelines, into a manhole, and then flows by gravity through a screening facility. The screened flow continues to the SBR tanks. Flow is directed into one (1) of the two (2) SBR tanks through two automated valves controlled by the SBR Control Panel.

The operation of an SBR is based on a fill-and-draw principle, which consists of five steps: fill, react, settle, decant, and idle. These steps can be altered for different operational applications and the general sequence is shown in **Figure 4.20**.

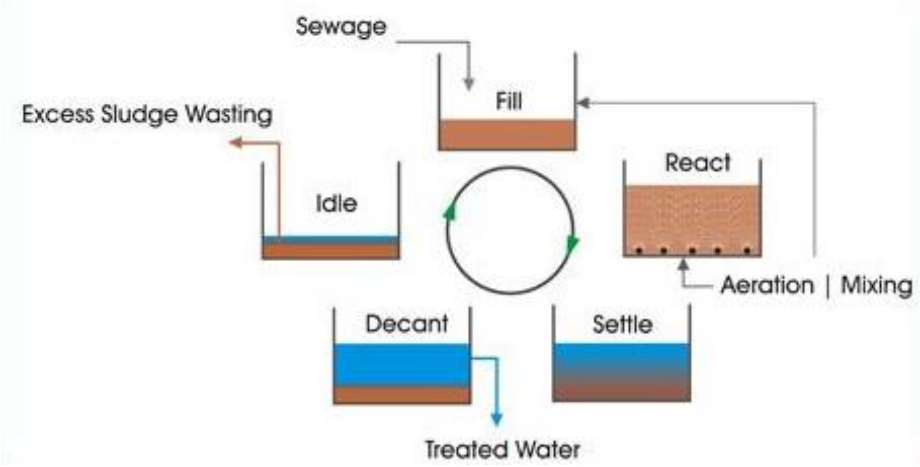


Figure 4.20: Sequencing Batch Reactor Sequence of Operation (Source: Aqua-Aerobic Systems, Inc.)

Fill

During the fill phase, the basin receives influent wastewater. Mixing and aeration can be varied during the fill phase to create the different environments for the biomass analogous to the conditions in a traditional activated sludge basin, anaerobic, oxic, and anoxic.

React

During this phase, no wastewater enters the basin, and the mechanical mixing and aeration units are on. Most of the carbonaceous BOD removal occurs in the react phase. Further nitrification occurs by allowing the mixing and aeration to continue. Because there are no additional volume and organic loadings, the rate of organic removal increases dramatically.

Settle

During this phase, activated sludge can settle under quiescent conditions — no flow enters the basin and no aeration and mixing takes place. The activated sludge tends to settle as a flocculent mass, forming a distinctive interface with the clear supernatant. This phase is a critical part of the cycle, because if the solids do not settle rapidly, some sludge can be drawn off during the subsequent decant phase and thereby degrade effluent quality.

Decant

During this phase, a decanter is used to remove the clear supernatant effluent. The floating decanter maintains the inlet orifice slightly below the water surface to minimize the removal of solids in the effluent removed during the decant phase, an example is shown in **Figure 4.21**. Floating decanters offer the operator flexibility to vary fill and draw volumes.

Idle

This step occurs between the decant and the fill phases. The time varies, based on the influent flow rate and the operating strategy. During this phase, a small amount of activated sludge at the bottom of the SBR basin is pumped out.

Figure 4.21: SBR Tank w/Surface Mixer/Aerator and Decant Device (Credit: Aqua-Aerobic Systems, Inc.)

Decant from the SBR flows into a post equalization tank, and waste sludge is pumped into an aerated sludge digestion tank. Submersible pumps send the SBR decant to a cloth media filter. The filtered effluent flows by gravity through a UV light disinfection channel, and then into the wet well of the Effluent Pump Station. Flow is either pumped to the effluent storage lagoon or flows by gravity to the chlorine contact tank.

4.6.2 Process/Equipment Assessment

4.6.2.1 Influent Screening

The influent screening is rotating drum screen manufactured by Lakeside. The screen is reported to effectively remove solids and is operating as intended. Operations also reported that this model of screen is no longer manufactured by Lakeside, and the cost of spare parts have increased significantly, as has the lead time to obtain parts. It is recommended to replace the screen, retrofitting the existing concrete channel as needed.

4.6.2.2 Sequencing Batch Reactor

The SBR provides treatment of the influent wastewater. BOD is removed and the influent TKN is nitrified to ammonia. The SBR is also able to partially denitrify the ammonia to nitrogen gas, to provide BNR levels of treatment, typically less than 5 mg/L of TN in the treatment plant effluent. **Table 4.10** provides the physical arrangement of the SBR's two (2) rectangular tanks.

Table 4.10: Existing SBR Tanks		
Parameter	Value	Units
Length, each	70.5	Ft
Width, each	53.2	Ft
Volume at Min. Side Water Depth, each	0.402	Million Gallons
Volume at Avg. Side Water Depth, each	0.464	Million Gallons
Volume at Max. Side Water Depth, each	0.589	Million Gallons

The SBR process equipment in each of the two (2) SBR basins includes:

- One (1) Influent Actuated Valve
- One (1) Surface Mixer
- Five (5) Removable Fine Bubble Aeration Diffuser assemblies
- One (1) Decant Mechanism
- One (1) Submersible Sludge Transfer Pump

The equipment is in good shape and is operating as intended. Although the equipment is nearing its expected life, it may have additional years of service left, in the range of 3-5 years with close attention to following factory advised maintenance and rebuilds.

The air for the liquid treatment process, and the post equalization tank, is supplied by three (3) 50 Horsepower (HP) blowers located in the Filter and Blower Building. Each blower has the design operating point of 525 SCFM, at a pressure of 10.7 PSIG. The existing blowers are operating as intended and appear to have many years of service life left with close attention and following the factory advised maintenance and rebuilds.

4.6.2.3 Post Equalization Tank

The decant from the SBR flows into the post equalization tank for aeration and to reduce the fluctuations in the flow to the downstream processes. A summary of the physical arrangement of the post equalization tank is in **Table 4.11**.

Table 4.11: Existing Post Equalization Tank		
Parameter	Value	Units
Length	52.9	Ft
Width	36.7	Ft
Min. Basin Volume	0.021	Million Gallons
Max. Basin Volume	0.146	Million Gallons
Working Volume	0.125	Million Gallons

Equipment in the post equalization tank includes:

- Fine Bubble Diffuser Assemblies

- Two (2) Submersible Centrifugal Filtration Feed Pumps

The equipment is in good shape and is operating as intended. Although the equipment is nearing its expected life, it appears to have many additional years of service left with close attention to following the factory advised maintenance and rebuilds.

4.6.2.4 Sludge Holding Tank

Sludge wasted from the SBR is pumped into the sludge holding tank for stabilization (i.e., reduction of volatile solids). The sludge holding tank physical layout information is in **Table 4.12**.

Table 4.12: Existing Sludge Holding Tank

Parameter	Value	Units
Length	52.9	Ft
Width	32.3	Ft
Min. Basin Volume	0.138	Million Gallons
Max. Basin Volume	0.197	Million Gallons

Equipment in the sludge holding tank includes:

- One (1) 10 HP surface mixer
- Two (2) 30 HP floating aerators
- Supernate Pump
- Sludge Transfer Pump

The equipment is in good shape and is operating as intended. Although the equipment is nearing its expected life, it may have many additional years of service left with close attention and following factory advised maintenance and rebuilds.

4.6.2.5 Cloth Media Filtration

Treated wastewater from the post equalization tank is pumped to a cloth media filter for the removal of suspended solids. The media filter is an AquaDisk unit manufactured by Aqua Aerobic Systems Inc., the same manufacturer as the SBR. The filter is a packaged unit complete with controls and backwashing and solids wasting system, see **Figure 4.22** which shows the main components of a disk filter.

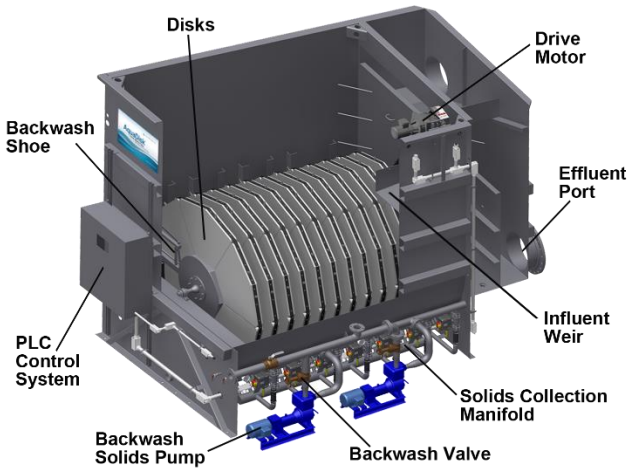


Figure 4.22: Cloth Media Filter Components (Credit: Aqua-Aerobic Systems, Inc.)

The media filter has been reported by operations to experience excessive head loss during typical wet weather flows, causing bypassing of the filter, degrading the effluent quality. The filter has produced excellent quality effluent during dry weather flows.

4.6.2.6 UV Light Disinfection

The filtered wastewater flows by gravity through a UV light disinfection channel. A total of twenty-four (24) low pressure high output ultraviolet lamps. The intense UV light inactivates microorganisms by destroying nucleic acids and disrupting their DNA. A typical unit can be seen in **Figure 4.23.**

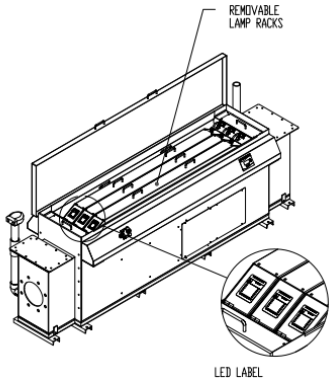


Figure 4.23: UV Disinfection Unit Isometric View (Credit: Enaqua)

The UV unit design parameters are included in **Table 4.13.**

Table 4.13: Existing UV Disinfection		
Parameter	Value	Units
Peak Hour Flow	0.75	MGD
Quantity of UV Reactors	1	-
Number of Total Lamps	24	-
UV Dose (Calculated)	> 40	mJ/cm^2
Effluent Quality	< 84	MPN/100 mL E. Coli

The UV disinfection system was installed in 2016 and is operating as intended. Additional units will be needed for the expansion to 1.0 MGD AAF. Additionally, Class III and Class IV Water Reuse will require more stringent Fecal Coliform effluent quality.

4.6.2.7 Effluent Pump Station

Design information on the two (2) Goulds 20 HP effluent pumps was not available, but operations reports that the pump station can get overwhelmed during wet weather flows. The pumps were installed as part of the 2003 upgrade.

4.6.2.8 Chlorine Contact Tank

When the WWTP is discharging to the stream, effluent flows by gravity from the Effluent Pump Station to the chlorine contact tank, and then to the cascade steps aeration, and then the outfall.

The isolation gates in the chlorine contact tank are beyond their expected life and need replacement. The concrete tank is in fair shape.

As a back up to the UV disinfection system, when flowing to the stream, sodium hypochlorite solution can be added to the Effluent Pump Station, with subsequent dechlorination at the end of the chlorine contact tank.

4.6.2.9 Chemical Addition

Polyaluminum chloride (PACl) solution is added to the SBR to precipitate ortho-phosphorus for subsequent removal through settling, and in the cloth media filter. PACl dosing consists of a dosing pump pulling solution from a drum.

Sodium hypochlorite solution is used in cleaning the cloth media filter, and as a back up to the UV disinfection process. Sodium hypochlorite dosing consists of a dosing pump pulling solution from a tote.

4.6.2.10 Existing Electrical System

The existing electrical service for Centreville Water Wastewater Treatment Plant is provided from Delmarva Power (DP) company owned 500 kVA, 25 kV to 480/277-volt, 3 phase, 4 wire, pad mounted transformer. The existing transformer secondary feeders installed underground to serve an 800-amp main distribution panel (MDP) via an 800-amp enclosed circuit breaker and an 800-amp automatic transfer switch (ATS) with bypass located in the existing electrical room of the Filter and Blower Building. A 500kW engine driven generator provides backup power.

The existing MDP serves the existing WWTP buildings including the existing Panel DP in the electrical room, 600-amp motor control centers (MCC) A and B in the Blower room and a 75 kVA transformer located outside of the existing Lab Building. The existing Panel DP, 400 amp, 480/277 volt, 3 phase, 4 wire, serves the lighting, 3 phase motors and a 30 kVA, 480-208/120 volt, 3 phase, 4 wire, dry type transformer mounted on the wall to serve the existing Panel PA, 100-amp, 208/120 volt, 3 phase, 4 wire for the receptacles and miscellaneous loads.

The existing Lab Building Is served by a 75 kVA, 480-208/120-volt, 3 phase, 4 wire pad mounted dry type transformer outside of the building. The existing transformer feeders enter the building via old CT cabinet to a 400-amp distribution panel which in turn serves the existing MCC, Panel PC and Panel PD. The existing MCC is located in the existing Lab Building workroom and the Panel PD is located in the Pump Building (old Admin Building).

4.6.2.11 Existing Controls System

The plant currently has no centralized monitoring or control system for operation of the plant. Currently all operations are performed manually by operators physically going to the process areas and starting and stopping equipment as required. Operators must go to the different instruments throughout the plant to take readings and manually collect process data.

The SBR system is provided with the manufacturer's Programmable Logic Control (PLC) based control panel to provide for automatic operations of the system. However, the system must be started locally at the control panel and process data is only able to be monitored at panel mounted interface screen. The manufacturers control panel is corroded beyond its useful life. The floor stands for the panel enclosure are almost entirely decayed by rust with the weight of the panel seemingly supported by the conduits entering at the bottom of the panel.

The PLC controller in the SBR control panel is also at the end of its supported lifecycle. The manufacturer of this product has ceased manufacturing this model and no longer supports it for technical assistance, maintenance, or software interface.

Alarms throughout the plant are relayed through an alarm notification system called Mission. The Mission system provides a common trouble alarm for a process area without providing any amplifying information to allow for advanced troubleshooting or prioritizing response. The Mission system is also used at the Town's pump stations, tanks and water treatment plants for monitoring alarms at these facilities. When an alarm is active, the Mission system will use a cellular connection to notify operators based on a pre-programmed calling list.

4.6.2.12 Existing Spray Irrigation Effluent Disposal

Currently the Town has an MDE discharge permit to spray irrigate 0.542 million gallons per day (MGD) of treated effluent on 223.7 acres of suitable spray area from March 1 to December 15. They have mainly center pivot spray rigs, but also have three fixed head spray nozzles located near the control building. There are ten (10) spray fields with individual approved spray rates that vary from 0.3 inches per week to 2 inches per week, per field.

Currently, they spray at approximately 0.5 MGD among 173.44 acres of irrigation fields. Often the existing fields are sprayed 8 to 12 hours per day.

The Town is not permitted to use chicken manure on the spray fields. They apply chemical fertilizer because more nitrogen is required per the annual Nutrient Management Report than is in the effluent. The nitrogen concentration in the effluent is typically 2 mg/L or lower. At the spray fields the main crop grown is corn, with some soybeans also.

The existing storage pond's original design was not specified large enough. The pond was built in 2001 when the spray rigs were built.

Water levels and groundwater quality are monitored in ten monitoring wells on a quarterly basis. Water quality is monitored at three stream sites quarterly. On a weekly basis, water levels are measured in ten piezometers which are located near the various center pivots. Permission to spray effluent is conditional on water levels observed in the piezometers.

The surficial geologic formation that underlies the area is Upland Deposits according to the Geologic Map of Maryland (1968). The Upland Deposits are gravel, sand, silt, and clay that were deposited in the Quaternary Period of earth history.

Underneath the Quaternary layer are sediments of the Calvert Formation, which formed in the Tertiary Period. The upper part of the Calvert Formation is exposed in stream valleys in the Centreville area. At the Town spray field property, the Calvert Formation is represented by a layer of green silty sand exposed in the stream valley.

According to the Natural Resources Conservation Space (NRCS) Soil Survey of Queen Anne's County, Maryland the Town spray fields are underlain by soils of the Matapeke-Mattapex-Nassawango map unit. The farms located to the northwest and to the northeast of the Town spray fields are underlain by soils of the Ingleside-Pineyneck-Unicorn map unit. Soils at both the existing spray fields and the considered expansion farms are both well-drained which is advantageous. Both can also include soils that have a wet substratum.

4.7 Water and Energy Audits

The Centreville WWTP is supplied with potable water from the Town's water treatment and distribution system. The Town does not currently meter the potable water use. The WWTP does not have an onsite treated effluent water reuse system, and therefore all water used in the treatment and maintenance operations is potable water.

A water audit of current significant uses of potable water was conducted at the site and is summarized in **Table 4.14**.

Table 4.14: Existing Significant Water Uses

Use	Estimated Instantaneous Flow	Estimated Average Daily Usage
	gpm	gpd
Influent Screen Spray Water	2	1,000
SBR Scum Spray Down	5	50
Miscellaneous Cleaning During Maintenance	10	100

The electric usage of the WWTP is only metered for the entire site. The current major energy demands are summarized in **Table 4.15**.

Table 4.15: Existing Major Electrical Demands

Major Electrical Demands	Quantity	Electric Demand, Each
Aeration Blowers	3	50 HP
Sludge Holding Aeration Blowers	2	30 HP
SBR Mixers	2	20 HP
UV Disinfection	1	15 kW
Effluent Pumps	2	20 HP
Buil/ding Electric Heat, Total	-	35 kW, total

For the period January 2020 through March of 2023 the WWTP used an average of 1,091 kWh each day. The annual average daily electric usage for 2020 through 2022 is summarized in **Table 4.16**.

Table 4.16: Recent Electrical Usage	
Year	Annual Average Electric Demand (kWh / Day)
2020	1,107
2021	1,057
2022	1,048

5 Need for Project

The annual average daily flows from the Centreville WWTP from 2014 to 2022 are shown in **Table 5.1**, with an annual average daily flow of 0.40 MGD.

Table 5.1: Historical Centreville Effluent Flow

	2014	2015	2016	2017	2018	2019	2020	2021	2022
Annual Average Flow (MGD)	0.36	0.38	0.36	0.32	0.40	0.44	0.42	0.51	0.41

The annual average effluent flows have recently exceeded 80% of the existing facility's permitted flow (0.542 MGD), with the average of the last three calendar years (2020-2022) averaging 0.45 MGD, which is 83% of the permitted flow. As discussed in **Section 3.4**, the population is expected to continue to grow.

5.1 Health, Sanitation and Security

Maintaining the health, sanitation, and safety of the population served, as well as the areas impacted by the disposal of the treated effluent are key drivers for the project.

The influent screen, treatment system aeration capacity, tertiary filter, UV disinfection, and Effluent Pump Station regularly reach their practical operating limits during wet weather events. The systems are operating as designed, and maintenance is timely, but these systems do not have sufficient capacity to handle the full range of flows and loads the WWTP is currently experiencing.

As discussed in **Section 5.2**, the majority of the treatment plant is reaching 20 years old. The concrete tanks are in excellent condition. The mechanical process systems are reaching the end of their useful life, and the control systems have exceeded their useful life. The SBR main control panel is no longer supported by the manufacturer. Without the control system operating, a sequencing batch reactor requires a dedicated operator to provide manual operation 24/7. This represents a significant risk to maintaining treatment.

The spray irrigation system is also showing signs that maintaining compliance with the discharge permit requirements will become more challenging as flows increase. During extended wet periods the treated effluent storage lagoon has approached its capacity, and the spray irrigation fields are also approaching their practical limits.

Due to the stress on the treatment plant and disposal sites, and despite the efforts of the Town's operations department, the NPDES discharge permit has been violated multiple times over the past three years. As the system continues to age and flows increase the system will approach a tipping point where it is unable to reliably meet the discharge permits.

5.2 Aging Infrastructure

The majority of the WWTP, the effluent storage lagoon and spray irrigation system were brought online in 2005. Mechanical process equipment at WWTPs has a generally accepted expected life of 20 years. As the equipment exceeds this, the cost to repair the equipment starts to outweigh the cost of replacement. More importantly, when equipment is offline waiting for repairs, it is not available to contribute to the treatment capacity.

Control systems have the shortest expected life of equipment at a WWTP. The specific expected life will depend on the manufacturer continuing to support the hardware and software. With the constant changes and upgrades in processor based systems, the manufacturers must use the currently proven technology to keep costs competitive and can only support so many different systems with spare parts, programming, and updates. The

primary hardware in the Centreville sequencing batch reactor's main control panel is no longer supported by the manufacturer. As such replacement parts are no longer readily available, can take months to find and can be many times the cost of supported systems.

5.3 Reasonable Growth

The project is consistent with the Maryland "Smart Growth" legislation which established Priority Funding Areas (PFA). The wastewater treatment plant lies completely within a Maryland Department of Planning PFA. The Queen Anne's County Comprehensive Plan for Water and Sewer identifies the planned growth for the Town of Centreville and projects a buildout sanitary flow of 1.75 MGD.

6 Upgrade and Expansion Alternatives

The primary goals for the upgraded and expanded treatment process are:

1. Provide ENR levels of treatment and continue compliance with the NPDES discharge permit (refer to **Section 2.3.1**).
2. Provide liquid and solids treatment for 1.0 MGD annual average influent flow and associated wet weather flows.

There are several facilities that require expansion and/or upgrades to accommodate the increased level of treatment and hydraulic throughput regardless of the treatment alternative that is selected. Equipment catalogs for the major equipment described in this section are included in **Appendix D**.

The three alternatives considered are:

Alternative 1 – Expand the SBR process, expand the post flow equalization tank, and add a denitrifying tertiary filter.

Installing two additional SBR tanks will expand the current process that has been proven to be effective. The SBR operation is already understood, operating, and maintaining the system will remain straightforward. To accommodate for increased flow, the post equalization tank would also be expanded, and a tertiary denitrifying filter would be added downstream of the SBR. The process will require more space and need to deal with the aging SBR infrastructure. The SBR's main control panel is no longer supported and finding replacement parts is difficult.

Alternative 2 – Replace the existing SBR system with a 5-stage conventional activated sludge process and add a tertiary filter with denitrifying capability.

This biological process reduces nitrogen and phosphorus compounds by switching between both high and low oxygen environments. Flow passes through distinct anaerobic, anoxic, aeration, post anoxic, and reaeration stages, similar to a "Bardenpho" configuration. The anaerobic zone enriches phosphorus-accumulating organisms that help remove phosphorus in later stages. Denitrification occurs in both anoxic zones, where denitrifying bacteria converts nitrates into nitrogen gas. In the aeration stage, nitrification occurs, converting ammonia to nitrate, and is recycled to the first anoxic zone. The reaeration stage helps release any more nitrogen gas minimize denitrification occurring within the subsequent clarifier. RAS from the secondary clarifier is pumped to the dewatering facility and the rest of the flow is further treated by a denitrifying filter. Due to the change in treatment technology, additional operator knowledge will be required to maintain and operate the system.

Alternative 3 – Replace the existing SBR system with to a 5-stage MBR activated sludge process.

The process configuration is similar to Alternative 2 utilizing 5-stages, however solid separation is facilitated via the membrane and not via clarifiers. The membrane has a pore size of approximately 1 micron, that allows water to permeate while retaining the activated sludge in the reactor. The effluent is pulled through the membranes, which are commonly either a tube or plate style, the resulting permeate has a low turbidity with the excess sludge being removed from the reactor basins. This results in a high-quality effluent without the need for a tertiary filter, and results in a compact process that also has a longer sludge retention time. The membrane does limit the hydraulic throughput of the treatment process and an influent flow equalization tank is required upstream of the MBR to ensure flux through the MBR does not exceed its capacity. The existing SBR tanks would be converted into influent flow equalization tanks. Additionally, knowledge to operate and maintain the new system as well as the additional process equipment compared to the other alternatives, will be required.

In addition to the three alternatives, a 'do nothing' option was also initially considered but is not a practical option. The current flows to the WWTP exceed 80% of the design capacity, and as indicated in the recent performance,

the WWTP has occasionally exceeded the permit limits. Therefore, the existing plant is only marginally capable of treating the existing flows. As the plant equipment ages the repairs and associated downtime will increase, which will degrade the effective treatment capacity. Refer to **Section 5**.

6.1 Common Upgrades

Upgrades that are common to all three alternatives include:

1. Expand influent screening. Alternatives 1 and 2 will be a 6-mm effective opening screen, and Alternative 3 will require a 2-mm opening screen.
2. Construct/convert influent flow equalization tank(s).
3. Expand UV disinfection.
4. Expand chemical dosing.
5. Review options for expansion of treated effluent disposal.
6. Install sludge treatment and dewatering.
7. Install an on-site non-potable water system.
8. Miscellaneous refurbishment of reused facilities.
9. Electrical and control system upgrades.

6.1.1 Influent Screening

Due to the age of the existing influent screen, difficulty in procuring replacement parts, and to accommodate higher peak flows, it is recommended to replace the screen. The existing screen has performed well, and the operations staff is familiar with operating and maintaining this style of screen. Additionally, the existing concrete channel appears in fair condition and can be reused with some modification and refurbishment (e.g. spalling and crack repair).

For Alternatives 1 and 2 it is recommended that the replacement screen be the same style as the existing screen. The existing mechanical screen bypass channel and manual bar rack would remain in place to serve as back up to the additional mechanical screen.

The influent screen for Alternatives 1 and 2 would comply with the design criteria in **Table 6.1**.

Table 6.1: Influent Mechanical Screen Design Basis – Alternatives 1 and 2

Parameter	Value	Units
Quantity, Duty/Standby	1/0	Unit
Peak Flow	4	MGD
Screen Opening	6	mm
Screen Basket Diameter	40	Inches
Ancillary Equipment	Integrated Screenings Washer/Compactor with Bagger	-
Basis of Design	Lakeside – Raptor	-

Alternative 3 – MBR Activated Sludge requires a more robust screening system with smaller openings to protect the membranes. For Alternative 3, it is recommended to provide both coarse and fine screens in series, with 1 duty and 1 standby screen for each size. The existing screen channels will be expanded to add a channel for a second coarse screen. The existing screen will be replaced. A dual channel fine screen facility will be constructed to the north of the existing screens. The influent screen for Alternative 3 would comply with the design criteria in **Table 6.2**.

Table 6.2: Influent Mechanical Screen Design Basis – Alternative 3		
Parameter	Value	Units
Coarse Screens		
Quantity, Duty/Standby	1/1	Unit
Peak Flow, Each Screen	4	MGD
Screen Opening	½	inch
Ancillary Equipment	Screenings Washer/Compactor with Bagger	-
Basis of Design	Duperon Low Flow	-
Fine Screens		
Quantity, Duty/Standby	1/1	Unit
Peak Flow, Each Screen	4	MGD
Screen Opening	2	mm
Ancillary Equipment	Screenings Washer/Compactor with Bagger	-
Basis of Design	Huber Band Screen	-

6.1.2 Influent Flow Equalization Tank

To accommodate fluctuations in influent flows during wet weather events, an influent flow equalization (EQ) tank is recommended for each alternative. The equalization tank will reduce the peak flows (peak shaving) to the SBRs, activated sludge basins, or MBRs and therefore improve the effluent quality during wet weather events. The influent flow EQ tank will be designed to provide wet weather peak flow shaving at the 1.0 MGD annual average flow conditions. Since the current influent flows are not measured, the tank will be sized based on typical municipal peak flow characteristics. A conservative peak day peaking factor of 3 will be used, therefore a peak day flow of 3.0 MGD is expected. A 500,000-gallon working volume concrete tank is recommended to reduce the peak day flow through the treatment process to 2.5 MG. Redundant 750 gpm submersible pumps with variable frequency drives (VFD) will be mounted in the EQ tank to pump flow that is diverted from the EQ tank to the SBRs, activated sludge basins, or MBRs.

For Alternative 1 – SBR, a new 500,000-gallon working volume tank would need to be constructed onsite. For Alternative 2 – Conventional Activated Sludge and Alternative 3 – MBR Activated Sludge, the existing SBR tanks can be converted into two (2) influent flow EQ tanks. As shown in **Table 4.9**, each existing SBR tank has a maximum working capacity of 0.589 MG. Refer to **Section 6.3** for site plan layouts for each alternative.

6.1.3 UV Disinfection

The existing UV system was upgraded after 2005 and is operating well; however, it is undersized to handle the peak day flow following the expansion to 1.0 MG annual average influent flow and associated wet weather flows. To better utilize the space available in the Filter and Blower Building, the existing UV system will be replaced with an enclosed low pressure high output inline system. **Table 6.3** summarizes the design basis for the replacement system.

Table 6.3: UV Disinfection Replacement System Design Basis		
Parameter	Value	Units
Quantity, Duty/Standby	1/1	-
Configuration	Parallel	-
Peak Day Flow	3.3	MGD
Design Transmittance	65	%
UV Dose	> 40	mJ/cm^2
Effluent Quality	< 116(1)	MPN/100 mL E. Coli
Number of Lamps, each unit	20	800W each, LPHO
Basis of Design	ETS – UV System, manufactured by Evoqua	-

(1) – Note that effluent quality limit would be 14 MPN/100 mL E. Coli if the new outfall extension is used, per **Section 6.1.5**.

6.1.4 Chemical Dosing

The existing chemical dosing system will be expanded for additional polyaluminum chloride (PACl) and methanol dosing. Increased dosing of PACl is required to precipitate higher concentrations of ortho-phosphorus in order to meet a TP concentration less than 0.3 mg/L, as required by ENR. To meet the target TP concentration, an estimated 240 gallons per day (gpd) of PACl will be required. PACl will be dosed upstream of the denitrification filters for Alternatives 1 and 2, and downstream of the MBR process for Alternative 3. PACl dosing capacity will be increased by replacing the existing PACl drums with an 8,000-gallon capacity double contained PACl bulk storage tank located in the Filter and Blower Building. Alternatively, two (2) 4,000-gallon double contained tanks may be installed for PACl storage, if the Filter and Blower Building cannot accommodate a single larger tank. 8,000 gallons of PACl storage will provide over 30 days of chemical storage. The existing PACl dosing pumps will likely need to be replaced to accommodate a higher capacity.

Each alternative will also include methanol dosing to aid in additional nitrate removal and subsequent reductions in TN concentration less than 3 mg/L, as required by ENR. To meet the target TN concentration, an estimated 65 gpd of methanol will be required. For Alternatives 1 and 2, methanol would be dosed just upstream of the denitrification filters. For Alternative 3, methanol would be dosed within the MBR tank. Methanol will be stored in a 4,000-gallon double contained bulk storage tank, within or outside of the Filter and Blower Building for Alternatives 1 and 2, or within the MBR Process Building for Alternative 3. 4,000 gallons of methanol storage will provide over 40 days of chemical storage.

6.1.5 Review of Effluent Disposal Options

As previously mentioned, Centreville WWTP currently discharges to Gravel Run through an existing outfall during the cold weather months (December 1 to March 31). During the warmer weather months (April 1 to November 30), effluent is discharged to the Town's spray irrigation site. Previously, Centreville WWTP was permitted to utilize spray disposal year round; however, with the most recent permit update in 2010 and updated MDE requirements, spray disposal is restricted to March 1 to December 15.

At the Town's current spray irrigation disposal site, there is a total usable disposal area of 173.44 acres. The disposal site is reported to be near capacity at current flows. Concurrently with the ENR expansion and upgrade of the Centreville WWTP, the Town is actively pursuing expansion of the effluent disposal capacity to accommodate the expected increase in WWTP influent flows.

The Town has unsuccessfully pursued expanding its spray irrigation area, despite years of searching for suitable land. Other water reuse options, such as indirect potable reuse (IPR), have been discussed but are not considered feasible in the near term. Therefore, expanding the surface water discharge to allow year-round

discharge is currently the most viable approach. This section provides a brief overview of the proposed work to expand the surface water discharge effluent disposal.

6.1.5.1 Year Round Stream Discharge

To allow for year-round surface discharge, the Town is proposing to relocate the plant outfall to Corsica River at a location downstream of the Watson Road Bridge, which would be consistent with MDE's approved report for TMDL of Nutrients for Corsica River (May 2000).

The Town is proposing to manage the plant's expanded effluent flow by maximizing use of the existing spray irrigation field capacity in combination with discharge to a new Corsica River outfall within the TMDL nutrient limits. During the irrigation season, the current permitted flow (0.542 MGD) will be applied to the fields with the remaining effluent flows (0.458 MGD) to Corsica River. Outside the irrigation period, all flows would be discharged to Corsica River. The assumption for this scenario is ENR effluent quality with a consistent treatment performance of 3 mg/L and 0.3 mg/L for TN and TP, respectively. This would allow for a nutrient loading to Corsica River that is well below the established TMDL limits for low flow periods and for the total annual limit. These assumptions provide a good overall nutrient load margin of safety, especially during low flow (warm) periods where nutrient loads to Corsica River are most critical and where the utilization of the spray fields is greater.

With year-round surface discharge, upgrades to the existing Effluent Pump Station will be required to send additional flow through the new outfall pipe and further into the Corsica River. Upgrades to the Effluent Pump Station are not recommended at this time as part of the ENR upgrade and expansion.

6.1.6 Biosolids Handling

The dewatered biosolids are currently disposed of in a landfill. By providing sufficient solids retention time in an aerobic digester, a Class B biosolids would be produced. This potentially could allow for land application of the dewatered biosolids.

For Alternative 1 – SBR, a new aerobic digester would be constructed in the footprint of the existing reed drying beds. For Alternative 2 – Conventional Activated Sludge and Alternative 3 – MBR Activated Sludge, the existing post equalization and sludge storage tanks will be retrofitted to be aerobic digesters. Refer to **Section 6.3** for site plan layouts for each alternative. The design criteria for the aerobic digester are provided in **Table 6.4**.

Table 6.4: Aerobic Digester Design Criteria

Parameter	Value	Units
Design Waste Sludge	16,000	gallons/day
	1,300	Lbs dry solids/day
	10,000	Mg-TSS/L
Digester Solids Concentration with Settling and Decant	20,000	Mg-TSS/L
Solids Retention Time	60	days
Number of Tanks	2	-
Working Volume, each	250,000(1)	gallons
Working Volume, Total	500,000(2)	gallons
Surface Aerator Mixers (3 in each Tank)	20	HP/each

(1) – For Alternatives 2 and 3, the retrofitted aerobic digesters will have an approximate working volume of 175,000 gallons each.
(2) – For Alternatives 2 and 3, the retrofitted aerobic digesters will have an approximate total working volume of 350,000 gallons.

There are several proven, reliable sludge dewatering methods that can be applied to Centreville WWTP. Similar to the treatment process, a primary consideration should be that the equipment is straightforward to operate and maintain. One widely utilized technology across the wastewater industry is the belt filter press (BFP). See **Figure 6.1** for a BFP. BPFs have many advantages, including:

- Low capital cost,
- Low energy consumption,
- Simple operation and maintenance, and
- Ability to handle stringy solids (i.e. rags) and plastics.

Prior to sludge being deposited on the BFP, the sludge is conditioned with polymer to promote the coagulation of solids. The polymers would be received in a concentrated liquid format in 55-gallon drums. Polymer would be pumped by peristaltic pump to a make down tank, a 300-500-gallon fiberglass tank where potable water is added to condition the polymer and get the proper concentration for dosing. The polymer solution is then pumped into an injection ring located in the belt filter press feed pipeline and mixed in-line with the sludge.

During the dewatering operation, as the dewatered cake is discharged, the press belts are continuously washed with spray water. A wash water skid equipped with a booster pump will provide the pressure to adequately wash the belts.

The cake will be discharged from the belt filter press onto a belt conveyor which conveys the cake into a roll off storage container until it is taken for disposal.

Another technology considered is the volute dewatering press. The volute dewatering press is similar in overall configuration to a screw press, with a center conveying screw pushing the solids that are larger than the openings in the dewatering drum towards the discharge end. See **Figure 6.2** for a volute dewatering press, and **Figure 6.3** for a typical screw press. The screw press uses a static perforated, or slotted drum which separates the solids. The volute press utilizes the annular space between donut shaped plates to separate out the solids. The screw and volute press both have low capital costs and low energy consumption.

The volute dewatering press and screw press have fewer moving parts than the belt filter press which should translate to lower maintenance costs.

The BFP has low capital cost and low energy consumption as advantages that have led to numerous installations. The dewatering equipment will be further evaluated during the design of the expansion.

A dewatered cake storage area will be provided with a permeable asphalt floor and a pre-engineered clear span roof.

Figure 6.1: Belt Filter Press (Credit: Andritz)

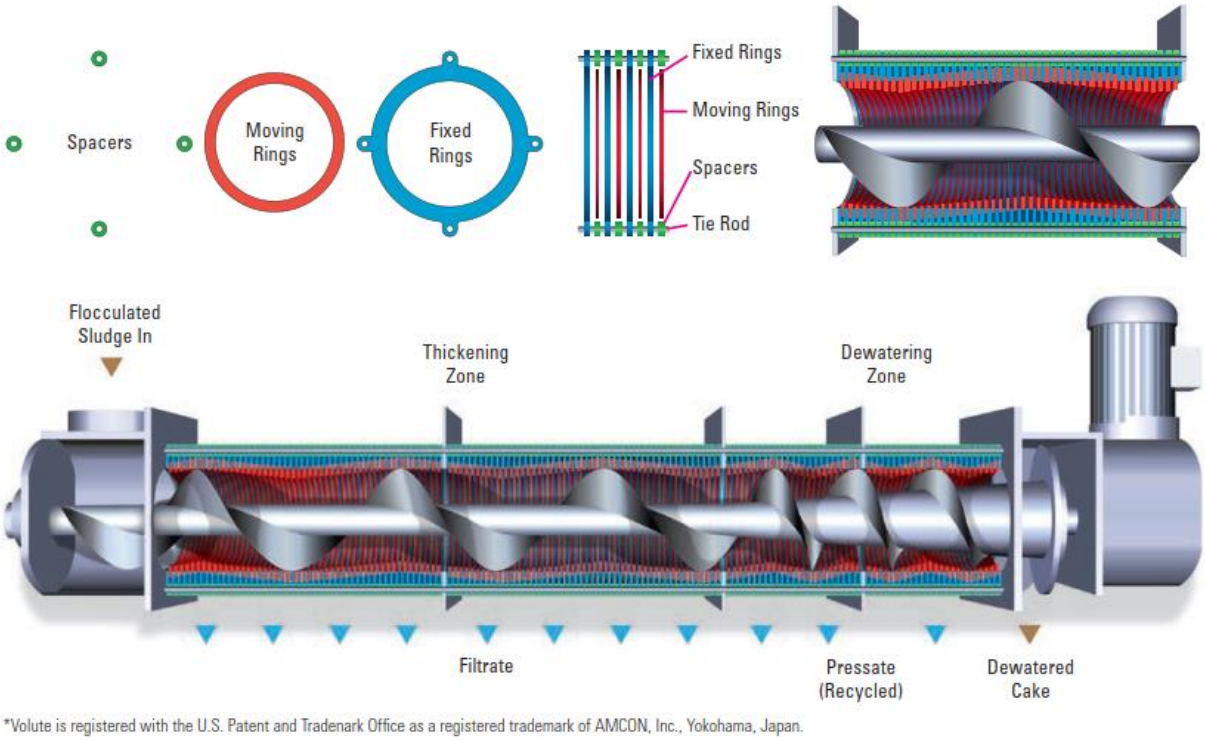


Figure 6.2: Volute Dewatering Press (Credit: Process Wastewater Technologies, LLC)

Figure 6.3: Screw Press (Credit: Schwing Bioset, Inc.)

To expand the biosolids handling process and to house additional equipment, a Dewatering Facility and Covered Cake Storage Facility will be constructed onsite. Refer to **Section 6.3** for site plan layouts for each alternative.

The Dewatering Facility will consist of the following architectural characteristics:

- 4-inch Brick veneer with CMU block bearing wall, with steel roof trusses, and standing seam metal roof.
- Fiberglass reinforced plastic (FRP) doors, windows, frames, etc., as required, with new reinforced concrete slab.
- This building will be an enclosure for covering sludge tanks.
- One bay will be two stories for covering the sludge tanks, and the other bay will be one story for vehicles.

The Covered Cake Storage Facility will consist of the following architectural characteristics:

- Pre-engineered steel portal framed building with standing seam metal roof, with all four sides open to the exterior, over a new reinforced concrete slab.

6.1.7 Non-Potable Water System

A non-potable water system will be installed to be used in a variety of applications throughout the WWTP. The non-potable water system will allow for onsite reuse of the treated plant water and subsequent reduction in potable water demand at the WWTP. Currently, the WWTP utilizes potable water for all its water needs. Installation of a non-potable water system will result in a cost savings for plant operation, as well as an increase in efficiency of the WWTP. Refer to **Section 6.5.1** for additional water and energy efficiency considerations for this project.

The non-potable water system will be installed within the Filter and Blower Building. The system will be skid mounted and have an approximate capacity of 200 gpm. The system will draw non-potable water supply from the UV effluent and have non-potable storage in an approximately 5,000-gallon capacity tank. Pumps mounted on the skid will draw non-potable water from the tank and pump to a distribution system throughout the WWTP. Non-potable water can be used for applications such as spray water for the influent screens, pump seal water, wash down, or yard hydrants throughout the WWTP.

6.1.8 Laboratory and Administration Building

The current Laboratory and Administration Building was not designed to accommodate the number of current operators. For example, the building does not have a designated office space. Instead desks are placed in the electrical distribution room, and in the entryway. The restroom was designed for single occupancy and is serving as the locker/changing room. In addition, the plant expansion, and the move to more stringent ENR effluent quality will result in an increase in the quantity and type of laboratory tests that are needed to maintain process control.

The expansion project will include the renovation of the existing space including the demolition of the existing laboratory cabinets and restroom. The available space will be re-allocated to provide separate spaces for:

- Laboratory
- Office Space
- Separate locker room with shower and bathroom
- Electrical Distribution and Control Room

The existing Lab Building consists of 4-inch Brick veneer with CMU block bearing walls, with steel roof trusses, asphalt fiberglass roof, and existing hollow metal doors, windows, frames. The existing structure is to remain and be painted as required. The interior spaces will be renovated with new finishes, including acoustical ceilings, painted walls, doors, and frames, casework, fixtures, etc. A roof leak was discovered at a portion of the existing asphalt fiberglass roof while onsite, which will be repaired or replaced as necessary. **Figure 6.4** shows the existing Lab Building.

Figure 6.4: Existing Lab Building

6.1.9 Filter and Blower Building

The existing Filter and Blower Building consists of 4-inch Brick veneer with CMU block bearing walls, with steel roof trusses, asphalt fiberglass roof, and existing hollow metal doors, windows, frames. The existing structure is to remain and be painted as required. Interior work will include removal of existing process equipment, expansion of the electrical room, replacement of the existing filters and UV system, expansion of the PACl chemical storage and dosing system, and replacement of the MCC's. New finishes, including acoustical ceilings, painted walls, doors, and frames, casework, fixtures, etc., will be provided. **Figure 6.5** shows the existing Filter and Blower Building.

Figure 6.5: Existing Filter and Blower Building

6.1.10 Control Building

The existing Control Building consists of 4-inch Brick veneer with CMU block bearing walls, with steel roof trusses, asphalt fiberglass roof, and existing hollow metal doors, windows, frames. The existing structure is to remain and be painted as required. The interior spaces will be removed and refurbished for other uses. New finishes, including acoustical ceilings, painted walls, doors, and frames, casework, fixtures, etc., will be provided. **Figure 6.6** shows the existing Control Building.

Figure 6.6: Existing Control Building

6.1.11 Electrical System Upgrades

The electrical system upgrades proposed herein include all three treatment alternatives, with the exception of the MBR Process Building (see **Section 6.1.11.7**), which would only be required for Alternative 3 (MBR Activated Sludge). The existing electrical loads for the WWTP utilize approximately 25% (peak demand of 101 kW and average demand of 90 kW) of the existing 500 kVA transformer capacity, and the existing incoming electrical equipment in the Filter and Blower Building will not require electrical upgrade. The existing 500kW engine driven generator is sufficiently sized for the planned expansions.

6.1.11.1 Filter and Blower Building

The existing electrical equipment, including an enclosed circuit breaker, automatic transfer switch, panelboards MDP, DP and PA, and low voltage transformer, in the electrical room is in fair condition. However, the existing MCC's in the Blower Room should be replaced with new MCC's. The existing circuit breakers in the existing MCC's located have been overheated and tripped in the summer months even with portable fans blowing directly towards the MCC's. High ambient temperature is the worst enemy for the electrical equipment and shortens the life of the electrical equipment.

Therefore, the existing MCC's should be replaced with new MCC's in a new conditioned space in the Filter and Blower Building to prolong the equipment's life and avoid any nuisance tripping from the heat. The new MCC will be sized per the motor list, shall be bigger than the previous two MCC's, and will consolidate the existing as well as new process loads. All the branch circuits from this MCC will be new with a new feeder circuit from panelboard MDP.

6.1.11.2 Lab Building

The existing electrical equipment in the Lab Building is antiquated and should be replaced with new electrical equipment, including the transformer outside (which has been damaged and moved), switchboard, and Panel PC. Moreover, this equipment is original equipment that was not updated to properly protect the electrical loads/equipment and do not have proper working clearance in accordance with the National Electrical Code (NEC) due to the existing work benches, microwave oven, and refrigerator. All existing feeders and branch circuit wiring in the building should be replaced with new conduit and wires. All new LED lighting and receptacles will also be provided based on the new building layout.

6.1.11.3 Pump Building (Old Control/Admin Building)

The existing Panel PD is a relatively new panel in good condition and has proper working clearance. The existing panel will remain. However, the existing feeder from the Lab Building shall be replaced from a new distribution panel.

6.1.11.4 Replacement Influent Screening

The screens are being replaced, and a new control panel complete with variable frequency drives (VFDs), circuit breakers, and controls will be provided outside mounted on a strut frame.

6.1.11.5 New Dewatering Facility

A new feeder will be run to this building, and new distribution equipment will be provided, including panelboards and dry type transformers. Electrical fixtures including receptacles, lighting, and switches will also be provided.

6.1.11.6 New MBR Process Building

For Alternative 3 – MBR Activated Sludge, a new feeder will be run to the MBR Process Building, and new distribution equipment will be provided, including panelboards and dry type transformers. Electrical fixtures including receptacles, lighting, and switches will also be provided.

6.1.11.7 General Site Electrical

The new electrical loads are anticipated to double, and a 150 kVA pad mounted transformer and a 600-amp distribution panel are proposed to accommodate the proposed treatment facility electrical loads and spare capacity. All new feeders and branch circuit breakers shall be properly protected. Site lighting shall be provided per revised layout plan. All outside feeders shall run in underground ductbank system.

In summary, the following electrical upgrades are proposed:

1. Existing service is adequate for all three alternatives and shall be retained.
2. Replace interior lighting for the whole plant with LED lighting.
3. Provide new lighting and controls for new proposed building.
4. Provide new LED site lighting for the whole plant.
5. Replace existing MCCs with new in the Filter and Blower Building.
6. New feeders and branch circuits for proposed upgrades.
7. New panelboards, feeders, branch circuits and fixtures for Lab building, MBR Process building and Dewatering Facility.
8. Provide new ductbank system.
9. Provide new site lighting.

6.1.12 Control System Upgrades

To help achieve the operational goals of the advance treatment systems proposed, a centralized Plant Control System (PCS) should be developed to provide the ability for centralized monitoring and supervisory control. Individual processes should be provided with a dedicated PLC control panel that will provide the local control for the individual process equipment and collect process data from local instruments.

Centralized supervisory control would allow operators to interface with the local PLC based control systems that are providing process control at the different process facilities. The distributed nature of this type of system builds reliability into the system by not relying on a single processor to remotely control a process. If there is a failure in communications or a local control panel, the remaining system will continue to operate based on programming and commands issued locally by the dedicated processor. This type of system saves on the installation of conduit and wire by locating the controller near the process area and also allows for the use of less expensive control equipment that has lower total memory and input/output point capability to control a limited scope of equipment.

The PCS system will collect monitored process data from field instrumentation and archive these data in a historian function. The data historian will allow for review of operations through historical trends and creating daily/monthly or annual reports. The automated and centralized collection of these data will facilitate in optimizing the process control resulting in possible savings in energy, chemicals and reduced workloads while providing the data trail to ensure regulatory compliance.

The PCS should be extended to provide remote monitoring of the pump stations, tanks and water treatment plants throughout the town. Similar type of local control panels should be located at these facilities to replace the aged control equipment and to communicate with the centralized PCS. Using the PCS to interface with these other facilities is practical in the sense that it makes full use of the software and hardware that will be purchase for the wastewater treatment plant. These systems are scalable to allow for additional capacity without impeding on the overall efficiency or functions for the plant.

Communications between the WWTP centralized PCS and the remote sites will most efficiently be performed through the use of cellular network technology. Using a third-party cellular provider for remote communications is a low-cost solution that makes use of the providers existing infrastructure and security practices at established low-cost GSA pricing.

6.2 Treatment Alternative Upgrades

Three (3) alternatives to upgrade and expand the Centreville WWTP have been developed. The different upgrades that are required for each treatment alternative are detailed below. Preliminary hydraulic profiles for each of the three alternatives is included in **Appendix E**.

6.2.1 Alternative 1 – Expand the Sequencing Batch Reactor

6.2.1.1 SBR Process

Expanding the existing SBR process from 0.542 MGD to 1.0 MGD to provide the design effluent quality would require the following major scope components:

- Construct two (2) additional SBR tanks outside of the existing SBR tank structure with floating mixers, removable fine bubble aeration grids, and decant arms.
- Double the capacity of the existing post equalization (post EQ) tank by removing the dividing wall between the existing post EQ tank and sludge holding tank and replacing the equipment.
- Install denitrification filters and a denitrification filter control building and pump station.

- Install three (3) additional blowers in the existing blower room.
- Add storage and handling for the addition of an external carbon source (methanol) to SBR.

Refer to **Section 4.5.1** for a description of the SBR treatment process. **Table 6.5** outlines the design specifications for the SBRs.

Table 6.5: SBR Design Basis

Parameter	Value	Units
No. of Basins	4	-
Length, each	70.5	Ft
Width, each	53.2	Ft
Volume each at Avg. Side Water Depth	0.47	Million Gallons
Food to Mass Ratio	0.064	Lbs BOD5/lb MLSS-Day
MLSS Concentration	4,000	Mg/l at Min. Water Depth
Hydraulic Retention Time	1.17	Days at Avg Water Depth
Solids Retention Time	17.9	Days
Estimated Dry Sludge Produced	1,984	Lbs WAS/Day
Actual Oxygen Required	7,453	Lbs O2/Day
Air Flowrate per Basin	1,670	SCFM

6.2.1.2 SBR with Aerobic Granular Sludge

If Alternative 1 is pursued, there is an option to decrease the required SBR tank capacity by installing an AquaNereda® Aerobic Granular Sludge process, manufactured by Aqua-Aerobic Systems, within the SBRs. The AquaNereda® Aerobic Granular Sludge process uses an optimized batch cycle structure with granular sludge to decrease settling time. Therefore, it can operate at higher concentrations, allowing for more treatment capacity within the existing tank volume.

The main benefit of the SBR with aerobic granular sludge option is that only three (3) total SBR tanks would be required, rather than four (4) SBR tanks that are required for the standard SBR Alternative 1. This would increase and optimize the amount of available site space at the WWTP. Additional costs of the SBR with aerobic granular sludge option include the cost of the SBR granular sludge equipment, which is estimated to be approximately 25% higher than the cost of the standard SBR Alternative 1 equipment.

6.2.1.3 Effluent Filtering

Due to the hydraulic limitations the existing cloth media filter will be replaced with a deep bed downflow intermittent backwash sand media filter (IBF). As an additional benefit, with the addition of a carbon source, the IBF will be able to simultaneously denitrify the secondary effluent from the SBR, as well as remove particulate solids.

The IBFs are deep mono media type filters where the influent wastewater flows into the filter by overflowing a weir at the top of the filter. The water flows downward through the sand media, support gravel and underdrain. The treated effluent flows out of the bottom of the filter into the effluent pipeline and to the treated effluent clearwell. The bed is backwashed by pumping water from the clearwell into the bottom of the filter where the underdrain distributes the treated effluent across the filter. The backwash water overflows the influent weir and is discharged,

by automatic valves and associated piping, into the mudwell. The biofilm develops on the sand media and sufficient biomass remains in place through the backwash process.

In the denitrifying mode, a carbon source is required. Methanol or glycerin will be added to the filter influent and the nitrate in the influent is converted to nitrogen gas that escapes the process. In the IBF process the removal of solids and excess biomass produced in the denitrifying mode is accomplished through the intermittent backwash of the sand media bed.

In denitrifying mode, the IBF can reliably achieve less than 1.0 mg/L nitrate, even at high influent nitrate concentrations. During maximum month design conditions, the nitrate levels will be less than 12 mg/L, making the IBF a reliable treatment process.

The IBF systems also remove total phosphorus as a result of the particulate solids capture and from a small fraction of biological consumption of soluble phosphorus, typically less than 0.02 mg/L per mg/L nitrate removed. While simultaneous denitrification and phosphorus removal through chemical addition and precipitation can be achieved in the filter, chemical phosphorus removal will be performed upstream of the DN filter stage, i.e. in the SBR or activated sludge process.

The number of filter cells required depends on both hydraulic (peak) flow (relative to filter headloss) and nitrate loading (performance efficiency). Based on the 1.0 MGD design conditions (average and maximum month) the IBF process would consist of three (3) filter cells (144 SF of filtration area per filter cell), for a total of 2,592 CF of active filtration volume.

The IBF filters would consist of concrete above grade tanks with influent channels integrated into the structure.

An online nutrient analyzer will be installed in a small building adjacent to the filters. The analyzer will have centrifugal pumps recirculating flow from the sample points (filter influent and effluent) to the analyzer and back to just downstream of the sample point. One sample pump will draw water from the denitrification filter pump station discharge pipeline (influent). The sample point will be up stream of the methanol injection point. A second sample pump will draw water from the denitrification filter discharge pipeline (effluent).

A control system for controlling the filtration and backwashing operations of three filters will be located in the new building, including level transmitters, sensors, control panels, analyzers, and a magnetic flow meter (i.e. magmeter). The external carbon storage tank and dosing system will be located adjacent to the IBF. Two (2) submersible backwash pumps (25 HP each), two (2) submersible mudwell pumps (6.5 HP each), and two (2) positive displacement blowers will be provided.

The design specifications for the IBF are shown in **Table 6.6.**

Table 6.6: Denitrifying Filter Design Basis		
Parameter	Value	Units
Quantity	3 Total	Unit
Peak Flow, total	3.3	MGD
Avg TSS to Filter	30	mg/l
Nitrate and Nitrite to Filter	< 8.0	mg/l
Filtration Area, Each	144	sq feet
Filtration Area, Total	432	sq feet
Avg TSS from Filter	< 5.0	mg/l
Nitrate and Nitrite from Filter	< 1.0	mg/l
Hydraulic Loading Rate (average)	< 2.0	gpm/sq feet
Hydraulic Loading Rate (maximum month)	< 3.0	gpm/sq feet
Hydraulic Loading Rate (peak flow)	< 5.0	gpm/sq feet
Ancillary Equipment	Integrated Controls and Backwash System	-
Basis of Design	elimi-NITE Denitrification System, manufactured by Leopold	-

6.2.1.4 Post Equalization Tank

Additional post equalization tank capacity will be required for the expansion. For Alternative 1, the existing sludge holding tank would be converted for additional post equalization tank capacity. The concrete wall that currently separates the existing post equalization tank and existing sludge holding tank would be demolished to effectively double the capacity of the existing post equalization tank. New surface agitators will be installed in the post equalization tank.

6.2.2 Alternative 2 – Conventional Activated Sludge

6.2.2.1 Activated Sludge Process

Conversion of the existing SBR process to a conventional activated sludge process to provide the design effluent quality, as well as expand the design capacity from 0.542 MGD to 1.0 MGD would require the following major scope components:

- Construct two (2) 5-stage activated sludge basins and two (2) rectangular secondary clarifiers.
- Convert the existing SBR tanks to two (2) separate influent flow equalization tanks, as described in **Section 6.1.2**, and convert the existing post EQ tank and the existing sludge holding tank into two (2) aerobic digesters, as described in **Section 6.1.6**.
- Install denitrification filters and a denitrification filter control building and pump station.

Figure 6.4 depicts a schematic of the 5-stage process. Influent first flows through an anerobic tank, where oxygen devoid conditions are conducive to phosphorus-accumulating organisms to release phosphate into the wastewater, ensuring it is more readily available to be removed in the further stages than if it remained in biomass.

Flow then enters the first anoxic zone where the majority of denitrification occurs. Denitrifying bacteria use nitrate as an electron acceptor to covert its nitrogen through a series of steps, ultimately becoming nitrogen gas.

The water then enters the aerobic zone where nitrification primarily occurs. Through aerobic bacteria, ammonium is oxidized to nitrite and ultimately nitrate, where it is then recycled, called mixed liquor, to the previous stage for denitrification.

Next, the post anoxic zone aids with removing nitrates from the previous aerobic zone that are not recycled back to the first anoxic zone. A carbon source may be supplemented here to aid in nitrification. Methanol is one ideal substance; however, due to Maryland's colder climate, it may only prove effective with attached-growth media. Other carbon sources such as acetate, ethanol, or sugar are suitable carbon sources for ordinary bacteria (methanol requires slow growing methylotrophic bacteria) that can still be effective to cooler climates.

Fine bubble diffusers incorporate air in the final rearation zone to help release any more nitrogen gas that has formed as well as minimize inhibit any more denitrification from occurring in the following secondary clarifiers. This will allow the sludge to settle better and ensure no potential nitrogen gas bubbles form and rise and mixing the water in the process.

As mentioned, water flows to secondary clarifiers following the 5-stage process, where it then flows to a denitrification filter for further nitrogen removal. RAS from the secondary clarifiers is pumped to the Dewatering Facility by submersible pumps within the secondary clarifiers. Design specifications for the denitrification filter are discussed in **Section 6.2.1.3**.

Some key differences between a 5-stage activated sludge process and SBR include that 5-stage activated sludge process will have continuous flow while an SBR delivers flow in batches, which could play a role in treatment efficacy of other treatment technologies like UV disinfection. 5-stage processes are typically favored for nutrient removal, as it can simultaneously remove nitrogen and phosphorus. However, it has a higher footprint and has a higher energy consumption. A schematic overview of the 5-stage process is depicted in **Figure 6.7**.

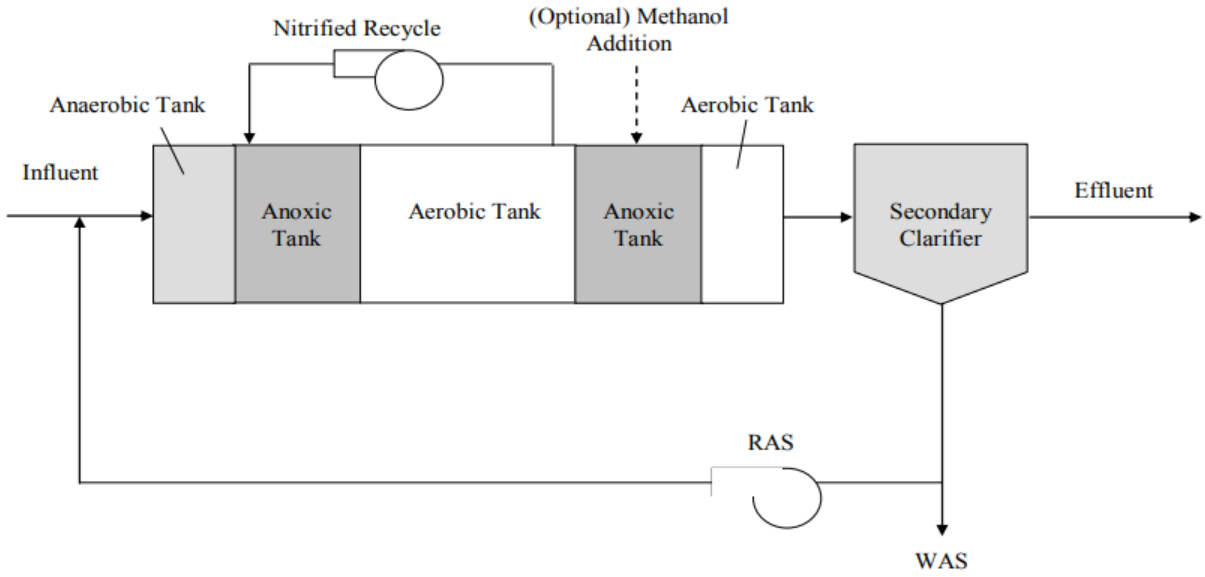


Figure 6.7: Schematic of 5-Stage Process (Credit: EPA)

Design criteria for the 5-stage activated sludge basins and the secondary clarifiers are listed in **Tables 6.7 and 6.8**, respectively.

Table 6.7: 5-Stage Activated Sludge Basin Design Basis		
Parameter	Value	Units
No. of Trains	2	Trains
No. of Stages	5	-
Length of Train, each	110	ft
Width of Train, each	35	ft
Volume each at Avg. Side Water Depth	0.52	Million Gallons
Solids Retention Time	10-20	Days
RAS Recycle Ratio	50-100	%
Internal Nitrate Recycle	300	%
MLSS Concentration	3000-4000	mg/L
HRT 1st Zone (Anaerobic)	0.5-1.5	Hr
HRT 2nd Zone (Anoxic)	1-3	Hr
HRT 3rd (Aerobic)	4-12	Hr
HRT 4th Stage (Post anoxic)	2-4	Hr
HRT 5th Stage (Reaeration)	0.5-1	Hr

Table 6.8: Secondary Clarifier Design Basis		
Parameter	Value	Units
No. of Clarifiers	2	-
Length, each	60	ft
Width, each	35	ft
Average SOR	250	gpd/sq feet
Peak SOR	800	gpd/sq feet
Average SOR with one Clarifier Offline	500	gpd/sq feet
Average SLR at 100% RAS	14	Lbs/day/sq feet
Peak SLR at 50% RAS	35	Lbs/day/sq feet
Basis of Design	Ovivo	-

6.2.2.2 Effluent Filtering

Similar to Alternative 1 (SBR Expansion), the existing cloth media filter will be replaced with a deep bed downflow IBF. Refer to the description and design basis in **Section 6.2.1.3** for the proposed filter upgrades.

6.2.3 Alternative 3 – Membrane Bioreactor (MBR) Activated Sludge

6.2.3.1 MBR Process

Conversion of the existing SBR process to a MBR activated sludge process to provide the design effluent quality, as well as expand the design capacity from 0.542 MGD to 1.0 MGD would require the following major scope components:

- Construct a two (2) train 5-stage activated sludge facility, with a larger 5th zone to install MBR equipment.
- Construct an MBR Process Building to house blowers and storage/equipment for the addition of an external carbon source (methanol) to the MBR.

- Convert the existing SBR tanks to two (2) separate influent flow equalization tanks, as described in **Section 6.1.2**, and convert the existing post EQ tank and the existing sludge holding tank into two (2) aerobic digesters, as described in **Section 6.1.6**.

The four stages prior to the MBR system typically include anaerobic, preanoxic, aerobic, and postanoxic stages, similar to the 5-stage activated sludge process. The fifth stage includes the MBR system, which uses a membrane filter with a pore size of approximately 1 micron to allow water to pass through while leaving behind the activated sludge. The effluent is pulled through the membranes, which are commonly either a tube or plate style, the resulting permeate has a low turbidity with the excess sludge being removed from the reactor basins.

This results in a high-quality effluent without the need for a tertiary filter and results in a compact process that also has a longer sludge retention time. Since there is no need for settling, MBR's can also operate at higher mixed liquor suspended solids (MLSS) concentrations.

The membrane limits the hydraulic throughput of the treatment process, so an influent flow equalization tank is required upstream of the MBR to ensure flux through the MBR does not exceed its capacity. MBRs also incur fouling and would need to be cleaned 2-4 times a year with Citric Acid or sodium hypochlorite, although reducing sludge age can reduce fouling.

MBR’s smaller footprint and high-quality effluent are due to higher volumetric loading rates resulting in lower hydraulic retention times compared to conventional activated sludge (CAS) systems. Although MBRs are energetically more expensive than CAS systems, they have become significantly more efficient in the past 10 years compared to the only slight improvements in CAS technology, becoming 14% less expensive, in relation to CAS systems.

These advancements are due to primarily the reduction in air scour energy for membrane cleaning due to new diffuser technology, greater membrane packing density, decreased maintenance costs, longer operating life, and increased use of gravity permeation from membranes. MBR's higher energy costs are due membrane aeration and permeate pumps that CAS do not have, as well as the cost of RAS pumping being four times higher in the MBRs than in a CAS system.

Table 6.9 lists the design specifications of the 5-stage activated sludge basins with the MBR system.

Table 6.9: 5-Stage Activated Sludge Basin with MBR Design Basis		
Parameter	Value	Units
No. of Trains	3	Trains
No. of Cassettes per Train	3	Cassettes
No. of Modules installed per Train	132	Modules
Membrane Tank Internal Dimensions (One Train) L x W x H	21.7’ x 9’ x 13’	Ft
Solids Retention Time	10-20	Days
RAS Recycle Ratio	50-100	%
Internal Nitrate Recycle	300	%
MLSS Concentration	8000	mg/L
Total Pre-Anoxic Tank Working Volume	70,000	Gallons
Total Aerobic Working Volume	280,000	Gallons
Total Post-Anoxic Tank Working Volume	110,000	Gallons
Total Bioreactor Working Volume (excluding Membranes)	460,000	Gallons
Total Design HRT (including Bioreactors and Membrane Tanks)	11.9	Hours
Basis of Design	Veolia	-

The MBR Process Building will consist of the following architectural characteristics:

- 4-inch Brick veneer with CMU block bearing wall, with steel roof trusses, and stranding seam metal roof.
- FRP doors, windows, frames, etc., as required, with a new reinforced concrete slab.
- This building will be an enclosure for covering process equipment/blowers, chemical cleaning systems for the membranes, and methanol chemical storage/dosing equipment.

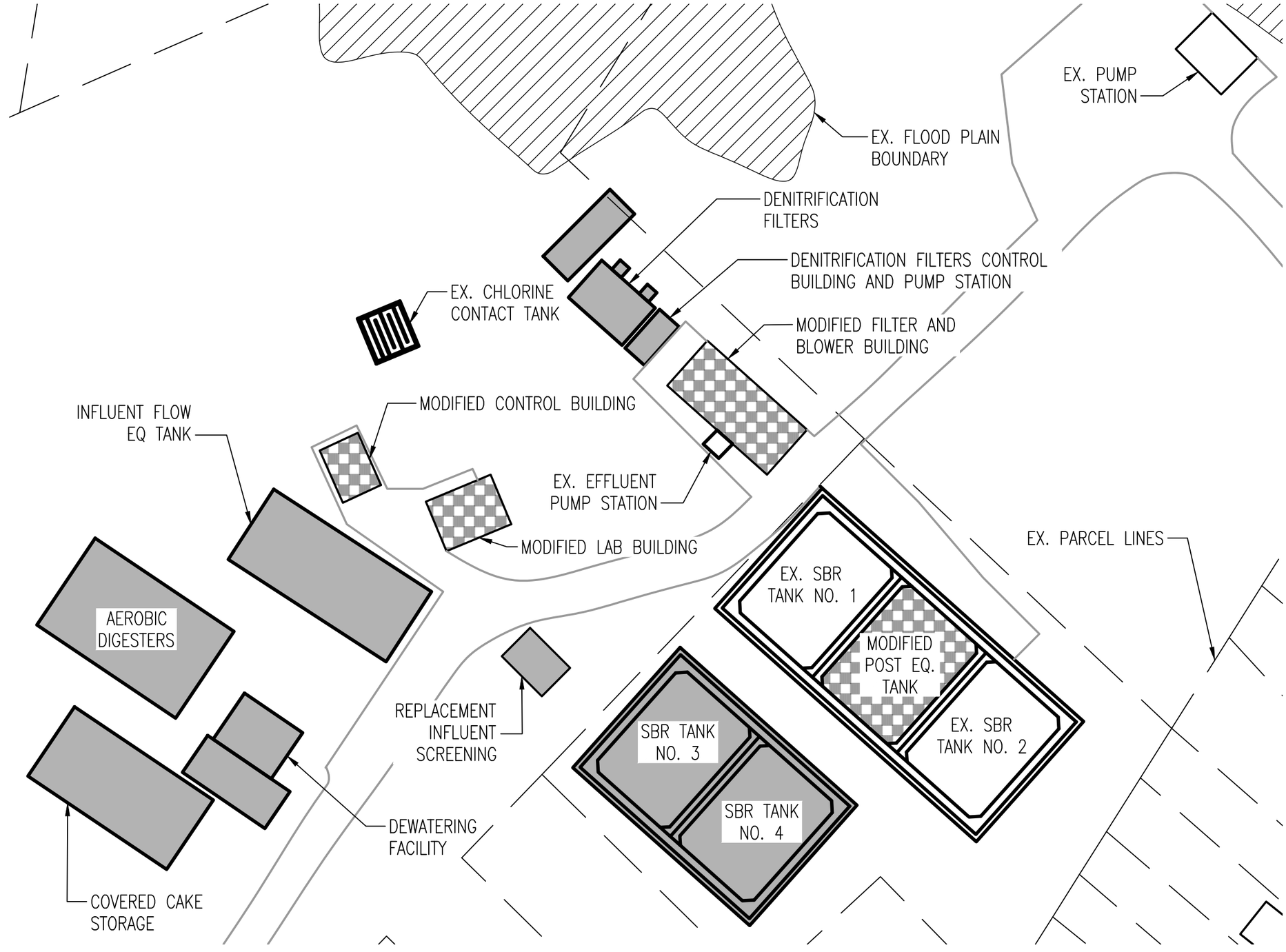
6.3 Site Plans and Schematics

Alternative 1 – SBR will include the post EQ tank expansion, which includes the volume of the existing post EQ and sludge holding tanks. Two additional SBR tanks, adjacent to the current ones, will be constructed. Additionally, denitrification filters will be installed, and their respective Control Building will be built adjacent to the Filter and Blower Building. Finally, the sludge drying reed beds would be transformed to include the influent flow equalization tank, aerobic digesters, Dewatering Facility, and Covered Cake Storage Facility.

Alternative 2 – Conventional Activated Sludge and Alternative 3 – MBR Activated Sludge would see the existing SBR tanks converted into two (2) influent flow equalization tanks, while the middle tanks would be converted into two (2) aerobic digesters. The Dewatering Facility and Covered Cake Storage Facility will be constructed to the south of the influent screening, influent flow equalization tanks, and aerobic digesters. Across the road, where the existing sludge drying reed beds are located, a 2 train 5-stage activated sludge process would be constructed.

At the end of the train, Alternative 2 will have secondary clarifiers, while Alternative 3 will have the MBR tanks and MBR Process Building, housing the blower and methanol storage and feed equipment. Similar to Alternative 1, Alternative 2 will have denitrification filters installed, and their respective Control Building will be built adjacent to the Filter and Blower Building.

All three alternatives will include replacement of the influent screening, and backup generator, which will all be constructed in the same relative location of the existing facilities, respectively. The Control and Lab Buildings will each be modified, as discussed in **Sections 6.1.8, 6.1.9,** and **6.1.10**.



ALTERNATIVE 1 SBRs SITE PLAN

SCALE: 1" = 50'

REVISIONS		

CLIENT INFORMATION

TOWN OF CENTREVILLE
CENTREVILLE, MD

WWTP UPGRADE

KEY PLAN

GRAPHIC SCALES

0' 25' 50'

SCALE: 1" = 50'

SIGNATURE

PRELIMINARY DESIGN
NOT FOR
CONSTRUCTION

PROFESSIONAL CERTIFICATION.
I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND, LICENSE NO. _____
EXPIRATION DATE: _____

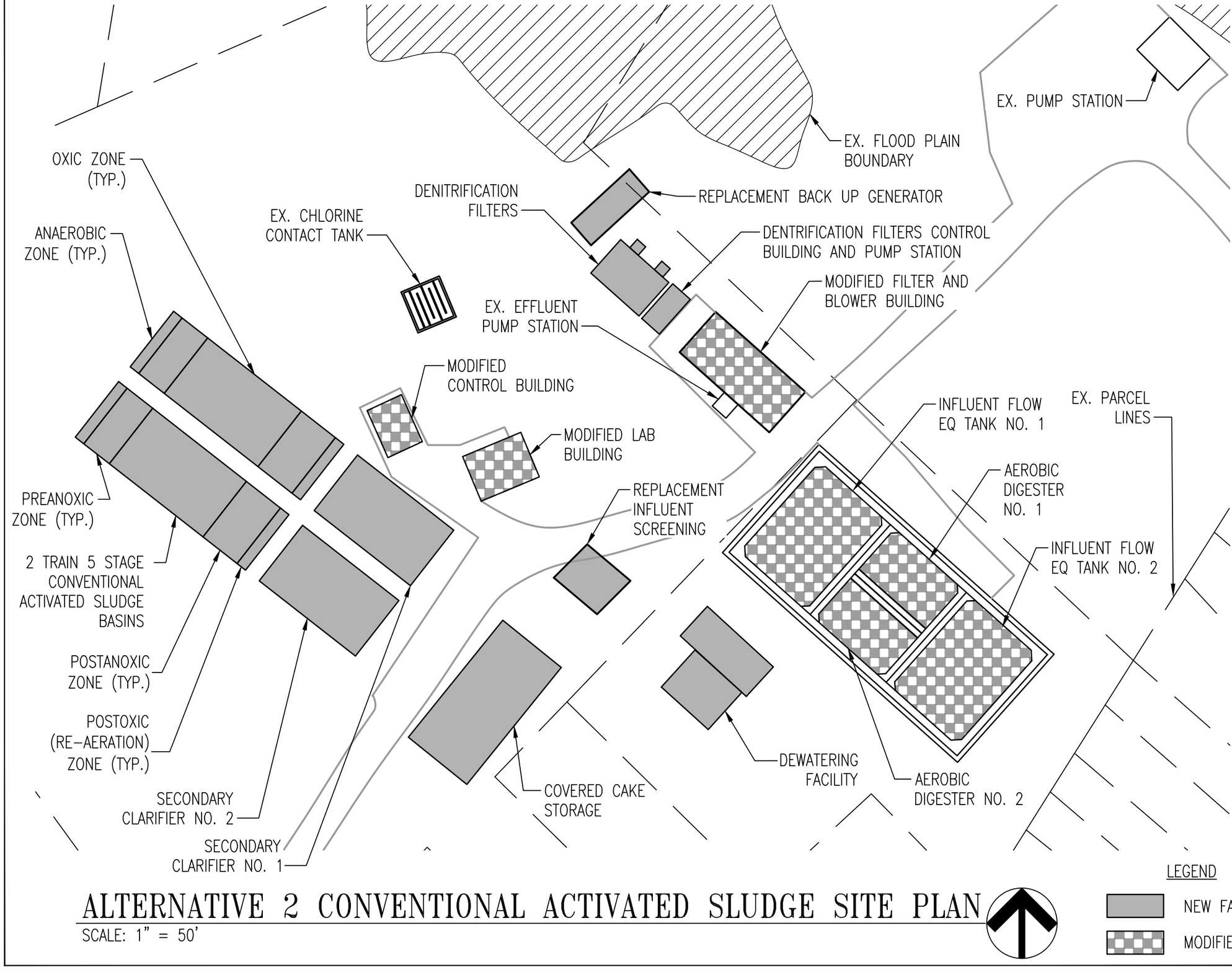
Whitman, Requardt & Associates, LLP
801 South Caroline Street, Baltimore, Maryland 21231

ALTERNATIVE 1
PROPOSED SITE PLAN

FIGURE NO.

