Wastewater Treatment Plant

Upgrade and Expansion

Preliminary Engineering Report

Town of Warrenton, VA

Department of Utilities

March 2022

WRA WO 18667.000

TOWN OF WARRENTON WASTEWATER TREATMENT PLANT UPGRADE AND EXPANSION PRELIMINARY ENGINEERING REPORT

EXECUTIVE SUMMARY

The Town of Warrenton's existing wastewater treatment plant is rated and permitted for 2.5 million gallons per day (MGD) average daily flow (ADF). The plant has undergone several upgrades and expansions since its original construction in the 1950's. In 2009 the plant was upgraded for nutrient reduction (nitrogen and phosphorus) as part of the Chesapeake Bay Restoration Program. In 2021 the plant's trickling filter and Rotating Biological Contactors (RBCs) were replaced with a "Moving Bed Bio-Reactor" (MBBR) process. The MBBR is a newer and more efficient technology that combines the functions of the trickling filter and RBCs into one process tank. In addition, this new process can be expanded to handle additional flows and wastewater loads.

As plant flows have gradually increased over the past decade, with monthly average flows sometimes approaching 80-90% of the permitted capacity, the Town has recognized the need to assess the reliable treatment capacity of the existing facilities and, if the treatment capacity can be expanded, what upgrades would be required. In May 2017, WRA performed a capacity assessment to evaluate what would be required for the plant to expand to 3.0 MGD, with the Town anticipating the need for an additional 0.50 MGD (20% increase) capacity above the current rated 2.5 MGD capacity. In 2019, WRA performed a supplemental capacity assessment to expand beyond 3.0 MGD. The findings suggested that an expansion to 3.0 MGD would be the most practical and economically feasible to achieve. In February 2020, WRA also prepared a separate Solids Handling Facility Evaluation Report addressing required upgrades to the solids handling processes.

This Plant Upgrade and Expansion Preliminary Engineering Report (PER) serves to combine the previous Plant Capacity Evaluations with the Solids Handling Facility evaluations and updated plant information since the installation of the MBBR process (startup in early 2021) and provides the basis of design for the upgrade and expansion of the existing plant from 2.5 MGD to 3.0 MGD average daily flow (ADF).

Current annual average plant flows are about 70-80% of the permitted capacity and when to expand the Town's wastewater treatment capacity depends on the rate of growth in the service areas. For planning level purposes, it is assumed that the design for a plant expansion in a CIP program would be completed and ready for construction within the next 5 – 10 years. The capacity expansion would include several major items: New Headworks Facilities (Screen and Grit), New Primary and Secondary Clarifiers and associated pumping stations (to replace existing clarifiers), and new additional Primary Digester. The Town has had discussions with the VADEQ about incorporating plant expansion provisions in the next permit cycle. New discharge limitations associated with 3.0 MGD ADF would be included in the permit and conditional upon the full implementation of the plant expansion elements as recommended in this PER.

"Near-term" improvements are also recommended and include needed plant upgrades and retrofits planned for the next 0 – 5 years to keep the plant reliably operating and extend the service life of treatment processes and equipment. These are considered part of the Town's Capital Asset Replacement Program (CARP). From a fiscal planning aspect, short term (0 – 2 years) and intermediate term (2 – 5 years) improvement phases are considered with planning level construction costs for each phase at $1 - 1.5M and $5.5 - 6.0M, respectively. The plant expansion (CIP) construction budget cost is $12.5 – 13.0M, thus the total CARP+CIP is about $20M. Further details are presented in **Section 7** "Recommended Facility Plan".

A preliminary site facility layout for the plant expansion is included in **Appendix J**.

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1 BACKGROUND

The Town of Warrenton owns and operates an advanced wastewater treatment plant currently permitted for 2.5 million gallons per day (MGD). The original plant was constructed in the late 1950's as a single stage 0.5 MGD trickling filter plant followed by an expansion to 1.0 MGD in 1978. A major plant upgrade and further expansion was completed in 1990 to provide a total of 2.5 MGD treatment capacity and to meet effluent limits for Total Kjeldahl Nitrogen (TKN). A rotating biological contactor (RBC) process was added to expand and improve the biological treatment, including a new primary and secondary clarifier. New solids handling facilities were also constructed, including sludge thickening, anaerobic digestion and sludge dewatering. Later, in 1998 the plant was modified again to achieve compliance with effluent ammonia-nitrogen limits by upgrading the RBC units. In 2007, the plant's gas chlorine disinfection system was replaced with a UV-disinfection system, followed by a facility upgrade to comply with nutrient reduction requirements for nitrogen and phosphorus through the Virginia Water Quality Improvement Fund as part of the Chesapeake Bay Restoration program. The plant operates under VPDES permit No. VA0021172, included in **Appendix A**.

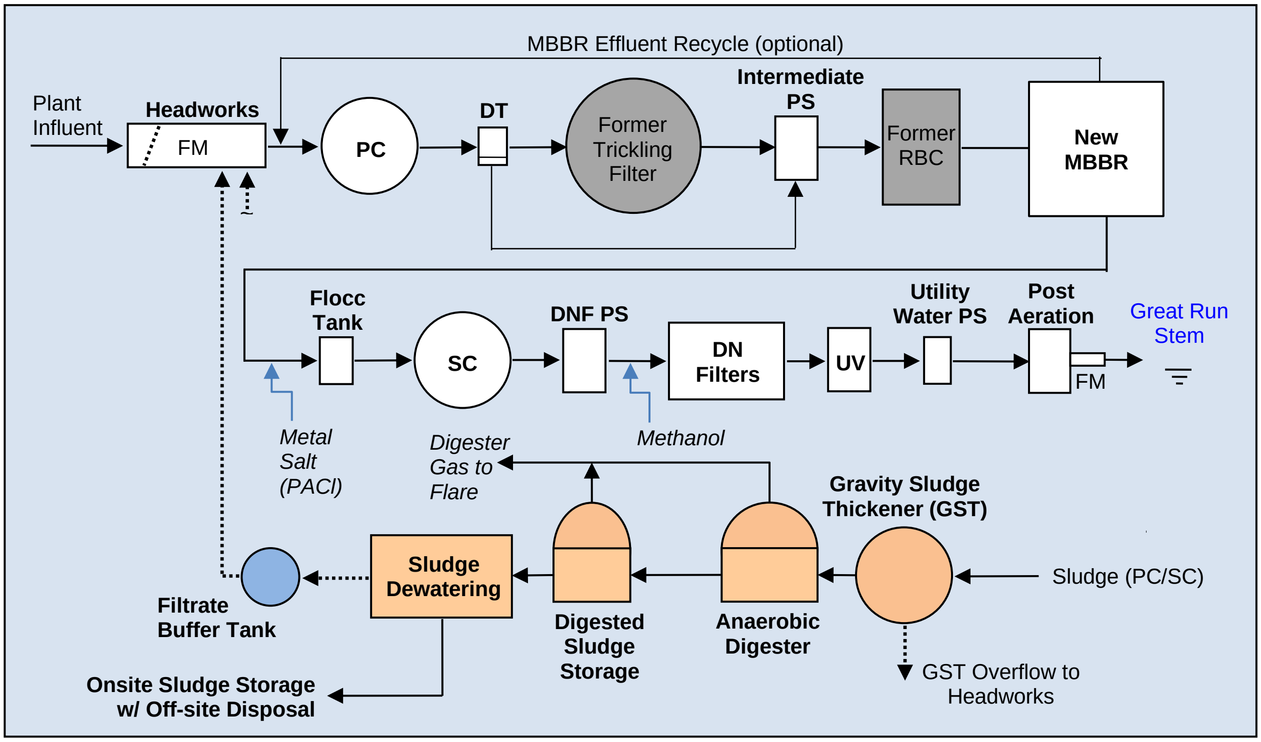
The plant has historically performed well and has consistently complied with its effluent permit limits for BOD_5, TSS, ammonia and bacteria (e.coli). In addition, the plant has met nutrient removal requirements for total nitrogen and total phosphorus since the plant was upgraded to meet nutrient removal requirements in 2009. In 2021, the original single stage trickling filter and conventional rotating biological contactors (RBC), were replaced with a "Moving Bed Bio-Reactor" (MBBR) process, a newer technology that combines BOD removal and nitrification into one process tank. Similar to the trickling filter/RBC, the MBBR is an attached growth process where the biofilm is attached to small plastic carriers suspended in the wastewater within the reactor tank by process air and/or mechanical mixing. The plastic carriers are retained in the tank by retaining screens while treated wastewater passes through to the secondary clarifiers. Since the startup of the MBBR process in early 2021, the performance (BOD and ammonia removal) has equaled or exceeded the old TF-RBC processes.

Daily plant flows have slightly increased over the past decade and have averaged on an annual basis about 2.0 MGD in recent years. The plant has also experienced consecutive months with monthly average flows near 90% of the current permitted flow of 2.5 MGD. After discussions with staff and evaluations of current performance and potential capacity expansions, it was deemed reasonable that the current capacity could increase to 3.0 MGD. In February 2020, WRA also performed a separate Solids Handling Facility Evaluation Report that addressed required upgrades to the solids handling processes. This Plant Upgrade and Expansion Preliminary Engineering Report (PER) serves to combine the previous Plant Capacity Evaluations with the Solids Handling Facility Evaluations and updated plant information since the installation of the MBBR process and provides the basis of design for the upgrade and expansion of the existing plant to 3.0 MGD average daily flow (ADF).

2 EXISTING TREATMENT FACILITIES

2.1 Existing Process Configuration

The current plant process flow is illustrated below and described in the following.



Existing Plant Process Flow Diagram

Raw wastewater from the Town's collection system enters the preliminary treatment works which include mechanical screening, aerated grit removal and influent flow metering (FM). Metered flow is conveyed via gravity to the primary clarifiers (PC). Primary Effluent is pumped (via the intermediate plant pumping station) to the Moving Bed Bio-Reactor (MBBR) process for BOD removal and to provide nitrification to comply with the plant's effluent ammonia limits. MBBR effluent flows to the secondary clarifiers for suspended solids removal. A flash mixing/flocculation tank is provided upstream of the secondary clarifiers for addition of Metal salt (poly-aluminum chloride, PACL) for phosphorus removal and improved solids removal.

Secondary fully nitrified effluent is conveyed to the denitrification (DN) pumping station and pumped to the tertiary denitrification (DN) filters for total nitrogen removal, and for additional phosphorus and solids removal. Spent backwash water from the denitrification filters is discharged to the intermediate plant pumping station. Denitrified filter effluent flows through the UV-disinfection reactors, followed by mechanical post aeration and effluent flow metering (FM) before final discharge to Great Run, a tributary to Rappahannock River. Non-potable plant reuse water is drawn after UV-disinfection.

The plant produces primary sludge, secondary sludge from the MBBR process and tertiary sludge from the DN filters. Sludge is also received from the Town's water treatment plant as it is discharged through the sanitary sewer system. Settled primary and secondary sludges are withdrawn intermittently from the clarifiers and pumped to the gravity sludge thickener (GST). Underflow from the GST is pumped to a mesophilic anaerobic digester with a floating cover and gas mixing integral with the cover (Pearth™). The digester temperature is maintained by sludge recirculation through a “tube-in-a-tube” heat exchanger. Digested sludge is pumped to a sludge holding tank with a flexible membrane cover for gas storage. Sludge is pumped from the sludge holding tank to a belt filter press for dewatering. Dewatered cake is stored on site in covered sludge storage bays and periodically hauled and disposed off-site through contract operations. Filtrate, which is high in ammonia, is retained in an adjacent holding tank and returned (equalized) at a low constant rate to the primary influent.

The following **Table 2.1** provides a summary of the plant’s existing unit processes. The existing site facilities are shown on the aerial and topo views in **Appendix B**.

Table 2.1: Summary of Existing Unit Processes

Process Unit	Qty.	Unit Sizing
LIQUID TREATMENT:		
Mechanically Cleaned Influent Screen	1	¼-inch screen; rated for 5.0 MGD peak flow By-pass channel w/ manual bar rack
Grit Removal	2	Aerated Grit Chambers, each 3.5' W x 25' L x 5.5' D (480 ft^3)
Influent Flow Meter	1	12-inch Parshall Flume; flow measuring capacity: 3' D (14 MGD)
Primary Clarifiers	2 2	No. 1 and 2: 26' diameter x 10.5 SWD (530 ft^2 each) No. 3 and 4: 34' diameter x 10.5 SWD (900 ft^2 each) Total surface area: 2,860 ft^2; Total volume: 210,000 ft^3
Former Trickling Filter	1	125' diameter x 5' media depth. Tank depth 10'. Estimated useable storage volume: 900,000 gallons.
Intermediate Plant Pumps	4	Each 1,800 gpm @ 55' TDH; 40 HP w/VFD
Former Rotating Biological Contactors (RBC)	21	3 trains, 7 RBC units each. 26'W x 115'L x 5'D reactor Estimated usable storage volume: 300,000 gallons (RBCs removed)
MBBR Process	2	2 trains, each train w/three (3) zones (BOD/Nitrification (2 zones)) Volume: 400,000 ft^3 per train; 800,000 ft^3 total (2 x 90'Lx40'Wx15' SWD) Media: 800 m^2/m^3 (50% media fill ratio) Aeration Blowers: 3 units, each 2,200 scfm, 125 HP
Flash Mixing	1	7.5 HP Mixer w/VFD Flash Mixing Tank Volume: 1,500 gallons
Flocculation Tanks	2	0.5 HP Flocculators w/VFD Flocculation Tank Volume: 17,900 gallons, each
Chemical Storage and Feed	2 2 1 2 1 2	Poly-aluminum Chloride Storage Tanks: 6,000 gallons each Poly-aluminum Chloride Feed Pumps: 25 gal/hr each Polymer Storage Tank: 900 gallons Polymer Feed Pumps: 20 gal/hr each Methanol Storage Tank: 11,800 gallons Methanol Feed Pumps: 25 gal/hr each
Secondary Clarifiers	1 1	No. 1: 64' diameter x 12' SWD (3,215 ft^2) No. 2: 50' diameter x 12' SWD (1,960 ft^2) Total surface area: 5,175 ft^2; Total volume: 440,000 ft^3
Denitrification Filter Pumps	4	2,200 gpm @ 29' TDH; 30 HP w/VFD
Denitrification Filters	4	Filter cells: 11.33' W x 26.83' L x 6' media depth; filter area each 304 ft^2 (2) Backwash submersible pumps; 1,824 gpm @ 27' TDH; 25 HP each (2) Low pressure air scour blowers; 1,520 scfm @ 11 psig; 125 HP each
UV Disinfection	2	14" in-line UV reactors; medium pressure/high intensity; 5 MGD each
Plant Reuse Water Pumps	2	370 gpm @160' TDH; 20 HP (submersible)
Post Aeration Tanks	2	Each Tank: 15' L x 15' W x 11' D (total volume 37,000 gallons)
Effluent Flow Metering	1	12-inch Parshall Flume; flow measuring capacity: 3' D (14 MGD)
SOLIDS HANDLING:		
Primary Sludge Pumps	2	50 gpm; 3 HP each
Secondary Sludge Pumps	2	240 gpm; 7.5 HP each
Gravity Thickener	1	28' diameter x 12' SWD (52,000 gallons); (615 ft^2 surface area)
Anaerobic Digester	1	Digester No. 1: 50' dia.; 20' SWD; 290,000 gallons (digestion)
Digested Sludge Storage	1	Digester No. 2: 40' dia., 20' SWD; 185,000 gallons (sludge holding)
Belt Filter Press	1	1-meter press
Filtrate Buffer Tank	1	30,000 gallons filtrate holding/equalization tank
Dewatered Sludge Storage	1	165'Lx55'W; 9,000 ft^2 total area (covered); 8 bays (20' wide)

2.2 Plant Influent Wastewater Loads

The plant does not routinely sample and analyze influent wastewater. However, prior to preparing the July 2016 Preliminary Engineering Report for the MBBR Installation a two-week sampling program was conducted in March 2016 to characterize the influent and establish wastewater loads for preliminary design. Grab samples were collected just upstream of the influent flow meter (after screening and grit removal) three times a day, at the beginning of each shift, and then composited. The composite samples were analyzed for five-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), total Kjeldahl nitrogen (TKN), ammonia and total phosphorus (TP). Influent alkalinity ($CaCO_3$) was also measured. In addition, side stream ammonia and TKN were measured from the belt filter press filtrate holding tank as the dewatering filtrate from anaerobically digested sludge typically has high ammonia concentration.

The sampling was targeted during a period with minimum precipitation to obtain dry weather baseline wastewater characteristics. Concentrations for BOD_5 ranged from 123 to 295 mg/L; TSS from 61 to 144 mg/L; TKN from 24 to 34 mg/L; and the average alkalinity was 145 mg/L ($CaCO_3$). These are all within the range of typical domestic wastewater. The average daily wastewater flows for the sampling period varied from 1.76 to 2.36 MGD. **Table 2.2** shows the representative primary influent wastewater concentrations based on the sampling data for plant influent and side stream flow from the filtrate holding tank. The TKN and ammonia recycle loads from the dewatering process account for about 15% and 25%, respectively, of the plant influent. The sampling results are included in **Appendix C**.

Table 2.2: Influent Wastewater Concentrations (mg/L)

	BOD_5	TSS	TKN	NH_3-N	TP	Alkalinity
Plant Influent	200	100	30	20	4.0	145
BFP Filtrate*			333	294		
Primary Influent	**200**	**100**	**35**	**25**	**5.0**	**145**

*Average side stream flow at 20 gallons per minute (gpm).

Supplemental wastewater sampling was also conducted back in 2006 (during March) prior to the nutrient removal upgrade design. The recent 2016 sample data are similar to the wastewater characteristics obtained at that time. The 2006 data is also included in **Appendix C** for reference.

2.3 Plant Flows

Plant flows are recorded via the influent flow meter. **Figure 1** shows the historical daily average flows for 2013 - 2021, and the 30-day moving average flow. **Figure 2** shows the recorded maximum (peak hour) flow for the same period. For wastewater loads and treatment capacity evaluations the maximum month flow factor is used, while the peak (hour) flow factor is used for review of plant hydraulics. **Table 2.3** shows the annual average flow for the period, the corresponding maximum month (30-day) flow, maximum/average month factor, maximum total daily flow and factor. The total annual rainfall (inches) is also listed, showing higher annual plant flows during relatively wet years.

The plant annual average flow for the period 2013-2021 was about 1.9 MGD. The maximum month peak factor to be used in the evaluations is 1.3 (30% above annual average flow) and the maximum daily flow factor is 2.2. The maximum (peak hour) flows recorded for the period is about 6 MGD corresponding to a peak flow factor of 3.0. These flow factors are representative of this size facility, system age and service area.