6.8

SCALE: 1" = 50'		
DATE: DECEMBER 2023	SHEET XX OF XX	
DES: LMA	DRAWN: LMA	CHECK: DRN



ALTERNATIVE 2 CONVENTIONAL ACTIVATED SLUDGE SITE PLAN

SCALE: 1" = 50'

REVISIONS		

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TOWN OF CENTREVILLE
CENTREVILLE, MD

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KEY PLAN

GRAPHIC SCALES

0' 25' 50'

SCALE: 1" = 50'

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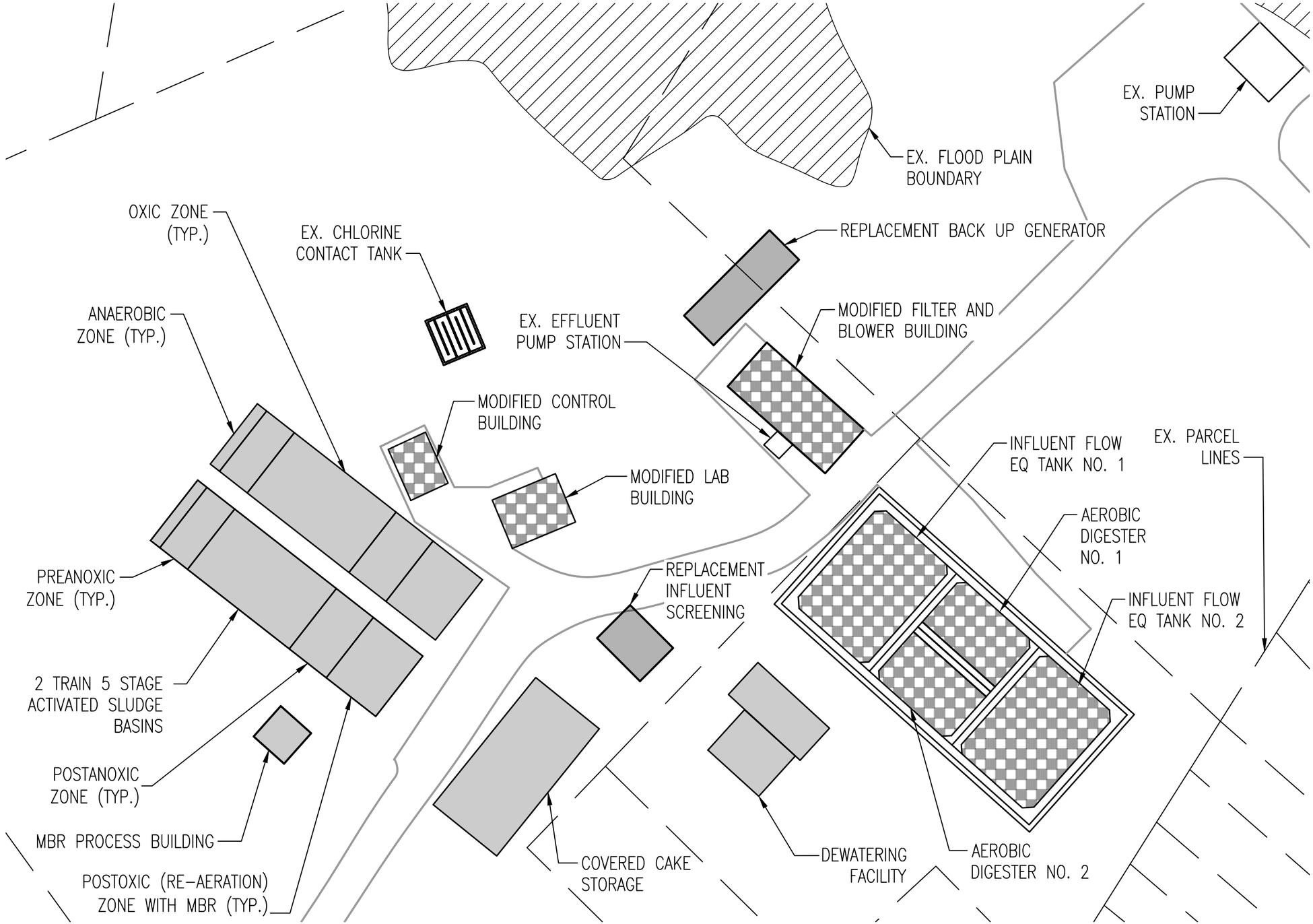
ALTERNATIVE 2
PROPOSED SITE LAYOUT

FIGURE NO.

6.9

SCALE: 1" = 50'		
DATE: DECEMBER 2023	SHEET XX OF XX	
DES: LMA	DRAWN: LMA	CHECK: DRN



ALTERNATIVE 3 MBR ACTIVATED SLUDGE SITE PLAN

SCALE: 1" = 50'

REVISIONS		

CLIENT INFORMATION

TOWN OF CENTREVILLE
CENTREVILLE, MD

WWTP UPGRADE

KEY PLAN

GRAPHIC SCALES

0' 25' 50'

SCALE: 1" = 50'

SIGNATURE

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CONSTRUCTION

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801 South Caroline Street, Baltimore, Maryland 21231

ALTERNATIVE 3
PROPOSED SITE LAYOUT

FIGURE NO.

6.10

SCALE: 1" = 50'		
DATE: DECEMBER 2023	SHEET XX OF XX	
DES: LMA	DRAWN: LMA	CHECK: DRN

6.4 Environmental Impact

Environmental impacts associated with each design alternative are quantified in **Table 6.10** and summarized by alternative below. Alternative 3 – MBR Activated Sludge would have the least environmental impacts compared to both Alternative 1 – SBR and Alternative 2 – Conventional Activated Sludge.

Table 6.10: Environmental Impacts by Design Alternative for Centreville WWTP Site

Environmental Resource	Alternative 1 (SQFT)	Alternative 2 (SQFT)	Alternative 3 (SQFT)
Palustrine Emergent (PEM) Wetland	0	0	0
Palustrine Forested (PFO) Wetland	459	486	0
Perennial Stream	0	0	0
Wetland 25-ft Buffer	2,199	2,985	177
Forest Stands	1,733	5,598	178
FEMA Floodplain	29	22	0
Forest Interior Dwelling Bird (FIDS) Habitat	9,190	21,513	13,307
Tier 2 Catchment	55,137	49,184	47,259
Chesapeake Bay Critical Area	55,137	49,184	47,259

6.4.1 Alternative 1 – Expand the Sequencing Batch Reactor

Alternative 1 – SBR would impact existing wetlands/wetland buffer, forest, the 100-year floodplain, all located in the northernmost portion of the LOD. There would be impacts to FIDS habitat across the northern, northeastern, and western portions of the LOD. There would also be impacts to the Gravel Run 1 Tier II (High Quality) catchment and CBCA throughout the entire LOD. Alternative 1 would not impact any streams.

6.4.2 Alternative 2 – Conventional Activated Sludge

Alternative 2 – Conventional Activated Sludge would impact existing wetlands/wetland buffer, forest located in the northernmost and westernmost portions of the LOD. This alternative would impact the 100-year floodplain located in the northernmost portion of the LOD. There would be impacts to the FIDS habitat throughout the northern and western portions of the LOD. There would also be impacts to the Gravel Run 1 Tier II (High Quality) catchment and CBCA throughout the entire LOD. Alternative 2 would not impact any streams.

6.4.3 Alternative 3 – Membrane Bioreactor

Alternative 3 – MBR Activated Sludge would impact existing wetland buffer in the northwestern portion of the LOD. There would be impacts to forests in the northernmost portion of the LOD and the FIDS habitat throughout the northern, northeastern, and western portions of the LOD. This alternative would also the Gravel Run 1 Tier II (High Quality) catchment and CBCA throughout the entire LOD. Alternative 3 would not impact streams or the 100-year floodplain.

6.5 Sustainability Considerations

The WWTP upgrade and expansion will be designed to reduce its impact on the environment and to be resilient to future changes in the climate as indicated in this section.

6.5.1 Water and Energy Efficiency

The existing WWTP utilizes potable water for all its water needs. The upgrade will include an onsite non-potable water system to utilize treated effluent for the process related water needs.

The treated effluent water quality will be sufficient to meet off-site Class III and IV reclaimed water requirements. Potential future off site water reuse includes irrigation of the Queen Anne County recreational fields located adjacent to the Town.

In addition to the onsite water reuse, the potable water use onsite will be reduced through the replacement of the existing plumbing fixtures with low flow.

Energy efficiency will be considered for the selection of lighting and equipment for the project. Examples of improved energy efficiency include:

- The existing florescent tube and halogen lights will be replaced with LED lights. New lights will only be LED.
- All equipment will use high efficiency motors.
- The UV disinfection system will have the latest generation of UV intensity measurement and lamp controller.
- Pumps will have variable frequency drives (VFD) to operate at optimal speeds.
- New process blowers will be high efficiency turbo blowers.
- Dewatering equipment will consider slow speed, low energy demand type equipment.

6.5.2 Green Infrastructure

The three alternatives will have similar opportunities for incorporating green infrastructure as deemed practical. As an example, the roof cover over the dewatered biosolids storage area will be designed to accommodate the future installation of solar PV cells. The solar PV cells will be connected to the utility electric grid to offset the electricity used by the WWTP. There may be other areas on the site that could accommodate additional solar PV cells.

6.5.3 Climate Related Considerations

The upgrade and expansion of the WWTP is required to protect the receiving stream and the environment from wastewater that does not meet the discharge permit requirements. Without an expansion of the treatment capacity, the likelihood of future process upsets increases with the increase in influent flows stressing the capabilities of the existing system.

The new facilities will be constructed to protect them from a 100-year flood with 2 feet of additional protection provided. New structures will have a finished floor or top of wall of at least 2 ft above the 100-year flood elevation.

By selecting Alternative 3 – MBR Activated Sludge, the proposed facilities would have the smallest footprint of the alternatives considered. Therefore, the facilities would have a smaller impact to the site and can be located to reduce their impact on environmentally important features such as the wetlands and forested areas.

6.6 Cost Estimates

A conceptual cost estimate was developed for each of the three treatment alternatives that are being considered. The cost estimates were developed using preliminary equipment supplier quotations based on the design concepts described in this preliminary engineering report. The cost estimate does not include expansion of the

effluent discharge, such as the cost of extending the outfall into the Corsica River or the cost to acquire and spray discharge to additional irrigation sites.

The cost estimates for each of the treatment alternatives were developed using the expertise and experience of the WRA engineers. The cost estimates presented represent WRA's best engineering judgement and assumes that competitive bids are received. However, the unpredictability of the current market should be taken into consideration when the project goes to bid. The estimates were prepared in accordance with AACE Class 4 Budgetary (planning-level) construction cost requirements. All costs are presented in 2023 dollars and will need to be indexed using the annual inflation rate. Contingency cost, an allowance that reflects the uncertainty associated with a construction cost opinion based on a "predesign" study of the indicated facilities, is included as a 30% markup in the estimate. Additionally, an escalation markup of 4% per year is also included in the estimate.

The conceptual cost estimates for each alternative are presented in **Table 6.11**. Refer to **Appendix A** for detailed breakdown.

Table 6.11: Conceptual Construction Cost Estimates for Treatment Alternatives			
	Alternative 1: SBR	Alternative 2: Conventional Activated Sludge	Alternative 3: MBR Activated Sludge
Base Facilities			
Interior Demolition (Lab, Control, and Filter and Blower Buildings)	$ 95,000	$ 95,000	$ 95,000
Influent Screening Expansion	$ 825,000	$ 825,000	$ 825,000
Methanol Facility	$ 618,000	$ 618,000	$ 618,000
Non-Potable Water System	$ 54,000	$ 54,000	$ 54,000
Dewatering Facility	$ 2,413,000	$ 2,413,000	$ 2,413,000
Covered Cake Storage Facility	$ 835,000	$ 835,000	$ 835,000
Lab Building Refurbishment	$ 139,000	$ 139,000	$ 139,000
Control Building Refurbishment	$ 130,000	$ 130,000	$ 130,000
Filter and Blower Building Refurbishment	$ 348,000	$ 348,000	$ 348,000
Base Subtotal Cost	**$ 5,457,000**	**$ 5,457,000**	**$ 5,457,000**
Facilities for ENR Alternatives			
Influent Flow EQ Tank(s), Aerated, with Pumping	$ 2,054,000	$ 2,019,000	$ 2,019,000
Existing Tank Modifications	$ 214,000	$ 643,000	$ 643,000
Clarifier Tanks, Equipment, and RAS Pumps	-	$ 3,864,000	-
Denitrification Filter Tanks, Equipment and Controls	$ 3,112,000	$ 3,112,000	-
Miscellaneous Process Piping and Equipment	$ 157,000	$ 235,000	$ 784,000
Additional SBR Tanks, Equipment and Controls	$ 3,564,000	-	-
Activated Sludge Equipment	-	$ 1,012,000	-
MBR Process Equipment and Controls, including MBR Process Building	-	-	$ 5,789,000
Post EQ Tank and Equipment	$ 78,000	-	-
UV Disinfection System	$ 642,000	$ 642,000	$ 642,000
Aerobic Digester Tank and Equipment	$ 1,427,000	$ 78,000	$ 78,000
Alternative Subtotal Cost	**$ 11,248,000**	**$ 11,605,000**	**$ 9,955,000**
Alternative Plus Base – Subtotal Construction Cost	**$ 16,705,000**	**$ 17,062,000**	**$ 15,412,000**
Electrical	$ 2,517,000	$ 2,722,000	$ 4,169,000
Site Civil, including Yard Piping and Demolition (15% Alternative + Base)	$ 2,506,000	$ 2,559,000	$ 2,312,000
Site SCADA (5% Alternative + Base)	$ 835,000	$ 853,000	$ 771,000
Subtotal	**$ 22,563,000**	**$ 23,196,000**	**$ 22,664,000**
Contingency (30%)	$ 6,769,000	$ 6,959,000	$ 6,799,000
Escalation to December 2026 (4%/year)	$ 3,662,000	$ 3,766,000	$ 3,678,000
Grand Total Construction Cost	**$ 32,994,000**	**$ 33,921,000**	**$ 33,141,000**

6.7 Design Criteria

The influent basis of design flows and loads for the upgrade and expansion are included in **Table 6.12**.

Table 6.12: Influent Basis of Design

Parameter	Units	Annual Average	Max Month	Max Day	Peak Inst.	Start Up Min Day
Flow	MGD	1.0	1.2	3.0	3.3	0.2
Wastewater Temperature	Degrees C	20	12			
Biochemical Oxygen Demand	mg/l	130	156			
	lbs/day	1,084	1,561			
Total Suspended Solids	mg/l	145	174			
	lbs/day	1,209	1,741			
Total Kjeldahl Nitrogen	mg/l	35	42			
	lbs/day	292	420			
Total Phosphorus	mg/l	8	8			
	lbs/day	67	80			

The design effluent quality basis of design for the project are summarized in **Table 6.13**. Each alternative must meet the effluent basis of design.

Table 6.13: Effluent Basis of Design

Parameter	Units	Annual Monthly Average	Max Month
Biochemical Oxygen Demand	mg/l	<10	<10
Turbidity[1]	NTU	<2	<5 any time
Total Suspended Solids	mg/l	<10	<10
Total Nitrogen	mg/l	<3	<3
Total Phosphorus	mg/l	<0.3	<0.3
E. Coli[2]	MPN / 14 mL E. Coli Monthly Median	1	23

[1] Class IV Reclaimed Water Requirements, [2] Anticipated requirement with relocated outfall to Corsica River

6.8 Land Requirements

The WWTP upgrade and expansion will be constructed on developed land owned by the Town.

Future expansion of the spray irrigation system would require at least 300 acres of suitable land located near the Town. The identification, testing, and development of the field will be considered separately from the WWTP upgrade.

6.9 Potential Construction Issues

The construction of the three alternatives will have potential construction issues that need to be identified, the risks understood, and mitigation plans developed. Based on experience and knowledge of the site, an initial list of specific construction related issues and methods to mitigate the risk have been developed as summarized in **Table 6.14**.

In order to maintain plant operations during construction, both existing SBRs are required to remain online until the selected treatment process is constructed and put into service. For Alternative 2 – Conventional Activated Sludge and Alternative 3 – MBR Activated Sludge, this requires the 2 train 5-stage activated sludge basins to be constructed and put into service before either of the SBR tanks are converted into influent flow equalization tanks. The proposed site layouts for each of the three alternatives, described in **Section 6.3**, allow for maintenance of plant operations during construction.

Table 6.14: Summary of Potential Construction Issues		
Issue	Risk	Planned Mitigation Methods
Encountering groundwater during excavations	Dewatering excavation expense	Plan for thorough soil borings and geotechnical investigations early during design
Encountering unidentified underground piping and structures	Change in scope during construction	Review all available information. During design conduct subsurface investigation and test pitting where there are potential obstructions
Product and equipment delivery longer than expected	Delay in construction schedule	Realistically estimate delivery times based on estimates from named manufacturers and experience with other projects and keep in contact with key manufacturers during construction
Integration of manufacturer supplied control panels with the plant SCADA	Insufficient process data relayed to the SCADA from the manufacturer's control panels	Complete process and instrumentation diagrams, Input/Output lists and control descriptions will be included in the Contract Documents
Level of automation that operations can maintain	Automation is too complex for operations to troubleshoot and maintain	Conduct workshops with operations to custom tailor the control system and the level of automation with the needs and skills of operations
Treatment process testing	Assessing the treatment process under design conditions	Contract Documents will include a 30 day testing period of the complete treatment plant with a requirement to operate the plant with equipment and treatment trains offline to simulate design conditions. Testing conditions, sampling and requirements for the system passing the testing will be included.
Turn over of treatment facilities	In complex upgrade projects some treatment facilities will be brought online before substantial completion	The definition of substantial completion for individual facilities and major equipment, and the responsibilities for the Owner and Contractor between facility substantial completion and final completion will be clearly defined in the specifications.

The design phase will discover additional potential construction issues and where practical the Contract Documents will identify the area the Installing Contractor should be aware of.

7 Alternative Evaluation

7.1 Effluent Water Quality Comparison

Each of the three alternatives are capable of meeting the treatment and capacity goals for this project. To verify this, the expected secondary effluent water quality of each alternative was evaluated by modeling each of the three treatment alternatives using BioWin software. Each treatment alternative was modeled under average flow conditions and maximum monthly (simulating wet weather) flow conditions.

Table 7.1 shows the different influent conditions that were used for modeling average conditions versus maximum monthly conditions for each alternative. These influent conditions are based on composite influent sampling data of the WWTP conducted in September/October 2017 and in March 2023, which is included in **Appendix C**. Note that influent sampling data was limited since it is not conducted on a regular basis.

Table 7.1: BioWin® Model Influent Conditions

Condition	Flow	Temperature	Biochemical Oxygen Demand (BOD)	Volatile Suspended Solids (VSS)	Total Suspended Solids (TSS)	Total Kjeldahl Nitrogen (TKN)
	(MGD)	(Deg C)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Average	1.0	20	130	116	145	35
Maximum Monthly	1.2	12	156	139	174	42

Additional influent conditions were assumed in the model which did not change between average and maximum monthly model runs. These conditions include:

- Total Phosphorus = 8.0 mg/L
- Total Sulfur = 10 mg/L
- Nitrate = 0 mg/L
- pH = 7.3
- Alkalinity = 6.0 mmol/L

As stated in **Section 2.3.1**, the treatment quality goals for ENR include a TN concentration below 3.0 mg/L and a TP concentration below 0.3 mg/L. The reduction in TP at Centreville WWTP will depend on upgrades to the existing chemical dosing system and amount of PACl added to precipitate phosphorus. PACl chemical dosing was not modeled in BioWin. Therefore, this modeling study focused on comparing TN reduction in the biological treatment process for each of the three treatment alternatives.

Table 7.2 lists the biological treatment quality parameters that were monitored in the secondary effluent in BioWin, as well as the target concentrations for each of the three alternatives in order to meet the effluent quality goals of this project. The parameters that were monitored include concentrations of MLSS, cBOD, TSS, ammonia, filtered TKN, and nitrate + nitrite.

Table 7.2: Target Secondary Effluent Water Quality Parameters		
Biological Treatment Parameter	Alternative 1 (SBR) and Alternative 2 (Conventional Activated Sludge)	Alternative 3 (MBR Activated Sludge)
MLSS	<= 4,000 mg/L	<= 8,000 mg/L
cBOD	<= 30 mg/L	<= 2 mg/L
TSS	<= 20 mg/L	Non-detect
Ammonia	< 1.0 mg/L	< 1.0 mg/L
Filtered TKN	< 2.0 mg/L	< 2.0 mg/L
Nitrate + Nitrite	< 8.0 mg/L	< 1.0 mg/L

As shown in **Table 7.2**, Alternatives 1 and 2 have the same target effluent quality concentrations with respect to nitrate (/nitrite) and rely on the downstream denitrification filters to complete the nitrogen removal, although Alternative 2 can also incorporate methanol addition in the post-anoxic zone for enhanced nitrogen removal and use the tertiary filters for final solids removal only. For Alternative 3 all nitrogen removal is within the MBR process tankage as there is no additional downstream removal process, and is facilitated by methanol addition within the MBR secondary anoxic zone to reduce nitrate + nitrite concentrations below 1 mg/L.

All three alternatives require ammonia concentrations to be below 1 mg/L. MBRs can typically operate at higher MLSS concentrations compared to conventional activated sludge clarifiers, which is why Alternative 3 has a higher allowable MLSS concentration.

Tables 7.3 and 7.4 show the secondary effluent water quality results from modeling at both average and maximum monthly conditions.

Table 7.3: Secondary Effluent Water Quality BioWin Modeling Results – Average Conditions					
Condition	Biological Treatment Parameter	Units	Alternative 1: SBR Expansion	Alternative 2: Conventional Activated Sludge	Alternative 3: MBR Activated Sludge[(1)]
Average	Flow	MGD	1.0	1.0	1.0
	MLSS	mg/L	3,600	2,500	5,100
	cBOD	mg/L	6.0	2.4	1.0
	TSS	mg/L	20	9	0
	Ammonia	mg/L	0.30	0.12	0.06
	Filtered TKN	mg/L	1.3	1.4	1.2
	Nitrate	mg/L	2.9	4.0	0.08
	Nitrite	mg/L	0.05	0.03	0.01
	Total Nitrogen	mg/L	4.6	5.6	1.4

(1) – Note that Alternative 3 (MBR Activated Sludge) modeling includes 75 gpd of methanol addition in the postanoxic zone.

Table 7.4: Secondary Effluent Water Quality BioWin Modeling Results – Maximum Monthly Conditions					
Condition	Biological Treatment Parameter	Units	Alternative 1: SBR Expansion	Alternative 2: Conventional Activated Sludge	Alternative 3: MBR Activated Sludge[(1)]
Maximum Monthly	Flow	MGD	1.2	1.2	1.2
	MLSS	mg/L	3,800	3,600	7,500
	cBOD	mg/L	10	3.5	0.9
	TSS	mg/L	20	14	0
	Ammonia	mg/L	0.40	0.30	0.17
	Filtered TKN	mg/L	1.5	1.7	1.5
	Nitrate	mg/L	1.4	5.2	0.70
	Nitrite	mg/L	0.8	0.1	0.04
	Total Nitrogen	mg/L	4.1	7.3	2.4

(1) – Note that Alternative 3 (MBR Activated Sludge) modeling includes 75 gpd of methanol addition in the postanoxic zone.

The secondary effluent quality of all three alternatives meets all of the target quality parameters listed in **Table 7.2**. The BioWin modeling results for filtered TKN concentrations are below 2 mg/L; however, the historical average TKN concentrations from 2014-2022, as listed in **Section 4.4**, are below 1 mg/L. It is assumed that BioWin is not properly accounting for the biodegradable portion of TKN, which is why filtered TKN concentrations are reporting unusually high in the models. In conclusion, BioWin modeling of each of the three treatment alternatives confirms that each alternative is capable of meeting the treatment and capacity goals for this project.

7.2 Life Cycle Cost Analysis

A life cycle cost analysis was performed on the three alternatives. A life cycle cost analysis combines the initial capital cost with the net present value of the operating costs across the expected life of the project into a present worth total. The life cycle cost analysis provides a more complete picture of the costs of the project than just the capital cost.

For the life cycle cost analysis, the electrical loads for the major equipment are multiplied by the percentage of time per year the equipment is expected to be running. Equipment with variable speed drives and variable loads are calculated using the expected annual average load.

Labor for each alternative was compared to the existing cost of labor for the current WWTP and extrapolated to consider the increased complexity of the upgrade as well as the increased size of the plant to treat the expanded flows.

The chemical costs indicated in **Table 7.5** under ‘Annual Chemical Costs’ are the estimated costs of methanol to drive the denitrification process and the addition of PACl to precipitate phosphorus. The design average influent nitrogen and phosphorus and the goals for effluent nitrogen and phosphorus concentrations are used in the calculations at an annual average influent flow of 1.0 MGD.

As noted in the **Table 7.5** footnote, the membrane cleaning chemical costs are included in the ‘Annual Maintenance/Repairs Costs’ for the Alternative 3 – MBR Activated Sludge. The ‘Annual Maintenance/Repair Costs’ also includes the annual contribution to replacement of the membranes every ten years.

For the life cycle cost analysis the project is assumed to have no salvage value at the end of the 20 years.

Table 7.5: Life Cycle Cost Analysis			
	Alternative 1 – SBR Expansion	Alternative 2 – Conventional Activated Sludge	Alternative 3 – MBR Activated Sludge
WWTP Capital Cost	$32,994,000	$33,921,000	$33,141,000
Operating Cost			
Annual Maintenance/Repair Costs(1)	$133,076	$147,141	$226,647
Annual Electric Cost	$ 55,157	$77,528	$84,877
Annual Burdened Labor	$384,800	$395,200	$499,200
Annual Chemical Costs	$336,886	$336,886	$336,886
Operating Cost Subtotal	$909,919	$956,755	$1,147,609
Real Discount Rate(2)	2%	2%	2%
Project Life, years	20	20	20
Operating Cost Present Value	$14,880,000	$15,650,000	$18,770,000
Present Worth	**$47,874,000**	**$48,571,000**	**$51,911,000**

(1) Maintenance estimated at 2% of equipment cost for Alternatives 1 and 2 and 2.5% for Alternative 3 to account for membrane replacement and cleaning chemicals
(2) December 2022 OMB Circular No. A-94

The life cycle cost analysis results in the present worth ranging from approximately $48 million for Alternative 1 up to $52 million for Alternative 3. The results are within 8% of each other. Considering the variability in estimating construction and operating costs, the three alternatives are similar in life cycle costs.

7.3 Non-Monetary Evaluation

Life cycle costs include items of each alternative that have a dollar value. The value of the project will also be influenced by factors that do not have a direct cost measure. The following criteria for the non-monetary evaluation have been defined based on feedback from the Town of Centreville

- Leverages operators experience
- Operational simplicity
- Ease of maintenance
- Use of existing assets
- Compatibility with water reuse
- Ability to evolve with future technologies
- Ability to expand treatment process in the future
- Available site space for future improvements

The non-monetary evaluation criteria are categorized and weighted as described below.

Leverages Operators Experience

Operators currently at the Centreville WWTP have experience with operating the existing two-tank SBR system. This criterion evaluates the complexity in training operators for each of the three treatment alternatives. This criterion was assigned a weighting factor of 5%, due to significantly different levels of training that would be required for each of the three alternatives.

Operational Simplicity

Each of the three alternatives will have different day-to-day involvement for operators and will require different levels of attention to maintain operation. Because some of the alternatives are more complicated to operate, this criterion was assigned a weighting factor of 5%.

Ease of Maintenance

The equipment for each treatment alternative must be accessible for maintenance once it is placed into service. This criterion considers how often the equipment for each alternative will require servicing, as well as the availability of replacement parts and how complex the equipment is to maintain. This criterion has been assigned a weighting factor of 10%.

Use of Existing Assets

For each treatment alternative, it is desired to reuse the existing tanks at the WWTP to minimize construction costs. The amount of new equipment, tanks, and facilities will differ for each treatment alternative. Therefore, this criterion has been assigned a weighting factor of 10%.

Compatibility with Water Reuse

The Town of Centreville plans for future potable water reuse using the WWTP effluent. This criterion evaluates how each treatment alternative positions the Town to move towards potable water reuse in the future. This includes how much expansion to the treatment process will be required in the future to meet the effluent quality levels required for potable water reuse. This criterion has been assigned a weighting factor of 10%.

Ability to Evolve with Future Technologies

It is important to the Town that the Centreville WWTP is positioned to incorporate future treatment technologies and remain on the forefront for wastewater treatment. This category considered how flexible each treatment alternative is for incorporating future technologies. Because this criterion has a high importance to the Town, it has been assigned a weighting factor of 20%.

Ability to Expand Treatment Process in the Future

Federal and state regulatory agencies may establish more stringent effluent quality requirements in the future—therefore, this category considers how each treatment alternative can be expanded in the future to meet higher effluent quality. This criterion has a high importance to the Town and therefore has been assigned a weighting factor of 20%.

Available Site Space for Future Improvements

Future expansion and development in the Town of Centreville will require additional expansion of the WWTP beyond the planned 1.0 MGD capacity. This category considers how much site space will be available after construction of each treatment alternative. It is desired to maintain as much site space as possible for future expansion efforts. Because of this, this criterion has been assigned a weighting factor of 20%.

Each of the evaluation criteria noted above have been weighted to reflect their relative importance to the construction and operation of the treatment process. The weighting factors were discussed with the Town staff and represent the consensus opinion. Each alternative was assigned a score based on a scale of 1 to 10, with 1 being the lowest or least desirable and 10 being the highest or most desirable for a given criterion. The total score for each category was then determined by multiplying the individual criteria scores by the assigned weight, and then summing up the weighted scores. **Table 7.6** presents the final criteria ranking tabulation.

Table 7.6: Non-Monetary Evaluation of Treatment Alternatives

Weight %	5		5		10		10		10		20		20		20		Total Score	Rank
	Leverages Operators Experience		Operational Simplicity		Ease of Maintenance		Use of Existing Assets		Compatibility with Water Reuse		Ability to Evolve with Future Technologies		Ability to Expand Treatment Process in the Future		Available Site Space for Future Improvements			
	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments	Score	Comments		
Alternative 1: SBR Expansion	10	Operators are highly familiar with the existing SBR technology, which is currently used at the WWTP.	10	The SBR process has a relatively low complexity for operators.	10	The SBR process requires minimal maintenance of equipment.	10	The existing SBR tanks and SBR equipment will be reused for the SBR expansion.	10	The SBR process will provide effluent quality suitable for future water reuse.	4	The SBR tanks cannot easily be modified to accommodate future technologies. SBR is seen as an older, conventional treatment process.	4	This alternative requires the most amount of site space. It will be the most challenging to further expand the future treatment capacity.	4	Requires relatively high amount of site disturbance.	**640**	**3**
Alternative 2: Conventional Activated Sludge	8	Operators will be able to use knowledge of the existing SBR process to learn the new conventional activated sludge process.	6	The activated sludge process is moderately complex for operators.	8	The activated sludge process requires relatively low maintenance equipment.	8	Existing tank structures will be reused; however, new equipment is required in the existing SBR tanks.	10	The activated sludge process will provide effluent quality suitable for future water reuse.	7	The activated sludge basins are adaptable and can be modified to accommodate future technologies.	6	This alternative requires a moderate amount of site space. There will be space to construct additional activated sludge basins for future expansion.	6	Requires relatively low amount of site disturbance.	**710**	**2**
Alternative 3: MBR Activated Sludge	1	The MBR process is significantly different than the existing SBR process and will require considerable training.	1	The MBR process has highly complex equipment that requires a lot of operational attention.	1	The MBR process requires significant maintenance of complex equipment.	8	Existing tank structures will be reused; however, new equipment is required in the existing SBR tanks.	10	The MBR process will provide effluent quality suitable for future water reuse.	8	The MBR technology is a newer treatment technology on the forefront of wastewater treatment. New technologies will evolve throughout the future to further improve the MBR process.	10	This alternative minimizes the amount of site space required. There will be space to construct additional MBR tanks for future expansion.	10	Requires least amount of site disturbance.	**760**	**1**

Based on the results of the evaluation, of the three treatment alternatives evaluated, Alternative 3 – MBR Activated Sludge received the highest score based on the criteria listed in this section.

As a result of the life cycle cost analysis and the non-monetary evaluation, Alternative 3 – MBR Activated Sludge is the recommended treatment upgrade for the Centreville WWTP. This alternative will be further developed during detailed design.

8 Recommended Upgrades and Expansion

8.1 Preliminary Project Design

A summary of the project scope for the expansion and upgrade of the Centreville WWTP to an MBR activated sludge treatment process is detailed in this section. **Table 8.1** lists the preliminary project design and facility upgrades that are required for the recommended alternative.

Table 8.1: Preliminary Project Design – Alt 3 MBR Activated Sludge

Facility	Description
Influent Screening	Replace the existing mechanical screen with a bar rack rated at 4.0 MGD (peak hydraulic flow) and install new center feed fine screens down stream of bar rack.
Influent Flow Equalization Tank	Convert the existing SBR process tanks to two (2) 500,000-gallon working capacity each influent flow EQ tanks with surface aerator/mixers. Submersible pumps will pump flow from the EQ tank to the MBRs.
MBR Process	Install 2 train, 5-stage activated sludge process with membranes to separate solids from treated effluent. Fine bubble diffusers will be installed to incorporate air from proposed high efficiency blowers. Anoxic and swing zones will be agitated with submersible mixers. Permeate pumps will draw effluent through membranes. Low head propeller pumps for internal recycle and return activated sludge will be installed. Waste sludge pumps will pull mixed liquor from the reactors and discharge into the aerobic digesters. Chemical cleaning facilities will be provided to clean the membranes.
Chemical Dosing	Provide a double contained PACl tank located in the Filter and Blower Building with a minimum of 30 days of storage and dosing system. Provide methanol storage with a minimum of 30 days of storage and dosing facility.
UV Disinfection	Install two (2) in-line low pressure high output (LPHO) UV disinfection units to replace existing.
Effluent Disposal	To be further evaluated: • Additional spray irrigation disposal, • Relocate outfall and expand stream discharge to year-round, and • Planning for future beneficial water reuse.
Non-potable Plant Water System	Install a non-potable water system that draws from the UV effluent to a buffer tank in the Filter and Blower Building. Install pumps to distribute non-potable water supply from the buffer tank throughout the WWTP.
Aerobic Digesters	Retrofit the existing post EQ and sludge holding tanks to two (2) aerobic digesters with ability to thicken solids and decant liquid back to treatment process.
Biosolids Dewatering System	Install new biosolids handling building for dewatering process. New covered sludge cake storage area for Class B biosolids.
Plant Control System and SCADA	Provide enhanced process controls at separate process areas with routine functions or complex control loops with centralized monitoring and control workstation for operator interface. Provide capabilities to provide hub for Town wide SCADA system of utilities.
Administration/Laboratory Space	Reconfigure the Administration/Laboratory Building to better utilize the space for the laboratory uses and provide dedicated space for locker rooms and offices.

8.2 Permit Requirements

Impacts to wetlands and other WOTUS would require Section 404 authorization from the U.S. Army Corps of Engineers (USACE) for the discharge of dredge or fill material. Impacts to waterways, 100-year floodplains, nontidal wetlands, 25-foot nontidal wetland buffers would require a Maryland Nontidal Wetlands and Waterways Permit. Additionally, a Section 401 Water Quality Certificate from MDE is required for any impacts to waterways or wetlands requiring a USACE Section 404 authorization. Projects with the potential to impact Tier II waters are subject to MDE's Tier II Antidegradation Review. Early coordination with MDE will be initiated during the permitting process to determine whether additional avoidance measures and best management practices (BMPs) are required. Impacts to forest, trees, and FIDS habitat within the CBCA would require coordination with the Chesapeake Bay Critical Area Commission (CAC) and/or the Queen Anne's County Critical Area Program.

Table 8.2 summarizes the expected permits that will need to be obtained during the design phase of the project. Additional environmental permits will be identified during design.

Table 8.2: Permit Requirements

Permitting Agency	Permit
Maryland Department of the Environment (MDE)	Sewerage Construction Permit
Maryland Department of the Environment (MDE)	Modification to NPDES Surface Water Discharge Permit
Maryland Department of the Environment (MDE)	NPDES Permit for Stormwater Discharge During Construction Activities
Queen Anne's County	Sediment and Erosion Control Plan Permit
Queen Anne's County	Stormwater Management Permit

8.3 Sustainability Considerations

The WWTP upgrade and expansion to an MBR treatment process will be designed to reduce its impact on the environment and to be resilient to future changes in the climate as indicated in this section.

8.3.1 Water and Energy Efficiency

As described in **Sections 6.1.7 and 6.5.1**, a non-potable water system will be installed at the Centreville WWTP to promote water efficiency by reducing the onsite potable water demand and reusing treated plant effluent. The treated effluent water quality will be sufficient to meet off-site Class III and IV reclaimed water requirements. New developments will be encouraged to connect into the reclaimed water for irrigation of common spaces.

Energy efficiency will also be at the forefront for the selection of lighting and equipment for the project. Examples of improved energy efficiency include:

- The existing florescent tube and halogen lights will be replaced with LED lights. New lights will only be LED.
- All equipment will use high efficiency motors.
- The UV disinfection system will have the latest generation of UV intensity measurement and lamp controller.
- Pumps will have variable frequency drives (VFD) to operate at optimal speeds.

- New process blowers will be high efficiency turbo blowers.
- Dewatering equipment will only consider slow speed, low energy demand type equipment.

8.3.2 Green Infrastructure

As described in **Section 6.5.2**, the selected treatment Alternative 3 will incorporate green infrastructure at a reasonable cost. The canopy over the dewatering cake storage area will be designed to accommodate the future installation of solar cells. The solar cells will be connected to the utility electric grid to offset the electricity used by the WWTP.

8.3.3 Climate Related Considerations

As described in **Section 6.5.3**, the upgrade and expansion of the WWTP is required to protect the receiving stream and the environment from wastewater that does not meet the discharge permit requirements. Without an expansion of the treatment capacity, the likelihood of future process upsets increases with the increase in influent flows stressing the capabilities of the existing system.

The new facilities will be constructed to protect them from a 100-year flood with 2 feet of additional protection provided. New structures will have a finished floor or top of wall of at least 2 ft above the 100-year flood elevation.

With the recommended treatment Alternative 3 – MBR Activated Sludge, the proposed facilities will have the smallest footprint of the alternatives considered and can be located to reduce the impact on environmental features such as wetlands and forested areas.

Additionally, expansion of the sludge treatment and handling facilities will result in Class B biosolids. This could potentially allow for land application of the dewatered biosolids, which is a more solution to minimizing landfill disposal.

8.4 Construction Cost Estimate

A budgetary cost estimate of construction for the recommended treatment alternative (Alternative 3 – MBR Activated Sludge) is included below. The cost estimate was developed using preliminary equipment supplier quotations based on the design criteria and unit costs for structures and ancillary construction. All three treatment alternatives were analyzed for construction and life cycle cost (see **Sections 6.6 and 7.2**), but this section will focus on the construction cost estimate of the recommended Alternative 3.

The estimates were prepared in accordance with AACE Class 4 Budgetary (planning-level) construction cost requirements. All costs are presented in 2023 dollars and will need to be indexed using the annual inflation rate. Contingency cost, an allowance that reflects the uncertainty associated with a construction cost opinion based on a planning level stage of the facilities, is included as a 30% markup in the estimate. Additionally, an escalation markup of 4% per year is also included in the estimate.

The estimated total construction cost for Alternative 3 – MBR Activated Sludge is summarized in **Table 8.3**. Additional cost breakdowns for Alternative 3 – MBR Activated Sludge are included in **Appendix A**.

Table 8.3: Scope and Construction Cost Estimate – Alternative 3 (MBR Activated Sludge)		
Item No.	Category	Cost
1	Interior Demolition (Lab, Control, and Filter and Blower Buildings)	$95,000
2	Influent Screening Expansion	$825,000
3	Converting Influent Flow Equalization Tanks, Aerated, with Pumping	$2,019,000
4	Methanol Facility	$618,000
5	UV Disinfection System	$642,000
6	Non-Potable Water System	$54,000
7	Dewatering Facility	$2,413,000
8	Covered Cake Storage Facility	$835,000
9	Lab, Control, and Filter and Blower Buildings Refurbishments	$617,000
10	Existing Tank Modifications	$643,000
11	Miscellaneous Process Piping and Equipment	$784,000
12	MBR Process Building, MBR Equipment and Controls	$5,789,000
13	Aerobic Digester Tank and Equipment	$78,000
14	Electrical	$4,169,000
15	Site Civil, including Yard Piping and Demolition (15% Items 1-12)	$2,312,000
16	Site SCADA (5% Items 1-12)	$771,000
	Subtotal	$22,664,000
	Design Contingency (30% of Subtotal)	$6,799,000
	Escalation to December 2026 (4%/year)	$3,678,000
	Total	**$33,141,000**
	Total (Low Range -20%)	*$26,513,000*
	Total (High Range +50%)	*$49,712,000*

8.5 Annual Operating Budget

8.5.1 Income

The Town projects income for the sewer system primarily from ongoing sewer service fees with some new connection fees expected. **Table 8.4** summarizes the currently projected annual income for the sewer system for the next five fiscal years.

Table 8.4: Sewer System Income	
Fiscal Year	Projected Annual Income
FY24	$1,531,427
FY25	$1,607,998
FY26	$1,704,478
FY27	$1,826,791
FY28	$1,972,694

8.5.2 Annual O&M Costs

The primary operating and maintenance costs after Alternative 3 is implemented are summarized in **Table 7.5**, with Alternative 3 repeated in **Table 8.5** for ease of reference.

Table 8.5: Annual Sewer System O&M Costs	
Alternative 3 – MBR Activated Sludge	Annual Costs
Maintenance/Repair Costs(1)	$226,647
Electric Cost	$ 84,877
Burdened Labor	$499,200
Chemical Costs	$336,886
Total Operating and Maintenance Costs	**$1,147,610**

(1) - Maintenance is estimated at 2.5% of equipment cost for Alternative 3 to account for membrane replacement and cleaning chemicals.

8.5.3 Debt Repayments

The Town's existing debt is being serviced from the annual budget. Additional debt will primarily be serviced through anticipated connection fees and additional sewer service fees from the planned and anticipated developments within the current town boundary and by the annexation of adjacent development.

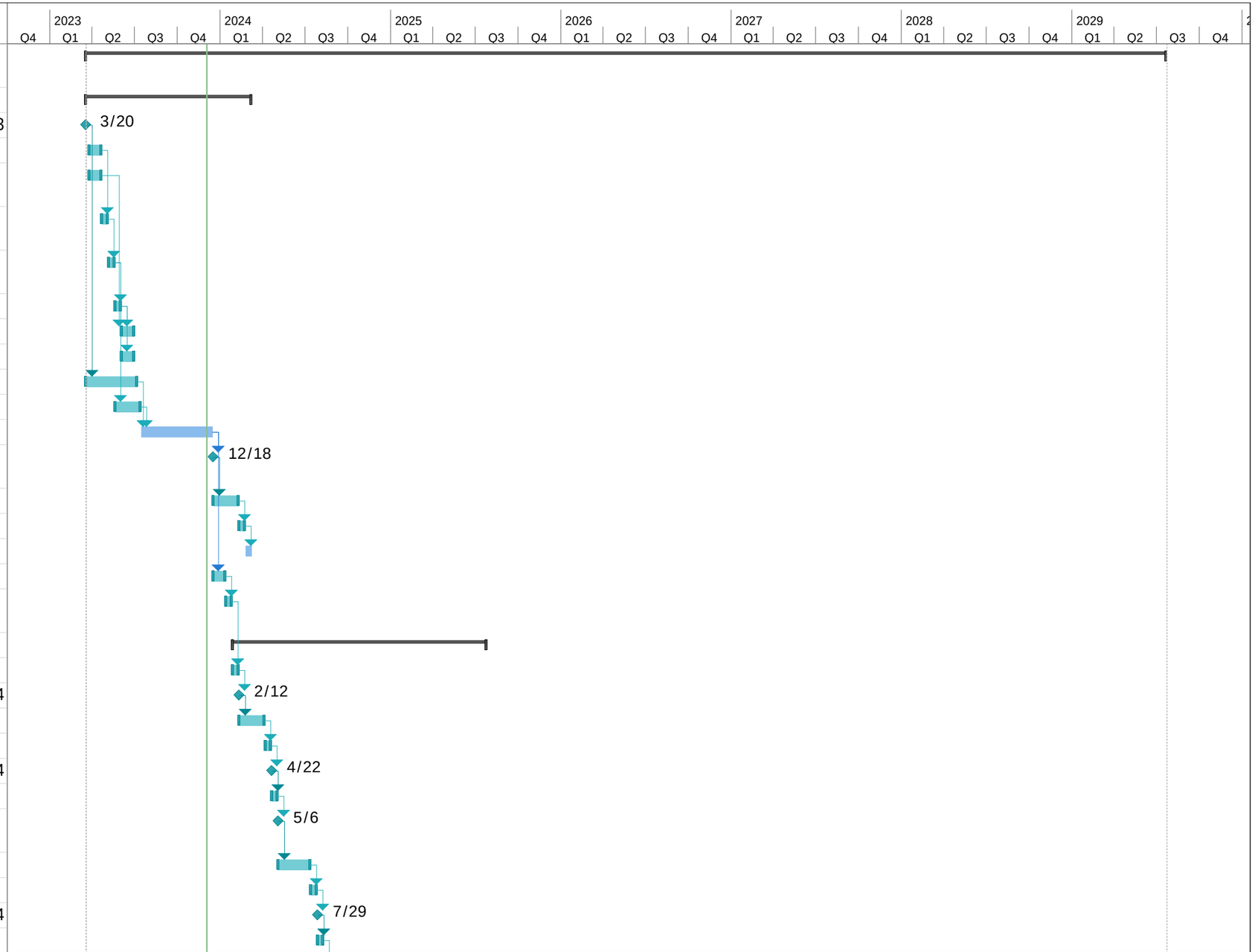
8.5.4 Reserves

The Town maintains a healthy reserve fund. As the Town grows, the reserve fund will also be increased to keep pace with the increased operating and maintenance costs of the expanded treatment plant.

8.6 Project Implementation Schedule

A preliminary construction schedule has been developed for the scope of work. The task durations for each of the facility upgrades detailed in this report are included in **Figure 8.1**.

ID	Task Name	Duration	Start	Finish
1	Centreville WWTP ENR Upgrade and Expansion	1655 days	Mon 3/20/23	Mon 7/23/29
2	PER Development	255 days	Mon 3/20/23	Fri 3/8/24
3	Start PER Update	0 days	Mon 3/20/23	Mon 3/20/23
4	Advertise for M/WBE	4 wks	Mon 3/27/23	Fri 4/21/23
5	Town Assembles Requested Information	4 wks	Mon 3/27/23	Fri 4/21/23
6	Develop ENR PER Amendment	2 wks	Mon 4/24/23	Fri 5/5/23
7	Town Review PER Amendment	2 wks	Mon 5/8/23	Fri 5/19/23
8	Sub Agreements	2 wks	Mon 5/22/23	Fri 6/2/23
9	Develop Draft PER	4 wks	Mon 6/5/23	Fri 6/30/23
10	Topo Survey	4 wks	Mon 6/5/23	Fri 6/30/23
11	Develop Alternatives	16 wks	Mon 3/20/23	Fri 7/7/23
12	Subconsultant Field Worl	8 wks	Mon 5/22/23	Fri 7/14/23
13	Develop PER	22 wks	Mon 7/17/23	Fri 12/15/23
14	Draft PER to Town and MDE	0 days	Mon 12/18/23	Mon 12/18/23
15	Review Draft PER	8 wks	Mon 12/18/2	Fri 2/9/24
16	Incorporate Comments	2 wks	Mon 2/12/24	Fri 2/23/24
17	Finalize PER	2 wks	Mon 2/26/24	Fri 3/8/24
18	Develop Design Proposal	4 wks	Mon 12/18/2	Fri 1/12/24
19	Town Reviews Design Proposal	2 wks	Mon 1/15/24	Fri 1/26/24
20	ENR Upgrade Design	390 days	Mon 1/29/24	Fri 7/25/25
21	Project Set Up	2 wks	Mon 1/29/24	Fri 2/9/24
22	Design Kick Off w Town	0 days	Mon 2/12/24	Mon 2/12/24
23	30% Design	8 wks	Mon 2/12/24	Fri 4/5/24
24	30% Design Internal QA	2 wks	Mon 4/8/24	Fri 4/19/24
25	30% Design to Town	0 days	Mon 4/22/24	Mon 4/22/24
26	Town Reviews 30% Desig	2 wks	Mon 4/22/24	Fri 5/3/24
27	30% Design Comment Review Meeting	0 days	Mon 5/6/24	Mon 5/6/24
28	60% Design	10 wks	Mon 5/6/24	Fri 7/12/24
29	60% Design Internal QA	2 wks	Mon 7/15/24	Fri 7/26/24
30	60% Design to Town	0 days	Mon 7/29/24	Mon 7/29/24
31	Town Reviews 60% Desig	2 wks	Mon 7/29/24	Fri 8/9/24

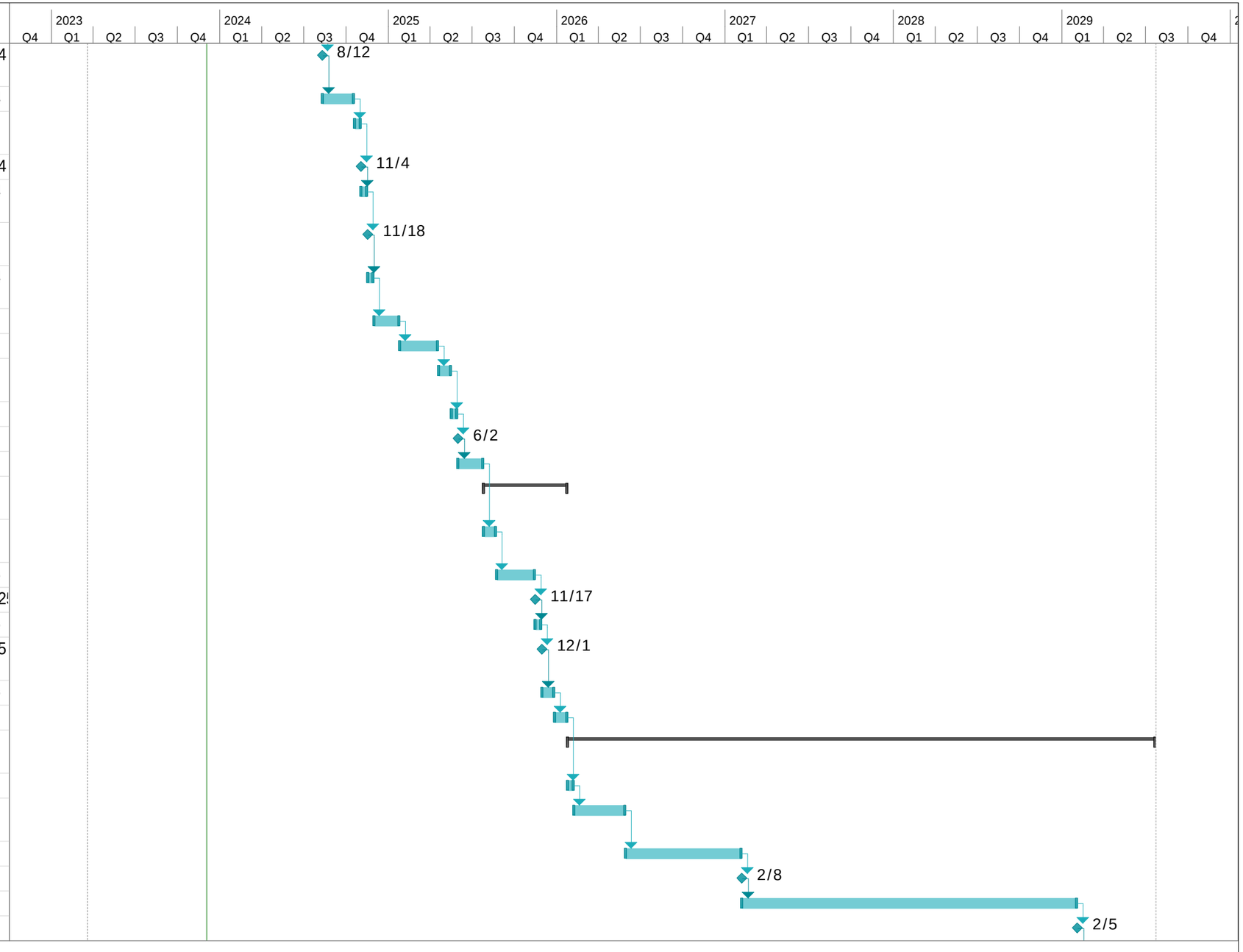


Project: Centreville WWTP ENR
Date: Mon 12/4/23

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone

Figure 8.1: Project Implementation Schedule

ID	Task Name	Duration	Start	Finish
32	60% Design Comment Review Meeting	0 days	Mon 8/12/24	Mon 8/12/24
33	Pre-Final Design	10 wks	Mon 8/12/24	Fri 10/18/24
34	Pre-Final Design Internal QA	2 wks	Mon 10/21/24	Fri 11/1/24
35	Pre-Final Design to Town	0 days	Mon 11/4/24	Mon 11/4/24
36	Town Reviews Pre-Final Design	2 wks	Mon 11/4/24	Fri 11/15/24
37	Pre-Final Design Comment Review	0 days	Mon 11/18/24	Mon 11/18/24
38	Design Review Meeting with MDE	2 wks	Mon 11/18/24	Fri 11/29/24
39	MDE Review	8 wks	Mon 12/2/24	Fri 1/24/25
40	Permitting	12 wks	Mon 1/27/25	Fri 4/18/25
41	Develop Bid Ready Documents	4 wks	Mon 4/21/25	Fri 5/16/25
42	Bid Ready Doc Internal Q	2 wks	Mon 5/19/25	Fri 5/30/25
43	Bid Ready Docs to Town	0 days	Mon 6/2/25	Mon 6/2/25
44	Town Finalizes Funding	8 wks	Mon 6/2/25	Fri 7/25/25
45	ENR Upgrade and Expansion Bidding	130 days	Mon 7/28/25	Fri 1/23/26
46	Town Prepares for Advertisement	4 wks	Mon 7/28/25	Fri 8/22/25
47	Advertise	12 wks	Mon 8/25/25	Fri 11/14/25
48	Open Bids	0 days	Mon 11/17/25	Mon 11/17/25
49	Bid Review	2 wks	Mon 11/17/25	Fri 11/28/25
50	Bid Recommendation to MDE	0 days	Mon 12/1/25	Mon 12/1/25
51	MDE Bid Review	4 wks	Mon 12/1/25	Fri 12/26/25
52	Construction NTP	4 wks	Mon 12/29/25	Fri 1/23/26
53	ENR Upgrade and Exp Construction	910 days	Mon 1/26/26	Mon 7/23/29
54	Issue PO's	2 wks	Mon 1/26/26	Fri 2/6/26
55	Shop Drawing Submittals and Review	16 wks	Mon 2/9/26	Fri 5/29/26
56	Major Equipment Deliver	36 wks	Mon 6/1/26	Fri 2/5/27
57	Mobilize Site	0 days	Mon 2/8/27	Mon 2/8/27
58	Construction	104 wks	Mon 2/8/27	Fri 2/2/29
59	Substantial Completion	0 days	Mon 2/5/29	Mon 2/5/29

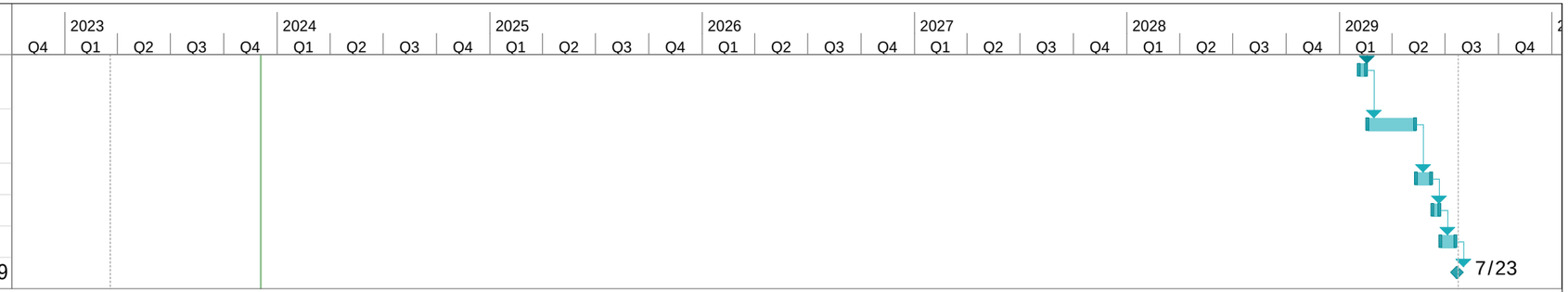


Project: Centreville WWTP ENR
Date: Mon 12/4/23

Task	Project Summary	Manual Task	Start-only	Deadline			
Split	Inactive Task	Duration-only	Finish-only	Progress			
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress			
Summary	Inactive Summary	Manual Summary	External Milestone				

Figure 8.1: Project Implementation Schedule

ID	Task Name	Duration	Start	Finish
60	Operations Process Training	2 wks	Mon 2/5/29	Fri 2/16/29
61	Commissioning and Start Up	12 wks	Mon 2/19/29	Fri 5/11/29
62	Process Testing	4 wks	Mon 5/14/29	Fri 6/8/29
63	Develop Punchlist	2 wks	Mon 6/11/29	Fri 6/22/29
64	Project Closeout	4 wks	Mon 6/25/29	Fri 7/20/29
65	Final Completion	0 days	Mon 7/23/29	Mon 7/23/29



Project: Centreville WWTP ENR
Date: Mon 12/4/23

Task	Project Summary	Manual Task	Start-only	Deadline
Split	Inactive Task	Duration-only	Finish-only	Progress
Milestone	Inactive Milestone	Manual Summary Rollup	External Tasks	Manual Progress
Summary	Inactive Summary	Manual Summary	External Milestone	

Figure 8.1: Project Implementation Schedule

9 Project Asset Management

9.1 Inventory of Critical Assets

After the implementation of the Centreville WWTP ENR Upgrade and Expansion project the following will be the Town's Critical Assets at the WWTP:

1. Incoming Power Distribution
2. Back Up Power Generator
3. Aeration Blowers - Existing
4. Aeration Blowers – New
5. Administration/Lab Building
6. Disinfection (Filter and Blower) Building
7. Control Building
8. Influent Screening Facility
    a. Mechanically Cleaned Screens
    b. Washer/Compactor
    c. Concrete Channels
9. Process Tanks
    a. Flow EQ Tanks
    b. Aerobic Digesters
    c. Diffusers
10. MBR Trains
    a. Mixers
    b. Diffusers
    c. Internal Recycle Pumps
11. Ultraviolet Light Disinfection
12. Effluent Pump Station
13. Dewatering Facility
    a. Dewatering Press
    b. Polymer Storage and Dosing
    c. Sludge Conveyor
14. Covered Cake Storage Area

9.2 Condition of Critical Assets

All critical assets will be new with the exception of the following:

A. Incoming Power Distribution
B. Aeration Blowers – Existing
C. Administration/Lab Building
D. Disinfection (Filter and Blower) Building
E. Process Tanks
F. Effluent Pump Station

The condition of the critical assets is described below:

A. Incoming power distribution
   The incoming power distribution includes the utility owned transformer and cables to the overhead power system. The incoming switchboard owned by the Town is in in good condition with many years of remaining expected life.

B. Aeration Blowers – Existing

The three existing aeration blowers are 20 years old and are operating as designed and are in good condition. The blowers have many years of remaining expected life.

The existing aeration blowers will be used for processes that are ancillary to the treatment process, specifically to provide aeration of the two influent flow equalization tanks and the two aerated digesters. The blowers will have a standby unit.

C. Administration/Lab Building

The Administration/Lab Building will be refurbished with the project and will have many years of remaining expected life.

D. Disinfection (Filter and Blower) Building

The Disinfection (Filter and Blower) Building is in good condition with many years of remaining expected life.

E. Process Tanks

The concrete process tanks are in good condition with more than 30 years of remaining expected life. The mechanical equipment will be replaced with the project. Handrails, lighting, and other appurtenances will be refurbished or replaced during the upgrade.

9.3 Critical Asset Maintenance and Replacement Plan

With the installation of the majority of the equipment and tanks being newly installed with the upgrade and expansion project, there is the typically a cut to maintenance budgets. In conjunction with the lower maintenance budget, the Town must institute a replacement fund which is funded annually with the monies the Town would have spent maintaining 20+ year old equipment. Therefore, with funding similar to current, the Town will be prepared for the eventual replacement of equipment as needed with the saved funds.

9.4 Critical Asset Energy and Water Efficiency Plan

There are two parts of critical asset energy and water efficiency: operational efficiency and future upgrades.

Operational efficiency refers to how the treatment process is actually operated compared with the optimal theoretical energy and water efficiency. For example, aeration is the single largest cost for the activated sludge treatment process and automating the speed of the blowers to provide just enough air to meet the process requirements, will save considerable energy compared to manually operating the blowers.

The ENR upgrade will include simple and proven process instrumentation and automation to assist the operations to operate the treatment process with operational efficiency. Examples include in tank continuous read dissolved oxygen and ammonia instruments to monitor the treatment process and adjust aeration needs automatically using Ammonia Based Aeration Control (ABAC). Chemical dosing will also have flow pacing implemented to automatically adjust the phosphorus precipitant to adjust dosing based on continuous flow measurement inputs. The methanol dosing will be controlled based on nitrate readings entering and leaving the second anoxic zones.

Water efficiency will be primarily through the replacement of potable water use with non-potable water everywhere practical.

Future upgrades consider the improvements in energy efficiency over time. For example, at some point in the future, it is likely the ultraviolet (UV) light disinfection system installed with the ENR upgrade and expansion which is highly efficient by today's standards, will be eclipsed by future technologies of UV disinfection, or another completely different technology. The Town's DPW needs to keep up to date with the latest equipment available by attending wastewater conferences, or by bringing a consulting engineer into an on call contract. The on call engineer can be tasked with reviewing the energy efficiency of the treatment processes and make recommendations for improvements.

Appendix A

Cost Estimate Line Items

Centreville ENR Upgrade and 1 MGD Expansion 8-Dec-23
Town of Centreville
Preliminary Construction Cost Estimate

	Alt 1 - 4 SBR	Alt 2 - Act Sludge	Alt 3 - MBR
Alternative 3 Facilities			
Existing Tank Modifications	$ 214,000	$ 643,000	$ 643,000
Clarifier Tanks, Equipment and RAS PS	$ -	$ 3,864,000	$ -
Denitrification Filter Tanks, Equip and Controls	$ 3,112,000	$ 3,112,000	$ -
Misc Process Piping and Equipment	$ 157,000	$ 235,000	$ 784,000
Additional SBR Tanks, Equip, and Controls	$ 3,564,000	$ -	$ -
Activated Sludge Equipment	$ -	$ 1,012,000	$ -
MBR Process Equipment and Controls	$ -	$ -	$ 5,789,000
Post EQ Tank and Equipment	$ 78,000	$ -	$ -
Aerobic Digester Tank and Equipment	$ 1,427,000	$ 78,000	$ 78,000
Ultraviolet Disinfection System	$ 642,000	$ 642,000	$ 642,000
Pre-Flow EQ Tank, Aerated, w Pumping	$ 2,054,000	$ 2,019,000	$ 2,019,000
Alternative Subtotal Cost	**$ 11,248,000**	**$ 11,605,000**	**$ 9,955,000**
Base Facilities			
Interior Demolition (Lab, Control, and Filter and Blower Buildings)	$ 95,000	$ 95,000	$ 95,000
Influent Screening Expansion	$ 825,000	$ 825,000	$ 825,000
Methanol Facility	$ 618,000	$ 618,000	$ 618,000
Non-Potable Water System	$ 54,000	$ 54,000	$ 54,000
Dewatering Facility	$ 2,413,000	$ 2,413,000	$ 2,413,000
Covered Cake Storage	$ 835,000	$ 835,000	$ 835,000
Lab Building Refurb	$ 139,000	$ 139,000	$ 139,000
Control Building Refurb	$ 130,000	$ 130,000	$ 130,000
Filter & Blower Building Refurb	$ 348,000	$ 348,000	$ 348,000
Base Subtotal Cost	**$ 5,457,000**	**$ 5,457,000**	**$ 5,457,000**
Alternative Plus Base - Subtotal Construction Cost	**$ 16,705,000**	**$ 17,062,000**	**$ 15,412,000**
Electrical	$ 2,517,000	$ 2,722,000	$ 4,169,000
Site Civil, inc Yard Piping and Demo (15%)	$ 2,505,750	$ 2,559,300	$ 2,311,800
Site SCADA (5%)	$ 835,250	$ 853,100	$ 770,600
Subtotal	$ 22,563,000	$ 23,196,400	$ 22,663,400
Contingency (30%)	$ 6,769,000	$ 6,959,000	$ 6,799,000
WWTP ENR Total Const Cost (December 2023 Dollars)	**$ 29,332,000**	**$ 30,155,400**	**$ 29,462,400**
Escalated to December 2026 (4%/year)	**$ 32,994,000**	**$ 33,921,000**	**$ 33,141,000**

MARK-UP SUMMARY

PROJECT NAME:	**Centreville WWTP ENR Upgrade and Expansion PER**	CLIENT: Town of Centreville	ESTIMATED BY: WRA
PROJECT LOCATION:	**Centreville, Maryland**	DESIGN SUBMISSION: PER	WORK ORDER NUMBER: 14375-000

MARKUP	DESCRIPTION			MATERIAL MARKUP %	LABOR MARKUP %	EQUIPMENT MARKUP %
SUBCONTRACTOR MARKUPS						
LOCATION FACTORS	Factors from Means Location Factor Tables and City Cost Index Tables to account for market conditions at project location	City	Centreville			
		Material	100.00%	**0.00%**	**0.00%**	**0.00%**
		Labor	100.00%			
		Equipment	100.00%			
WORK RESTRICTION FACTOR/PHASING	This factor adjusts for project specific elements including: restriction on work hours, security requirements, limited site access, phasing, etc.				**0.00%**	
SALES TAX ON MATERIAL & EQUIPMENT	Sales tax may be added to materials costs, equipment costs, and sub-contractor work. State = MD			**6.00%**		**6.00%**
LABOR BURDEN					**29.17%**	
Workers Comp. Insurance	State specific; Means 2022				**9.00%**	
Fixed Overhead	Federal and State Unemployment, FICA, Risk Insurance & Liability; Means 2015				**18.50%**	
INSTALLING CONTRACTOR OVERHEAD	Home office overhead for Installing Contractor. This markup is typically in the range of 8 - 12%			**10.00%**	**10.00%**	**10.00%**
INSTALLING CONTRACTOR PROFIT	Profit for Installing Contractor. This markup is typically in the range of 8 - 12%			**10.00%**	**10.00%**	**10.00%**
TOTAL MARKUP - SUBCONTRACTOR				**1.283**	**1.563**	**1.283**
PRIME CONTRACTOR MARKUPS						
GENERAL REQUIREMENTS & CQC	Job office overhead costs including quality control, temporary facilities, project security, clean-up, etc. Line items (Div 01) or percentage can be used. Typically 5% - 15% of project cost, including 3% CQC.			**5.00%**	**5.00%**	**5.00%**
PRIME OVERHEAD	Home office overhead for Prime contractor. This markup is typically in the range of 5 - 10%. For small projects self-performed by the Prime, this could be 0%.			**8.25%**	**8.25%**	**8.25%**
PRIME PROFIT	Profit for Prime Contractor. This markup is typically in the range of 5 - 10%. For small projects self-performed by the Prime, this could be 0%.			**6.00%**	**6.00%**	**6.00%**
BOND	The bond is used to pay for completion of construction if the contractor fails to do so. Typically ranges from 0.5% - 2%, depending on Contractor's past performance.			**1.50%**	**1.50%**	**1.50%**
ESCALATION	Cost growth (escalation) from the date of the estimate to the estimated mid-point of construction. Source of escalation index = (Means, ENR, NAVFAC, etc.) *Note: Escalation is calculated in summary spreadsheet			**0.00%**	**0.00%**	**0.00%**
DESIGN CONTINGENCY	Required to account for cost of unknowns based on level of design development.			**0.00%**	**0.00%**	**0.00%**
MISC. PROJECT-SPECIFIC MARKUP	(Enter description here. This will not be used for most projects.)					
TOTAL MARKUP - PRIME CONTRACTOR				**1.223**	**1.223**	**1.223**
TOTAL MARKUP - COMBINED				**1.568**	**1.911**	**1.568**

DETAILED COST: GENERAL REQUIREMENTS

PROJECT NAME:	**Centreville WWTP ENR Upgrade and Expansion PER**	CLIENT: Town of Centreville	ESTIMATED BY: WRA
PROJECT LOCATION:	**Centreville, Maryland**	DESIGN SUBMISSION: PER	WORK ORDER NUMBER: 14375-000

SOURCE	ITEM DESCRIPTION	QUANTITY	UNIT OF MEASURE	UNIT COSTS			TOTAL COSTS			TOTAL
				MATERIAL	LABOR	EQUIPMENT	MATERIAL	LABOR	EQUIPMENT	
	DEMOLITION									
	3 existing buildings: miscellaneous interior demolition of interior partitions, casework, etc.	1	LS	$ -	$ 50,000.00	$ -	$ -	$ 50,000	$ -	$ 50,000
	NEW WORK									
	Dewatering Building	1960	Sq Ft	$ 150.00	$ 150.00	$ 10.00	$ 294,000	$ 294,000	$ 19,600	$ 607,600
Alfa Laval Quote	2m Belt Filter Press	1	LS	$ 385,500.00	$ 115,650.00	$ -	$ 385,500	$ 115,650	$ -	$ 501,150
	Sludge Conveyors	1	LS	$ 100,000.00	$ 100,000.00	$ -	$ 100,000	$ 100,000	$ -	$ 200,000
	Polymer System	1	LS	$ 100,000.00	$ 15,000.00	$ -	$ 100,000	$ 15,000	$ -	$ 115,000
	Non-Potable Water System	1	LS	$ 25,000.00	$ 7,500.00	$ -	$ 25,000	$ 7,500	$ -	$ 32,500
	Influent Screening Concrete	100	CY	$ 400.00	$ 400.00	$ -	$ 40,000	$ 40,000	$ -	$ 80,000
Huber Quote	Influent Screens	2	ea	$ 160,000.00	$ 48,000.00	$ -	$ 320,000	$ 96,000	$ -	$ 416,000
	Methanol Facility	1	LS	$ 150,000.00	$ 200,000.00	$ -	$ 150,000	$ 200,000	$ -	$ 350,000
	Covered Cake Storage	3200	Sq Ft	$ 75.00	$ 75.00	$ -	$ 240,000	$ 240,000	$ -	$ 480,000
	Lab Building Refurbishment	800	Sq Ft	$ 50.00	$ 50.00	$ -	$ 40,000	$ 40,000	$ -	$ 80,000
	Control Building Refurbishment	750	Sq Ft	$ 50.00	$ 50.00	$ -	$ 37,500	$ 37,500	$ -	$ 75,000
	Filter & Blower Building Refurbishment	2000	Sq Ft	$ 50.00	$ 50.00	$ -	$ 100,000	$ 100,000	$ -	$ 200,000
	SUBTOTAL DIRECT COSTS						$ 1,832,000	$ 1,335,650	$ 19,600	$ 3,187,250
	SUBCONTRACTOR MARKUP						$ 517,723	$ 751,833	$ 5,539	$ 1,275,095
	SUBTOTAL						$ 2,349,723	$ 2,087,483	$ 25,139	$ 4,462,345
	PRIME CONTRACTOR MARKUP						$ 523,741	$ 465,289	$ 5,603	$ 994,634
	BASE BID DIVISION 1 - TOTAL COSTS						**$ 2,873,464**	**$ 2,552,772**	**$ 30,742**	**$ 5,456,979**

DETAILED COST: ALTERNATIVE 1 - SBRs

PROJECT NAME:	**Centreville WWTP ENR Upgrade and Expansion PER**	CLIENT: Town of Centreville	ESTIMATED BY: WRA
PROJECT LOCATION:	**Centreville, Maryland**	DESIGN SUBMISSION: PER	WORK ORDER NUMBER: 14375-000

SOURCE	ITEM DESCRIPTION	QUANTITY	UNIT OF MEASURE	UNIT COSTS			TOTAL COSTS			TOTAL
				MATERIAL	LABOR	EQUIPMENT	MATERIAL	LABOR	EQUIPMENT	
	DEMOLITION									
				$ -	$ -	$ -	$ -	$ -	$ -	$ -
				$ -	$ -	$ -	$ -	$ -	$ -	$ -
				$ -	$ -	$ -	$ -	$ -	$ -	$ -
	NEW WORK									
Evoqua Budget Quote	Closed Vessel Low Pressure UV System	1	ls	$ 357,448.00	$ 107,234.40	$ -	$ 357,448	$ 107,234	$ -	$ 464,682
							$ -	$ -	$ -	$ -
Leopold Budget Quote	Denitrification Filters Equipment	1	ls	$ 1,500,000.00	$ 450,000.00	$ -	$ 1,500,000	$ 450,000	$ -	$ 1,950,000
	Denitrifiction Concrete	300	CY	$ 400.00	$ 400.00	$ -	$ 120,000	$ 120,000	$ -	$ 240,000
							$ -	$ -	$ -	$ -
AquaSBR Budget Quote	AquaSBR System	1	ls	$ 821,640.00	$ 246,492.00	$ -	$ 821,640	$ 246,492	$ -	$ 1,068,132
	2 x SBR Tank Concrete	1500	CY	$ 400.00	$ 400.00	$ -	$ 600,000	$ 600,000	$ -	$ 1,200,000
				$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Existing Tank Modifications	1	LS	$ 100,000.00	$ 30,000.00	$ -	$ 100,000	$ 30,000	$ -	$ 130,000
				$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Misc Process Piping	1	LS	$ 100,000.00	$ -	$ -	$ 100,000	$ -	$ -	$ 100,000
				$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Post EQ Modifications	1	LS	$ 50,000.00	$ -	$ -	$ 50,000	$ -	$ -	$ 50,000
				$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Pre-Eq Tank Concrete	750	CY	$ 400.00	$ 400.00	$ -	$ 300,000	$ 300,000	$ -	$ 600,000
	Pre-Eq Pumps, Blowers and Diffusers	1	LS	$ 400,000.00	$ 200,000.00	$ -	$ 400,000	$ 200,000	$ -	$ 600,000
				$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Aerobic Digester Concrete	900	CY	$ 400.00	$ 400.00	$ -	$ 360,000	$ 360,000	$ -	$ 720,000
	Aerobic Digester Blowers and Equipment	1	LS	$ 50,000.00	$ 50,000.00	$ -	$ 50,000	$ 50,000	$ -	$ 100,000
				$ -	$ -	$ -	$ -	$ -	$ -	$ -
				$ -	$ -	$ -	$ -	$ -	$ -	$ -
	SUBTOTAL DIRECT COSTS						$ 4,759,088	$ 2,463,726	$ -	$ 7,222,814
	SUBCONTRACTOR MARKUP						$ 587,808	$ 1,386,823	$ -	$ 1,974,631
	SUBTOTAL						$ 5,346,896	$ 3,850,549	$ -	$ 9,197,445
	PRIME CONTRACTOR MARKUP						$ 1,191,796	$ 858,268	$ -	$ 2,050,063
	BASE BID DIVISION 1 - TOTAL COSTS						**$ 6,538,692**	**$ 4,708,817**	**$ -**	**$ 11,247,508**

DETAILED COST: ALTERNATIVE 1 (SBRs) - ELECTRICAL

PROJECT NAME:	**Centreville WWTP ENR Upgrade and Expansion**	CLIENT: Town of Centreville	ESTIMATED BY: WRA, DEI
PROJECT LOCATION:	**Centreville, Maryland**	DESIGN SUBMISSION: PER	WORK ORDER NUMBER: 14375-000

SOURCE	ITEM DESCRIPTION	QUANTITY	UNIT OF MEASURE	UNIT COSTS			TOTAL COSTS			TOTAL
				MATERIAL	LABOR	EQUIPMENT	MATERIAL	LABOR	EQUIPMENT	
	DEMOLITION									
	Demolition	1	LS	$ -	$ 100,000.00	$ -	$ -	$ 100,000	$ -	$ 100,000
	NEW WORK									
	Filter Building									
	600A Motor Control Center (MCC-A)	1	EA	$ 200,000.00	$ 20,000.00	$ -	$ 200,000	$ 20,000	$ -	$ 220,000
	Branch Circuit Wiring from MCC-A	1	LS	$ 100,000.00	$ 150,000.00	$ -	$ 100,000	$ 150,000	$ -	$ 250,000
	New Feeder for 600 MCC-A	1	LS	$ 15,000.00	$ 3,500.00	$ -	$ 15,000	$ 3,500	$ -	$ 18,500
	Existing Panel DP modifications including new breakers and branch circuits	1	LS	$ 30,000.00	$ 15,000.00	$ -	$ 30,000	$ 15,000	$ -	$ 45,000
	Lighting and Branch Wiring	2000	SF	$ 7.00	$ 5.00	$ -	$ 14,000	$ 10,000	$ -	$ 24,000
	Lab Building									
	208V Panelboard	2	EA	$ 10,000.00	$ 2,000.00	$ -	$ 20,000	$ 4,000	$ -	$ 24,000
	Lighting and Branch Wiring	750	SF	$ 6.00	$ 4.00	$ -	$ 4,500	$ 3,000	$ -	$ 7,500
	Receptacles including branch wiring	750	SF	$ 2.00	$ 3.00	$ -	$ 1,500	$ 2,250	$ -	$ 3,750
	Dewatering Building									
	480V Panelboard	1	EA	$ 15,000.00	$ 3,000.00	$ -	$ 15,000	$ 3,000	$ -	$ 18,000
	208V Panelboard	2	EA	$ 10,000.00	$ 2,000.00	$ -	$ 20,000	$ 4,000	$ -	$ 24,000
	Lighting and Branch Wiring	1900	SF	$ 7.00	$ 5.00	$ -	$ 13,300	$ 9,500	$ -	$ 22,800
	Receptacles including branch wiring	1900	SF	$ 3.00	$ 4.00	$ -	$ 5,700	$ 7,600	$ -	$ 13,300
	Branch circuits for mechanical loads	1900	SF	$ 6.00	$ 8.00	$ -	$ 11,400	$ 15,200	$ -	$ 26,600
	Dry type transformer 45kVA	2	EA	$ 2,500.00	$ 1,250.00	$ -	$ 5,000	$ 2,500	$ -	$ 7,500
	Outside									
	600A Motor Control Center (MCC-B) including VFDs	1	EA	$ 150,000.00	$ 40,000.00	$ -	$ 150,000	$ 40,000	$ -	$ 190,000
	Branch Circuit Wiring from MCC-B including underground ducts	1	LS	$ 100,000.00	$ 125,000.00	$ -	$ 100,000	$ 125,000	$ -	$ 225,000
	Feeder for Dewatering Building	1	LS	$ 10,000.00	$ 20,000.00	$ -	$ 10,000	$ 20,000	$ -	$ 30,000
	Feeder for Control Building	1	LS	$ 5,000.00	$ 8,000.00	$ -	$ 5,000	$ 8,000	$ -	$ 13,000
	Site Lighting and Branch Wiring	1	LS	$ 40,000.00	$ 40,000.00	$ -	$ 40,000	$ 40,000	$ -	$ 80,000
	Testing and Commisioning	1	LS	$ -	$ 40,000.00	$ -	$ -	$ 40,000	$ -	$ 40,000
	Grounding and Bonding	1	LS	$ 25,000.00	$ 50,000.00	$ -	$ 25,000	$ 50,000	$ -	$ 75,000
	SUBTOTAL DIRECT COSTS						$ 785,400	$ 672,550	$ -	$ 1,457,950
	SUBCONTRACTOR MARKUP						$ 221,954	$ 378,617	$ -	*$ 600,571*
	SUBTOTAL						$ 1,007,354	$ 1,051,167	$ -	*$ 2,058,521*
	PRIME CONTRACTOR MARKUP						$ 224,534	$ 234,300	$ -	*$ 458,834*
	BASE BID DIVISION 16 - TOTAL COSTS						**$ 1,231,888**	**$ 1,285,466**	**$ -**	**$ 2,517,354**

DETAILED COST: ALTERNATIVE 2 - CONVENTIONAL ACTIVATED SLUDGE

PROJECT NAME:	**Centreville WWTP ENR Upgrade and Expansion PER**	CLIENT: Town of Centreville	ESTIMATED BY: WRA
PROJECT LOCATION:	**Centreville, Maryland**	DESIGN SUBMISSION: PER	WORK ORDER NUMBER: 14375-000

SOURCE	ITEM DESCRIPTION	QUANTITY	UNIT OF MEASURE	UNIT COSTS			TOTAL COSTS			TOTAL
				MATERIAL	LABOR	EQUIPMENT	MATERIAL	LABOR	EQUIPMENT	
	DEMOLITION									
				$ -	$ -	$ -	$ -	$ -	$ -	$ -
				$ -	$ -	$ -	$ -	$ -	$ -	$ -
				$ -	$ -	$ -	$ -	$ -	$ -	$ -
	NEW WORK									
Ovivo Budget Quote	60' Dia. Sludge Rapid Removal Clarifiers	2	ea	$ 291,500.00	$ 145,750.00	$ -	$ 583,000	$ 291,500	$ -	$ 874,500
	Clarifier Concrete	1300	CY	$ 400.00	$ 400.00	$ -	$ 520,000	$ 520,000	$ -	$ 1,040,000
	RAS Pump Station	1	LS	$ 500,000.00	$ -	$ -	$ 500,000	$ -	$ -	$ 500,000
Evoqua Budget Quote	Closed Vessel Low Pressure UV System	1	ls	$ 357,448.00	$ 107,234.40	$ -	$ 357,448	$ 107,234	$ -	$ 464,682
Leopold Budget Quote	Denitrification Filters	1	ls	$ 1,500,000.00	$ 450,000.00	$ -	$ 1,500,000	$ 450,000	$ -	$ 1,950,000
	Denitrifcation Concrete	300	CY	$ 400.00	$ 400.00	$ -	$ 120,000	$ 120,000	$ -	$ 240,000
	Internal Recycle Pumps	8	ea	$ 25,000.00	$ 7,500.00		$ 200,000	$ 60,000	$ -	$ 260,000
	Fine Bubble Diffusers and Blowers	1	LA	$ 250,000.00	$ 100,000.00	$ -	$ 250,000	$ 100,000	$ -	$ 350,000
	Reactor Tank Modifications	1	LS	$ 40,000.00	$ 12,000.00	$ -	$ 40,000	$ 12,000	$ -	$ 52,000
	Reactor Tank Concrete	400	CY	$ 400.00	$ 400.00	$ -	$ 160,000	$ 160,000	$ -	$ 320,000
	Misc Process Piping and Equipment	1	LS	$ 150,000.00	$ -	$ -	$ 150,000	$ -	$ -	$ 150,000
	Aerobic Digester Tank Modifications	1	LS	$ 50,000.00	$ -	$ -	$ 50,000	$ -	$ -	$ 50,000
	Pre-Eq Pumps, Blowers and Diffusers	2	LS	$ 400,000.00	$ 200,000.00	$ -	$ 800,000	$ 400,000	$ -	$ 1,200,000
	SUBTOTAL DIRECT COSTS						$ 5,230,448	$ 2,220,734	$ -	$ 7,451,182
	SUBCONTRACTOR MARKUP						$ 788,454	$ 1,250,044	$ -	*$ 2,038,498*
	SUBTOTAL						$ 6,018,902	$ 3,470,778	$ -	*$ 9,489,680*
	PRIME CONTRACTOR MARKUP						$ 1,341,582	$ 773,619	$ -	*$ 2,115,201*
	BASE BID DIVISION 3 - TOTAL COSTS						**$ 7,360,484**	**$ 4,244,397**	**$ -**	**$ 11,604,881**

DETAILED COST: ALTERNATIVE 2 (CONVENTIONAL ACTIVATED SLUDGE) - ELECTRICAL

PROJECT NAME:	Centreville WWTP ENR Upgrade and Expansion PER	CLIENT: Town of Centreville	ESTIMATED BY: WRA, DEI
PROJECT LOCATION:	Centreville, Maryland	DESIGN SUBMISSION: PER	WORK ORDER NUMBER: 14375-000

SOURCE	ITEM DESCRIPTION	QUANTITY	UNIT OF MEASURE	UNIT COSTS			TOTAL COSTS			TOTAL
				MATERIAL	LABOR	EQUIPMENT	MATERIAL	LABOR	EQUIPMENT	
	DEMOLITION									
	Demolition	1	LS	$ -	$ 100,000.00	$ -	$ -	$ 100,000	$ -	$ 100,000
	NEW WORK									
	Filter Building									
	600A Motor Control Center (MCC-A)	1	EA	$ 200,000.00	$ 20,000.00	$ -	$ 200,000	$ 20,000	$ -	$ 220,000
	Branch Circuit Wiring from MCC-A	1	LS	$ 100,000.00	$ 150,000.00	$ -	$ 100,000	$ 150,000	$ -	$ 250,000
	New Feeder for 600 MCC-A	1	LS	$ 15,000.00	$ 3,500.00	$ -	$ 15,000	$ 3,500	$ -	$ 18,500
	Existing Panel DP modifications including new breakers and branch circuits	1	LS	$ 30,000.00	$ 15,000.00	$ -	$ 30,000	$ 15,000	$ -	$ 45,000
	Lighting and Branch Wiring	2000	SF	$ 7.00	$ 5.00	$ -	$ 14,000	$ 10,000	$ -	$ 24,000
	Lab Building									
	208V Panelboard	2	EA	$ 10,000.00	$ 2,000.00	$ -	$ 20,000	$ 4,000	$ -	$ 24,000
	Lighting and Branch Wiring	750	SF	$ 6.00	$ 4.00	$ -	$ 4,500	$ 3,000	$ -	$ 7,500
	Receptacles including branch wiring	750	SF	$ 2.00	$ 3.00	$ -	$ 1,500	$ 2,250	$ -	$ 3,750
	Dewatering Building									
	480V Panelboard	1	EA	$ 15,000.00	$ 3,000.00	$ -	$ 15,000	$ 3,000	$ -	$ 18,000
	208V Panelboard	2	EA	$ 10,000.00	$ 2,000.00	$ -	$ 20,000	$ 4,000	$ -	$ 24,000
	Lighting and Branch Wiring	1900	SF	$ 7.00	$ 5.00	$ -	$ 13,300	$ 9,500	$ -	$ 22,800
	Receptacles including branch wiring	1900	SF	$ 3.00	$ 4.00	$ -	$ 5,700	$ 7,600	$ -	$ 13,300
	Branch circuits for mechanical loads	1900	SF	$ 6.00	$ 8.00	$ -	$ 11,400	$ 15,200	$ -	$ 26,600
	Dry type transformer 45kVA	2	EA	$ 2,500.00	$ 1,250.00	$ -	$ 5,000	$ 2,500	$ -	$ 7,500
	Outside									
	600A Motor Control Center (MCC-B) including VFDs	1	EA	$ 200,000.00	$ 40,000.00	$ -	$ 200,000	$ 40,000	$ -	$ 240,000
	Branch Circuit Wiring from MCC-B including underground ducts	1	LS	$ 150,000.00	$ 150,000.00	$ -	$ 150,000	$ 150,000	$ -	$ 300,000
	Feeder for Dewatering Building	1	LS	$ 10,000.00	$ 20,000.00	$ -	$ 10,000	$ 20,000	$ -	$ 30,000
	Feeder for Control Building	1	LS	$ 5,000.00	$ 8,000.00	$ -	$ 5,000	$ 8,000	$ -	$ 13,000
	Site Lighting and Branch Wiring	1	LS	$ 40,000.00	$ 40,000.00	$ -	$ 40,000	$ 40,000	$ -	$ 80,000
	Testing and Commisioning	1	LS	$ -	$ 40,000.00	$ -	$ -	$ 40,000	$ -	$ 40,000
	Grounding and Bonding	1	LS	$ 25,000.00	$ 50,000.00	$ -	$ 25,000	$ 50,000	$ -	$ 75,000
	SUBTOTAL DIRECT COSTS						$ 885,400	$ 697,550	$ -	$ 1,582,950
	SUBCONTRACTOR MARKUP						$ 250,214	$ 392,691	$ -	*$ 642,905*
	SUBTOTAL						$ 1,135,614	$ 1,090,241	$ -	*$ 2,225,855*
	PRIME CONTRACTOR MARKUP						$ 253,123	$ 243,009	$ -	*$ 496,132*
	BASE BID DIVISION 16 - TOTAL COSTS						**$ 1,388,737**	**$ 1,333,250**	**$ -**	**$ 2,721,986**

DETAILED COST: ALTERNATIVE 3 - MBR ACTIVATED SLUDGE

PROJECT NAME:	**Centreville WWTP ENR Upgrade and Expansion PER**	CLIENT: Town of Centreville	ESTIMATED BY: WRA
PROJECT LOCATION:	**Centreville, Maryland**	DESIGN SUBMISSION: PER	WORK ORDER NUMBER: 14375-000

SOURCE	ITEM DESCRIPTION	QUANTITY	UNIT OF MEASURE	UNIT COSTS			TOTAL COSTS			TOTAL
				MATERIAL	LABOR	EQUIPMENT	MATERIAL	LABOR	EQUIPMENT	
	DEMOLITION									
				$ -	$ -	$ -	$ -	$ -	$ -	$ -
				$ -	$ -	$ -	$ -	$ -	$ -	$ -
				$ -	$ -	$ -	$ -	$ -	$ -	$ -
	NEW WORK									
Evoqua Budget Quote	Closed Vessel Low Pressure UV System (1/2 for MBR)	1	ls	$ 357,448.00	$ 107,234.40	$ -	$ 357,448	$ 107,234	$ -	$ 464,682
Quote	MBR Equipment	1	ls	$ 4,000,000.00	$ -	$ -	$ 3,000,000	$ 1,000,000	$ -	$ 4,000,000
	New MBR Process Building	400	SF	$ 150.00	$ 150.00	$ -	$ 60,000	$ 60,000	$ -	$ 120,000
	Reactor Tank Modifications	1	LS	$ 40,000.00	$ 12,000.00	$ -	$ 40,000	$ 12,000	$ -	$ 52,000
	Reactor Tank Concrete	400	CY	$ 400.00	$ 400.00	$ -	$ 160,000	$ 160,000	$ -	$ 320,000
	Misc Process Piping	1	LS	$ 500,000.00	$ -	$ -	$ 500,000	$ -	$ -	$ 500,000
	Pre-Eq Pumps, Blowers and Diffusers	2	LS	$ 400,000.00	$ 200,000.00	$ -	$ 800,000	$ 400,000	$ -	$ 1,200,000
	Aerobic Digester Tank Modifications	1	LS	$ 50,000.00	$ -	$ -	$ 50,000	$ -	$ -	$ 50,000
	SUBTOTAL DIRECT COSTS						$ 4,967,448	$ 1,739,234	$ -	$ 6,706,682
	SUBCONTRACTOR MARKUP						$ 454,986	$ 979,009	$ -	*$ 1,433,995*
	SUBTOTAL						$ 5,422,434	$ 2,718,243	$ -	*$ 8,140,677*
	PRIME CONTRACTOR MARKUP						$ 1,208,633	$ 605,882	$ -	*$ 1,814,515*
	BASE BID DIVISION 4 - TOTAL COSTS						**$ 6,631,067**	**$ 3,324,126**	**$ -**	**$ 9,955,192**

DETAILED COST: ALTERNATIVE 3 (MBR ACTIVATED SLUDGE) - ELECTRICAL

PROJECT NAME:	Centreville WWTP ENR Upgrade and Expansion PER	CLIENT: Town of Centreville	ESTIMATED BY: WRA, DEI
PROJECT LOCATION:	Centreville, Maryland	DESIGN SUBMISSION: PER	WORK ORDER NUMBER: 14375-000

SOURCE	ITEM DESCRIPTION	QUANTITY	UNIT OF MEASURE	UNIT COSTS			TOTAL COSTS			TOTAL
				MATERIAL	LABOR	EQUIPMENT	MATERIAL	LABOR	EQUIPMENT	
	DEMOLITION									
	Demolition	1	LS	$ -	$ 100,000.00	$ -	$ -	$ 100,000	$ -	$ 100,000
	NEW WORK									
	Filter Building									
	600A Motor Control Center (MCC-A)	1	EA	$ 200,000.00	$ 20,000.00	$ -	$ 200,000	$ 20,000	$ -	$ 220,000
	Branch Circuit Wiring from MCC-A	1	LS	$ 100,000.00	$ 150,000.00	$ -	$ 100,000	$ 150,000	$ -	$ 250,000
	New Feeder for 600 MCC-A	1	LS	$ 15,000.00	$ 3,500.00	$ -	$ 15,000	$ 3,500	$ -	$ 18,500
	Existing Panel DP modifications including new breakers and branch circuits	1	LS	$ 30,000.00	$ 15,000.00	$ -	$ 30,000	$ 15,000	$ -	$ 45,000
	Lighting and Branch Wiring	2000	SF	$ 7.00	$ 5.00	$ -	$ 14,000	$ 10,000	$ -	$ 24,000
						$ -				
	Lab Building					$ -				
	208V Panelboard	2	EA	$ 10,000.00	$ 2,000.00	$ -	$ 20,000	$ 4,000	$ -	$ 24,000
	Lighting and Branch Wiring	750	SF	$ 6.00	$ 4.00	$ -	$ 4,500	$ 3,000	$ -	$ 7,500
	Receptacles including branch wiring	750	SF	$ 2.00	$ 3.00	$ -	$ 1,500	$ 2,250	$ -	$ 3,750
	MBR Process Building									
	480V Panelboard	1	EA	$ 15,000.00	$ 3,000.00	$ -	$ 15,000	$ 3,000	$ -	$ 18,000
	208V Panelboard	2	EA	$ 10,000.00	$ 2,000.00	$ -	$ 20,000	$ 4,000	$ -	$ 24,000
	Lighting and Branch Wiring	400	SF	$ 7.00	$ 5.00	$ -	$ 2,800	$ 2,000	$ -	$ 4,800
	Receptacles including branch wiring	400	SF	$ 3.00	$ 4.00	$ -	$ 1,200	$ 1,600	$ -	$ 2,800
	Branch circuits for mechanical loads	400	SF	$ 6.00	$ 8.00	$ -	$ 2,400	$ 3,200	$ -	$ 5,600
	Dry type transformer 45kVA	2	EA	$ 2,500.00	$ 1,250.00	$ -	$ 5,000	$ 2,500	$ -	$ 7,500
	Dewatering Building									
	480V Panelboard	1	EA	$ 15,000.00	$ 3,000.00	$ -	$ 15,000	$ 3,000	$ -	$ 18,000
	208V Panelboard	2	EA	$ 10,000.00	$ 2,000.00	$ -	$ 20,000	$ 4,000	$ -	$ 24,000
	Lighting and Branch Wiring	1900	SF	$ 7.00	$ 5.00	$ -	$ 13,300	$ 9,500	$ -	$ 22,800
	Receptacles including branch wiring	1900	SF	$ 3.00	$ 4.00	$ -	$ 5,700	$ 7,600	$ -	$ 13,300
	Branch circuits for mechanical loads	1900	SF	$ 6.00	$ 8.00	$ -	$ 11,400	$ 15,200	$ -	$ 26,600
	Dry type transformer 45kVA	2	EA	$ 2,500.00	$ 1,250.00	$ -	$ 5,000	$ 2,500	$ -	$ 7,500
	Outside									
	600A Motor Control Center (MCC-B) including VFDs	1	EA	$ 300,000.00	$ 40,000.00	$ -	$ 300,000	$ 40,000	$ -	$ 340,000
	Branch Circuit Wiring from MCC-B including underground ducts	1	LS	$ 250,000.00	$ 200,000.00	$ -	$ 250,000	$ 200,000	$ -	$ 450,000
	Feeder for MBR Process Building	1	LS	$ 10,000.00	$ 20,000.00	$ -	$ 10,000	$ 20,000	$ -	$ 30,000
	Feeder for Dewatering Building	1	LS	$ 10,000.00	$ 20,000.00	$ -	$ 10,000	$ 20,000	$ -	$ 30,000
	Feeder for Control Building	1	LS	$ 5,000.00	$ 8,000.00	$ -	$ 5,000	$ 8,000	$ -	$ 13,000
	Site Lighting and Branch Wiring	1	LS	$ 40,000.00	$ 40,000.00	$ -	$ 40,000	$ 40,000	$ -	$ 80,000
	Diesel Generator 750kW including ATS	1	EA	$ 500,000.00	$ 50,000.00	$ -	$ 500,000	$ 50,000	$ -	$ 550,000
	Testing and Commisioning	1	LS	$ -	$ 40,000.00	$ -	$ -	$ 40,000	$ -	$ 40,000
	Grounding and Bonding	1	LS	$ 25,000.00	$ 50,000.00	$ -	$ 25,000	$ 50,000	$ -	$ 75,000
	SUBTOTAL DIRECT COSTS						$ 1,641,800	$ 833,850	$ -	$ 2,475,650
	SUBCONTRACTOR MARKUP						$ 463,973	$ 469,422	$ -	*$ 933,394*
	SUBTOTAL						$ 2,105,773	$ 1,303,272	$ -	*$ 3,409,044*
	PRIME CONTRACTOR MARKUP						$ 469,366	$ 290,493	$ -	*$ 759,858*
	BASE BID DIVISION 16 - TOTAL COSTS						**$ 2,575,139**	**$ 1,593,764**	**$ -**	**$ 4,168,903**

Appendix B

Existing NPDES Stream and Spray Discharge Permits

DISCHARGE PERMIT

DISCHARGE PERMIT

NPDES Discharge Permit Number: MD0020834	**State Discharge Permit Number:** 20-DP-0116
Effective Date: 12/01/2021	**Expiration Date:** 11/30/2026
Modification Date: (Not applicable)	**Reapplication Due Date:** 11/30/2025

Pursuant to the provisions of Title 9 of the Environment Article, Annotated Code of Maryland, and regulations promulgated thereunder, and the provisions of the Clean Water Act, 33 U.S.C. Section 1251 et seq., and implementing regulations 40 CFR Parts 122, 123, 124 and 125, the Department of the Environment hereby establishes conditions and requirements pertinent to the wastewater treatment plant and collection system and authorizes:

Town of Centreville
101 Lawyers Row
Centreville, Maryland 21617

TO DISCHARGE FROM: Centreville Wastewater Treatment Plant

LOCATED AT: 116 Johnstown Lane
Centreville, Queen Anne's County
Maryland 21617

THROUGH OUTFALL: 001A (WWTP Effluent)

TO: Gravel Run, designated as Use – I waters, which is protected for water contact recreation and nontidal warmwater aquatic life; in accordance with the following special and general conditions and a map incorporated herein and made a part hereof.

I. DEFINITIONS

A. "Ambient temperature" of the effluent receiving stream means the water temperature that is not impacted by a point source discharge, and it shall be measured in areas of the stream representative of typical or average conditions of the stream segment in question.

B. "Bypass" means the intentional diversion of pollutants from any portion of a treatment or collection facility.

C. "BOD_5 (Biochemical Oxygen Demand)" means the amount of oxygen consumed in a standard BOD_5 test without the use of a nitrification inhibitor at 20 degree centigrade on an unfiltered sample.

D. "Clean Water Act" means the Federal Water Pollution Control Act, as amended, 33 U.S.C. Section 1251 et seq.

E. "CFR" means the Code of Federal Regulations.

F. "COMAR" means the Code of Maryland Regulations.

G. "Department" means the Maryland Department of the Environment (MDE).

H. Discharge Limits

1. "Daily *maximum* (or *minimum)*" limitation means the *highest* (or *lowest)* allowable the daily averages in a calendar month. The daily discharge expressed as concentration (in mg/l) shall be calculated by dividing total of measurement readings by number of sample collected during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. The daily discharge expressed as loading rate (in pounds/day) is calculated by using this formula {daily average concentration (mg/l) x the same day total flow (in million gallons) x 8.34}.

2. "Weekly average *(maximum* or *minimum)*" limitation means the *highest* or *lowest* allowable average of "daily discharges" over a calendar week, calculated as the sum of all "daily discharges" measured during a calendar week divided by the number of "daily discharges" measured during that week. Each of the following 7-day periods is defined as a calendar week: Week 1 is Days 1 - 7 of the month; Week 2 is Days 8 - 14; Week 3 is Days 15 - 21; and Week 4 is Days 22 - 28. *For weekly average maximum*, if the "daily discharge" on days 29, 30 or 31 exceeds the "weekly average" discharge limitation, MDE may elect to evaluate the last 7 days of the month as Week 4 instead of Days 22 - 28. *For weekly average minimum*, if the "daily discharge" on days 29, 30 or 31 is lower than the "weekly average" discharge limitation, MDE may elect to evaluate the last 7 days of the month as Week 4 instead of Days 22 - 28.

I. DEFINITIONS

3. "Monthly average *maximum* (or *minimum)*" limitation means the *highest* (or *lowest)* allowable monthly average concentration or waste load of a parameter over a calendar month. The monthly average is calculated as the sum of all daily discharges for a parameter sampled and/or measured in that calendar month divided by the number of days on which monitoring was performed.

4. "Minimum or maximum" limit means the lowest or highest allowable value measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling.

5. "Monthly loading rate (in pounds/month)" means the total load of a parameter calculated for that calendar month. It is calculated using this formula {(monthly average concentration in mg/l) x (Total monthly flow in Million Gallons) x 8.34}.

6. "Year-to-date cumulative load (pounds)" value means cumulative load of a pollutant in the effluent through each reporting month in a calendar year. It is calculated as a sum of the individual total monthly loads from January through the reporting month in a calendar year.

7. "Annual Maximum Loading Rate (in pounds/year)" limit means the maximum load allowed for a pollutant in the effluent to be discharged in a calendar year. The Year-to-date cumulative load (as defined above in Definition I.H.6) shall be used to determine the compliance status of this requirement.

8. "Monthly log mean (Monthly geometric mean)" limit means the highest allowable value calculated as the logarithmic or geometric mean of all samples taken in the calendar month. The geometric mean is the antilogarithm of the mean of the logarithms.

I. Discharge Monitoring

1. "Composite sample" means a combination of individual samples obtained at hourly or smaller intervals over a time period. Either the volume of each individual sample is proportional to discharge flow rates or the sampling interval (for constant volume samples) is proportional to the flow rates over the time period used to produce the composite.

2. "Grab sample" means an individual sample collected over a period of time not exceeding 15 minutes.

3. "Estimated flow" value means a calculated volume or discharge rate which is based on a technical evaluation of the sources contributing to the discharge including, but not limited to, pump capabilities, water meters, and batch discharge volumes.

I. DEFINITIONS

4. "Measured flow" value means any method of liquid volume measurement, the accuracy of which has been previously demonstrated in engineering practice, or for which a relationship to absolute volume has been obtained.

5. "Recorded flow" means any method of providing a permanent, continuous record of flow including, but not limited to, circular and strip charts.

6. "Monthly average flow" means the total flow for a calendar month divided by the number of days in the same month.

J. "i-s (immersion stabilization)" means a calibrated device immersed in the effluent or stream, as applicable, until the temperature reading is stabilized.

K. "NetDMR" means a nationally-available electronic reporting tool, initially designed by states and later adapted for national use by EPA, which can be used by NPDES-regulated facilities to submit discharge monitoring reports (DMRs) electronically to EPA through a secure Internet application over the National Environmental Information Exchange Network (NEIEN). EPA can then share this information with authorized states, tribes, and territories.

L. "NPDES (National Pollutant Discharge Elimination System)" means the national system for issuing permits as designated by the Clean Water Act.

M. "Nondetectable Level" for total residual chlorine means a residual concentration of less than 0.10 mg/l as determined using either the DPD titrimetric or chlorimetric method or an alternative method approved by the Department.

N. "Outfall" means the location where the effluent is discharged into the receiving waters.

O. "Overflow" means any loss of wastewater or discharge from a sanitary sewer system, combined sewer system or wastewater treatment plant bypass (as defined in I.B) which results in the direct or potential discharge of raw, partially treated wastewater into the waters of the State.

P. "Permittee" means an individual or organization holding the discharge permit issued by the Department.

Q. "POTW" means a publicly owned treatment works.

R. "Sampling Point" means the effluent sampling location in the outfall line(s) downstream from the last addition point or as otherwise specified.

S. "Sanitary Sewer Overflow (SSO)" means a discharge of untreated or partially treated sewage from a separate sewer system before the sanitary wastewater reaches the headworks of a wastewater treatment facility, pursuant to COMAR 26.08.10.01.

I. DEFINITIONS

T. "Secondary Treatment" means the treatment of sewage to produce effluent equal to or better than the following quality, except as provided for 40 CFR §133.103, or paragraphs (d), (e) or (f) of the same section:

1. Five-day biochemical oxygen demand (BOD_5):

   a. 30 milligrams/liter – average for a 30-day period;

   b. 45 milligrams/liter – average for a 7-day period;

   c. The 30-day average percent removal shall not be less than 85 percent.

2. Total Suspended Solids (TSS):

   a. 30 milligrams/liter – average for a 30-day period;

   b. 45 milligrams/liter – average for a 7-day period;

   c. The 30-day average percent removal shall not be less than 85 percent.

3. Bacterial Control: As required to meet water quality standards.

U. "Significant Industrial User (SIU)" is defined as any industrial user (IU) that:

1. is subject to national categorical standards; and

2. any other IU that:

   a. discharges an average of 25,000 gallons per day or more of process wastewater (excluding sanitary, non-contact cooling and boiler blowdown wastewater); or

   b. contributes a process wastestream that makes up 5% or more of the average dry weather hydraulic or organic capacity of the POTW; or

   c. is designated as such by the POTW on the basis that the IU has a reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement; or

   d. is found by the POTW, the Department, or the Environmental Protection Agency (EPA) to have significant impact either individually or in combination with other contributing industries to the POTW, on the quality of the sludge, the POTW's effluent quality, or air emissions generated by the system.

I. DEFINITIONS

V. "TKN (Total Kjeldahl Nitrogen)" means organic nitrogen plus ammonia nitrogen.

W. "TSS (Total Suspended Solids)" means the residue retained on the filter by an analysis done in accordance with Standard Methods or other approved methods.

X. "Upset" means the exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation

II. SPECIAL CONDITIONS

A. Effluent Limitations, Outfall 001A [(1) (2) (3) (4)(21)]

These limitations shall be applicable from December 1 through March 31 only. No stream discharge is permitted from April 1 through November 30 from Outfall 001A. The rest of the year, the wastewater will be disposed of by spray irrigation to the ground waters of the State, as regulated by Groundwater Discharge Permit No. 14-DP-3323. The quality of the effluent discharged by the facility at a discharge point location (Outfall 001A) shall be limited at all times as shown below:

	Maximum Effluent Limits, except as noted					
Effluent Characteristics	**Monthly Average Loading Rate, Pounds/day**	**Weekly Average Loading Rate, Pounds/day**	**Daily Average Loading Rate, Pounds/day**	**Monthly Average Concentration, mg/l**	**Weekly Average Concentration, mg/l**	**Daily Average Concentration, mg/l**
BOD_5 (12/1 to 3/31)	130	190	N/A	28	42	N/A
BOD_5, Percent Removal [(8)]			85 % minimum monthly average			
TSS (12/1-3/31)	130	190	N/A	28	42	N/A
TSS, Percent Removal [(8)]			85 % minimum monthly average			

	Maximum Effluent Limits		
Effluent Characteristics	**Total Monthly Loading Rate, Pounds/Month**	**Annual Maximum Loading Rate, Pounds/Season**	**Monthly Average Concentration, mg/l**
Total Phosphorus-P[(4) (5)(6)] (12/1 – 3/ 31)	140	457	1.0
Total Nitrogen-N[(4(5(6)] (12/1- 3/31)	750	3,004	5.5

	Effluent Limits	
Effluent Characteristics	**Maximum**	**Minimum**
E. coli	116 MPN/ 100 ml monthly geometric mean value	N/A
Total Residual Chlorine	(See footnote – 7)	N/A
pH	8.5	6.5
Dissolved Oxygen (All Year)	N/A	5.0 mg/l at anytime

II. SPECIAL CONDITIONS

A. Effluent Limitations, Continued

An annual average flow of 0.542 million gallons per day (mgd) was used in waste allocation calculations (expressed as waste loading rate limit), and this unit shall be used when reporting on the Discharge Monitoring Report (DMR) as required by General Condition III.A.2. Notification is to be provided to the Department at least 180 days before the annual average flow is expected to exceed this flow level. If a permit modification is required, the Department will initiate the public participation NPDES process. Because this facility is authorized to discharge only 4 months per year, the permitted flow is equivalent to a minor facility.

Footnotes for effluent limitations:

(1) When this permit is renewed, the new limitations may not be equal to the above limitations. There shall be no discharge of floating solids or visible foam other than trace amounts.

(2) The permit may also be reopened in accordance with the requirements of MDE's Watershed Permitting Plan under which all discharge permits in a watershed are issued the same year.

(3) The specific designated use of Corsica River of the Lower Chester River Mesohaline segment is Use II – Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting. The Maryland Department of the Environment (MDE) has identified the waters of the Corsica River of the Lower Chester River Mesohaline segment on the State's Integrated Report as impaired by the following pollutants (listing year and Integrated Report Assessment Unit Identification in parentheses): total suspended solids (1996; MD-CHSMH), nutrients (1996; MD-CHSMH), fecal coliform (1996; MD-CHSMH-Corsica_River), and polychlorinated biphenyls (PCBs) in fish tissue (2002; MD-CHSMH-02130507) and impacts to biological communities (2004; MD-CHSMH). Nutrients, fecal coliform, and PCB TMDLs for the restricted shellfish harvesting portion of the Corsica River were approved by the US EPA in 2000, 2005, and 2011 respectively. This permit is in conformance with these TMDLs and the "Chesapeake Bay TMDL for Nitrogen, Phosphorus, and Sediment" established on December 29, 2010. When TMDLs for other remaining parameters are completed, limits may be imposed, after the public participation process, to incorporate any TMDL requirements.

(4) The loading caps for the Centreville WWTP for the seasonal stream discharge from December 1 through March 31, equal to 3,004 pounds for TN and 457 pounds for TP. The permittee shall also comply with the monthly loading cap limits of 750 lbs/month and 140 lbs/months for TN and TP respectively. The first exceedance of the permit limit shall be counted and reported as daily exceedances beginning from the first exceedance, determined to the nearest day, through March 31. In addition, after any such exceedance, the permittee shall demonstrate to the Department's satisfaction that the facility is optimizing its nutrient removal capability, and neither the arrival of the next season (December 1 thru March 31) nor the issuance of a permit renewal during a period of noncompliance shall obviate continuance of any noncompliance status related to treatment optimization requirements.

(5) The current plant operates the Biological Nutrient Removal (BNR) process on a year round basis and the Town is also authorized under groundwater permit GW 14-DP-3323 to operate the spray irrigation system 365 days a year. Consequently, the level of nutrient control that is achieved by the combined surface water and ground water systems is equivalent to Enhanced Nutrient Removal (ENR) level treatment and an ENR upgrade at this plant is not required.

(6) The permittee may request that the permit be reopened and modified to include nutrient trading consistent with the most current "Maryland Policy for Nutrient cap Management and Trading in Maryland's Chesapeake Bay Watershed" in effect at that time.

(7) Total residual chlorine limitation of the nondetectable level shall be applicable, when chlorine or any chlorine-containing compound is used in any treatment process(es), including but not limited to disinfection, that could become a potential constituent of the effluent discharged from the Centreville WWTP. The wastewater shall be dechlorinated to reduce effluent total residual chlorine concentration to the nondetectable level (See definition I.M).

(8) In accordance with 40CFR §133.102, the 30-day average percent removal for BOD_5 and TSS shall not be less than 85 (eighty-five) percent as the minimum level of effluent quality attainable by the secondary treatment. Refer to the footnotes 22 and 23 for further details for calculations and reporting requirements toward compliance to the BOD_5 and TSS percent removal effluent limitations (See Definition I.T).

II. SPECIAL CONDITIONS

B. (1) (a) Minimum Monitoring Requirements[21]:

The effluent characteristics listed below in Table B shall be monitored at the sampling point (Definition I.R). If the sampling point is other than the outfall 001A, the permittee shall ensure that the effluent samples taken at the above stated sampling point are representative of the effluent quality discharged at the Outfall 001A.

Effluent Characteristics	Monitoring Period	Measurement Frequency	Sample Type
BOD_5 [9][19]	All Year	Two per week	24-hour composite
Total Suspended Solids [9][19]	All Year	Two per week	24-hour composite
BOD_5, Percent Removed [9][22][23]	All Year	One per month	Calculated
TSS, Percent Removed [9][22][23]	All Year	One per month	Calculated
TKN [9][10][11][12][19]	All Year	Two per week	24-hour composite
Total Ammonia Nitrogen as N [9][10][11][12][19]	All Year	Two per week	24-hour composite
Total Phosphorus as P [9][11][13][19]	All Year	Two per week	24-hour composite
Total Nitrogen as N [9][12][13][19]	All Year	Two per week	Calculated
(Nitrite + Nitrate) as N [9][10][11][12][19]	All Year	Two per week	24-hour composite
Organic Nitrogen as N [9][10][12][19]	All Year	Two per week	Calculated
Orthophosphate as P [9][10][11][19]	All Year	Two per week	24-hour composite
E. coli [9][19]	All Year	Two per week	Grab
Total Residual Chlorine [9][14][15]	All Year	Two per day	Grab
Dissolved Oxygen [9][15]	All Year	Two per day	Grab
pH [9][15]	All Year	Two per day	Grab
Flow [9][16][17][20]	All Year	Continuous	Recorded
Total Flow [9][18][20]	All Year	Monthly	Calculated

II. SPECIAL CONDITIONS

B. (1) (b) Raw Wastewater Influent at Sampling Point 101A:

The quality of the wastewater influent entering the Centreville WWTP shall be monitored at Influent Chamber All the times as shown below:

Wastewater Influent Characteristics	Monitoring Period	Measurement Frequency	Sample Type
BOD_5 [9][22][23]	All Year	Two per month	Grab
Total Suspended Solids [9][22][23]	All Year	Two per month	Grab

B. Minimum Monitoring Requirements, continued:

Footnotes for the monitoring requirements (B)(1)(a) and (B (1)(b):

(9) "STORET" (short for STOrage and RETrieval) is a widely-used repository for water quality data reporting and monitoring. The STORET codes for the effluent characteristics described as limitations and/or monitoring requirements are: BOD_5 (00310), BOD_5 percent removed (81010), Total Suspended Solids (00530), Total Suspended Solids percent removed (81011), TKN (00625), Total Ammonia Nitrogen as N (00610), Total Phosphorus as P (00665), Total Nitrogen as N (00600), (Nitrite + Nitrate) as N (00630), Organic Nitrogen as N (00605), Orthophosphate as P (04175), Fecal Coliform (74055), E. Coli (51040), Total Residual Chlorine (50060), Dissolved Oxygen (00300), pH (00400), Flow (50050), and Total monthly flow (82220)

(10) This parameter (without effluent limitations) must be monitored, and it shall be reported on the Monthly Operating Report (MOR) as individual results and on the Discharge Monitoring Report as monthly average concentrations.

(11) The monitoring of total phosphorus, total ammonia nitrogen, TKN, (nitrite + nitrate)-N and orthophosphate shall be two per week 24 hour composite samplings.

(12) Total nitrogen as N (in mg/l) is a calculated parameter as the sum of individual results for total ammonia nitrogen as N, organic nitrogen as N and (nitrite + nitrate) as N. Total Kjeldahl Nitrogen (TKN) is defined as the total concentration of organic nitrogen and ammonia as N. All nitrogen species must be sampled at the same day. The monitoring result for organic nitrogen may be calculated through the subtraction of the total Ammonia as N monitoring result from the result of TKN sample taken at the same day.

(13) The permittee shall also calculate and report on the DMR the TN and TP total monthly loads (Definition I.H.5) plus seasonal cumulative December 1 thru March 31loads (Definition I.H.6) for the outfall- 001A.

(14) The Minimum monitoring requirements of Two per day-grab samplings for total residual chlorine shall be applicable, when chlorine or any chlorine compound is used in any treatment process(es), including but not limited to disinfection, that could become a potential constituent of the effluent discharged from the Centreville WWTP. The minimum level (quantification level) for total residual chlorine is 0.10 mg/l. The permittee may report all results below the minimum level as <0.10 mg/l. All results reported below the minimum level shall be considered in compliance.

(15) Samples for these parameters (total residual chlorine, pH and dissolved oxygen) shall be taken at intervals evenly distributed throughout the staffed period each day to comply with the General Condition III.A.1 for the representative sampling requirements.

II. SPECIAL CONDITIONS

(16) Flows shall be reported in million gallons per day (mgd) to at least the nearest 1,000 gallons per day. (Example: A flow of 524,699 gallons per day shall be reported as 0.525 mgd.). For each calendar month, flows shall be reported on the MOR as daily individual results and on the DMR as monthly average (mgd) and daily maximum (mgd).

(17) Continuous electronic flow measurement and recording which can produce a permanent record are acceptable to the Department.

(18) Total monthly flow is a calculated parameter equal to sum of the daily flow results in a calendar month. It shall be reported on the monthly DMR as Total monthly flow in million gallons (MG) to at least the nearest 1,000 gallons. (Example: A flow of 15,524,699 gallons shall be reported as 1.53 MG).

(19) The permittee shall distribute the timing for effluent sampling with minimum of 48-hour apart for two per week monitoring frequencies. The 48 hours interval for two per week sampling shall be defined as the period between the starting times of the two consecutive effluent sample collections for the same effluent parameter.

(20) Effluent flow to outfall 001A and to the spray irrigation system shall be measured and reported year round on the monthly DMR reports.

(21) See General Condition III.A.2.a.ii.

(22) The BOD_5 and TSS in the raw wastewater influent and effluent shall be sampled on the same day. The measurements shall be utilized to calculate the BOD_5 and TSS percent removed using the formula listed below in the footnote 23, and the results shall be used to complying with the Percent removal limits of BOD_5 and TSS (Special Condition II.A).

Upon the effective date of the discharge permit, if the DMR records from the last 12 months indicate the average removal efficiencies for these pollutants at the facility are significantly higher than the required 85%, the permittee may petition for performance – based monitoring frequency reduction for BOD_5 and TSS in the raw wastewater influent.

(23) At the end of each calendar month, the monthly percent (%) of the parameter (BOD_5 and TSS) removed shall be calculated using the following formula:

Monthly Percent (%) of Parameter Removed = ((A-B)/A) x 100

Where:

A = Monthly Average Concentration of Parameter in Influent in mg/l

B = Monthly Average Concentration of Parameter in Effluent in mg/l

STATE GROUNDWATER DISCHARGE PERMIT

STATE GROUNDWATER DISCHARGE PERMIT

STATE DISCHARGE PERMIT NUMBER	**20-DP-3323**
NPDES ID NUMBER	**MD3323R05**
EFFECTIVE DATE	**01/01/2022**
EXPIRATION DATE	**12/31/2026**

Pursuant to the provisions of Title 9 of the Environment Article, Annotated Code of Maryland, and regulations promulgated thereunder, the Department of the Environment, hereinafter referred to as "the Department", hereby authorizes

The Town of Centreville
101 Lawyer's Row
Centreville, Maryland 21617

hereinafter referred to as "Permittee", to discharge treated wastewater by spray irrigation as described herein, from:

Centerville Wastewater Irrigation Facility
751 Hope Road
Centreville, Maryland 21617

to groundwaters of the State in accordance with the following special and general conditions, including the attached maps made a part hereof.

I. SPECIAL CONDITIONS

A. Waste and Wastewater Limitations

1. This Permittee is authorized to discharge treated wastewater via spray irrigation to ground waters of the State at the site shown on Maps A & B up to a maximum annual average flow of 0.542 million gallons per day. The authorized discharge period is March 1 through December 15.

2. Prior to discharge at the spray irrigation site, all wastewaters shall be treated to produce an effluent which does not exceed the following maximum limitations and is in accordance with the approved nutrient management plan required under Condition I.B.7.

Parameter Code (STORET)	Effluent Parameter	Effluent Limitations			Monitoring Requirements	
		Loading		Concentration		
		Monthly Average	Yearly Maximum	Monthly Average	Monitoring Frequency	Sample Type[4][5]
50050	Flow	0.542 mgd[1]	N/A	N/A	Continuous	Recorded
00310	BOD_5	N/A	N/A	30 mg/l	Twice/Week	8hr-Comp
00530	Suspended Solids	N/A	N/A	30 mg/l	Twice/Week	8hr-Comp
00400	pH	N/A	N/A	6.5 – 8.5[2]	Daily	Grab
00600	Total Nitrogen (N)[3]	N/A	N/A	8 mg/l	Twice/Week	8hr-Comp
00625	TKN	N/A	N/A	Report Value	Twice/Week	8hr-Comp
00630	Nitrate + Nitrite (N+N)	N/A	N/A	Report Value	Twice/Week	8hr-Comp
74055	Fecal Coliform[6]	N/A	N/A	200 MPN/100ml	Twice/Week	Grab

(1) This is a yearly average sewage flow. Flow shall be measured via flow measurement device installed at spray irrigation control building and evaluated on Calendar year basis.
(2) These are minimum (6.5) and maximum (8.5) values of pH.
(3) A permit modification is required for any future expansion of this facility. Such a modification shall include a yearly nitrogen load limitation to groundwater of no more than 13,199 lbs/year at the spray irrigation system. The 13,199 lbs/year nitrogen loading requirement was determined based on 0.542 mgd average daily flow and 8 mg/l effluent nitrogen concentration. Total nitrogen is defined as the sum of Nitrate plus Nitrite (N+N) and Total Kjeldahl Nitrogen (TKN). The concentration of each constituent shall also be reported. This nitrogen loading cap is not an assigned allocation for discharge to the Bay via groundwater because other natural processes reduce the amount of nitrogen reaching the Bay from this system. The factsheet of this permit includes calculations for estimating the amount of nitrogen delivered to the nearby surface water from this system.
(4) Composite samples shall be obtained from the effluent line leaving the wastewater treatment plant.
(5) Grab samples shall be obtained from the effluent line just prior to entering the storage lagoon.
(6) The fecal coliform shall be determined as a geometric mean of the monthly data.

I. SPECIAL CONDITIONS

3. Groundwater samples taken from ten (10) groundwater monitoring wells per requirements of Section I.C.2. shall be monitored by the permittee according to the following limitations:

   a. The discharge of the wastewater authorized in this permit shall not cause groundwater quality to exceed the limitations listed below, as measured in the designated down gradient monitoring wells (MWs 2, 3, 4, 5, 6, 7, 9 and 10 shown on Map B). The Table below includes limitations based on the drinking water standards for NO_2 (Nitrite 00615), Total Dissolved Solids (70295), Chloride (00940), and Fecal Coliform (74055):

Parameter Code (STORET)	Parameter	Groundwater Quality Yearly Average Limitations[2] [3]	Measurement Frequency	Sample Type
00620	NO_3 (Nitrate)	Footnote (1)	Once every 3 months	Grab
00615	NO_2 (Nitrite)	1 mg/l	Once every 3 months	Grab
00625	TKN	Footnote (1)	Once every 3 months	Grab
00600	Total Nitrogen ($TKN+NO_2+NO_3$)	Footnote (1)	Once every 3 months	Grab
00400	pH	Footnote (1)	Once every 3 Months	Grab
00650	PO_4 (Total Phosphate)	Footnote (1)	Once every 3 months	Grab
70295	Total Dissolved Solids	500 mg/l	Once every 3 months	Grab
00940	Chloride	250 mg/l	Once every 3 months	Grab
74055	Fecal Coliform	Non-Detect	Once every 3 months	Grab

(1) Monitoring required without limitation.

(2) For any reported exceedance, if the average groundwater quality in either background upgradient well (MW1 and MW8) exceeds the groundwater discharge standards, the Department may evaluate whether a violation exists on a case-by-case basis.

(3) The groundwater quality limitations are not applicable to the upgradient wells (MW1 and MW8) as shown on Map B.

   b. For other parameters not included in (a) above, the discharge of the treated wastewater, which is authorized in this permit, shall not cause an exceedance of the groundwater quality standards adopted by the Department of the Environment in COMAR 26.04.01, and 26.08.02.09.C. For any exceedance, if the average groundwater quality in the background upgradient wells exceeds the groundwater discharge standards, the Department may evaluate whether a violation exists on a case-by-case basis.

I. SPECIAL CONDITIONS

B. Land Application Requirements and Limitations

1. The Permittee shall apply treated wastewaters via spray irrigation on areas (223.7 acres suitable area, 173.44 acres installed with center pivots and spray guns) shown on the attached Map B.

2. The Permittee is prohibited from discharges of any wastewater to surface water except as authorized under a separate surface water discharge permit.

3. At no time shall spray irrigation be conducted on areas with bare unvegetated soils except on wheel tracks and during seeding periods. Excessive irrigation resulting in surface run-off beyond the property line or ponding causing vegetation die off is prohibited. Spray irrigation of treated wastewater that results in or is likely to result in surface runoff to surface water is prohibited.

4. Irrigation of treated wastewater shall not take place during periods of precipitation, freezing conditions, and saturated soil. Irrigation of treated wastewater that results in aerosols or droplets being carried off site is prohibited. The permittee shall provide a storage facility designed to hold treated wastewater during periods when surface discharge and irrigation cannot take place. The storage facility shall be sealed or constructed to prevent the direct seepage of stored waters into ground waters beneath the site. A minimum of a two-foot freeboard at the storage facility shall be maintained at all times. An easily observable staff gauge for measuring the water level in the lagoon shall be maintained. The permittee shall notify the Department when the water level in the lagoon reaches the two and half-foot freeboard level. Water elevation indicating two and half-foot freeboard shall be marked on the staff gauge.

5. The annual average hydraulic loading rates shall be limited to 2"/week in spray fields 1 (23.1 acres), 3 (33.5 acres), 5 (23.7 acres) and 6 (8.1 acres); 0.6"/wk in spray field 4 (30.7 acres); 0.5"/wk in spray field 2 (35.4 acres) and 0.3"/wk in spray fields 7 (25.3 acres), 8 (2.2 acres) and 9 (41.7 acres). The locations of spray fields are shown in Map B. The actual annual average hydraulic loading rate of each spray field must be computed and included in the Annual Spray Irrigation Report required per General Condition II.A.3.

6. Irrigation shall be terminated in any spray field with depth to groundwater table of less than two feet from the ground surface within the wetted spray field.

7. The Permittee shall annually update and submit to the department by January 15 for approval a nutrient management plan for the spray irrigation system. The plan shall include procedures to minimize nitrogen discharge to the groundwater system. The plan shall be prepared in accordance with COMAR 15.20.08.05 with applicable effluent characteristics. The permittee has ruled out the potential for applying chicken manure waste as fertilizer at this site and therefore such application is prohibited. Any changes made to the NMP must be approved by the Department.

I. SPECIAL CONDITIONS

8. A reserve spray irrigation area with a design capacity equivalent to 25% of permitted flow should be identified and set aside in case future adjustments in application rates are necessary. The required 25% reserve area is in addition to and separate from the required buffer zone in Condition 9 below.

9. The Permittee shall provide adequate means to prevent spray droplets from entering adjacent properties, either by direct application or wind carry-over. These means shall include a buffer zone that is:

   a. Two hundred feet (200) from the wetted perimeter of the spray irrigation site to property lines in open areas or one hundred feet (100) in areas with tree buffer.

   b. Five hundred feet (500) from the wetted perimeter of the spray irrigation site to houses or other occupied structures in open areas or two hundred fifty feet (250) in area with tree buffer.

   Other alternate means may also be approved by the Maryland Department of the Environment as suitable to control the movement of spray onto adjacent land (i.e., wind break of tightly placed trees; etc.). Upon review and approval by the Department, the buffer zone distance specified in items 9.a and 9.b above may be reduced to meet the buffer distance stipulated in §9-303.1 of the Environmental Article if the effluent quality meets the reclaimed water quality of BOD_5 < 10 mg/l, total suspended solids <10 mg/l and fecal coliform <3 MPN/100 ml.

10. Daily logs of the response of each disposal area to the application of treated effluent shall be kept by the plant operator. Subjects to be included in the log are:

    a. Area(s) or section(s) under irrigation.

    b. Application rates (hourly and weekly). Each spray field that is in use shall have a flow meter to accurately determine the irrigation rate.

    c. Instances of ponding or runoff.

    d. Weather conditions.

    e. Water level in the lagoon.

    f. Weekly measurement of groundwater table depth.

    The log shall be kept at the spray irrigation site and be available for inspection by the Department personnel upon request.

I. SPECIAL CONDITIONS

11. The permittee shall implement a set of standard operating procedures (SOPs) for the supervision of any temporary certified operator to ensure permit requirements are being implemented. The SOPs shall include daily review of the operating logs by the supervising operator. The SOPs shall be kept onsite and be available for inspection by the Department personnel upon request.

C. Monitoring Requirements of the Land Application System

1. The wastewater treatment plant and the spray irrigation system shall be operated by a Maryland State Certified Operator in accordance with the provisions of COMAR 26.06.01 and consistent with the approved operation and maintenance manual. In order to ensure that the Operator is proficient in the operation of the spray irrigation system, the operator shall take required training courses, when available, at a frequency approved by the MD Board of Waterworks and Waste Systems Operator. This training shall be specific to the operation of the wastewater system in addition to any other training requirements of the operator's class.

2. The Permittee is responsible for the proper installation, operation and maintenance of ten (10) groundwater monitoring wells to be used for obtaining grab or pumped samples of the groundwater. Locations of the wells are shown on the attached Map B.

3. The Permittee shall take and analyze one water sample every three months from each monitoring well.

   a. Water samples may be obtained by either pumping or bailing the monitoring wells. Prior to taking the sample, a volume of water equal to 300% of the wetted volume of the casing and screen shall be removed.

   b. The water sample shall be analyzed for the parameters shown in I.A.3.a.

   The Permittee shall install and maintain piezometers for monitoring the groundwater levels in spray fields where shallow groundwater tables (<2') are expected.

4. The Permittee shall maintain three (3) surface water monitoring stations along tributaries of the Three Bridge Branch adjacent to the irrigation site for monitoring stream water quality. Sampling frequency and parameters for surface water quality analyses shall be the same as specified in Section I.C.3. The locations of these sampling stations are shown on the attached Map B.

Appendix C

Influent Sampling Data and 9-Year Effluent Operating Data

Data 1: Operating Effluent Weekly Spreadsheets

			Stream Effluent													Spray Effluent							
			Flow	BOD		TSS		TKN	Ammonia	NO2 + NO3		Total Nitrogen-N		TP		E. Coli Geomean	Flow	BOD	TSS	TKN	NO2 + NO3	Ammonia	TP	E. Coli
Year	Month	Week	MGD	mg/L	lbs/day	mg/L	lbs/day	mg/L	mg/L	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	MPN/100 ml	MGD	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	MPN/100 ml
2014	1-Jan	1	0.320	5.50	16.15	4.50	13.43	0.79	0.27	0.90	2.73	1.69	5.07	0.09	0.26	1.00								
		2	0.351	2.50	6.75	4.50	12.12	0.78	0.32	1.74	4.64	2.52	6.76	0.07	0.20	1.00								
		3	0.312	2.00	5.30	4.00	10.59	1.21	0.54	1.45	3.88	2.65	6.99	0.08	0.20	1.00								
		4	0.324	1.55	4.47	2.25	5.83	1.53	0.27	1.82	5.46	3.36	10.47	0.09	0.30	1.00	0.322	2.31	4.05	0.93	2.24	0.23	0.344	7.4
	1-Feb	1	0.355	6.00	21.97	4.00	14.65	1.04	0.33	2.57	9.38	3.61	13.20	0.07	0.25	1.00	0.368	3.88	4.50	1.09	1.99	0.25	0.473	1.8
		2	0.358	4.50	11.68	4.00	10.39	1.56	0.42	2.52	6.53	4.07	10.57	0.10	0.27	1.00	0.522	3.75	4.38	0.90	2.23	0.23	1.143	11.5
		3	0.374	2.69	7.73	4.75	13.92	0.98	0.22	2.68	7.79	3.65	10.63	0.09	0.27	1.76	0.570	2.40	4.30	0.62	2.18	0.20	1.049	6.0
		4	0.360	6.00	17.01	4.00	11.64	0.54	1.10	2.66	7.86	3.19	9.43	0.09	0.25	3.26	0.568	2.42	4.25	0.68	2.19	0.27	0.905	5.9
	1-Mar	1	0.367	8.50	25.67	4.00	11.76	4.79	3.51	1.91	5.52	6.69	20.23	2.33	7.25	1.00	0.238	2.44	4.33	0.80	2.48	0.20	1.180	1.8
		2	0.336	5.50	15.74	5.00	14.22	1.17	0.37	2.14	6.10	3.31	9.42	0.17	0.49	3.26	0.267	2.67	4.00	0.80	2.66	0.21	0.736	1.9
		3	0.344	4.50	13.19	4.00	12.11	0.80	0.20	2.32	7.08	3.12	9.52	0.19	0.58	2.00	0.07	2.15	4.00	0.78	2.21	0.20	0.526	1.8
		4	0.336	4.50	12.03	4.50	12.03	0.95	0.20	2.74	7.41	3.69	9.97	0.31	0.83	2.05								
	1-Apr	1																						
		2																						
		3																						
		4															0.378	4.48	5.40	1.20	1.48	0.27	0.342	1.8
	1-May	1															0.472	4.13	6.08	1.08	1.40	0.24	0.763	5.0
		2															0.289	4.51	3.74	1.02	1.14	0.26	1.861	6.7
		3															0.619	4.37	0.94	0.42	1.60	0.12	1.572	1.8
		4															0.481	3.27	2.56	0.73	1.66	0.13	1.328	1.9
	1-Jun	1															0.245	6.26	1.30	1.04	1.61	0.14	1.689	4.3
		2															0.298	1.47	2.75	0.50	2.08	0.13	0.973	1.8
		3															0.173	1.89	1.44	0.70	2.00	0.12	0.531	1.8
		4																						
	1-Jul	1																						
		2																						
		3																						
		4															0.0717	3.46	3.22	0.39	1.67	0.16	0.596	3.6
	1-Aug	1															0.306	3.36	1.44	0.37	1.64	0.16	1.582	1.8
		2															0.395	3.83	1.22	0.34	1.26	0.32	2.244	2.0
		3															0.382	3.04	0.56	1.36	1.52	0.64	3.143	4.5
		4															0.597	3.97	1.10	0.97	1.56	0.15	3.151	6.4
	1-Sep	1															0.506	5.22	1.88	0.86	1.67	0.18	2.574	1.9
		2															0.323	4.23	2.56	1.03	1.70	0.15	1.815	1.8
		3															0.274	1.71	1.30	1.05	1.59	0.15	1.684	1.8
		4															0.170	2.41	0.88	0.98	1.64	0.18	1.408	1.8
	1-Oct	1																						
		2																						
		3																						
		4															0.060	2.59	1.81	1.01	1.32	0.29	0.899	1.8
	1-Nov	1															0.201	3.23	0.75	0.59	1.07	0.11	1.348	4.5
		2															0.564	4.08	3.00	0.68	1.70	0.11	2.056	11.0
		3															0.245	3.34	1.19	0.53	1.17	0.12	2.538	14.6
		4																						
	1-Dec	1	0.315	1.28	3.46	0.50	1.35	1.00	0.10	2.05	5.54	3.05	8.24	0.18	0.50	1.00								
		2	0.306	4.19	10.94	2.50	6.53	0.88	0.15	1.99	5.24	2.87	7.56	0.14	0.37	1.00								
		3	0.303	2.31	5.69	1.00	2.48	0.90	0.13	1.89	4.64	2.79	6.86	0.13	0.31	1.00								
		4	0.319	9.00	32.58	4.00	14.48	0.75	0.20	2.43	8.80	3.18	11.52	0.10	0.36	1.00								
2015	1-Jan	1	0.315	2.06	5.09	0.50	1.23	1.00	0.12	1.90	4.65	2.90	7.10	0.11	0.27	1.80								
		2	0.332	2.86	9.09	0.50	1.59	1.74	0.10	1.87	5.95	3.61	11.46	0.10	0.32	1.00								
		3	0.373	6.32	16.72	2.25	5.93	0.80	0.15	1.95	5.21	2.75	7.36	0.09	0.25	1.41								
		4	0.376	2.22	6.58	2.25	6.75	0.94	0.16	1.49	4.38	2.43	7.14	0.15	0.43	1.41								
	1-Feb	1	0.344	3.08	9.30	0.50	1.52	0.72	0.11	1.58	4.82	2.29	7.03	0.23	0.71	1.00								
		2	0.321	3.20	8.72	1.25	3.49	0.63	0.12	1.19	3.26	1.82	4.99	0.14	0.39	1.76								
		3	0.320	2.20	5.56	0.50	1.27	0.45	0.10	1.90	4.83	2.35	5.96	0.16	0.41	7.10								
		4	0.322	2.10	5.74	6.50	17.72	0.60	0.14	1.24	3.38	1.84	5.00	0.20	0.54	1.00								
	1-Mar	1	0.412	3.67	12.00	0.75	2.50	0.60	0.16	1.84	6.04	2.44	8.02	0.15	0.49	8.92								
		2	0.415	5.81	19.61	0.75	2.54	0.79	0.21	2.06	6.95	2.85	9.60	0.31	1.04	6.82								
		3	0.411	3.08	11.37	1.00	3.77	1.17	0.10	1.92	7.23	3.08	11.40	0.31	1.19	38.78								
		4	0.366	4.64	14.22	1.00	3.10	0.67	0.22	2.08	6.50	2.75	8.59	0.26	0.81	7.96								
	1-Apr	1																						
		2																						
		3																						
		4																						
	1-May	1																						
		2																						
		3																						
		4																						
	1-Jun	1																						
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		3																						
		4																						
	1-Jul	1																						
		2																						
		3																						
		4																						
	1-Aug	1																						
		2																						
		3																						
		4																						
	1-Sep	1																						
		2																						
		3																						
		4																						
	1-Oct	1																						
		2																						
		3																						
		4																						
	1-Nov	1																						
		2																						
		3																						
		4																						
	1-Dec	1	0.431	1.59	5.62	0.50	1.82	0.40	0.12	2.30	8.36	2.69	9.80	0.14	0.49	4.02								
		2	0.397	3.20	10.49	0.75	2.44	0.40	0.10	1.97	6.67	2.37	8.01	0.15	0.49	32.23								
		3	0.413	2.35	8.58	0.50	1.74	0.40	0.10	2.60	9.03	2.99	10.41	0.19	0.66	13.10								
		4	0.478	2.22	10.18	0.50	2.13	0.45	0.11	2.31	9.85	2.76	11.81	0.16	0.71	12.46								
2016	1-Jan	1	0.406	2.24	7.77	1.75	6.11	0.44	0.10	2.88	10.01	3.31	11.53	0.14	0.49	11.65								
		2	0.401	3.42	8.28	2.25	7.52	0.40	0.23	3.61	9.07	4.00	10.17	0.47	1.17	58.30								
		3	0.439	2.00	6.60	0.50	1.62	0.48	0.17	2.56	8.12	3.05	9.66	0.22	0.70	144.50								
		4	0.424	2.81	8.83	1.00	3.31	0.36	0.10	2.85	9.44	3.21	10.61	0.17	0.57	50.02								
	1-Feb	1	0.481	4.29	16.80	0.75	2.94	0.35	0.31	1.68	6.59	2.03	7.95	0.26	1.00	8.12								
		2	0.469	1.31	5.26	0.50	2.01	0.85	0.16	1.99	8.00	2.84	11.40	0.13	0.52	1.00								
		3	0.473	1.74	7.30	2.50	10.35	0.33	0.24	2.46	10.18	2.79	11.58	0.13	0.54	1.00								
		4	0.470	1.33	5.49	0.75	3.05	0.72	0.12	1.73	7.44	2.45	10.64	0.13	0.57	1.00								
	1-Mar	1	0.457	1.00	3.77	2.00	7.54	0.38	0.23	1.97	7.43	2.35	8.85	0.13	0.49	4.88								
		2	0.461	1.87	8.10	1.50	6.16	0.37	0.19	2.04	8.60	2.41	10.15	0.13	0.52	1.41								
		3	0.449	1.10	4.06	0.50	1.86	0.37	0.13	2.26	8.30	2.63	9.71	0.19	0.70	4.38								
		4	0.414	2.79	10.44	1.25	4.82	0.39	0.11	2.23	8.40	2.61	9.85	0.33	1.21	1.00								
	1-Apr	1																						
		2																						
		3																						
		4																						
	1-May	1																						
		2																						
		3																						
		4																						
	1-Jun	1																						
		2																						
		3																						
		4																						
	1-Jul	1																						
		2																						
		3																						