Regarding the peak hour flows it is noted that the influent flow chart maxes out at 6 MGD and flows above this rate are not quantified on the charts. Peak flows capped at 6 MGD occur on average 3-5 times per year, typically associated with high rainfall intensity events. The plant has handled these peak flows without overflow incidents. It is suspected that some flow attenuation/temporary backup may occur in the trickling filter (TF) as it is connected to the plant intermediate pumping station wet well, but due to the TF being covered this is difficult to verify.

Table 2.3: Historical Plant Flows (MGD) and Rainfall

	Annual Average Flow	Maximum Month Flow	MM/AA Factor	Maximum Daily Flow	MD/AA Factor	Annual Total Rainfall
2013	2.0	2.42	1.18	4.7	2.35	52”
2014	2.0	2.60	1.30	5.9	2.95	48”
2015	1.9	2.20	1.18	3.4	1.79	42”
2016	1.7	2.65	1.26	3.8	2.24	37”
2017	1.7	2.26	1.33	3.3	1.94	43”
2018	2.2	2.77	1.26	4.7	2.14	70”
2019	2.0	2.80	1.40	4.9	2.45	43”
2020	1.9	2.53	1.33	4.1	2.16	51”
2021*	1.8	2.33	1.29	3.7	2.06	-
Average	**1.9**		**1.28**		**2.23**	**48”**

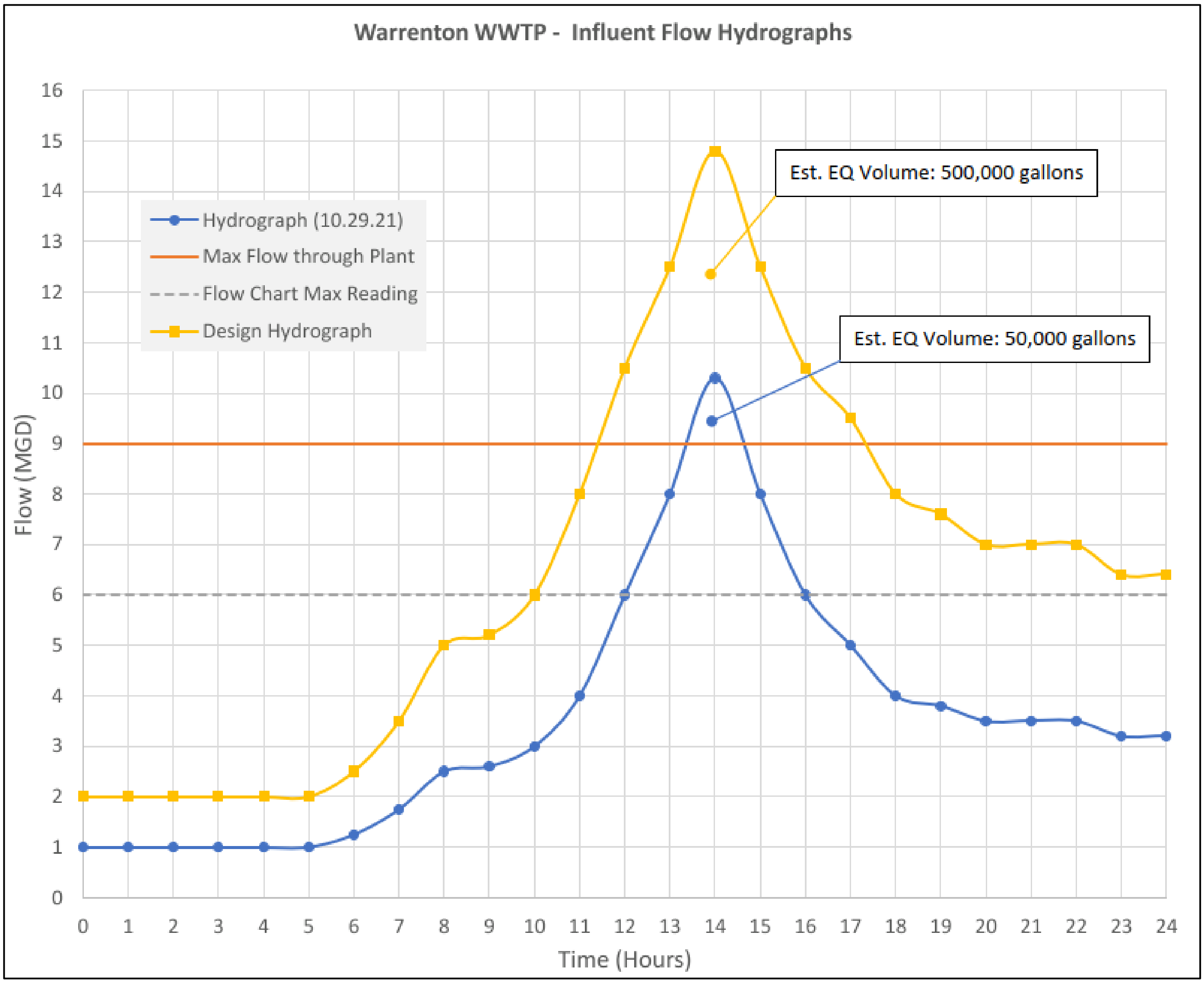
) Data through September

It is also noted during extreme wet weather events the upstream collection system Cedar Run Pump Station surcharges into the adjacent holding lagoon for temporary storage. The lagoon is drained back to the pump station and pumped to the WWTP during lower flows. However, the Cedar Run pumping capacity is reportedly limited to about 1.5 MGD so its flow contribution during wet weather events is relatively low compared to the total peak flows to the plant.

During high flow events when the flows are expected to exceed 6 MGD, plant operations staff occasionally records the maximum flow rate by measuring the depth of flow in the influent parshall flume and the tabulated flow rate corresponding to a 12-inch flume throat. To estimate the plant’s historical peak hour flows (beyond 6 MGD), the day-time rain event on October 29, 2021, was evaluated in more detail. The flow chart is included in **Appendix D**. The chart shows between noon and 4 PM the influent flow exceeded 6 MGD. Based on parshall flume depth measurement around 2 PM, the flow peaked at about 10.3 MGD which corresponds to a peak flow factor of 5.7 (derived as 10.3 MGD divided by the annual average flow for 2021 at 1.8 MGD). The Cedar Run pump station daily records for October 2021 are also included in the appendix and show a pumped flows rate of about 1.3 MGD for this event (10.29.21). It is also noted that the Cedar Run storage pond depth was about 2 feet, but otherwise empty during the month.

Based on the flow chart information and the peak flow observed an influent flow hydrograph was approximated for the rain event on October 29, 2021, as shown on the graph below. A 3.0 MGD ADF “design hydrograph” was also simulated, based on the plant capacity expansion from 2.5 MGD to 3.0 MGD, by scaling up the 10.29.21 hydrograph with the following assumptions: The dry weather flow for the month of October 2021 was about 1.6 MGD with no significant daily precipitation except for a few days at the end of the month. The wet-to-dry weather peak flow factor associated with the additional future dry weather flow of 1.4 MGD, that would make up the 3.0 MGD ADF (1.6 MGD + 1.4 MGD), is assumed to be capped at 3.0. As the Town is evaluating extending its sewer boundaries via pipe extensions, these connections, constructed with newer piping standards, should have much less infiltration and inflow (I/I). Also, the Town has made continuous efforts with I/I studies and evaluations on its collection system to identify deficiencies and address sub-areas subject to high inflow. Recent system repairs and improvements have shown a reduction in extraneous flows.

In the 2009 Nutrient Reduction design, and for the recent MBBR design, the hydraulic design peak flow was selected at 9 MGD which corresponds to a peaking factor of 3.6 for the current permitted ADF capacity of 2.5 MGD, and a peaking factor of 3.0 for the expansion to 3.0 MGD ADF. Thus, up to 9 MGD flow will be processed through the plant processes while flows above 9 MGD will need to be managed through wet weather flow equalization. As shown on the projected "design hydrograph" a peak-hour flow rate could reach 15 MGD and an estimated flow equalization volume of 500,000 gallons would be needed to capture and store flows that exceed 9 MGD, and for a much longer duration than for the current peak flow conditions. The former trickling filter (TF) has a useable volume of 900,000 gallons (with the media removed) and would be suitable as an equalization tank. Excess peak flows would be diverted to the TF and stored before draining to the plant intermediate pumping station when the peak influent flows have subsided. Currently, all flows enter the existing primary clarifiers and then through the dosing tank for the former trickling filter to the intermediate plant pumping station wet well. If the pumps cannot keep up with the incoming flow the wet well backs up into the trickling filter tank.



Influent Flow Hydrographs and Estimated Equalization Storage Volume

2.4 Plant Effluent Performance

Under the current effluent discharge permit (**Appendix A**) the plant is required to comply with monthly and weekly limits for concentration and wastewater loads for BOD_5 and TSS, and with monthly and weekly concentration limits for ammonia-nitrogen. For nutrients, the permit requires a calendar year average effluent concentration of 4.0 mg/L, or less for total nitrogen (TN) and 0.3 mg/L or less for total phosphorus. There is a corresponding annual load allocation for TN (30,456 lbs) and TP (2,284 lbs) based on the permitted average daily flow of 2.5 MGD. **Table 2.4** shows the discharge permit limits.

Table 2.4: Current Plant Discharge Permit Limits (at 2.5 MGD ADF)

Parameter	Monthly Average	Weekly Average
Flow = 2.5 MGD		
BOD_5	10 mg/L (95 kg/d)	15 mg/L (140 kg/d)
TSS	10 mg/L (95 kg/d)	15 mg/L (140 kg/d)
Ammonia-N	1.4 mg/L	1.7 mg/L
E.coli	126 MPN/100mL	n/a
	Calendar Year Average	**Annual Load Allocation**
Total Nitrogen	4.0 mg/L	30,456 lbs
Total Phosphorus	0.3 mg/L	2,284 lbs

The graphs on **Figures 3A, 3B, 4A and 4B** show the historical monthly and weekly effluent concentrations for BOD_5 and TSS for 2013-2021 which are well below the permit limits. For ammonia-nitrogen (**Figures 5A** and **5B**), the monthly and weekly effluent concentrations are averaging less than 0.5 mg/L, with the exception of a period between October 2013 and March 2014 during which the (former) trickling filter was offline for repairs for an extended time. During this time full BOD_5 removal was shifted to the (former) RBC process resulting in reduced nitrification capacity and higher effluent ammonia levels. This resulted in effluent ammonia concentrations for November 2013 and January 2014 that exceeded the monthly and weekly limits. Once the trickling filter was brought online, the nitrification capacity was restored, and effluent ammonia concentrations improved. In late 2020 and early 2021, biological treatment was transitioned from the tricking filter/RBC process to the new MBBR process, and the trickling filter and RBCs were taken offline. The MBBR process has since provided for combined BOD removal and complete nitrification (ammonia removal).

The plant provides bacterial inactivation through ultra-violet (UV) disinfection and is consistently well below the E.coli limits of 126 MPN/100 mL.

Table 2.5 shows the calendar year average effluent concentrations for total nitrogen and total phosphorus for 2013-2021, well below the permit requirements for nutrient discharge. **Figures 6** and **7** shows the monthly concentrations. **Table 2.5** also shows the nitrogen fractions (ammonia, nitrate and organic-N).

In summary, the plant has consistently performed well and complied with the effluent permit limits for all parameters.

Table 2.5: Annual Average Plant Effluent for Nitrogen and Total Phosphorus (mg/L)

	Annual Average Flow	Total Nitrogen (TN)	Total Kjeldahl Nitrogen (TKN)	Nitrate Nitrogen (NO_3)	Ammonia Nitrogen (NH_3)	Organic Nitrogen (Org-N)	Total Phosphorus (TP)
2013	2.0 MGD	3.5	1.4	2.1	0.47	0.93	0.15
2014	2.0 MGD	3.4	1.3	2.1	0.49	0.81	0.21
2015	1.9 MGD	3.3	1.5	1.8	0.22	1.28	0.20
2016	1.7 MGD	3.1	1.3	1.8	0.16	1.14	0.26
2017	1.7 MGD	2.8	1.3	1.5	0.10	1.2	0.15
2018	2.2 MGD	3.5	1.2	2.3	0.10	1.1	0.14
2019	2.0 MGD	2.4	0.9	1.5	0.10	0.8	0.21
2020	1.9 MGD	2.3	1.0	1.3	0.11	0.9	0.17
2021	1.8 MGD	3.9	1.4	2.5	0.22	1.2	0.17

3 PLANT EXPANSION

3.1 Flows and Wastewater Loads

This section discusses the plant capacity expansion to an average design flow of 3.0 MGD and considers the average day, maximum month, and peak flow and wastewater loadings for the liquid treatment and solids handling process, where applicable. As previously discussed, the design maximum month (MM) flow is assumed 30% higher than the average month. The design peak (hour) hydraulic flow is selected as peak-to-average ratio of 3.0 based on the evaluation in Section 2.3. **Table 3.1** shows the design flows and wastewater characteristics used for the plant expansion evaluation. The wastewater concentrations are based on the previously analyzed influent sampling data and are assumed to be the same for all flows.

Table 3.1: Flows and Influent Wastewater Concentrations for Plant Capacity Expansion.

ADF (MGD)	MM (MGD)	Peak (MGD)	Primary Influent (mg/L)					
			BOD_5	TSS	TKN	NH_3-N	TP	Alkalinity
3.0	3.9 (1.3)	9.0 (3.0)	200	100	35	25	5.0	145

As discussed in Section 2.3 wet weather peak flow rates exceeding 9.0 MGD will need to be diverted to flow equalization tankage.

3.2 Effluent Requirements for Plant Expansion

The capacity expansion review considers the effluent limits in the plant's current discharge permit and anticipated modifications in the permit requirements associated with an expansion. In discussions with VADEQ concentration limits for BOD_5 and TSS will remain, and the current waste load allocations would increase correspondingly. For ammonia concentrations are expected to remain, however, as part of the next permit cycle the Freshwater Ammonia Criteria could require slightly more stringent concentration limits. For nutrients (nitrogen and phosphorus) the annual waste load allocation would remain, and the corresponding average concentrations would be lowered.

Table 3.2 shows the anticipated effluent concentrations for BOD_5, TSS, ammonia, total nitrogen and total phosphorus at the existing permitted capacity (2.5 MGD) and proposed expansion (3.0 MGD).

Table 3.2: Effluent Limits at Current Capacity, and Requirements at 3.0 MGD ADF

Parameter	Monthly Average		Weekly Average	
Average Design Flow	2.5 MGD	3.0 MGD	2.5 MGD	3.0 MGD
BOD_5	10 mg/L	10 mg/L	15 mg/L	15 mg/L
TSS	10 mg/L	10 mg/L	15 mg/L	15 mg/L
Ammonia-N	1.4 mg/L*		1.7 mg/L*	
E.coli	126 MPN/100 mL		n/a	
	Calendar Year Average		Annual Load Allocation	
Average Design Flow	2.5 MGD	3.0 MGD		
Total Nitrogen	4.0 mg/L	3.33 mg/L	30,456 lbs	
Total Phosphorus	0.3 mg/L	0.25 mg/L	2,284 lbs	
* Values may be subject to future Freshwater Ammonia Criteria				

There would be no change in the effluent requirements for BOD_5 and TSS. Although slightly more stringent ammonia limits could be imposed due to the Freshwater Ammonia Criteria, they are still expected to be met with the recently installed MBBR process, which has demonstrated excellent ammonia removal performance since startup.

Table 3.2 shows that the annual TN concentration equivalent would be 3.33 mg/L at 3.0 MGD ADF. Total nitrogen is the sum of TKN (ammonia + organic nitrogen) and nitrate/nitrite. To meet the effluent TN requirement, each of these parameters (ammonia, organic-N and nitrate) need to be targeted at 1 mg/L or less based. As noted previously, ammonia in the plants effluent has consistently been at levels of 0.2 mg/L or less, and the organic nitrogen about 1.0 mg/L, which is considered mostly non-biodegradable (refractory). The effluent nitrate has been about 2 mg/L. For compliance at 3 MGD, the effluent nitrate concentration will need to be trimmed. Per discussions with plant operations, the nitrate levels are controlled based on economical methanol dosing while still targeting an overall effluent TN level below 4 mg/L. Based on the plant's experience nitrate can be further reduced through a slight increase in methanol dose (without impacting effluent BOD).

Total phosphorus is removed primarily through chemical addition and precipitation in the secondary clarifiers. Additional polishing occurs in the denitrification filters. With continued chemical addition, denitrification/filtration and low effluent suspended solids the plant should be able to meet the annual average TP limits (Table 3.2) for the plant expansion.

The following Sections 4 and 5 evaluate the liquid and solids treatment units and the anticipated upgrades required for the plant expansion to 3.0 MGD ADF. While the plant expansion planning horizon is longer term, 5-10 years out, the Sections also discuss needed near-term improvements to replace or upgrade aging equipment and extend the service life and treatment reliability of the existing facilities. From a planning level aspect, the "near-term" improvements include items that are short term, 0-2 years, and items that are intermediate term, 2-5 years. The time schedule covers the initial planning, design and construction award phases, but not the actual construction completion time. A summary table is presented in Section 7 showing anticipated upgrades and expansion phasing for various process unit, as well as fiscal planning level budgets.

4 LIQUID TREATMENT FACILITIES

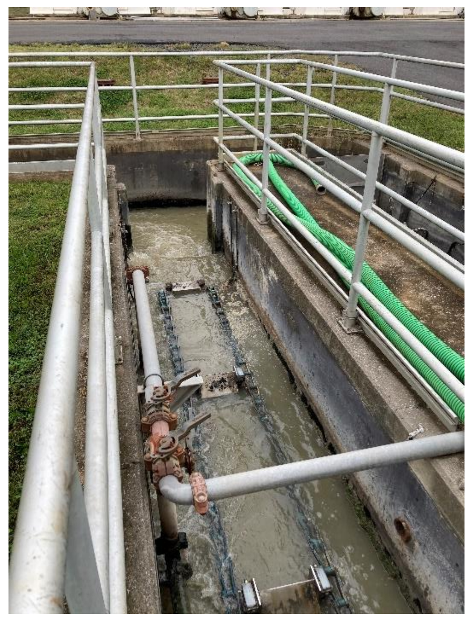
4.1 Preliminary Treatment (Headworks)

Influent wastewater to the facility flows through a mechanically cleaned bar screen (1/4" bar spacings) that is rated for a peak flow of 5 MGD. Flows above the 5 MGD rating is directed through a parallel channel with a manually cleaned bar rack. Both the mechanical screen and manual bar rack are located outdoors.

While the existing facilities could handle the overall estimated re-rated peak flow (9.0 MGD), during high flow events nearly half of the peak flow event (4 MGD) would have to bypass the 5 MGD rated screen and instead flow through the manually cleaned bar rack. This could be a maintenance problem for the MBBR process as rags and floatable material may build up and clog the MBBR screens.