			Stream Effluent														Spray Effluent							
			Flow	BOD		TSS		TKN	Ammonia	NO2 + NO3		Total Nitrogen-N		TP		E. Coli Geomean	Flow	BOD	TSS	TKN	NO2 + NO3	Ammonia	TP	E. Coli
Year	Month	Week	MGD	mg/L	lbs/day	mg/L	lbs/day	mg/L	mg/L	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	MPN/100 ml	MGD	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	MPN/100 ml
		4																						
	1-Aug	1																						
		2																						
		3																						
		4																						
	1-Sep	1																						
		2																						
		3																						
		4																						
	1-Oct	1																						
		2																						
		3																						
		4																						
	1-Nov	1																						
		2																						
		3																						
		4																						
	1-Dec	1																						
		2																						
		3																						
		4																						
	1-Jan	1	0.419	2.37	9.01	0.50	1.86	0.68	0.11	1.01	3.71	1.69	6.17	0.18	0.64	1.00								
		2	0.385	4.64	14.33	4.50	13.88	1.23	0.18	1.53	5.06	2.75	8.97	0.25	0.82	1.00								
		3	0.372	3.76	12.06	0.50	1.57	1.59	0.43	1.13	3.62	2.72	8.63	0.38	1.20	1.00								
		4	0.405	1.73	6.07	0.50	1.75	0.59	0.13	1.33	4.64	1.92	6.71	0.19	0.65	1.00								
	1-Feb	1	0.364	3.15	9.18	1.00	2.92	1.05	0.13	1.63	4.78	2.68	7.90	0.43	1.25	1.00								
		2	0.370	2.85	8.91	1.75	5.65	0.48	0.12	1.81	5.63	2.29	7.11	0.39	1.20	1.00								
		3	0.349	1.56	4.72	0.75	2.27	0.49	0.11	1.86	5.65	2.35	7.17	0.49	1.48	1.00								
		4	0.376	2.34	7.29	0.75	2.34	0.69	0.10	1.32	4.10	2.01	6.25	0.67	2.09	1.00								
	1-Mar	1	0.357	1.04	3.02	1.25	3.64	0.56	0.16	1.42	4.13	1.98	5.74	0.86	2.48	1.00								
		2	0.404	2.05	5.46	1.75	4.57	0.96	0.16	1.46	4.19	2.42	6.90	0.85	2.47	1.00								
		3	0.392	2.71	8.83	2.50	8.52	0.78	0.19	1.30	4.29	2.08	6.89	0.44	1.44	1.00								
		4	0.382	3.27	11.12	1.25	4.06	0.99	0.21	1.15	3.92	2.14	7.28	0.38	1.26	1.00								
	1-Apr	1																						
		2																						
		3																						
		4																						
	1-May	1																						
		2																						
		3																						
		4																						
	1-Jun	1																						
		2																						
		3																						
2017		4																						
	1-Jul	1																						
		2																						
		3																						
		4																						
	1-Aug	1																						
		2																						
		3																						
		4																						
	1-Sep	1																						
		2																						
		3																						
		4																						
	1-Oct	1																						
		2																						
		3																						
		4																						
	1-Nov	1																						
		2																						
		3																						
		4																						
	1-Dec	1	0.375	1.77	5.04	2.50	7.16	0.78	0.14	1.83	5.31	2.61	7.59	0.60	1.72	1.00								
		2	0.371	1.80	5.95	3.00	9.59	0.93	0.55	1.80	5.86	2.72	8.88	0.52	1.67	4.45								
		3	0.365	3.70	10.83	2.00	5.85	1.43	0.21	1.27	3.71	2.70	7.90	0.29	0.85	27.10								
		4	0.371																					
	1-Jan	1	0.362	5.66	16.510	2.50	7.385	0.86	0.205	1.61	4.804	2.47	7.370	0.64	1.977	44.75								
		2	0.427	6.190	21.249	2.250	8.134	1.555	0.612	0.936	3.155	2.491	8.506	0.180	0.614	55.050								
		3	0.366	1.820	5.536	2.500	7.631	1.410	0.496	0.747	2.299	2.157	6.615	0.220	0.671	28.400								
		4	0.377	3.513	10.579	6.667	20.477	1.373	0.235	1.861	5.739	3.234	9.928	0.170	0.517	10.767								
	1-Feb	1	0.404	4.305	13.586	3.000	9.533	1.455	0.295	2.119	6.790	3.574	11.446	0.165	0.527	1.000								
		2	0.545	3.915	15.783	5.000	19.124	2.610	1.477	1.927	7.221	4.537	17.445	0.625	2.523	10.100								
		3	0.474	3.080	12.656	4.000	16.434	1.110	0.389	0.841	3.455	3.070	12.611	0.255	1.047	3.100								
		4	0.440	3.255	12.254	2.750	10.146	0.770	0.327	1.580	5.816	2.350	8.641	0.450	1.659	1.000								
	1-Mar	1	0.416	3.265	12.008	1.250	4.285	0.710	0.343	1.816	6.733	2.526	9.403	0.785	2.863	7.100								
		2	0.446	3.555	13.851	3.000	11.972	0.535	0.306	1.816	7.355	2.351	9.501	0.670	2.658	101.250								
		3	0.451	3.355	11.642	1.750	6.595	1.065	0.270	1.748	6.252	2.813	9.987	0.440	1.569	1.000								
		4	0.454	2.677	10.538	1.000	3.891	1.310	0.354	1.904	7.550	3.214	12.930	1.073	4.178	55.733								
	1-Apr	1															0.000	4.66	0.75	1.52	1.66	0.29	0.86	1.90
		2															0.000	1.990	0.500	1.415	1.470	0.436	1.450	2.000
		3															0.015	7.230	1.250	3.055	0.982	1.910	1.260	3.250
		4															0.336	4.650	0.500	1.100	1.462	0.343	0.760	1.800
	1-May	1															0.700	3.505	0.750	1.420	1.745	0.28	1.54	1.90
		2															0.258	1.000	1.750	1.460	1.329	0.183	2.615	4.500
		3															0.000	4.145	1.000	0.845	1.633	0.100	1.515	2.600
		4															0.379	3.243	1.000	0.848	1.723	0.132	1.448	4.300
	1-Jun	1															1.094	1.989	1.185	1.267	1.730	0.119	1.165	1.000
		2															0.390	1.465	1.500	0.730	2.133	0.120	1.785	1.500
		3															0.661	2.545	0.500	0.880	1.720	0.100	0.635	23.000
2018		4															0.235	1.000	2.000	1.135	1.930	0.100	1.465	4.850
	1-Jul	1															0.407	4.360	0.500	1.955	1.211	0.100	1.380	6.500
		2															0.655	3.960	0.500	1.265	2.168	0.105	1.575	1.500
		3															0.624	1.460	1.250	1.280	1.466	0.103	2.280	16.500
		4															0.100	2.480	1.167	0.720	1.442	0.102	2.877	4.633
	1-Aug	1															0.510	1.610	1.750	0.725	1.295	0.100	1.585	4.850
		2															0.483	1.480	0.100	1.290	1.142	0.108	2.050	6.700
		3															0.641	2.445	0.750	0.750	1.006	0.108	2.050	1.000
		4															0.829	3.030	2.500	1.303	1.007	0.100	2.243	1.000
	1-Sep	1															0.661	0.100	0.500	0.930	1.193	0.104	3.030	1.500
		2															0.000	4.850	3.000	0.730	1.584	0.140	2.650	3.100
		3															0.679	4.360	0.500	0.720	1.310	0.108	2.340	4.200
		4															0.000	2.520	0.750	0.720	1.788	0.100	2.200	1.500
	1-Oct	1															0.631	1.425	0.500	1.235	1.573	0.106	2.050	2.050
		2															0.141	3.625	1.500	0.760	1.575	0.105	2.450	1.000
		3															0.353	2.185	1.750	0.925	1.615	0.107	2.015	3.650
		4															0.427	2.278	0.875	0.948	1.768	0.117	1.570	2.325
	1-Nov	1															0.000	1.525	0.750	1.120	1.759	0.110	0.550	2.000
		2															0.077	1.375	0.500	1.150	1.980	3.130	0.125	1.050
		3															0.498	2.900	3.500	0.895	1.973	2.868	0.100	0.220
		4															0.276	2.355	1.750	0.720	1.956	2.676	0.114	0.520
	1-Dec	1	0.558	1.470	6.880	3.000	14.045	0.860	0.199	2.071	9.636	2.931	13.648	0.645	2.981	1.000								
		2	0.554	2.255	10.146	0.500	2.250	0.790	0.163	2.891	13.003	3.681	16.558	0.315	1.418	1.000								
		3	0.758	2.160	12.609	1.750	10.087	0.720	0.166	1.878	11.413	2.598	15.776	0.260	1.584	4.250								
		4	0.730	4.383	#DIV/0!	2.833	#DIV/0!	0.837	0.205	1.627	#DIV/0!	2.464	#DIV/0!	0.233	#DIV/0!	1.000								
	1-Jan	1	0.735	2.400	#DIV/0!	0.500	#DIV/0!	0.720	0.259	1.722	#DIV/0!	2.442	#DIV/0!	0.205	#DIV/0!	6.050								
		2	0.644	1.745	#DIV/0!	0.500	#DIV/0!	0.720	0.385	2.018	#DIV/0!	2.738	#DIV/0!	0.465	#DIV/0!	1.000								
		3	0.633	1.740	#DIV/0!	3.250	#DIV/0!	0.720	0.280	1.950	#DIV/0!	2.670	#DIV/0!	0.400	#DIV/0!	1.600								
		4	0.640	1.477	#DIV/0!	0.500	#DIV/0!	0.720	0.287	2.352	#DIV/0!	3.072	#DIV/0!	0.450	#DIV/0!	2.067								
	1-Feb	1	0.583	1.955	#DIV/0!	1.750	#DIV/0!	0.720	0.100	2.719	#DIV/0!	3.439	#DIV/0!	0.610	#DIV/0!	1.000								
		2	0.613	1.560	#DIV/0!	0.500	#DIV/0!	0.720	0.100	2.327	#DIV/0!	3.047	#DIV/0!	0.650	#DIV/0!	1.000								

			Stream Effluent														Spray Effluent							
			Flow	BOD		TSS		TKN	Ammonia	NO2 + NO3		Total Nitrogen-N		TP		E. Coli Geomean	Flow	BOD	TSS	TKN	NO2 + NO3	Ammonia	TP	E. Coli
Year	Month	Week	MGD	mg/L	lbs/day	mg/L	lbs/day	mg/L	mg/L	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	MPN/100 ml	MGD	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	MPN/100 ml
	[illegible]	3	0.623	1.880	#DIV/0!	0.500	#DIV/0!	0.790	0.129	2.375	#DIV/0!	3.165	#DIV/0!	0.560	#DIV/0!	1.000								
		4	0.645	1.903	#DIV/0!	1.333	#DIV/0!	0.720	0.232	2.901	#DIV/0!	3.621	#DIV/0!	0.757	#DIV/0!	1.000								
	1-Mar	1	0.729	2.720	#DIV/0!	2.000	#DIV/0!	0.720	0.259	2.342	#DIV/0!	3.062	#DIV/0!	0.640	#DIV/0!	100.750								
		2	0.667	2.675	#DIV/0!	0.500	#DIV/0!	0.820	0.173	1.591	#DIV/0!	2.411	#DIV/0!	0.640	#DIV/0!	1.500								
		3	0.614	2.570	#DIV/0!	0.500	#DIV/0!	1.120	0.380	1.331	#DIV/0!	2.451	#DIV/0!	0.240	#DIV/0!	1.000								
		4	0.624	3.165	#DIV/0!	1.000	#DIV/0!	0.855	0.394	1.549	#DIV/0!	2.404	#DIV/0!	0.295	#DIV/0!	1.000								
	1-Apr	1															0.525	1.860	0.750	0.720	1.287	2.007	0.251	0.225
		2															0.546	1.620	0.500	0.750	1.407	2.157	0.233	0.280
		3															0.356	1.390	0.750	0.800	1.890	2.690	0.260	0.680
		4															0.390	1.677	1.000	1.250	1.972	3.222	0.351	1.030
	1-May	1															0.111	1.435	0.500	0.910	2.106	3.016	0.285	1.865
		2															0.053	1.245	0.500	0.720	1.814	2.534	0.171	1.830
		3															0.502	1.270	0.500	0.720	2.392	3.112	0.232	1.965
		4															0.086	1.090	0.500	0.987	1.745	2.732	0.194	1.387
	1-Jun	1															0.038	1.135	0.500	0.930	2.488	3.418	0.297	1.615
		2															0.147	1.395	1.250	1.900	1.996	3.896	0.191	1.075
		3															0.614	1.015	0.500	0.835	1.271	2.106	0.121	1.465
2019		4															0.523	1.155	0.500	0.885	1.403	2.288	0.113	2.035
	1-Jul	1															0.330	1.000	0.500	0.850	1.156	2.006	0.100	2.215
		2															0.713	1.610	0.300	1.180	1.186	2.366	0.100	2.480
		3															0.663	1.010	0.750	0.790	1.227	2.017	0.391	2.900
		4															0.854	1.175	0.500	0.720	1.144	1.864	0.130	2.563
	1-Aug	1															0.681	1.295	0.500	0.720	1.289	2.009	0.120	1.950
		2															0.480	1.050	0.500	1.970	1.455	3.425	0.110	1.340
		3															0.641	1.515	2.250	1.000	1.500	2.500	0.100	1.295
		4															0.411	1.070	0.500	0.860	1.615	2.475	0.100	1.980
	1-Sep	1															0.412	1.030	0.500	1.000	1.558	2.558	0.100	1.860
		2															0.471	1.000	0.500	1.000	1.758	2.758	0.100	1.700
		3															0.537	1.085	0.500	1.000	1.500	2.500	0.111	1.965
		4															0.304	1.115	0.750	1.000	1.659	2.659	0.121	1.905
	1-Oct	1															0.221	1.230	1.000	1.000	1.437	2.536	0.195	1.537
		2															0.090	1.010	0.500	1.000	1.799	2.799	0.111	2.250
		3															0.036	1.000	0.500	1.000	1.455	2.498	0.157	1.750
		4															0.032	1.103	0.625	1.000	1.868	2.868	0.337	1.950
	1-Nov	1															0.265	1.355	1.250	1.000	1.317	2.317	0.100	1.620
		2															0.111	1.280	0.500	1.000	1.411	2.411	0.142	1.535
		3															0.509	1.085	0.500	1.000	1.447	2.447	0.186	1.280
		4															0.194	2.520	0.750	0.790	0.922	1.712	0.295	0.970
	1-Dec	1	0.442	1.840	#DIV/0!	0.750	#DIV/0!	0.500	0.145	0.873	#DIV/0!	1.373	#DIV/0!	1.535	#DIV/0!	1.500								
		2	0.455	1.720	#DIV/0!	0.750	#DIV/0!	0.573	0.285	1.524	#DIV/0!	2.096	#DIV/0!	1.985	#DIV/0!	102.350								
		3	0.396	2.325	#DIV/0!	0.500	#DIV/0!	0.685	0.889	0.862	#DIV/0!	1.547	#DIV/0!	0.950	#DIV/0!	200.500								
		4	0.412	1.177	#DIV/0!	0.833	#DIV/0!	0.500	0.161	0.816	#DIV/0!	1.316	#DIV/0!	0.377	#DIV/0!	72.000								
	1-Jan	1	0.415	1.535	#DIV/0!	0.750	#DIV/0!	0.500	0.415	0.878	#DIV/0!	1.378	#DIV/0!	0.630	#DIV/0!	2.600								
		2	0.450	1.295	#DIV/0!	0.500	#DIV/0!	0.500	0.269	1.164	#DIV/0!	1.664	#DIV/0!	0.465	#DIV/0!	101.250								
		3	0.413	1.000	#DIV/0!	0.750	#DIV/0!	0.568	0.221	1.029	#DIV/0!	1.596	#DIV/0!	0.950	#DIV/0!	4.200								
		4	0.441	1.530	#DIV/0!	0.500	#DIV/0!	0.500	0.226	1.383	#DIV/0!	1.883	#DIV/0!	0.753	#DIV/0!	2.367								
	1-Feb	1	0.457	1.595	#DIV/0!	0.500	#DIV/0!	0.500	0.211	1.254	#DIV/0!	1.754	#DIV/0!	0.965	#DIV/0!	12.100								
		2	0.474	2.920	#DIV/0!	1.250	#DIV/0!	0.570	0.557	1.303	#DIV/0!	1.873	#DIV/0!	1.335	#DIV/0!	101.250								
		3	0.466	1.945	#DIV/0!	0.500	#DIV/0!	0.675	0.577	1.279	#DIV/0!	1.954	#DIV/0!	0.865	#DIV/0!	200.500								
		4	0.402	3.265	#DIV/0!	0.500	#DIV/0!	0.730	0.379	1.128	#DIV/0!	1.858	#DIV/0!	1.050	#DIV/0!	200.500								
	1-Mar	1	0.448	2.010	#DIV/0!	0.500	#DIV/0!	0.690	0.538	1.094	#DIV/0!	1.784	#DIV/0!	0.830	#DIV/0!	200.500								
		2	0.445	1.615	#DIV/0!	0.750	#DIV/0!	0.500	0.484	1.049	#DIV/0!	1.549	#DIV/0!	0.515	#DIV/0!	100.750								
		3	0.444	1.980	#DIV/0!	1.750	#DIV/0!	0.903	0.501	0.932	#DIV/0!	1.835	#DIV/0!	0.950	#DIV/0!	1.000								
		4	0.470	2.177	#DIV/0!	0.500	#DIV/0!	0.878	0.555	0.920	#DIV/0!	1.798	#DIV/0!	0.967	#DIV/0!	200.500								
	1-Apr	1															0.376	1.640	1.750	0.848	5.136	5.983	0.443	1.635
		2															0.000	1.470	1.250	0.568	1.562	1.779	0.309	1.450
		3															0.056	1.535	0.750	0.535	1.445	1.980	0.291	2.160
		4															0.096	1.310	1.833	0.617	1.592	2.209	0.277	1.390
	1-May	1															0.020	1.640	1.500	0.500	1.545	2.045	0.218	1.915
		2															0.416	1.685	1.000	4.090	0.478	4.568	3.420	1.830
		3															0.514	1.400	1.250	0.588	1.120	1.707	0.215	0.885
		4															0.082	2.100	0.500	0.500	1.238	1.738	0.260	2.015
	1-Jun	1															0.419	1.170	1.500	0.500	1.210	1.710	0.248	1.770
		2															0.456	1.085	0.500	4.770	1.093	5.863	0.310	2.535
		3															0.365	1.650	0.500	2.080	0.863	2.943	0.229	1.765
2020		4															0.676	1.400	0.667	0.958	0.991	1.950	0.166	2.620
	1-Jul	1															0.374	1.560	1.500	0.500	1.024	1.524	0.126	2.500
		2															0.391	1.090	1.500	0.500	1.266	1.766	0.175	2.380
		3															0.734	1.270	0.500	0.500	1.356	1.856	0.333	2.400
		4															0.330	1.323	0.667	0.798	1.496	2.033	0.471	1.870
	1-Aug	1															0.000	1.945	0.750	1.313	3.542	4.854	0.391	2.950
		2															0.477	2.805	0.750	1.018	1.317	2.335	1.303	2.515
		3															0.190	1.160	0.500	0.990	1.863	2.853	0.247	2.630
		4															0.609	1.665	0.500	0.823	1.793	2.615	0.169	2.420
	1-Sep	1															0.304	1.900	0.500	1.393	1.612	3.004	0.154	1.730
		2															0.311	1.970	0.500	0.905	1.904	2.809	0.149	1.685
		3															0.579	1.095	0.750	0.500	1.502	2.002	0.189	1.685
		4															0.544	1.920	1.125	0.521	1.358	1.880	0.166	1.303
	1-Oct	1															0.188	2.900	0.500	0.500	1.167	1.667	0.254	1.180
		2															0.203	3.385	0.500	0.500	1.010	1.510	0.276	0.865
		3															0.466	2.460	0.750	0.695	1.436	2.131	0.238	1.485
		4															0.404	2.015	0.500	0.533	1.147	1.679	0.409	1.635
	1-Nov	1															0.726	1.305	0.500	0.500	1.273	1.773	0.462	1.935
		2															0.349	1.345	0.500	0.500	1.233	1.733	0.377	1.480
		3															0.805	3.310	0.750	0.500	1.264	1.765	0.362	1.585
		4															0.277	2.255	0.500	2.853	1.435	3.788	0.519	1.135
	1-Dec	1	0.701	1.550	#DIV/0!	1.250	#DIV/0!	2.293	0.427	1.190	#DIV/0!	3.482	#DIV/0!	0.785	#DIV/0!	20.150								
		2	0.658	1.810	#DIV/0!	0.500	#DIV/0!	2.855	0.521	1.283	#DIV/0!	4.138	#DIV/0!	0.815	#DIV/0!	76.100								
		3	0.753	1.800	#DIV/0!	0.500	#DIV/0!	2.770	0.441	1.703	#DIV/0!	4.473	#DIV/0!	1.335	#DIV/0!	164.600								
		4	0.731	1.897	#DIV/0!	1.500	#DIV/0!	4.867	0.300	1.668	#DIV/0!	6.534	#DIV/0!	0.857	#DIV/0!	381.300								
	1-Jan	1	0.778	1.515	#DIV/0!	1.500	#DIV/0!	<1.0	0.275	1.762	#DIV/0!	2.262	#DIV/0!	1.165	#DIV/0!	1.000								
		2	0.717	1.375	#DIV/0!	3.000	#DIV/0!	0.510	0.397	1.957	#DIV/0!	2.712	#DIV/0!	1.000	#DIV/0!	<1.0								
		3	0.699	1.815	#DIV/0!	3.500	#DIV/0!	<1.0	0.430	1.819	#DIV/0!	2.819	#DIV/0!	0.900	#DIV/0!	1.000								
		4	0.634	1.460	#DIV/0!	1.000	#DIV/0!	1.030	0.192	2.134	#DIV/0!	3.149	#DIV/0!	0.715	#DIV/0!	<1.0								
	1-Feb	1	0.644	1.370	#DIV/0!	<0.5	#DIV/0!	1.020	0.187	2.005	#DIV/0!	3.025	#DIV/0!	0.900	#DIV/0!	<1.0								
		2	0.634	1.490	#DIV/0!	1.000	#DIV/0!	<1.0	0.225	2.396	#DIV/0!	3.396	#DIV/0!	0.850	#DIV/0!	1082.150								
		3	0.676	1.605	#DIV/0!	2.000	#DIV/0!	1.050	0.156	3.268	#DIV/0!	4.293	#DIV/0!	0.735	#DIV/0!	1213.500								
		4	0.743	1.640	#DIV/0!	1.000	#DIV/0!	<1.0	0.296	2.475	#DIV/0!	3.475	#DIV/0!	0.455	#DIV/0!	<1.0								
	1-Mar	1	0.799	<1.0	#DIV/0!	20.500	#DIV/0!	<1.0	0.314	2.148	#DIV/0!	3.148	#DIV/0!	0.360	#DIV/0!	<1.0								
		2	0.693	2.065	#DIV/0!	<0.5	#DIV/0!	2.155	1.438	1.715	#DIV/0!	3.870	#DIV/0!	0.400	#DIV/0!	<1.0								
		3	0.651	1.170	#DIV/0!	<0.5	#DIV/0!	<1.0	0.200	1.776	#DIV/0!	2.776	#DIV/0!	0.105	#DIV/0!	1210.300								
		4	0.651	1.580	#DIV/0!	1.500	#DIV/0!	1.910	0.273	1.886	#DIV/0!	3.190	#DIV/0!	0.157	#DIV/0!	7.750								
	1-Apr	1															0.628	2.607	<0.5	1.350	1.593	0.265	0.340	4.650
		2															0.569	2.530	1.000	1.300	2.194	0.780	0.295	3.100
		3															0.542	2.220	<0.5	0.970	2.125	0.170	0.170	11.550
		4															0.540	2.995	2.500	2.420	2.065	1.010	0.860	2419.600
	1-May	1															0.503	2.740	1.500	1.950	2.015	0.523	2.550	<1.0
		2															0.477	2.350	<0.5	1.620	2.460	0.655	2.100	<1.0
		3															0.468	3.230	1.500	2.775	2.615	0.457	2.100	1.000
		4															0.468	2.970	<0.5	2.405	3.085	0.572	2.900	<1.0
	1-Jun	1															0.457	2.900	<0.5	1.445	2.835	0.217	1.900	1.000
		2															0.453	2.920	<0.5	1.145	2.545	0.156	2.170	<1.0
		3															0.438	2.550	<0.5	0.455	2.645	0.143	2.200	<1.0
		4															0.438	3.175	3.000	1.338	2.853	0.224	2.643	<1.0
	1-Jul	1															0.443	2.380	<0.5	1.210	2.145	0.186	1.715	1.000
		2															0.415	2.380	<0.5	1.280	2.215	0.262	1.080	<1.0
		3															0.418	2.240	<0.5	<1.0	3.085	0.209	1.920	2.795
		4															0.398	2.930	<0.5	<1.0	3.495	0.215	2.120	1.000
	1-Aug	1															0.408	3.215	<0.5	1.255	1.390	0.374	0.700	<1.0
		2															0.416	4.195	2.000	1.620	0.855	0.599	0.785	<1.0
		3															0.434	5.350	1.000	9.900	1.845	8.790	0.405	143.700
		4															0.420	2.583	3.000	1.923	2.093	0.154	1.357	3.767
		1															0.412	1.660	<0.5	1.320	2.000	0.165	1.450	3.100

			Stream Effluent														Spray Effluent							
			Flow	BOD		TSS		TKN	Ammonia	NO2 + NO3		Total Nitrogen-N		TP		E. Coli Geomean	Flow	BOD	TSS	TKN	NO2 + NO3	Ammonia	TP	E. Coli
Year	Month	Week	MGD	mg/L	lbs/day	mg/L	lbs/day	mg/L	mg/L	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	MPN/100 ml	MGD	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	MPN/100 ml
	1-Sep	2															0.421	1.850	1.000	1.120	2.265	0.160	1.365	3.100
		3															0.412	1.585	<0.5	<1.0	2.145	0.170	1.410	<1.0
		4															0.441	1.533	<0.5	<1.0	1.997	0.166	1.737	1.000
	1-Oct	1															0.400	1.460	<0.5	<1.0	1.840	0.218	2.100	<1.0
		2															0.401	1.910	2.000	1.070	1.435	0.219	1.565	>2419.6
		3															0.397	1.280	<0.5	1.450	1.565	0.274	1.485	<1.0
		4															0.431	1.320	1.000	1.370	1.395	0.348	2.185	1210.300
	1-Nov	1															0.413	1.455	<0.5	2.070	0.950	0.381	1.765	<1.0
		2															0.406	1.300	<0.5	2.270	1.560	0.366	2.600	<1.0
		3															0.393	1.300	<0.5	2.985	0.815	0.416	1.465	5.200
		4															0.428	1.365	1.000	1.840	0.760	0.474	0.977	<1.0
	1-Dec	1	0.472	1.435	#DIV/0!	1.000	#DIV/0!	2.155	0.808	0.785	#DIV/0!	2.940	#DIV/0!	1.000	#DIV/0!	<1.0								
		2	0.443	1.855	#DIV/0!	<0.5	#DIV/0!	1.470	0.792	0.915	#DIV/0!	2.695	#DIV/0!	0.935	#DIV/0!	1.000								
		3	0.424	1.620	#DIV/0!	<0.5	#DIV/0!	1.435	0.819	0.965	#DIV/0!	2.400	#DIV/0!	0.700	#DIV/0!	<1.0								
		4	0.439	2.340	#DIV/0!	1.000	#DIV/0!	2.527	1.078	0.817	#DIV/0!	3.343	#DIV/0!	0.767	#DIV/0!	1.000								
	1-Jan	1	0.468	1.555	#DIV/0!	<0.5	#DIV/0!	1.825	0.551	1.470	#DIV/0!	3.295	#DIV/0!	0.510	#DIV/0!	<1.0								
		2	0.458	1.29	#DIV/0!	<0.5	#DIV/0!	3.42	0.5485	1.05	#DIV/0!	4.47	#DIV/0!	0.6	#DIV/0!	<1.0								
		3	0.484	1.595	#DIV/0!	<0.5	#DIV/0!	1.975	0.6595	0.92	#DIV/0!	2.895	#DIV/0!	0.7	#DIV/0!	<1.0								
		4	0.425	1.895	#DIV/0!	1	#DIV/0!	1.81	0.854	1.007	#DIV/0!	2.817	#DIV/0!	0.78	#DIV/0!	<1.0								
	1-Feb	1	0.479	1.400	#DIV/0!	1.000	#DIV/0!	1.450	0.630	0.845	#DIV/0!	2.295	#DIV/0!	0.795	#DIV/0!	5.400								
		2	0.434	1.850	#DIV/0!	<0.5	#DIV/0!	1.430	0.604	0.445	#DIV/0!	1.875	#DIV/0!	0.615	#DIV/0!	<1.0								
		3	0.430	1.480	#DIV/0!	<0.5	#DIV/0!	1.460	0.726	0.710	#DIV/0!	2.170	#DIV/0!	0.600	#DIV/0!	<1.0								
		4	0.447	4.093	#DIV/0!	2.333	#DIV/0!	1.923	1.043	0.633	#DIV/0!	2.557	#DIV/0!	1.043	#DIV/0!	1.000								
	1-Mar	1	0.431	5.380	#DIV/0!	2.000	#DIV/0!	1.830	1.080	1.255	#DIV/0!	3.085	#DIV/0!	0.850	#DIV/0!	<1.0								
		2	0.449	3.690	#DIV/0!	2.000	#DIV/0!	1.620	0.870	1.380	#DIV/0!	3.000	#DIV/0!	1.100	#DIV/0!	1.000								
		3	0.455	3.635	#DIV/0!	<0.5	#DIV/0!	1.490	0.730	1.295	#DIV/0!	2.785	#DIV/0!	1.050	#DIV/0!	2.000								
		4	0.421	3.193	#DIV/0!	4.500	#DIV/0!	1.460	0.653	1.270	#DIV/0!	2.730	#DIV/0!	0.920	#DIV/0!	1210.300								
	1-Apr	1															0.446	2.730	3.000	1.445	1.285	0.880	0.930	1.000
		2															0.421	1.555	2.000	1.020	1.450	0.485	1.350	1210.300
		3															0.419	1.330	<0.5	<1.0	0.930	0.301	0.950	<1.0
		4															0.399	1.945	2.000	<1.0	0.510	0.145	1.700	2.000
	1-May	1															0.418	1.820	<0.5	1.225	0.915	0.442	3.000	307.600
		2															0.402	3.090	<0.5	1.280	0.475	0.527	2.170	<1.0
		3															0.412	3.570	<0.5	1.450	0.130	0.693	2.200	346.000
		4															0.430	2.587	3.000	1.920	0.443	0.687	2.490	4.100
	1-Jun	1															0.391	2.580	4.000	1.975	0.520	0.556	2.515	1.000
		2															0.398	2.755	<0.5	1.415	0.565	0.703	2.630	1.000
		3															0.385	3.180	<0.5	1.130	0.785	0.423	2.730	1210.300
		4															0.400	2.207	1.000	1.205	0.703	0.209	2.620	1.000
	1-Jul	1															0.391	1.380	<0.5	1.260	1.130	0.270	3.330	1.000
		2															0.417	1.410	5.000	1.160	1.390	0.287	3.040	<1.0
		3															0.420	1.925	2.000	1.040	1.555	0.336	2.815	<1.0
		4															0.392	1.875	1.000	<1.0	1.480	0.264	2.665	<1.0
	1-Aug	1															0.391	1.445	<0.5	<1.0	2.515	0.218	3.015	1222.750
		2															0.384	1.480	<0.5	1.140	1.670	0.156	4.150	<1.0
		3															0.351	1.445	<0.5	1.220	6.375	0.124	3.620	<1.0
		4															0.353	1.687	4.500	1.110	3.383	0.164	3.700	1210.300
	1-Sep	1															0.367	2.065	<0.5	<1.0	4.555	<0.1	1.835	<1.0
		2															0.369	2.050	2.000	<1.0	4.610	<0.1	2.850	<1.0
		3															0.352	2.910	1.000	1.670	2.435	<0.1	3.000	3.000
		4															0.352	1.745	1.000	<1.0	2.265	0.122	2.250	353.800
	1-Oct	1															0.413	1.615	1.000	<1.0	2.450	0.127	0.783	42.800
		2															0.381	1.945	1.500	1.030	2.135	<0.1	2.100	<1.0
		3															0.384	1.550	<0.5	<1.0	1.790	<0.1	2.750	1.000
		4															0.404	1.560	<0.5	<1.0	2.450	<0.1	2.470	<1.0
	1-Nov	1															0.391	-	-	-	-	-	-	<1.0
		2															0.371	1.510	<0.5	<1.0	1.580	<0.1	0.333	<1.0
		3															0.390	1.490	2.000	<1.0	1.420	<0.1	0.833	<1.0
		4															0.378	1.640	2.000	<1.0	1.565	0.106	1.235	<1.0
	1-Dec	1	0.476	1.130	#DIV/0!	1.000	#DIV/0!	1.030	0.149	2.435	#DIV/0!	2.950	#DIV/0!	2.420	#DIV/0!	<1.0								
		2	0.440	1.505	#DIV/0!	<0.5	#DIV/0!	1.040	0.173	2.030	#DIV/0!	2.550	#DIV/0!	2.785	#DIV/0!	<1.0								
		3	0.539	1.150	#DIV/0!	<0.5	#DIV/0!	<1.0	0.223	2.125	#DIV/0!	2.125	#DIV/0!	1.184	#DIV/0!	1.000								
		4	0.508	1.195	#DIV/0!	1.000	#DIV/0!	1.150	0.170	2.863	#DIV/0!	3.247	#DIV/0!	2.163	#DIV/0!	1613.400								
		2014-2022																						
		Max	0.799	9.000	#DIV/0!	20.500	#DIV/0!	4.867	3.510	3.608	#DIV/0!	6.690	#DIV/0!	2.785	#DIV/0!	1613.400	1.094	7.230	6.075	9.900	6.375	8.790	4.150	2419.600
		Average	0.469	2.635	#DIV/0!	1.913	#DIV/0!	1.061	0.361	1.730	#DIV/0!	2.772	#DIV/0!	0.558	#DIV/0!	77.370	0.383	2.238	1.448	1.171	1.702	1.167	1.243	63.835
		Min	0.303	1.000	#DIV/0!	0.500	#DIV/0!	0.333	0.100	0.445	#DIV/0!	1.316	#DIV/0!	0.069	#DIV/0!	1.000	0.000	0.100	0.100	0.336	0.130	0.100	0.100	0.220

Data 2: Operating Effluent Annual Spreadsheet

	Stream Effluent														Spray Effluent										Total Flow
Calendar	Flow	BOD		TSS		TKN	Ammonia	NO2 + NO3		Total Nitrogen-N		TP		Geomean E. Coli	Flow	BOD	TSS	TKN	NO2 + NO3	Total Nitrogen-N	Ammonia	TP	Geomean E. Coli	
Year	MGD	mg/L	lbs/day	mg/L	lbs/day	mg/L	mg/L	mg/L	lbs/day	mg/L	lbs/day	mg/L	lbs/day	MPN/100 ml	MGD	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	MPN/100 ml	MGD
2014	0.34	4.19	12.17	3.53	10.08	1.20	0.50	2.09	5.97	3.29	9.45	0.25	0.76	1.28	0.25	2.72	4.22	0.82	2.28	3.10	0.22	0.79	3.54	0.58
2015	0.38	3.15	9.92	1.31	3.91	0.71	0.14	1.89	6.13	2.61	8.37	0.18	0.57	4.52	0.25	3.87	3.03	0.85	1.62	2.31	0.18	1.13	2.72	0.63
2016	0.45	2.15	7.87	1.21	4.57	0.45	0.17	2.32	8.44	2.76	10.13	0.21	0.76	4.80	0.25	3.44	1.57	0.81	1.58	2.39	0.23	2.02	2.57	0.70
2017	0.38	2.50	7.88	1.77	5.48	0.85	0.20	1.46	4.60	2.32	7.29	0.46	1.43	1.22	0.21	3.17	1.52	0.90	1.42	2.30	0.16	1.82	5.99	0.59
2018	0.49	3.44	12.27	2.80	10.26	1.13	0.37	1.72	6.74	2.91	11.36	0.45	1.82	20.59	0.36	2.76	1.17	1.09	1.58	2.63	0.19	1.68	3.69	0.84
2019	0.59	2.02	9.917	0.99	4.836	0.72	0.28	1.83	8.985	2.55	12.511	0.66	3.241	31.31	0.37	1.27	0.67	0.98	1.58	2.56	0.18	1.67	5.22	0.96
2020	0.51	1.87	7.992	0.79	3.358	1.34	0.41	1.21	5.186	2.55	10.906	0.88	3.750	117.81	0.37	1.76	0.86	1.00	1.50	2.46	0.40	1.84	7.64	0.88
2021	0.59	1.63	8.052	2.84	14.036	1.86	0.54	1.63	8.063	3.15	15.528	0.68	3.348	461.08	0.45	2.41	1.89	1.96	2.03	3.77	0.57	1.58	236.15	1.04
2022	0.46	2.40	9.166	2.08	7.940	1.74	0.63	1.39	5.301	2.82	10.799	1.16	4.428	2.40	0.39	2.06	2.35	1.37	1.83	2.71	0.37	2.43	234.03	0.85
2014-2022																								
Max	0.588	4.187	12.274	3.529	10.261	1.338	0.500	2.319	8.985	3.287	12.511	0.877	3.750	117.814	0.368	3.869	4.221	1.091	2.275	3.097	0.399	2.021	7.643	
Avg	0.447	2.758	9.717	1.770	6.071	0.914	0.294	1.789	6.578	2.712	10.002	0.441	1.762	25.933	0.292	2.713	1.864	0.922	1.650	2.535	0.224	1.567	4.481	
Min	0.335	1.870	7.865	0.786	3.358	0.446	0.136	1.214	4.597	2.316	7.286	0.176	0.571	1.225	0.208	1.271	0.666	0.810	1.423	2.305	0.164	0.794	2.569	
										Max Load (lbs/year)														
										TN:	1501.3	TP:	450.0											

Data 3: Influent Sample Spreadsheet

Centreville WW 24 hr Composite Influent Sampling 2023							Centreville WW 24 hr Composite Influent Sampling 2017							
Sample Date	BOD	TSS	Ammonia	TKN	Nitrate/Nitrite		Sample Date	BOD	TSS	Ammonia	TKN	Nitrate/Nitrite	pH	TP
3.20.23	148	76	28.2	36.4	0.24	1	9.19.17	71.53	57	26.3	26.41	<0.065	7.06	1.5
3.22.23	115	121	27.5	36.7	1.91	2	9.20.17	79.8	57	26.5	29.13	<0.042	7.12	1.73
3.24.23	135	137	21	16.2	<0.10	3	10.03.17	184.8	358	39.8	46.46	<0.065	7.57	7.97
3.27.23	129	124	21.1	34.4	<0.10	4	10.04.17	101.1	70	28.4	32.88	<0.042	7.34	3.63
3.29.23	122	189	26	41.3	<0.10	5	10.10.17	132.2	60	36.2	31.85	<0.042	7.19	3.57
3.31.23	109	50	37.4	38.2	1.01	6	10.11.17	199.3	120	30.3	38.46	<0.042	7.27	5.57
						7	10.17.17	96.7	75	32.1	29.45	0.304	7.26	2.4
						8	10.18.17	106.5	62.5	36.9	30.27	<0.065	7.22	2.13
						9	10.24.17	180.4	73	35.9	37.12	<0.065	7.2	3.53

Appendix D

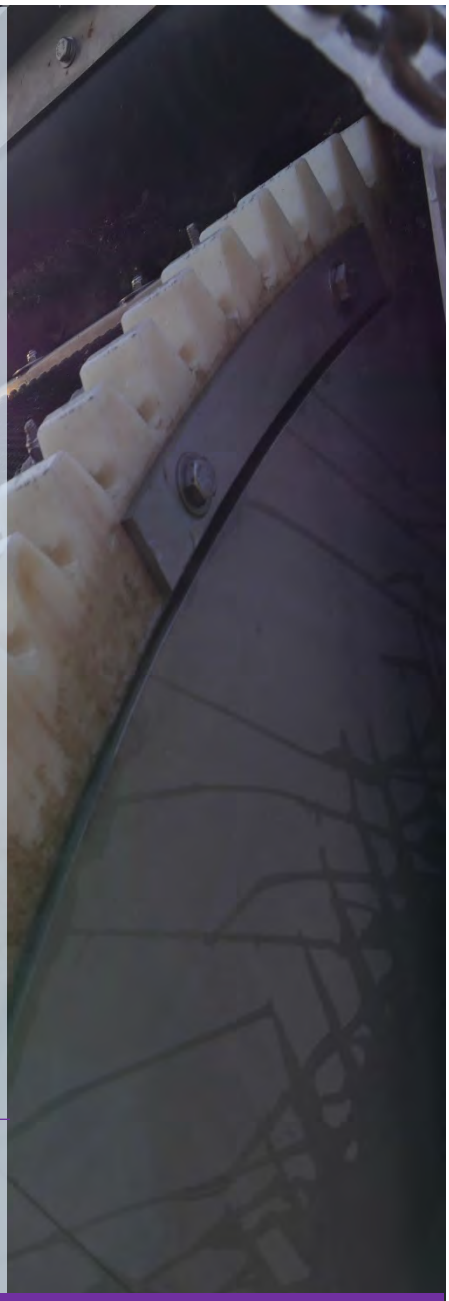
Major Process Equipment Catalog Information

Item 1: Influent Screening

OVIVO Worldwide Experts in Water Treatment

BUDGETARY PROPOSAL

May 02, 2023



CENTREVILLE WWTP

TOWN OF CENTREVILLE MARYLAND

Ovivo® Ozzy™ Cup Screen

PREPARED FOR

Whitman, Requardt & Associates, LLP

David Nixson, P.E.

AREA REPRESENTATIVE

Sherwood Logan & Associates

Andrew Kreider

PREPARED BY:

RICHARD QUICK

Phone: (801) 931-3000

Richard.Quick@ovivowater.com

Ovivo USA, LLC is pleased to submit a budgetary proposal for the following equipment (the "Products") on the project indicated above (the "Project").

While every effort has been made to ensure this quotation captures the intent of the project, we do anticipate further discussion in order to clarify and/or finalize the scope, terms & conditions and other details prior to any formal agreement. We look forward to your favorable review of our offer to further discussions on this important project.

THIS BUDGETARY PROPOSAL CONSTITUTES A NON-BINDING ESTIMATE OF PRICE(S) FOR CERTAIN GOODS AND/OR SERVICES THAT MAY BE PROVIDED BY OVIVO USA, LLC FROM TIME TO TIME, BUT SHALL NOT BE CONSTRUED AS A CONTRACTUAL OFFER FOR OVIVO USA, LLC TO PROVIDE SUCH GOODS AND/OR SERVICES. ANY CONTRACTUAL OFFER FOR THE SUPPLY OF GOODS AND/OR SERVICES BY OVIVO USA, LLC SHALL BE CONVEYED TO CUSTOMER IN THE FORM OF OVIVO USA, LLC STANDARD PROPOSAL DOCUMENT, WHICH INCLUDES, BUT IS NOT LIMITED TO, ITS STANDARD TERMS AND CONDITIONS OF SALE. SUCH PROPOSAL FORM MAY BE PROVIDED TO CUSTOMER UPON REQUEST.

Budgetary Pricing for Proposed Equipment:

ITEM	EQUIPMENT	PRICE
I	Ovivo® Ozzy™ Cup Screen, 6' Diameter, Troughing, Controls, Model 250 Compactor, and Field Service	** *$503,00

*Please see your local Ovivo Rep for:

- Explosion proof environments
- **Special Spec Requirements or Testing**

** Pricing is only valid for 30 days

ITEM I STANDARD SCOPE OF SUPPLY

ITEMS INCLUDED:

- Two (2) Ovivo® Ozzy™ Cup Screens, 304 SS Fabrication, 5 MGD max flow each screen, to include:
  - Drum Screen width: 3‘.
  - Drum screen diameter: 6’.
  - 1HP, 1800 RPM, TEFC helical gear motor suitable for 460/3/60 supply, Outdoor (TEFC).
  - Standard nylon rack and pinion gear drive.
  - Spray wash hood and nozzles.
  - 2mm Ovivo ProPaPanel®.
  - Underflow spray wash.
  - Seal and diverter plate in SS with UHMW Seal plates for flow path.
  - 1.0” brass solenoid valve and pressure gauge.
  - Wash water requirement of 25 GPM @ 45 psi minimum.
  - Anchor and Assembly Fasteners.
  - Trough between Ozzy and Compactor, 9” x 9” x 10’ Long.

- Two (2) Shafted Screw Compactor, Ovivo Model 250 in 304 SS, to include:
  - Capacity: 64 cubic feet per hour.
  - Motor size: 3HP,1800 RPM, screw compactor motor suitable for 460/3/60 supply, Outdoor (TEFC).
  - Shafted screw in ASTM A36 carbon steel.
  - Screw brush on periphery of screw flights- Nylon.
  - U-shaped screw housing /drainage trough approximately 1mm smaller diameter than drum screen.
  - Self-aligning thrust and radial load bearing to support the screw at the inlet end.
  - High performance plastic sleeve bearing at the outlet end of the screw.
  - Screw compactor reject drain connection: 4-inch diameter.
  - Wash water requirement for screening rinse: 6-16 GPM @ 16 psig, 1.0-inch NPT with brass solenoid.
  - Tubular 304 stainless steel compactor discharge chute angled at a minimum of 45 degrees.
  - 304 SS stainless steel discharge chute supports.
  - Anchor and Assembly Fasteners

- Two (2) Standard NEMA 4 Control Panel:
  - 460 VAC System.
  - Main Disconnect.
  - H-O-A Switch.
  - Motor Starters with Timers.
  - HI and HI HI Float Switches.
  - Solenoid Valve Control.
  - Emergency Stop Pushbutton.

- Freight, FCA to job site.

ITEMS NOT INCLUDED (But not limited to the following):

- Access ladder, platform, or stairs.
- Concrete, grout, or concrete design.
- Consumables.
- Control panel mounting and field wire terminations.
- Disposal of any kind.
- Dumpster.
- Field wire and field conduit
- Field or shop paint.
- Grating.
- Installation.
- Lubricants.
- Man lifts or cranes.
- Offloading at job site.
- Piping and piping insulation.
- Recordings of training sessions.
- Spares.
- Special tools.
- Special site PPE.
- Storage.
- **Taxes.**

FIELD SERVICE OPTION:

- One (1) Trip / Three (3) Days at the site to assist in adjusting, servicing, and checking out these mechanisms, and in training the operators in maintenance, troubleshooting, and repair of the equipment.
- Additional service days can be purchased at the current rate.

TYPICAL LEAD TIMES:

Submittals: 10 weeks after Purchaser's receipt of Ovivo's written acknowledgement of an approved purchase order.
Shipping: 24 weeks after receipt of approved drawings from Purchaser.

SIZING INFORMATION

Step 1 OZZY Sizing

		DATE:	5/2/2023
REVN. #:	A (INITIAL RELEASE)	SHEET REV:	0
PROJECT NUMBER / ORDER NUMBER:	Centreville WWTP		
CLIENT:	Town of Centreville		
OVIVO ENGINEER:	RQ	SITE:	
OVIVO MANAGER:	JRH	SCREEN LOCATION:	IN DOOR
PRODUCT NAME:	Ozzy Single Entry Drum Screen	LIQUID BEING SCREENED:	SEWAGE WATER
# OF DUTY & STAND-BY SCREENS:	1 Duty + 1 Standby	FLOW CONDITIONS:	PEAK
SCREEN SERVICE LOCATION:	MEMBRANE PROTECTION	WEATHER:	WET

SUMMARY OF GENERAL INFORMATION

VELOCITY CALCULATIONS FOR DRUM SCREEN (WITH 100% CLEAN MESH):					**MESH SIZE**	**2.00**	**mm**
FLOW	7.74	ft^3/s	0.219	m^3/s			
FLOW (MGD)	**5.00**	MGD					
FLOW (GPM-US)	**3,472**	GPM (US)					
INLET WATER DEPTH	2.75	ft	0.838	m			
VELOCITIES THROUGH INLET							
V_{SE} @ SPECIFIED WATER LEVEL	1.90	ft/s	0.580	m/s			
VELOCITIES THRU' MESH @100% CLEAN							
DRUM SCREEN WIDTH:	2.77	ft	0.845	m			
V_{MESH} @ SPECIFIED WATER LEVEL	1.41	ft/s	0.430	m/s			

SUMMARY OF TOTAL HEAD-LOSSES FOR DRUM SCREEN:

HEADLOSS CALCULATIONS ARE DERIVED FROM THE STANDARD FLUID EQUATION $V = C(2gH)^{1/2}$,THIS EQUATION HAS BEEN REDUCED TO THE FOLLOWING STANDARDS BASED ON YEARS OF INVESTIGATION.

ACROSS MESH $\Delta H = 116*V^2$
SEALING WALL $\Delta H = 135*V^2$

BASED ON FOLLOWING UNITS:
ΔH = HEADLOSS (mm)
V = VELOCITY (m/s)

THE BELOW IS A SUMMATION OF THE TOTAL HEADLOSS ACROSS THE SCREEN @ THE WATER LEVEL & % CLEAN

WATER LEVEL CONDITION: PEAK	**%CLEAN**	**INCH**		**mm**
HEADLOSS ACROSS MESH	100%	0.8	ΔH	21
HEADLOSS ACROSS SEALING WALL	100%	1.8	ΔH	45
TOTAL HEADLOSS @LEVEL & % CLEAN	100%	2.6	ΔH	67
TOTAL HEADLOSS @LEVEL & % CLEAN	75%	3.3	ΔH	84
TOTAL HEADLOSS @LEVEL & % CLEAN	50%	5.2	ΔH	131
TOTAL HEADLOSS @LEVEL & % CLEAN	25%	15.3	ΔH	389

IMPORTANT: THE RESULTANT HEADLOSSES ARE BASED ON THE FOLLOWING INPUTS:

SCREEN SERVICE	**MEMBRANE PROTECTION**			
FLOW	7.74	ft3/s	0.219	m3/s
FLOW	5.00	MGD	3472	GPM(US)
DECK ELEVATION	3.50	ft	1.07	m
CHANNEL DEPTH (w/o drum invert)	3.50	ft	1.07	m
CHANNEL WIDTH (minimum)	4.50	ft	1.37	m
VELOCITY THRU' INLET @ SPECIFIED FLOW	1.90	ft/s	0.58	m/s
VELOCITY THRU' INLET CILLS	1.86	ft/s	0.57	m/s
VELOCITY THRU' MESH	1.41	ft/s	0.43	m/s
VELOCITY THRU' EXIT	1.11	ft/s	0.34	m/s
PROPAPANEL HOLE DIAMETER	0.08	in	2.00	mm
Total Mesh % opening	0.35	%	0.35	%

CORRESPONDING DRAWING DIMENSIONS:

DRUM SCREEN LEVELS (ELEVATIONS):

WATER ELEVATION (FROM UNDER DRUM INVERT)	2.75	ft	0.84	m
SCREEN CENTRELINE LEVEL	3.78	ft	1.15	m
UNDER DRUM INVERT	0.00	ft	0.00	m
	WATER LEVEL CONDITION: PEAK			
INLET WATER DEPTH	2.75	ft	0.838	m
INLET ELEVATION	0.00	ft	0.000	m

DRUM SCREEN DETAILS:

DIAMETER OF SCREEN	6.00	ft	1.829	m
DRUM SCREEN OUTLET CHAMBER WIDTH	3.00	ft	0.914	m
DRUM SCREEN WIDTH	2.77	ft	0.845	m

DRUM SCREEN DIMENSIONS (A Frame):				
Min. Free Board "A"	**0.75**	ft	**0.229**	m
PEAK Trial Immersion Level "B"	**1.97**	ft	**0.600**	m
Drum Center to Deck Level "C"	**0.28**	ft	**0.451**	m
Nominal Drum Diameter "D"	**6.00**	ft	**1.829**	m
Height Under Drum "E"	**0.78**	ft	**0.238**	m
Screen Width Over all "F"	**3.00**	ft	**0.914**	m
Deck Level to Top of Drum "G"	**3.70**	ft	**1.128**	m
Diverter Plate Inlet Width "H"	**1.50**	ft	**0.457**	m
Channel Width (minimum) "J"	**4.50**	ft	**1.372**	m
Length of Drum Chamber (minimum) "K"	**10.58**	ft	**3.225**	m

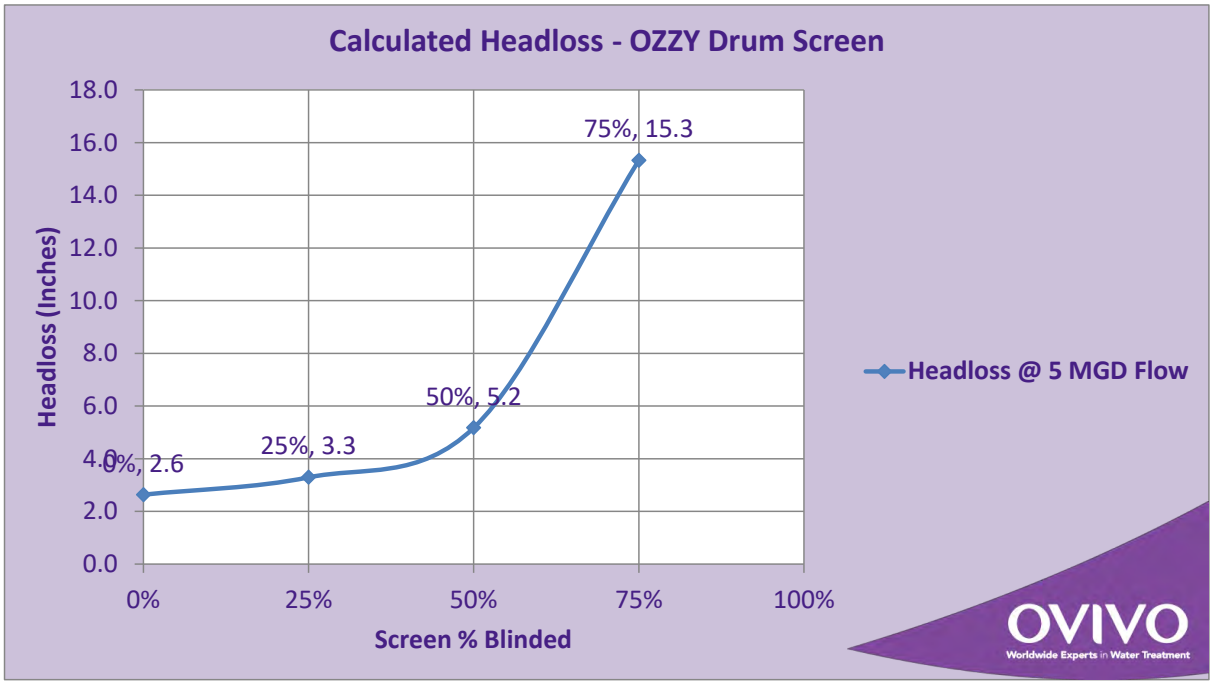
OZZY Sizing

Sheet Rev: 0

GRAPHICAL REPRESENTATION OF % BLOCKED MESH & HEADLOSS IN INCH

PERCENTAGE CLEAN MESH (%)	PERCENTAGE BLOCKED MESH (%)	HEADLOSS (INCH)
25%	75%	15.3
50%	50%	5.2
75%	25%	3.3
100%	0%	2.6

FLOW DESCRIPTION	**5 MGD Flow And 2.8 feet Inlet Water Depth.**	
GRAPH LINE LABEL	**Headloss @ 5 MGD Flow**	
FLOW IN MGD	5.0	MGD
UPSTREAM FLUID DEPTH	2.8	ft

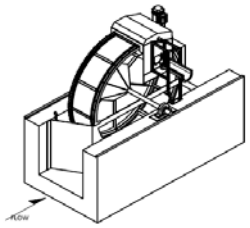


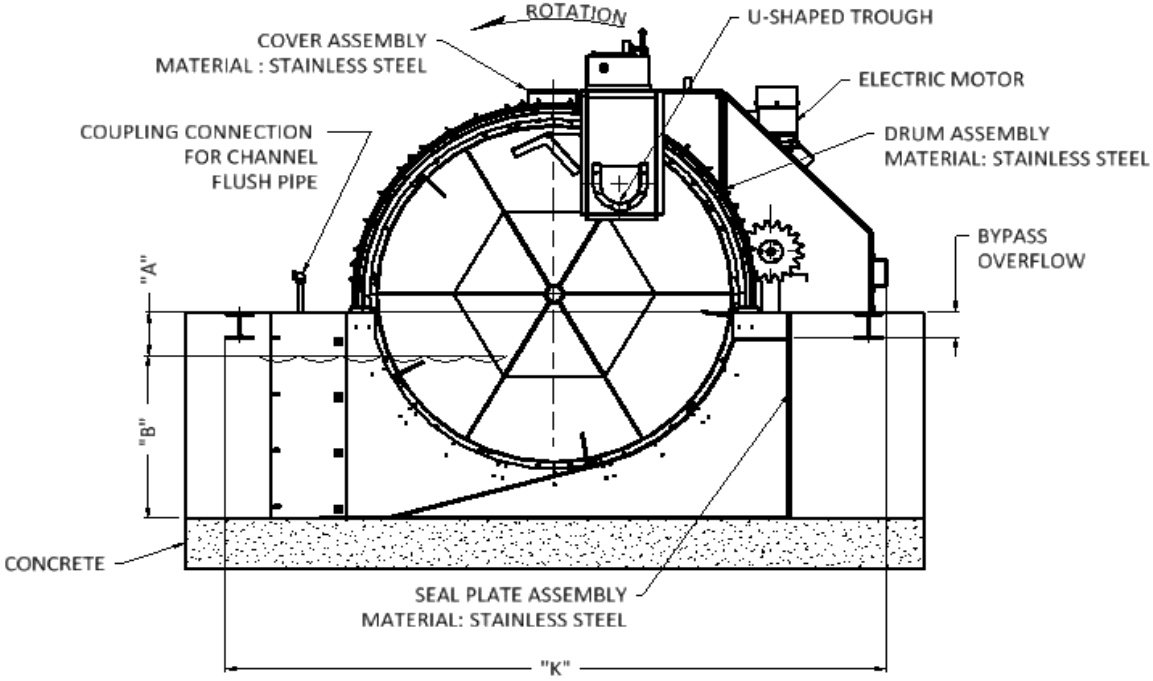
DRAWINGS

OZZY Sizing

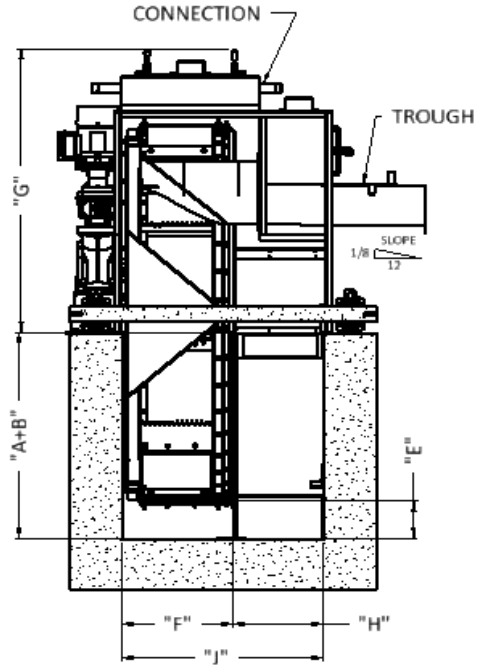
Sheet Rev: 4

(This dwg is for illustrative purposes only)





SIDE ELEVATION



FRONT ELEVATION VIEW

TOP OF TANK (**A+B**):	3.5 ft	COVER ABOVE TANK (**G**):	3.7 ft	DIVERTER INLET WIDTH (**H**):	1.5 ft
MIN. FREEBOARD (**A**):	0.75 ft	DRUM DIAMETER (**D**):	6.0 ft	TOTAL CHANNEL WIDTH (**J**)	4.5 ft
INLET WATER DEPTH (**B**):	2.75 ft	HEIGHT UNDER DRUM (**E**):	0.8 ft	MIN. CHAMBER LENGTH (**K**):	10.6 ft
		DRUM CHAMBER WIDTH (**F**):	3.0 ft		

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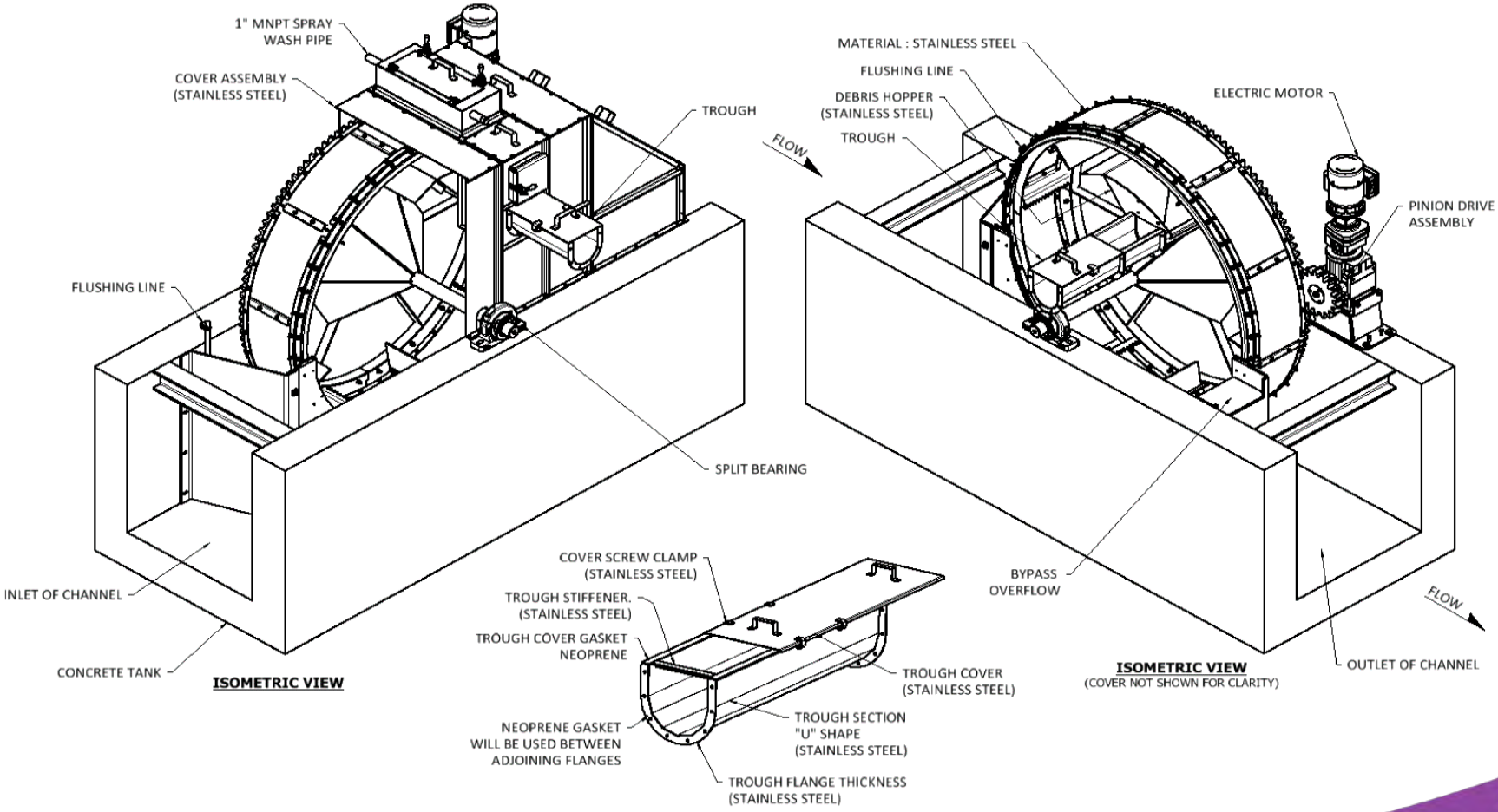


BROCHURES

OVIVO Worldwide Experts in Water Treatment

MUNICIPAL WASTEWATER
DRUM SCREENS

PROVEN OVIVO DRUM SCREEN TECHNOLOGY NOW SMALL, AND IN CHANNEL

- High performance capture ratios
- Straight channel design
- Exceptional solids handling capabilities
- Retrofitable to existing channels
- No maintenance below grade
- 6mm to 0.5mm apertures available
- Up to 5′ deep channels
- High reliability for constant flows

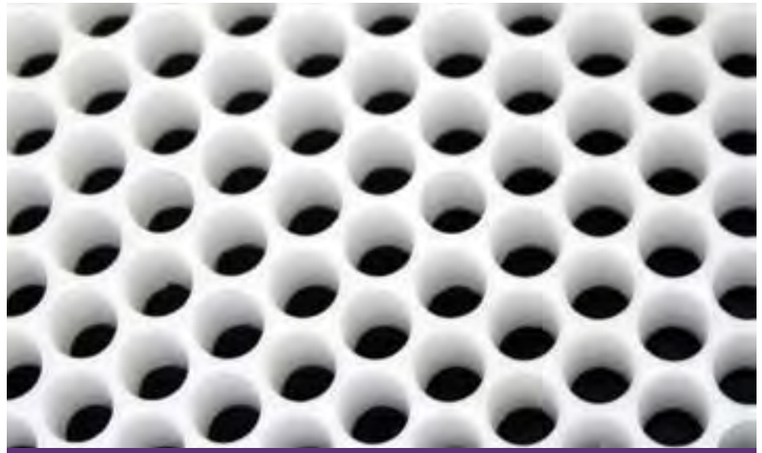
Interested in maximizing the life of your downstream equipment?

Call 1-855-GO-OVIVO to speak with an Ovivo Expert.

OVIVO® OZZY CUP SCREEN

OVIVO'S HIGH PERFORMANCE, LOW MAINTENANCE, ELITE SCREENING TECHNOLOGY

Ovivo's Ozzy drum screens are designed to meet the increasing demand for high capacity coarse and fine screening of raw or wastewater coupled with a robust low maintenance operation.



Close up of Ovivo's ProPaPanel® technology

THE OZZY CUP SCREEN IS THE RESULT OF DECADES OF EXPERIENCE DEVELOPING SOME OF THE LARGEST DRUM SCREENS IN THE WORLD

- Low capital and maintenance cost
- Low energy usage
- Simple, slow rotating mechanism
- Simple to maintain
- Paired with the Ovivo's ProPaPanel to reduced hair-pinning, and maximize corrosion resistance and durability.

THE OZZY CUP IS PAIRED WITH OVIVO'S J&A SCREW COMPACTORS OR SCREW PRESS FOR SCREENINGS HANDLING.

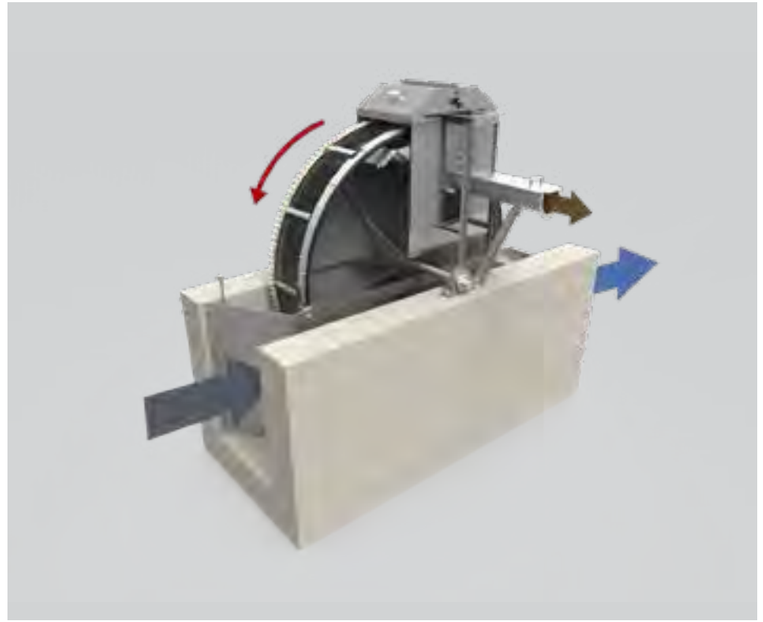
HOW IT WORKS

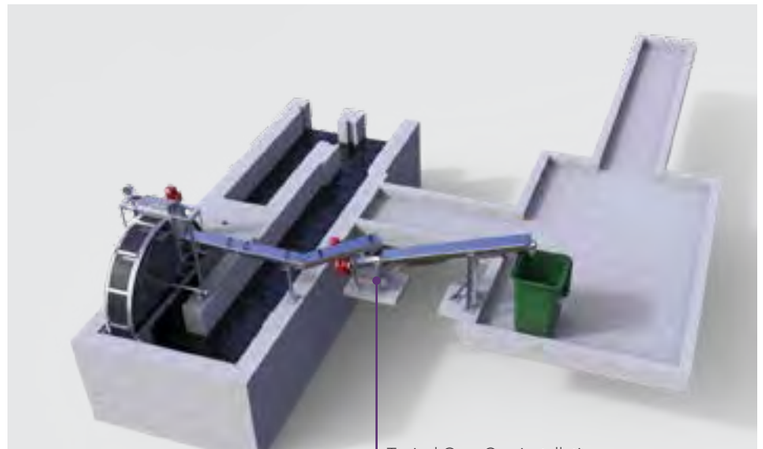
The Ovivo Ozzy Cup screen consists of a robustly constructed drum structure with a solid horizontal main shaft, which revolves slowly in heavy duty, self-aligning roller bearings.

Water flows from the inside to the outside of the drum through mesh panels arranged around its periphery. Mesh panels are cleaned by spray wash nozzles mounted on the outer side of the drum screen. The screenings are then caught by a screening hopper and conveyed to the screw compactor through a sluice trough.

The screen is driven by a simple drive unit positioned at deck level. The final drive is a nylon pinion, which engages with a gear ring on the outside of the drum.

The drum screen structure can be designed to support high differential loading without failure of the mesh panels, thereby ensuring that the downstream plant does not become contaminated by unscreened water and debris.





Typical Ozzy Cup installation with use of an incline screw press

Design allows for the Ozzy Cup to be installed in new or existing straight channels

OVIVO® Ozzy Cup Drum Screen

AVAILABLE SIZES

Diameter*: 4′-8′ (2′-4′ channels depths)

Width*: 0.5′-3′+

Aperture diameter: 0.5, 1, 2, 3, 5, 6mm

Flow range up to 10 MGD at 150mg/L TSS*

**For specific flow capacity and sizing, please contact your local Ovivo Representative.*

ENGINEERING SERVICES

DESIGN AND ANALYSIS

Ovivo advanced 3D graphics and modeling, products are designed for different operating conditions and requirements for its customers.

SPARE PARTS

All spares supplied are genuine, guaranteed and supported by our detailed knowledge of all historical modifications or upgrades.

INSTALL, COMMISSION, MAINTAIN

Ovivo's service engineers can install, commission, maintain all machines and will visit sites around the world to advise on all aspects of our products.

TRAINING

As a supplier of engineered capital equipment, we offer our end users on-site or in-house training courses. Contact our spares and service managers for details of the courses available.

WaterExpert™
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ALL OF YOUR KNOWLEDGE,
ALL IN ONE PLACE.**

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1-855-GO-OVIVO

info@ovivowater.com
ovivowater.com

BUDGET PROPOSAL

Centreville, MD

Equipment:
HUBER Perforated Plate Screen ROTAMAT® RPPS 1200/2

Represented by:
Sherwood Logan Associates
Andrew Kreider
(410) 274-3716
akreider@sherwoodlogan.com

Regional Sales Director:
Brian Baker
704-840-3085
Brian.Baker@hhusa.net

Project Number: 497687
Revision: 0
Date: 5/9/2023

HUBER Technology, Inc.
1009 Airlie Pkwy, Denver, NC 28037
704-949-1010 | www.huber-technology.com

Design Information

Technical Data		
Peak Waste Water Design Flow Per Screen	**2.5**	**MGD**
TSS Concentration	**250**	**mg/L**
Screen Basket Spacing	**2**	**mm**
Maximum Upstream WaterLevel	**31.61**	**inch**
Screen Type	**Perforated Plate**	**-**
Screen Basket Diameter	**1200**	**mm**
Sealing between Stationary Baffle Plate and Rotating Drum	**Polyurethane Seal**	**-**
Installation type	**Channel**	**-**
Screen Angle	**35**	**°**
Wash Water Pressure	**75**	**psi**
Wash Water Consumption	**39**	**gpm**

Equipment Details

Model	HUBER Perforated Plate Screen ROTAMAT® RPPS 1200/2
Quantity	1 (including 1 standby unit)
Material	304L stainless steel construction; pickled and passivated in acid bath
Screen Design	Shafted screw with integrated maintenance free bearing and inclined auger tube
Screenings Wash	One (1) solenoid valve (s) for screenings wash, 1-inch, 120 VAC, 2-way, Class 1 Division 1, Brass body
Spray Bar	One (1) solenoid valve (s) for spraybar wash, 1-inch, 120 VAC, 2-way, Class 1 Division 1, Brass body
Press Zone	One (1) solenoid valve (s) for compaction wash, 1-inch, 120 VAC, 2-way, Class 1 Division 1, Brass body
Cleaning Brush	Stainless steel backed nylon brush with bristles for perforated plate basket cleaning
Motor Data	2 HP, 480 VAC, 3ph, 60 Hz, S.F. 1.15, Class 1 Division 1
Sensor	Level sensor for waterlevel measurement
Supports	304L Stainless Steel Construction
Anchor Bolts	M12, 316L, Included
Screen Basket Cover	Screen basket with hinged lid, 304L stainless steel

Control Details

Two (2) Main Control Panels	
Enclosure	NEMA 4X, Stainless Steel
PLC	Allen Bradley MicroLogix
HMI	Allen Bradley PanelView Plus 800
Pre-programmed and Factory Tested	

Pricing

Equipment	Model	Quantity	Pricing
HUBER Perforated Plate Screen	ROTAMAT® RPPS 1200/2	2	Included
HUBER Control Panel	HUBER Standard	2	Included
Freight and Startup Services	Standard HUBER Start-up Services	3 day(s), 1 trip(s)	Included
TOTAL:			**$320,000.00**

Standard delivery is 22-30 weeks from approval of submittals.

Thank you for your interest in HUBER Technology, Inc. If you have any questions, please do not hesitate to contact our Regional Sales Director or our local sales representative.

This proposal has been reviewed for accuracy and approved for issue by: JW

Notes and Technical Clarifications

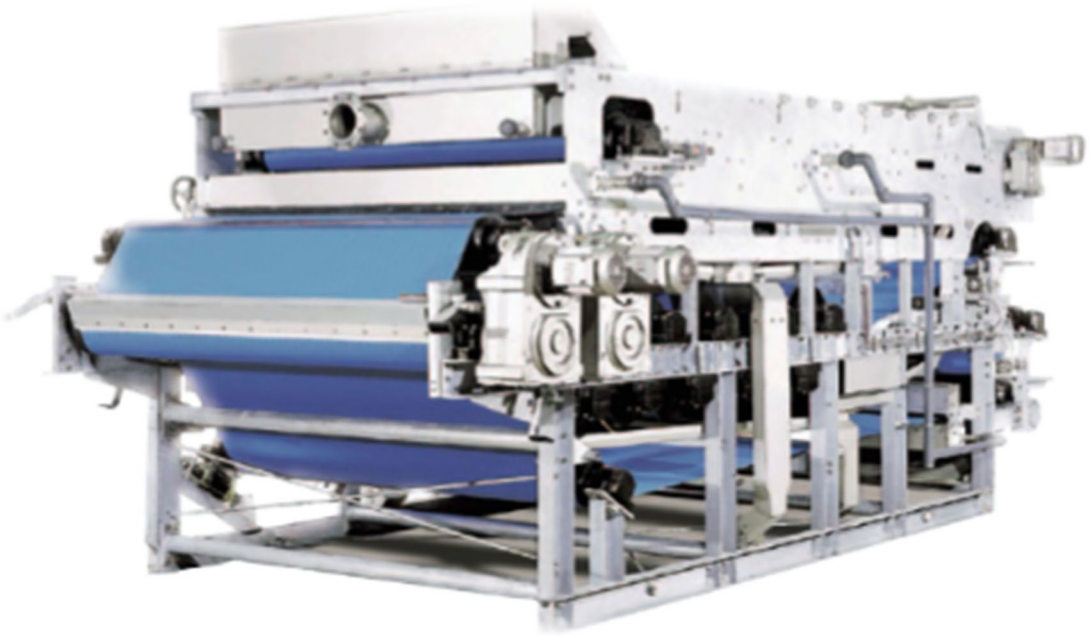
1. Equipment specification and drawings are available upon request.
2. If there are site-specific hydraulic constraints that must be applied, please consult the manufacturer's representative to ensure compatibility with the proposed system.
3. Electrical motor disconnects required per local NEC code are not included in this proposal.
4. All electrical interconnections, wirings, junction boxes, and terminations between the equipment and electrical components are to be provided by installing contractor.
5. HUBER Technology warrants all components of the system against faulty workmanship and materials for a period of 12 months from date of start-up or 18 months after shipment, whichever occurs first.
6. Budget estimate is based on HUBER Technology's standard Terms & Conditions and is quoted in US dollars unless otherwise stated.
7. Equipment recommendations are based on information provided to Huber Technology. Subsequent information which differs from what has been provided may alter the equipment recommendation.
8. Any item not specifically listed is not considered part of this scope of supply. Please contact the HUBER Technology representative listed for further clarification.
9. HUBER will ship all equipment to site inside of 20', 40' or 40'OT ocean containers as deemed appropriate by our factory. HUBER will not ship any equipment on flatbed truck. Flatbed truck shipping means that the equipment would need to be transferred at port from factory packaged containers to the flatbed. This process it out of HUBER's control and it is our experience that equipment always gets damaged during this process.
10. Equipment that is broken out in "Pricing" tab are only valid when packaged together.
11. All piping to and from the equipment is to be supplied by the installing contractor.

Item 2: Dewatering Solids

Alfa Laval Water & Wastewater Division

Project Name: Town of Centreville, MD WWTP

Alfa Laval AS-H Extended Belt Press G3 200 – 3 Belt (Klampress®) for Sludge Dewatering



Alfa Laval Reference No. 0496181 Rev 0
May 12, 2023
Quote Validity: 30 days

Prepared by:

Brian Ayres
Applications Engineer
Brian.Ayres@alfalaval.com

Alfa Laval, Inc.
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801 South Caroline Street
Baltimore, MD 21231

Prepared for:

Alfa Laval USA Inc.
Ref.: 0496181

May 12, 2023

PROJECT NAME **Town of Centreville, MD WWTP**
ALFA LAVAL REFERENCE **0496181**

Dear Mr. Nixson

Thank you for your enquiry. On behalf of Alfa Laval and our local representative Sherwood Logan & Associates, Inc., we are pleased to enclose our non-binding Budget Quotation for **One (1) Alfa Laval AS-H Extended Belt Press G3 200 – 3 Belt (Klampress®)**, 2Meter Belt Filter Press (BFP) (3 Belt) for the Town of Centreville, MD WWTP project.

The Alfa Laval AS-H Belt Press G3 is the next generation dewatering belt filter press that was developed from tried-and-true Klampress design. It is suitable for all municipal biosolids and residual sludge types and a wide variety of industrial solid / liquid separation applications. It incorporates variable energy mixing, flocculation, gravity drainage and pressure filtration within a single mechanical framework. The G3 belt press offers the versatility of a wide size range (up to 3 meters) and extensive modular options to meet individual process requirements. In summary…

- Flexible design – easily upgraded and reconfigured as your needs change
- High precision variable-orifice polymer mixer
- High volume, high cake solids performance
- Low maintenance, operator friendly design features
- Alfa Laval offers unrivalled 24-hour service agreements.

As requested, we have included the scope of supply and applicable process guarantees based on the defined influent sludge parameters. Technical details along with dimensional drawing for the proposed belt press including weights, are enclosed in the proposal.

Alfa Laval recommends the described equipment per the outlined technical specifications, and additional clarifications for greater understanding of the offer. We trust that we have interpreted your requirements correctly and shall be pleased to provide any additional information which may be required in support of our proposal.

Note: Kindly indicate our Quotation Reference in your Purchase Order/ Letter of Acceptance/ Sales Contract and all our correspondences if the order is confirmed to us.

Regards,
Mark Schlitzkus

Mark Schlitzkus
Regional Sales Manager
Alfa Laval Inc.

CC: Andrew Kreider, P.E. | Sherwood Logan & Associates, Inc.

CONTENTS

1. BASIS OF DESIGN.

General Data

Sludge Origin:	Municipal Wastewater Treatment Plant
Duty:	Dewatering

Sizing Data

Number of units

Operating:	1
Standby:	0

Customer requirements:
2 m press with gravity deck.

2. PROPOSAL

2.1. One (1) Alfa Laval AS-H Extended Belt Press G3 200 – 3 Belt (Klampress®), will come complete and include the following scope of supply:

- Components fabricated of the finest corrosion-resistant material
  - the frame will be carbon steel, hot dipped galvanized
  - chicane rods and holders shall be carbon steel galvanized
  - all sheet metal components will be Type 316L stainless steel
- Extended gravity section
- Rollers. See description under 5.4.4 below
  - Eight (8) solid rollers
  - Perforated roller
- Bearings greased lubricated
- Three (3) belts
- Hydraulic actuated belt alignment and positioning system
- Hydraulic power unit
  - One-gallon reservoir
  - Hydraulic oil pump and drive motor
  - Other parts to make a complete operational system
- Belt wash system
  - Washwater requirements
  - 120 GPM at minimum of 85 PSI at the BFP
- Power requirements
  - One (1) 2 HP GRAVITY ZONE DRIVE UNIT
  - One (1) 3 HP BELT DRIVE UNIT
  - One (1) 1 HP HYDRAULIC UNIT

2.2. One (1) Main Control Panel

- One (1) Enclosure, NEMA 4X, 304SS, wall mount enclosure
- One (1) Main disconnect breaker with operating handle
- One (1) Control power transformer
- One (1) 480V surge suppressor
- One (1) 120V surge suppressor
- One (1) AB Power flex 525, 3HP VFD, 480VAC with fuse protection (PRESSURE SECTION DRIVE)
- One (1) AB Power flex 525, 2HP VFD, 480VAC with fuse protection (GRAVITY SECTION DRIVE)
- One (1) Motor starters Non-reversing, IEC, 1HP rated with circuit protection (HPU)
- One (1) Motor starters Non-reversing, IEC, 10HP rated with circuit protection (WWBP)
- One (1) 24VDC power supply
- One (1) Allen Bradley, CompactLogix L30ER controller with I/O as required.
- One (1) Unmanaged ethernet switch
- Five (5) Red Line PID controller with window kit
- One (1) Alarm horn
- One (1) Elapsed time meter
- One (1) Ground bar
- One (1) Internal cooling fan

- One (1) Panel heater with thermostat
- One (1) Alarm horn
- LOT of Pilot Operators
- LOT of Terminal blocks, relays, dry contacts, and supplementary circuit protection as required

2.3. One (1) Inline, Non-clog, Variable Orifice Mixer

- Complete with an injection manifold system and a four-port vortex polymer injection ring.

2.4. One (1) Washwater Booster Pump, which shall have the following specs:

- Goulds Centrifugal Pump
- Flow rate – 120 GPM
- Max Pressure – 120 psi

2.5. One (1) Lot Spare Parts, which shall be provided as follows:

- One (1) set of filter belts
- Two (2) sets of doctor blades
- Two (2) sets of rubber seals for the gravity zone & wash box
- One (1) set of bearings of each size used

2.6. Service time as follows:

- One (1) Field Service Engineer,
- up to eight (8) days, @ 10 hr./day, with up to three (3) round trips, per unit for start-up, commissioning, and training.
- Any additional service time resulting from non-Alfa Laval-warranty delays, will be charged at the rate in effect at the time of service.

2.7. Also included with pricing:

- Warranty**:** Per the enclosed Alfa Laval's Standard Terms & Condition of Sale. Alfa Laval reserves the right to review operating and maintenance records to ensure compliance.

Each unit is warranted to be free from defects in materials and workmanship for a period of twelve months after successful completion of Acceptance Testing, beneficial use, or for a period not to exceed eighteen months from shipment, whichever occurs first. Alfa Laval reserves the right to review operating and maintenance records to ensure compliance.

- We are offering this FCA Incoterms 2020

- Electronic Submittal and O&M Manual

2.8. Dimensioned drawing (See Appendix A)

2.9. Notes of Clarification

- Scope of supply is per Alfa Laval standard BFP configuration, and in accordance with typical specifications and drawings. Any additional items not explicitly stated in this proposal or standard to Alfa Laval's typical specifications are not included in this quotation. The specified equipment is intended for installation within a non-hazardous safe area.
- Equipment to be supplied by Alfa Laval (and /or sub-supplier), as specified in this quotation, are standard machines. Any modifications / additions other than those expressly specified in the quotation shall incur extra engineering cost, material cost and delivery time.

- Technical submittal documentation shall be per Alfa Laval's (and /or sub-supplier) standards, delivered electronically, in English language. Additional documentation requirements shall incur extra engineering cost, material cost and delivery time.

- The enclosed quotation is a non-binding budgetary quotation. Therefore, price, scope and other terms contained within this budgetary quotation are subject to considerable variations when preparing our binding quotation. All scope of supply modifications / additions requires prior agreement by both parties and written acknowledgement by Alfa Laval.

2.10. Escalation Charges:

- In the event that delivery of equipment cannot be made on the scheduled delivery date agreed upon between Alfa Laval and Purchaser and as evidenced by the terms of the contract, due to Purchaser delay, Alfa Laval reserves the right to assess reasonable escalation charges to the project at the rate of 1% per month of the contract value for material price escalation for each month that the project is delayed.

- Given the current volatility in steel prices over the past twelve months, Alfa Laval has made this offer based upon shipment of the offered products contained herein within the schedule dictated above. Should the projected shipment schedule fall outside this period for any reason, pricing shall be subject to review and revision.

2.11. Exclusions from this quotation:

- All mechanical & electrical Installation
- Equipment offloading and placement
- Field wiring, conduit, and electrical flexible connections...etc.; contractor shall remain responsible for meeting all relevant electrical codes
- Pipes, valves, and fittings...etc.
- Sludge Hopper with Level Probes/Sensors
- Feed Pump, Booster pump, strainers, etc.
- Associated equipment, i.e., sludge macerators, feed pumps, polymer preparation & dosing unit, cake conveyors, centrate tanks and pumps…etc.
- Measuring instruments between equipment and associated equipment
- Noise abatement enclosures
- Odor control equipment

- Inspection and access platforms or ladders
- Utilities and consumables (polymer, power, water, and other consumables required during testing, start-up and commissioning)
- Lab services fees for the performance test and startup
- Storage and handling fees
- Detailed or project specific related engineering
- Duties, taxes, bonds…etc.
- Freight to jobsite

2.12. Process performance is per specified basis of design.

- The belt filter press performance (cake solids, loading, hydraulic throughput, etc.) is verified through onsite analysis of representative sampling during equipment commissioning. Variation of sludge feed may impact performance.

3. COMMERCIAL TERMS

3.1. Pricing

Item	Description	Qty.	Unit Price	Extended Price
1	Belt Filter Press G3 200 – 3 belt Extended	1	Included	Included
2	Set of Controls	1	Included	Included
3	Set of Ancillaries	1	Included	Included
4	Commissioning	1	Included	Included
5	Booster Pump	1	Included	Included
Total Budget Price				**$385,500.00**

3.2. Payment Terms.

- 10% with PO, N10 days
- 10% upon Alfa Laval Submittal Delivery, N30 days
- 75% upon delivery or availability to deliver should owner encounter delays, N30 days
- 5% upon acceptance or beneficial use, whichever comes first, N30 days, but not later than 120 days from shipment.

3.3. Estimated Delivery Time

- Submittals: 8 -12 weeks from fully executed PO
- Belt Filter Press: 20 - 24 weeks from receipt of approved submittals and/or release to manufacture

3.4. Quotation validity

- 30 days

4. ALFA LAVAL

4.1. About us

Alfa Laval is a leading global provider of separation, heat transfer, and fluid handling technology. Founded in 1883 and for more than 130 years, we have built a global presence with service centers and partners in nearly 100 countries. This offers local expertise, supported by the global breadth and depth of Alfa Laval. With these as its base, Alfa Laval aims to help enhance the productivity and competitiveness of its customers in various industries all over the world. Alfa Laval – Our Company.

4.2. Wastewater Separation Technologies

We remain committed to being the technology leader in design innovations, delivering reduced power & polymer consumption, increased cake dryness, and increased capacity within the same footprint. Alfa Laval - Municipal wastewater treatment

- Decanter Centrifuge
- Belt Filter Press
- Gravity Belt Thickener
- Rotary Drum Thickener
- SBR / MBR / Pkg. Plants

4.3. Lab & Pilot Testing

Alfa Laval's DNA is to continuously bring value to our customers. Our state-of-the-art wastewater laboratory, located in the Houston, TX service center; allows Alfa Laval to analyze the optimal technology for your specific separation requirements. Additionally, Alfa Laval provides separation equipment available for on-site field testing and demonstration. These include decanter centrifuge, rotary drum filter, and belt press.

4.4. Always at Your Service:

- 24/7 Support
- 75+ Authorized Service Providers
- 4 - USA Service Centers -
- Indianapolis US Parts Distribution Center
- OEM Parts – 450,000+ Spare Parts in Stock
- 50+ Field Technicians

Alfa Laval - Service and support in the USA

4.5. Spare Parts

- **A smart choice**
  Boost productivity and maximize uptime with quality genuine parts from Alfa Laval. With easy access to a broad range of long-lasting high-quality parts, you can lower your total cost of ownership and preserves the value of your equipment throughout its entire life cycle.

- **Available everywhere**
  Through our global service network, you have easy access to our extensive genuine spare parts inventory through 11 major Alfa Laval distribution centers.

  Alfa Laval maintains an extensive inventory of spare parts that supports our current product range as well as some legacy parts, which are up to 100 years old. Our parts inventory system contains specific information, such as technical details and availability, for more than 450,000 parts, and we have more than 50,000 unique items in stock.

  The Americas are conveniently served through the American Distribution Center (AMDC), which is centrally located in Greenwood, IN, USA.
  Alfa Laval AMDC
  200 South Park Blvd
  Greenwood, IN 46143

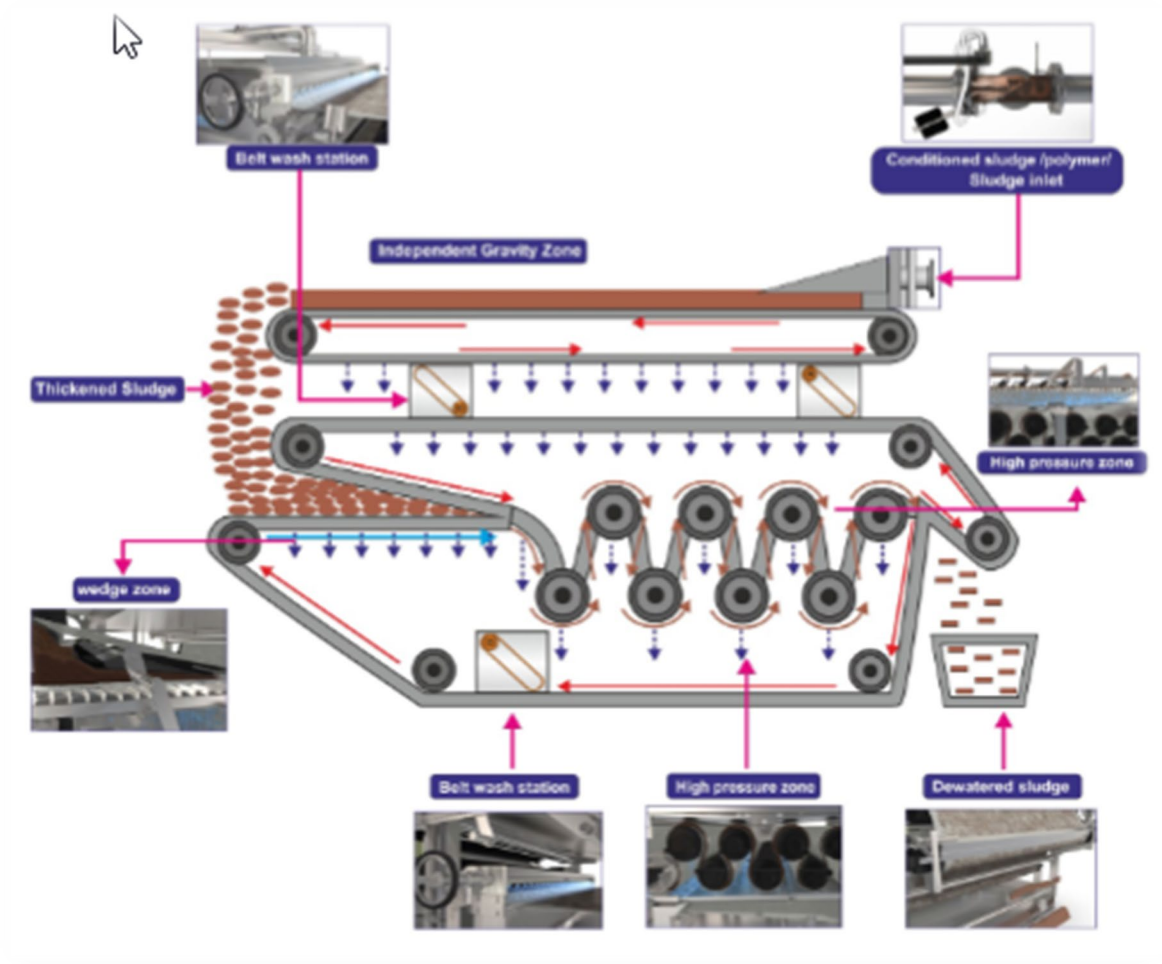
- **Unmatched quality**
  Designed for durability, reliability and productivity, our parts deliver outstanding performance time and time again. Manufactured to precise specifications, Alfa Laval parts have proven performance in our material and test laboratories as well as in process lines around the world.

- **Traceability and certification**
  Parts are continuously improved to meet the highest standards and comply with various certification requirements and regulations, such as REACH. Alfa Laval - Spare parts

5. ALFA LAVAL AS-H BELT PRESS G3 – GENERAL DESCRIPTION

See how it works in less than 3 min. Alfa Laval AS-H Belt Press G3
The Alfa Laval AS-H Belt Press G3 is considered the industry standard for superior value, performance and durability for sludge dewatering. The G3 belt press is designed for low polymer consumption, high throughput rates, and high solids content and is available in a wide size range and extensive modular options to meet individual process requirements.

5.1. Working Principle



The Belt Filter Press is furnished with an independent gravity drainage section with manual tensioning, and it can be operated on demand, as either as thickening device only or as a pre-thickening device prior to dewatering. This unit has separate speed control on the gravity section.
The thickened sludge is then sandwiched by a second filter belt before further dewatering by a series of decreasing diameter rollers. Final moisture removal is achieved by shear rollers arranged to give minimum 180-degree belt wrap in order to optimize dewatering.

5.2. Benefits

- Thorough uniform mixing of polymer into sludge
- Higher volumetric throughput and solids loading
- Higher cake dry solids
- Low power consumption
- Low polymer usage
- Better filtrate quality
- Low maintenance requirements
- Long life design
- Modular design allows upgrades to add more rollers in the pressure zone or an extended gravity zone

5.3. Features

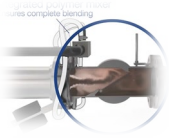
- Available in 8 roller and 12 roller designs in the pressure section
- Extended gravity deck model for thinner sludges Sludge
- Open frame design allows for maximum access for normal maintenance
- Adjustable wedge dewatering zone for process optimization
- Pre-installed hydraulic system for automatic belt tensioning and steering
- Radial grid and perforated roller to accelerate dewatering

5.4. Mechanical Requirements

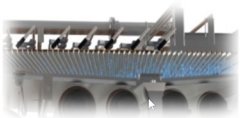
5.4.1. Sludge Conditioning System

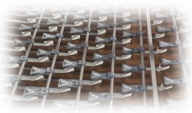
Sludge/polymer mixer valve

- Variable orifice, in-line polymer mixer that combines polymer and sludge instantly.
- Optimizes polymer effectiveness and minimized polymer consumption.



5.4.2. Gravity Drainage Section

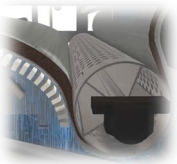




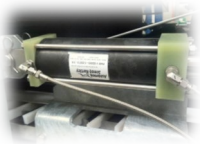
Even sludge distribution prior to a two-stage high efficiency gravity drainage areas fitted with easy to operate and maintain sludge ploughs and precisely arranged support grid to optimize filtrate removal.

5.4.3. Pressure Section

- Adjustable wedge dewatering zone
  - Initiates application of pressure to the dewatering process.
  - Adjustable during operation.



- Radial pressure dewatering zone
  - Radial grid and perforated roller to prevent pressure-shock of sludge in the pressure zone.
- Full pressure dewatering zone
  - Optional number of pressure rollers depending on dewatering requirements.
  - Belt wrap of 180 degrees or greater maximizing cake dry solids



5.4.4. Roller design

- Specialized forged end construction.
- Rubber coated drive roller and thermoplastic nylon coated pressure rollers for corrosion resistance.

5.4.5. Bearings

- Bearings with triple labyrinth seal and specially designed shaft mounted splash guards.
- Extended lubrication cycle (every 6 months).

5.4.6. Belt Drive

- Input power to the drive roller shaft shall be supplied through an A.C., variable frequency drive unit. Speed shall be controlled through cyclical variation in motor current, which is operator set at the control panel. The drive roller speed reduction is obtained through a helical gear reducer.

5.4.7. Belt Alignment System

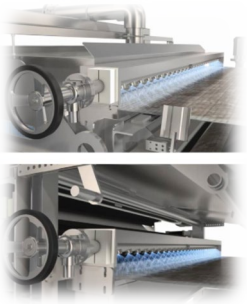
- Autosensing, hydraulic steering system.
- Continuous, smooth guidance control without the need for operator intervention.

5.4.8. Belt Tensioning System

- Pre-installed and press-mounted to minimize on site installation requirements.
- Hydraulically controlled and adjustable for continuous operation, reduced belt wear and optimum performance for a prolonged belt life.

5.4.9. Belt Wash System

- Efficient and continuous washing of top and bottom belts.
- Split spray bar option for easy removal and maintenance in rooms with limited space



5.4.10. Safety Features

- E-Stop: Trip Cord

6. ELECTRICAL ASSEMBLY AND CONTROLS

6.1. General Considerations

- The control panel shall accept a 460 VAC, 60 hertz, 3-phase power input. A main disconnect circuit breaker and operator mechanism shall be included. When the disconnect is in the open position, all power shall be removed from the control system. IEC rated motor starters shall be provided for the hydraulic unit and washwater pump. A VFD will be supplied for the belt drive. A control power transformer shall be included that will provide 120 VAC control power to the system. All logic functions for the system shall be performed by an industrial programmable logic controller (PLC) located in the control panel.

- Located on the front of the control panel shall be a CONTROL POWER OFF/ON switch. When in the ON position, the CONTROL POWER ON pilot light will be illuminated and control power shall be distributed to the control system. When in the OFF position, the control system shall be held de energized. Also located on the control panel shall be an EMERGENCY STOP pushbutton. It shall be an illuminated mushroom head style pushbutton that when depressed shall immediately de energize all moving equipment in the system. An alarm horn shall be included for audible alarm annunciation.

6.2. Programmable Logic Controller (PLC)

- The PLC shall be a modular type with discrete and analog capabilities. The CPU shall have 4K minimum RAM for user instructions. The unit shall have battery backed RAM and EEPROM backup. The PLC shall be an Allen Bradley CompactLogix or equal.

6.3. Variable Frequency Drive (VFD)

- The VFD shall be UL listed and shall be Allen Bradley Powerflex type or approved equal.

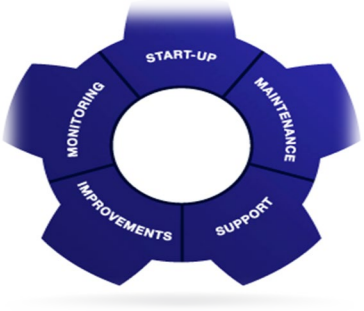
6.4. System Operation

- As a minimum, the following control pilot devices or functionality shall be located on the front of the control panel or available via an HMI screen:
  - HAND/OFF/AUTO MODE selector switch
  - HAND MODE indicator
  - AUTO MODE indicator
  - AUTO START pushbutton
  - AUTO STOP pushbutton
  - SYSTEM RESET pushbutton
  - ALARM SILENCE pushbutton
  - LAMP TEST pushbutton
  - PRESS READY indicator
  - DEWATERING OFF/ON selector switch
  - WASHDOWN CYCLE ON indicator
  - BELT INSTALLATION OFF/ON selector switch

- WASHWATER PUMP START pushbutton
- WASHWATER PUMP STOP pushbutton
- WASHWATER PUMP RUNNING indicator
- HYDRAULIC PUMP START pushbutton
- HYDRAULIC PUMP STOP pushbutton
- HYDRAULIC PUMP RUNNING indicator
- BELT DRIVE START pushbutton
- BELT DRIVE STOP pushbutton
- BELT DRIVE RUNNING indicator
- BELT DRIVE SPEED controller (0-100%)
- CONVEYOR START pushbutton
- CONVEYOR STOP pushbutton
- CONVEYOR RUNNING indicator
- SLUDGE PUMP START pushbutton
- SLUDGE PUMP STOP pushbutton
- SLUDGE PUMP RUNNING indicator
- SLUDGE PUMP SPEED controller (0-100%)
- POLYMER PUMP START pushbutton
- POLYMER PUMP STOP pushbutton
- POLYMER PUMP RUNNING indicator
- POLYMER PUMP SPEED controller (0-100%)
- LOW WASHWATER PRESSURE indicator
- LOW HYDRAULIC PRESSURE indicator
- BELT MISALIGNED indicator
- BELT BROKEN indicator
- NO CAKE indicator
- EMERGENCY STOPPED indicator
- BELT DRIVE FAIL indicator

7. SERVICE

7.1. 360º Service Portfolio



Alfa Laval partners with you for the entire life cycle of your equipment – from start-up, through operation, monitoring and maintenance, all the way to reconditioning and eventual redesign. Our goal is to ensure that our equipment continuously gives you optimized process performance.

7.2. Alfa Laval Service Centers:

You can trust Alfa Laval service technicians to maintain your equipment in peak performance and minimize the risk of unscheduled production stops. Our local service centers are equipped with the tools and expertise to improve the performance of your rotating drum thickeners. Join us on a virtual tour of our state-of-the-art facilities.

Alfa Laval - Houston service center

7.3. Commissioning

Alfa Laval specialists commission equipment to ensure optimal performance. Services consist of installation review, performance checks, process optimization and operator training. The commissioning process ends with a handover or acceptance certificate and is often the first day of warranty.

Services consist of:

- installation review
- performance checks
- process optimization
- operator training

The commissioning process ends with a handover or acceptance certificate and is often the first day of warranty.

The commissioning:

- Enables trouble-free start-up and process fine-tuning.
- Advice on optimizing process conditions.
- Checks on surrounding components, systems and controls and optimization recommendations.
- Help to reduce maintenance costs with a customized proposal to optimize maintenance.

7.4. Preventive Maintenance

Highly experienced Alfa Laval specialists can formulate and implement an optimal maintenance plan for your equipment.
Service intervals are determined by various factors, including type of application as well as the usage and condition of the equipment.
The service can be performed on site or in the Alfa Laval Service Center located in Houston, Texas.

The preventive maintenance:

- Delivers peace of mind and operational reliability
- Secures maximum throughput
- Increases overall equipment lifetime and provides good cost control
- Maintains safe equipment operation

7.5. Rebuilds and upgrades

7.5.1. Repair

Alfa Laval specialists repair the equipment according to your needs, replacing unsafe or worn parts as required, and then reassemble the equipment.

- Minimizes downtime
- Maximizes production performance
- Extends the lifetime of equipment
- Prevents equipment from consequential damage and accidents

7.5.2. Equipment Upgrades

- There is a wide range of upgrade solutions available to ensure your Alfa Laval equipment features the latest technical developments.
- As operating conditions change over time, new challenges can call for a review of the current installations.
- Equipment Upgrades can also include control upgrades that improve equipment automation.

8. TERMS AND CONDITIONS OF SALES

These Terms and Conditions of Sale ("Terms and Conditions") apply to all quotations, orders, and contracts for Alfa Laval Inc. products (hereafter "Equipment") and associated services ("Services") as used in these Terms and Conditions, the word "Equipment" includes all hardware, parts, components, software, and options.

1. **ACCEPTANCE**: Our sale to you is limited to and expressly made conditional on your assent to these Terms and Conditions and, if applicable, on the attendant quotation, both of which form a part of the contract between us and which supersede and reject all prior agreements, representations, discussions, or negotiations, whether written or oral, with respect to this sale and any conflicting terms and conditions of yours, whether signed by you. Any terms and conditions contained in your purchase order or request for quotation or other form which are different from, in addition to, or vary from these Terms and Conditions are expressly rejected, shall not be binding upon us, and are void and of no force or effect. These Terms and Conditions may not be changed except by the written agreement of both parties.

2. **PRICES**: Unless otherwise specified in writing, all quoted prices are in U.S. Dollars and are firm for thirty (30) days from the date of offer. Prices quoted are exclusive of taxes, freight and insurance, and you agree to pay any and all sales, revenue, excise or other taxes (exclusive of taxes based on our net income) applicable to the purchase of Equipment. If you claim an exemption from any such taxes, you shall provide us with a tax exemption certificate acceptable to the taxing authorities.

3. **DELIVERY; FORCE MAJEURE**: Dates for the furnishing of Services and/or delivery or shipment of Equipment are approximate only and are subject to change. Quoted lead times are figured from the date of receipt of complete technical data and approved drawings as such may be necessary. We shall not be liable, directly, or indirectly, for any delay in delivery or failure to deliver caused by carriers or by labor difficulties, shortages, strikes or stoppages of any sort, or difficulties in obtaining materials from ordinary sources and suppliers. In addition, we shall not be liable for any such delays or for any failure to perform our obligations under an order or contract due to any one or more of the following events, whether foreseeable or not: war, hostilities, military operations, terrorism, riots, disorder, accidents, floods, storms, natural disasters, fires, acts of God, epidemics and/or pandemics (and specifically in relation hereto and notwithstanding anything else stated herein, whether or not outbreak of such epidemic or pandemic has occurred prior to acceptance of this order or execution of a contract for the Services), governmental, judicial or administrative decisions, decrees or orders, embargoes or blockades, or any causes beyond our reasonable control. Unless otherwise specifically agreed in writing by us, in no event shall we be liable for any damages or penalties whatsoever, or however designated, resulting from our failure to perform or delay in performing due to any of the causes specified in this paragraph 3.

4. **SHIPMENT, RISK OF LOSS, TITLE**: All sales are made F.O.B. Alfa Laval shipping point, unless otherwise noted. Duty, brokerage fees, insurance, packing and handling as applicable are not included unless otherwise noted. Our liability for delivery ceases upon making delivery of Equipment to the carrier at the shipping point in good condition. The carrier shall be your agent. Risk of loss shall pass to you upon such delivery. Regardless of the delivery term specified, we shall retain title to the Equipment until final payment thereof has been made.

5. **CREDIT AND PAYMENT**: Payment terms are (30) days net, unless agreed otherwise by us in writing. *Pro rata* payments shall become due with partial shipments. Any discount period which may be granted by us begins on the invoice date and all payments are due 30 days after the invoice date. All payments shall be made without deduction, deferment, set-off, lien or counterclaim of any nature.

All amounts due not paid within 30 days after the date such amounts are due and payable shall bear interest at the lesser of 1.5 percent per month or the maximum rate of interest allowed by law. We reserve the right at any time to suspend credit or to change credit terms provided herein, when, in our sole opinion, your financial condition so warrants. Failure to pay invoices when such invoices are due and payable, at our election, shall make all subsequent invoices immediately due and payable irrespective of terms, and we may withhold all subsequent deliveries until the full account is settled. We shall not, in such event, be liable for delay of performance or nonperformance of contract in whole or in part subsequent to such event.

6. **SECURITY AGREEMENT:** You hereby grant us a security interest in the Equipment, including a purchase money security interest, and in such materials, proceeds and accessories thereof, to secure payment of the purchase price of the Equipment. You authorize us to file or record a purchase order or copy thereof or any UCC financing statement
showing our interest in the Equipment in all jurisdictions where we may determine filing to be appropriate, and you agree to sign all such documents reasonably related thereto promptly following our request. You will not encumber the Equipment with any mortgage, lien, pledge or other attachment prior to payment in full of the price therefor.

7. **CANCELLATIONS AND CHANGES**: Orders which have been accepted by us are not subject to cancellation or changes in specification except upon prior written agreement by us and upon terms that will indemnify us against all losses resulting from or arising out of such cancellation or change in specifications. In the absence of such indemnification, we shall be entitled to recover all damages and costs of whatever nature permitted by the Uniform Commercial Code.

8. **DEFERRED SHIPMENT**: If shipment is deferred at your request, payment of the contract price shall become due when you are notified that the Equipment is ready for shipment. If you fail to make payment or furnish shipping instructions, we may either extend the time for so doing or cancel the contract. In case of deferred shipment at your request, storage and other reasonable expenses attributable to such delay shall be payable by you.

9. **EQUIPMENT WARRANTY AND REMEDY**:
(a) For new Equipment only, we warrant to you that the Equipment that is the subject of this sale is free from defects in design (provided that we have design responsibility), material and workmanship. The duration of this warranty is twelve (12) months from start-up or eighteen (18) months from delivery to you, whichever occurs first (the "Warranty Period"). If you discover within the Warranty Period a defect in design, material, or workmanship, you must promptly notify us in writing. Within a reasonable time after such notification, we shall repair, replace, or, at our option, refund you the price of the defective Equipment or part thereof.
(b) For repairs, parts and Services provided by us, we warrant to you that the repairs, parts and Services we provide to you will be free from defects in material and workmanship. The duration of this warranty is ninety (90) days from as applicable (i) the date the Equipment which required the repairs, parts or Services is returned to you by us, (ii) the date of your receipt of the part, or (iii) the date of completion of the repair or other Services, if performed at your facility. If during this ninety-day period you discover a defect in the repairs, parts or Services you must promptly notify us in writing, and we shall correct such defect with either new or used replacement parts or reperform the Services as applicable. If we are unable to correct the defect after a reasonable number of attempts, we will provide a refund of the price paid for the defective repair, parts or Services.
(c) All warranty service is subject to our prior examination and approval and will be performed by us at your facility or at service centers designated by us. All transportation to and from the designated service center will be at our expense. The remedies set forth above are your exclusive remedies for breach of warranty. Unless otherwise agreed in writing by us, our warranty extends only to you and

is not assignable to or assumable by any subsequent purchaser, in whole or in part, and any such attempted transfer shall render all warranties provided hereunder null and void and of no further force or effect.

(d) The warranties set forth above are inapplicable to and exclude any product, components or parts not manufactured by us or covered by the warranty of another manufacturer. We shall have no responsibility for defects, loss or damage to the extent caused by (i) normal wear and tear, (ii) your failure to follow all installation and operation instructions or manuals or to provide normal maintenance, (iii) repairs or modifications by you or by others not under our direct supervision, or (iv) a product or component part which we did not design, manufacture, supply, or repair.

(e) **DISCLAIMER OF IMPLIED WARRANTIES**. THE WARRANTIES SET FORTH ABOVE AND IN SECTION 12 BELOW ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

10. **LIMITATION OF LIABILITY**: In no event shall we be liable, and you hereby waive any claims against us and release us from liability to you, for any indirect, special, punitive, incidental, or consequential damages whatsoever based upon breach of warranty, breach of contract, negligence, strict tort, or any other legal theory. In no circumstance, shall we be liable for, however such damages are characterized, loss of profits, loss of savings or revenue, loss of use of the Equipment or any associated equipment, cost of capital, cost of any substitute Equipment, facilities or services, downtime, or loss of prospective economic advantage. **OUR AGGREGATE LIABILITY FOR FAILURE TO PERFORM, BREACH OF WARRANTY OR BREACH OF OTHER CONTRACTUAL OBLIGATIONS SHALL NOT EXCEED THE TOTAL PRICE PAID TO US FOR THE EQUIPMENT AND SERVICES THAT ARE THE SUBJECT OF ANY CLAIM BY YOU.**

11. **OWNERSHIP:** All drawings, designs, specifications, data and other proprietary rights supplied by us (including without limitation in connection with the Equipment) have been prepared or assembled by us and are (and shall remain) exclusively our property, and upon our request you agree to execute any additional documents needed to give effect to the foregoing. Such drawings, designs and specifications have been furnished in order to provide full documentation and on the condition that they shall not be disclosed, reproduced or copied in any manner whatsoever, in whole or in part, except for your internal use as necessary, and upon the further condition that, as our sole property, they shall not be used for furnishing information and/or disclosed, in whole or in part, to others or otherwise for any purpose not specifically authorized in a writing signed by one of our corporate officers.

12. **PATENT INFRINGEMENT**

(a) We make no express or implied warranties of non-infringement with respect to the Equipment. We will, however, defend, indemnify and hold you harmless from any third party apparatus claims based upon an issued U.S. patent to the extent such claim relates to the Equipment supplied and sold to you; provided, however, that we undertake no indemnification in respect of third-party rights (i) where the alleged patent infringement is based upon or related to any method, process or design claims in third-party U.S. patents, any combination of the Equipment with other equipment not supplied by us, or any modifications of the Equipment made by you and not approved by us, or (ii) to the extent the alleged infringement is directly attributable to the negligence or intentional misconduct of you or otherwise for which you are obligated to indemnify us for under paragraph 12(c).

(b) We shall assume defense of a claim at our expense in accordance with these Terms and Conditions, provided you shall notify us within 30 days of your receipt of notice of an alleged third-party claim that you believe would entitle you to patent infringement indemnification pursuant to paragraph 12(a). You acknowledge and agree that we shall have the sole right to settle or otherwise

compromise such a third-party claim, including but not limited to the right to either (i) modify the Equipment to avoid infringement if you are agreeable to the modification, (ii) repurchase the Equipment from you at a price equal to the then-current fair market value of the Equipment, or (iii) secure rights by assignment or license to permit continued use of the Equipment.

(c) If a third-party charges us with patent infringement relating to Equipment sold by us to you, we shall have the right to either (i) modify the Equipment to avoid infringement if you are agreeable to the modification, (ii) repurchase the Equipment from you at a price equal to the then-current fair market value of the Equipment, or (iii) secure rights by assignment or license to permit continued use of the Equipment. If a third party charges us with patent infringement on the bases set forth in paragraph 12(a)(i) or (ii), you shall indemnify and hold us harmless for all expenses as well as any awards of damage assessed against us, and, without limiting any of our other rights and remedies available at law or in equity, we shall also have the right to modify or repurchase the Equipment or to secure rights for continued use by way of assignment or license as set forth in this paragraph.

13. **INSPECTION**: Upon prior written notice, you may make reasonable inspections of Equipment at our facility. We reserve the right to determine the reasonableness of the request and to select an appropriate time and location for such inspection. You agree to execute appropriate confidentiality provisions upon our request prior to visiting our facility. All costs of inspection shall be solely determined by us and shall be payable by you. No inspection or expediting by you at the facilities of our suppliers is authorized.

14. **SOFTWARE PROVISIONS**: If software is provided hereunder (whether such is integrated into the Equipment or otherwise operates alongside the same), you are hereby granted a non-exclusive, non-sublicensable, non-transferable, royalty free license to access and use such software as provided and as intended with our Equipment. Without limiting the foregoing, under the foregoing license you may specifically: (i) use our software in machine readable object code only and only with the Equipment provided; (ii) copy our software into any machine-readable object code form solely for back up purposes in support of your use of our software on the Equipment provided in accordance with these Terms and Conditions; and (iii) create one additional copy of the software for archival purposes only. This license may only be assigned, sublicensed, or otherwise transferred by you with our prior written consent. You hereby recognize and acknowledge that the software provided to you hereunder comprises valuable trade secret and/or copyright property of Alfa Laval (or its licensors) and you covenant that you will take adequate precautions against access to the software by, or disclosure of the software to, anyone not authorized hereunder to use or have access to the software as contemplated herein. The software is subject to the confidentiality obligations set forth below in paragraph 15.

15. **CONFIDENTIALITY:** Subject to any non-disclosure or confidentiality agreement already in effect between us, any drawings, data, software or other information exchanged between us is proprietary or confidential to us and shall not be used or disclosed by you without our prior written consent. Confidential information shall not be any information that (i) is known previously to you under no obligation of secrecy; (ii) becomes known to the public through no breach of an obligation of secrecy by you; or (iii) is independently developed by you without use or reference to any of the confidential information or materials provided to you by us.

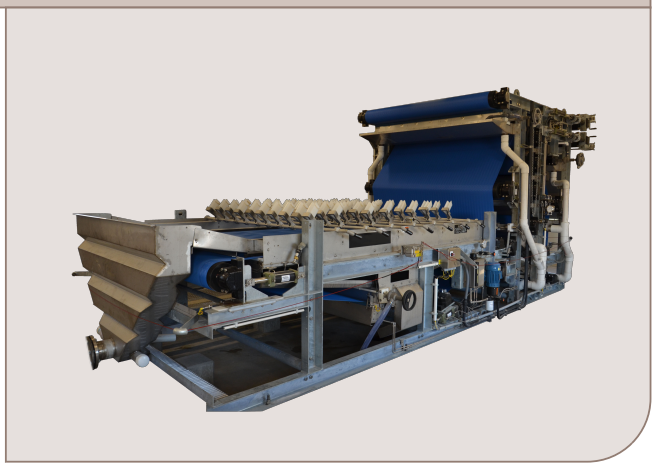
16. **INAPPLICABILITY OF CISG:** The parties specifically agree that the United Nations Convention on Contracts for the International Sale of Goods shall not apply to any sale or order or the contract between us.

17. **GOVERNING LAW & VENUE**: These Terms and Conditions and any dispute or claim arising out of or related to an order or the contract between us shall be finally decided in accordance with the laws of the Commonwealth of Virginia, without giving effect to the provisions thereof relating to conflict of laws. You agree that the venue for any such dispute shall lie in the United States District Court for the Eastern District of Virginia, Richmond Division. In the event that federal jurisdiction cannot be established pursuant to 28 U.S.C. §§ 1331 or 1332, the venue for any such dispute shall lie in the Circuit Court of Henrico County, Virginia. You expressly submit and waive any objection to the sole and exclusive jurisdiction of such courts.

18. **GENERAL:** All previous agreements or understandings between us, either oral or written, with regard to the subject order, with the exception of a pre-existing non-disclosure agreement between us, are void and these Terms and Conditions constitute the entire agreement between us with respect to the matters addressed herein. Neither of us shall assign an order or contract to which these Terms and Conditions apply without the prior written consent of the other party, which consent shall not be unreasonably withheld. If any provision of these Terms and Conditions is held to be invalid or unenforceable, such holding shall not affect the validity or enforceability of any other provision herein. No waiver by either of us of any default or breach by the other party will operate as or be deemed a waiver of any subsequent default or breach.

Alfa Laval AS-H Belt Press KPZ

Sludge dewatering machine



Introduction

The Alfa Laval AS-H Belt Press KPZ is considered the industry standard for superior value, performance and durability for sludge dewatering.

The belt press KPZ is designed for low polymer consumption, high throughput rates, and high cake dry solids content and is available in a wide size range and extensive modular options to meet individual process requirements.

Application

The Alfa Laval AS-H Belt Press KPZ is a sludge dewatering machine suitable for all municipal wastewater sludge types and a wide variety of industrial solid / liquid separation applications, such as paper, petrochemical, mineral, food processing, pharmaceutical and chemical. The belt press KPZ incorporates variable energy mixing, flocculation, gravity drainage, adjustable wedge, extended pressure filtration area, and offers the versatility of a wide size range and extensive modular options to meet individual process requirements.

Benefits

- Thorough uniform mixing of polymer into sludge
- Higher volumetric throughput and solids loading
- Highest cake dry solids in class
- Low power consumption
- Low polymer usage
- High quality filtrate
- Low maintenance requirements
- Long life design
- Operator level gravity deck
- Elevated discharge height for ease of cake handling
- Reduced civil construction costs

Scope of supply

The sludge dewatering system will consist of an independently operating belt thickener and a belt press and all appurtenances. Each belt press will be a complete assembly consisting of a sludge conditioning system, gravity drainage section, vertical pressure section, a belt alignment and tensioning system and a belt washing system.

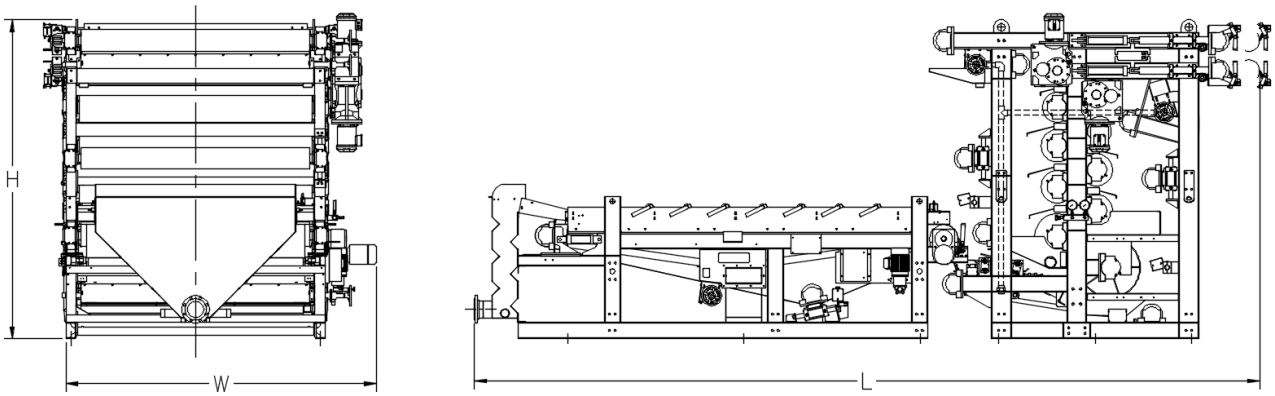
Working principle

Its operating principle is to condition the feed sludge with a polyelectrolyte and drain the flocculated sludge over an endless, horizontal porous filter belt. The thickened sludge is subjected to gradually increasing pressure between a pair of belts that pass through the adjustable wedge and roll grid zone before being further dewatered by a series of decreasing diameter rollers. Final moisture removal is achieved by shear rollers arranged to give minimum 180 degree belt wrap at up to 70 pli in order to optimize dewatering. Independent belts for each of the separate thickening and dewatering zones allow for optimized process control.

Options

- Clad 316SS rollers
- Stainless bearing housings
- Cascading washdown, self cleaning
- Paddle feed distribution

Dimensions



Available in 8 roller and 10 roller designs in the vertical pressure section

10 roller version

Model	Length		Width		Height	
	(mm)	(inches)	(mm)	(inches)	(mm)	(inches)
Belt Press KPZ 100	7,620	300	2,362	93	3,225	127
Belt Press KPZ 150	7,620	300	2,870	113	3,225	127
Belt Press KPZ 200	7,620	300	3,378	133	3,225	127

200001580-7-EN-GB

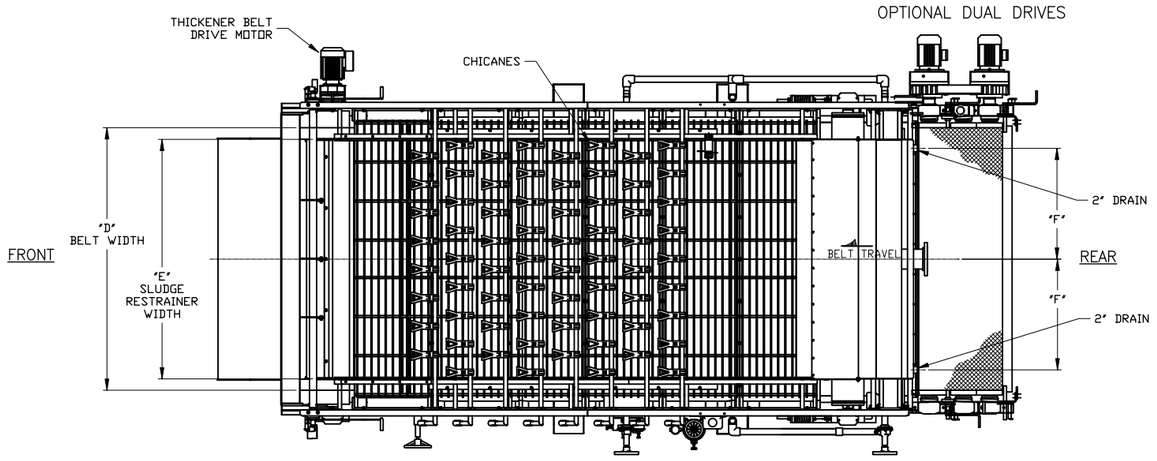
How to contact Alfa Laval

Up-to-date Alfa Laval contact details for all countries are always available on our website at www.alfalaval.com

REV. 7

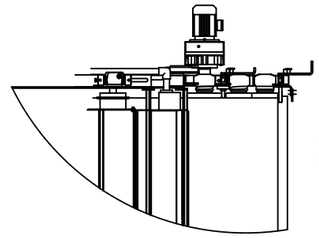
B4MATR7.DWG

MACHINE SIZE	DIMENSION "A"	DIMENSION "B"	DIMENSION "C"	DIMENSION "D"	DIMENSION "E"	DIMENSION "F"	ESTIMATED WT.
1.5 METER	117 3/8" (2981)	78 7/8" (1978)	80 3/8" (2042)	67" (1700)	60 1/4" (1530)	26 3/4" (680)	19,000 lb
2.0 METER	137 3/8" (3490)	98 7/8" (2511)	100 3/8" (2550)	86 5/8" (2200)	80 1/4" (2038)	36 7/8" (937)	22,500 lb
2.5 METER	159 3/8" (4049)	120 7/8" (3070)	122 3/8" (3118)	106 3/8" (2700)	102 1/4" (2600)	46" (1168)	26,500 lb



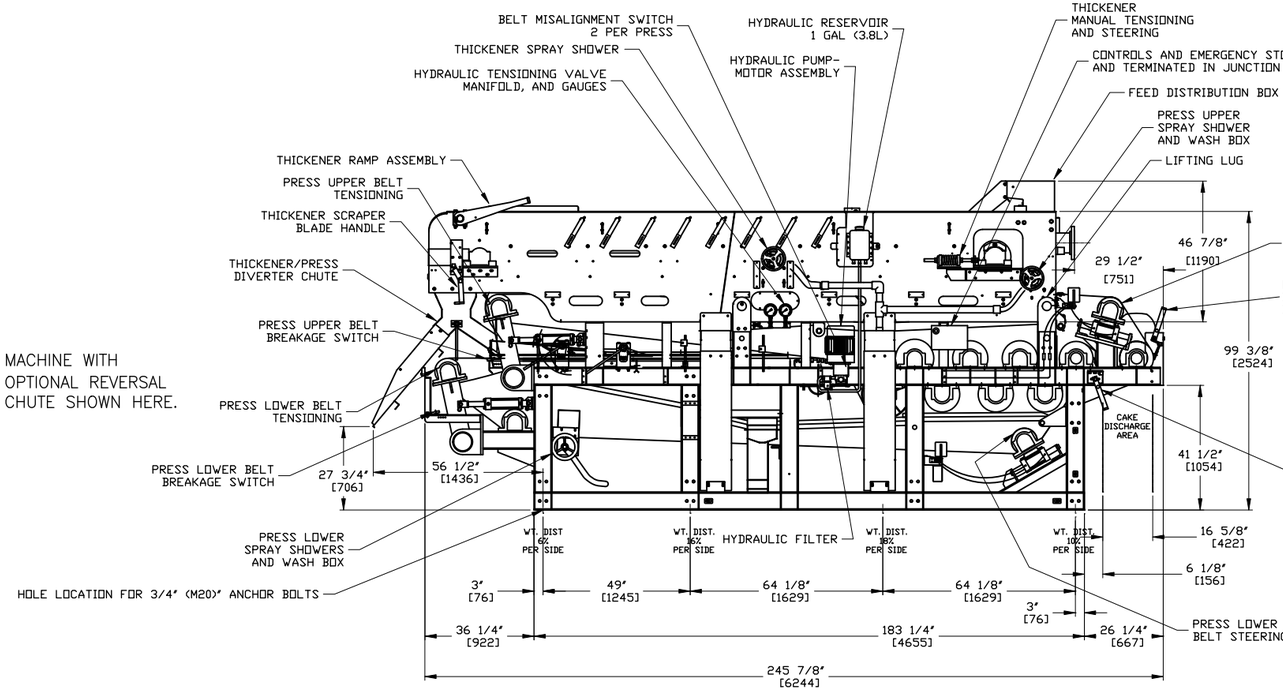
TOP VIEW

OPTIONAL DUAL DRIVES

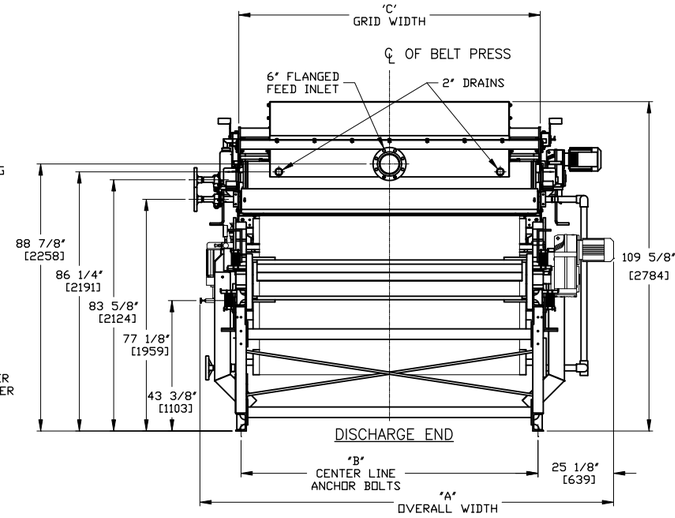


SINGLE DRIVE STANDARD ON 8 ROLL MACHINE.

MACHINE WITH OPTIONAL REVERSAL CHUTE SHOWN HERE.



8 ROLLER CONFIGURATION



TOLERANCE UNLESS NOTED		
	INCHES	MILLIMETERS
FRACTION	+/- 1/32	N/A
X.	+/-0.100	+/-3.0
X.X	+/-0.030	+/-1.0
X.XX	+/-0.015	+/-0.5
X.XXX	+/-0.005	+/-0.1

REVISIONS

REV	DATE	DESCRIPTION	BY	APP'D
1	9/06	GBT DISCHARGE DIMENSIONS CORRECTED	DY	
2	10/08	ADDED 2.5m DIMENSIONS	MCA	DY
3	4/22	UPDATED HYDRAULIC PUMP LOCATION	MCA	MCA
4				
5				
6				

REVISIONS

REV	DATE	DESCRIPTION	BY	APP'D
7				
8				
9				
10				
11				
12				

DRAWN	MM	DATE 9/8/06
CHECKED	MM	DATE 9/8/06
APPROVED	CMT	DATE 9/8/06
NEXT ASS'Y	N/A	WEIGHT SEE TABLE

NOTE:
1)DEBURR ALL SHARP EDGES.
2)MARK WITH PART NUMBER PER WORK OR PURCHASE ORDER

ALFA LAVAL

ALFA LAVAL INC
10470 Deer Trail Drive
Houston, Texas 77038
Phone: 281-449-0322
FAX: 281-449-1324

TITLE
GENERAL ARRANGEMENT
KLAMPRESS, 3 BELT OPTION
1.5, 2.0, 2.5 METER, 8 ROLL CONFIG.

SCALE	DWG. NO.	REV
1/50	SK003117	3

CUSTOMER N/A

Item 3: Sequence Batch Reactor

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Process Design Report

CENTREVILLE WWTP MD

Design# 171293
Option: Preliminary SBR Design

AquaSBR®

Sequencing Batch Reactor

May 03, 2023
Designed By: Xu Ye

6306 N. Alpine Rd Loves Park, IL 61111
(815) 654-2501 www.aqua-aerobic.com

Upstream Recommendations

- Neutralization is required ahead of the biological system if the pH is expected to fall outside of 6.5-8.5 for significant durations.

- Coarse screening and grit removal is recommended (by others) ahead of the biological system.

- Elevated concentration of hydrogen sulfide can be detrimental to both civil and mechanical structures. If anaerobic conditions exist in the collection system, steps should be taken to eliminate hydrogen sulfide prior to the treatment system.

Flow Considerations

- The maximum flow, as shown on the design, has been assumed as an organic maximum that represents an increased organic load. An oxygen peaking factor of 1.5 has been included to accommodate this additional load while maintaining a residual DO concentration of 2 mg/l, which is the same approach as previous SBR design.

Biological Process

- The decanter performance is based upon a free-air discharge following the valve and immediately adjacent to the basin. Actual decanter performance depends upon the complete installation including specific liquid and piping elevations and any associated field piping losses to the final point of discharge. Modification of the high water level, low water level, centerline of discharge, and / or cycle structure may be required to achieve discharge of full batch volume based on actual site installation specifics.

Aeration

- The aeration system has been designed to provide 1.25 lbs. O2/lb. BOD5 applied and 4.6 lbs. O2/lb. TKN applied at the design average loading conditions, while maintaining a residual DO concentration of 2 mg/l.

- A common standby blower will be shared among the biological reactors.

- Depending on the actual yard piping from the blowers to the diffuser system and the heat losses associated with the yard piping, additional provisions for cooling of the air (i.e. incorporating heat exchangers) and/or modification of in-basin piping and/or diffuser sleeve material may be required. Aqua-Aerobic Systems, Inc. may need to modify the following equipment offering to ensure compatibility of all in-basin components with actual air temperatures.

Digester

- A supernatant pump has already been installed in the digester.

- The digester aeration system has been designed based on 2.0 lbs O2/lb VSS removed.

- The air supply for the digester system is based on each basin receiving 100% of the total sludge produced per day.

Process/Site

- The design loading parameters have been assumed to be the same as previous design loading conditions (engineer to verify).

- The anticipated effluent nitrogen requirement is predicated upon an influent waste temperature of 10 °C or greater. While lower temperatures may be acceptable for a short-term duration, nitrification and (if required) denitrification below 10 °C can be unpredictable, requiring special operator attention.

- Sufficient alkalinity is required for nitrification, as approximately 7.1 mg alkalinity (as CaCO3) is required for every mg of NH3-N nitrified. If the raw water alkalinity cannot support this consumption, while maintaining a residual concentration of 50 mg/l, supplemental alkalinity shall be provided (by others).

- This system has been designed to be expandable from a Phase I average flow of 0.5 MGD to an ultimate, Phase II average flow of 1.2 MGD. This expansion will utilize the Phase I, post-equalization basin as well as the Phase I digester.

- Phase I blowers may need to be re-belted and sheaved to meet phase II operating requirements (by others). The engineer should give thought to piping and site layout to facilitate the expansion.

- The control panel for Phase I has been replaced incorporate Phase II equipment.

- Influent to the biological system is a typical municipal wastewater application. Influent TP shall be either in a particle associated form or in a reactive soluble phosphate form or in a soluble form that can be converted to reactive phosphorus in the biological system. Soluble hydrolyzable and organic phosphates are not removable by chemical precipitation with metal salts. A water quality analysis is required to determine the phosphorus speciation with respect to soluble and insoluble reactive, acid hydrolyzable and total phosphorus at the system Influent, point(s) of chemical addition, and final effluent.

- Chemical feed lines (i.e. metal salts) shall be furnished to each reactor, aerobic digester and dewatering supernatant streams as necessary.

- pH monitoring and control in a range of 6.5-8.5 of the biological reactor is required when adding metal salts.

- The average and maximum design flow and loading conditions, shown within the report, are based on maximum month average and maximum day conditions, respectively.

Post-Secondary Treatment

-The following processes follow the Biological process:
- Effluent flow equalization.

Equipment

- Changes in basin geometry may require alterations in the equipment recommendation.

- The basins are not included and shall be provided by others.

- Influent is assumed to enter the reactor above the water level, away from the decanter, and to avoid splashing or direct discharge in the immediate vicinity of other equipment. If the influent enters the basin below the water level, adequate hydraulic capacity shall be made in the headworks to prevent backflow from one reactor to the other during transition of influent.

- Based on the process requirements and selected equipment, the reactor wall height should be at least 25 ft in all basins.

- Scope of supply includes freight, installation supervision and start-up services.

- Equipment selection is based upon the use of Aqua-Aerobic Systems' standard materials of construction and electrical components, suitable for non-classified electrical environments.

- The system has been designed to fit within existing basin dimensions and add one extra basin.

- The basin dimensions reported on the design have been assumed based upon the required volumes and assumed basin geometry. Actual basin geometry may be circular, square or rectangular with construction materials including concrete or steel.

- The control panel does not include motor starters or VFDs, which should be provided in a separate MCC (by others).

- Provisions should be made, by others, for overflows in each of the recommended basins.

- Aqua-Aerobic Systems, Inc. is familiar with various “Buy American” Acts (i.e. AIS, ARRA, Federal FAR 52.225, EXIM Bank, USAid, PA Steel Products Act, etc.). As the project develops Aqua-Aerobic Systems can work with you to ensure full compliance of our goods with various Buy American provisions if they are applicable/required for the project. When applicable, please provide us with the specifics of the project’s “Buy American” provisions.

AquaSBR® - Sequencing Batch Reactor - Design Summary

Design#: 171293

Project: CENTREVILLE WWTP MD

Option: Preliminary SBR Design

Designed by Xu Ye on Wednesday, May 3, 2023

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

DESIGN INFLUENT CONDITIONS

Avg. Design Flow (ADF)	= 1.2 MGD	= 4,542 m³/day
Max Design Flow (MDF)	= 3 MGD	= 11,356 m³/day

DESIGN PARAMETERS

	Influent	mg/l	Effluent Required	<= mg/l	Anticipated	<= mg/l
Bio/Chem Oxygen Demand:	BOD5	250	BOD5	10	BOD5	10
Total Suspended Solids:	TSS	250	TSS	20	TSS	20
Total Kjeldahl Nitrogen:	TKN	40	--	--	--	--
Ammonia Nitrogen:	--	--	NH3-N	1	NH3-N	1
Oxidized Nitrogen:	--	--	NOx-N	10	NOx-N	10
Total Phosphorus:	TP	8	TP	1	TP	1

SITE CONDITIONS

	Maximum		Minimum		Elevation (MSL)
Ambient Air Temperatures:	85 F	29.4 C	30 F	-1.1 C	30 ft
Influent Waste Temperatures:	68 F	20.0 C	50 F	10.0 C	9.1 m

SBR BASIN DESIGN VALUES

			Water Depth			Basin Vol./Basin		
No./Basin Geometry:	= 3 Rectangular Basin(s)		**Min (LWL)**	= 13.9 ft	= (4.2 m)	**Min (Vlwl)**	= 0.39 MG	= (1,475.3 m³)
Freeboard:	= 2.0 ft	= (0.6 m)	**Avg (AWL)**	= 16.7 ft	= (5.1 m)	**Avg (Vawl)**	= 0.47 MG	= (1,778.1 m³)
Length of Basin:	= 70.5 ft	= (21.5 m)	**Max (HWL)**	= 21.0 ft	= (6.4 m)	**Max (Vhwl)**	= 0.59 MG	= (2,232.4 m³)
Width of Basin:	= 53.3 ft	= (16.2 m)						

Number of Cycles:	= 5 per day/basin (advances cycles beyond MDF)	
Cycle Duration:	= 4.8 hr/cycle	
Food/Mass (F/M) ratio:	= 0.064 lbs. BOD5/lb. MLSS-Day	
MLSS Concentration:	= 4,000 mg/l @ LWL	
Hydraulic Retention Time:	= 1.174 days @ AWL	
Solids Retention Time:	= 17.9 days	
Est. Net Sludge Yield:	= 0.793 lbs. WAS/lb. BOD5	
Est. Dry Solids Produced:	= 1,984.3 lbs. WAS/day	= (900.1 kg/day)
Est. Solids Flow Rate:	= 120 gpm (23,792 gal/day)	= (90.1 m³/day)
Decant Flow Rate @ MDF:	= 2,857 gpm (as avg. from HWL to LWL)	= (180.2 l/sec)
LWL to CenterLine Discharge:	= 1.0 ft	= (0.3 m)
Lbs. O2/lb. BOD5	= 1.25	
Lbs. O2/lb. TKN	= 4.6	
Peak O2 Factor:	= 1.5	
Actual Oxygen Required:	= 7,453 lbs./day	= (3,380.9 kg/day)
Air Flowrate/Basin:	= 1,670 SCFM	= (47.3 Sm³/min)
Max. Discharge Pressure:	= 10.7 PSIG	= (74 KPA)
Daily Max. Month Avg. Estimated Power*:	= 1,426.9 kWh/day	

* Power consumption calculations in this document are based on maximum month conditions. Detailed power vs. loading calculations can be provided if requested.

POST-SBR EQUALIZATION DESIGN PARAMETERS

Avg. Daily Flow (ADF):	= 1.2 MGD	= (4,542 m³/day)
Max. Daily Flow (MDF):	= 3 MGD	= (11,356 m³/day)
Decant Flow Rate from (Qd):	= 2,857 gpm	= (10.8 m³M)
Decant Duration (Td):	= 70 min	
Number Decants/Day:	= 15	
Time Between Start of Decants:	= 96 min	

POST-SBR EQUALIZATION VOLUME DETERMINATION

The volume required for equalization/storage shall be provided between the high and the low water levels of the basin(s). This Storage Volume (Vs) has been determined by the following:

Vs = [(Qd -(MDF x 694.4)] x Td = 54,157 gal = (7,240.2 ft³) = (205.0 m³)

The volumes determined in this summary reflect the minimum volumes necessary to achieve the desired results based upon the input provided to Aqua. If other hydraulic conditions exist that are not mentioned in this design summary or associated design notes, additional volume may be warranted.

Based upon liquid level inputs from each SBR reactor prior to decant, the rate of discharge from the Post-SBR Equalization basin shall be pre-determined to establish the proper number of pumps to be operated (or the correct valve position in the case of gravity flow). Level indication in the Post-SBR Equalization basin(s) shall override equipment operation.

POST-SBR EQUALIZATION BASIN DESIGN VALUES

No./Basin Geometry:	= 1 Rectangular Basin(s)				
Length of Basin:	= 52.8 ft	= (16.1 m)			
Width of Basin:	= 33.0 ft	= (10.1 m)			
Min. Water Depth:	= 1.5 ft	= (0.5 m)	**Min. Basin Vol. Basin:**	= 19,560.8 gal	= (74.1 m³)
Max. Water Depth:	= 5.7 ft	= (1.7 m)	**Max. Basin Vol. Basin:**	= 73,717.5 gal	= (279.1 m³)

POST-SBR EQUALIZATION EQUIPMENT CRITERIA

Mixing Energy with Diffusers:	= 0.1 SCFM/ft² of reactor	
SCFM Required to Mix:	= 209 SCFM/basin	= (355 Nm³/hr/basin)
Max. Discharge Pressure:	= 4.0 PSIG	= (27.67 KPA)
Avg. Power Required:	= 90.4 kW-hr/day	

AEROBIC DIGESTER DESIGN PARAMETERS

Sludge Flowrate to the Digester	= 23,790.0 gal/day	= (90.1 m³/day)
Inlet Sludge Concentration	= 1.00%	
Solids Loading to the Digester	= 1,984.1 lb/day	= (900.0 kg/day)
Inlet Volatile Solids Fraction	= 73.4%	

AEROBIC DIGESTER BASIN DESIGN VALUES

No./Basin Geometry:	= 1 Rectangular Basin(s)				
Length of Basin:	= 52.8 ft	= (16.1 m)			
Width of Basin:	= 36.7 ft	= (11.2 m)			
Min. Water Depth:	= 14.7 ft	= (4.5 m)	**Min. Basin Vol. Basin:**	= 212,957.1 gal	= (806.2 m³)
Max. Water Depth:	= 21 ft	= (6.4 m)	**Max. Basin Vol. Basin:**	= 304,224.4 gal	= (1,151.7 m³)

AEROBIC DIGESTER PROCESS DESIGN PARAMETERS

Solids Retention Time:	= 25.6 days	
Digester Design Temperature:	= 20 C	
Volatile Solids Destruction:	= 40%	
Digester Solids Concentration:	= 2%	
Oxygen Supplied for Digestion:	= 2 lbs O2 per lb VSS Destroyed	
Oxygen Distribution Per Basin:	= 100.0%	
Actual Oxygen Required:	= 1,165.1 lb/day	= (528.5 kg/day)
Volatile Percentage After Digestion:	= 62.3%	
Estimated Dry Solids to be Removed:	= 1,401.6 lb/day	= (635.8 kg/day)
Volume of Solids to be Removed:	= 8,402.6 gal/day	= (31.81 m³/day)
Estimated Supernatant Volume:	= 91,267.3 gal/basin	= (345.48 m³/basin)
Assumed Supernatant Duration:	= 180 minutes	
Calculated Supernatant Flow:	= 507.0 gpm	= (32.0 l/sec)

1. The Volatile Solids Destruction listed above shall be used for determination of the oxygen demand during summer conditions. It should be noted that the actual VSS destruction will be dependant upon digester inlet condition, temperature, and operating conditions.
2. The Digester Solids Concentration is reflected as an average concentration, assuming the operations include frequent settling and supernating practices.

AEROBIC DIGESTER EQUALIZATION EQUIPMENT CRITERIA

Mixing Energy with Aerators:	= 140 HP/MG	= (27.58 W/m³)
NPHP Provided:	= 2.0	= (1.5 kW)
Mixing Energy with DDMs	= 40 HP/MG	= (7.88 W/m³)
NPHP Provided:	= 10	= (7.5 kW)
Max. Flow Rate Required Basin:	= 120 gpm	= (0.454 m³/min)
Avg. Power Required:	= 198.24 kW-hr/day	

AquaSBR

Influent Valves

1 Influent Valve(s) will be provided as follows:

- 16 inch DeZurik electrically operated Plug Valve(s).

Mixers

1 AquaDDM Direct Drive Mixer(s) will be provided as follows:

- 20 HP Aqua-Aerobic Sstems Endura Series Model FSS DDM Mixer(s).

Mixer Mooring

3 Mixer pivotal mooring assembly(ies) consisting of:

- 304 stainless steel pivotal mooring arm(s).
- #8 AWG four-conductor electrical service cable(s).
- Electrical cable strain relief grip(s), 2 eye, wire mesh.

Decanters

1 Decanter assembly(ies) consisting of:

- 8x7 Aqua-Aerobics decanter(s) with fiberglass float, 304 stainless steel weir, galvanized restrained mooring frame, and painted steel power section with #14-10 conductor power cable.
- Decant pipe(s).
- 4" schedule 40 galvanized steel mooring post.
- Galvanized steel dewatering support post(s).
- 14 inch DeZurik electrically operated butterfly valve(s) with Limitorque actuator.

Transfer Pumps/Valves

1 Submersible pump assembly(ies) consisting of the following items:

- 2.4 HP Submersible Pump(s) with painted cast iron pump housing, discharge elbow, and multi-conductor electrical cable.
- 3 inch diameter swing check valve.
- Upper guide bar bracket(s).
- 304 stainless steel guide bar(s).

Retrievable Fine Bubble Diffusers

8 Retrievable Fine Bubble Diffuser Assembly(ies) consisting of:

- 25 diffuser tubes consisting of two flexible EPDM porous membrane sheaths mounted on a rigid support pipe with 304 stainless steel band clamps.
- 304 stainless steel manifold weldment.
- 304 stainless steel leveling angles.
- 304 stainless steel leveling studs.
- Galvanized vertical support beam.
- Galvanized vertical air column assembly.
- Galvanized upper vertical beam and pulley assembly.
- Galvanized top support bracket.
- 3" EPDM flexible air line with stainless steel quick disconnect end fittings.
- Galvanized threaded flange.
- 3" manual isolation butterfly valve with ductile iron body, NBR seat, ductile iron disk and one-piece stainless steel shaft.
- Quick disconnect cam lock adapter.
- 304 stainless steel adhesive anchors.
- Brace angles.

Positive Displacement Blowers

4 Positive displacement Blower Package(s), with each package consisting of:

- Aerzen 50HP Rotary Positive Displacement Blower(s).

Air Valves

2 Air Control Valve(s) will be provided as follows:

- 8 inch DeZurik electrically operated butterfly valve(s) with Limitorque actuator.

Level Sensor Assemblies

1 Pressure Transducer Assembly(ies) each consisting of:

- Pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting pipe weldment(s).

1 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

Instrumentation

1 Dissolved Oxygen Assembly(ies) consisting of:

- DO probe(s).

1 Process Controller(s) consisting of:

- Controller and display module(s).

Controls

Controls wo/Starters

1 Controls Package(s) will be provided as follows:

- NEMA 12 panel enclosure suitable for indoor installation and constructed of painted steel.
- Fuse(s) and fuse block(s).
- Compactlogix Processor.
- Operator interface(s).
- Remote access Ethernet modem(s).

Item 4: Aerobic Granular Sludge

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Process Design Report

CENTREVILLE WWTP MD

Design# 171290
Option: Preliminary AquaNereda Retrofit Design

AquaNereda®

Aerobic Granular Sludge Technology

May 03, 2023
Designed By: Xu Ye

6306 N. Alpine Rd Loves Park, IL 61111
(815) 654-2501 www.aqua-aerobic.com

Upstream Recommendations

- For primary influent designs, ¼ inch (6 mm) perforated plate-style screening and grit removal, consisting of 95% removal at 140 mesh, is required ahead of the AquaNereda system. For primary effluent designs, screening requirements may be relaxed at the discretion of Aqua-Aerobic Systems. If alternative screening and grit removal methods are planned ahead of the AquaNereda system, please discuss screening with Aqua-Aerobic Systems to understand the impacts of the approach.