Grit is settled in two parallel aerated grit channels. Grit is removed with chain and buckets and conveyed to outdoor grit bins.

Influent Screen (foreground) and Grit Collectors (background)



Grit Channel with Chain and Bucket

Given the aging equipment, and winter-time freezing issues and odor concerns with an outdoor installation, the Town is considering a new headworks building and new screen and grit removal facility. The new facility would be designed for an expanded 3.0 MGD ADF headworks, or with provisions to expand at a later time. The screening and grit removal processes would be sized to handle the future peak-hour flow of 15 MGD (based on the previous "design hydrograph"). The new headworks would be constructed adjacent to the existing facility. A conceptual layout is shown in **Appendix E.** consisting of two screen channels with mechanically cleaned bar screens (1.4-inch spacings) and overflow/bypass channel, and downstream vortex type grit removal with a grit classifier and dewatering unit. Equipment would be housed in a new building (the grit tank itself would be outdoors). The new facility will meet the SCAT regulations for treatment redundancy.

The existing 12-inch Parshall flume has adequate flow measuring capacity for average and peak flows up to 14 MGD. No modifications or replacement of the Parshall Flume are anticipated; however, influent flow metering may be re-configured when a new headworks facility is designed. While the Parshall Flume can measure the required peak flows, the existing flow chart is only capable of measuring and recording flows up to 6 MGD. The Town may consider upgrading or replacing the chart recorder at some point before the plant expansion.

4.2 Primary Clarifiers

Existing primary clarification includes two (2) 26-ft diameter units and two (2) 34-diameter units. Primary No. 4 was added in the 1990 plant upgrade. Tankage and piping are from the original construction, but the clarifier mechanisms have been replaced over the years, most recently for PC No. 2 (26-ft diameter).

Primary Clarifiers (with sludge pumping station) and former Trickling Filter (covered)

A key design criterion for primary clarifier sizing is the hydraulic surface overflow rate (SOR). Conventional design guidelines (Manual of Practice No. 8) and SCAT regulations recommend the SOR not exceeding 1,000 gpd/ft^2 at average design flow and 2,500 gpd/ft^2 for peak flow, and the hydraulic retention time (HRT) should be minimum 2 hours at average design flow. **Table 4.1** summarizes the SOR for the existing units at the current flows, at the plant permitted capacity (2.5 MGD) and at the plant expansion (3.0 MGD). While the SOR values for the existing units are within the design range up to the permitted capacity, the design values are exceeded for the plant expansion flows. For the future plant expansion, it is recommended that the existing units be replaced with two (2) new 60-ft diameter units to provide adequate capacity.

Flow distribution and a new primary sludge pumping station would also be constructed with the new clarifiers. Siting of these facilities would be in the open area adjacent to the former trickling filter, near the plant entrance. At that time the existing primary clarifiers could be re-purposed as sludge blending/ holding tanks. Primary clarifier No. 4 may need to be demolished to accommodate the new clarifiers. Typical clarifier information sheets are included in **Appendix F**.

Wet weather flows in excess in excess of 9 MGD would be diverted before the new primary clarifiers to the former trickling filter, stored and drained back to the intermediate pumping station during low flows. It is noted that the excess flow stored in the trickling filter that did not receive primary treatment would be pumped directly to the MBBR process. Preferably, all flows should receive primary treatment upstream of the MBBR process; however, a partial flow bypass around the primary clarifiers should be acceptable as long as a new Headworks facility is constructed and provided with mechanically cleaned bar screens (with no greater than ¼-inch bar spacings) that are sized for screenings removal at the maximum flows to the plant, including the grit removal unit, to protect the downstream MBBR process.

Table 4.1: Primary Clarifier Design Criteria, Current Permit (2.5 MGD) and Plant Expansion (3.0 MGD)

	Annual Average Flow	Maximum Month Flow	Peak Flow	Average Flow w/One Unit out of Service
Surface Overflow Rate (SOR) Design Criteria:				
Design Range (gpd/ft^2)	800 – 1000	800 – 1000	2,000 – 3,000	800 – 1,000
SCAT Regulations (gpd/ft^2)	< 1,000		< 2,500	< 1,000
Existing PCs at current Plant Flows	1.9 MGD	2.5 MGD	11.5 MGD[1]	1.9 MGD
No of Ex. Units in Service	4	4	4	3
Total clarifier surface area (ft^2)	2,860	2,860	2,860	1,960
Surface Overflow Rate (SOR) (gpd/ft^2)	664	874	4,021	969
Existing PCs at Permitted Flow (2.5 MGD)	2.5 MGD	3.25 MGD	9.0 MGD[2]	2.5 MGD
No of Ex. Units in Service	4	4	4	3
Total clarifier surface area (ft^2)	2,860	2,860	2,860	1,960
Surface Overflow Rate (SOR) (gpd/ft^2)	874	1,136	3,147	1,276
Existing PCs at Plant Expansion (3.0 MGD)	3.0 MGD	3.9 MGD	9.0 MGD[2]	3.0 MGD
No of Ex. Units in Service	4	4	4	3
Total clarifier surface area (ft^2)	2,860	2,860	2,860	1,960
Surface Overflow Rate (SOR) (gpd/ft^2)	1,049	1,364	3,147	1,531
New PCs at Plant Expansion (3.0 MGD)	3.0 MGD	3.9 MGD	9.0 MGD[2]	3.0 MGD
No of new Units in Service	2	2	2	1
Clarifier Diameter (ft)	60	60	60	60
Total clarifier surface area (ft^2)	5,652	5,652	5,652	2,826
Surface Overflow Rate (SOR) (gpd/ft^2)	531	690	1,592	1,062
Existing SCs at Plant Expansion (3.0 MGD)[3]	3.0 MGD	3.9 MGD	9.0 MGD[2]	3.0 MGD
No of Ex. Units in Service	2	2	2	1
Ex. Clarifier Diameters (ft)	50' & 64'	50' & 64'	50' & 64'	50'
Total clarifier surface area (ft^2)	5,175	5,175	5,175	1,960
Surface Overflow Rate (SOR) (gpd/ft^2)	580	754	1,739	1,531

[1]Actual observed peak-hour flows to the plant
[2]Flows in excess of 9 MGD would be diverted to the wet weather equalization tank (former TF)
[3]Alternatively converting the existing secondary clarifiers to primary clarifiers for the plant expansion

Section 4.6 discusses the need for new secondary clarifiers at the plant expansion to 3.0 MGD, to be installed in the area of the former RBCs. As such, an alternative to providing new primary clarifiers would be to convert the two existing secondary clarifiers, a 50 ft diameter unit and a 64 ft diameter unit. The bottom entry in **Table 4.1** shows that the existing secondary units have nearly the same total surface area as two new 60 ft diameter units and that the SOR values are within the acceptable design range. Assuming that the new secondary clarifiers are constructed first, subsequently converting the existing secondary clarifiers would save construction costs compared to new primary clarifier construction and would also preserve open areas within the plant. The existing secondary sludge pumping station would be renovated and if feasible the underflow sludge piping could be connected directly to the pumps, eliminating the telescoping valves and sight wells.

4.3 (Former) Trickling Filter

After the new MBBR process was placed in service in early 2021, the trickling filter and RBCs were taken offline. Occasionally, during high flow events the intermediate pumping station wet well backs up the primary effluent into the trickling filter which serves as flow attenuation and excess flow storage. The former trickling filter concrete tank has a useable storage volume of about 900,000 gallons that can be used for wet weather flows. As indicated in Section 2.3, the projected peak influent flow hydrograph at the expanded plant capacity would require 500,000 gallons storage to hold and equalize influent flows in excess of 9 MGD. In the near-term it is recommended that the existing plastic media be removed and continue to use the tank for high flow management. The trickling filter cover should remain in-place.

4.4 Intermediate Plant Pumping Station

The intermediate pumping station pumps primary clarifier effluent to the MBBR process via a new 20-inch force main extension from the existing RBCs. The four (4) submersible pumps were recently upgraded to larger units (1,800 gpm or 2.5 MGD each). With the new MBBR process, the peak pumping capacity is estimated at about 8 MGD with three of the four pumps operating, and about 10 MGD with all units in service.

SCAT regulations require that pumping stations with three or more pumping units shall be designed to meet the maximum sewage flow, or 2.5 times the average flow, whichever is greater, with one unit out of service. Since the design peak flow of 9.0 MGD (at 3.0 MGD ADF) is greater than the capacity with any one unit out of service, SCAT requirements dictate that an additional pumping unit may be required. However, there is limited room to install an additional pump and plant operations suspect a reduced pumping capacity in part due to the short section of a small diameter (12”) force main leaving the station. The line transitions to 16-inch diameter outside the station and runs up to the RBCs and ties to a new 20-inch extension to the MBBR process. In the near-term, a sizing upgrade to the discharge force main is recommended to improve the pumping capacity. Given the age of this facility, a complete station renovation or replacement is recommended for a plant expansion. The existing submersible pumps may also be replaced with vertical solids handling (VSH) pumps. See VSH pump information in **Appendix G**.

4.5 Moving Bed Bio-Reactor (MBBR) Process

The MBBR process was recently installed and replaced the trickling filter and RBCs. The MBBR process receives primary effluent and provides for BOD removal and ammonia removal (nitrification). It consists of two (2) parallel reactor trains each with three (3) zones separated by partition walls with media retaining screens. The first zone is aerated for BOD removal; the second and third zones are also aerated and provide full nitrification. Aeration is supplied by two (2) variable speed-controlled blowers located in the adjacent Blower and Control Building. A third blower is provided as standby. Process air supply and air valve position for each zone is controlled through dissolved oxygen (DO) setpoint. In-situ ammonia analyzers are installed in the third zone also provide the option for ammonia-based aeration. Fully nitrified effluent from MBBR process is conveyed to the secondary clarifiers for solids removal and subsequently to the tertiary denitrification filters for nitrogen removal. The third zone is equipped with a top-mounted mixer and the air flow can be turned off to allow for de-oxygenation while keeping the media in suspension with the mixer, or to provide anoxic conditions for partial (post)-denitrification. Currently, the third zone does not have provisions for external carbon addition.

MBBR Process - Reactor Trains 1 and 2

MBBR Aeration Blowers

The MBBR system was placed in service in early 2021 with average plant flows at about 2.0 MGD or 80% of the current permitted design flow and the system has performed very well since startup. The influent ammonia concentrations have been consistent with the MBBR design criteria, and effluent ammonia levels after the second zone (first stage nitrification zone) average below 0.5 mg/l. This would suggest a robust nitrification reserve capacity in the last zone for additional flow and loadings. The MBBR tank volume was designed for a media fill ratio of 50% based on media with a specific surface area of nominally 800 m^2/m^3. For the plant expansion to 3.0 MGD it was envisioned that additional media would be added, up to 60% fill ratio (20% media increase), if needed, to accommodate future flow and wastewater loading without the need to build more tankage. The aeration blowers were also sized for an expanded capacity; therefore, no other improvements are needed for the MBBR process for expansion 3.0 MGD. As flows and loads increase in the future the need for adding more media can be evaluated based on treatment performance.

4.6 Secondary Clarifiers

MBBR effluent is conveyed to the flash mixing/flocculation tanks where metal salt (poly-aluminum chloride, "PACl") is added for chemical phosphorus removal in the secondary clarifiers. The existing chemical storage tank volume (6,000 gallons) is sufficient for the plant expansion to 3.0 MGD but the tank is old and needs secondary containment. A new tank with containment area is recommended as a near-term improvement.

The two existing secondary clarifiers include one 64 feet diameter unit and one 50 feet diameter unit, each with 12-ft sidewater depth, and with a total surface area of 5,175 ft^2. The clarifier depth is within the recommended range. The SCAT regulations indicate that the surface overflow rate (SOR) should not exceed 500 gpd/ft^2 and 1,200 gpd/ft^2 at average and peak flows, respectively, for clarifiers following an attached growth biological process. Also, the SCAT regulations indicate that for conventional clarifiers used with chemical clarification, the design SOR shall not exceed 600 gpd/ft^2. The estimated solids loading rates (SLR) based on typical MBBR effluent (100-150 mg/l TSS) are well below the SCAT criteria for attached growth processes (SCAT criteria: 0.6-1.0 lbs/ft^2/hr at average design; 1.6 lbs/ft^2/hr at peak loading). **Table 4.2** summarizes the SOR for the existing units at the current flows, at the plant permitted capacity (2.5 MGD) and at the plant expansion (3.0 MGD). While the SOR values for the existing units are within the design range up to the permitted capacity, the design values are exceeded for the plant expansion flows. For the future plant expansion, it is recommended that the existing units be replaced with two (2) new 75 ft diameter units to provide adequate capacity.

Secondary Clarifier

Table 4.2: Secondary Clarifier Design Criteria, Current Permit (2.5 MGD) and Plant Expansion (3.0 MGD)

	Annual Average Flow	Maximum Month Flow	Peak Flow[1]	Average Flow w/One Unit out of Service
Surface Overflow Rate (SOR) Design Criteria:				
Design Range (gpd/ft^2)	400 – 600	< 600	1,000 – 1,200	400 – 600
SCAT Regulations (gpd/ft^2)	< 500		< 1,200	< 500
Existing SCs at current Plant Flows	1.9 MGD	2.5 MGD	9.0 MGD	1.9 MGD
No of Ex. Units in Service	2	2	2	1
Total clarifier surface area (ft^2)	5,175	5,175	5,175	1,960
Surface Overflow Rate (SOR) (gpd/ft^2)	367	483	1,739	969
Existing SCs at Permitted Flow (2.5 MGD)	2.5 MGD	3.25 MGD	9.0 MGD	2.5 MGD
No of Ex. Units in Service	2	2	2	1
Total clarifier surface area (ft^2)	5,175	5,175	5,175	1,960
Surface Overflow Rate (SOR) (gpd/ft^2)	483	628	1,739	1,276
Existing SCs at Plant Expansion (3.0 MGD)	3.0 MGD	3.9 MGD	9.0 MGD	3.0 MGD
No of Ex. Units in Service	2	2	2	1
Total clarifier surface area (ft^2)	5,175	5,175	5,175	1,960
Surface Overflow Rate (SOR) (gpd/ft^2)	580	754	1,739	1,531
New SCs at Plant Expansion (3.0 MGD)	3.0 MGD	3.9 MGD	9.0 MGD	3.0 MGD
No of new Units in Service	2	2	2	1
Clarifier Diameter (ft)	75	75	75	75
Total clarifier surface area (ft^2)	8,831	8,831	8,831	4,416
Surface Overflow Rate (SOR) (gpd/ft^2)	340	442	1,019	679
[1]Flows in excess of 9 MGD would be diverted to the equalization tank (former TF)				

Flow distribution with mixing/flocculation and a new secondary sludge pumping station would also be constructed with the new clarifiers. Siting of these facilities would be in the area of the former RBCs, adjacent to the MBBR tanks. Rather than circular clarifiers, rectangular units with chain and scrapers would offer a better fit within the footprint of the former RBCs. They would each be about 110 ft long by 40 ft wide with similar surface area to the 75 ft diameter units. The existing clarifiers may be converted to flow equalization before the DN filters or removed to make room for a new headworks facility, or if the DN filter facility was to be expanded in the future. Rectangular clarifier information sheets are included **Appendix H**.

4.7 Denitrification Filter (DNF) Pumping Station

The DNF pumping station was constructed as part of the 2009 Nutrient Removal Upgrade. It pumps secondary nitrified effluent to the tertiary denitrification filters. The pumping station is designed for a peak flow of 9.6 MGD (with three pumps online and one pump standby). The station also has (emergency) overflow provision to allow flows to by-pass the DNF facility and be conveyed via gravity to UV-disinfection. At the expansion to 3.0 MGD ADF, the design peak flow (9.0 MGD) is within the station safe pumping capacity and no upgrades to the pumping station are anticipated.

4.8 Tertiary Denitrification Filters

Nitrates in the secondary clarifier effluent (from the MBBR process) are denitrified in the tertiary denitrification filters, installed in the 2009 Nutrient Removal Upgrade, to provide total nitrogen removal and effluent phosphorus polishing. External carbon (methanol) is added to the process. The facility includes four deep-bed (4) filters, each 11.5ft W x 26ft L with 6 feet media depth. Each filter area is nominally 300 ft^2, or 1,200 ft^2 total with all filters online. A clearwell holding tank provides filtered effluent for filter backwashing. The clearwell houses two (2) submersible backwash pumps. A mudwell tank stores spent backwash water that is drained back to the intermediate plant pumping station. Air scour blowers for filter backwashing and the main filter control panel are housed in the adjacent Blower/Control Building.

The existing DN filters were specified to treat up to 3.0 MGD average flow, a maximum month flow of 3.9 MGD, and a peak hourly flow of 9.0 MGD.

DN Filter Pump Station (left) and DN Filter Facility

DN Filter Cell

Methanol Storage

The average nitrate concentration to the DN filters is about 18 mg/L. At the plant expansion to 3.0 MGD ADF the hydraulic filter loading and volumetric (empty bed) nitrate loading would be about 1.8 gpm/ft^2 and up to 60 lbs-nitrate/1,000 ft^3/day, which are within conventional deep bed DN filter design criteria. During maximum month conditions where the filter loading is higher, the denitrification performance (and TN removal) may be slightly lower. However, there is no monthly permit limit for total nitrogen, and it would not affect the ability to meet the annual nitrogen mass load limit. The filter peak hydraulic loading (at 9 MGD) would be about 5 gpm/ft^2 which is also acceptable. Thus, the filter capacity is adequate, and no additional filters or other upgrades are required for expansion to 3.0 MGD ADF.

The methanol facility includes a nominal 12,000-gallon steel storage tank in a covered containment area and redundant methanol feed pumps. No improvements are anticipated.

4.9 Effluent Disinfection

Prior to the 2009 Nutrient Removal Upgrade the gas chlorination/dechlorination facilities were replaced with an ultra-violet (UV) disinfection system. The system includes two parallel 14-inch in-line medium pressure/high intensity UV Reactors located in a below-grade vault. Each reactor is rated for 5 MGD. There is provision to add a future third unit which will require a new below-grade vault and connection to existing piping. Recently, the Town upgraded the UV electrical and control system.

At current conditions, one UV Reactor is operating at average flows and the second reactor is turned on at higher flows. Daily grab samples are analyzed for E.coli and as long as the lamps are kept clean and replaced periodically (typically after 7,000-8,000 hours of operation), the average values are generally less than 10 MPN/100 mL, well below the permit limit of 126 MPN/100 mL (geometric mean). The SCAT regulations require that if no more than two UV banks are provided, each UV bank shall be capable of disinfecting the maximum daily flow (not peak-hour flow). Based on plant records for 2013 - 2021, the average ratio of maximum daily-to-average flow is about 1.6. Thus, at 3.0 MGD ADF, the maximum daily flow is projected at 4.8 MGD, less than 5 MGD. Therefore, unless otherwise required by VADEQ, the need for an additional UV unit is not anticipated for the plant expansion.