- Neutralization is required ahead of the biological system if the pH is expected to fall outside of 6.5-8.5 for significant durations.

- Elevated concentration of hydrogen sulfide can be detrimental to both civil and mechanical structures. If anaerobic conditions exist in the collection system, steps should be taken to eliminate hydrogen sulfide prior to the treatment system.

- Flow equalization is required ahead of the biological reactor(s) to provide interruption of flow during the non-fill phases.

Flow Considerations

- The maximum flow, as shown on the design, has been assumed as an organic maximum that represents an increased organic load. An oxygen peaking factor of 1.5 has been included to accommodate this additional load while maintaining a residual DO concentration of 2 mg/l.

Aeration

- The aeration system has been designed to provide 1.25 lbs. O2/lb. BOD5 applied and 4.6 lbs. O2/lb. TKN applied at the design average loading conditions, while maintaining a residual DO concentration of 2 mg/l.

- A common standby blower will be shared among the biological reactors.

- Depending on the actual yard piping from the blowers to the diffuser system and the heat losses associated with the yard piping, additional provisions for cooling of the air (i.e. incorporating heat exchangers) and/or modification of in-basin piping and/or diffuser sleeve material may be required. Aqua-Aerobic Systems, Inc. may need to modify the following equipment offering to ensure compatibility of all in-basin components with actual air temperatures.

Process/Site

- The anticipated effluent nitrogen requirement is predicated upon an influent waste temperature of 10 °C or greater. While lower temperatures may be acceptable for a short-term duration, nitrification and (if required) denitrification below 10 °C can be unpredictable, requiring special operator attention.

- Sufficient alkalinity is required for nitrification, as approximately 7.1 mg alkalinity (as CaCO3) is required for every mg of NH3-N nitrified. If the raw water alkalinity cannot support this consumption, while maintaining a residual concentration of 50 mg/l, supplemental alkalinity shall be provided (by others).

- This system has been designed to be expandable from a Phase I average flow of 0.5 MGD to an ultimate, Phase II average flow of 1.2 MGD. This expansion will utilize the Phase I, post-equalization basin as well as the Phase I digester. It will require splitting one reactor from phase I into two Nereda reactors, and using the other SBR reactor for ancillary basins. Existing influent valves and blowers will be kept for the retrofit.

- Phase I blowers may need to be re-belted and sheaved to meet phase II operating requirements (by others). The engineer should give thought to piping and site layout to facilitate the expansion.

- The control panel for Phase I has not been sized to incorporate Phase II equipment and will require additional hardware for future expansion.

- Influent to the biological system is a typical municipal wastewater application. Influent TP shall be either in a particle associated form or in a reactive soluble phosphate form or in a soluble form that can be converted to reactive phosphorus in the biological system. Soluble hydrolyzable and organic phosphates are not removable by chemical precipitation with metal salts. A water quality analysis is required to determine the phosphorus speciation with respect to soluble and insoluble reactive, acid hydrolyzable and total phosphorus at the system Influent, point(s) of chemical addition, and final effluent.

- Chemical feed lines (i.e. metal salts) shall be furnished to each reactor, aerobic digester and dewatering supernatant streams as necessary.

- pH monitoring and control in a range of 6.5-8.5 of the biological reactor is required when adding metal salts.

- The average and maximum design flow and loading conditions, shown within the report, are based on maximum month average and maximum day conditions, respectively.

Post-Secondary Treatment

-The following processes follow the Biological process:
- Effluent flow equalization.

Equipment

- Changes in basin geometry may require alterations in the equipment recommendation.

- The basins are not included and shall be provided by others.

- The influent enters the basin near the reactor floor. Adequate hydraulic capacity shall be made in the headworks to prevent backflow from one reactor to the other during transition of influent.

- Based on the process requirements and selected equipment, the reactor wall height should be at least 25 ft for all basins.

- Scope of supply includes freight, installation supervision and start-up services.

- Equipment selection is based upon the use of Aqua-Aerobic Systems' standard materials of construction and electrical components, suitable for non-classified electrical environments.

- The post-EQ pump was not included in our previous scope of supply. Engineer should make sure the post-EQ pumps have the capacity of 1,100 gpm.

- The system has been designed to fit within existing basin dimensions. The ancillary basins are based on assumed basin dimensions.

- The control panel does not include motor starters or VFDs, which should be provided in a separate MCC (by others).

- Provisions should be made, by others, for overflows in each of the recommended basins.

- Aqua-Aerobic Systems, Inc. is familiar with various “Buy American” Acts (i.e. AIS, ARRA, Federal FAR 52.225, EXIM Bank, USAid, PA Steel Products Act, etc.). As the project develops Aqua-Aerobic Systems can work with you to ensure full compliance of our goods with various Buy American provisions if they are applicable/required for the project. When applicable, please provide us with the specifics of the project’s “Buy American” provisions.

INFLUENT BUFFER DESIGN PARAMETERS

Avg. Daily Flow:	= 1.20 MGD	= 4,542 m3/day
Max. Daily Flow:	= 3.00 MGD	= 11,356 m3/day
No. of AGS Reactors:		= 2

INFLUENT BUFFER VOLUME DETERMINATION

The volumes determined in this summary reflect the minimum volumes necessary to achieve the desired results based upon the input provided to Aqua. If other hydraulic conditions exist that are not mentioned in this design summary or associated design notes, additional volume may be warranted.

INFLUENT BUFFER BASIN DESIGN VALUES

No./Basin Geometry:	= 1 Rectangular Basin(s)	
Min. Water Depth:	= 0.0 ft	= (0.0 m)
Max. Water Depth:	= 14.4 ft	= (4.4 m)
Min. Basin Vol. Basin:	= 0 gallons	= (0.0 m³)
Max. Basin Vol. Basin:	= 124,161.0 gallons	= (470.0 m³)

DESIGN INFLUENT CONDITIONS

Avg. Design Flow = 1.20 MGD = 4,542 m3/day

Max Design Flow = 3.00 MGD = 11,356 m3/day

DESIGN PARAMETERS	Influent	mg/l	Effluent Required	<= mg/l	Effluent Anticipated	<= mg/l
Bio/Chem Oxygen Demand:	BOD5	250	BOD5	10	BOD5	10
Total Suspended Solids:	TSS	250	TSS	20	TSS	20
Total Kjeldahl Nitrogen:	TKN	40	TKN	--	TKN	--
Total Ammonia Nitrogen:	--	--	NH3-N	1.0	NH3-N	1.0
Total Nitrate Nitrogen:	--	--	NOxN	10	NOxN	10
Phosphorus:	Total P	8	Total P	1.0	Total P	1.0

SITE CONDITIONS

	Maximum		Minimum		Elevation (MSL)
Ambient Air Temperatures: Influent	85 F	29.0 C	30 F	-1.0 C	30 ft
Waste Temperatures:	68 F	20.0 C	50 F	10.0 C	9.0 m

AGS BASIN DESIGN VALUES

			Water Depth			Basin Vol./Basin	
No./Basin Geometry:	2 Rectangular Basin(s)		**Process Level (PWL):**	21.0 ft	(6.4 m)	0.29 MG	(1,100 m³)
Freeboard (from PWL):	2.8 ft	(0.9 m)	**Discharge Level (DWL):**	22.3 ft	(6.8 m)		
Length of Basin:	34.7 ft	(10.6 m)	**Top of Wall (TOW):**	24.0 ft	(7.3 m)		
Width of Basin:	53.3 ft	(16.2 m)					

PROCESS DETAILS

Cycle Duration: = 4.5 Hours/Cycle

Food/Mass (F/M) ratio: = 0.065 lbs. BOD5/lb. MLSS-Day

MLSS Concentration: = 8000 mg/l

Hydraulic Retention Time: = 0.48 Days

Solids Retention Time: = 17.78 Days

Est. Net Sludge Yield: = 0.81 Lbs. WAS/lb. BOD5

Est. Dry Solids Produced: = 2032.0 lbs. WAS/Day = (921.7 kg/Day)

AERATION DETAILS

Lbs. O2/lb. BOD5 = 1.25

Lbs. O2/lb. TKN = 4.60

Peak O2 Factor: = 1.50

Actual Oxygen Required: = 7453 lbs./Day = (3380.7 kg/Day)

Max. Discharge Pressure: = 10.66 PSIG = (74 KPA)

Max. Air Flowrate/Basin: = 1,183 SCFM

Min. Air Flowrate/Basin: = 296 SCFM

Max. Simultaneous Air: = 1,771 SCFM

Min. Simultaneous Air: = 566 SCFM

RETURN FLOW ESTIMATES

Daily Estimated Return Flow: = 0.18 MGD

Max. Instantaneous Return Flow: = 325 GPM

POWER CONSUMPTION

Average Aeration Power Consumption: = 541 kWh/day (at 80% design load)

SLUDGE BUFFER DESIGN VALUES

No./Basins Geometry:	= 1 Rectangular Basin(s)	
Minimum Level:	= 1.0 ft	= (0.3 m)
Max. Level:	= 15.4 ft	= (4.7 m)
Max. Basin Volume:	= 25,399 gallons	= (96.0 m³)
Length of Basin:	= 17.0 ft	= (5.2 m)
Width of Basin:	= 13.0 ft	= (4.0 m)

SLUDGE BUFFER VOLUME DETERMINATION

The sludge buffer volume has been determined based on the sludge production and the concentration of sludge from the AquaNereda reactors. The Sludge from this basin will be pumped to the sludge handling system, and the supernatant back to the head of the plant.

SLUDGE BUFFER EQUIPMENT CRITERIA

Max. Sludge Flow Rate Required:	= 70 gpm	= (16 m³/hr)
Max. Supernatant Flow Rate Required:	= 282 gpm	= (64 m³/hr)
Average Power Consumption:	= 16 kWh/day (at 80% design load)	

POST-EQUALIZATION DESIGN PARAMETERS

Avg. Daily Flow (ADF):	= 1.20 MGD	= (4,542 m³/day)
Max. Daily Flow (MDF):	= 3.00 MGD	= (11,356 m³/day)
Decant Flow Rate from (Qd):	= 3,381 gpm	= (768 m³/hr)
Decant Duration (Td):	= 50 min	

POST-EQUALIZATION VOLUME DETERMINATION

The volumes determined in this summary reflect the minimum volumes necessary to achieve the desired results based upon the input provided to Aqua-Aerobic. If other hydraulic conditions exist that are not mentioned in this design summary or associated design notes, additional volume may be warranted.

POST- EQUALIZATION BASIN DESIGN VALUES

No./Basin Geometry:	= 1 Rectangular Basin(s)	
Min. Basin Vol. Basin:	= 0 gal	= (0 m³)
Max. Basin Vol. Basin:	= 72,571 gal	= (275 m³)

POST- EQUALIZATION EQUIPMENT CRITERIA

Max. Flow Rate Required Basin:	= 2,179.4 gpm	= (495.0 m³/hr)
Avg. Power Required:	= 136.8 kW-hr/day	

AEROBIC DIGESTER DESIGN PARAMETERS

Sludge Flowrate to the Digester	= 23,790.0 gal/day	= (90.1 m³/day)
Inlet Sludge Concentration	= 1.00%	
Solids Loading to the Digester	= 1,984.1 lb/day	= (900.0 kg/day)
Inlet Volatile Solids Fraction	= 73.4%	

AEROBIC DIGESTER BASIN DESIGN VALUES

No./Basin Geometry:	= 1 Rectangular Basin(s)				
Length of Basin:	= 52.8 ft	= (16.1 m)			
Width of Basin:	= 36.7 ft	= (11.2 m)			
Min. Water Depth:	= 14.7 ft	= (4.5 m)	**Min. Basin Vol. Basin:**	= 213,015.1 gal	= (806.4 m³)
Max. Water Depth:	= 21 ft	= (6.4 m)	**Max. Basin Vol. Basin:**	= 304,307.3 gal	= (1,152.0 m³)

AEROBIC DIGESTER PROCESS DESIGN PARAMETERS

Solids Retention Time:	= 25.6 days	
Digester Design Temperature:	= 20 C	
Volatile Solids Destruction:	= 40%	
Digester Solids Concentration:	= 2%	
Oxygen Supplied for Digestion:	= 2 lbs O2 per lb VSS Destroyed	
Oxygen Distribution Per Basin:	= 100.0%	
Actual Oxygen Required:	= 1,165.1 lb/day	= (528.5 kg/day)
Volatile Percentage After Digestion:	= 62.3%	
Estimated Dry Solids to be Removed:	= 1,401.6 lb/day	= (635.8 kg/day)
Volume of Solids to be Removed:	= 8,402.6 gal/day	= (31.81 m³/day)
Estimated Supernatant Volume:	= 91,292.2 gal/basin	= (345.58 m³/basin)
Assumed Supernatant Duration:	= 180 minutes	
Calculated Supernatant Flow:	= 507.2 gpm	= (32.0 l/sec)

1. The Volatile Solids Destruction listed above shall be used for determination of the oxygen demand during summer conditions. It should be noted that the actual VSS destruction will be dependant upon digester inlet condition, temperature, and operating conditions.
2. The Digester Solids Concentration is reflected as an average concentration, assuming the operations include frequent settling and supernating practices.

AEROBIC DIGESTER EQUIPMENT CRITERIA

Mixing Energy with Aerators:	= 140 HP/MG	= (27.58 W/m³)
NPHP Provided:	= 2.0	= (1.5 kW)
Mixing Energy with DDMs	= 40 HP/MG	= (7.88 W/m³)
NPHP Provided:	= 10	= (7.5 kW)
Max. Flow Rate Required Basin:	= 244 gpm	= (0.924 m³/min)
Avg. Power Required:	= 198.24 kW-hr/day	

AquaNereda

Influent Distribution System

2 Influent Distribution Assembly(ies) consisting of:

- Influent distribution system consisting of HDPE and PVC pipe with supports.

Effluent Weir Assembly

2 Effluent Weir Assembly(ies) consisting of:

- Concrete main effluent channel(s) provided by others.
- Stainless steel weir assembliy(ies) with supports.

Sludge Removal System

2 Solids Waste System(s) consisting of:

- HDPE or Stainless steel solids waste system(s).
- Pressure transmitter(s).

2 Sludge Decant/WLC Valve Set(s) consisting of:

- Each reactor includes two (2) of the following automatic control valves and two (2) of the following manual throttling valves:
- 14 inch DeZurik electrically operated butterfly valve(s) with Limitorque actuator.
- 14 inch diameter DeZurik manual plug valve(s).

2 Air Valve Set(s) consisting of:

- Each reactor includes two (2) of the following automatic valves and one (1) of the following manual valves:
- 4 inch DeZurik electrically operated butterfly valve(s) with Limitorque actuator.
- 4 inch manual butterfly valve(s).

Fixed Fine Bubble Diffusers

2 Fixed Fine Bubble Diffuser Assembly(ies) consisting of:

- 304 SS, 12 Ga. drop pipe(s).
- PVC, Sch 40 Manifold(s) with connection to drop pipe.
- PVC, Air distributor(s) with connection to the manifold and required PVC pipe joint connections.
- 304 Stainless steel piping supports with vertical supports, clamps, adjusting mechanism and anchor bolts.
- Fine bubble diffuser assemblies.
- Air muffler(s).

Positive Displacement Blowers

1 Positive displacement Blower Package(s), with each package consisting of:

- Aerzen 50HP Rotary Positive Displacement Blower(s).

Air Valves

2 Air Control Valve(s) will be provided as follows:

- 6 inch DeZurik electrically operated butterfly valve(s) with Limitorque actuator.
- Auma actuator will be upgraded from open/close service to modulating service.
- Air flow meter(s).
- Flow conditioner(s).

Level Sensor Assemblies

2 Pressure Transducer Assembly(ies) each consisting of:

- Pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting pipe weldment(s).

2 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

Instrumentation

1 Server Based Control and Monitoring System will be provided as follows:

- Process Controller Server.
- Small server monitor.
- Process Operator Station.

2 Dissolved Oxygen Assembly(ies) consisting of:

- DO probe(s).

2 TSS Sensor(s) will be provided as follows:

- TSS probe(s).

2 ORP Sensor(s) will be provided as follows:

- ORP sensor(s).

2 pH Sensor(s) will be provided as follows:

- pH probe(s).

1 Phosphorus Analyzer(s) will be provided as follows:

- Phosphate analyzer(s).

1 Filtrax Sampling System(s) will be provided as follows:

- Sampling system.

1 Process Controller(s) consisting of:

- Controller and display module(s).

2 Process Controller(s) consisting of:

- Controller(s).

1 Process Control System will be provided as follows:

- Hach SC1000 display module.
- FRP enclosure(s) for SC1000 Display.

1 Ammonium Probe(s) will be provided as follows:

- Ammonium probe(s).
- Controller(s).

AquaNereda: Sludge Buffer

Transfer Pumps/Valves

1 External Pump Assembly(ies) consisting of the following items:

- 7.5HP Pump assembly(ies).

1 Sludge Valve(s) consisting of the following items:

- 3 inch DeZurik electrically operated Plug Valve(s).

1 Supernatant Valve(s) consisting of the following items:

- 6 inch DeZurik electrically operated Plug Valve(s).

Sludge Removal System

1 Solids Removal Assembly(ies) consisting of:

- Solids removal assembly(ies) consisting of PVC and/or HDPE pipe with supports.

Level Sensor Assemblies

1 Pressure Transducer Assembly(ies) each consisting of:

- Pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting pipe weldment(s).

1 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

Instrumentation

1 Hach TSS WAS Sensor(s) will be provided as follows:

- Hach Solitax Inline sc stainless steel pipe isertion probe with stainless steel wiper and 33 ft electric cable. One (1) probe per basin.

1 Process Controller(s) consisting of:

- Controller and display module(s).

AquaNereda: PLC Controls

Controls wo/Starters

1 Controls Package(s) will be provided as follows:

- NEMA 12 panel enclosure suitable for indoor installation and constructed of painted steel.
- Fuse(s) and fuse block(s).
- Compactlogix Processor.
- Operator interface(s).
- Remote access Ethernet modem(s).

Item 5: Final Clarifier

OVIVO Worldwide Experts in Water Treatment

BUDGET PROPOSAL

DATE: 05/02/2023

TOWN OF CENTREVILLE, MD

SECONDARY CLARIFIER MECHANISMS BUDGETARY QUOTE

PREPARED FOR

Whitman, Requardt & Associates, LLP
David R. Nixson, P.E.

AREA REPRESENTATIVE

Sherwood-Logan & Associates
Andrew Kreider, P.E.
AKreider@sherwoodlogan.com

NOTE

PREPARED BY

Cedric Sirantoine
Phone (801) 931-3000
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Ovivo USA, LLC
4246 Riverboat Road – Suite 300
Salt Lake City, Utah 84123-2583

Revision	Date	Description
Original		

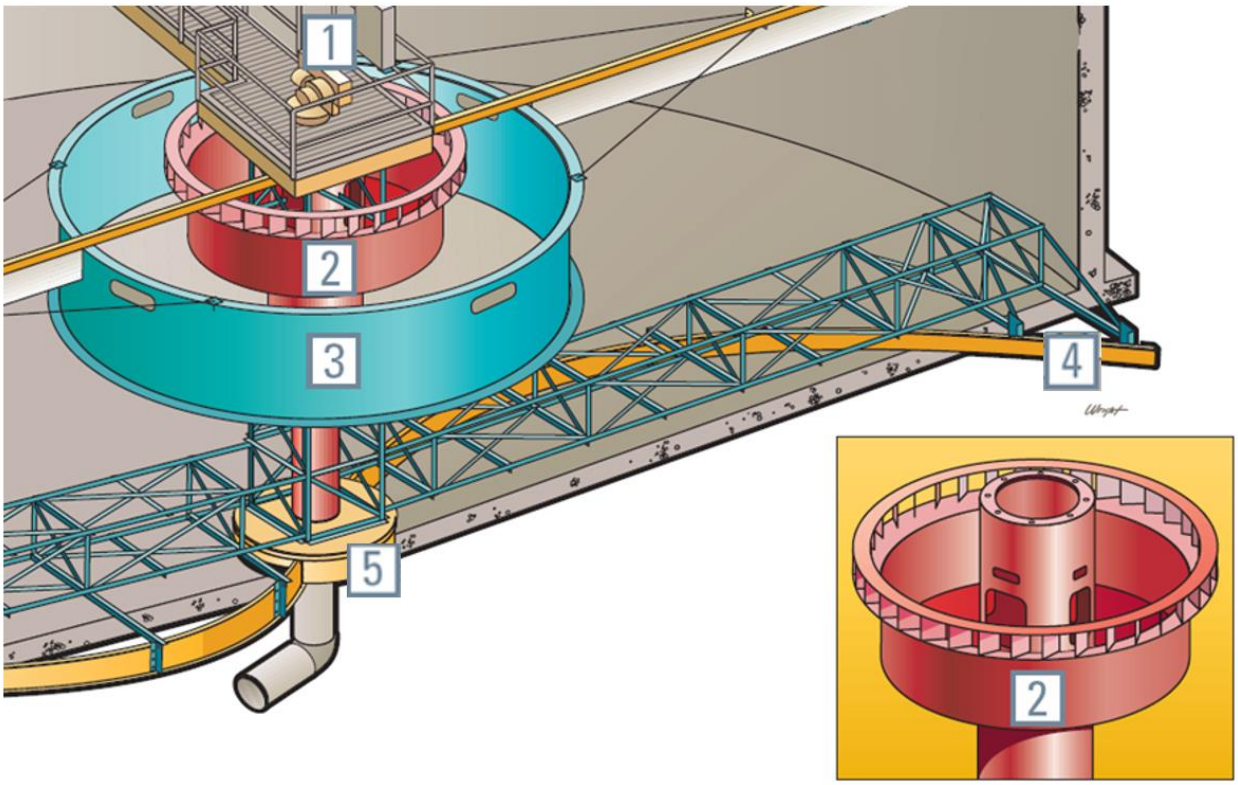
REQUEST:

Whitman, Requardt & Associates, LLP requested a budget proposal for the supply of two new 60' secondary clarifier mechanisms for the upgrade of the Town of Centreville, MD WWTP.

SCOPE OF SUPPLY:

OVIVO proposes the supply of two (2) new 60' diameter sludge rapid removal clarifiers with its C4D-360-FTS type spiral scraper clarifier mechanism.

Ovivo's Spiral Scraper Clarifier offers rapid sludge removal with spiral blades and a rotating sludge collection drum. The Spiral Scraper Clarifier offers full radius skimming and an enhanced energy dissipation well: the EquaFlo 360™.



1 : Drive
2 : EquaFlo360™ EDI
3: Feedwell
4: Scraper spiral blade
5: Sludge collection drum

ITEM I – SECONDARY CLARIFIERS – Ovivo type C4D-360-FTS

Ovivo (formerly EIMCO Water Technologies) proposes to supply two (2) Ovivo type C4D-360-FTS Clarifier Mechanisms suitable for installation in new 60' diameter concrete tanks. The design of the proposed mechanisms is based upon our standard engineering practices and details which will meet the intent of the Engineer's specifications.

ITEMS INCLUDED PER CLARIFIER:

- Complete Ovivo C30HT drive assembly, with:
  - 30" pitch diameter main gear
  - 35" diameter ball bearing with liner strips
  - Cast iron turntable
  - Gear motor, chain and sprocket.
  - Epoxy coated aluminum drive control with 3 alarm switches

  Drive unit is completely factory assembled, calibrated, tested and finish painted. C30HT Drive is rated at 17,100 ft-lbs AGMA 20 years Cont. @ 0.05 rpm
- Clarifier control panel: NEMA 4X SST enclosure, uses 480VAC, 3ph, 60hz, Hand/Off/Auto selector switch, push buttons, alarm horn, test circuit.
- Walkway steel beams design extending from the tank wall to the center operating platform, 3' wide with 1-1/4" aluminum I-bar grating.
- Platform, 8ft square, steel frame and 1-1/4" aluminum I-bar grating.
- Aluminum handrail around platform and walkway, 1-1/2" diameter 2-rail with 4" toe channel, mechanical system.
- Cage, square box truss design, steel.
- Rake arms, two full radius arms, square box truss design, with spiral blades and 304 SS squeegees.
- Sludge collection manifold in carbon steel
- Center column 20" diameter x ¼" plate, flanged with influent ports, steel.
- EquaFlo360™ EDI, 6' dia x 2'-6" deep, 3/16" thick plate, with distributing vanes all around the perimeter.
- Feedwell 16' diameter x 5'-0" deep x 3/16" steel plate, with supports from rake arms.
- Two (2) full radius scum skimmers with one full radius scum collection trough.
- Anchor bolts, 316 Stainless Steel.
- Assembly fasteners, 316 Stainless Steel.
- Operation and Maintenance manuals.
- Service as noted in the "Field Service" section of this proposal.
- Surface preparation and paint as noted in the "Surface Preparation and Paint" section of this proposal.
- Freight, FCA factory, freight allowed to jobsite.

ITEMS NOT INCLUDED (But not limited to the following):

- Field welding. Minimal field welding will be necessary.
- Anchor templates and grout shield. We provide bolt circle dimensions for the center column and anchor positions.
- Demolition or erection services.
- Finish painting.
- Lamp posts.
- VFD controller.
- Lubricants.
- Electrical controls or control panels, push button stations, alarms, starters, mounting plates or brackets, conduit, wiring, mounting channels, photocells, etc… other than clarifier control panels.
- Stairways, access walkways, interconnecting walkways, gratings, etc., outside tank.
- Handrail around tank.
- Scum piping below or flexible connector to scum box stub nozzle.
- Dissimilar metals protection (bituminous paint or isolation tape) for aluminum handrail and grating mounted to steel walkway members. Mastic/sealant/packing is also by others.
- Tank, platform or feedwell covers of any kind.
- Any field measurements required for provision of this equipment.

WEIGHTS:

APPROXIMATE TOTAL WEIGHT OF ONE (1) MECHANISM	21000 LBS.
APPROXIMATE WEIGHT OF THE HEAVIEST SINGLE COMPONENT	2300 LBS.

FIELD SERVICE PER CLARIFIER:

Our proposal includes the service of a qualified service engineer for the following:

- Four (4) Days / Two (2) Trips at the site to assist in adjusting, servicing, and checking out these mechanisms, and in training the operators in maintenance, troubleshooting, and repair of the equipment. Static torque testing is included in these services.

SURFACE PREPARATION AND PAINT

Ovivo's drive unit will receive a surface preparation of SSPC-SP-06 and will be coated with two (2) coats of Tnemec N69F and one (1) top coat of Tnemec Endura-shield 73. Gearmotors are coated by the manufacturer.

Submerged and non-submerged fabricated steel will receive a surface preparation of SSPC-SP-06 and will be coated with one (1) coat of Tnemec N69F. Finish paint on the mechanism is not included and shall be provided in the field by installing contractor.

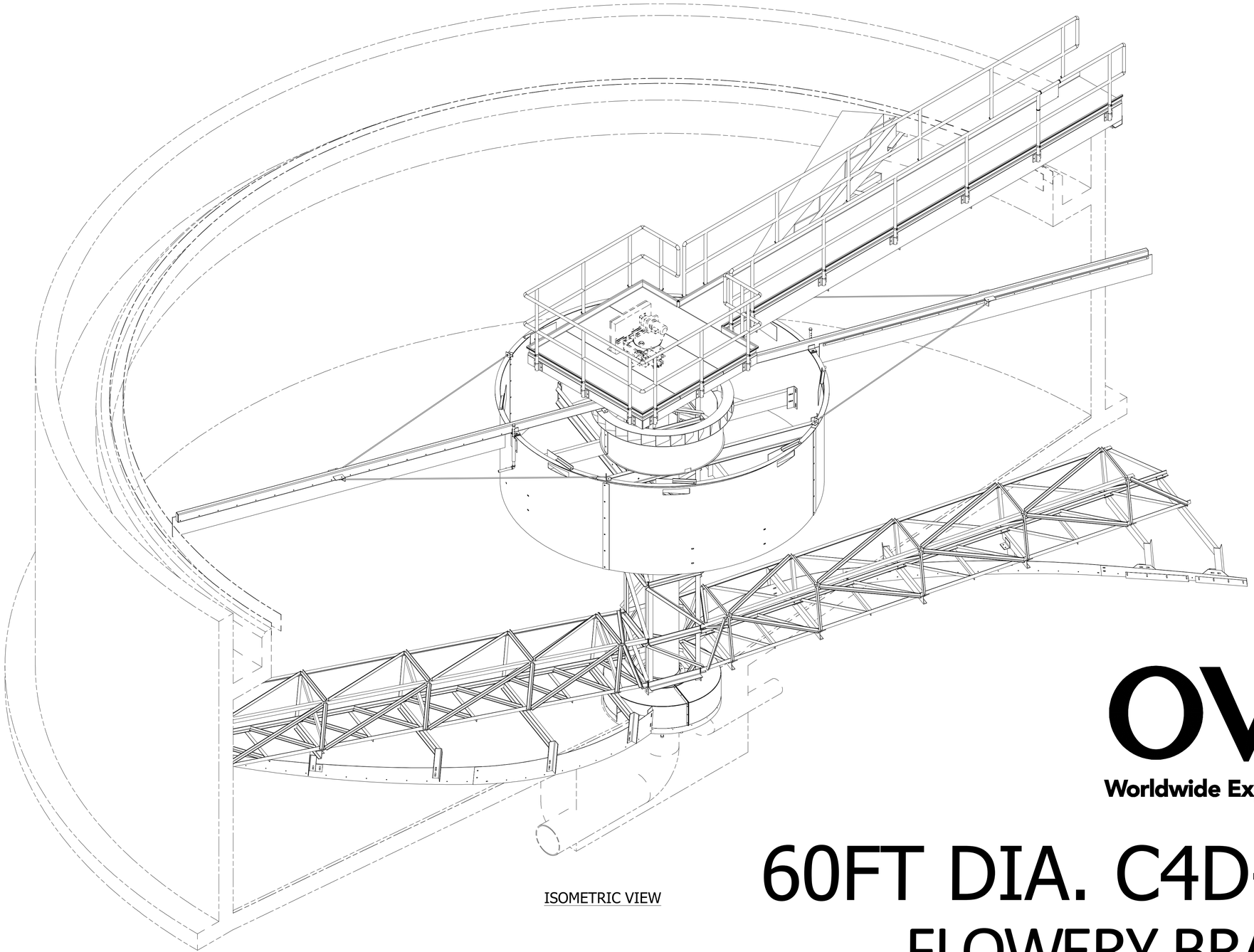
Alternate: Submerged and non-submerged fabricated steel will be 304 stainless steel

PRICING

ITEM	SPECIFICATION SECTION	EQUIPMENT	ESTIMATED SHIP DATE*	PRICE
I	N/A	Two (2) Spiral blade clarifier C4D-360-FTS (primed carbon steel)	*	$ 583,000
I	Alternate	Two (2) Spiral blade clarifier C4D-360-FTS (304SST)	*	$ 775,000

DELIVERY

*Ovivo will submit drawings for approval within **ten (10) weeks** after Purchaser's receipt of Ovivo's written acknowledgement of an approved purchase order. Ovivo intends to start shipping the Products **thirty-two (32) weeks** after receipt of approved drawings from Purchaser.



ISOMETRIC VIEW

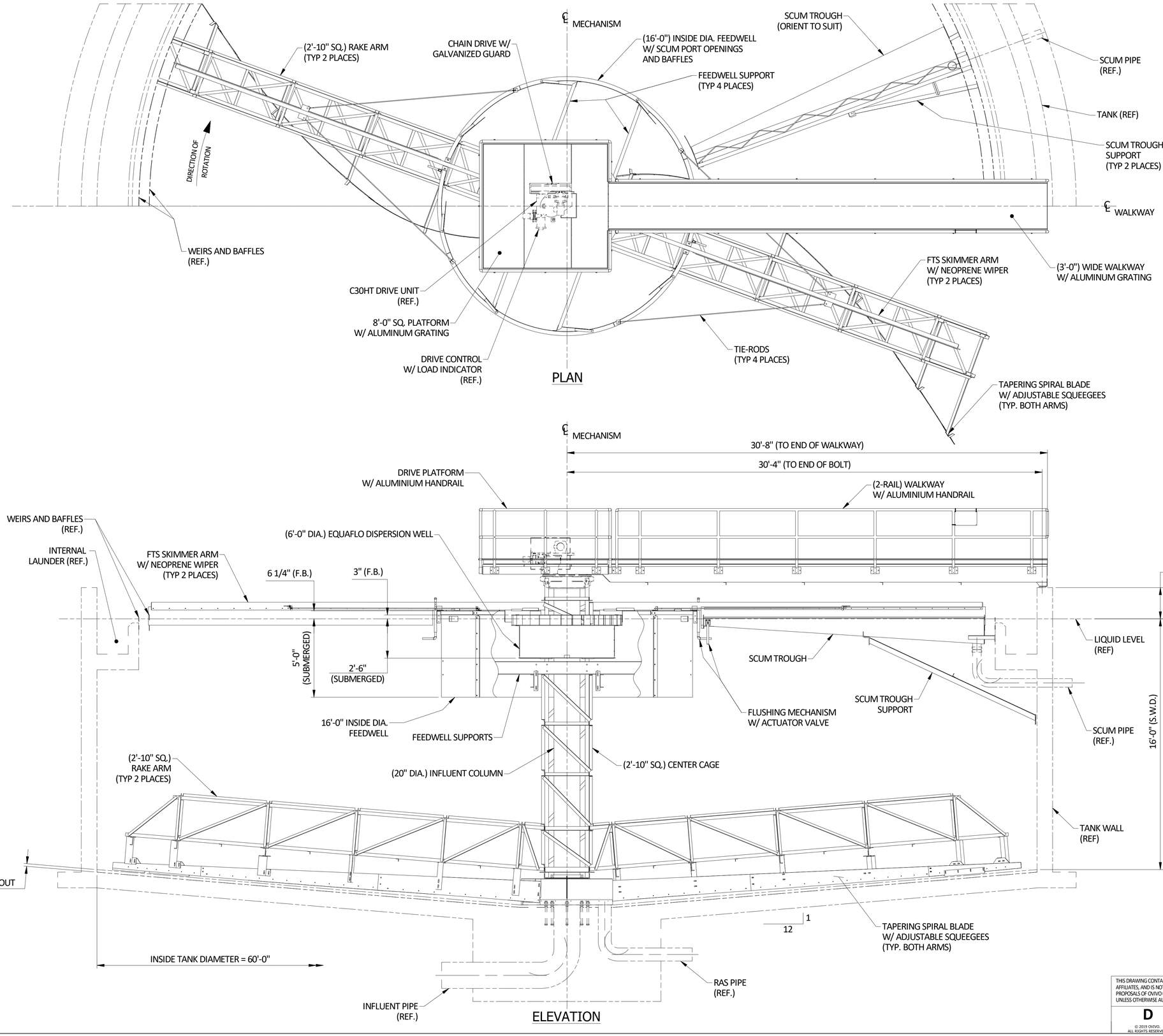
OVIVO

Worldwide Experts in **Water Treatment**

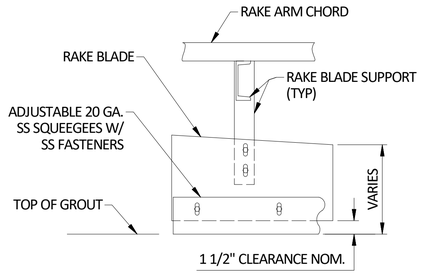
60FT DIA. C4D-FTS CLARIFIER

FLOWERY BRANCH WRF, GA

						D			THIRD ANGLE PROJECTION	OVIVO **Worldwide Experts** in **Water Treatment**	
							REF. FROM	--	DO NOT SCALE PRINTS	**GENERAL ARRANGEMENT 60'-0" DIA. TANK C4D-FTS TYPE CLARIFIER**	
							DATE (mm/dd/yyyy)	7/22/2020	**WORKMANSHIP STANDARD ES0001 APPLIES**		
INITIAL RELEASE					A	DRAWN	AK	ORIGINAL S.O.	DWG. NO.	60FT_C4D-FTS_FLOWERY-251	SHEET **1** OF **2**	REV **A**
REVISION DESCRIPTION	EN/ECO	BY	CHECK'D	DATE	REV	CHECK'D	SSS	SALES ASSIST			



PLAN



SPIRAL BLADE DETAILS

ELEVATION

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Worldwide Experts in Water Treatment

D	DO NOT SCALE PRINTS	DWG. NO.	60FT_C4D-FTS_FLOWERY-251	SHEET 2 OF 2	REV A

WORKMANSHIP STANDARD ES0001 APPLIES

SECTION -----
SECONDARY CLARIFIER EQUIPMENT
COLUMN-SUPPORTED SPIRAL SCRAPER TYPE

PART 1 - GENERAL

1.01 DESCRIPTION

A. There shall be furnished two (2) clarifier mechanisms, each suitable for installation in a concrete basin as shown on the contract drawings.

B. Each mechanism shall be a center column supported center feed unit with peripheral effluent collection. A center drive mechanism shall be provided for rotation of the two rake arms with spiral type rake blades.

C. The equipment shall be designed to effectively settle mixed liquor suspended solids and scrape the settled solids from the basin floor to the sludge withdrawal drum as shown on the drawings. The clarified effluent shall be collected uniformly by the peripheral launder. Surface scum shall be collected by the scum skimming equipment and discharged through the scum withdrawal pipe.

D. The equipment furnished for each clarifier mechanism shall include but not be limited to: walkway with handrails, center drive assembly, center drive platform, center support column with inlet openings, flocculating feedwell, inner dispersion inlet well (EDI), center cage, sludge collection arms with spiral rake blades, rotating sludge collection drum, surface scum skimming equipment, effluent weir plates and scum baffle, peripheral density wall baffles, anchor bolts and assembly fasteners.

E. Except where specifically indicated otherwise, all plates and structural members designated for submerged service shall have a minimum thickness of 1/4 inch. All structural steel will conform to ASTM A-36 requirements and steel plate will conform to ASTM A283C requirements. All anchor bolts used to secure the mechanism to the tank shall be 316 stainless steel. All fasteners shall be high strength steel. Handrail, skimmer, and rake blade squeegee fasteners shall be 304 stainless steel.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A.	CONCRETE	Division 3
B.	STEEL MATERIAL	Division 5
C.	FINISHES	Division 9
D.	CONTROLS	Division 13
E.	MOTORS	Division 16

1.03 PROCESS REQUIREMENTS

A.	Design average flow	(*) MGD
B.	Design Peak flow	(*) MGD
C.	Design average recycle flow	(*) MGD
D.	Design maximum recycle flow	(*) MGD
E.	Design average solids loading rate	(*) lb/day/ft^2
F.	Design maximum solids loading rate	(*) lb/day/ft^2

G.	Drive continuous torque	17,100 ft-lb
H.	Drive 100% design torque	25,000 ft-lb
I.	Drive momentary peak torque	68,000 ft-lb
J.	Mechanism rotation	Clockwise
K.	Rake arm tip speed,	8-12 ft/min

1.04 DESIGN REQUIREMENTS

A.	Basin diameter	60'-0"
B.	Side water depth	14'-0"
C.	Tank freeboard	18"
D.	Floor slope	1:12
E.	Center column diameter	20"
F.	Feedwell diameter	16’-0”
G.	Feedwell submerged depth	5’ 0”
H.	Energy dissipating inlet (EDI) diameter	6’-0”
I.	EDI submerged depth	2’-6”
J.	Cage minimum size	2’-10” square
K.	Rake arm minimum size	2’-10” square
L.	Spiral blade height at tank wall	6"
M.	Spiral blade height near tank center	18"
N.	Rotating sludge drum diameter	5’-10”
O.	Rotating sludge drum height	18"
P.	Scum trough width	full clarification radius

1.05 FIELD SERVICE REQUIREMENTS

A.	Number of eight-hour days	4
B.	Number of trips to jobsite	2

1.06 REFERENCES

A. American Society of Testing Materials (ASTM):
   1. A-36 Structural Steel Specifications
   2. 304 Bolt Specifications
   3. A-123 Hot-Dip Galvanized Coatings
   4. A-153 Hot-Dip Galvanized Bolts
   5. A-48 Cast Iron Specifications
   6. A-536 Ductile Iron Specifications
   7. A-283C Steel Plate Specifications

B. American Iron and Steel Institute (AISI), Heat Treated Steel Specifications

C. American Gear Manufacturers' Association (AGMA), Gear Ratings

D. American Welding Society (AWS), Current Standards

E. Anti-friction Bearing Manufacturers' Association (AFBMA), Bearing Life Specifications

F. National Electrical Manufacturer's Association (NEMA), Motor Design Standards and Standards for Control Enclosures

1.07 QUALITY ASSURANCE

A. The clarifier equipment manufacturer shall modify his standard equipment to meet the minimum values specified for dimensions, design, and the intent of this specification.

B. The clarifier equipment shall be manufactured by Ovivo, USA (formerly EIMCO Water Technologies).

C. Manufacturers regularly engaged in the manufacture of the clarifier equipment as specified herein and who can demonstrate equipment of this specified design, in actual service for a period of not less than 5 years will be considered as acceptable manufacturers.

D. Manufacturers shall show evidence of quality assurance in manufacturing and supplying equipment essential in details to the equipment herein specified.

E. Manufacturers not named in the specification and meeting the requirements as set forth in paragraph C and D must submit to the Engineer, 15 working days prior to the bid date, detailed information describing how their proposed equipment will meet the specification. The detailed information shall include, but not be limited to dimensional data, materials of construction and an installation list with address, telephone number, and an individual's name directly employed by the owner of the equipment. Plan holders will be notified of approved manufacturers by addendum, five (5) working days prior to bid date.

1.08 CONTRACTOR'S SUBMITTALS

A. The contractor shall submit complete shop drawings of all equipment furnished for this project as covered by these specifications. The contractor's submittal must include a certification that the submitted material describes exactly the equipment to be provided. Substitutions of equipment subsequent to submittal approval will not be accepted.

B. The clarifier equipment manufacturer shall furnish as a minimum the following design and description information to establish compliance with these specifications:

1. Certified general arrangement and tank dimensional drawings.
2. Certificate of design stamped by a Registered Professional Engineer stating that the equipment to be provided for this project meets or exceeds all design requirements of these specifications. The certificate shall state the respective loads and design criteria.
3. Drive mechanism rating calculations, stamped by a Registered Professional Engineer, verifying the compliance of the drive gears and bearings with the specified continuous torque rating and bearing life rating.
4. Motor data and catalog information. Electrical drawings as applicable to the supply of the clarifier equipment manufacturer.
5. Catalog cut sheets for purchased sub-components.

1.09 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals will be provided by the clarifier manufacturer at least two weeks prior to shipment of all major equipment components. Each manual shall be a bound, indexed binder with drawings and parts lists prepared specifically for this project rather than general instructions that are not designed for this project.

B. As a minimum the manual shall contain:

1. Certified as-built drawings (general arrangement and general arrangement detail drawings).
2. Erection drawings.
3. A complete bill of materials for the equipment including the weights of all structural steel components.
4. Installation and maintenance instructions for the specific equipment including the erection sequence, maintenance and trouble-shooting check points, and complete lubrication procedures with recommended grades of lubricants.
5. Cut sheets for all equipment items purchased from sub-vendors.
6. A list of the clarifier manufacturer's recommended spare parts specifically denoting wear items, long delivery items, and all items convenient for stocking as optional replacement items.

1.10 DELIVERY

A. Fabricated assemblies shall be shipped in the largest sections permitted by carrier regulations, properly match-marked for ease of field erection.

B. All components shall be erected immediately upon receipt from the clarifier manufacturer or stored in strict conformance with storage recommendations provided by the clarifier manufacturer in the operations and maintenance manual.

C. The mechanism shall be lubricated in strict accordance with the instructions of the clarifier manufacturer's field service representative. The required lubricants shall be provided by the contractor.

PART 2 - PRODUCTS

2.01 GENERAL

A. Each clarifier mechanism shall be of the center-drive type, supported on a stationary influent column, with the flow entering at the bottom of the influent column and flowing upward to the inlet openings and dispersed into the tank through the EDI and flocculating feedwell. The clarifier shall be designed to remove sludge uniformly from the bottom of the tank.

2.02 CENTER DRIVE ASSEMBLY

A. The center drive assembly shall consist of an integral motor and primary speed reducer coupled through roller chain and sprockets to a secondary worm/worm gear

reducer driving the main gear through a pinion and shall have an integral overload protection system.

B. All gears and bearings shall be oil bath lubricated with the main bearing totally submerged in oil and the teeth of the main spur gear submerged at least 70 per cent in the oil bath. Oil pumps for lubrication or grease lubricated bearings are not considered appropriate for this application and will not be allowed. The oil reservoir for the main bearing and gear shall have a section of minimum depth 5 inches below the main bearing to positively prevent contamination of the main bearing and gears with condensate or other contaminants. Gear and bearing housings must also be fitted with oil level sight glasses and condensate drains. Condensate must be allowed to drain from a low point of the housing. Condensate and contaminants will not be allowed to drain through the lower pinion bearing.

C. Drive components will be located via a machined, registered fit to preserve the alignment of key drive components under all load conditions. Inspection of the completed drive unit shall be accomplished at the clarifier manufacturer's shop, with reports of all tests and certifications of material hardness being made available for review at the Engineer's request prior to shipment to the job site.

D. Major drive components, main gears and bearings must be designed to allow for separate and individual replacement by plant personnel to facilitate quick and economical repairs.

E. The complete center drive assembly, including the overload protection device, shall be a regularly manufactured in-house product of the clarifier manufacturer. The center drive assembly is a key element in a successful clarifier installation, therefore drive assemblies purchased from third party vendors will not be accepted.

F. The drive motor shall be minimum 3/4 horsepower and shall be totally enclosed, fan cooled, with a 1.15 service factor, and have bearings with a minimum B10 rating of 50,000 hours. Operating electric current will be 230/460 volt, 3 phase, and 60 hertz. Each motor will be NEMA Design B employing Class F insulation designed for an ambient temperature of 40 degree. C.

G. The gearmotor primary speed reducer shall drive a secondary worm gear reducer through a #60 roller chain and steel sprockets enclosed in a galvanized 22 gauge steel guard. A constant speed motor shall drive the speed reducer. Sprockets and chain shall be designed for the connected horsepower of the drive with a minimum service factor of 4.0. Provision shall be made for adjustment of chain tension.

H. The main drive unit shall consist of a worm gear secondary reduction unit, pinion and main spur gear assembly. The secondary reducer shall be a worm/worm gear reducer specifically designed for this application. The worm gear shall be centrifugally cast high strength manganese bronze. The worm shall be hardened alloy steel. A single piece pinion shall be keyed to the worm gear to transmit power from the worm gear to the spur gear. In order to maintain proper alignment between the pinion and the spur gear, the pinion will be supported by bearings both above and below the spur gear. The bearings shall be fitted into precision machined bearing pilots to positively insure bearing and gear alignment.

I. The main spur gear material shall be high strength ductile iron per ASTM A536 grade 100-70-03 or equal. The gear shall have a nominal pitch diameter of 30 inches with a 4.75 inch face width or the equivalent nominal spur gear surface area of 440 square inches. Spur gear surface area is defined as the spur gear pitch diameter multiplied by the spur gear face width multiplied by 3.14.

J. The main gear shall rotate and be supported on a ball bearing assembly provided with four replaceable liner strips fitted into the main gear and turntable base. Liner strips shall be special vacuum degassed carbon corrected alloy steel hardened to a Rockwell hardness of at least 43 to 46 RC. The turntable base shall be a minimum 1 inch thick to insure adequate structural rigidity to properly support the drive bearing and gear.

K. The main gear and bearing shall be completely enclosed in an ASTM A-48 Class 30A cast iron housing provided with neoprene dust seals. In order to ensure the maximum possible base rigidity and vibration dampening, the gear housing shall be of full sidewall construction, integral with the base. Prior to assembly, the base shall be thoroughly inspected for seep holes or inclusions and given a hydrostatic test to insure no leaks are in the oil containment area. Shop inspection reports must be made available for review.

L. The drive unit shall be equipped with an electro-mechanical overload control device actuated by thrust from the worm shaft. The pointer shall provide a visual reading of the relative main gear output torque on a 0 to 100 percent graduated scale. The 100 percent reading shall equal the 100 percent drive rating as specified in section 1.03. The control device shall also activate an alarm switch for warning of impending overload, a motor cutout switch for overload protection and a back-up safety motor cutout switch for back up overload protection. In lieu of a back-up safety motor cutout switch a slip clutch assembly will be acceptable upon review by the Engineer. The respective switches in the overload control device shall be factory calibrated and set to the following settings:

1. Alarm - 40% of scale
2. Motor cutout - 85% of scale
3. Back-up motor cutout or slip clutch - 100% of scale.

All drive control components shall be mounted in a weatherproof enclosure of either epoxy coated aluminum construction or stainless steel with a gasket-sealed, removable cover. The pointer shall be covered with a clear plastic enclosure and shall be above the walkway surface for visibility from the walkway. Amperage sensing devices are not acceptable for torque overload protection due to their inability to react quickly enough to prevent damage to the drive. Overload devices with exposed linkage connections will not be accepted due to possible corrosion problems. Devices which react to rotational movement of the secondary reduction unit will not be allowed due to possible misalignment of gearing created by the movement of the reduction unit.

M. The center drive unit shall be designed for the continuous torque rating as specified in section 1.03. The continuous torque shall be defined as the minimum torque at which the drive mechanism may operate continuously 24 hours per day, 365 days per year, for 20 years, at the specified sludge collector arm speed. Main gear and

pinion calculations shall be based upon ANSI/AGMA 2001-C95 standards for rating the pitting resistance and bending strength of involute spur and helical gear teeth. Calculations shall clearly present the values used for the following design parameters:

1. Number of pinions
2. Actual face width
3. Tooth geometry (I and J factors)
4. Load distribution factor
5. Allowable contact stress
6. Allowable bending stress
7. Pinion pitch diameter
8. Hardness ratio factor
9. Elastic coefficient
10. Life factor

The load distribution factor shall be determined by the empirical method. For parameters which are material dependent, such as allowable contact stress, the calculations shall include a complete description of material and heat treatment used.

Worm gearing shall be designed and rated to equal or exceed the specified continuous torque and life. The basis for rating shall be ANSI/AGMA 6034-B92 standards for durability rating and design of worm gear reducers.

The continuous torque rating for the drive unit shall be the lowest value determined for the gearing.

2.03 WALKWAY ACCESS BRIDGE

A. The clarifier shall be provided with a 36 inch clear open width walkway extending from the tank wall to the center drive platform. The walkway shall be supported at the center by the drive unit and supported on the opposite end by the tank wall. As a minimum the walkway shall be designed to safely withstand all dead loads plus a live load of 50 pounds per square foot with a maximum deflection of l/360, over the entire span. The walkway shall consist of beams or a structural steel truss, with either sufficiently braced to resist the specified design loads. The walkway decking shall be 1-1/4 inch aluminum I-Bar grating.

B. A center drive operations platform shall be provided. It shall be a minimum of 8 feet square to provide clearance around the center assembly and drive control for maintenance and service. The drive platform shall be decked with 1-1/4 inch aluminum I-Bar grating and have sufficient structural steel supports to meet the specified design load conditions.

C. Provide handrails with toe plate along both sides of the walkway and around the center drive platform. The handrailing shall be in conformance with the handrail specifications, found within this set of bid documents, and shall be as shown on the drawings.

2.04 CENTER CAGE AND RAKE ARMS

A. The center cage shall be of steel box truss construction, with connections for the two (2) sludge removal arms, rotating sludge collection drum and feedwell supports. The top of the cage shall be bolted to the main gear which shall rotate the cage with

the attached arms and feedwell. The minimum angle size used for construction of the cage and rake arms shall be 2 inch x 2 inch x 1/4 inch members.

B. The clarifier mechanism shall include two (2) sludge removal arms of steel truss construction, with steel spiral rake blades and adjustable 20 gauge 304 stainless steel squeegees. The rake blades shall provide complete raking of the basin floor twice per revolution.

C. The rake blades shall consist of a minimum 3/16 inch thick steel plate. The blades shall be constructed to a logarithmic spiral curve with a constant 30 degree angle of attack. Blade depth shall vary as noted in Article 1.04. Each rake truss support arm shall be provided with the necessary outrigger bracing and other blade support structures, to ensure that the complete blade can be properly located and adjusted in the field.

D. The rake blades shall terminate in the center to within 1 inch of the rotating sludge collection drum. The 1 inch space shall be sealed with a neoprene seal.

E. The structural calculations for the rake arm shall include an analysis of the torsional loads from the spiral curve blade.

F. The cage and rake arms shall be designed such that calculated stresses do not exceed the AISC allowable stress at the drive 100% rating.

2.05 ROTATING SLUDGE COLLECTION DRUM

A. A rotating sludge collection drum shall be provided to collect settled solids raked to the center by the rotating spiral blades. The collected sludge shall be discharged from the tank by way of the RAS sludge pipe as shown on the contract drawings.

B. The sludge collection drum shall rotate with the center cage and shall be provided with sludge collection ports located directly in front of each rotating spiral rake blade. The ports shall be sized to collect thickened sludge from the bottom most dense sludge layer to maximize underflow solids concentration.

C. The rotating sludge drum shall be constructed of ¼ inch steel plate. A neoprene seal shall be provided to seal against the center column. A stainless steel seal shall be provided to seal against the tank floor.

2.06 CENTER COLUMN

A. A stationary center column shall be provided which shall serve as the influent pipe. One end shall have a 1-1/4 inch support flange for bolting to the foundation with a minimum of eight (8) 1-1/4 inch diameter anchor bolts as shown on the plans. A similar flange shall be provided at the top of the column for supporting and securing the center drive assembly. Minimum center column thickness shall be 1/4".

B. Influent openings shall be provided in the upper portion of the column to allow unrestricted passage of the flow into the energy dissipating feedwell. Influent velocity shall be reduced by providing a total inlet port area a minimum of 135 percent of the center column cross sectional area.

2.07 ENERGY DISSIPATING INLET (EDI)

A The clarifier shall be equipped with an energy dispersion inlet (EDI) located inside the rotating flocculation feedwell. The dispersion well shall be designed to dissipate the energy of the incoming flow by way of evenly spaced tangentially oriented vanes along the entire 360 degrees of the EDI circumference.

B The influent column discharge ports will be set below the EDI vanes, providing immediate containment and baffling of the influent via the EDI floor and cylindrical shell.

C The lower rim of the vane support ring extends back towards the column, forming a lip that provides additional flow baffling and energy dispersion.

D The energy dissipating inlet shall have a bottom plate extending to within one inch of the center column. The bottom plate of the EDI shall be provided with properly sized drain holes.

E The well shall be constructed of 3/16 inch plate.

2.08 FLOCCULATING FEEDWELL

A. The flocculating feedwell shall be supported by structural members attached to the rotating center cage. The feedwell shall be fabricated out of 3/16 inch steel plate with upper and lower reinforcing rim angles and stiffeners as required. Properly sized scum ports shall be equally spaced around the feedwell periphery to allow scum to exit from the feedwell at water level.

2.09 SURFACE SCUM SKIMMING EQUIPMENT

A. Each clarifier shall be equipped with two full radius skimmer arm assemblies to collect and discharge surface scum into a full radius scum trough cantilevered from the tank wall.

B. Each skimmer arm shall be either a structural steel truss assembly or a fabricated tube assembly connected to the center cage and cantilevered from the rotating feedwell. Tie rods shall be properly located to allow adjustment of the skimmer arm as well as to resist horizontal forces.

C. Each skimmer arm shall be equipped with a hinged 1/2 inch 60 durometer neoprene wiper blade extending the full width of the arm. The neoprene blade shall be fastened to the arm with stainless steel fasteners with steel back-up bars

D. The full radius scum trough shall be fabricated from 1/4 inch steel plate and shall be supported from the tank wall as shown on the drawings. The trough and support structure shall be designed for all dead loads plus a 200 hundred pound point load at the feedwell end of the trough with no more than 1/2 inch deflection. The approach ramp of the trough shall be of radial design, having a tapered width and a variable slope that will enable the full length of the skimmer wiper to make simultaneous and continuous contact with the entire ramp along a radial line, at

each revolution of the skimmer arm. The trough shall be 8 inches wide with a uniformly sloped bottom to allow scum to discharge toward the tank wall. Fabrication of the trough shall be true and free of warpage. A 6 inch schedule 40 pipe connection shall be provided at for connection to the scum drain line.

E. The clarifier equipment manufacturer shall furnish a flush valve assembly for automatic flushing of the scum trough and scum pipe. The flush valve assembly shall be adjustable to allow 0 to 20 gallons of clarified effluent to enter the scum trough as the skimmer assembly passes over the scum box. The assembly shall consist of a stainless steel lever, UHMW seal plate and neoprene diaphragm mounted to the scum trough. The diaphragm shall be opened and closed by an easily adjustable, submerged actuation arm mounted to the rotating feedwell. The flush volume adjustment mechanism shall be above the water level and shall include at least three settings.

2.10 EFFLUENT WEIR AND SCUM BAFFLE

A. Effluent weir plates shall consist of 9 inch deep x 1/4 inch thick FRP sections with 2-1/2 inch deep 90 degree V-notches at 6 inch intervals. The weir sections shall be fastened to the tank wall using 304 stainless steel cinch anchor bolts hex nuts and 5 inch diameter FRP washers, allowing for vertical adjustment. To prevent leakage all surfaces between the launder walls and weir plates shall be given a seal coat of suitable mastic by the erection contractor.

B. The scum baffle plates shall consist of 12 inch deep x 1/4 inch thick FRP sections supported from the tank wall by FRP angle brackets secured with 304 stainless steel cinch anchor bolts and hex nuts, allowing for vertical and radial adjustment.

2.11 PERIPHERAL DENSITY CURRENT BAFFLES

Insert specification language if applicable

2.12 SURFACE PREPARATION AND PAINTING

A. All non-submerged steel shall be sandblasted to SSPC-SP-6 specifications and given one coat of manufacturer's epoxy primer 2-3 MDFT. All submerged steel shall be sandblasted to SSPC-SP-10 specifications and given one coat of manufacturer's epoxy primer 2-3 MDFT.

B. Prior to assembly of the drive unit, the castings shall have been sandblasted and thoroughly cleaned to remove any foreign particles in the drive base. After assembly, the drive mechanism shall be solvent cleaned and power wire brushed as needed prior to application of manufacturer's standard primer.

C. Gear motors shall be furnished with manufacturer's standard enamel.

2.13 SPARE PARTS

A. The following spare parts shall be provided.
   1. One (1) sight glass or dip stick for each main drive housing containing oil.
   2. One (1) set of neoprene skimmer wipers for each mechanism.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The equipment shall be erected in strict accordance with the manufacturer's recommendations. A 2" layer of grout shall be applied to the tank floor in strict accordance with the manufacturer's recommendations. Screed boards shall be supplied by the erecting contractor.

3.02 SERVICE

A. The equipment manufacturer shall provide a service representative properly trained in inspection and operation of the mechanism to approve the installation, certify that the torque settings of the drive overload protection device are correct, perform the torque test and instruct the owner's personnel on maintenance and operation. If additional service is required due to the mechanisms not being fully operational, at the time of service requested by the contractor, the additional service days will be at the contractor's expense.

3.03 TORQUE TEST

A. The clarifier mechanism shall be field torque tested. The purpose of the torque test is to verify the structural integrity of the mechanism structural steel design and center drive unit. The testing shall be carried out under the supervision of the equipment manufacturer's representative and as approved by the Engineer before the mechanisms are accepted and placed into operation.

C. The torque test shall consist of securing the rake arms by cables to anchor bolts installed by the contractor in the tank floor at locations specified by the equipment manufacturer. A load shall be applied gradually to the scraper arm by means of a ratchet lever and cylinder connected to the cable assembly.

D. The magnitude of the applied load shall be measured by calculating the torque from the distance of the line of action of each cable to the center line of the mechanism. A reading shall be taken at the 100% value of the drive design torque.

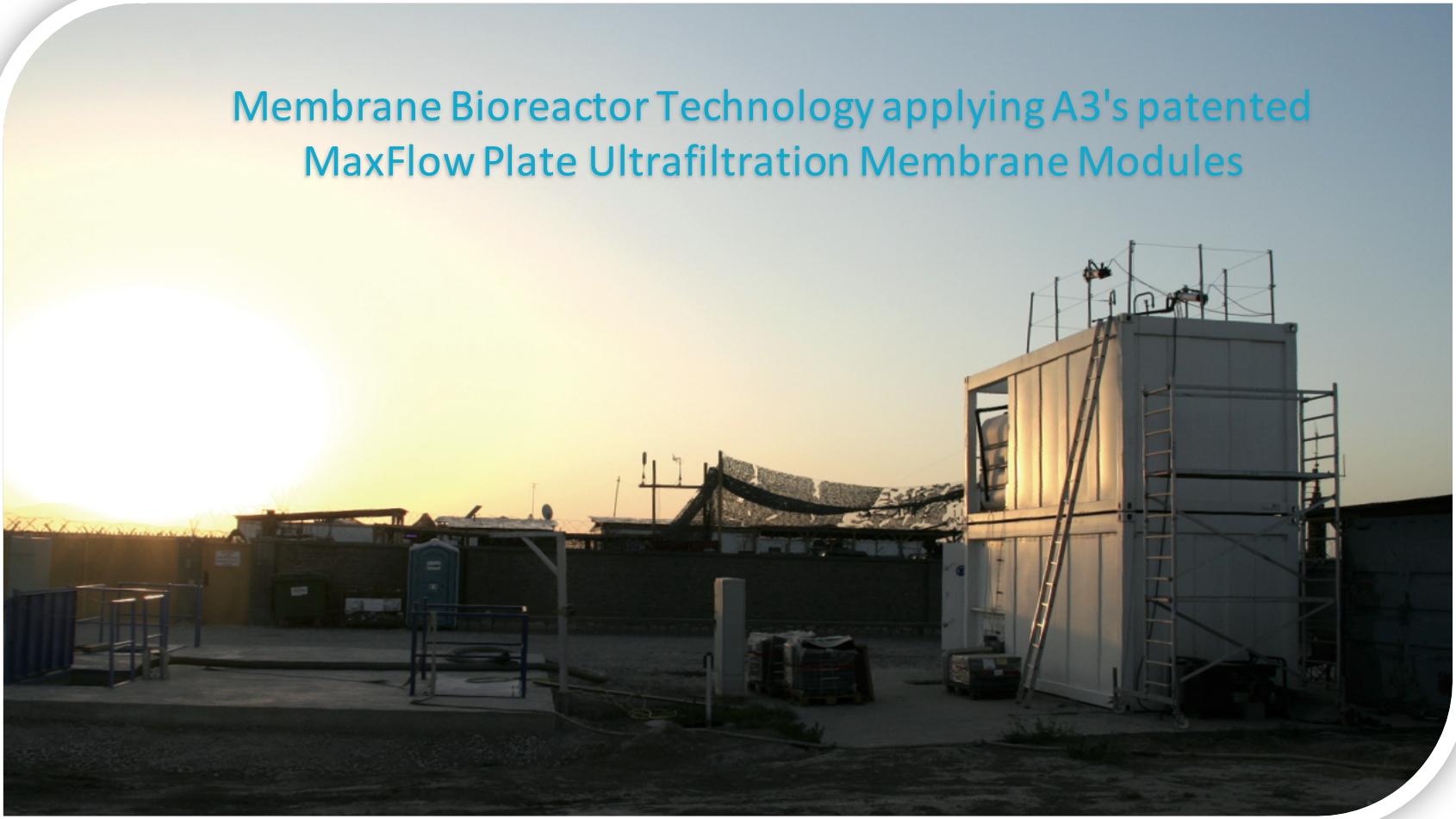
E. The manufacturer's service representative shall verify that the alarm, motor cut-out, and back up safety motor cut-out switches are properly set and are in proper operation to protect the clarifier mechanism as specified.