UV-disinfection In-line Reactors

The current two-reactor configuration has a hydraulic capacity greater than 10 MGD (with both reactors online). An increase in the hydraulic gradient, due to additional head-loss across the UV reactors at higher flows, will be sufficiently contained within the DN filter effluent clear-well.

4.10 Post Aeration

The existing post aeration tanks are provided with mechanical surface aerators to meet the permit requirements for dissolved oxygen in the final effluent. No improvements are anticipated for the plant expansion to 3.0 MGD, however, given the age of the mechanical mixers, near-term upgrades/motor replacement may be required.

Post Aeration Tank and Surface Aerator

The existing 12-inch effluent Parshall flume, downstream of the post-aeration tank can adequately measure maximum flows up to 14 MGD. Thus, no modifications are required for the expansion to 3.0 MGD.

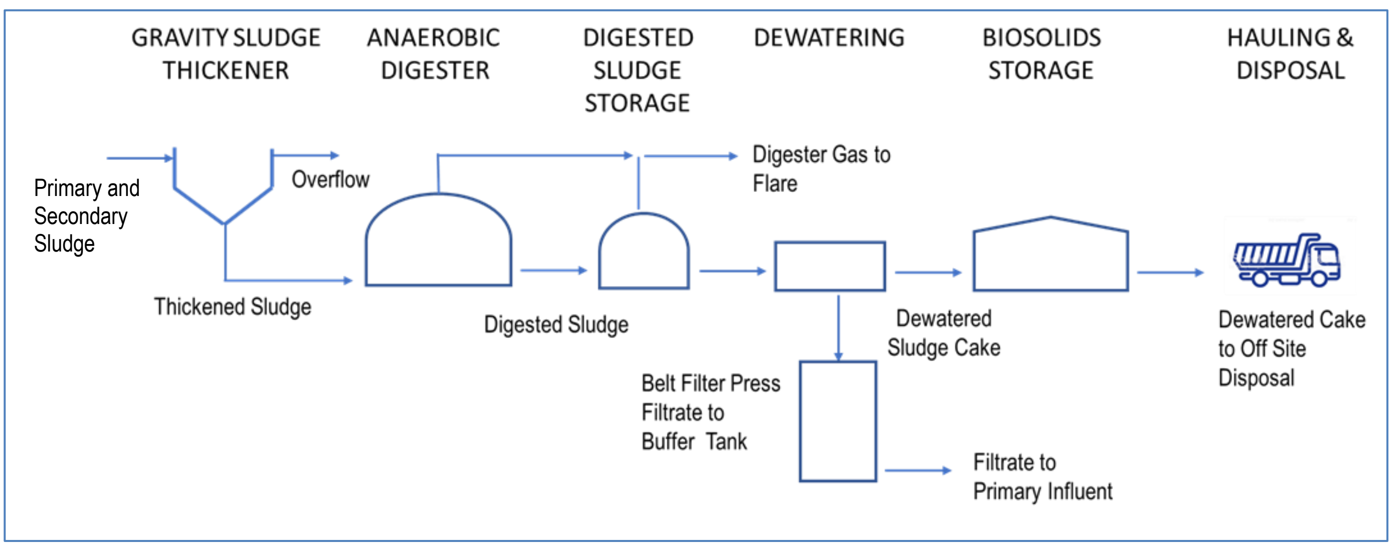
5 SOLIDS HANDLING FACILITIES

A separate solids handling upgrade and expansion evaluation report was completed in February 2020 and included in **Appendix K**. This Section 5 summarizes the solids handling facilities and recommended upgrades, near-term and for the plant expansion to 3.0 MGD, based on the 2020 report and more recent discussions with the Town.

The existing solids handling flow schematic is shown below. The plant produces primary sludge, secondary sludge from the MBBR process and tertiary sludge from the DN filters. Metal salt (poly-aluminum chloride, PACL) is added to the secondary clarifiers for improved solids and chemical phosphorus removal. Sludge is also received from the Town's water treatment plant as it is discharged through the sanitary sewer system.

Settled primary and secondary sludges are withdrawn intermittently from the clarifiers through telescoping valves into separate sludge sight wells. Primary sludge is withdrawn between 8:00 AM and 12:00 AM (16 hours over two shifts). The primary sludge sight well (3,000 gallons) is filled 4-5 times during this period and pumped to the gravity sludge thickener (GST). Secondary sludge is withdrawn and pumped to the GST for 15 minutes each hour, 24/7. The pumping rate is about 50 gallons per minute. The total daily sludge flow (primary + secondary) to the GST is about 30,000 – 35,000 gallons. The mixed solids content average about 1.0-1.5%, and the estimated daily dry solids feed to the GST is about 3,700 lbs.

Underflow from the GST is pumped intermittently (15 minutes each hour) to a mesophilic anaerobic digester with a floating cover. The digester temperature is maintained by sludge recirculation through a "tube-in-a-tube" heat exchanger. Digester mixing is done with a Pearth™ gas mixing system integral with the floating cover. Digested sludge is pumped intermittently to a sludge holding tank with a flexible membrane cover for gas storage. Sludge is pumped from the sludge holding tank to a belt filter press for dewatering, operating 7-10 hours per day, 5 days per week. Dewatered cake drops into a dump truck below the dewatering building and is unloaded and stored on site on a covered sludge storage pad. Stored sludge is hauled and disposed off-site through contract operations. Dewatering filtrate is stored and equalized in a buffer tank, and then metered into the primary influent.



Existing Solids Handling Process Schematic

Key design information for the solids handling process tankage and equipment is summarized in **Table 5.1**.

Table 5.1: Existing Solids Handling Facilities and Equipment

Equipment	Year Installed	Design Parameter	Value
Primary Sludge Wet Well	1989	Volume	3,000 gallons
Primary Sludge Pumps	1989	Flowrate	50 gpm (piston pumps)
Secondary Sludge Wet Well	1989	Volume	3,000 gallons
Secondary Sludge Pumps	1989	Flowrate	50 gpm (piston pumps)
Gravity Sludge Thickener	1989	Diameter	28 ft
		Side Water Depth	12 ft
Anaerobic Digester	1989	Diameter	50 ft
		Side Water Depth, Maximum Straight	20 ft
		Maximum Operating Volume	293,000 gallons
		Working Volume, 85%	250,000 gallons
		Cover	Floating
		Mixing	Pearth™ Gas Mixing
		Boiler	Envirex 560,000 BTU/hr
		Heat Exchanger	Tube in Tube with hot water recirculation 42.21 sq ft HEX area
		Recirculation Pumps (2)	WEMCO Model 3 Size 4 X 3 Recessed Impeller Centrifugal 150 gpm @ 34 ft head
		Sludge Transfer Pumps - 6 Total: Transfer from GST underflow to Digester (2); Transfer from Digester to Sludge Storage (2); Transfer from Sludge Storage to Belt Filter Press (2)	ITT Marlow Model BE82W Plunger Pump 240 gpm @ 45 ft head
		Waste Gas Flare	Open style with manual ignition Mounted at grade 6-inch diameter
Sludge / Gas Holding Tank	1970	Diameter	40 ft
		Side Water Depth	20 ft
		Volume	185,000 gallons
	2010	Cover	Flexible Gas Holding
Belt Filter Press	2012	Belt Width	1 meter
		Hydraulic Capacity, current operation	30-35 gpm
Filtrate Buffer Tank	2000	Volume	30,000 gallons
Dewatered Sludge Storage (covered)	1970	Length, Width Area	165 ft, 55 ft (8 bays) 9,330 sq ft

The estimated sludge production at the current permitted capacity of 2.5 MGD and for the expansion to 3.0 MGD is shown in **Table 5.2** as a flow proportional increase from the existing conditions.

Table 5.2: Projected Solids Loadings

Parameter	Annual Average Daily Influent Flow (MGD)		
	Current (1.9)	2.5	3.0
Total dry solids (lbs/day)	3,700	4,900[1]	5,900[1]
Volumetric flow (gallons per day)[2]	45,000	59,000	70,500

[1] Proportional to plant flows at current solids estimates at annual average flow (1.9 MGD)

[2] Using annual average 1% combined total dry solids in the sludge feed

5.1 Sludge Pumping

Both the primary and secondary sludge pumping stations use piston (plunger) pumps to convey sludge from the sight wells to the GST influent. The pumps are maintenance intensive, and the Town has refurbished the pumps several times since the original installation in 1989 and is considering replacements in the near-term.

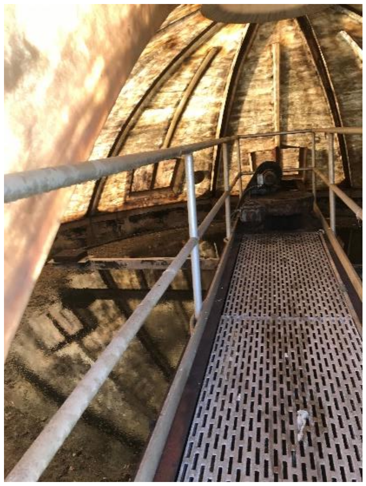
Sludge Pumps (primary and secondary sludge)

For the plant expansion to 3.0 MGD the sludge pump stations would be replaced with the new primary and secondary clarifier sludge pump stations as discussed in Section 4. The pumps and suction piping would be connected directly to the clarifier underflow piping in lieu of telescoping valves and sight wells. The pumps would be rotary lobe or progressing cavity type and located in the new pump station basement(s).

5.2 Gravity Thickening

Primary and secondary sludges are pumped (independently) to the gravity sludge thickener (GST). The GST is provided with a cover for odor control. As indicated in the 2020 Solids Handling Facilities report, the projected sludge flow and solids loading at the current permitted 2.5 MGD and expansion to 3.0 MGD capacity are within the typical design values for the existing GST and additional GST tanks would not be needed. However, the plant has recently experienced difficulty in settling the sludge in the GST resulting in diluted sludge to the digester and causing excessive carry-over solids in the GST overflow. This reduces the solids capture and results in increased levels of in-plant solids recycle. This in turn has caused poor settling in the primary clarifiers and thus exacerbating the problem. The plant has started to add polymer to primary clarifiers and the GST influent and is considering also adding metal salt (PACl).

GST w/Cover



GST Interior

There is significant buildup of floatable debris which blinds the overflow weirs and traps solids. On a quarterly basis the cover is removed, and the debris is cleaned out (contract operation). Improving the influent screening could alleviate some of this and sludge screening (both primary and secondary sludges) is another option. The sludge screen would be housed in an adjacent building and tie into the GST sludge feed line.

Due to the age and the plant's operating experience, the GST needs a complete refurbishment including replacement of the sludge collection mechanism and pickets, center access bridge, cover, and concrete repairs, where needed. The Town has recently issued a construction contract to perform this work and should be completed in 2023.

5.3 Anaerobic Digestion

Thickened sludge is digested and stabilized in existing Anaerobic Digester No.1. Digester No. 2 is used for digested sludge holding, with no mixing or heating provided, prior to sludge dewatering (two-stage digestion). The plant's permit requires adequate capacity (volume, heating and mixing) to meet the Class B sludge stabilization requirements per EPA Part 503, i.e. solids retention time (SRT) of 15 days and volatile solids reduction of 38% or greater. At the projected sludge quantities for the current 2.5 MGD plant capacity the SRT Anaerobic Digester No. 1 is estimated at about 13-15 days, and at the expansion to 3.0 MGD, the SRT is estimated at about 10 days. To increase the digester SRT, there are two options:

- Reduce the sludge flow rate (volume) by increasing the thickened sludge underflow % solids
- Provide additional digester volume.

The 2020 Solids Handling Facilities report evaluated the options: 1) replacing the existing GST with mechanical thickening facilities to increase the thickened sludge underflow % solids or 2) adding a second primary digester (similar in size to the existing digester). The evaluation found that the cost of a new digester with control building, would be comparable to building new mechanical sludge thickening facilities that would require thickening equipment, power and control building, sludge pumps, chemical feed and sludge holding tankage (since mechanical thickening is typically not operated 24/7 like the GST). It was also considered to modify Digester No. 2 to become a primary digester;

however, this would leave the plant without sludge holding/storage prior to sludge dewatering and new tankage would need to be constructed.

Primary Digester No. 1

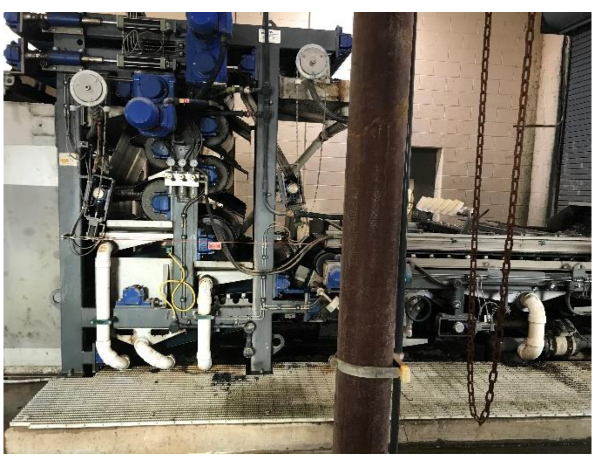
Digested Sludge Holding and Gas Storage

To provide adequate operational flexibility and to meet sludge stabilization requirements, a second, new, primary digester is recommended for the plant expansion to 3 MGD. A new electrical service and standby power will be required for the second digester facility. As the plant flows gradually near the 2.5 MGD permitted capacity the planning and design of the new digester facility should be initiated such that a new primary digester is constructed and operational in the anticipation of further increase in average plant flows.

Given the age and condition of the existing digester, it is recommended that the existing digester plug valves, heat exchanger, sludge pumps (feed, recirculation and transfer) and electrical motor control center (MCC) be replaced in the near-term to improve operability of the existing equipment and extend the service life. It is also anticipated that the membrane cover for the digested sludge holding tank will need replacement (installed in 2010) in the next 5-10 years.

5.4 Sludge Dewatering

The existing 1-meter sludge dewatering belt filter press (BFP) is relatively new (Installed in 2012). Dewatering operation is on weekdays during normal shift hours, typically 50 hours/week (10 hours/day, 5 days/week), processing about 12,600 gallons per day with a sludge feed rate of 30 gpm to the BFP. The average dry solids cake is about 13-14%. Dewatered sludge is transferred to the adjacent covered storage.



Belt Filter Press (sludge dewatering)

Dewatered Cake Transfer to On-Site Storage

Based on the projected sludge quantities at the expansion to 3.0 MGD an increase in BFP operating time is expected. As the flows near 2.5 MGD the operating time will require two full shifts (16 hours) and at the expansion to 3.0 MGD, weekend operation may also be required. It is recommended a new higher capacity BFP, 1.5 meter or 2-meter size, be considered in the long-term planning, to increase the throughput and reduce the dewatering hours. It should be feasible to fit at least a 1.5-meter BFP in the existing dewatering room. Another option is to consider alternate dewatering equipment such a conventional centrifuge or a screw press. Both machines can achieve higher cake solids (20% or higher) which would reduce hauling and disposal costs and eliminate the need for additional cake storage area.

The dewatering filtrate, which is high in ammonia, is stored and equalized in a 30,000-gallon tank and returned to the primary influent at a controlled rate to equalize the nitrogen (ammonia) recycle load to the plant. The existing holding/equalization tank is adequate.

5.5 Dewatered Sludge Storage

Dewatered sludge/biosolids is stored on-site and periodically hauled out for off-site land application through third party contract operations. As reviewed in the 2020 Solids Handling Facilities report, the existing sludge storage area footprint will need to increase for additional sludge storage at 2.5 MGD, and expansion to 3.0 MGD. It is recommended to expand the existing slab by 10-15 feet to the west (into the hill on the side of the digesters) and construct a concrete retaining/push wall (to replace the existing wooden barrier). In addition, the existing clear roof height is inadequate for full access and operation of a wheel loader to move the sludge. A new pre-engineered metal building (PEMB) frame is recommended to replace the roof over the existing and proposed expansion area. These modifications could be near-term depending on the contract hauling frequency or considered long-term improvements.

Biosolids Storage (back-end view)

5.6 Future Biosolids Management and Disposal

The current anaerobic digestion process at Warrenton WWTP is permitted as an EPA 503 “Process to Significantly Reduce Pathogens” (PSRP) that produces Class B biosolids for land application, with the requirement that the sludge in the anaerobic digester is held for at least 15 days (pathogen reduction) and achieving at least 38% volatile solids reduction (vector attraction reduction).

State biosolids regulations are likely to become more stringent in the future. There may be more reporting requirements, a higher quality of biosolids required for land application, reductions in land application rates, and restrictions on land available for application. With potentially more stringent biosolids disposal regulations in the future, the flexibility to produce Class A biosolids should be considered. Class A biosolids will have fewer restrictions on where they can be land applied. Allowable disposal areas include publicly accessible and residential lands.

To achieve Class A quality, the biosolids must undergo one of the EPA 503 approved treatment Processes to Further Reduce Pathogen (PFRP) levels. While there are advanced digestion and pre-treatment alternatives that can achieve Class A, one of the common methods involves heat drying the (anaerobically digested) dewatered cake to greater than 90% dry solids. Heat drying will also reduce on-site storage requirements and transportation costs. Even though significant energy (from natural or digester gas) will be required, an evaluation including cost savings in disposal, i.e., through beneficial reuse compared to landfilling, could show benefits in Class A heat drying.

The higher the percent solids in the dewatered cake, the less heat energy that must be used to dry the cake. In fact, the capital and higher operating costs of new dewatering equipment can potentially be fully offset by subsequent fuel savings in the heat drying operation. Therefore, it is common to dewater sludge using centrifuges (or screw press) to increase the dewatered sludge solids. The centrifuge (or screw press) would replace the existing belt filter press in a future scenario.

There are several sludge dryers available, generally categorized into a direct and indirect type. A paddle-type dryer, is an indirect dryer that would be appropriate for Warrenton WWTP. A heat transfer oil would be heated in a natural gas fired boiler, and the hot oil would be circulated through the hollow paddle mixer elements. The paddles rotate to mix the sludge, improving heat transfer characteristics, and to transport the sludge through the dryer. Dried biosolids would be conveyed to and stored on-site under cover before off-site hauling.

Komline-Sanderson Paddle Dryer

The dryer would be housed in a building adjacent to the dewatering process. Part of the existing sludge storage facility could be removed to make room for the heat drying facility since less storage area would be required for the dried cake. A heat drying facility could be implemented through a turn-key project where a third-party entity would design, build and operate the facility for a given contract period, typically 20 years. The plant would still operate the anaerobic digester(s) with the flexibility to produce both Class B and Class A biosolids.