END OF SECTION

Item 6: Membrane Bioreactor

MODERN WASTEWATER SOLUTIONS

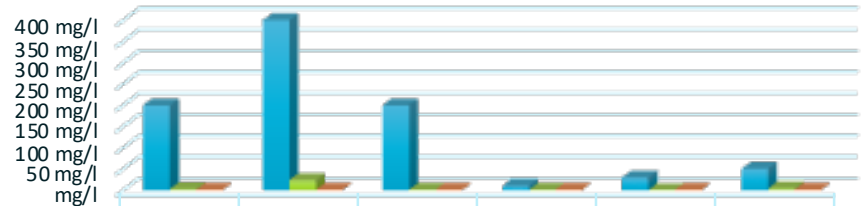
Budget Proposal # 965



A3-USA, Inc 1674 Fountaintown Road Chinquapin, NC 28521

Process Summary

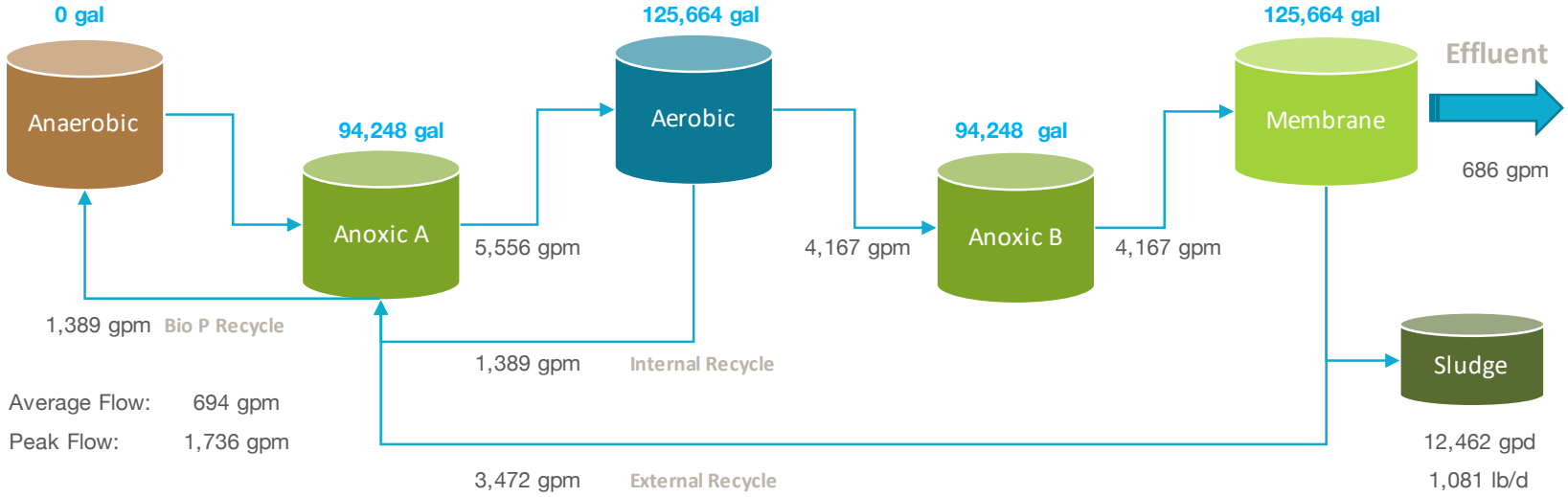
Influent & Effluent Parameters



	BOD	COD	TSS	P	NH4	TN
Influent	200 mg/l	400 mg/l	200 mg/l	10 mg/l	30 mg/l	50 mg/l
Effluent	2.0 mg/l	24.0 mg/l	1.0 mg/l	0.4 mg/l	0.3 mg/l	3.3 mg/l
Removal	99.0%	94.0%	99.5%	96.0%	99.1%	93.4%

PROCESS PARAMETERS

Sludge Age	33 d
Total Reactor Volume	439,824 gal
Total SOR	3,854 kgO2/d
MLSS in Anoxic / Aerobic Tank	10,436 mg/l
MLSS in Membrane Tank	12,569 mg/l
HRT	11 h
F/M RATIO (BOD)	0.046
F/M RATIO (COD)	0.093
Total Membrane Surface	211,575 sf



Aeration	Flow	Pressure
EQ	272 scfm	8.0 psi
Sludge	698 scfm	8.0 psi
Aerobic	582 scfm	8.0 psi
Membrane	1,187 scfm	8.0 psi

Applied Options:

NO	DAF
NO	RO

9/28/23

MBR Budgetary Equipment Cost - Option I

Column	Equipment		Quantity	Included
1	**CONTEC fine screen - 2 mm**		2	✓
		Screening press	1	✓
		Screening stand	2	✓
		Heating system	2	✓
	Controls			
2		Flow meter - liquid - E&H, Badger, ifm efector	6	✓
3		Flow meter - gas - ifm efector	2	✓
4		pH sensor - GO Systemelektronik	0	
5		Pressure & temperature sensors - ifm efector	4	✓
6		Level transducers / sensors - ifm efector, TBD	6	✓
7		Turbidity meter - GO Systemelektronik	1	✓
8		MLSS probe - Chemitec	2	✓
9		DO probe - GO Systemelektronik	4	✓
10		ORP probes - E&H	0	
	Blowers & Pumps & Mixers			
11		EQ pump - submersible sewage pumps (KSB, Faggiolati)	3	✓
12		External recyle pump - submersible propeller pumps (Faggiolati)	3	✓
13		Internal recyle pump - self priming centrifugal pumps (Phantom)	2	✓
14		Sludge waste pump - progressive cavity pumps (Seepex)	2	✓
15		Permeate pump - rotary lobe pumps (Vogelsang IQ152-158)	5	✓
16		Blowers - Tri-lobe blowers with s/s sound enclosure	8	✓
17		Mixer - Faggiolati	4	✓
18		Mixer EQ tank	0	
	Aeration Equipment			
19		EQ tank coarse bubble aeration - Jaeger	1	✓
20		Aerobic tank fine bubble aeration - Jaeger	2	✓
21		Sludge tank coarse bubble aeration - Jaeger	1	✓

Column	Equipment	Quantity	Included
	Chemical Feed Systems		
22	Membrane module cleaning in-place system	2	✓
23	Chemical feed systems (misc.) - Prominent	1	✓
24	Chemical feed systems (pH) - Prominent	1	✓
25	Chemical feed systems (alum; P removal)	1	✓
28	Chemical feed systems (Nitrogen addition)	0	
	Piping & Valves & Guide Rail Systems		
29	Liquid & air piping between skids & process basin	several	✓
30	Manual valves for air & liquid piping (check & plug & ball valves)	several	✓
31	Automatic actuated valves for air & liquid piping (ball & butterfly valves)	2	✓
32	Manual knife gate valves (all stainless steel for screen)	2	✓
33	Membrane module guide rail system	14	✓
	Membrane Modules		
34	#U20	0	
35	#U70	224	✓
36	Quick disconnect hoses for air line	14	✓
37	Quick disconnect hoses for permeate line	14	✓
	Misc. Equipment Systems		
38	Membrane sludge dewatering system	0	
39	600 KW back-up generator including transfer switch, distribution panel, step-down transformer, & 120 Volt panel	0	
40	Sludge dewatering screw press & polymer system	1	✓
41	Effluent tank including aeartion system (HDPE)	0	
42	UV system	2	✓
43	Grit removal system including conveyor (304 s/s)	0	
44	Mechanical influent grease traps (stainless steel)	0	
45	DAF system & polymer system & flocculator (100 gpm)	0	

Column	Equipment	Quantity	Included
	Tanks & skids		
46	Control Panel & MCC & SCADA	3	✓
47	Process tanks (fiberglass)	0	
48	Pre-assembled & wired equipment skid with blowers, MCC, etc. (skid material: carbon steel with Line-X liner; 55' x 9')	1	✓
49	Pre-assembled & wired equipment skid with permeate pumps, UV system, control panel, etc. (skid material: carbon steel with Line-X liner; 35' x 8')	1	✓
50	Pre-assembled & wired equipment skid with screw dewatering presses, polymer system, sludge waste pumps, etc. (skid material: carbon steel with Line-X liner; 32' x 10.5')	1	✓
	Start-up & Construction services		
51	Complete eletrical field wiring of all components provided by A3-USA (above ground conduit material and junction boxes are included)	0	
52	Influent pump station	0	
53	Concrete pads for package system, back-up generator, and dumpster	0	
54	Installation including off-loading of all equipment delivered by A3-USA	0	
55	Start-up service (weekly)	4	✓
56	Onsite set-up of skid mounted equipment including all piping connections in between skids, wiring, etc.	0	
57	Shipment to job site	6	✓
58	Surveying, excavation, soild compacting, fencing, main electrical service, etc.	0	
	Payment Terms		
	To Be Determined	1	✓
TOTAL BUDGETARY EQUIPMENT PRICE		**$5,250,000**	

MBR Budgetary Equipment Cost - Option II

Item	Equipment		Quantity	Included
1	**CONTEC fine screen - 2 mm**		0	
		Screening press	0	
		Screening stand	0	
		Heating system	0	
	Controls			
2		Flow meter - liquid - E&H, Badger, ifm efector	4	✓
3		Flow meter - gas - ifm efector	2	✓
4		pH sensor - GO Systemelektronik	0	
5		Pressure & temperature sensors - ifm efector	4	✓
6		Level transducers / sensors - ifm efector, TBD	2	✓
7		Turbidity meter - GO Systemelektronik	1	✓
8		MLSS probe - Chemitec	0	
9		DO probe - GO Systemelektronik	0	
10		ORP probes - E&H	0	
	Blowers & Pumps & Mixers			
11		EQ pump - submersible sewage pumps (KSB, Faggiolati)	0	
12		External recyle pump - submersible propeller pumps (Faggiolati)	0	
13		Internal recyle pump - self priming centrifugal pumps (Phantom)	0	
14		Sludge waste pump - progressive cavity pumps (Seepex)	0	
15		Permeate pump - rotary lobe pumps (Vogelsang IQ152-158)	5	✓
16		Blowers - Tri-lobe blowers with s/s sound enclosure	3	✓
17		Mixer - Faggiolati	0	
18		Mixer EQ tank	0	
	Aeration Equipment			
19		EQ tank coarse bubble aeration - Jaeger	0	
20		Aerobic tank fine bubble aeration - Jaeger	0	
21		Sludge tank coarse bubble aeration - Jaeger	0	

Item	Equipment	Quantity	Included
	Chemical Feed Systems		
22	Membrane module cleaning in-place system	2	✓
23	Chemical feed systems (misc.) - Prominent	0	
24	Chemical feed systems (pH) - Prominent	0	
25	Chemical feed systems (alum; P removal)	0	
28	Chemical feed systems (Nitrogen addition)	0	
	Piping & Valves & Guide Rail Systems		
29	Liquid & air piping between skids & process basin	0	
30	Manual valves for air & liquid piping (check & plug & ball valves)	0	
31	Automatic actuated valves for air & liquid piping (ball & butterfly valves)	2	✓
32	Manual knife gate valves (all stainless steel for screen)	0	
33	Membrane module guide rail system	14	✓
	Membrane Modules		
34	#U20	0	
35	#U70	224	✓
36	Quick disconnect hoses for air line	14	✓
37	Quick disconnect hoses for permeate line	14	✓
	Misc. Equipment Systems		
38	Membrane sludge dewatering system	0	
39	600 KW back-up generator including transfer switch, distribution panel, step-down transformer, & 120 Volt panel	0	
40	Sludge dewatering screw press & polymer system	0	
41	Effluent tank including aeartion system (HDPE)	0	
42	UV system	0	
43	Grit removal system including conveyor (304 s/s)	0	
44	Mechanical influent grease traps (stainless steel)	0	
45	DAF system & polymer system & flocculator (100 gpm)	0	

Item	Equipment	Quantity	Included
	Tanks & skids		
46	Control Panel & MCC & SCADA	2	✓
47	Process tanks (fiberglass)	0	
48	Pre-assembled & wired equipment skid with blowers, MCC, etc. (skid material: carbon steel with Line-X liner; 55' x 9')	1	✓
49	Pre-assembled & wired equipment skid with permeate pumps, UV system, control panel, etc. (skid material: carbon steel with Line-X liner; 35' x 8')	1	✓
50	Pre-assembled & wired equipment skid with screw dewatering presses, polymer system, sludge waste pumps, etc. (skid material: carbon steel with Line-X liner; 32' x 10.5')	0	
	Start-up & Construction services		
51	Complete eletrical field wiring of all components provided by A3-USA (above ground conduit material and junction boxes are included)	0	
52	Influent pump station	0	
53	Concrete pads for package system, back-up generator, and dumpster	0	
54	Installation including off-loading of all equipment delivered by A3-USA	0	
55	Start-up service (weekly)	4	✓
56	Onsite set-up of skid mounted equipment including all piping connections in between skids, wiring, etc.	0	
57	Shipment to job site	4	✓
58	Surveying, excavation, soild compacting, fencing, main electrical service, etc.	0	
	Payment Terms		
	To Be Determined	1	✓
TOTAL BUDGETARY EQUIPMENT PRICE		**$3,500,000**	

Biological Process Calculation

Influent Charateristics	Symbol	Value	Units
Type of wastewater		municipal	
Temperature	T	10	°C
pH	-	7.5	-
H_2CO_3 alkalinity	Alk_i	200	mg/l as $CaCO_3$
Site pressure / elevation	$p_{a,i}$	14.5	psi
Average daily flow	Q_i	1,000,000	gpd
Peak daily flow	$Q_{i,\ max,d}$	2,500,000	gpd
Hourly peak flow	$Q_{i,\ max,p}$	1,736	gpm
Peak factor	-	2.5	-
Average daily flow	Q_i	3,785	m^3/d
Max. monthly average daily flow	$Q_{i,\ max,d}$	9,463	m^3/d
Hourly peak flow	$Q_{i,\ max,h}$	394.3	m^3/h
Total BOD	$S_{BOD,i}$	200	mgBOD/l
Total COD	$S_{COD,i}$	400	mgCOD/l
COD/BOD ratio	-	2.00	-
Rapidly biodegradable COD	$S_{s,i}$	100	mgCOD/l
Volitale fatty acids (VFA)	$S_{VFA,i}$	15	mgCOD/l
Fermentable COD	$S_{F,i}$	85	mgCOD/l
Slowly biodegradable COD	$S_{ss,i}$	216	mgCOD/l
Biodegradable COD	$S_{bio,i}$	316	mgCOD/l
Soluble inert COD	$S_{SIN,i}$	24	mgCOD/l
Particulate inert COD	$S_{PIN,i}$	60	mgCOD/l

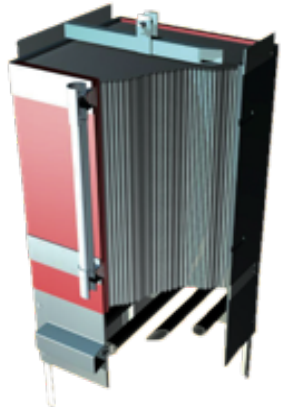
Influent Charateristics	Symbol	Value	Units
NO_3	$N_{NO3,i}$	0.0	mg/l
NH_4	$N_{a,i}$	30.0	mg/l
TKN	$N_{TKN,i}$	50.0	mg/l
TP	P_i	10.0	mg/l
Dissolved Oxygen	$S_{O2,i}$	0.0	mg/l
FSA fraction	$f_{a/TKN,i}$	0.6	-
Fixed (inorganic) suspended solids	$X_{FSS,i}$	47.5	mgISS/l
TSS concentration	$S_{TSS,i}$	200.0	mgTSS/l
Total BOD mass	$FS_{BOD,i}$	757.0	kgBOD/d
Total COD mass	$FS_{COD,i}$	1,514.0	kgCOD/d
Total NH_4 mass	$FS_{a,i}$	113.6	kgNH_4/d
Total TKN mass	$FS_{TKN,i}$	189.3	kgTKN/d
Total P mass	$FS_{P,i}$	37.9	kgP/d

Effluent Characteristics	Symbol	Value	Units
Waste Sludge	FX_t	1,081	lb/d
Waste Sludge	Q_w	12,462	gpd
Effluent BOD	$S_{BOD,e}$	< 3	mgBOD/l
Effluent COD	$S_{COD,e}$	24	mgCOD/l
Effluent TSS	$S_{TSS,e}$	1.0	mgTSS/l
Effluent P	P_e	0.4	mgP/l
Effluent NH_4	$N_{a,e}$	0.3	mgN/l
Effluent NO_3	$N_{NO3,e}$	1.5	mgN/l
Effluent TN (N_{ne} + N_{te})	$N_{t,e}$	3.3	mgN/l

Bioreactor Characteristics	Symbol	Value	Units
Temperature	T_{bio}	10	°C
Sludge retention time / Sludge age	SRT	33	d
Reactor volume	$V_{P,chosen}$	439,824	gallons
Reactor volume	$V_{P,chosen}$	1,665	m^3
Reactor volume	$V_{P,calc}$	411,255	gallons
Average MLSS concentration	X_{TSS}	10,500	mgTSS/l
Food to microorganism ratio	$F/M_{BOD,used}$	0.046	kgBOD/kgMLSS
Food to microorganism ratio	$F/M_{COD,used}$	0.093	kgCOD/kgMLSS
Membrane tank MLSS concentration	X_M	12,569	mgTSS/l
Aerobic/Anoxic tank MLSS concentration	X_{Bio}	10,436	mgTSS/l
Number of anaerobic zones	$\#_{AN}$	0	-
Number of anoxic zones	$\#_{AO}$	1	-
Number of aerobic zones	$\#_{AE}$	1	-
External recycle ratio	m	5	-
Internal recycle ratio	a	2	-
DO in m recycle	O_m	1	mgO_2/l
DO in a recycle	O_a	0	mgO_2/l
Recycle ratio to anaerobic tank (PAO)	s	0	-
DO in s recycle	$S_{O2,s}$	0	mgO_2/l
Nitrate on s recycle	$S_{NO3,s}$	0	mg/l
TKN/COD ratio	$f_{TKN/COD}$	0.125	mgTKN/mgCOD
Carbon source addition (Micro C)	B_{MicroC}	0.0	lb/d
Carbon source addition (Micro C)	S_{MicroC}	0.00	gpd
Nominal hydraulic retention time	HRT_n	10.6	h
Actual hydraulic retention time	HRT_a	1.3	h

Biological Oxygen Demand	Symbol	Value	Units
OD for synth & endo respiration (PAO)	FO_{PAO}	0	kgO_2/d
OD for synth & endo respiration (OHO)	FO_{OHO}	972	kgO_2/d
Mass carbonaceous oxygen demand	FO_C	972	kgO_2/d
Carbonaceous oxygen utilization rate	O_c	58%	-
Nitrification oxygen demand	FO_n	667	kgO_2/d
Total oxygen demand	FO_t	1,638	kgO_2/d
Oxygen recovered by denitrification	FO_d	402	kgO_2/d
Net total oxygen demand (AOR)	FO_{td}	1,236	kgO_2/d
Oxygen saturation @ operating temp.	c_s	11.3	mg/l
Desired oxygen level	c_x	2.0	mg/l
Transfer coefficient	α	0.40	-
Diffuser water depth	DWD	14	feet
Oxygen transfer efficiency	OTE	2	%
Standard total oxygen demand (SOR)	SOR	3,854	kgO_2/d
Required air flow	Q_{air}	**1,193**	scfm
Oxygen requir. per volume & depth	OS	18.6	$gO_2/(Nm_3*m_D)$

Membrane Module Design	Symbol	Value	Units
Permeate on cycle	T_o	8	minute
Permeate off cycle (relaxation)	T_s	2	minute
Effective membrane module surface	$A_{m,eff}$	87.8	m^2
Effective membrane module surface	$A_{m,eff}$	945	ft^2
Total number of membrane modules	N_M	224	-
Total membrane module surface	A_{total}	19,656	m^2
Total membrane module surface	A_{total}	211,575	ft^2
Nominal average daily flux	$Q_{ave,n}$	10.0	lmh
Nominal max. daily flux	$Q_{ave,n,max,mo}$	25.1	lmh
Nominal peak hourly flux	$Q_{peak,n}$	25.1	lmh
Average daily flux (excluding rest cycle)	$Q_{ave,n}$	**4.7**	gfd
Max. Daily flux (ex. rest cycle)	$Q_{ave,n,max,mo}$	**11.8**	gfd
Peak hourly flux (ex. rest cycle)	$Q_{peak,n}$	**11.8**	gfd
Total membrane module displacement vol.	$V_{modules}$	2,464	ft^3
Total membrane module displacement vol.	$V_{modules}$	18,431	gallons
Aeration modules	A#	75	-
Membrane module aeration requirement	Q_{am}	28.5	acfm
Total membrane modules aeration	$Q_{am,total}$	2,128	acfm
Membrane diffuser water depth	DWD_m	13.0	feet
Oxygen requirement per volume & depth	OS	14	$gO_2/(Nm_3*m_D)$
Standard oxygen rate, membrane aeration	SOR_m	10,462	lbO_2/d
Standard oxygen rate, membrane aeration	SOR_m	4,792	kgO_2/d



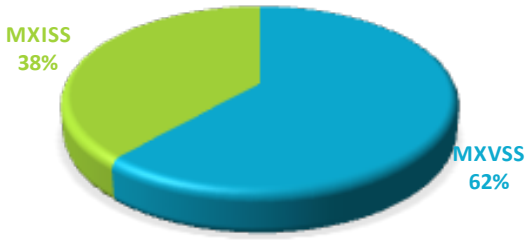
- ✓ Patented, innovative A3's MaxFlow™ membrane filtration modules manufactured in USA.
- ✓ The MaxFlow™ module "open channel design" provides optimal biofilm control, minimizes the quantity of chemical cleaning procedures and avoids module clogging.
- ✓ The compact module design enables dual-stack and triple-stack installations. It allows for a high membrane packing density resulting in a small footprint and high energy efficiency.
- ✓ Most existing conventional treatment plants can be retrofitted with MaxFlow™ membranes due to the

Kinetic Constants	Symbol	Value	Units
Yield coefficient OHO	Y_{OHO}	0.40	mgVSS/mgCOD
Yield coefficient OHO,OBS	$Y_{OHO,obs}$	0.06	mgVSS/mgCOD
Fermentation rate at 20°C	$k_{F,20}$	0.06	m3/gVSSd
Temperature coefficient for $k_{F,T}$	Θ_{kF}	1.029	-
Fermentation rate at T	$k_{F,T}$	0.05	m3/gVSSd
Endogenous respiration rate (decay)	$b_{OHO,20}$	0.24	gVSS/gVSSd
Endogenous respiration rate T	$b_{OHO,T}$	0.18	gVSS/gVSSd
Yield coefficient FSA	Y_A	0.10	mgVSS/mgFSA
Nitri. pH sensitivity coefficient	K_I	1.13	-
Nitri. pH sensitivity coefficient	K_{max}	9.50	-
Nitri. pH sensitivity coefficient	K_{II}	0.30	-
Max. specific growth rate at 20°C	μ_{Am}	0.45	1/d
Max. spec. growth rate - Temp/pH	μ_{AmTpH}	0.14	1/d
Half saturation coefficient	K_n	0.75	mgFSA/l
Half saturation coefficient - Temp	K_{nT}	0.24	mgFSA/l
Endogenous respiration rate (decay)	b_A	0.04	1/d
Temperature coefficient for $k_{F,T}$	θ_n	1.123	-
Endogenous respiration rate T	b_{AT}	0.013	1/d
Temperature sensitivity coefficient	Θ_{nk1}	1.20	-
Temperature sensitivity coefficient	Θ_{nk2}	1.05	-
Temperature sensitivity coefficient	Θ_{nk3}	1.03	-
Denitrification rates at 20°C	k_1	0.70	-
Denitrification rates at 20°C	k_2	0.10	-
Denitrification rates at 20°C	k_3	0.08	-
Denitrification rates	k_{1T}	0.113	-
Denitrification rates	k_{2T}	0.062	-
Denitrification rates	k_{3T}	0.060	-
Yield coefficient PAO	Y_{PAO}	0.45	gAVSS/gCOD
Yield coefficient PAO	$Y_{PAO,obs}$	0.20	gAVSS/gCOD
Endogenous respiration rate (decay)	b_{PAO_20}	0.04	gEVSS/gCOD
Temperature coefficient for $k_{F,T}$	$\Theta_{b,PAO}$	1.029	-
Endogenous respiration rate T	$b_{PAO,T}$	0.03	gEVSS/gVSSd

Stoichiometric Constants	Symbol	Value	Units
COD/BOD ratio	-	2.00	-
Readily biodeg. org. fraction (RBCOD)	$f_{s,COD}$	0.25	g/gTCOD
Non-biodegradable particulate COD	$f_{PNb,COD}$	0.15	g/gTCOD
Non-biodegradable soluble COD	$f_{SNb,COD}$	0.06	g/gTCOD
SVFA fraction of RBCOD	$f_{SVFA,SSi}$	0.15	$g/gCOD_{SS}$
VSS/TSS of activated sludge	f_{VT}	0.62	mgVSS/mgTSS
COD/VSS of activated sludge	f_{cv}	1.48	kgCOD/kgVSS
True synthesis fraction	f_s^0	0.57	-
Endogenous residue fraction	$f_{H/E,OHO}$	0.2	-
ISS content of OHOs	$f_{ISS,OHO}$	0.15	-
Active fraction - VSS	f_{avOHO}	23%	-
Active fraction - TSS	f_{at}	14%	-
Influent FSA fraction	$f_{FSA,i}$	0.60	-
Non-bio. soluble orgN fraction (inerts)	$f_{SNb,N}$	0.03	-
Non-bio. particulate orgN fraction	f_n	0.12	-
Permissible unaer. sludge mass fraction	f_{xm}	0.63	-
Design unaerated sludge mass fraction	f_{xt}	0.43	-
Minimum primary anoxic mass fraction	f_{x1min}	0.16	-
Primary anoxic mass fraction	f_{x1}	0.21	-
Secondary anoxic mass fraction	f_{x2}	0.21	-
Anaerobic mass fraction	f_{AN}	0.00	-
Non-bio. particulate orgP fraction	$f_{P,XE,OHO}$	0.05	mgP/mgVSS
Endogenous residue fraction	$f_{XE,PAO}$	0.25	gEVSS/gAVSS
P fraction in active PAO mass	$f_{P,PAO}$	0.38	gP/gAVSS
VSS/TSS ratio for PAO active mass	$f_{VT,PAO}$	0.46	gVSS/gTSS
Ratio of P release /VFA uptake	$f_{PO4,REL}$	0.5	gP/gCOD
Frac. of fixed inorganic s. solids of PAO	$f_{FSS,PAO}$	1.3	gFSS/gAVSS
P content of TSS	$f_{P,TSS}$	0.043	gP/gTSS
P content of VSS	$f_{P,FSS,i}$	0.02	gP/gVSS
TKN/COD ratio	f_{ns}	0.13	mgTKN/mgCOD
Nitrogen content of active biomass	$f_{N,VSS}$	0.10	gN/gAVSS

Biological Mass Balance	Symbol	Value	Units
Sludge age	SRT	33	d
Mixed liquor suspended solids	X_{TSS}	10,500	mgTSS/l
Readiable biodegradabe COD flux	$FS_{S,i}$	379	kgCOD/d
Daily flux of VFAs	$FS_{VFA,i}$	57	kgCOD/d
Daily flux of fermentable COD	$FS_{F,i}$	321	kgCOD/d
Daily flux of biodegradable COD	$FS_{bio,i}$	1,196	kgCOD/d
Daily flux of particulate inert COD	$FS_{PIN,i}$	227	kgCOD/d
Daily flux of fixed inorganic sus. solids	$FS_{ISS,i}$	180	kgISS/d
Influent particulate non-bio. COD	$FX_{VSS,i}$	153	kgVSS/d
Mass nitrogen into sludge prod.	FN_{Sludge}	37	kgN/d
Mass of nitrate generated per day	FN_{NO3}	146	kgN/d
VFAs stored by PAOs	$FS_{S,PAO}$	0	kgCOD/d
Remaining biodegradable COD	$FCOD_{b,OHO}$	1,196	kgCOD/d
Mass nitrifiers	MX_A	341	kgVSS
Active biomass PAO	MX_{PAO}	0	KgAVSS
Endogenous active biomass PAO	$MX_{E,PAO}$	0	kgEVSS
Bio mass	MX_{bio}	2,285	kgVSS
Active organism mass	MX_{OHO}	2,285	kgVSS
Endogenous residue mass	$MX_{E,OHO}$	2,720	kgVSS
Non-biodegradable particulate mass	MX_{Iv}	5,064	kgVSS
Volatile suspended solids mass	MX_{VSS}	10,069	kgVSS
Inorganic suspended solid mass	MX_{ISS}	6,276	kgISS
Total suspended solids mass	MX_{TSS}	16,344	kgTSS
Mass/Sludge TSS wasted	FX_t	495	KgTSS/d
Mass/Sludge VSS wasted	FX_V	305	kgVSS/d
Effluent COD	$S_{COD,e}$	24	mgCOD/l
COD mass out (effluent and waste)	$FS_{COD,e}$	91	kgCOD/d
Mass/Sludge COD wasted	$FX_{COD,s}$	452	kgCOD/d

Alkalinity	Symbol	Value	Units
Alkalinity Nitrification as CaCO3 (consumed)	Alk_{Nitri}	275	mg/l as $CaCO_3$
Alkalinity Denitrification as CaCO3 (recovered)	$Alk_{Denitri}$	144	mg/l as $CaCO_3$
Alkalinity ef	Alk_e	100	mg/l as $CaCO_3$
Alkalinity inf	Alk_i	200	mg/l as $CaCO_3$
Alkalinity Alum (consumed)	Alk_{Alum}	13.6	mg/l as $CaCO_3$
Alkalinity Total	Alk_{total}	55	mg/l as $CaCO_3$
Alkalinity Added	Alk_{added}	45	mg/l as $CaCO_3$
Alkalinity Added	$XAlk_{added}$	370	lb/d
Density caustic solution (50%)	-	12.76	lb/gal
Alkalinity recovered	$Alk_{recovered}$	0.4	lb$CaCO_3$/lb
Caustic needed	-	147.9	lb/d
Caustic needed	-	11.6	gpd



$$V_P = \frac{MX_{TSS}}{X_{TSS}}$$

$$FX_t = \frac{MX_{TSS}}{SRT}$$

$$MX_{TSS} = MX_{ISS} + MX_{VSS}$$

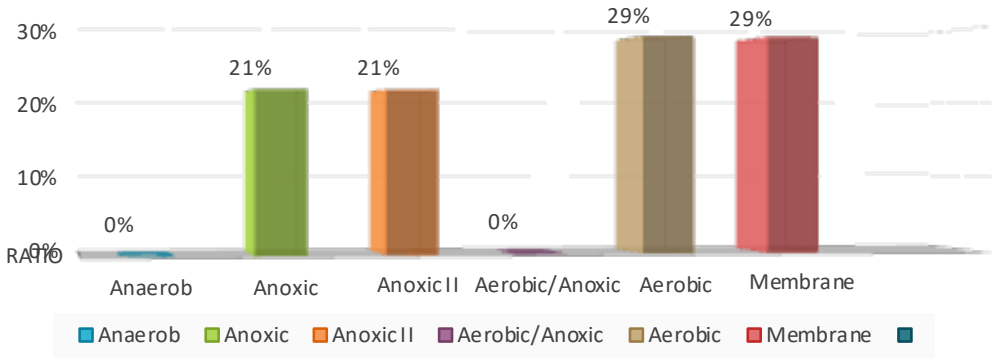
N Removal	Symbol	Value	Units
Factor of safety	S_f	1.2	-
Nitrogen requirements	FN_{synth}	31	kgN/d
Nitrogen requirements	$TKN_{i,synth}$	8.06	gN/m3
Influent non-bio. soluble organic N	$N_{nbios,i}$	1.5	mgN/l
Influent non-bio. particulate org. N	$N_{nbiop,i}$	4.9	mgN/l
Influent biodegradable organic N	$N_{bio,i}$	18.5	mgN/l
Effluent non-bio. soluble organic N	$N_{nbios,e}$	1.5	mgN/l
NH4 concentration avail. for nitri.	N_{an}	38.8	mgN/l
Effluent ammonia	$N_{a,e}$	0.3	mgN/l
Effluent TKN	$N_{TKN,e}$	1.8	mgN/l
N concentration into sludge prod.	N_s	9.7	mgN/l
Nitrification capacity	N_c	38.5	mgN/l
Denitrification potential RBCOD	$D_{p1RBCOD}$	14.1	$mgNO_3$-N/l
Denitrification potential SBCOD	$D_{p1SBCOD}$	8.0	$mgNO_3$-N/l
Denitrification potential RBCOD	$D_{p3RBCOD}$	0.0	$mgNO_3$-N/l
Denitrification potential SBCOD	$D_{p3SBCOD}$	7.8	$mgNO_3$-N/l
Minimum sludge age for nitri.	SRT_m	15.0	d
Denitrification potential primary tank	D_{p1}	22.2	mgN/l
Denitrification potential secondary tank	D_{p3}	7.8	mgN/l
Denitri. potential recycle rate ($f_{xm} = f_{xdm}$)	D_{p^*}	35.5	mgN/l
Effluent nitrate	$N_{NO3,e}$	1.5	mgN/l
Effluent nitrate @ f_{xdm} & recycle rate	N_{NO3,e^*}	4.8	mgN/l

P Removal	Symbol	Value	Units
COD lost in anaerobic reatcor	$S_{F,ANn}$	0.0	$gCOD/m^3$
COD lost in anaerobic reatcor	S_{F,ANn^*}	0.0	$gCOD/m^3$
Fermentable COD for AN reactor	$S_{F,I,conv}$	0.0	$gCOD/m^3$
DO in influent	$S_{O2,i}$	0.0	mgO_2/l
PO_4 release AN reactor	$S_{PO4,rel}$	0.0	gP/m^3
P removal by PAOs	ΔP_{PAO}	0.0	gP/m^3
P removal by OHOs	ΔP_{OHO}	0.5	gP/m^3
P removal by endgeneous biomass	ΔP_{XE}	1.1	gP/m^3
P removal by influent inert mass	ΔP_{XI}	2.0	gP/m^3
P into sludge production	P_s	3.5	gP/m^3
Potential P removal by system	$\Delta P_{SYS,POT}$	7.1	gP/m^3
Actual P removal by system	$\Delta P_{SYS,ACT}$	7.1	gP/m^3
Effluent particulate P from TSS	$X_{P,e}$	0.0	gP/m^3
Influent total P	P_i	10.0	gP/m^3
Effluent total P	P_{e^*}	2.9	gP/m^3
P precipitated	P_{prec}	2.5	mgP/l
Precipitation chemical	B_{Alum}	249.2	lb/d
Precipitation chemical	Solution	22.5	gal/d
Density Alum	z_{AL}^{3+}	0.100	lb_{AL}/lb_{prec}
Density Iron	z_{FE}^{3+}	0.077	lb_{FE}/lb_{prec}
Alum efficiency	-	40.0	g/kg
Chemical precipitation sludge	-	47.5	lb/d

Mechanical Process Calculation

Tank Dimensions	Trains	Length	Width	Dia.	Degree	Height	Liquid level	Volume per train	Volume Total	Volume Total
Anaerobic	0	.00 ft	.00 ft	.00 ft	0.0	.00 ft	.00 ft	gal	gal	0.0 m3
Anoxic I	2	30.00 ft	14.00 ft	.00 ft	0.0	17.00 ft	15.00 ft	47,124 gal	94,248 gal	356.7 m3
Aerobic	2	40.00 ft	14.00 ft	.00 ft	0.0	17.00 ft	15.00 ft	62,832 gal	125,664 gal	475.6 m3
Anoxic II	2	30.00 ft	14.00 ft	.00 ft	0.0	17.00 ft	15.00 ft	47,124 gal	94,248 gal	356.7 m3
Anoxic Buffer	0	.00 ft	.00 ft	.00 ft	0.0	.00 ft	.00 ft	gal	gal	0.0 m3
Membrane	2	40.00 ft	14.00 ft	.00 ft	0.0	17.00 ft	15.00 ft	62,832 gal	125,664 gal	475.6 m3
Sludge	1	50.00 ft	30.00 ft	.00 ft	0.0	17.00 ft	15.00 ft	168,300 gal	168,300 gal	637.0 m3
EQ	1	60.00 ft	30.00 ft	.00 ft	0.0	17.00 ft	15.00 ft	201,960 gal	201,960 gal	764.4 m3

Tank Design	Symbol	Value	Units			
Total process tank volume		439,824	gallons	Weir level	3.6	inches
Total process tank volume$_{calc}$		**411,255**	gallons	Weir length	20.0	ft
Unaerated tank percentage		43	%	Velocity	1.80	fps
Total tank volume		**810,084**	gallons	Vertical tank	0	
Membrane modules volume		18,431	gallons	Horz. Tank	0	
F/M$_{used,BOD}$		0.046	kgBOD/kgMLSS	Diameter	0	ft
F/M$_{used,COD}$		0.093	kgCOD/kgMLSS			



Process Volume Distribution

Air Flow Design	Symbol	Membrane per train	Aerobic per train	Sludge	EQ	Unit
Minimum air flow	$Q_{A,re}$	1,064	596	675	270	acfm / scfm
Chosen air flow - actual	$Q_{A,\ chosen}$	1,064	538	646	251	acfm
Chosen air flow - inlet	$Q_{A,chosen}$	2,017	989	1,186	461	m^3/h
Chosen air flow - inlet	$Q_{A,chosen}$	**1,187**	**582**	**698**	**272**	scfm
Chosen air flow - piping	$Q_{A,chosen}$	765	375	450	175	acfm
Pipe pressure	p_b	8.0	8.0	8.0	8.0	psi
Pipe losses	H	0.11	0.11	0.11	0.13	psi
Equivalent length in pipe looses	L_p	600	600	400	400	feet
Pipe diameter	d	8.0	6.0	6.0	4.0	inches
Internal pipe diameter	d_i	8.33	6.36	6.36	4.26	inches
Standard temperature	T_1	293	293	293	293	K
Pipe temperature	T_2	332	332	332	332	K
Constant	f	0.02	0.02	0.02	0.02	-
Air velocity	v	**33.7**	**28.4**	**34.0**	**29.5**	fps
Atmospheric pressure	$p_{a,l}$	14.5	14.5	14.5	14.5	psi
Absolute pressure	p_2	22.5	22.5	22.5	22.5	psi
Pressure due to tank liquid level	$p_{DWD,m}$	5.7	6.3	6.3	6.3	psi
Pressure due to aeration device	p_{DWD}	0.7	0.5	0.5	0.5	psi
Pressure due to pipe losses & elev.	$p_{DWD,S}$	0.5	0.5	0.5	0.5	psi
Total pipe losses	p_t	6.9	7.3	7.3	7.3	psi
Total pipe losses	p_t	473.7	505.1	504.6	506.6	mbar

$$H = 9.82 \cdot 10^{-8} \cdot \frac{\left(f \cdot L_p T_2 Q_{A,chosen}\right)}{\left(p_2 d_i\right)^5}$$

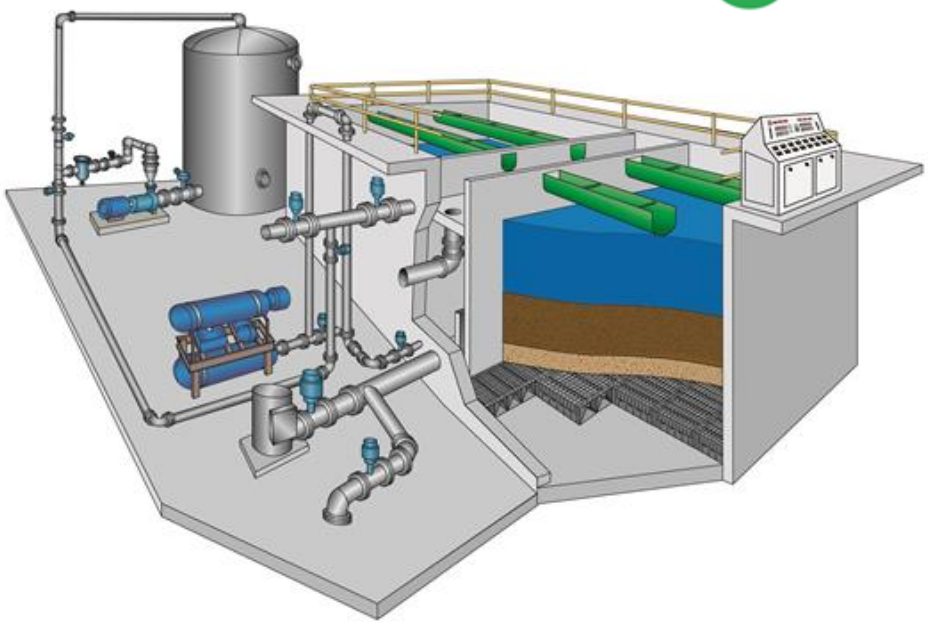
$$f = \frac{\left(0.029 \cdot d_i^{0.027}\right)}{Q_{A,chosen}^{0.148}} \qquad T_2 = T_1 \left(\frac{p_2}{p_{a,1}}\right)^{0.283}$$

Item 7: Denitrifying Filters

Budget Proposal

WWTP

Centreville, MD



prepared for:

Centreville, MD

5/2/2023

Xylem Water Solutions USA, Inc.
108 Tomlinson Dr
Zelienople, PA 16063
Mr. Chris Ball
Direct: 724-453-2109
Mobile: 724-713-7145
Email: chris.ball@xylem.com

5/2/2023

Project name : Centreville, MD WWTP
Project number : I23178

To Whom It May Concern,

Based on your inquiry, we are pleased to forward the following proposal to your attention. Thank you for the opportunity to offer our equipment and services for the Centreville, MD WWTP.

We hope that our proposal comes up to your expectation. If you have any questions please do not hesitate to contact us.

Respectfully,

Chris Ball
Senior Sales Engineer

1 Xylem Overview

Xylem is a leading global water technology provider, enabling customers to transport, treat, test and efficiently use water in public utility, residential and commercial building services, industrial and agricultural settings. The company does business in more than 150 countries through a number of market-leading product brands, and its people bring broad applications expertise with a strong focus on finding local solutions to the world's most challenging water and wastewater problems.

Xylem's treatment business offers a portfolio of products and systems designed to effectively meet the demands and challenges of treating water and wastewater. From smarter aeration to advanced filtration to chemical-free disinfection, Xylem leverages its well-known Treatment brands, Flygt, Leopold, Sanitaire, and Wedeco, to offer hundreds of solutions backed by a comprehensive, integrated portfolio of services designed to ensure we can meet our customers' needs in a number of different industries including municipal water and wastewater, aquaculture, biogas and agriculture, food and beverages, pharmaceuticals, and mining.

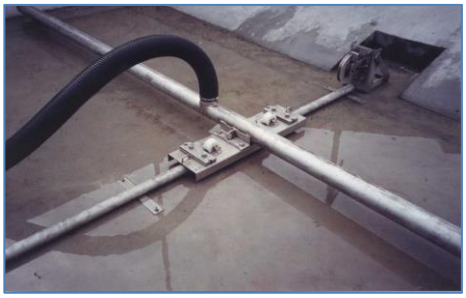
Our scientists and engineers utilize their deep applications expertise and continually listen and learn from our customers' situations to create solutions that not only use less energy and reduce life-cycle costs, but also promote the smarter use of water.

Leopold has long been a worldwide leader in the water and wastewater treatment industry supplying both filtration and clarification systems. Leopold both designs and supplies systems for gravity filtration, clarification, denitrification, sludge collection and backwash water recovery. Leopold solutions are ideal for algae, contaminant, and nutrient removal, desalination pretreatment, reuse, SDI, and taste and odor reduction. Since its establishment in 1924, Leopold has pioneered and acquired a number of innovative technologies aimed at improving the quality of water while reducing costs. With over 8,000 installations, customers from around the world have come to rely on Leopold's expertise and technological leadership in water and wastewater treatment.

Since 1924 Leopold has been designing and manufacturing rapid gravity media filtration and clarification solutions for treating water and wastewater.

Leopold supplies potable drinking water treatment plants with media filtration, backwash water recovery, reuse and desalination pretreatment solutions, while supplying wastewater treatment plants with tertiary filtration and denitrification solutions. They also supply both potable and wastewater treatment plants with dissolved air flotation (DAF) clarification, ozone enhanced biologically active filtration systems and sludge collection solutions.

Leopold engineers are available to help analyze, evaluate and design all aspects of a complete filtration system, including evaluating influent water qualities, determining optimal loading rates and best design configuration, selecting the best media characteristics, and designing the backwash process. Xylem's Leopold Filterworx performance filter system comes complete with flume, underdrains, integral media support, engineered media, backwash water troughs, and system controls. The result is a cost effective, efficient, high-performance system designed to meet customer requirements.



Leopold also offers sludge collection solutions with the Clari-VAC floating sludge collector and the CT2 submerged sludge collector. These systems are used in final clarifiers to remove the sludge solids. For those areas where nitrogen and phosphorus removal is required, Leopold provides elimi-NITE denitrification systems which convert the filters to become biologically active so that the effluent meets the mandated nitrate and phosphorus levels.

For more information please visit us on our homepage:

http://www.xylem.com/treatment/us/brands/leopold

Xylem, Inc.
www.xylem.com/treatment

2 General Process Description

2.1 PROCESS DESCRIPTION

elimi-NITE® Denitrification System General Process Description

The elimi-NITE Denitrification System is an attached growth, microbiological process. This gravity, downflow, packed-bed denitrification system is physically identical to a deep-bed downflow sand filter. Denitrifying microorganisms attach to the filter media, which provides the support system for their growth. A carbon source such as methanol, acetic acid, molasses, etc. is added upstream of the packed-bed filter and a nitrified influent is filtered through the media. The packed-bed filter system is well suited for denitrification because it provides the necessary hydraulic detention time for the biological reaction to take place. The filter media is composed of a coarse, hard, predominately siliceous material. This media can filter out solids and serve as a support system for the denitrifying microorganisms. The downflow packed-bed system eliminates the requirement for downstream filtration or clarification required of other denitrification systems.

As denitrification occurs, nitrogen gas accumulates in the filter media, which increases the headloss over the headloss due to the accumulation of solids. The nitrogen gas bubbles are periodically released from the media by taking the filter off line and applying backwash water for a few minutes. This process is called the nitrogen release cycle or filter bumping. The frequency of the nitrogen release cycle is a function of both nitrate removal and a minimum acceptable time between cycles, typically less than one hour. Usually a filter needs to be bumped once every four to eight hours, again depending on the nitrogen loading rate. The bumps are usually set on a time basis. After a bump the headloss in the filter is reduced or recovered. However, when the liquid level in the filter reaches a designated high level, signifying that the bumps are not effective in reducing headloss, a full backwash is performed on the filter.

The elimi-NITE Denitrification System is comprised of the following basic principles:

- A packed deep-bed layer of sand for biomass attachment and retention of suspended solids
- A Leopold Universal® Type S® Filter System for distribution of air and water for superior backwashing of the elimi-NITE filter module.
- A complete chemical feed system of the carbon source for denitrification (future)
- Automated backwash sequence and controls optimized for each applications requirement utilizing Leopold FilterWorx™ Control System.

The full backwash consists of the following sequence:

- Influent and effluent valves are closed
- Waste valve is opened
- Blower is started
- Air isolation valve is opened, vent valve is closed and air only wash for approximately one minute
- Backwash pump is started
- Backwash isolation valve is opened and air/water backwash for approximately 15 minutes
- Air isolation valve is closed, vent valve is open and the blower is stopped

- Water only backwash continues for approximately 5 minutes to purge air from the filter
- Backwash isolation valve is closed and the backwash pump is stopped
- Waste valve is closed
- Influent and effluent valves are opened

Gases such as nitrogen or dissolved oxygen will build-up high levels in the filter and cause air binding. In this case the filters are water-only “bumped.” The bump consists of isolating the filters from the influent flow, closing the effluent valve, starting the backwash pump, opening the backwash valve, opening the waste valve (optional if the water depth stays below the effluent launder) and backwashing the filter for approximately 2-5 minutes. This reversal of flow allows the built-up gases to escape the filter. The filter is then put back on-line. The bumps can be programmed to occur either on time or on level and are site specific.

3 Technical Description

3.1 DESIGN CRITERIA:

The elimi-NITE Denitrification System described here-in is a wastewater treatment system designed for the removal of nitrate-nitrogen.

The elimi-NITE Denitrification System that shall be furnished and installed is described in Section 3.2 - Scope of Supply.

The system has been designed based on Leopold's standard specifications using the following criteria:

Plant Flow	MGD
AAF MMF PHF	1.00 1.20 3.30

Note: Please define the following parameters to help optimize the denitrification process.

The elimi-NITE Denitrification System is based on treating the influent the filters with the following characteristics:

Influent Parameter	mg/L	Given	Assumed
Total Suspended Solids (TSS)	30	X	-----
Nitrates	8.0	X	-----
N-Ammonia	-----	-----	-----
Minimum Water Temperature (°C)	12	X	-----

The elimi-NITE Denitrification System is designed to achieve the following monthly average effluent quality:

Effluent Parameters	mg/L	Given	Assumed
Total Suspended Solids (TSS)	<5.0	-----	X
Nitrates	1.0	X	-----
Total Nitrogen	3.0	-----	X

The external carbon source for the elimi-NITE Denitrification System that will be provided by others is methanol.

If Phosphorous removal is required, the phosphorous must be in an insoluble form. This may require the use of coagulants upstream of the Filtration System.

Elimi-NITE Denitrification System Design Criteria

Total number of filters	Three (3)
Active Filtration volume	2,592 ft^3
Total filtration area	432 ft^2
Individual filter sizing	
Area	144 ft^2
Length	12'-0"
Width	12'-0"
Media Depth	72"
Media volume	864 ft^3

Media Type

Coarse Silica Sand	1/8" x No.12 – 72"

Loading Rates	**Filter Loading Rate (Three)**	**with one in backwash (Two)**
At 1.00 MGD (AAF)	1.61 gpm/ft^2	2.41 gpm/ft^2
At 1.20 MGD (MMF)	1.93 gpm/ft^2	2.89 gpm/ft^2
At 3.30 MGD (PHF)	5.31 gpm/ft^2	7.96 gpm/ft^2

Backwash Rates	
Design concurrent water rate	6 gpm/ft^2
Design concurrent air rate	5 scfm/ft^2
Design high water rate	6 gpm/ft^2
Designed Driving Head	8'-0"

3.2 SCOPE OF SUPPLY

Xylem Water Solutions USA, Inc will supply only the items specifically detailed within this proposal.

Filter Internals:

Three (3)	**Complete elimi-NITE filters**, 432 square feet effective filtration area total, 12’-0” by 12’-0” each inside filter dimensions utilizing a front flume arrangement including:
432 square feet	**Leopold Universal® Type XA® Underdrain** of the Dual/Parallel Lateral type, manufactured from corrosion resistant, high-density polyethylene supplied with necessary "O"-rings and carbon steel "L" anchor rods and clips. Epoxy, sealant, bonding agents, or other similar materials used during installation are not included and to be provided by others.
432 square feet	**I.M.S® 1000 MEDIA RETAINER** will be furnished. The scope includes molded thermoplastic I.M.S® 1000 media retainer factory installed onto the proposed underdrain block prior to shipment.
Three (3) sets	**Air Header Assemblies** shall be manufactured from schedule 10, type 304 stainless steel pipe. The air header pipe shall measure 6" in diameter and will run the width of the filter cell. The air header shall commence with a flange approximately 6” inside the filter cell. Mating flange and hardware is to be supplied by others. The air header pipe will have j-risers to provide air to each of the individual filter laterals.
Six (6)	**WASH TROUGHS:** Under this section, we propose to furnish six (6) Leopold Reinforced Fiberglass Troughs, Leo-Lite No. 87, measuring 12" wide x 12" deep x 12'-0" long, round bottom construction. Also included is the standard end hanger assembly fabricated from type 316 stainless steel and type 18-8 stainless steel hardware. Also included with the above troughs are reinforced fiberglass matched-die straight edge weir plates attached to the troughs with type 18-8 stainless steel fasteners. Also included shall be type 304 stainless steel stabilizers for stabilization of wash water troughs. Wash troughs shall have one closed end and one open discharge end with waterstop.

Media:

2,592 cubic feet	**Coarse Silica Sand** – 72” Depth Effective Size: 1/8” x No. 12 134 Tons

FilterWorx™ Control System:

Under this section, we propose to furnish the following FilterWorx™ Automatic Control System for the subject project for controlling the filtration and backwashing operations of three (3) filters. The system will consist of the following equipment:

Three (3) **Leopold model AFC-5000 Single Filter Control Panels.** The panels shall be housed in a NEMA 4X rated, 316 stainless steel enclosure. The panels shall include provisions for the automatic, semi-automatic, and manual control of the filtration and backwashing operations of one (1) filter. Logic functions shall be performed by an Allen Bradley Compact Logix Series PLC. Manual operation shall be independent of the PLC. Operator interface shall be via an Allen Bradley Panelview Plus 1000 touchscreen and Square D type ZB4 selector switches, pushbuttons and pilot lights.

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Three (3) **Siemens Hydroranger 200 Ultrasonic filter level transmitters**

One (1) **Siemens Hydroranger 200 Clearwell Level Transmitter**

One (1) **Siemens Hydroranger 200 Mudwell Level Transmitter**

Two (2) **Hach Nitratax Sensors and SC1000 Controllers (One Influent & One Effluent)**

One (1) **Hach Dissolved Oxygen Sensor**

Two (2) **Hach Phosphate Analyzers**

One (1) **Siemens 5100W 8" magnetic flow meter for filter influent**

One (1) Lot **Spare Equipment** consisting of:
One (1) PLC DI module
One (1) PLC DO module
One (1) PLC AI module
One (1) PLC AO module
Two (2) of each type of relay, selector switch, pushbutton, and pilot light used.

Automatic Valves:

Under this section we propose to furnish the following 150 lb. Class flanged butterfly valves conforming to AWWA C-504. The valves shall be flanged with EDPM seats, 316 stainless steel shafts and cast iron bodies per ASTM A126. Shaft seals should be self-compensating split V-type or O-ring packing made of BUNA-N per AWWA C-504 class B. The valves shall be supplied with the listed electric operators.

Quantity	Function	Size	Service
Three (3)	Influent	6-inch	open/close
Three (3)	Effluent	10-inch	open/close
Three (3)	BW Inlet	8-inch	open/close
Three (3)	BW Waste	10-inch	open/close
Three (3)	Air Inlet	6-inch	open/close
One (1)	Backwash Control	8-Inch	modulating
One (1)	Air Vent	2-inch	open/close

Pumps:

Two (2) **Submersible Backwash Pumps**. The pumps shall be rated for 864 gpm at an estimated 30 feet of head. Accessories shall include a 50' cable, leakage sensor, discharge connection and hardware, guide bar brackets and stainless steel lift chains. The pump motor shall be 25 hp, 60 Hz , 460v, 3 phase and have a cast iron housing, volute and impeller. Also included shall be a manual isolation butterfly valve and an air cushioned swing check valve. **The stainless steel guide bars shall be supplied by the contractor.**

Two (2) **Submersible Mudwell Pumps**. The pumps shall be rated for 188 gpm at an estimated 30 feet of head. Accessories shall include a 50' cable, leakage sensor, discharge

connection and hardware, guide bar brackets and stainless steel lift chains. The pump motor shall be 6.5 hp, 60 Hz , 460v, 3 phase and have a cast iron housing, volute and impeller. Also included shall be a manual isolation butterfly valve and an air cushioned swing check valve. **The stainless steel guide bars shall be supplied by the contractor.**

Blowers and Appurtenances:

Two (2) **Positive Displacement Blower Packages** The blower packages shall be capable of supplying air to the filters during backwash at a rate of 720 scfm. Included with the blower package are TEFC motor, silencer, filter, pressure relief valve, flexible connections, pressure gauges, temperature gauges, discharge check valve and discharge butterfly valve. The blower shall have a 460 volts, 3 phase, 60 hertz, TEFC motor. An acoustical enclosure will be included.

3.3 SERVICES

The services of a qualified Leopold technical representative to instruct the Contractor's personnel about the proper installation technique of the mechanical **filter equipment** will be provided for a period of nine (9) days (8 hr/day) on site plus six (6) days travel time to and from the job-site in three (3) trips.

The services of a qualified Leopold technical representative for **filter control system startup and operator training** will be provided for a period of twelve (12) days (8 hr/day) on site plus eight (8) days travel time to and from the job-site in four (4) trips.

Additional services may be obtained at the current prevailing rate plus living and travel expenses.

Should our service representative be scheduled and arrive on site at the time requested by the contractor/purchaser and the equipment is not ready, our standard per diem rate, plus travel and living expenses will apply.

4 Technical Clarification & Deviations

MEDIA:

Submittals:

Materials meet and/or exceed American Water Works Association Standard B100 (latest revision) for Filtering Material. Typical samples and/or test reports detailing the physical and chemical characteristics of the filtering material will be provided for review and approval as required by the specification. If independent testing is required per specification, test reports of the actual material produced will be submitted for approval prior to release for shipment.

Packaging and Placement of Materials:

Material will be packaged in semi-bulk containers, "Super Bags," with lifting sleeves and bottom discharge spout, containing approximately 2,000 to 4,000 pounds per sack.

Quantities:

Quantities indicated above are Xylem Water Solutions USA, Inc best calculations of the quantity requirements. Loss of gravel due to storage or handling is not covered by this proposal.

ITEMS NOT INCLUDED:

The following items, while not comprehensive, are not included in the elimi-NITE Denitrification System:

- Receiving, unloading, storing, and proper installation of supplied equipment and materials.
- Concrete for filter, building/architectural work and engineering thereof.
- Grout between and under the underdrain laterals in filters.
- Platforms, ladders, or walkways.
- Lubricants for mechanical equipment.
- Interconnecting piping, piping supports, and wall sleeves/pipes including flanges, bolts, nuts, and gaskets.
- Instrument air pipe, isolation valves, tubing, and engineering thereof.
- Electrical starters, circuit breakers, motor control center, conduit, and interconnecting wiring and engineering thereof, and 480 VAC, 3 phase, 60 HZ power.
- Water supply/disposal for flushing of filter internals, media installation or backwash testing.
- Lab services for performance guarantee testing.

5 Price & Scope of Supply

5.1 MAIN SCOPE

BASIS of PRICING:

Any items and/or accessories not specifically called out in this quotation must be construed as being furnished by others.

This quotation is considered firm for 90 days. Orders received more than 90 days after the date of this quotation is reviewed by Xylem Water Solutions USA, Inc before acceptance and is subject to changes in prices or delivery depending on conditions existing at the time of entry. Quoted prices are firm for delivery within 12 months from the delivery date stipulated in the plans & specifications or mutually agreed upon by Xylem Water Solutions USA, Inc. and Purchase Order issuer at time of order placement.

We do not include any applicable taxes.

Orders resulting from this quotation should be addresses to Xylem Water Solutions USA, Inc. 108 Tomlinson Dr., Zelienople, PA, 16063, USA.

We propose to furnish the material described in this document for **a total budget selling price of :**
$ _____.

Pricing for the equipment and field services outlined in this proposal, DAP Jobsite per Incoterms 2020.

For further information pertaining to the equipment contained in this proposal, please contact our area representative, who is:

Sherwood-Logan & Associates, Inc.
2140 Renard Ct.
Annapolis, MD 21401
Phone: (410) 274-3716
Email: AKreider@sherwoodlogan.com

Attention: Andrew Kreider

Pricing is based on the following payment terms (net 30 days):
10% following initial submittal for approval
80% following the date of the respective shipments of the product
5% following installation, not to exceed 150 days after shipment of the product *(whichever comes first)*
5% following start-up, not to exceed 180 days after shipment of the product *(whichever comes first)*

6 Commercial Terms & Conditions

6.1 DELIVERY SCHEDULE

6.1.1 Delivery time

Delivery of fabricated items and filter media 24 to 45 weeks after drawing approval.
Delivery of filter valves and control 30 to 60 weeks after drawing approval.

6.1.2 Production schedule

Submittal of PID's and mechanical drawings for approval 8 to 10 weeks after order acceptance.

Submittal of EIC drawings for approval 8 to 12 weeks after order acceptance.

6.2 TERMS AND CONDITIONS OF SALE – NORTH AMERICA

This order is subject to the Standard Terms and Conditions of Sale – Xylem Americas effective on the date the order is accepted. Terms are available at http://www.xyleminc.com/en-us/Pages/terms-conditions-of-sale.aspx and incorporated herein by reference and made a part of the agreement between parties.
Different terms are hereby rejected unless expressly assented to in writing.

AGREEMENT TO PURCHASE: BUYER agrees to purchase the equipment and services herein in accordance with the terms and conditions set forth above.

_____
(BUYER)

BY:_____

_____

_____

_____, 20 _____

ACCEPTANCE: SELLER hereby accepts BUYER'S offer to purchase.

Xylem Water Solutions USA, Inc.

BY:_____

_____

_____

_____, 20 _____

Item 8: UV Disinfection Unit

ETS-UV
an EVOQUA brand

PRELIMINARY ESTIMATE
ETS - UV SYSTEM

Project Name:	Centerville WWTP
Project Location:	Centerville, MD
Proposal No.:	23 UV 37 PB0
Proposal Date:	25-Apr-2023
Proposal Expires:	24-Jul-2023
Applications Engineer:	Martin Smith
Sales Manager:	Joe Ciurlino
Manufacturers Rep:	Envirep/TLC
Contact:	Dwight Swan
Phone:	(717) 503-4639
Email:	dswan@envirep.com
Consultant:	Whitman, Requardt & Associates, LLP
Contact:	David R. Nixson, P.E.
Phone:	(443) 824-1620
Email:	dnixson@wrallp.com

SCOPE OF SUPPLY

Qty	Description
	DESIGN CONSIDERATIONS
	Peak flowrate: 3.3 MGD
	Transmittance (1 cm light cell): 65%
	TSS: <10 mg/l
	Iron concentration: <0.1 mg/l
	Manganese concentration: <0.1 mg/l
	Influent e. coli: <40,000 MPN/100 ml
	Effluent e. coli: <116 MPN/100 ml
	Configuration: 2 parallel SW-835-14 (100% redundancy)
	SW-835-14
	UV Chamber
2	ETS-UV SW-835-14 UV system complete with:
	14" ANSI flange connections, 316L SS
	(8) 3.5 kW medium pressure UV lamps perpendicular to flow
	(8) Quartz thimbles
	Temperature sensor
	Automatic/Mechanical cleaning
	Access hatch
	(1) UV intensity sensor
	(1) Operation and maintenance manual
	Power/Control Cabinet
2	Free standing power/control cabinet, epoxy coated painted steel, complete with:
	Electronic ballast lamp drive
	Junction box (located nearby reactor, supplied by others)
	Spectra 3, 7" touch screen
	Dimensions: H 52 x W 30 x D 26-in
	Power supply: 480V, 3-Ph, 60Hz
	NEMA12 enclosure
	Cable - UV chamber to power/control cabinet
16	30 ft molded lamp cable
2	30 ft cable kit (sensors / motor)
	Supplied Spares
8	UV lamps
1	Electronic ballast
8	Quartz thimbles
8	Thimble seals
8	Wiper rings
1	Wiper flap for UV intensity monitor

ETS-UV
an EVOQUA brand

PRELIMINARY ESTIMATE
ETS - UV SYSTEM

SCOPE OF ENGINEERING

The following documentation shall be provided by Evoqua:
- Shop Drawing Submittal
    - Detailed Scope of Supply
    - Comments & Clarifications
    - Project Schedule
    - Technical Information / Equipment / Drawings
      Catalog Cutsheets
      Dimensional Drawings / General Assembly Drawings
      Functional Schematics / Piping and Instrumentation Diagrams (when applicable)
      Electrical Schematics (when applicable)
      Control Panel Layouts, Ladder Logic Diagrams (when applicable)
    - Receiving, Handling and Storage
    - Warranty Statement
- Operation and Maintenance Manuals
    - Ordering Information
    - Warranty Statement
    - Introduction
    - Safety Precautions
    - Preventive Maintenance General Information
    - Maintenance Record Card
    - Regional Offices
    - Technical Data
    - Installation
    - Operation
    - Service
    - Illustrations
    - Preventive Maintenance Kits and Spare Parts List
    - Additional Literature

NOTE - In an effort to be environmentally responsible, one (1) hard copy of the submittal and O+M will be supplied and up to eight (8) copies will be supplied on flash drive(s). Additional hardcopies of the submittal and O+M can be supplied at a cost of $50.00 each.

CLARIFICATIONS & EXCEPTIONS

Section	Part	Description
NOTICE		The scope of supply and pricing are based on Evoqua's standard equipment selection, standard terms of sale and warranty terms. Any variations from these standards may affect this quotation.

ITEMS NOT INCLUDED IN SCOPE

- Mechanical and electrical installation labor
- Civil work including supply of anchor bolts
- Interconnecting piping
- Interconnecting wiring (unless detailed above)
- Valves, fittings, appurtenances not specifically listed above
- Installation supervision
- All taxes, fees, lien waivers, certificates, bonds and licenses
- Room ventilation, air conditioning, or lighting
- Videotaping (unless a videotape agreement is signed)

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PRELIMINARY ESTIMATE
ETS - UV SYSTEM

COMMERCIAL OFFERING

Payment Terms:	30%	Due on Approval of Submittals
	60%	Due on Shipment of Equipment
	10%	Due on Startup (not to exceed 90 days after Equipment Shipment)
		All payments are due 30 days from date of invoice and are not subject to retention
EXW:	Factory	
Freight to Job Site:	Included	
Submittal:	4-6 weeks after receipt and approval of purchase order	
Shipment:	16-20 weeks after receipt of full information and approved drawings (when required)	
Startup:	4 On-site day(s) included over	2 Trip(s)
Training:	Concurrent with startup	
Extended Warranty:	Not Included	
Price:	**$264,352**	

Other Conditions:

1) Evoqua Water Technolgies, LLC (Evoqua) proposes to furnish materials, and/or equipment for the project identified at the beginning of this proposal. Any items not shown above as detailed under (i) 'SCOPE OF SUPPLY', (ii) 'SCOPE OF ENGINEERING', or (iii) other attachments to this proposal, are EXCLUDED. In addition:
   a. Evoqua' price will be held valid for a period of 90 days from the date of this proposal ("Proposal Date"); provided, however, in the event (A) Evoqua receives an order from Buyer within 90 days from the Proposal Date and the percentage change in the U.S. Department of Labor Consumer's Price Index (all items) (the "Index") as it existed two months prior to the Proposal Date and the Index as it existed two months preceding the month in which Evoqua receives Buyer's order is greater than 10%, then Evoqua shall have the right to reprice this proposal or (B) Buyer's order is received more than 90 days beyond the Proposal Date, then Evoqua shall have the right to reprice this proposal.
   b. Prices are in US Dollars.
   c. Local or state taxes are not included in this proposal.

2) This proposal by Evoqua is contingent upon: (i) Evoqua' written acceptance of the purchase order or other contractual document issued in response to this proposal; and (ii) Evoqua' satisfactory completion of an anti-corruption due diligence review, as applicable; and (iii) the enclosed terms and conditions contained in the following page(s) of this proposal, such terms to take precedence in the event of conflict with any other terms or documents incorporated into the contract arising out of this proposal unless otherwise agreed in writing.

3) All of the information supplied by Evoqua in connection with this proposal (including drawings, designs and specifications) (the "Information") is confidential and/or proprietary and has been prepared for your use solely in evaluating the purchase of the equipment and/or services described herein. Transmission of all or any part of the Information to others, or use by you for any purpose other than such evaluation, is expressly prohibited without Evoqua' prior written consent.

4) Please address & send your purchase order to:

   Neptune Benson Inc.
   334 Knight St Ste 3100
   Warwick, RI 02886-1286
   Attn: Martin Smith
   ph: 401.262.4731
   fax: 401.821.7129
   email: martin.smith@evoqua.com

ETS-UV
an EVOQUA brand

PRELIMINARY ESTIMATE
ETS - UV SYSTEM

Standard Terms & Conditions of Sale

1-May-15

1. Applicable Terms. These terms govern the purchase and sale of equipment, products, related services, leased products, and media goods if any (collectively herein "Work"), referred to in Seller's proposal ("Seller's Documentation"). Whether these terms are included in an offer or an acceptance by Seller, such offer or acceptance is expressly conditioned on Buyer's assent to these terms. Seller rejects all additional or different terms in any of Buyer's forms or documents.

2. Payment. Buyer shall pay Seller the full purchase price as set forth in Seller's Documentation. Unless Seller's Documentation specifically provides otherwise, freight, storage, insurance and all taxes, levies, duties, tariffs, permits or license fees or other governmental charges relating to the Work or any incremental increases thereto shall be paid by Buyer. If Seller is required to pay any such charges, Buyer shall immediately reimburse Seller. If Buyer claims a tax or other exemption or direct payment permit, it shall provide Seller with a valid exemption certificate or permit and indemnify, defend and hold Seller harmless from any taxes, costs and penalties arising out of same. All payments are due within 30 days after receipt of invoice. Buyer shall be charged the lower of 1 ½% interest per month or the maximum legal rate on all amounts not received by the due date and shall pay all of Seller's reasonable costs (including attorneys' fees) of collecting amounts due but unpaid. All orders are subject to credit approval by Seller. Back charges without Seller's prior written approval shall not be accepted.

3. Delivery. Delivery of the Work shall be in material compliance with the schedule in Seller's Documentation. Unless Seller's Documentation provides otherwise, delivery terms are ExWorks Seller's factory (Incoterms 2010). Title to all Work shall pass upon receipt of payment for the Work under the respective invoice. Unless otherwise agreed to in writing by Seller, shipping dates are approximate only and Seller shall not be liable for any loss or expense (consequential or otherwise) incurred by Buyer or Buyer's customer if Seller fails to meet the specified delivery schedule.

4. Ownership of Materials and Licenses. All devices, designs (including drawings, plans and specifications), estimates, prices, notes, electronic data, software and other documents or information prepared or disclosed by Seller, and all related intellectual property rights, shall remain Seller's property. Seller grants Buyer a non-exclusive, non-transferable license to use any such material solely for Buyer's use of the Work. Buyer shall not disclose any such material to third parties without Seller's prior written consent. Buyer grants Seller a non-exclusive, non-transferable license to use Buyer's name and logo for marketing purposes, including but not limited to, press releases, marketing and promotional materials, and web site content.

5. Changes. Neither party shall implement any changes in the scope of Work described in Seller's Documentation without a mutually agreed upon change order. Any change to the scope of the Work, delivery schedule for the Work, any Force Majeure Event, any law, rule, regulation, order, code, standard or requirement which requires any change hereunder shall entitle Seller to an equitable adjustment in the price and time of performance.

6. Force Majeure Event. Neither Buyer nor Seller shall have any liability for any breach or delay (except for breach of payment obligations) caused by a Force Majeure Event. If a Force Majeure Event exceeds six (6) months in duration, the Seller shall have the right to terminate the Agreement without liability, upon fifteen (15) days written notice to Buyer, and shall be entitled to payment for work performed prior to the date of termination. "Force Majeure Event" shall mean events or circumstances that are beyond the affected party's control and could not reasonably have been easily avoided or overcome by the affected party and are not substantially attributable to the other party. Force Majeure Event may include, but is not limited to, the following circumstances or events: war, act of foreign enemies, terrorism, riot, strike, or lockout by persons other than by Seller or its sub-suppliers, natural catastrophes or (with respect to on-site work), unusual weather conditions.

7. Warranty. Subject to the following sentence, Seller warrants to Buyer that the (i) Work shall materially conform to the description in Seller's Documentation and shall be free from defects in material and workmanship and (ii) the Services shall be performed in a timely and workmanlike manner. Determination of suitability of treated water for any use by Buyer shall be the sole and exclusive responsibility of Buyer. The foregoing warranty shall not apply to any Work that is specified or otherwise demanded by Buyer and is not manufactured or selected by Seller, as to which (i) Seller hereby assigns to Buyer, to the extent assignable, any warranties made to Seller and (ii) Seller shall have no other liability to Buyer under warranty, tort or any other legal theory. The Seller warrants the Work, or any components thereof, through the earlier of (i) eighteen (18) months from delivery of the Work or (ii) twelve (12) months from initial operation of the Work or ninety (90) days from the performance of services (the "Warranty Period"). If Buyer gives Seller prompt written notice of breach of this warranty within the Warranty Period, Seller shall, at its sole option and as Buyer's sole and exclusive remedy, repair or replace the subject parts, re-perform the Service or refund the purchase price. Unless otherwise agreed to in writing by Seller, (i) Buyer shall be responsible for any labor required to gain access to the Work so that Seller can assess the available remedies and (ii) Buyer shall be responsible for all costs of installation of repaired or replaced Work. If Seller determines that any claimed breach is not, in fact, covered by this warranty, Buyer shall pay Seller its then customary charges for any repair or replacement made by Seller. Seller's warranty is conditioned on Buyer's (a) operating and maintaining the Work in accordance with Seller's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to Seller. Seller's warranty does not cover (i) damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by Seller) and (ii) media goods (such as, but not limited to, resin, membranes, or granular activated carbon media) once media goods are installed. THE WARRANTIES SET FORTH IN THIS SECTION 7 ARE THE SELLER'S SOLE AND EXCLUSIVE WARRANTIES AND ARE SUBJECT TO THE LIMITATION OF LIABILITY PROVISION BELOW. SELLER MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

8. Indemnity. Seller shall indemnify, defend and hold Buyer harmless from any claim, cause of action or liability incurred by Buyer as a result of third party claims for personal injury, death or damage to tangible property, to the extent caused by Seller's negligence. Seller shall have the sole authority to direct the defense of and settle any indemnified claim. Seller's indemnification is conditioned on Buyer (a) promptly, within the Warranty Period, notifying Seller of any claim, and (b) providing reasonable cooperation in the defense of any claim.

9. Assignment. Neither party may assign this Agreement, in whole or in part, nor any rights or obligations hereunder without the prior written consent of the other party; provided, however, the Seller may assign its rights and obligations under these terms to its affiliates or in connection with the sale or transfer of the Seller's business and Seller may grant a security interest in the Agreement and/or assign proceeds of the agreement without Buyer's consent.

10. Termination. Either party may terminate this agreement, upon issuance of a written notice of breach and a thirty (30) day cure period, for a material breach (including but not limited to, filing of bankruptcy, or failure to fulfill the material obligations of this agreement). If Buyer suspends an order without a change order for ninety (90) or more days, Seller may thereafter terminate this Agreement without liability, upon fifteen (15) days written notice to Buyer, and shall be entitled to payment for work performed, whether delivered or undelivered, prior to the date of termination.

11. Dispute Resolution. Seller and Buyer shall negotiate in good faith to resolve any dispute relating hereto. If, despite good faith efforts, the parties are unable to resolve a dispute or claim arising out of or relating to this Agreement or its breach, termination, enforcement, interpretation or validity, the parties will first seek to agree on a forum for mediation to be held in a mutually agreeable site. If the parties are unable to resolve the dispute through mediation, then any dispute, claim or controversy arising out of or relating to this Agreement or the breach, termination, enforcement, interpretation or validity thereof, including the determination of the scope or applicability of this agreement to arbitrate, shall be determined by arbitration in Pittsburgh, Pennsylvania before three arbitrators who are lawyers experienced in the discipline that is the subject of the dispute and shall be jointly selected by Seller and Buyer. The arbitration shall be administered by JAMS pursuant to its Comprehensive Arbitration Rules and Procedures. The Arbitrators shall issue a reasoned decision of a majority of the arbitrators, which shall be the decision of the panel. Judgment may be entered upon the arbitrators' decision in any court of competent jurisdiction. The substantially prevailing party as determined by the arbitrators shall be reimbursed by the other party for all costs, expenses and charges, including without limitation reasonable attorneys' fees, incurred by the prevailing party in connection with the arbitration. For any order shipped outside of the United States, any dispute shall be referred to and finally determined by the International Center for Dispute Resolution in accordance with the provisions of its International Arbitration Rules, enforceable under the New York Convention (Convention on the Recognition and Enforcement of Foreign Arbitral Awards) and the governing language shall be English.

12. Export Compliance. Buyer acknowledges that Seller is required to comply with applicable export laws and regulations relating to the sale, exportation, transfer, assignment, disposal and usage of the Work provided under this Agreement, including any export license requirements. Buyer agrees that such Work shall not at any time directly or indirectly be used, exported, sold, transferred, assigned or otherwise disposed of in a manner which will result in non-compliance with such applicable export laws and regulations. It shall be a condition of the continuing performance by Seller of its obligations hereunder that compliance with such export laws and regulations be maintained at all times. BUYER AGREES TO INDEMNIFY AND HOLD SELLER HARMLESS FROM ANY AND ALL COSTS, LIABILITIES, PENALTIES, SANCTIONS AND FINES RELATED TO NON-COMPLIANCE WITH APPLICABLE EXPORT LAWS AND REGULATIONS.

13. LIMITATION OF LIABILITY. NOTWITHSTANDING ANYTHING ELSE TO THE CONTRARY, SELLER SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER INDIRECT DAMAGES, AND SELLER'S TOTAL LIABILITY ARISING AT ANY TIME FROM THE SALE OR USE OF THE WORK, INCLUDING WITHOUT LIMITATION ANY LIABILITY FOR MECHANICAL WARRANTY CLAIMS OR FOR ANY BREACH OR FAILURE TO PERFORM ANY OBLIGATION UNDER THE CONTRACT, SHALL NOT EXCEED THE PURCHASE PRICE PAID FOR THE WORK. THESE LIMITATIONS APPLY WHETHER THE LIABILITY IS BASED ON CONTRACT, TORT, STRICT LIABILITY OR ANY OTHER THEORY.

14. Rental Equipment / Services. Any leased or rented equipment ("Leased Equipment") provided by Seller shall at all times be the property of Seller with the exception of certain miscellaneous installation materials purchased by the Buyer, and no right or property interest is transferred to the Buyer, except the right to use any such Leased Equipment as provided herein. Buyer agrees that it shall not pledge, lend, or create a security interest in, part with possession of, or relocate the Leased Equipment. Buyer shall be responsible to maintain the Leased Equipment in good and efficient working order. At the end of the initial term specified in the order, the terms shall automatically renew for the identical period unless canceled in writing by Buyer or Seller not sooner than three (3) months nor later than one (1) month from termination of the initial order or any renewal terms. Upon any renewal, Seller shall have the right to issue notice of increased pricing which shall be effective for any renewed terms unless Buyer objects in writing within fifteen (15) days of issuance of said notice. If Buyer timely cancels service in writing prior to the end of the initial or any renewal term this shall not relieve Buyer of its obligations under the order for the monthly rental service charge which shall continue to be due and owing. Upon the expiration or termination of this Agreement, Buyer shall promptly make any Leased Equipment available to Seller for removal. Buyer hereby agrees that it shall grant Seller access to the Leased Equipment location and shall permit Seller to take possession of and remove the Leased Equipment without resort to legal process and hereby releases Seller from any claim or right of action for trespass or damages caused by reason of such entry and removal.

15. Miscellaneous. These terms, together with any Contract Documents issued or signed by the Seller, comprise the complete and exclusive statement of the agreement between the parties (the "Agreement") and supersede any terms contained in Buyer's documents, unless separately signed by Seller. No part of the Agreement may be changed or cancelled except by a written document signed by Seller and Buyer. No course of dealing or performance, usage of trade or failure to enforce any term shall be used to modify the Agreement. To the extent the Agreement is considered a subcontract under Buyer's prime contract with an agency of the United States government, in case of Federal Acquisition Regulations (FARs) flow down terms, Seller will be in compliance with Section 44.403 of the FAR relating to commercial items and those additional clauses as specifically listed in 52.244-6, Subcontracts for Commercial Items (OCT 2014). If any of these terms is unenforceable, such term shall be limited only to the extent necessary to make it enforceable, and all other terms shall remain in full force and effect. The Agreement shall be governed by the laws of the Commonwealth of Pennsylvania without regard to its conflict of laws provisions. Both Buyer and Seller reject the applicability of the United Nations Convention on Contracts for the international sales of goods to the relationship between the parties and to all transactions arising from said relationship.

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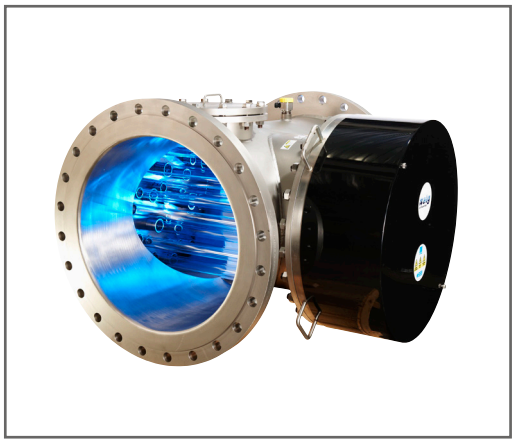
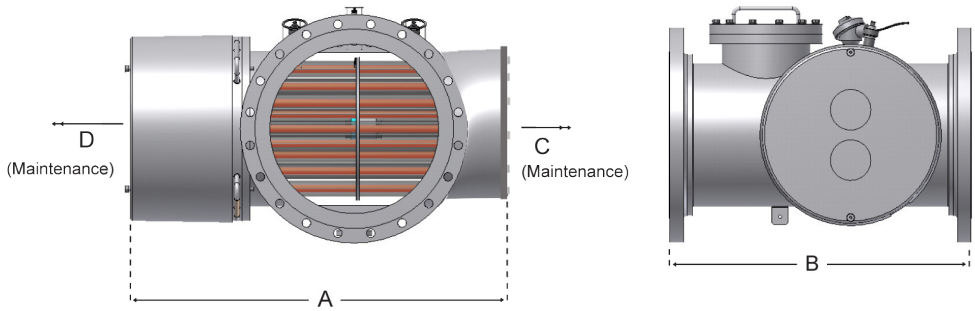
SPECIFICATION SHEET SW-835-14
Electronic Ballasts



Multi-lamp, medium pressure UV systems for wastewater applications

Model	Connection	# of Lamps	Lamp Power Per Lamp	Dimensions (inches)			
				A	B	C	D
SW-835-14	14 inches	8	3.5 kW	37	30	4	14



Drawings for illustration purposes only, use specific GA drawings for accuracy

SPECTRA Touch Control Panel	
Height	52 in
Width	30 in
Depth	26 in
Voltage	480 V
Frequency	60 Hz
Phase	3

CHAMBER
316L SS
ANSI 150# flanged connections
Install inline horizontally or vertically
Features:
Twist lock lamp connections
Variable power lamps
Dry UV intensity monitors
High purity quartz sleeves
Low voltage automatic wiper
Access hatch
One piece wiper ring
Temperature sensor
Drain and vent ports

CONTROL SYSTEM
NEMA 12 enclosure
Epoxy coated mild steel enclosure
Operational 32-113°F, RH < 90%
Features:
7" HMI touch screen
Microprocessor system for basic control to full plant system integration
MODBUS over Ethernet communication
Internet monitoring capability
Data logging capability with remote access
Multiple warning and alarms
Additional Information: Spectra Touch spec sheet

SYSTEM OPTIONS
304 or 316 NEMA 4X enclosures
Certified explosion-proof design
Skid mounted
Containerized
Internal/external polish or electropolish

INSTALLATION NOTES
Provide necessary maintenance space
Intstall in a dry area
Provide floor dain or sump
Lamps submerged at all times
Minimum of two conduits required
Chamber must be grounded

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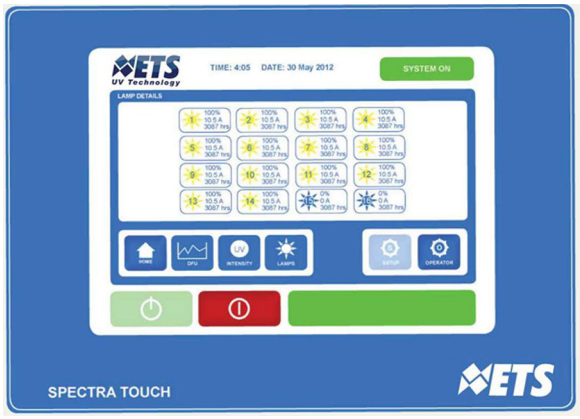
SPECIFICATION SHEET
SPECTRA TOUCH

ETS UV Technology microprocessor control system offers multiple levels of operation from basic controls to full plant system integration. Available on all UV systems. Existing systems can be upgraded to include a TOUCH control panel.