6 PLANT HYDRAULICS

The existing plant was designed with a maximum hydraulic capacity of 5 MGD (based on the 1990 upgrade), although the plant has historically experienced higher flows and conveyed through the plant without overflows. As part of the UV-Disinfection upgrade in 2006 and Nutrient Removal upgrade in 2009 some of the previous hydraulic restrictions in the plant were eliminated, and as discussed herein, it is recommended that the former trickling filter be used for high flow management to limit the peak flows through the plant to 9 MGD, after the influent headworks. This corresponds to a peak flow factor of 3.0 through the plant (from primary treatment onwards to post aeration) associated with the plant expansion to 3.0 MGD ADF. The DN Filter and Pumping Station, as well as the recent MBBR process, were hydraulically designed for 9 MGD.

Refer to **Appendix I** for a preliminary Hydraulic Profile for the plant.

7 RECOMMENDED FACILITY PLAN

Based on the foregoing evaluations of the existing plant treatment facilities and anticipated plant flow increase the recommended implementation of the plant upgrades and expansion fall into three phasing categories as summarized below.

“Near-term” improvements include needed upgrades and retrofits planned for the next 0 – 5 years to keep the plant reliably operating and the extend service life of treatment processes and equipment. These are considered part of the Town’s Capital Asset Replacement Program (CARP). From a fiscal planning aspect, short term (0 – 2 years) and intermediate term (2 – 5 years) improvement phases are considered. The plant expansion horizon is longer term, 5 – 10 years out, as flows gradually approach the current permitted average design flow of 2.5 MGD and the need to expand treatment processes become necessary. Plant expansion is under the Town’s Capital Improvements Program (CIP) and is envisioned to increase the permitted capacity by 0.5 MGD, to 3.0 MGD. The Town has had discussions with the VADEQ about including the plant expansion provision in the next permit cycle. New discharge limitations associated with 3.0 MGD ADF would be included in the permit and conditional upon the full implementation of the plant expansion elements as recommended in this Preliminary Engineering Report. The timeline indicated for each phase reflects the initial planning, design and bid documents to advertise for construction, but not the actual construction completion time.

Pending future conditions, plant flows, budget planning and improvement needs, certain facility upgrades and expansion elements shown below could be accelerated or deferred to another phase.

Phase I CARP Upgrades (0 – 2 years) – Estimated Planning Level Costs: $1.0 – 1.5M

Primary Clarifiers
- Replacement of sludge collection mechanism and motor drives (for three of four PC units)

Secondary Clarifiers
- Replacement of sludge collection mechanism and motor drives (for both SC units)
- Flash Mixing / Flocculation Tank (valve replacement; piping size upgrade; hydraulic bottleneck)

UV-Disinfection
- Electrical system and controls upgrade (construction contract has been procured and work is upcoming)

Post Aeration Tank
- Misc. Surface aerator motor replacement

Gravity Sludge Thickener (GST)
- All equipment replacement and interior concrete repairs (construction contract is pending approval)

Phase II CARP Upgrades (2 – 5 years) – Estimated Planning Level Costs: $5.5 – 6.0M

New Headworks Facility (CIP)
- Replace existing facilities with new screening and grit removal with expanded treatment capacity

Plant Pumping Station
- Pump upgrades and electrical/controls improvements

Chemical Storage Tanks
- Replace polymer-aluminum chloride (PACl) tanks and provide secondary containment

Sludge Pumps
- Upgrade primary and secondary sludge pumps and electrical/controls

New Sludge Screen

- Optional: Install new primary/secondary sludge screen before the GST

Primary Digester Upgrade

- Various upgrades/renovations:
  - Digester cover
  - Sludge Pumps
  - Digester Mixing
  - Heat Exchanger
  - Misc. Valve replacements
  - Electrical upgrades (MCC)

Digested Sludge Storage

- Piping modifications and gas storage membrane cover replacement

Dewatered Sludge Storage

- Expand storage area

<u>Phase III CIP Plant Expansion (5 – 10 years) – Estimated Planning Level Costs: $12.5 – 13.0M</u>

New Primary Clarifiers

- Clarifiers, flow distribution, sludge pump station
- Conversion of one existing PC to sludge blending and holding

New Secondary Clarifiers

- Clarifiers, flow distribution, sludge pump station

Plant Hydraulics

- Misc. piping size upgrades associated with plant capacity expansion

New Primary Digester No. 2

- Digester tank, cover, mixing, heating, pumps, electrical and controls
- New electrical service and standby power

Sludge Dewatering

- New larger size belt filter press, or replacement with new dewatering screw press

The following **Table 7.1** provides a planning level cost breakdown of the improvements/expansion items for the liquid treatment and solids handling processes with the phasing (1, 2 or 3), CARP and CIP indicated. It should be noted that annual costs for routine equipment maintenance and spare parts replacement are not included. The second **Table 7.2** shows the anticipated planning level fiscal phasing of improvements over the next five (5) years to 2027. Again, as future conditions may change the scheduling of the CARP or CIP expenditures can adjust.

<u>Facility Site Plan:</u> **Appendix J** shows the proposed facility site layout for the plant expansion with the new facilities including headworks (screen and grit removal), primary clarifiers, secondary clarifiers and additional primary digester. The headworks facility would be constructed adjacent to the existing influent screen and grit channels, keeping those in service while the new headworks is being built. The two new secondary clarifiers would be located in the area of the former RBCs, in a rectangular configuration with common wall to save footprint. The additional primary digester would be constructed into the hill behind the sludge storage and near the digested sludge holding tank. There are two options for the new primary clarifiers: Layout "A" in the open area adjacent to the former trickling filter (to be converted to high flow management and flow equalization); or Layout "B" where the existing secondary clarifiers are converted to primary clarifiers as discussed in Section 4. This would save construction costs and preserve the land area between the plant entrance and the trickling filter. However, it requires that the new secondary clarifiers be built first.

Table 7.1: Upgrade and Expansion Phasing and Planning Level Costs

Item	Phase	CARP	CIP	Est. Cost[1]	Notes
Liquid Treatment				**$10,175,000**	
New Headworks Building (screen & grit)	2		X	$1,800,000	Replace existing facilities
Ex Primary Clarifier Upgrades	1	X		$200,000	Sludge collection equip/CF drives
New Primary Clarifiers & Sludge PS	3		X	$3,500,000	
Ex. Plant Pumping Station Upgrade	2	X		$250,000	Pump upgrade, electrical/controls
Ex. MBBR[2]				$0	No Improvements[2]
Ex. Secondary Clarifier & Flocc Tank Upgr.	1	X		$250,000	Sludge collection equip/CF drives
New Secondary Clarifiers & Sludge PS	3		X	$3,500,000	Incl. RBC Demo
Ex. DN Filter Pumping Station[2]				$0	No Improvements[2]
Ex. DN Filters[2]				$0	No Improvements[2]
Ex. UV-Disinfection	1	X		$300,000	System Controls Upgrade (ongoing)
Ex. Post-Aeration Tanks Upgrade	1	X		$25,000	Minor
Ex. Plant NPW Pumps[2]				$0	No Improvements[2]
Chemical Storage Tanks Upgrade	2	X		$200,000	New PACL Tanks & Containment
Misc Plant Hydraulics / Piping Upgrade	3	X		$150,000	Piping size upgrades
Solids Handling				**$9,150,000**	
Ex. Primary Sludge Pumps Upgrade	2	X		$150,000	Pump upgrade, electrical/controls
Ex. Secondary Sludge Pumps Upgrade	2	X		$150,000	Pump upgrade, electrical/controls
Gravity Sludge Thickener (GST) Upgrade	1	X		$350,000	Construction contract pending
New Sludge Screen w/Enclosure	2		X	$300,000	Optional (pending GST + Headworks)
Ex. Primary Digester Upgrade	2	X		$2,000,000	Various upgrades/renovation
- Digester cover					
- Sludge pumps					- currently under replacement
- Digester mixing					
- Heat exchanger					
- Misc valves and other					
- Electrical Upgrade					
Ex. Digested Sludge Storage Upgrade	2	X		$350,000	Piping Mods/ Membrane Cover Repl.
New Digester No. 2	3		X	$5,000,000	Incl new Elec Standby Power
Sludge Dewatering Expansion	3		X	$500,000	New 2 meter BFP, or Screw Press
Expand Dewatered Sludge Storage	2		X	$350,000	
Future Class A Biosolids Heat Dryer[3]	*3*		X	*$0*	*Future planning (beyond Phase 3)*
Total Construction Costs				$19,325,000	
Phase 1: Short Term (0-2 years)				$1,125,000	
Phase 2: Intermediate Term (2-5 years)				$5,250,000	
Phase 3: Long Term (5-10 years)				$12,650,000	
CARP: Capital Asset Replacement Program				$4,375,000	
CIP: Capital Improvements Program (plant expansion to 3.0 MGD)				$14,650,000	

1) 2021 dollars (construction costs)

2) No CARP or CIP anticipated; only O&M costs

3) Estimated cost in order of magnitude: $10M (dryer equipment, building, dewatering upgrade)

Table 7.2: Fiscal Budget Planning

WWTP CIP/CARP Projects	CIP/CARP	Expansion	2022	2023	2024	2025	2026	2027	Beyond	Totals
Ex. UV Disinfection	CARP	N	$300,000							$300,000
Ex. Gravity Sludge Thickener Upgrades	CARP	N	$350,000							$350,000
Ex. Post-Aeration Tank Upgrade	CARP	N	$25,000							$25,000
Ex. Primary Sludge Pump Upgrades	CARP	N	$150,000							$150,000
Ex. Secondary Sludge Pump Upgrads	CARP	N		$150,000						$150,000
Ex. Chem. Storage Tank Upgrade	CARP	N		$200,000						$200,000
Ex. Digested Sludge Storage Upgrade	CARP	N		$350,000						$350,000
Ex. Primary Clarifier Upgrades	CARP	N		$200,000						$200,000
Ex. Plant Pump Station Upgrade	CARP	N			$250,000					$250,000
Ex. Primary Digester Upgrade	CARP	N			$500,000	$1,000,000	$500,000			$2,000,000
New Headworks Building	CIP	Y				$100,000	$1,200,000	$500,000		$1,800,000
Expand Dewatered Sludge Storage	CIP	Y						$350,000		$350,000
New Sludge Screen w/Enclosure	CIP	Y		$300,000						$300,000
Ex. Secondary Clarifier Upgrades	CARP	N					$250,000			$250,000
New Primary Clarifiers & Sludge Pump Station	CIP	Y					$1,000,000	$2,500,000		$3,500,000
New Secondary Clarifier & Sludge Pump Station	CIP	Y						$500,000	$3,000,000	$3,500,000
Misc Plant Hydraulics/Piping Upgrade	CIP	Y				$150,000				$150,000
Sludge Dewatering Expansion	CIP	Y				$100,000	$400,000			$500,000
New Digester No. 2	CIP	Y							$5,000,000	$5,000,000
Total Construction Costs (2021 dollars)			**$825,000**	**$1,200,000**	**$750,000**	**$1,350,000**	**$3,350,000**	**$3,850,000**	**$8,000,000**	**$19,325,000**

CARP: Capital Asset Replacement Program
CIP: Capital Improvements Program (plant expansion to 3.0 MGD)

Figures

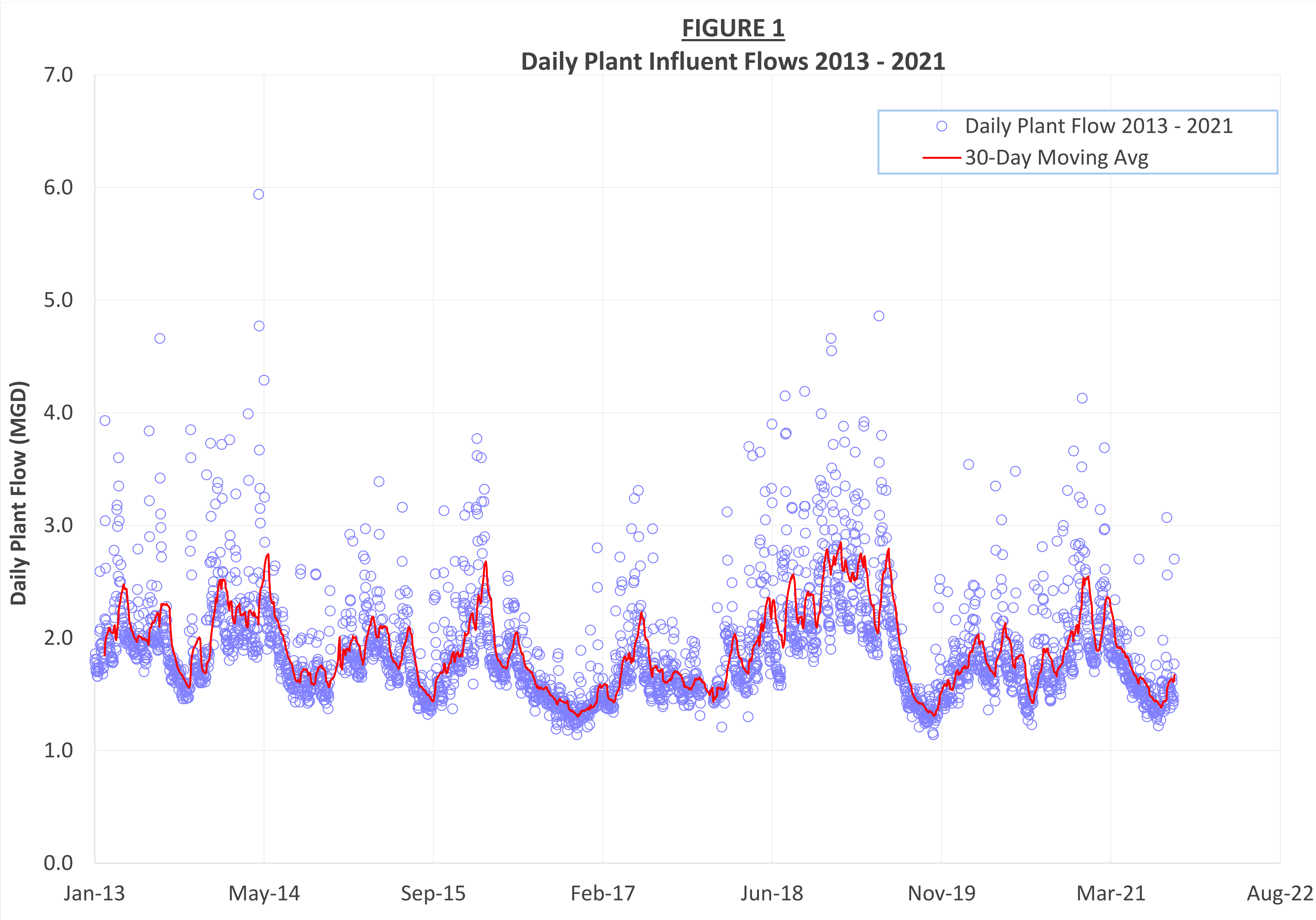


FIGURE 1
Daily Plant Influent Flows 2013 - 2021
Daily Plant Flow (MGD)
Daily Plant Flow 2013 - 2021
30-Day Moving Avg
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Jan-13
May-14
Sep-15
Feb-17
Jun-18
Nov-19
Mar-21
Aug-22

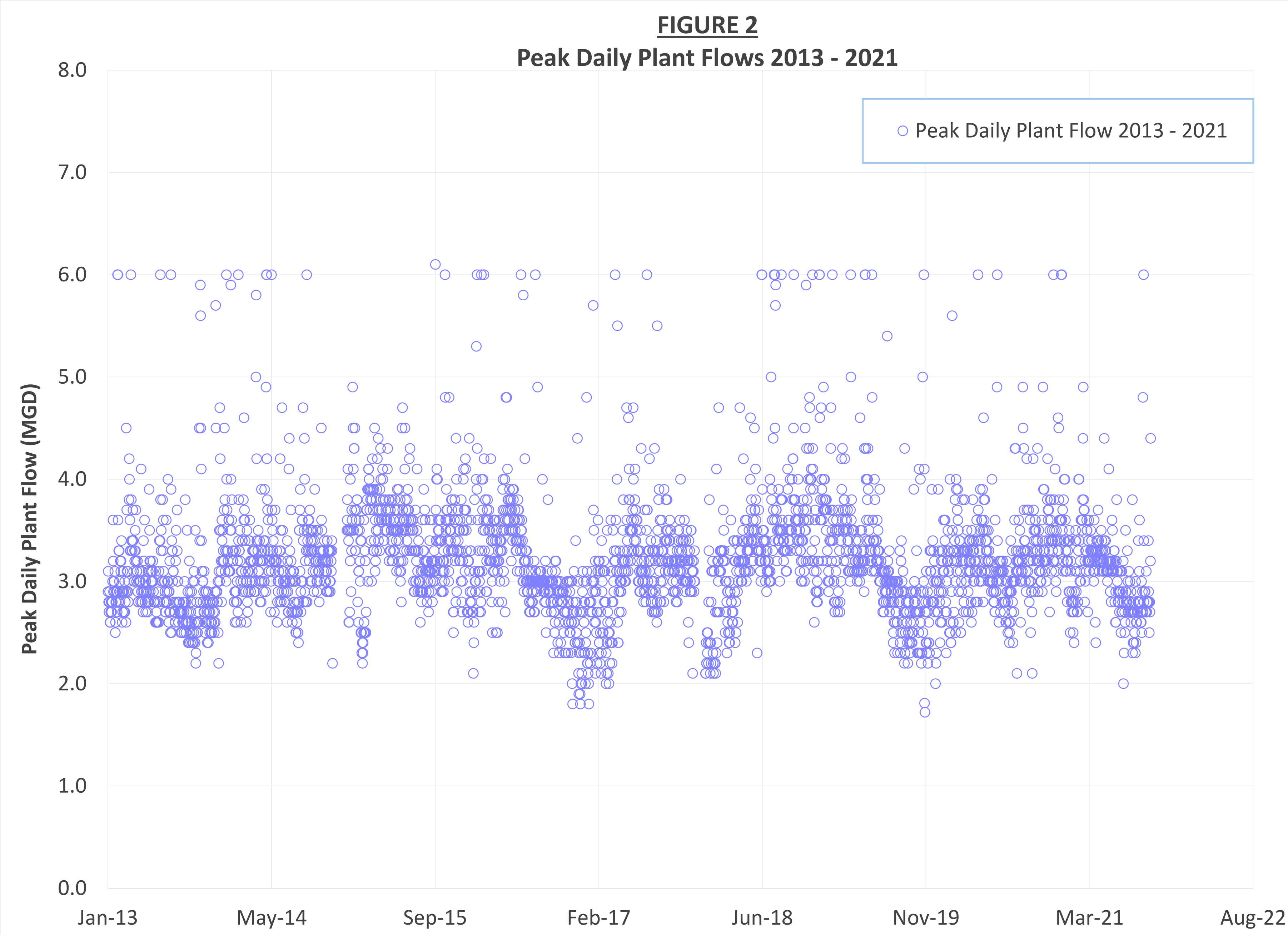


FIGURE 2
Peak Daily Plant Flows 2013 - 2021
Peak Daily Plant Flow 2013 - 2021
Peak Daily Plant Flow (MGD)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Jan-13
May-14
Sep-15
Feb-17
Jun-18
Nov-19
Mar-21
Aug-22

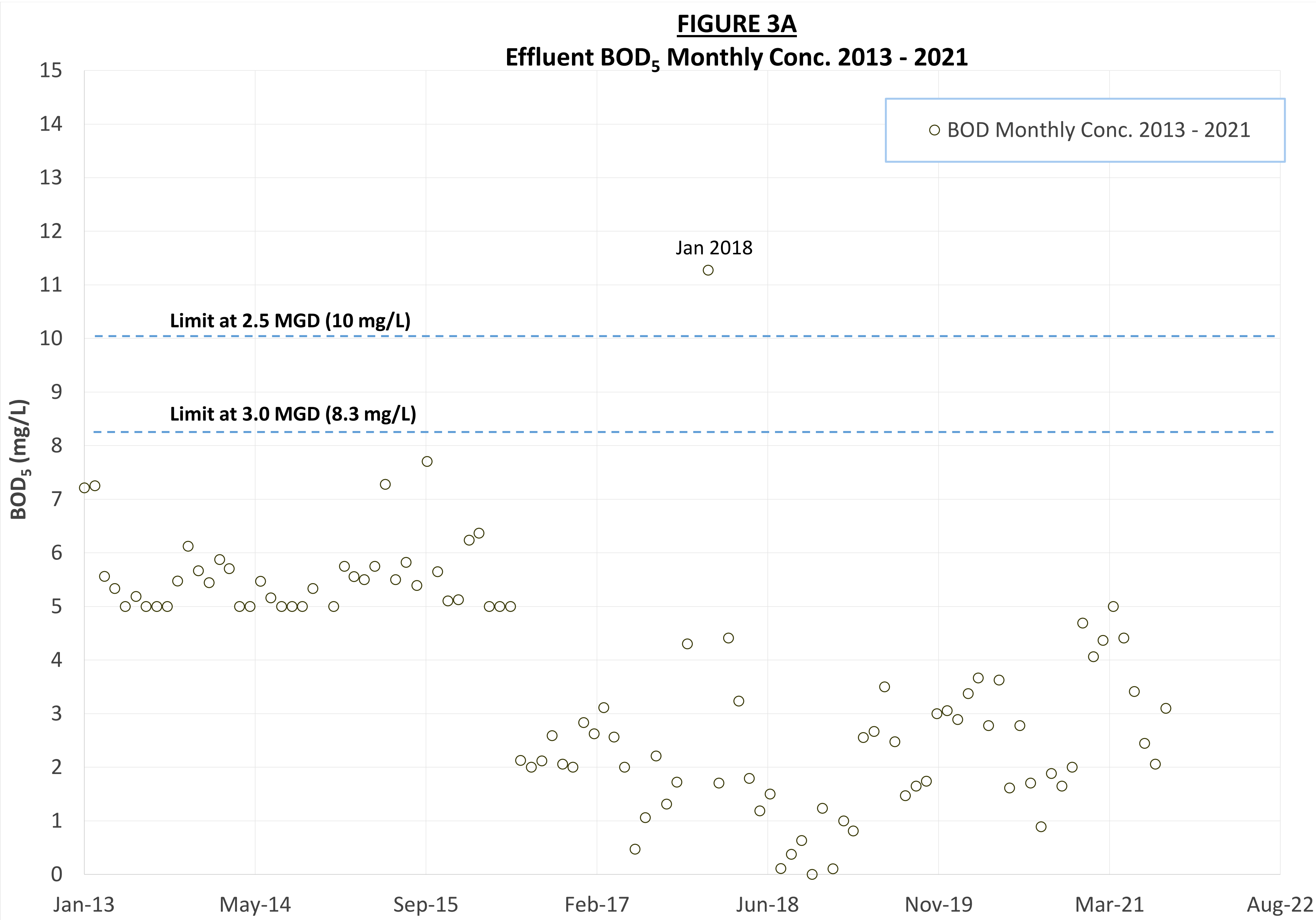


FIGURE 3A
Effluent BOD5 Monthly Conc. 2013 - 2021
BOD Monthly Conc. 2013 - 2021
Jan 2018
Limit at 2.5 MGD (10 mg/L)
Limit at 3.0 MGD (8.3 mg/L)
BOD5 (mg/L)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-13
May-14
Sep-15
Feb-17
Jun-18
Nov-19
Mar-21
Aug-22

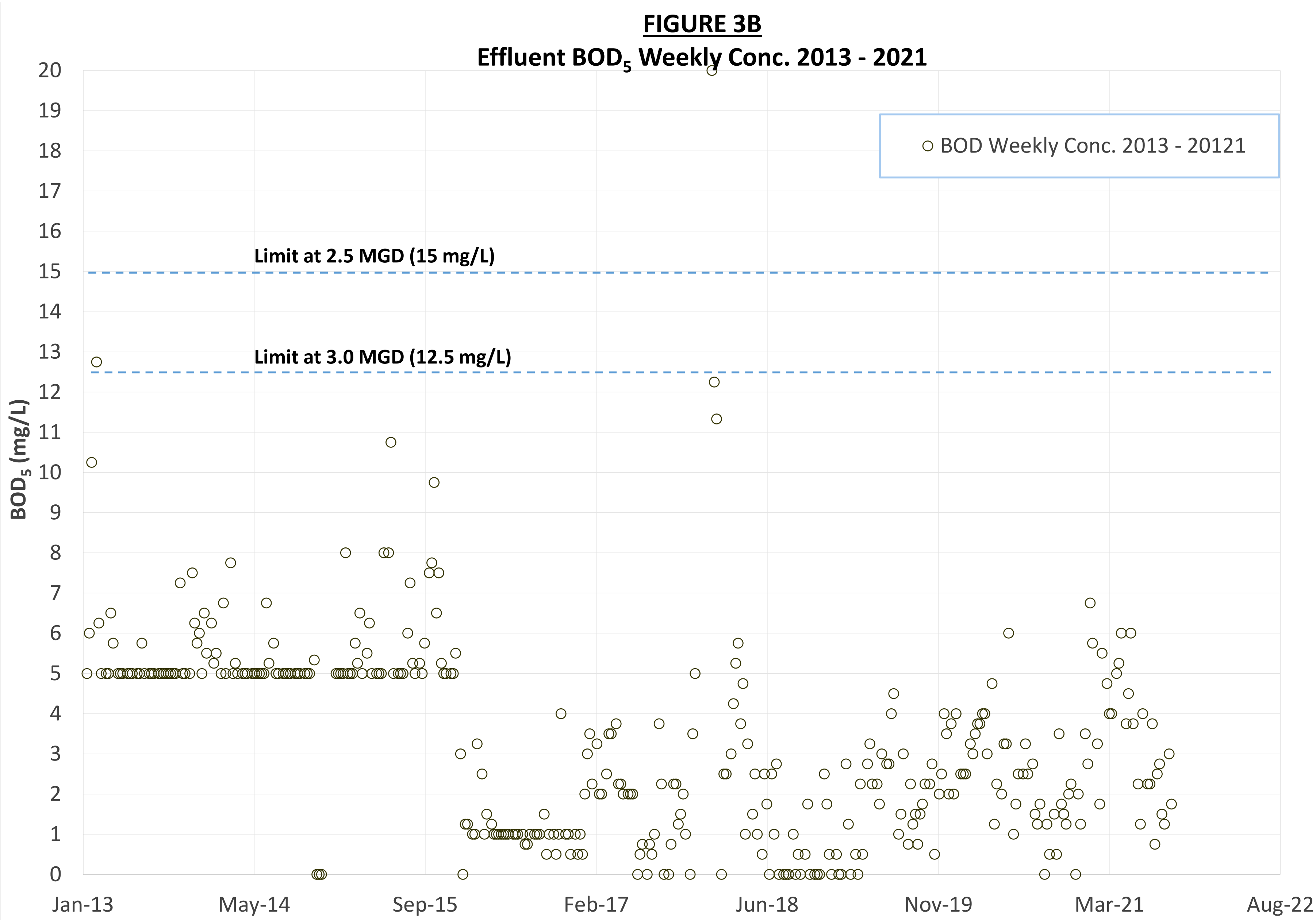


FIGURE 3B
Effluent BOD_5 Weekly Conc. 2013 - 2021
BOD Weekly Conc. 2013 - 20121
Limit at 2.5 MGD (15 mg/L)
Limit at 3.0 MGD (12.5 mg/L)
BOD_5 (mg/L)
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-13
May-14
Sep-15
Feb-17
Jun-18
Nov-19
Mar-21
Aug-22

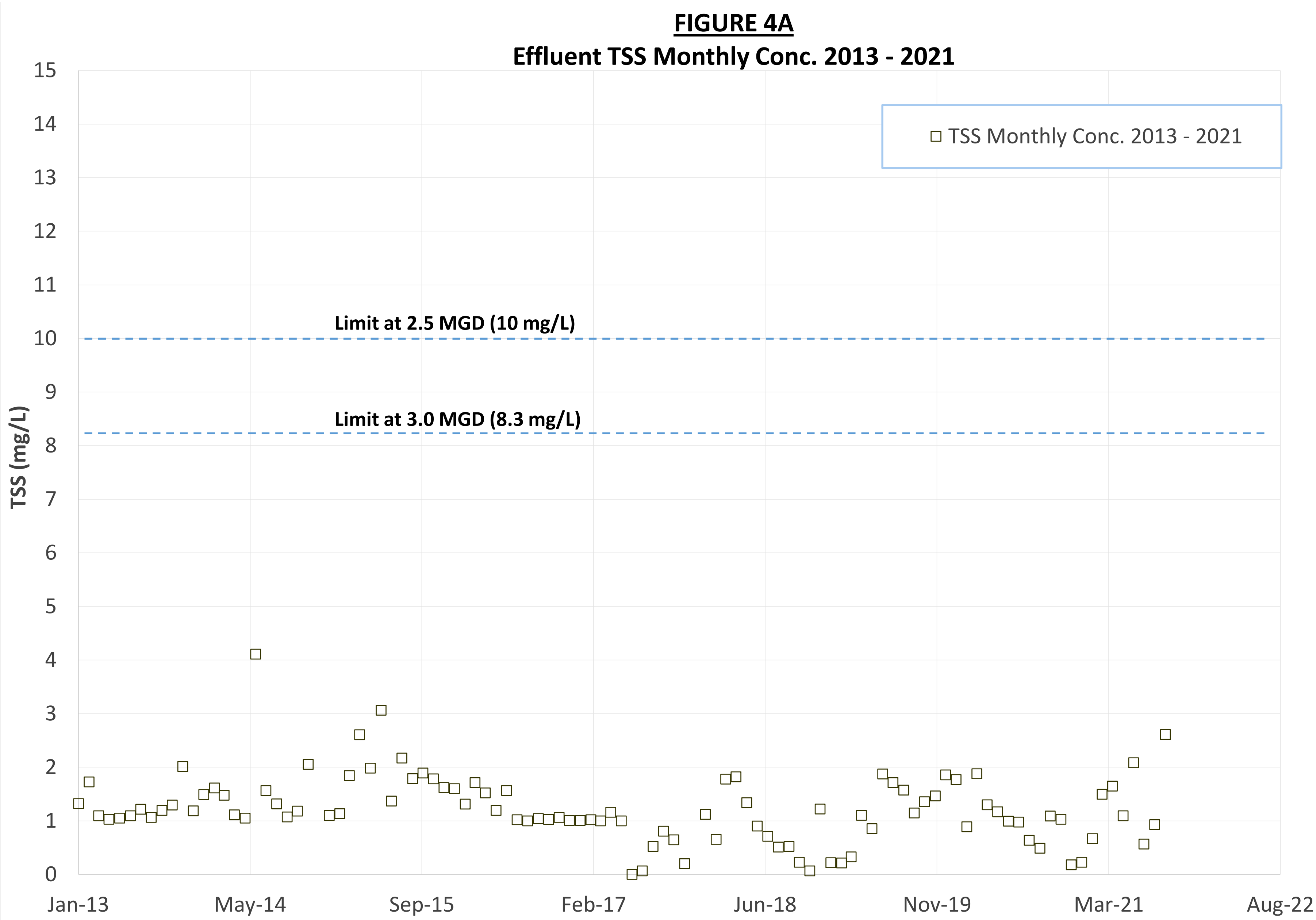
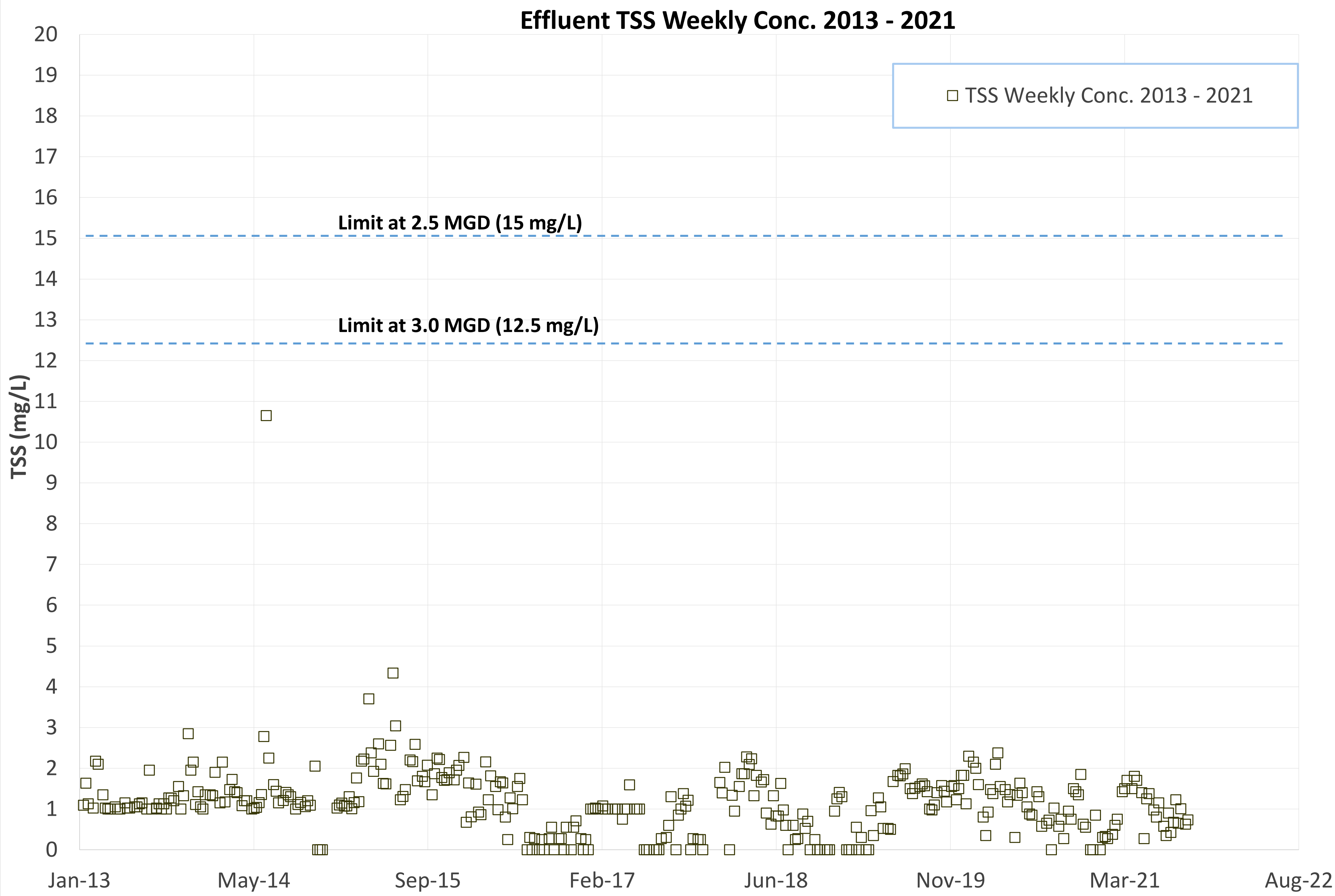


FIGURE 4A
Effluent TSS Monthly Conc. 2013 - 2021
TSS Monthly Conc. 2013 - 2021
Limit at 2.5 MGD (10 mg/L)
Limit at 3.0 MGD (8.3 mg/L)
TSS (mg/L)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-13
May-14
Sep-15
Feb-17
Jun-18
Nov-19
Mar-21
Aug-22

FIGURE 4B


Effluent TSS Weekly Conc. 2013 - 2021
TSS Weekly Conc. 2013 - 2021
Limit at 2.5 MGD (15 mg/L)
Limit at 3.0 MGD (12.5 mg/L)
TSS (mg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Jan-13
May-14
Sep-15
Feb-17
Jun-18
Nov-19
Mar-21
Aug-22