SIMPLE CONTROLS AND DISPLAY

- 7" resistive touch screen human machine interface (HMI)
- Glare free operation
- On screen trending
- STOP soft touch push buttons
- RESET soft touch push buttons
- Simple operation for any level of technical experience and expertise
- All alarm functions have a simple text message display

INTERFACE CONTROLS

- Ethernet connectivity/WiFi capability
- Selectable custom input and outputs
- Local and remote operation
- Process interrupt (valves, flow meters or pressure switches)
- Low UV alarm and shutdown
- Bleed temperature
- Flow meter input
- Automatic restart
- Variable power dosing
- Duty/Standby automatic changeover

ADVANCED DISPLAY FEATURES

- Improved noise resistance
- Distributed I/O possible
- On/Off control
- Lamp running indication/lamp current
- Power on indication
- Elapsed hours meter
- Lamp failed contact (volt free)
- UV intensity & UV dose mJ/cm2
- Flow rate (accepts a 4-20ma signal from a flow meter)
- Temperature, low UV alarm
- System spares listing
- Ground fault
- Wiper fault

ADVANCED DISPLAY FEATURES

The Touch has a built in data logging facility (retrievable by users on a standard PC or laptop). The parameters logged are:

- UV intensity required (set point)
- UV intensity measured
- Lamp current
- Temperature
- Flow (if flow meter connected)
- Time and date
- Alarms generated: restrike timer, low intensity, low dose, high temperature, PSU temperature, lamp fault and ground fault

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PRELIMINARY ESTIMATE
ETS - UV SYSTEM

Project Name:	Centerville WWTP
Project Location:	Centerville, MD
Proposal No.:	23 UV 37 PB1
Proposal Date:	25-Apr-2023
Proposal Expires:	24-Jul-2023
Applications Engineer:	Martin Smith
Sales Manager:	Joe Ciurlino
Manufacturers Rep:	Envirep/TLC
Contact:	Dwight Swan
Phone:	(717) 503-4639
Email:	dswan@envirep.com
Consultant:	Whitman, Requardt & Associates, LLP
Contact:	David R. Nixson, P.E.
Phone:	(443) 824-1620
Email:	dnixson@wrallp.com

SCOPE OF SUPPLY

Qty	Description
	DESIGN CONSIDERATIONS
	Peak flowrate: 3.3 MGD
	Transmittance (1 cm light cell): 65%
	TSS: <10 mg/l
	Iron concentration: <0.1 mg/l
	Manganese concentration: <0.1 mg/l
	Influent e. coli: <40,000 MPN/100 ml
	Effluent e. coli: <116 MPN/100 ml
	Configuration: 2 parallel UVLW-20800-20 (100% redundancy)
	UVLW-20800-20
	UV Chamber
2	ETS-UV UVLW-20800-20 UV system complete with:
	16" ANSI flange connections, 316L SS
	(20) 800 W low pressure high output UV lamps parallel to flow
	(20) Quartz thimbles
	Temperature sensor
	Automatic/Mechanical cleaning
	Access hatch
	(1) UV intensity sensor
	(1) Operation and maintenance manual
	Power/Control Cabinet
2	Free standing power/control cabinet, epoxy coated painted steel, complete with:
	Electronic ballast lamp drive
	Spectra 3, 7" touch screen
	Dimensions: H 79 x W 62 x D 24-in
	Power supply: 480V, 3ø, 4-Wire + GND (Wye), 60Hz
	NEMA12 enclosure
	Cables - UV chamber to power/control cabinet
2	30 ft cable set
	UVT Monitor
1	Online UVT Transmittance Monitor + Real Clean System
	Supplied Spares
4	UV lamps
2	Electronic ballasts
3	Quartz thimbles
3	Thimble seals
20	Wiper rings
1	Wiper flap for UV intensity monitor

SCOPE OF ENGINEERING

The following documentation shall be provided by Evoqua:
- Shop Drawing Submittal
  - Detailed Scope of Supply
  - Comments & Clarifications
  - Project Schedule
  - Technical Information / Equipment / Drawings
    Catalog Cutsheets
    Dimensional Drawings / General Assembly Drawings
    Functional Schematics / Piping and Instrumentation Diagrams (when applicable)
    Electrical Schematics (when applicable)
    Control Panel Layouts, Ladder Logic Diagrams (when applicable)
  - Receiving, Handling and Storage
  - Warranty Statement
- Operation and Maintenance Manuals
  - Ordering Information
  - Warranty Statement
  - Introduction
  - Safety Precautions
  - Preventive Maintenance General Information
  - Maintenance Record Card
  - Regional Offices
  - Technical Data
  - Installation
  - Operation
  - Service
  - Illustrations
  - Preventive Maintenance Kits and Spare Parts List
  - Additional Literature

NOTE - In an effort to be environmentally responsible, one (1) hard copy of the submittal and O+M will be supplied and up to eight (8) copies will be supplied on flash drive(s). Additional hardcopies of the submittal and O+M can be supplied at a cost of $50.00 each.

CLARIFICATIONS & EXCEPTIONS

Section	Part	Description
NOTICE		The scope of supply and pricing are based on Evoqua's standard equipment selection, standard terms of sale and warranty terms. Any variations from these standards may affect this quotation.

ITEMS NOT INCLUDED IN SCOPE

- Mechanical and electrical installation labor
- Civil work including supply of anchor bolts
- Interconnecting piping
- Interconnecting wiring (unless detailed above)
- Valves, fittings, appurtenances not specifically listed above
- Installation supervision
- All taxes, fees, lien waivers, certificates, bonds and licenses
- Room ventilation, air conditioning, or lighting
- Videotaping (unless a videotape agreement is signed)

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PRELIMINARY ESTIMATE
ETS - UV SYSTEM

COMMERCIAL OFFERING

Payment Terms:	30%	Due on Approval of Submittals
	60%	Due on Shipment of Equipment
	10%	Due on Startup (not to exceed 90 days after Equipment Shipment)
		All payments are due 30 days from date of invoice and are not subject to retention
EXW:	Factory	
Freight to Job Site:	Included	
Submittal:	4-6 weeks after receipt and approval of purchase order	
Shipment:	16-20 weeks after receipt of full information and approved drawings (when required)	
Startup:	5 On-site day(s) included over	2 Trip(s)
Training:	Concurrent with startup	
Extended Warranty:	Not Included	
Price:	**$357,448**	

Other Conditions:

1) Evoqua Water Technolgies, LLC (Evoqua) proposes to furnish materials, and/or equipment for the project identified at the beginning of this proposal. Any items not shown above as detailed under (i) 'SCOPE OF SUPPLY', (ii) 'SCOPE OF ENGINEERING', or (iii) other attachments to this proposal, are EXCLUDED. In addition:
   a. Evoqua' price will be held valid for a period of 90 days from the date of this proposal ("Proposal Date"); provided, however, in the event (A) Evoqua receives an order from Buyer within 90 days from the Proposal Date and the percentage change in the U.S. Department of Labor Consumer's Price Index (all items) (the "Index") as it existed two months prior to the Proposal Date and the Index as it existed two months preceding the month in which Evoqua receives Buyer's order is greater than 10%, then Evoqua shall have the right to reprice this proposal or (B) Buyer's order is received more than 90 days beyond the Proposal Date, then Evoqua shall have the right to reprice this proposal.
   b. Prices are in US Dollars.
   c. Local or state taxes are not included in this proposal.

2) This proposal by Evoqua is contingent upon: (i) Evoqua' written acceptance of the purchase order or other contractual document issued in response to this proposal; and (ii) Evoqua' satisfactory completion of an anti-corruption due diligence review, as applicable; and (iii) the enclosed terms and conditions contained in the following page(s) of this proposal, such terms to take precedence in the event of conflict with any other terms or documents incorporated into the contract arising out of this proposal unless otherwise agreed in writing.

3) All of the information supplied by Evoqua in connection with this proposal (including drawings, designs and specifications) (the "Information") is confidential and/or proprietary and has been prepared for your use solely in evaluating the purchase of the equipment and/or services described herein. Transmission of all or any part of the Information to others, or use by you for any purpose other than such evaluation, is expressly prohibited without Evoqua' prior written consent.

4) Please address & send your purchase order to:

   Neptune Benson Inc.
   334 Knight St Ste 3100
   Warwick, RI 02886-1286
   Attn: Martin Smith
   ph: 401.262.4731
   fax: 401.821.7129
   email: martin.smith@evoqua.com

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PRELIMINARY ESTIMATE
ETS - UV SYSTEM

Standard Terms & Conditions of Sale

1-May-15

1. Applicable Terms. These terms govern the purchase and sale of equipment, products, related services, leased products, and media goods if any (collectively herein "Work"), referred to in Seller's proposal ("Seller's Documentation"). Whether these terms are included in an offer or an acceptance by Seller, such offer or acceptance is expressly conditioned on Buyer's assent to these terms. Seller rejects all additional or different terms in any of Buyer's forms or documents.

2. Payment. Buyer shall pay Seller the full purchase price as set forth in Seller's Documentation. Unless Seller's Documentation specifically provides otherwise, freight, storage, insurance and all taxes, levies, duties, tariffs, permits or license fees or other governmental charges relating to the Work or any incremental increases thereto shall be paid by Buyer. If Seller is required to pay any such charges, Buyer shall immediately reimburse Seller. If Buyer claims a tax or other exemption or direct payment permit, it shall provide Seller with a valid exemption certificate or permit and indemnify, defend and hold Seller harmless from any taxes, costs and penalties arising out of same. All payments are due within 30 days after receipt of invoice. Buyer shall be charged the lower of 1 ½% interest per month or the maximum legal rate on all amounts not received by the due date and shall pay all of Seller's reasonable costs (including attorneys' fees) of collecting amounts due but unpaid. All orders are subject to credit approval by Seller. Back charges without Seller's prior written approval shall not be accepted.

3. Delivery. Delivery of the Work shall be in material compliance with the schedule in Seller's Documentation. Unless Seller's Documentation provides otherwise, delivery terms are ExWorks Seller's factory (Incoterms 2010). Title to all Work shall pass upon receipt of payment for the Work under the respective invoice. Unless otherwise agreed to in writing by Seller, shipping dates are approximate only and Seller shall not be liable for any loss or expense (consequential or otherwise) incurred by Buyer or Buyer's customer if Seller fails to meet the specified delivery schedule.

4. Ownership of Materials and Licenses. All devices, designs (including drawings, plans and specifications), estimates, prices, notes, electronic data, software and other documents or information prepared or disclosed by Seller, and all related intellectual property rights, shall remain Seller's property. Seller grants Buyer a non-exclusive, non-transferable license to use any such material solely for Buyer's use of the Work. Buyer shall not disclose any such material to third parties without Seller's prior written consent. Buyer grants Seller a non-exclusive, non-transferable license to use Buyer's name and logo for marketing purposes, including but not limited to, press releases, marketing and promotional materials, and web site content.

5. Changes. Neither party shall implement any changes in the scope of Work described in Seller's Documentation without a mutually agreed upon change order. Any change to the scope of the Work, delivery schedule for the Work, any Force Majeure Event, any law, rule, regulation, order, code, standard or requirement which requires any change hereunder shall entitle Seller to an equitable adjustment in the price and time of performance.

6. Force Majeure Event. Neither Buyer nor Seller shall have any liability for any breach or delay (except for breach of payment obligations) caused by a Force Majeure Event. If a Force Majeure Event exceeds six (6) months in duration, the Seller shall have the right to terminate the Agreement without liability, upon fifteen (15) days written notice to Buyer, and shall be entitled to payment for work performed prior to the date of termination. "Force Majeure Event" shall mean events or circumstances that are beyond the affected party's control and could not reasonably have been easily avoided or overcome by the affected party and are not substantially attributable to the other party. Force Majeure Event may include, but is not limited to, the following circumstances or events: war, act of foreign enemies, terrorism, riot, strike, or lockout by persons other than by Seller or its sub-suppliers, natural catastrophes or (with respect to on-site work), unusual weather conditions.

7. Warranty. Subject to the following sentence, Seller warrants to Buyer that the (i) Work shall materially conform to the description in Seller's Documentation and shall be free from defects in material and workmanship and (ii) the Services shall be performed in a timely and workmanlike manner. Determination of suitability of treated water for any use by Buyer shall be the sole and exclusive responsibility of Buyer. The foregoing warranty shall not apply to any Work that is specified or otherwise demanded by Buyer and is not manufactured or selected by Seller, as to which (i) Seller hereby assigns to Buyer, to the extent assignable, any warranties made to Seller and (ii) Seller shall have no other liability to Buyer under warranty, tort or any other legal theory. The Seller warrants the Work, or any components thereof, through the earlier of (i) eighteen (18) months from delivery of the Work or (ii) twelve (12) months from initial operation of the Work or ninety (90) days from the performance of services (the "Warranty Period"). If Buyer gives Seller prompt written notice of breach of this warranty within the Warranty Period, Seller shall, at its sole option and as Buyer's sole and exclusive remedy, repair or replace the subject parts, re-perform the Service or refund the purchase price. Unless otherwise agreed to in writing by Seller, (i) Buyer shall be responsible for any labor required to gain access to the Work so that Seller can assess the available remedies and (ii) Buyer shall be responsible for all costs of installation of repaired or replaced Work. If Seller determines that any claimed breach is not, in fact, covered by this warranty, Buyer shall pay Seller its then customary charges for any repair or replacement made by Seller. Seller's warranty is conditioned on Buyer's (a) operating and maintaining the Work in accordance with Seller's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to Seller. Seller's warranty does not cover (i) damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by Seller) and (ii) media goods (such as, but not limited to, resin, membranes, or granular activated carbon media) once media goods are installed. THE WARRANTIES SET FORTH IN THIS SECTION 7 ARE THE SELLER'S SOLE AND EXCLUSIVE WARRANTIES AND ARE SUBJECT TO THE LIMITATION OF LIABILITY PROVISION BELOW. SELLER MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

8. Indemnity. Seller shall indemnify, defend and hold Buyer harmless from any claim, cause of action or liability incurred by Buyer as a result of third party claims for personal injury, death or damage to tangible property, to the extent caused by Seller's negligence. Seller shall have the sole authority to direct the defense of and settle any indemnified claim. Seller's indemnification is conditioned on Buyer (a) promptly, within the Warranty Period, notifying Seller of any claim, and (b) providing reasonable cooperation in the defense of any claim.

9. Assignment. Neither party may assign this Agreement, in whole or in part, nor any rights or obligations hereunder without the prior written consent of the other party; provided, however, the Seller may assign its rights and obligations under these terms to its affiliates or in connection with the sale or transfer of the Seller's business and Seller may grant a security interest in the Agreement and/or assign proceeds of the agreement without Buyer's consent.

10. Termination. Either party may terminate this agreement, upon issuance of a written notice of breach and a thirty (30) day cure period, for a material breach (including but not limited to, filing of bankruptcy, or failure to fulfill the material obligations of this agreement). If Buyer suspends an order without a change order for ninety (90) or more days, Seller may thereafter terminate this Agreement without liability, upon fifteen (15) days written notice to Buyer, and shall be entitled to payment for work performed, whether delivered or undelivered, prior to the date of termination.

11. Dispute Resolution. Seller and Buyer shall negotiate in good faith to resolve any dispute relating hereto. If, despite good faith efforts, the parties are unable to resolve a dispute or claim arising out of or relating to this Agreement or its breach, termination, enforcement, interpretation or validity, the parties will first seek to agree on a forum for mediation to be held in a mutually agreeable site. If the parties are unable to resolve the dispute through mediation, then any dispute, claim or controversy arising out of or relating to this Agreement or the breach, termination, enforcement, interpretation or validity thereof, including the determination of the scope or applicability of this agreement to arbitrate, shall be determined by arbitration in Pittsburgh, Pennsylvania before three arbitrators who are lawyers experienced in the discipline that is the subject of the dispute and shall be jointly selected by Seller and Buyer. The arbitration shall be administered by JAMS pursuant to its Comprehensive Arbitration Rules and Procedures. The Arbitrators shall issue a reasoned decision of a majority of the arbitrators, which shall be the decision of the panel. Judgment may be entered upon the arbitrators' decision in any court of competent jurisdiction. The substantially prevailing party as determined by the arbitrators shall be reimbursed by the other party for all costs, expenses and charges, including without limitation reasonable attorneys' fees, incurred by the prevailing party in connection with the arbitration. For any order shipped outside of the United States, any dispute shall be referred to and finally determined by the International Center for Dispute Resolution in accordance with the provisions of its International Arbitration Rules, enforceable under the New York Convention (Convention on the Recognition and Enforcement of Foreign Arbitral Awards) and the governing language shall be English.

12. Export Compliance. Buyer acknowledges that Seller is required to comply with applicable export laws and regulations relating to the sale, exportation, transfer, assignment, disposal and usage of the Work provided under this Agreement, including any export license requirements. Buyer agrees that such Work shall not at any time directly or indirectly be used, exported, sold, transferred, assigned or otherwise disposed of in a manner which will result in non-compliance with such applicable export laws and regulations. It shall be a condition of the continuing performance by Seller of its obligations hereunder that compliance with such export laws and regulations be maintained at all times. BUYER AGREES TO INDEMNIFY AND HOLD SELLER HARMLESS FROM ANY AND ALL COSTS, LIABILITIES, PENALTIES, SANCTIONS AND FINES RELATED TO NON-COMPLIANCE WITH APPLICABLE EXPORT LAWS AND REGULATIONS.

13. LIMITATION OF LIABILITY. NOTWITHSTANDING ANYTHING ELSE TO THE CONTRARY, SELLER SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER INDIRECT DAMAGES, AND SELLER'S TOTAL LIABILITY ARISING AT ANY TIME FROM THE SALE OR USE OF THE WORK, INCLUDING WITHOUT LIMITATION ANY LIABILITY FOR MECHANICAL WARRANTY CLAIMS OR FOR ANY BREACH OR FAILURE TO PERFORM ANY OBLIGATION UNDER THE CONTRACT, SHALL NOT EXCEED THE PURCHASE PRICE PAID FOR THE WORK. THESE LIMITATIONS APPLY WHETHER THE LIABILITY IS BASED ON CONTRACT, TORT, STRICT LIABILITY OR ANY OTHER THEORY.

14. Rental Equipment / Services. Any leased or rented equipment ("Leased Equipment") provided by Seller shall at all times be the property of Seller with the exception of certain miscellaneous installation materials purchased by the Buyer, and no right or property interest is transferred to the Buyer, except the right to use any such Leased Equipment as provided herein. Buyer agrees that it shall not pledge, lend, or create a security interest in, part with possession of, or relocate the Leased Equipment. Buyer shall be responsible to maintain the Leased Equipment in good and efficient working order. At the end of the initial term specified in the order, the terms shall automatically renew for the identical period unless canceled in writing by Buyer or Seller not sooner than three (3) months nor later than one (1) month from termination of the initial order or any renewal terms. Upon any renewal, Seller shall have the right to issue notice of increased pricing which shall be effective for any renewed terms unless Buyer objects in writing within fifteen (15) days of issuance of said notice. If Buyer timely cancels service in writing prior to the end of the initial or any renewal term this shall not relieve Buyer of its obligations under the order for the monthly rental service charge which shall continue to be due and owing. Upon the expiration or termination of this Agreement, Buyer shall promptly make any Leased Equipment available to Seller for removal. Buyer hereby agrees that it shall grant Seller access to the Leased Equipment location and shall permit Seller to take possession of and remove the Leased Equipment without resort to legal process and hereby releases Seller from any claim or right of action for trespass or damages caused by reason of such entry and removal.

15. Miscellaneous. These terms, together with any Contract Documents issued or signed by the Seller, comprise the complete and exclusive statement of the agreement between the parties (the "Agreement") and supersede any terms contained in Buyer's documents, unless separately signed by Seller. No part of the Agreement may be changed or cancelled except by a written document signed by Seller and Buyer. No course of dealing or performance, usage of trade or failure to enforce any term shall be used to modify the Agreement. To the extent the Agreement is considered a subcontract under Buyer's prime contract with an agency of the United States government, in case of Federal Acquisition Regulations (FARs) flow down terms, Seller will be in compliance with Section 44.403 of the FAR relating to commercial items and those additional clauses as specifically listed in 52.244-6, Subcontracts for Commercial Items (OCT 2014). If any of these terms is unenforceable, such term shall be limited only to the extent necessary to make it enforceable, and all other terms shall remain in full force and effect. The Agreement shall be governed by the laws of the Commonwealth of Pennsylvania without regard to its conflict of laws provisions. Both Buyer and Seller reject the applicability of the United Nations Convention on Contracts for the international sales of goods to the relationship between the parties and to all transactions arising from said relationship.

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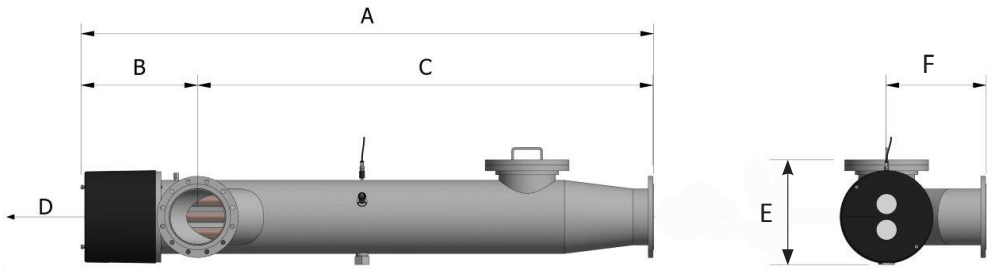
SPECIFICATION SHEET
UVLW RANGE

The UVLW is a range of 800W low pressure, high output amalgam UV systems that are validated to the 2003 and 2012 NWRI Reuse Guidelines

Model	Connection (Inches)	# of Lamps (800W)	Dimensions						Panel Dimensions		
			A	B	C	D	E	F	W	H	D
ULVW-6800-10	8	6	105	22	83	75	25	10	32	79	24
UVLW-6800-14	10	6	110	23	87	75	31	12	32	79	24
UVLW-8800-14	10	8	110	23	87	75	31	12	62	79	24
UVLW-16800-20	16	16	121	26	95	75	40	15	62	79	24
UVLW-20800-20	16	20	121	26	95	75	40	15	94	79	24
UVLW-22800-24	20	22	121	27	94	75	47	18	94	79	24
UVLW-30800-24	20	30	121	27	94	75	47	18	94	79	24
UVLW-30800-30	20	30	122	28	94	75	55	21	94	79	24
UVLW-45800-30	20	45	122	28	94	75	55	21	125	79	24



CHAMBER
316L SS
ANSI 150# flanged connections
Install inline, horizontally or vertically
Features:
Acess Hatch
Twist lock lamp connections
Dry UV intensity monitor
High purity quartz thimbles
Low voltage automatic wiper
One piece wiper ring
Temperature sensor
Drain and vent ports

CONTROL SYSTEM
NEMA 12 epoxy coated mild steel enclosure
Operational 32-113°F, RH <90%
Features:
7" HMI
Spectra II control system
MODBUS
Multiple warnings and alarms
Variable power lamps
480V/3-phase

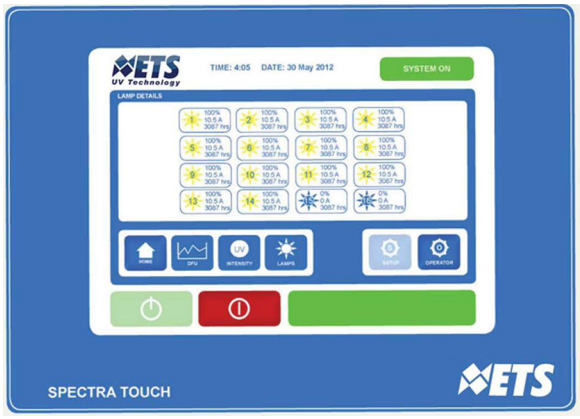
SYSTEM OPTIONS
304 or 316 NEMA 4X enclosures
Effluent flange location
Skid mounted
Containerized
Internal/external polish or electropolish

INSTALLATION NOTES
Provide necessary maintenance space
Install in a dry area
Provide floor drain or sump
Lamps submerged at all times
Minimum of two conduits required
Chamber must be grounded

ETS-UV™
an EVOQUA brand

SPECIFICATION SHEET
SPECTRA TOUCH

ETS UV Technology microprocessor control system offers multiple levels of operation from basic controls to full plant system integration. Available on all UV systems. Existing systems can be upgraded to include a TOUCH control panel.



SIMPLE CONTROLS AND DISPLAY

- 7" resistive touch screen human machine interface (HMI)
- Glare free operation
- On screen trending
- STOP soft touch push buttons
- RESET soft touch push buttons
- Simple operation for any level of technical experience and expertise
- All alarm functions have a simple text message display

INTERFACE CONTROLS

- Ethernet connectivity/WiFi capability
- Selectable custom input and outputs
- Local and remote operation
- Process interrupt (valves, flow meters or pressure switches)
- Low UV alarm and shutdown
- Bleed temperature
- Flow meter input
- Automatic restart
- Variable power dosing
- Duty/Standby automatic changeover

ADVANCED DISPLAY FEATURES

- Improved noise resistance
- Distributed I/O possible
- On/Off control
- Lamp running indication/lamp current
- Power on indication
- Elapsed hours meter
- Lamp failed contact (volt free)
- UV intensity & UV dose mJ/cm2
- Flow rate (accepts a 4-20ma signal from a flow meter)
- Temperature, low UV alarm
- System spares listing
- Ground fault
- Wiper fault

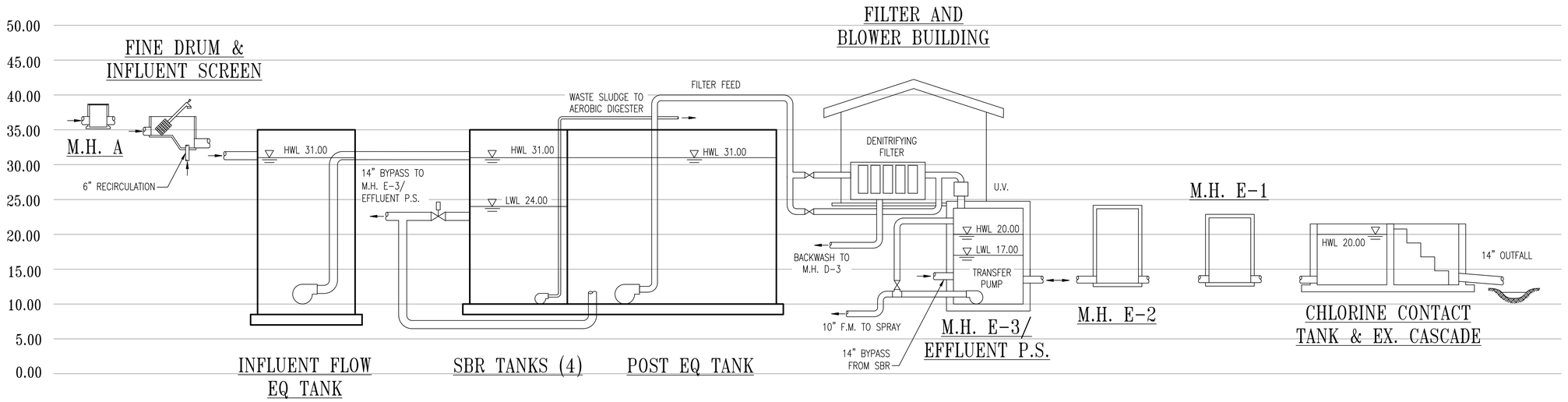
ADVANCED DISPLAY FEATURES

The Touch has a built in data logging facility (retrievable by users on a standard PC or laptop). The parameters logged are:

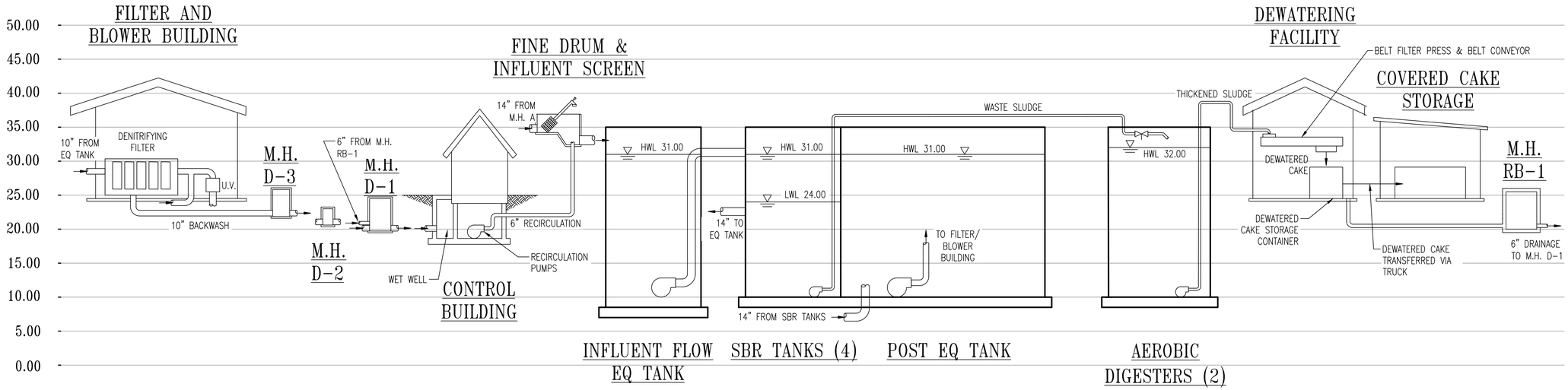
- UV intensity required (set point)
- UV intensity measured
- Lamp current
- Temperature
- Flow (if flow meter connected)
- Time and date
- Alarms generated: restrike timer, low intensity, low dose, high temperature, PSU temperature, lamp fault and ground fault

Appendix E

Preliminary Hydraulic Profiles



HYDRAULIC PROFILE - OUTFALL
NO SCALE



HYDRAULIC PROFILE - RECIRCULATION AND SLUDGE TRANSFER
NO SCALE

REVISIONS

CLIENT INFORMATION

TOWN OF CENTERVILLE
CENTERVILLE, MD

WWTP UPGRADE

KEY PLAN

GRAPHIC SCALES

SIGNATURE

PRELIMINARY DESIGN
NOT FOR
CONSTRUCTION

PROFESSIONAL CERTIFICATION:
I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND,
LICENSE NO. _____
EXPIRATION DATE: _____

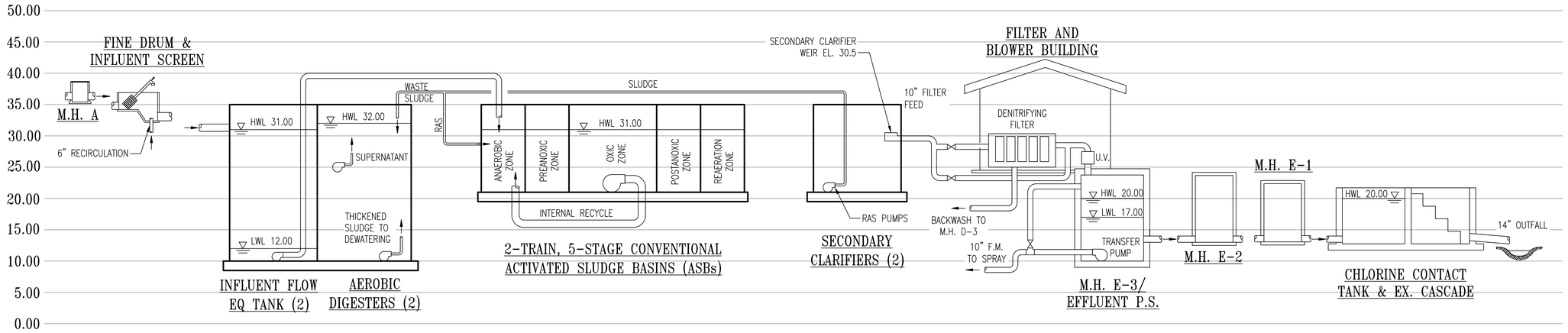
Whitman, Requardt & Associates, LLP
801 South Caroline Street, Baltimore, Maryland 21231

ALTERNATIVE 1
HYDRAULIC PROFILE

FIGURE NO.

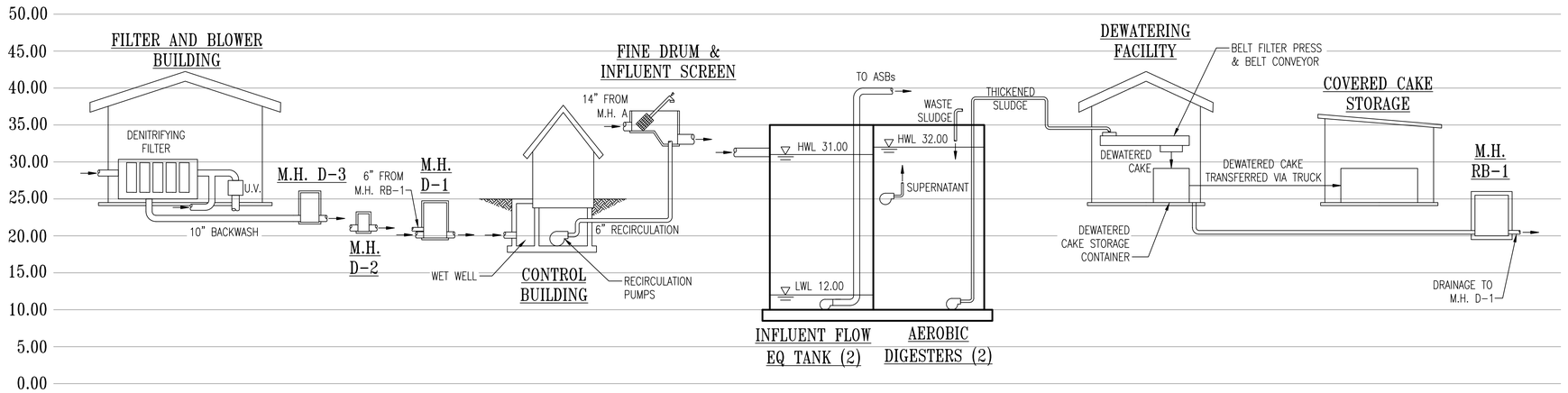
1

SCALE: NONE		
DATE: DECEMBER 2023	SHEET XX OF XX	
DES: KWS	DRAWN: KWS	CHECK: DRN



HYDRAULIC PROFILE - OUTFALL

NO SCALE



HYDRAULIC PROFILE - RECIRCULATION AND SLUDGE TRANSFER

NO SCALE

REVISIONS		

CLIENT INFORMATION

TOWN OF CENTERVILLE
CENTERVILLE, MD

WWTP UPGRADE

KEY PLAN

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LICENSE NO. _____
EXPIRATION DATE: _____

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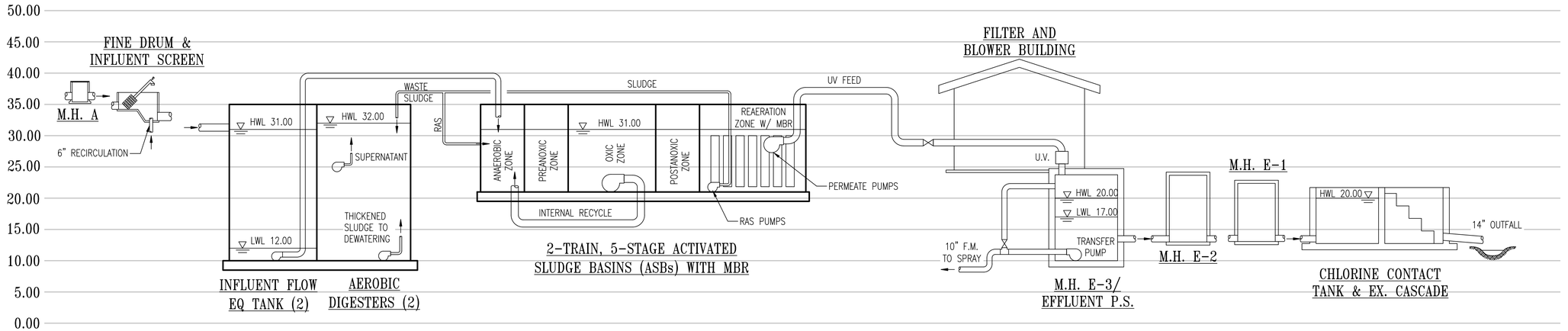
801 South Caroline Street, Baltimore, Maryland 21231

ALTERNATIVE 2
HYDRAULIC PROFILE

FIGURE NO.

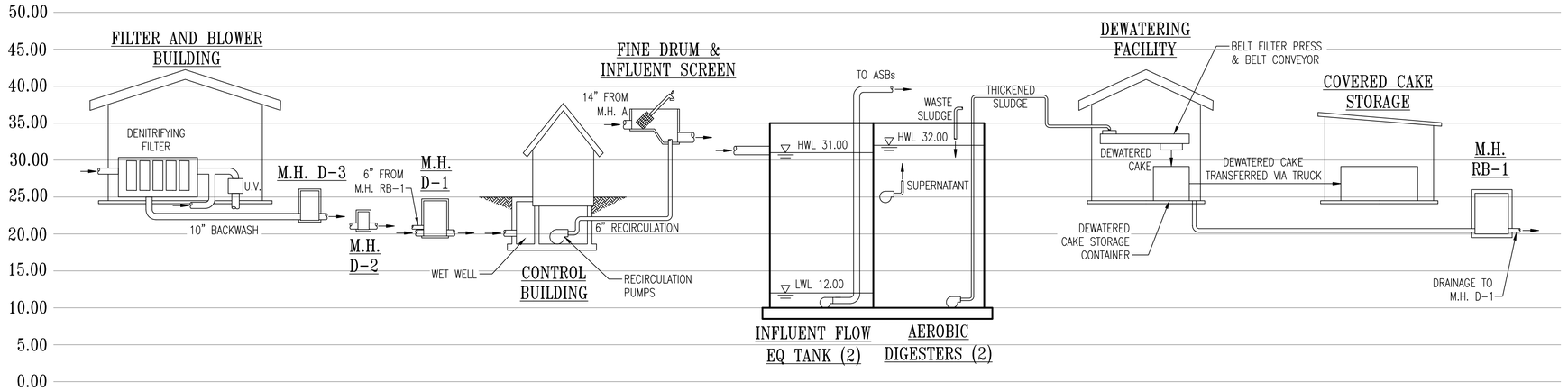
2

SCALE: **NONE**		
DATE: DECEMBER 2023	SHEET **XX** OF XX	
DES: **LMA**	DRAWN: **LMA**	CHECK: **DRN**



HYDRAULIC PROFILE - OUTFALL

NO SCALE



HYDRAULIC PROFILE - RECIRCULATION AND SLUDGE TRANSFER

NO SCALE

REVISIONS

CLIENT INFORMATION

TOWN OF CENTERVILLE
CENTERVILLE, MD

WWTP UPGRADE

KEY PLAN

GRAPHIC SCALES

SIGNATURE

PRELIMINARY DESIGN
NOT FOR
CONSTRUCTION

PROFESSIONAL CERTIFICATION:
I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND,
LICENSE NO. _____
EXPIRATION DATE: _____

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801 South Caroline Street, Baltimore, Maryland 21231

ALTERNATIVE 3
HYDRAULIC PROFILE

FIGURE NO.

3

SCALE: **NONE**		
DATE: DECEMBER 2023	SHEET **XX** OF XX	
DES: **LMA**	DRAWN: **LMA**	CHECK: **DRN**

Appendix F

Electrical Service Sizing and Single-Line Diagrams

ELECTRICAL SERVICE SIZING (EXISTING)						DATE: November 27, 2023			
PROJECT: Centerville WWTP									
LOCATION: Queen Anne's County						DESIGNED BY: SG CHECKED BY: KK			
ARCHITECT ENGINEER: Dhillon Engineering, Inc.									
Bldg.	**S. NO.**	**DESCRIPTION**	**HP**	**KW**	**KVA**	**VOLTAGE**	**PHASE**	**AMPS**	**REMARKS**
Filter Building	1	SBR Sludge Transfer Pump #1	2		2.8	460	3	3.4	
	2	DDM Mixer #1	20		21.6	460	3	27	
	3	Exhaust Fan EF-1	7.5		9.2	460	3	3	
	4	Filtered Feed Pump #1	7.5		9.2	480	3	11	
	5	SBR Blower #1	50		54.1	480	3	65	
	6	Digester Aeration #1	30		31.9	460	3	40	
	7	SBR Sludge Transfer Pump #2	2		2.8	460	3	3.4	
	8	DDM Mixer #2	20		21.6	460	3	27	
	9	Filtered Feed Pump #2	7.5		9.2	480	3	11	
	10	Exhaust Fan EF-2	0.5		0.9	460	3	1.1	
	11	Digester DDM Mixer	10		11.2	460	3	14	
	12	Digester Supernate Pump	3		3.9	460	3	4.8	
	13	SBR Blower #2	50		54.1	480	3	65	
	14	Digester Sludge Pump	2		2.9	480	3	3.4	
	15	SBR Blower #3	50		54.1	480	3	65	
	16	Digester Aeration #2	30		31.9	460	3	40	
	17	Panelboard DP			116	480	3		
Lab Building	1	Panelboard PC			25	208	3		
Control Bldg	1	Panelboard PD			20	208	3	77	
Total kVA =					**482.4**				

Thus, the total connected load = 482 kVA

Based on the email correspondence received, the plant has seen a historical demand of 101 kW in January 2022. This corresponds to a demand of 126 kVA at 0.8 power factor.

We will assume this existing load for new service sizing calculations for all the proposed options.

Amps at 480V = $\frac{475.6}{1.732 \; x \; 0.48}$ = 580.25 Amps

Service Size = 572.07 x 1.25 = 725.32 Amps

ELECTRICAL SERVICE SIZING (ALTERNATIVE 1)						DATE: November 27, 2023			
PROJECT: Centerville WWTP									
LOCATION: Queen Anne's County						DESIGNED BY: SG CHECKED BY: KK			
ARCHITECT ENGINEER: Dhillon Engineering, Inc.									
Bldg.	**S. NO.**	**DESCRIPTION**	**HP**	**KW**	**KVA**	**VOLTAGE**	**PHASE**	**AMPS**	**REMARKS**
	1	Existing Loads			126	480	3		
	2	SBR Blower #4	50		51.8	460	3	65	
	3	SBR Blower #5	50		51.8	460	3	65	
	4	Non-Potable Pump #1	20		22.5	480	3	27	
	5	Non-Potable Pump #2	20		22.5	480	3	27	
	6	Influent Screen	10		11.2	460	3	14	
	7	DNF Air Compressor #1	25		27.1	460	3	34	
	8	DNF Air Compressor #2	25		27.1	460	3	34	
	9	UV System			16	480	3		
	10	Digester Aeration #1	20		22.5	480	3	27	
	11	Digester Aeration #2	20		22.5	480	3	27	
	12	Digester Aeration #3	20		22.5	480	3	27	
	13	Dewatering Facility		20	25	460	3		
	14	Effluent Pump #1	100		98.8	460	3	124	
	15	Effluent Pump #2	100		98.8	460	3	124	
	16	Effluent Pump #3 (Standby)	100			460	3		
	17	HVAC Loads		10	12.5	480	3		
	18	Lighting		5	5	120	3		
Total kVA =					**663.6**				

Amps at 480V = $\frac{663}{1.732 \; x \; 0.48}$ = 798.21 Amps

Taking 25% spare capacity and contingency and assuming a demand factor of 0.5, we get demand amps = 498.88 Amps

Service Size = 498.88 x 1.25 = 623.60 Amps

Thus, the existing service size is sufficient enough to handle this proposed option.

Taking 90% max loading and 0.8 power factor on a 500 kW generator, we get available capacity on the generator = 500*0.9/0.8 = 562 kVA

= 676 Amps

The existing 500 kW generator is also adequate to handle the proposed loads.

ELECTRICAL SERVICE SIZING (ALTERNATIVE 2)						DATE: November 27, 2023			
PROJECT: Centerville WWTP									
LOCATION: Queen Anne's County						DESIGNED BY: SG CHECKED BY: KK			
ARCHITECT ENGINEER: Dhillon Engineering, Inc.									
Bldg.	**S. NO.**	**DESCRIPTION**	**HP**	**KW**	**KVA**	**VOLTAGE**	**PHASE**	**AMPS**	**REMARKS**
	1	Existing Loads			126	480	3		
	2	Aeration Blower #1	50		51.8	460	3	65	
	3	Aeration Blower #2	50		51.8	460	3	65	
	4	Non-Potable Pump #1	20		22.5	480	3	27	
	5	Non-Potable Pump #2	20		22.5	480	3	27	
	6	Digester Aeration #1	20		22.5	480	3	27	
	7	Digester Aeration #2	20		22.5	480	3	27	
	8	Digester Aeration #3	20		22.5	480	3	27	
	9	Digester Aeration #4	20		22.5	480	3	27	
	10	Digester Aeration #5	20		22.5	480	3	27	
	11	Digester Aeration #6	20		22.5	480	3	27	
	12	Anoxic Zone Mixers	5		6.1	460	3	7.6	
	13	Internal Recycle Pump #1	10		11.2	460	3	14	
	14	Internal Recycle Pump #2	10		11.2	460	3	14	
	15	Return Sludge Pump #1	10		11.2	460	3	14	
	16	Return Sludge Pump #2	10		11.2	460	3	14	
	17	Influent Screen	10		11.2	460	3	14	
	18	UV System			16	480	3		
	19	Dewatering Facility		20	25	460	3		
	20	DNF Air Compressor #1	25		27.1	460	3	34	
	21	DNF Air Compressor #2	25		27.1	460	3	34	
	22	Effluent Pump #1	100		98.8	460	3	124	
	23	Effluent Pump #2	100		98.8	460	3	124	
	24	Effluent Pump #3 (Standby)	101			460	3		
	25	HVAC Loads		10	12.5	480	3		
	26	Lighting		5	5	120	3		
Total kVA =					**782**				

Amps at 480V = $\frac{782}{1.732 \; x \; 0.48}$ = 940.63 Amps

Taking 25% spare capacity and contingency and assuming a demand factor of 0.5,
we get demand amps = 587.89 Amps

Service Size = 587.89 x 1.25 = 734.87 Amps

Thus, the existing service size is sufficient enough to handle this proposed option.

Taking 90% max loading and 0.8 power factor on a 500 kW generator, we get available
capacity on the generator = 500*0.9/0.8 = 562 kVA
= 676 Amps

The existing 500 kW generator is also adequate to handle the proposed loads.

ELECTRICAL SERVICE SIZING (ALTERNATIVE 3)						DATE: November 27, 2023			
PROJECT: Centerville WWTP									
LOCATION: Queen Anne's County						DESIGNED BY: SG CHECKED BY: KK			
ARCHITECT ENGINEER: Dhillon Engineering, Inc.									
Bldg.	**S. NO.**	**DESCRIPTION**	**HP**	**KW**	**KVA**	**VOLTAGE**	**PHASE**	**AMPS**	**REMARKS**
	1	Existing Loads			126	480	3		
	2	Aeration Blower #1	50		51.8	460	3	65	
	3	Aeration Blower #2	50		51.8	460	3	65	
	4	Non-Potable Pump #1	20		22.5	480	3	27	
	5	Non-Potable Pump #2	20		22.5	480	3	27	
	6	Digester Aeration #1	20		22.5	480	3	27	
	7	Digester Aeration #2	20		22.5	480	3	27	
	8	Digester Aeration #3	20		22.5	480	3	27	
	9	Digester Aeration #4	20		22.5	480	3	27	
	10	Digester Aeration #5	20		22.5	480	3	27	
	11	Digester Aeration #6	20		22.5	480	3	27	
	12	Anoxic Zone Mixers	5		6.1	460	3	7.6	
	13	Return Sludge Pump #1	10		11.2	460	3	14	
	14	Return Sludge Pump #2	10		11.2	460	3	14	
	15	Influent Screen	10		11.2	460	3	14	
	16	UV System			16	480	3		
	17	Dewatering Facility		20	25	460	3		
	18	DNF Air Compressor #1	25		27.1	460	3	34	
	19	DNF Air Compressor #2	25		27.1	460	3	34	
	20	Effluent Pump #1	100		98.8	460	3	124	
	21	Effluent Pump #2	100		98.8	460	3	124	
	22	Effluent Pump #3 (Standby)	101			460	3		
	23	Influent Pump #1	25		27.1	460	3	34	
	24	Influent Pump #2	25		27.1	460	3	34	
	25	Permeate Pump #1	25		27.1	460	3	34	
	26	HVAC Loads		10	12.5	480	3		
	27	Lighting		5	5	120	3		
Total kVA =					**840.9**				

Amps at 480V = $\frac{840.9}{1.732 \; x \; 0.48}$ = 1011.48 Amps

Taking 25% spare capacity and contingency and assuming a demand factor of 0.5,
we get demand amps = 632.17 Amps

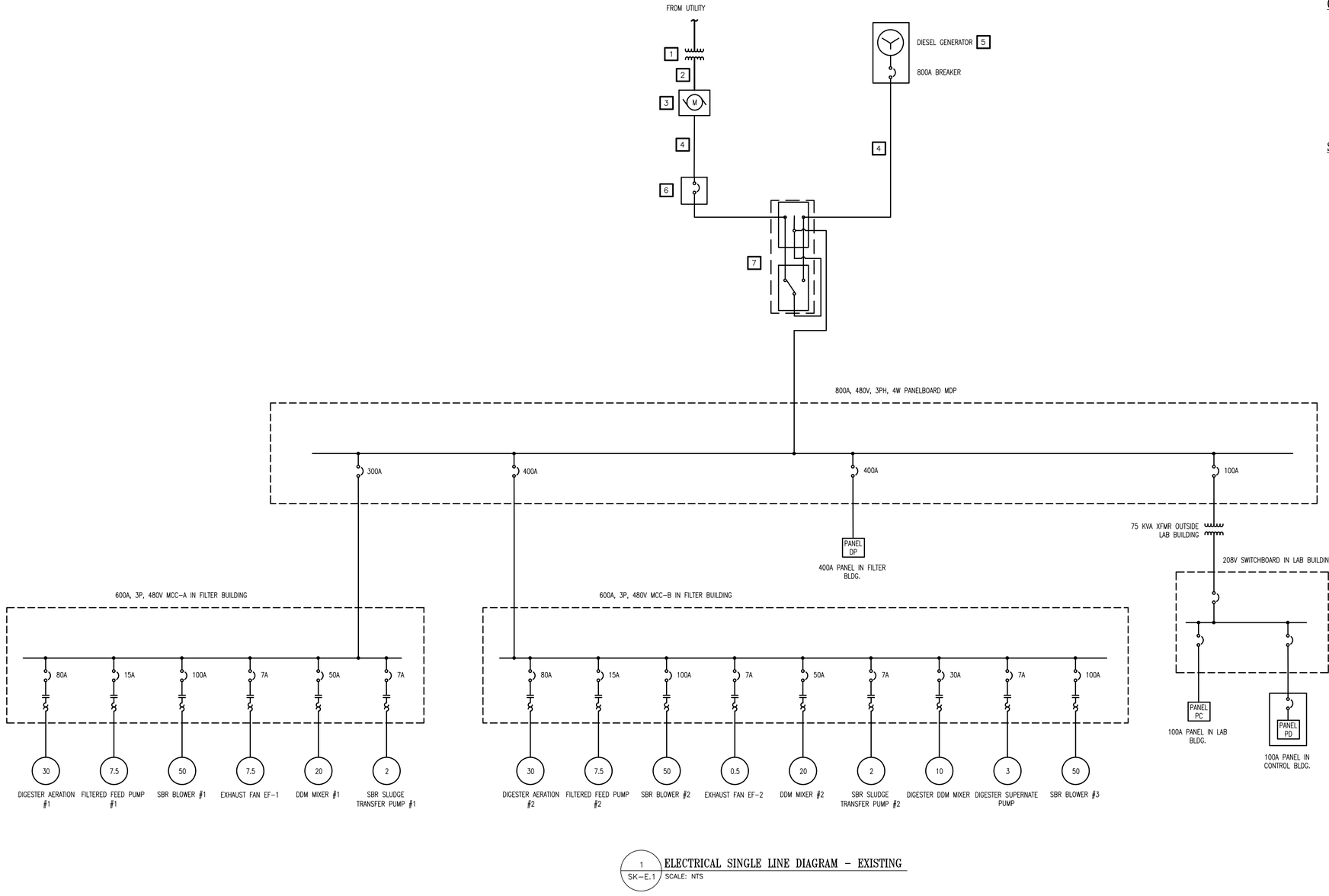
Service Size = 632.17 x 1.25 = 790.21 Amps

Thus, the existing service size is sufficient enough to handle this proposed option.

Taking 90% max loading and 0.8 power factor on a 500 kW generator, we get available
capacity on the generator = 500*0.9/0.8 = 562 kVA
= 676 Amps

ELECTRICAL SERVICE SIZING (ALTERNATIVE 3)						DATE: November 27, 2023			
PROJECT: Centerville WWTP						DESIGNED BY: SG CHECKED BY: KK			
LOCATION: Queen Anne's County									
ARCHITECT ENGINEER: Dhillon Engineering, Inc.									
Bldg.	**S. NO.**	**DESCRIPTION**	**HP**	**KW**	**KVA**	**VOLTAGE**	**PHASE**	**AMPS**	**REMARKS**

The existing 500 kW generator is also adequate to handle the proposed loads.



1 / SK-E.1 ELECTRICAL SINGLE LINE DIAGRAM - EXISTING

SCALE: NTS

GENERAL SHEET NOTES:

1. SPARES AND SPACES ARE NOT SHOWN ON THIS SKETCH.

SPECIFIC NOTES [X]:

1. PAD MOUNTED DELMERVA POWER COMPANY EXISTING MEDIUM VOLTAGE TRANSFORMER.
2. EXISTING UNDERGROUND DUCTBANK FOR UTILITY COMPANY PRIMARY FEEDER.
3. UTILITY COMPANY METERING.
4. EXISTING UNDERGROUND DUCTBANK FOR UTILITY COMPANY SECONDARY FEEDER.
5. EXISTING 500KW, 480/277V, 3PH, 4W DIESEL GENERATOR WITH SUB BASE TANK IN OUTDOOR WEATHERPROOF ENCLOSURE.
6. EXISTING 800A, 480V, 3P ENCLOSED CIRCUIT BREAKER IN NEMA-1 ENCLOSURE, SUITABLE FOR SERVICE.
7. EXISTING 800A, 480V, 3P AUTOMATIC TRANSFER SWITCH WITH BYPASS ISOLATION SWITCH IN NEMA-1 ENCLOSURE.

REVISIONS		

CLIENT INFORMATION

TOWN OF CENTERVILLE
CENTERVILLE

XXXX

KEY PLAN

GRAPHIC SCALES

SIGNATURE

Whitman, Requardt & Associates, LLP
1500 Market Street, Suite W2750, Philadelphia, Pennsylvania 19102

SINGLE LINE DIAGRAM
EXISTING CONDITIONS

DRAWING NO.

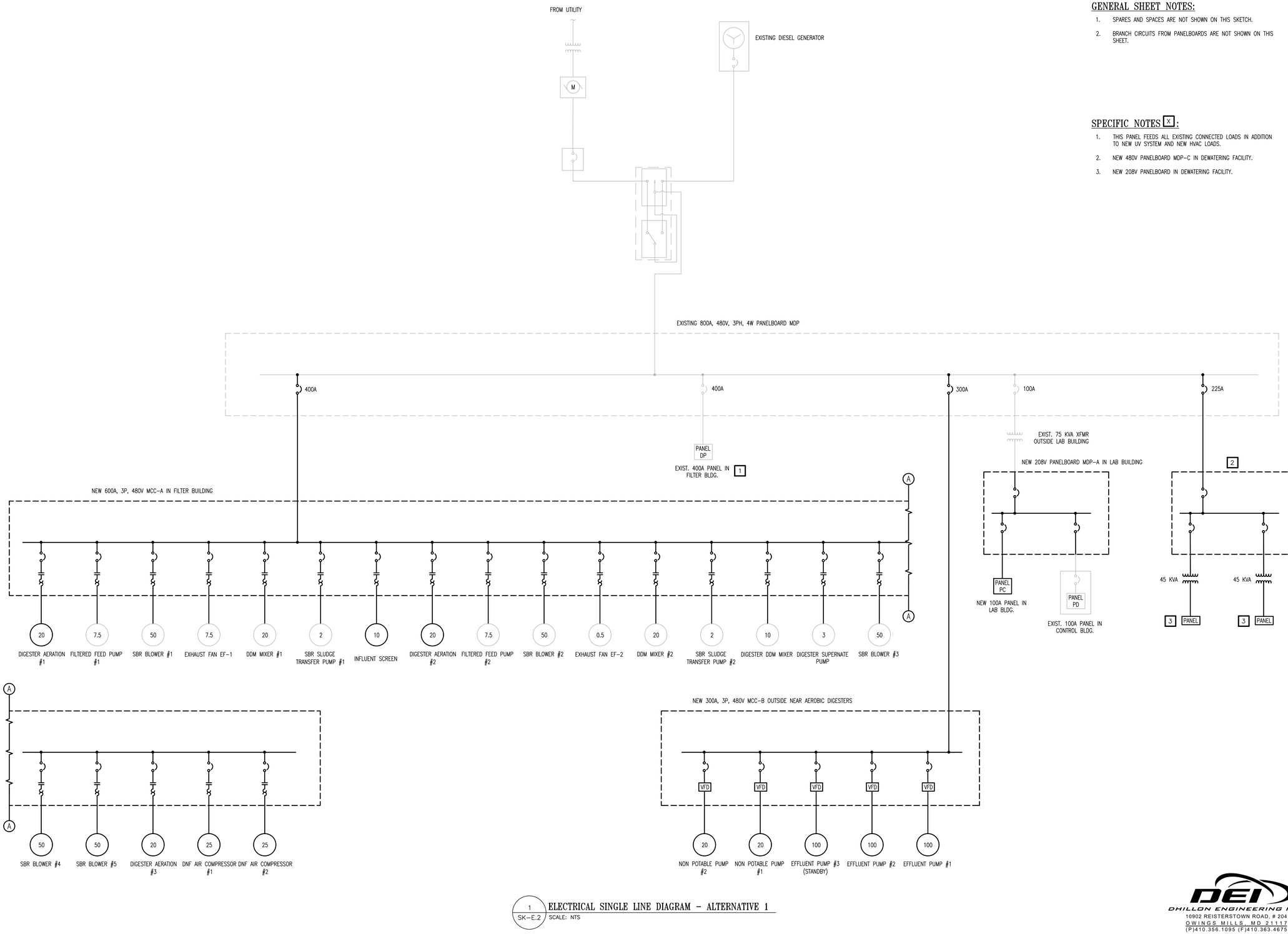
SK-E.1

SCALE: NONE		
DATE: NOV 2023	SHEET OF	
DES: SG	DRAWN: SG	CHECK: KK

PER REPORT

DHILLON ENGINEERING INC.
10902 REISTERSTOWN ROAD, # 204
OWINGS MILLS, MD 21117
(P)410.356.1095 (F)410.363.4675

FILENAME: Z:\PROJECTS\WRA\02 TOWN OF CENTERVILLE WWTP ENR UPGRADE\05 DRAWINGS\PRODUCTION\CENTERVILLE WWTP EXISTING DNE LINE DIAGRAM.DWG



1 / SK-E.2 ELECTRICAL SINGLE LINE DIAGRAM - ALTERNATIVE 1
SCALE: NTS

GENERAL SHEET NOTES:

1. SPARES AND SPACES ARE NOT SHOWN ON THIS SKETCH.
2. BRANCH CIRCUITS FROM PANELBOARDS ARE NOT SHOWN ON THIS SHEET.

SPECIFIC NOTES [X]:

1. THIS PANEL FEEDS ALL EXISTING CONNECTED LOADS IN ADDITION TO NEW UV SYSTEM AND NEW HVAC LOADS.
2. NEW 480V PANELBOARD MDP-C IN DEWATERING FACILITY.
3. NEW 208V PANELBOARD IN DEWATERING FACILITY.

REVISIONS		

CLIENT INFORMATION

TOWN OF CENTERVILLE
CENTERVILLE

XXXX

KEY PLAN

GRAPHIC SCALES

SIGNATURE

Whitman, Requardt & Associates, LLP
1500 Market Street, Suite W2750, Philadelphia, Pennsylvania 19102

SINGLE LINE DIAGRAM
ALTERNATIVE 1

DRAWING NO.

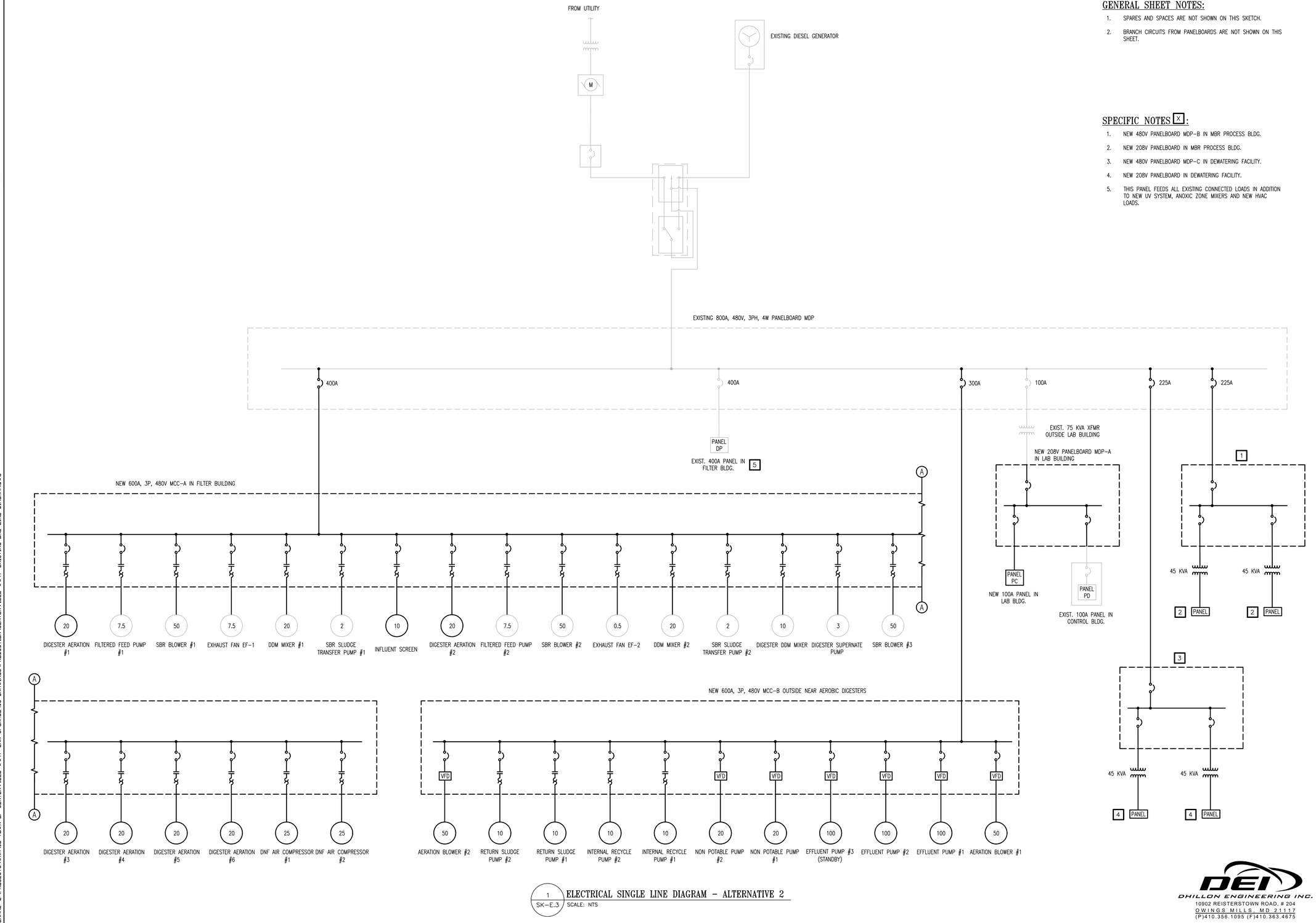
SK-E.2

SCALE: NONE		
DATE: NOV 2023	SHEET OF	
DES: SG	DRAWN: SG	CHECK: KK

PER REPORT

DHILLON ENGINEERING INC.
10902 REISTERSTOWN ROAD, # 204
OWINGS MILLS, MD 21117
(P)410.356.1095 (F)410.363.4675

FILENAME: Z:\PROJECTS\WRA\02 TOWN OF CENTERVILLE WWTP ENR UPGRADE\05 DRAWINGS\PRODUCTION\CENTERVILLE WWTP EXISTING ONE LINE DIAGRAM.DWG



1 SK-E.3 ELECTRICAL SINGLE LINE DIAGRAM - ALTERNATIVE 2
SCALE: NTS

GENERAL SHEET NOTES:

1. SPARES AND SPACES ARE NOT SHOWN ON THIS SKETCH.
2. BRANCH CIRCUITS FROM PANELBOARDS ARE NOT SHOWN ON THIS SHEET.

SPECIFIC NOTES [X]:

1. NEW 480V PANELBOARD MDP-B IN MBR PROCESS BLDG.
2. NEW 208V PANELBOARD IN MBR PROCESS BLDG.
3. NEW 480V PANELBOARD MDP-C IN DEWATERING FACILITY.
4. NEW 208V PANELBOARD IN DEWATERING FACILITY.
5. THIS PANEL FEEDS ALL EXISTING CONNECTED LOADS IN ADDITION TO NEW UV SYSTEM, ANOXIC ZONE MIXERS AND NEW HVAC LOADS.

REVISIONS		

CLIENT INFORMATION

TOWN OF CENTERVILLE
CENTERVILLE

XXXX

KEY PLAN

GRAPHIC SCALES

SIGNATURE

Whitman, Requardt & Associates, LLP
1500 Market Street, Suite W2750, Philadelphia, Pennsylvania 19102

SINGLE LINE DIAGRAM
ALTERNATIVE 2

DRAWING NO.

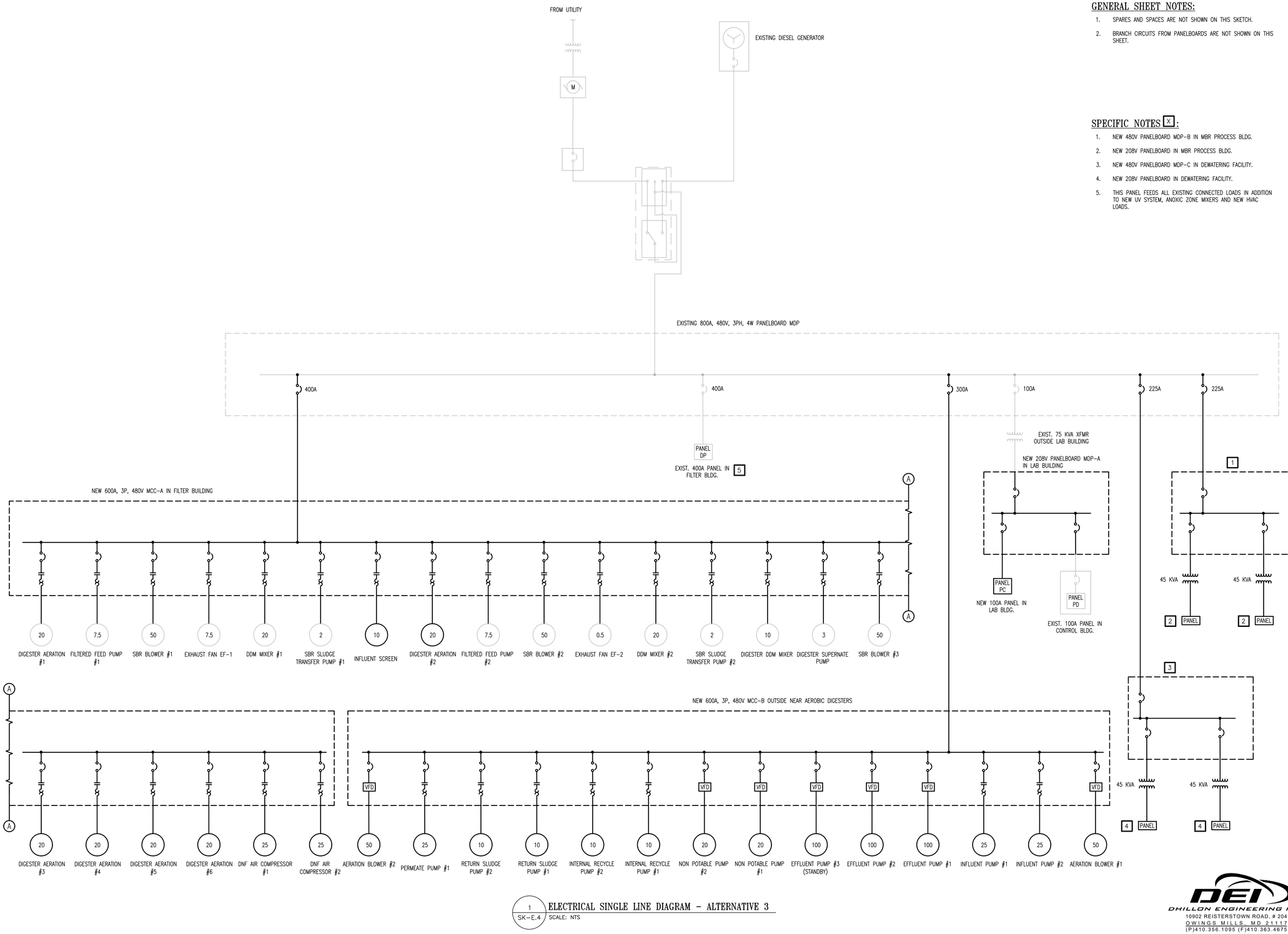
SK-E.3

SCALE: NONE		
DATE: NOV 2023	SHEET OF	
DES: SG	DRAWN: SG	CHECK: KK

DHILLON ENGINEERING INC.
10902 REISTERSTOWN ROAD, # 204
OWINGS MILLS, MD 21117
(P)410.356.1095 (F)410.363.4675

PER REPORT

FILENAME: Z:\PROJECTS\VRA\02 TOWN OF CENTERVILLE WWTP ENR UPGRADE\05 DRAWINGS\PRODUCTION\CENTERVILLE WWTP EXISTING ONE LINE DIAGRAM.DVG



1 / SK-E.4 ELECTRICAL SINGLE LINE DIAGRAM - ALTERNATIVE 3
SCALE: NTS

GENERAL SHEET NOTES:

1. SPARES AND SPACES ARE NOT SHOWN ON THIS SKETCH.
2. BRANCH CIRCUITS FROM PANELBOARDS ARE NOT SHOWN ON THIS SHEET.

SPECIFIC NOTES [X]:

1. NEW 480V PANELBOARD MDP-B IN MBR PROCESS BLDG.
2. NEW 208V PANELBOARD IN MBR PROCESS BLDG.
3. NEW 480V PANELBOARD MDP-C IN DEWATERING FACILITY.
4. NEW 208V PANELBOARD IN DEWATERING FACILITY.
5. THIS PANEL FEEDS ALL EXISTING CONNECTED LOADS IN ADDITION TO NEW UV SYSTEM, ANOXIC ZONE MIXERS AND NEW HVAC LOADS.

REVISIONS		

CLIENT INFORMATION

TOWN OF CENTERVILLE
CENTERVILLE

XXXX

KEY PLAN

GRAPHIC SCALES

SIGNATURE

Whitman, Requardt & Associates, LLP
1500 Market Street, Suite W2750, Philadelphia, Pennsylvania 19102

SINGLE LINE DIAGRAM
ALTERNATIVE 3

DRAWING NO.

SK-E.4

SCALE: NONE		
DATE: NOV 2023	SHEET	OF
DES: SG	DRAWN: SG	CHECK: KK

PER REPORT

DHILLON ENGINEERING INC.
10902 REISTERSTOWN ROAD, # 204
OWINGS MILLS, MD 21117
(P)410.356.1095 (F)410.363.4675

FILENAME: Z:\PROJECTS\VRA\02 TOWN OF CENTERVILLE VWTP ENR UPGRADE\05 DRAWINGS\PRODUCTION\CENTERVILLE VWTP EXISTING DNE LINE DIAGRAM.DVG