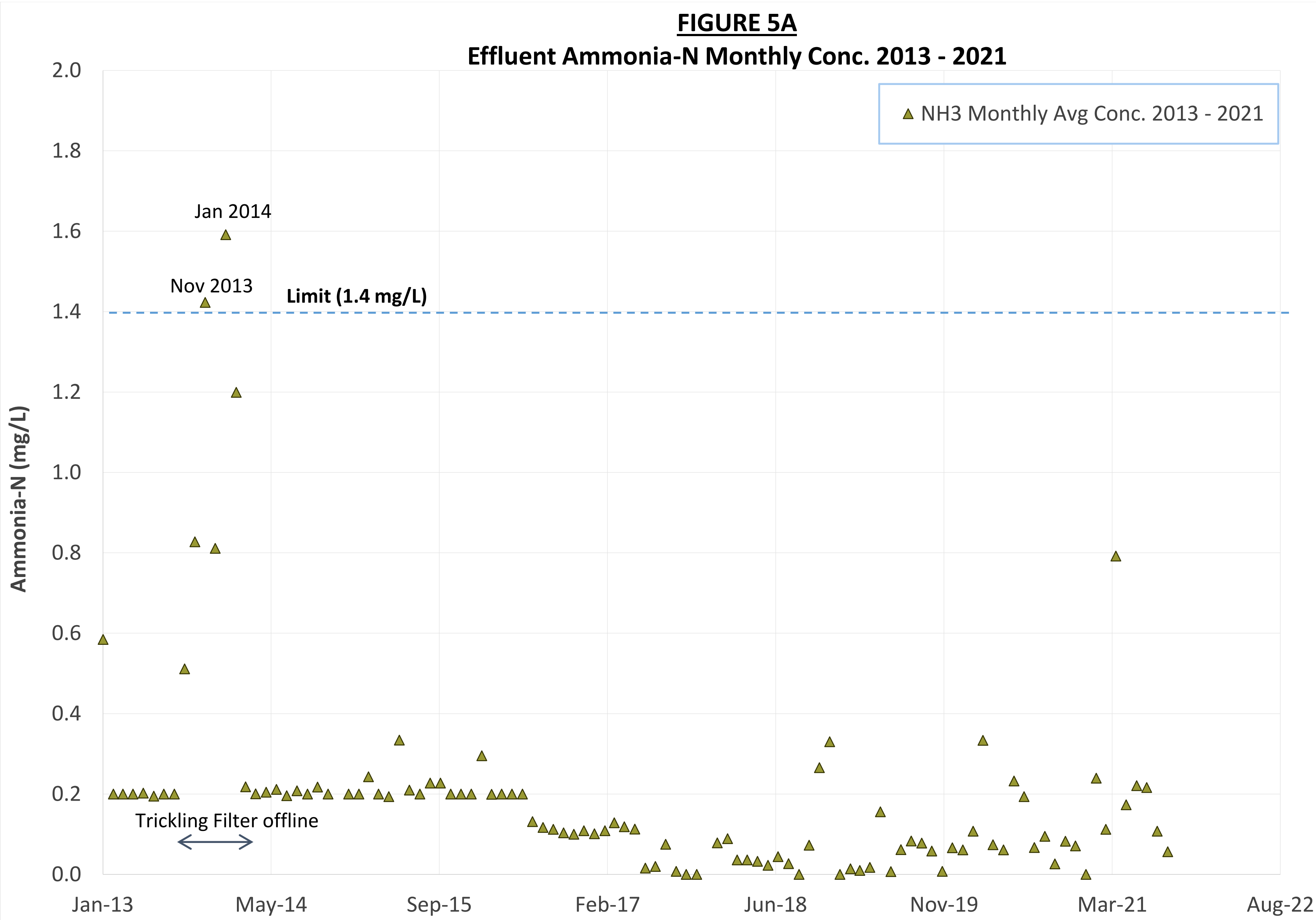


FIGURE 5A
Effluent Ammonia-N Monthly Conc. 2013 - 2021
NH3 Monthly Avg Conc. 2013 - 2021
Ammonia-N (mg/L)
Jan 2014
Nov 2013
Limit (1.4 mg/L)
Trickling Filter offline
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Jan-13
May-14
Sep-15
Feb-17
Jun-18
Nov-19
Mar-21
Aug-22

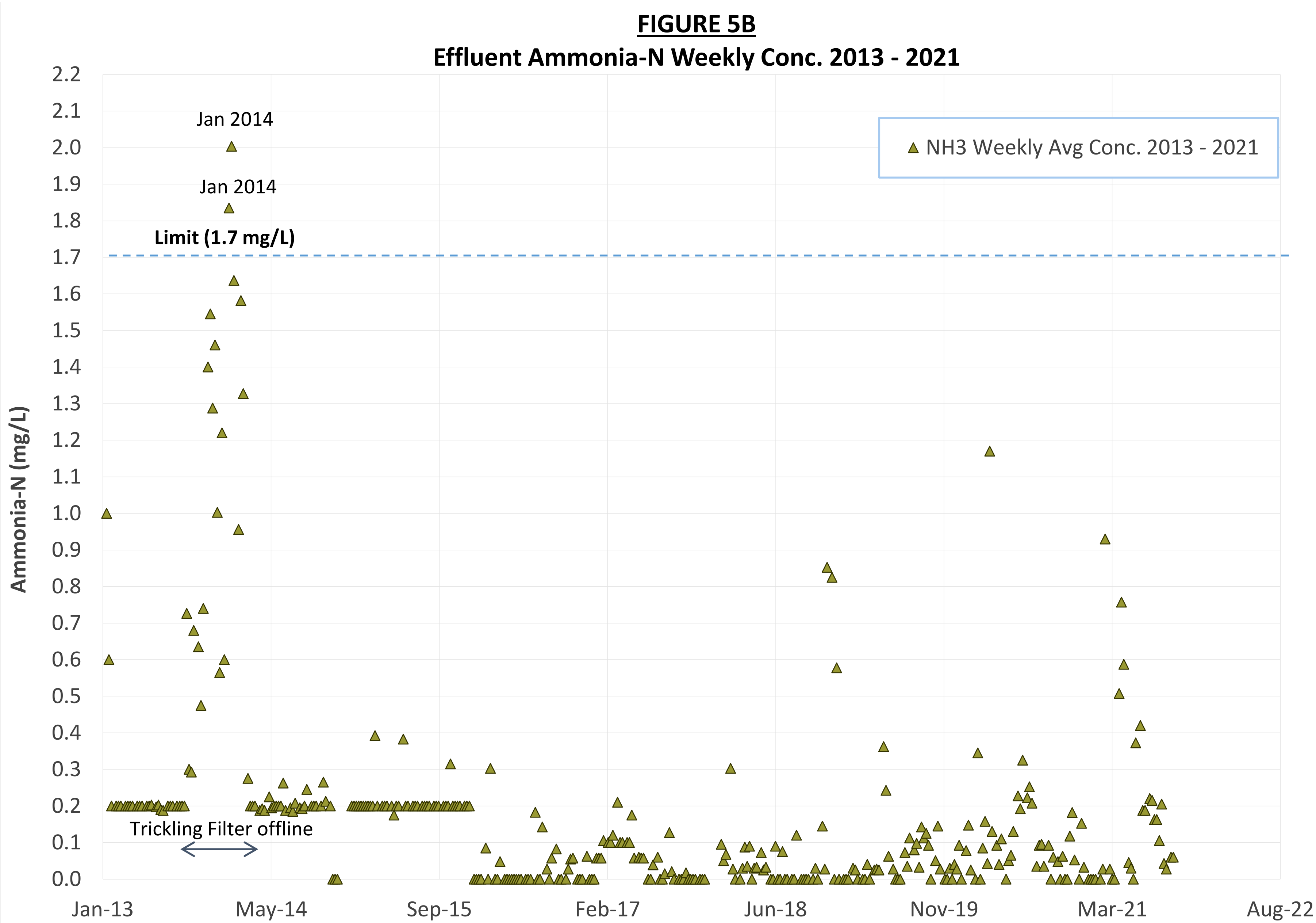


FIGURE 5B
Effluent Ammonia-N Weekly Conc. 2013 - 2021
Ammonia-N (mg/L)
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Jan 2014
Jan 2014
Limit (1.7 mg/L)
NH3 Weekly Avg Conc. 2013 - 2021
Trickling Filter offline
Jan-13
May-14
Sep-15
Feb-17
Jun-18
Nov-19
Mar-21
Aug-22

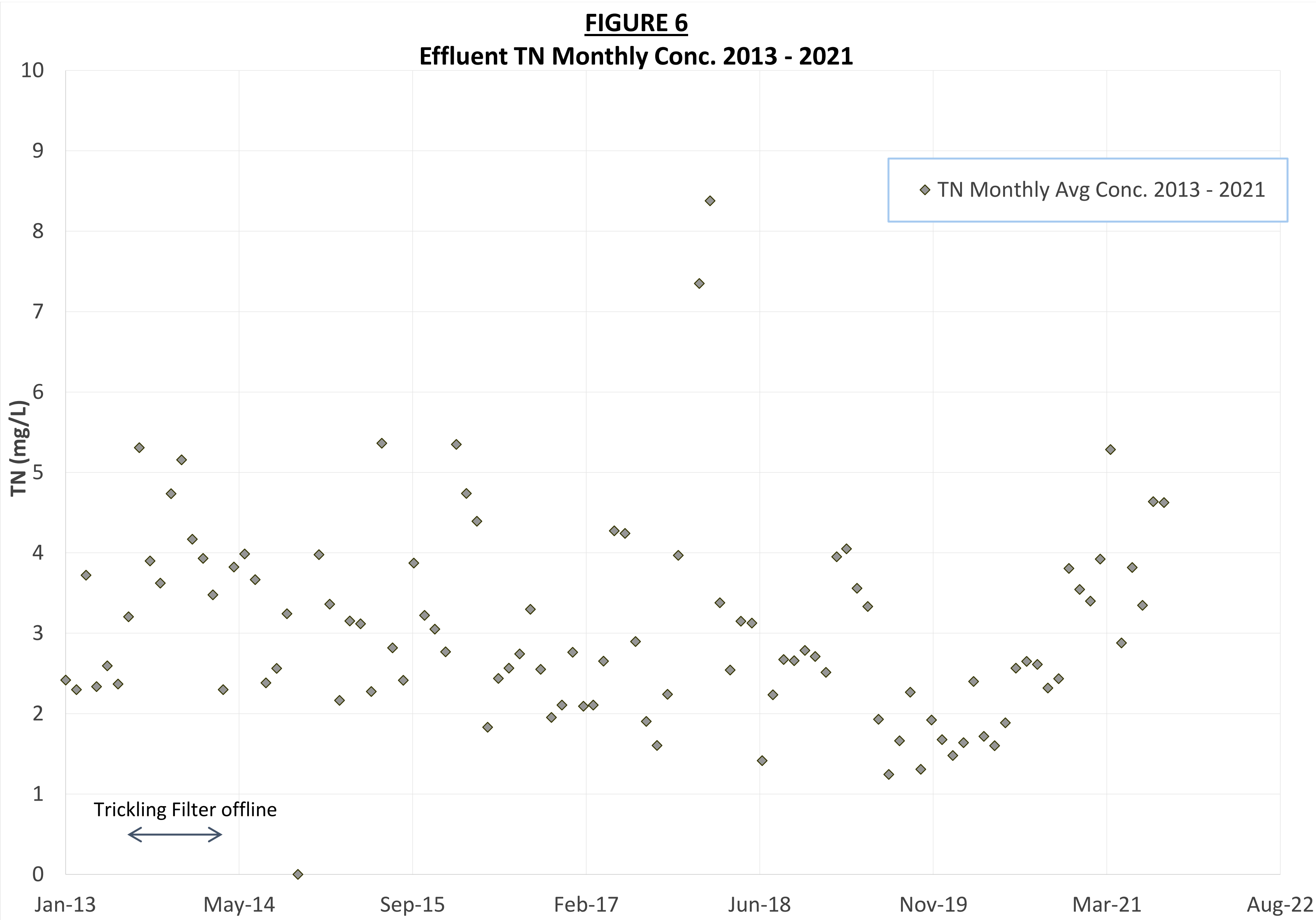


FIGURE 6
Effluent TN Monthly Conc. 2013 - 2021
TN (mg/L)
10
9
8
7
6
5
4
3
2
1
0
Jan-13
May-14
Sep-15
Feb-17
Jun-18
Nov-19
Mar-21
Aug-22
TN Monthly Avg Conc. 2013 - 2021
Trickling Filter offline

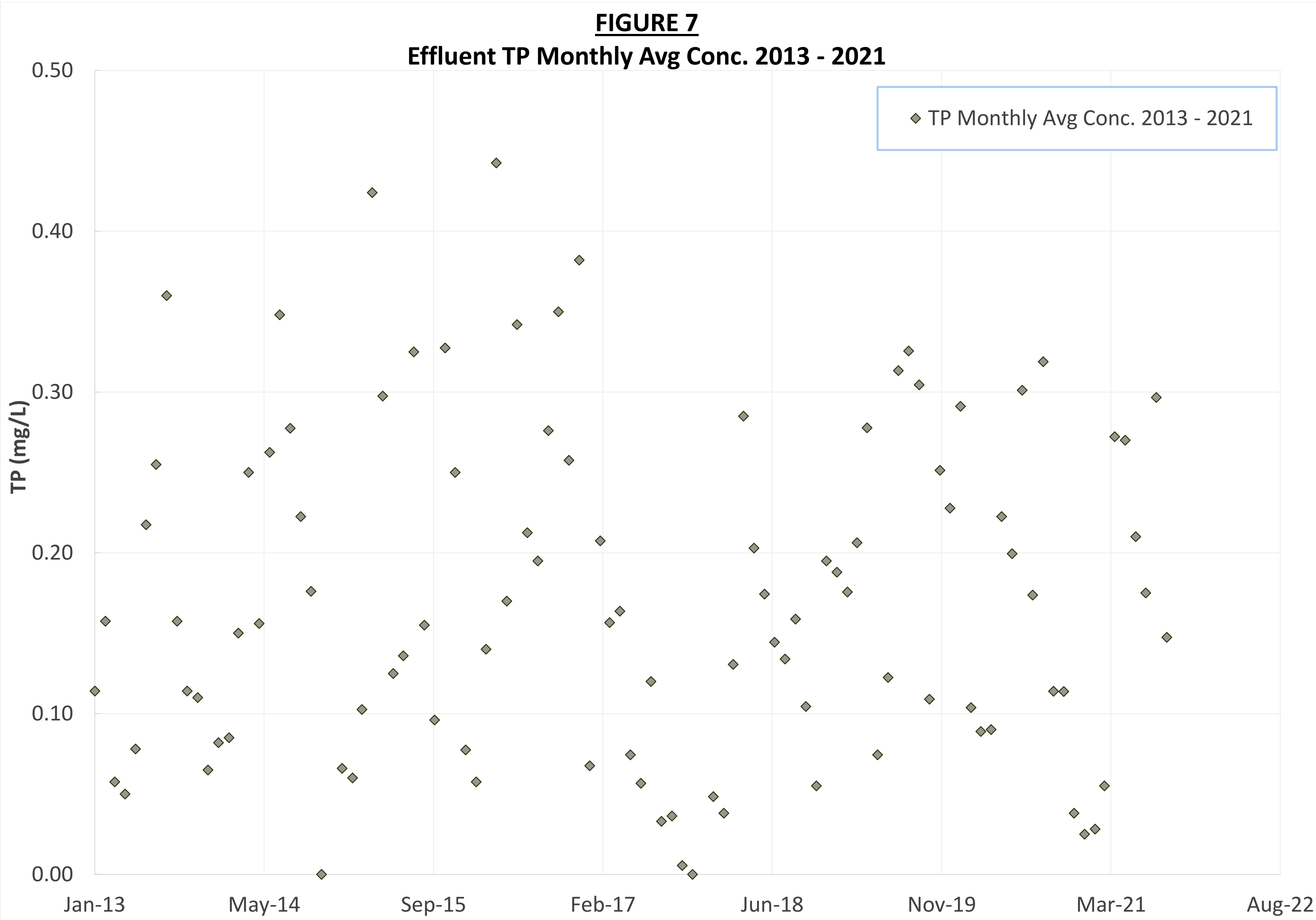


FIGURE 7
Effluent TP Monthly Avg Conc. 2013 - 2021
TP Monthly Avg Conc. 2013 - 2021
TP (mg/L)
0.50
0.40
0.30
0.20
0.10
0.00
Jan-13
May-14
Sep-15
Feb-17
Jun-18
Nov-19
Mar-21
Aug-22

Appendices

Appendix A

Plant NPDES Discharge Permit

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

NORTHERN REGIONAL OFFICE
13901 Crown Court, Woodbridge, Virginia 22193
(703) 583-3800
www.deq.virginia.gov

Molly Joseph Ward
Secretary of Natural Resources

David K. Paylor
Director

Thomas A. Faha
Regional Director

11 July 2016

CERTIFY RECEIPT REQUESTED

Via email at etucker@warrentonva.gov

Edward B. Tucker, Jr.
Director of Public Works and Utilities
Town of Warrenton
Post Office Drawer 341
Warrenton, VA 20188-0341

Re: Reissuance of VPDES Permit No. VA0021172
Town of Warrenton Wastewater Treatment Plant
Fauquier County

Dear Mr. Tucker:

The Department of Environmental Quality (DEQ) has approved the enclosed effluent limitations and monitoring requirements for the aforementioned permit. Copies of your permit and fact sheet are enclosed.

Discharge Monitoring Report (DMR) forms, excluding sludge DMRs, are no longer included in the reissuance package since you are enrolled in DEQ's electronic DMR (eDMR) program. The first electronic DMR submittal for the month of August is due by 10 September 2016. Please reference the effluent limits in your permit and report monitoring results in eDMR to the same number of significant digits as are included in the permit limits for the parameter.

The regional contact for eDMR is Rebecca Vice; she can be reached at 703-583-3922 or by email at Rebecca.Vice@deq.virginia.gov.

Please note that compliance with the permit's requirements for use and disposal of sewage sludge does not relieve you of your responsibility to comply with federal requirements set forth in 40 CFR Part 503. Until DEQ seeks and is granted authority to administer the Part 503 regulations by EPA, treatment works treating domestic sewage should continue to work directly with EPA to comply with them. For more information, you can call the EPA Region III office in Philadelphia at 215-814-5735.

Please note that if this permit is to be reissued in five years, there are specific testing requirements associated with the Form 2A reissuance application that are different from the testing requirements in your permit. In order to provide the necessary data for Form 2A you may need to begin additional sampling during the term of this permit prior to receiving a reissuance reminder letter from this agency. Please look at Form 2A Part D (Expanded Effluent Testing Data) and Part E (Toxicity Testing Data) for the sampling requirements. Please note that DEQ and EPA will no longer accept waiver requests from the sampling or testing requirements in the application forms.

As provided by Rule 2A:2 of the Supreme Court of Virginia, you have thirty days from the date of service (the date you actually received this decision or the date it was mailed to you, whichever occurred first) within which to appeal this decision by filing a notice of appeal in accordance with the Rules of the Supreme Court of Virginia with the Director, Department of Environmental Quality. In the event that this decision is served on you by mail, three days are added to that period.

Alternately, any owner under §§ 62.1-44.16, 62.1-44.17, and 62.1-44.19 of the State Water Control Law aggrieved by any action of the State Water Control Board taken without a formal hearing, or by inaction of the Board, may demand in writing a formal hearing of such owner's grievance, provided a petition requesting such hearing is filed with the Board. Said petition must meet the requirements set forth in §1.23(b) of the Board's Procedural Rule No. 1. In cases involving actions of the Board, such petition must be filed within thirty days after notice of such action is mailed to such owner by certified mail.

A Reliability Class I is assigned to this facility and this facility has Class I licensed operator requirements.

Please contact Douglas Frasier at 703-583-3873 or via email at Douglas.Frasier@deq.virginia.gov should you have any questions concerning the permit.

Respectfully,

Thomas A. Faha

for Bryant Thomas
Regional Water Permits & Planning Manager

Enc.: Permit for VA0021172
Fact Sheet for VA0021172

cc: DEQ-Water, OWPP
EPA-Region III, 3WP12
Department of Health, Culpeper
Water Compliance, NRO
Allen Chichester, Wastewater Superintendent via achichester@warrentonva.gov

Municipal Major 07/05/2016

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM(NPDES)
DISCHARGE MONITORING REPORT(DMR)

PERMITTEE NAME/ADDRESS(INCLUDE FACILITY NAME/LOCATION IF DIFFERENT)

NAME Warrenton Town Sewage Treatment Plant
ADDRESS Town of Warrenton
Warrenton VA 20186
FACILITY LOCATION 731 Frost Ave

VA0021172	801
PERMIT NUMBER	DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM				TO			

DEPT. OF ENVIRONMENTAL QUALITY (REGIONAL OFFICE)
Northern Regional Office
13901 Crown Court
Woodbridge VA 22193

NOTE: READ PERMIT AND GENERAL INSTRUCTIONS BEFORE COMPLETING THIS FORM.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX.	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
672 SOLIDS, TOTAL, SLUDGE AS PERCENT	REPORTD	*********	*********		*********						
	REQRMNT	*********	*********		*********	NL	NA	%		1/3M	COMP
680 ARSENIC, SLUDGE	REPORTD	*********	*********		*********						
	REQRMNT	*********	*********		*********	41	75	MG/KG		1/3M	COMP
681 MOLYBDENUM, SLUDGE	REPORTD	*********	*********		*********						
	REQRMNT	*********	*********		*********	NL	75	MG/KG		1/3M	COMP
682 ZINC, SLUDGE	REPORTD	*********	*********		*********						
	REQRMNT	*********	*********		*********	2800	7500	MG/KG		1/3M	COMP
683 LEAD, SLUDGE	REPORTD	*********	*********		*********						
	REQRMNT	*********	*********		*********	300	840	MG/KG		1/3M	COMP
684 NICKEL, SLUDGE	REPORTD	*********	*********		*********						
	REQRMNT	*********	*********		*********	420	420	MG/KG		1/3M	COMP
685 MERCURY, SLUDGE	REPORTD	*********	*********		*********						
	REQRMNT	*********	*********		*********	17	57	MG/KG		1/3M	COMP
686 COPPER, SLUDGE	REPORTD	*********	*********		*********						
	REQRMNT	*********	*********		*********	1500	4300	MG/KG		1/3M	COMP

ADDITIONAL PERMIT REQUIREMENTS OR COMMENTS

BYPASSES AND OVERFLOWS	TOTAL OCCURRENCES	TOTAL FLOW(M.G.)	TOTAL BOD5(K.G.)

I CERTIFY UNDER PENALTY OF LAW THAT THIS DOCUMENT AND ALL ATTACHMENTS WERE PREPARED UNDER MY DIRECTION OR SUPERVISION IN ACCORDANCE WITH A SYSTEM DESIGNED TO ASSURE THAT QUALIFIED PERSONNEL PROPERLY GATHER AND EVALUATE THE INFORMATION SUBMITTED. BASED ON MY INQUIRY OF THE PERSON OR PERSONS WHO MANAGE THE SYSTEM OR THOSE PERSONS DIRECTLY RESPONSIBLE FOR GATHERING THE INFORMATION, THE INFORMATION SUBMITTED IS TO THE BEST OF MY KNOWLEDGE AND BELIEF TRUE, ACCURATE AND COMPLETE. I AM AWARE THAT THERE ARE SIGNIFICANT PENALTIES FOR SUBMITTING FALSE INFORMATION, INCLUDING THE POSSIBILITY OF FINE AND IMPRISONMENT FOR KNOWING VIOLATIONS.

OPERATOR IN RESPONSIBLE CHARGE			DATE		
TYPED OR PRINTED NAME	SIGNATURE	CERTIFICATE NO.	YEAR	MO.	DAY
PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		TELEPHONE			
TYPED OR PRINTED NAME	SIGNATURE		YEAR	MO.	DAY

Municipal Major 07/05/2016

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM(NPDES)
DISCHARGE MONITORING REPORT(DMR)

PERMITTEE NAME/ADDRESS(INCLUDE FACILITY NAME/LOCATION IF DIFFERENT)

NAME Warrenton Town Sewage Treatment Plant
ADDRESS Town of Warrenton
Warrenton VA 20186

FACILITY LOCATION 731 Frost Ave

VA0021172	S01
PERMIT NUMBER	DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM				TO			

DEPT. OF ENVIRONMENTAL QUALITY (REGIONAL OFFICE)
Northern Regional Office
13901 Crown Court
Woodbridge VA 22193

NOTE: READ PERMIT AND GENERAL INSTRUCTIONS BEFORE COMPLETING THIS FORM.

PARAMETER		QUANTITY OR LOADING AVERAGE	QUANTITY OR LOADING MAXIMUM	UNITS	QUALITY OR CONCENTRATION MINIMUM	QUALITY OR CONCENTRATION AVERAGE	QUALITY OR CONCENTRATION MAXIMUM	UNITS	NO. EX.	FREQUENCY OF ANALYSIS	SAMPLE TYPE
687 CADMIUM, SLUDGE	REPORTD	*********	*********		*********						
	REQRMNT	*********	*********		*********	39	85	MG/KG		1/3M	COMP
688 LEVEL OF PATHOGEN REQUIREMENTS ACHIEVED	REPORTD	*********	*********		*********	*********					
	REQRMNT	*********	*********		*********	*********	NL	STCL#		1/3M	COMP
689 DESCRIPTION OF PATHOGEN OPTION USED	REPORTD	*********	*********		*********	*********					
	REQRMNT	*********	*********		*********	*********	NL	ALTR#		1/3M	COMP
690 VECTOR ATTRACTION REDUCTION OPTION USED	REPORTD	*********	*********		*********	*********					
	REQRMNT	*********	*********		*********	*********	NL	ALTR#		1/3M	COMP
597 SELENIUM, SLUDGE	REPORTD	*********	*********		*********						
	REQRMNT	*********	*********		*********	100	100	MG/KG		1/3M	COMP
	REPORTD									*******	
	REQRMNT										
	REPORTD									*******	
	REQRMNT										
	REPORTD									*******	
	REQRMNT										

ADDITIONAL PERMIT REQUIREMENTS OR COMMENTS

BYPASSES AND OVERFLOWS	TOTAL OCCURRENCES	TOTAL FLOW(M.G.)	TOTAL BOD5(K.G.)

OPERATOR IN RESPONSIBLE CHARGE

TYPED OR PRINTED NAME	SIGNATURE	CERTIFICATE NO.	DATE YEAR	MO.	DAY

PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TYPED OR PRINTED NAME	SIGNATURE	TELEPHONE	YEAR	MO.	DAY

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PERMITTEE NAME/ADDRESS(INCLUDE FACILITY NAME/LOCATION IF DIFFERENT)

NAME Warrenton Town Sewage Treatment Plant
ADDRESS Town of Warrenton
Warrenton VA 20186

FACILITY LOCATION 731 Frost Ave

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM(NPDES)
DISCHARGE MONITORING REPORT(DMR)

VA0021172	SP1
PERMIT NUMBER	DISCHARGE NUMBER

MONITORING PERIOD

	YEAR	MO	DAY		YEAR	MO	DAY
FROM				TO			

Municipal Major 07/05/2016

DEPT. OF ENVIRONMENTAL QUALITY (REGIONAL OFFICE)

Northern Regional Office
13901 Crown Court

Woodbridge VA 22193

NOTE: READ PERMIT AND GENERAL INSTRUCTIONS BEFORE COMPLETING THIS FORM.

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX.	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		AVERAGE	MAXIMUM	UNITS	MINIMUM	AVERAGE	MAXIMUM	UNITS			
691 ANNUAL AMT SLUDGE DISPOSED BY OTHER MTHD	REPORTD	*********			*********	*********	*********				
	REQRMNT	*********	NL	MTNYR	*********	*********	*********			1/3M	CALC
692 ANNUAL AMT SLUDGE INCINERATED	REPORTD	*********			*********	*********	*********				
	REQRMNT	*********	NL	MTNYR	*********	*********	*********			1/3M	CALC
693 ANNUAL SLUDGE PRODUCTION TOTAL	REPORTD	*********			*********	*********	*********				
	REQRMNT	*********	NL	MTNYR	*********	*********	*********			1/3M	CALC
694 ANNUAL AMT SLUDGE LAND APPLIED	REPORTD	*********			*********	*********	*********				
	REQRMNT	*********	NL	MTNYR	*********	*********	*********			1/3M	CALC
696 ANNUAL AMT SLUDGE DISPOSED IN LANDFILL	REPORTD	*********			*********	*********	*********				
	REQRMNT	*********	NL	MTNYR	*********	*********	*********			1/3M	CALC
	REPORTD										
	REQRMNT									*******	
	REPORTD										
	REQRMNT									*******	
	REPORTD										
	REQRMNT									*******	

ADDITIONAL PERMIT REQUIREMENTS OR COMMENTS

BYPASSES AND OVERFLOWS	TOTAL OCCURRENCES	TOTAL FLOW(M.G.)	TOTAL BOD5(K.G.)

I CERTIFY UNDER PENALTY OF LAW THAT THIS DOCUMENT AND ALL ATTACHMENTS WERE PREPARED UNDER MY DIRECTION OR SUPERVISION IN ACCORDANCE WITH A SYSTEM DESIGNED TO ASSURE THAT QUALIFIED PERSONNEL PROPERLY GATHER AND EVALUATE THE INFORMATION SUBMITTED. BASED ON MY INQUIRY OF THE PERSON OR PERSONS WHO MANAGE THE SYSTEM OR THOSE PERSONS DIRECTLY RESPONSIBLE FOR GATHERING THE INFORMATION, THE INFORMATION SUBMITTED IS TO THE BEST OF MY KNOWLEDGE AND BELIEF TRUE, ACCURATE AND COMPLETE. I AM AWARE THAT THERE ARE SIGNIFICANT PENALTIES FOR SUBMITTING FALSE INFORMATION, INCLUDING THE POSSIBILITY OF FINE AND IMPRISONMENT FOR KNOWING VIOLATIONS.

OPERATOR IN RESPONSIBLE CHARGE			DATE		
TYPED OR PRINTED NAME	SIGNATURE	CERTIFICATE NO.	YEAR	MO.	DAY
PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT		TELEPHONE			
TYPED OR PRINTED NAME	SIGNATURE		YEAR	MO.	DAY

This report is required by your VPDES permit and by law. (See, e.g., the Code of Virginia of 1950 §62.1-44.5 and 9 VAC 25-31-50.) Failure to report or failure to report truthfully can result in civil penalties of $32,500 per violation, per day and felony prosecutions which can carry a 15 year term.

DISCHARGE MONITORING REPORT (DMR) - GENERAL INSTRUCTIONS

1. Complete this form in permanent ink or indelible pencil. The use of 'correction fluid/tape' is not allowed.
2. Be sure to enter the dates for the first and last day of the period covered by the report on the form in the space marked "Monitoring Period".
3. For those parameters where the "permit requirement" spaces have a requirement or limitation, provide data in the "reported" spaces in accordance with your permit.
4. Enter the average and maximum quantities and units in the "reported" spaces in the columns marked "Quantity or Loading".
   KG/DAY = Concentration (mg/L) x Flow (MGD) x 3.785 G/D (Grams/Day) = Concentration (mg/L) x Flow (MGD) x 3785
5. Enter maximum, minimum, and/or average concentrations and units in the "reported" spaces in the columns marked "Quality or Concentration".
6. For all parameters enter the number of samples which do not comply with the maximum and/or minimum permit requirements in the "reported" space in the column marked "No. Ex." (Number of Exceedances). If none, enter "0". Do NOT include monthly average violations in this field. Include any Maximum 7-Day Average and Maximum Weekly Average violations in this field. Permittees with continuous pH, or temperature monitoring requirements should consult the permit for what constitutes an exceedance and report accordingly.
7. You are required to sample (at a minimum) according to the Sample Frequencies and Sample Types specified in your permit.
8. Enter the actual frequency of analysis for each parameter (number of times per day, week, month, etc.) in the "reported" space in the column marked "Frequency of Analysis".
9. Enter the actual type of sample (Grab, 8HC, 24HC, etc) collected for each parameter in the "reported" space in the column marked "Sample Type".
10. Enter additional required data or comments in the space marked "additional permit requirements or comments". If additional required data or comments are appended to the DMR, reference appended correspondence in this field.
11. Record the number of bypasses during the month, the total flow in million gallons (MG) and BOD5 in kilograms (KG) in the proper columns in the section marked "Bypasses and Overflows".
12. The operator in responsible charge of the facility should review the form and sign in the space provided. If the plant is required to have a licensed operator or if the operator in responsible charge of the facility is a licensed operator, the operator's signature and certificate number must be reported in the spaces provided.
13. The principal executive officer then reviews the form and must sign in the space provided and provide a telephone number where he/she can be reached. Every page of the DMR must have an original signature.
14. Send the completed form(s) with original signatures to your Department of Environmental Quality Regional Office by the 10th of each month unless otherwise specified in the permit.
15. You are required to retain a copy of the report for your records.
16. Where violations of permit requirements are reported, attach a brief explanation in accordance with the permit requirements describing causes and corrective actions taken. Reference each separate violation by date.
17. If you have any questions, contact the Department of Environmental Quality Regional Office listed on the DMR.

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

Permit No.	**VA0021172**
Effective Date:	**August 1, 2016**
Expiration Date:	**July 31, 2021**

AUTHORIZATION TO DISCHARGE UNDER THE VIRGINIA POLLUTANT DISCHARGE ELIMINATION SYSTEM AND THE VIRGINIA STATE WATER CONTROL LAW

In compliance with the provisions of the Clean Water Act as amended and pursuant to the State Water Control Law and regulations adopted pursuant thereto, the following owner is authorized to discharge in accordance with the information submitted with the permit application, and with this permit cover page, Part I – Effluent Limitations and Monitoring Requirements, Part II – Conditions Applicable To All VPDES Permits and Part III – Biosolids Conditions and Requirements, as set forth herein.

Owner Name:	Town of Warrenton
Facility Name:	Town of Warrenton Wastewater Treatment Plant
County:	Fauquier
Facility Location:	731 Frost Avenue, Warrenton, VA 20186

The owner is authorized to discharge to the following receiving stream:

Stream Name:	Great Run, UT
River Basin:	Rappahannock River
River Subbasin:	None
Section:	4
Class:	III
Special Standards:	None

Thomas A. Faha
Director, Northern Regional Office
Department of Environmental Quality

July 11, 2016
Date

A. Effluent Limitations and Monitoring Requirements

Outfall 001 – 2.5 MGD Facility

1. There shall be no discharge of floating solids or visible foam in other than trace amounts.
2. This facility has Total Nitrogen and Total Phosphorus calendar year load limits associated with this outfall included in the current Registration List under registration number VAN020028, enforceable under the General VPDES Watershed Permit Regulation for Total Nitrogen and Total Phosphorus Dischargers and Nutrient Trading in the Chesapeake Watershed in Virginia.
3. During the period beginning with the permit's effective date and lasting until the expiration date, the permittee is authorized to discharge from Outfall Number 001. Such discharges shall be limited and monitored by the permittee as specified below.

Parameter	Discharge Limitations						Monitoring Requirements	
	Monthly Average (1)		Weekly Average (1)		Minimum	Maximum (1)	Frequency	Sample Type
Flow (2) (MGD)	NL		NA		NA	NL	Continuous	TIRE
pH	NA		NA		6.0 S.U.	9.0 S.U.	1/D	Grab
Biochemical Oxygen Demand (BOD_5) (3)	10 mg/L	95 kg/day	15 mg/L	140 kg/day	NA	NA	4D/W (9)	24H-C
Total Suspended Solids (TSS) (3) (4)	10 mg/L	95 kg/day	15 mg/L	140 kg/day	NA	NA	4D/W (9)	24H-C
Dissolved Oxygen	NA		NA		6.5 mg/L	NA	1/D	Grab
Total Kjeldahl Nitrogen (TKN)	NL mg/L		NL mg/L		NA	NA	1/W	24H-C
Ammonia, as N	1.4 mg/L		1.7 mg/L		NA	NA	4D/W (9)	24H-C
E. coli (Geometric Mean) (5)	126 n/100 mL		NA		NA	NA	1/D	Grab
$NO_2 + NO_3$ as Nitrogen	NL mg/L		NA		NA	NA	1/W	24H-C
Total Nitrogen (6)	NL mg/L		NA		NA	NA	1/W	Calculated
Total Nitrogen – Year to Date (7)	NL mg/L		NA		NA	NA	1/M	Calculated
Total Nitrogen – Calendar Year (7)	4.0 mg/L		NA		NA	NA	1/YR	Calculated
Total Phosphorus	NL mg/L		NA		NA	NA	1/W	24H-C
Total Phosphorus – Year to Date (7)	NL mg/L		NA		NA	NA	1/M	Calculated
Total Phosphorus – Calendar Year (7)	0.3 mg/L		NA		NA	NA	1/YR	Calculated
Chronic Toxicity – *C. dubia* (8)	NA		NA		NA	NL TU_c	1/YR	24H-C
Chronic Toxicity – *P. promelas* (8)	NA		NA		NA	NL TU_c	1/YR	24H-C

(1) See Part I.B.
(2) The design flow is 2.5 MGD.
(3) At least 85% removal for BOD_5 and TSS shall be attained.
(4) TSS shall be expressed as two significant figures.
(5) Between 10 AM and 4 PM.
(6) Total Nitrogen is the sum of Total Kjeldahl Nitrogen and NO_2+NO_3 Nitrogen and shall be calculated from the results of those tests.
(7) See Part I.B.3. for nutrient reporting calculations.
(8) See Part I.D. for toxicity monitoring requirements.
(9) See Part I.E.10.

MGD = Million gallons per day.
NA = Not applicable.
NL = No limit; monitor and report.
S.U. = Standard units.
TIRE = Totalizing, indicating and recording equipment.

1/D = Once every day.
4D/W = Four days per week.
1/W = Once per week.
1/M = Once every month.
1/YR = Once every calendar year.

24H-C = A flow proportional composite sample collected manually or automatically, and discretely or continuously, for the entire discharge of the monitored 24-hour period. Where discrete sampling is employed, the permittee shall collect a minimum of twenty-four (24) aliquots for compositing. Discrete sampling may be flow proportioned either by varying the time interval between each aliquot or the volume of each aliquot. Time composite samples consisting of a minimum of twenty-four (24) grab samples obtained at hourly or smaller intervals may be collected where the permittee demonstrates that the discharge flow rate (gallons per minute) does not vary by 10% or more during the monitored discharge.

Grab = An individual sample collected over a period of time not to exceed 15-minutes.

B. Quantification Levels and Compliance Reporting

1. Quantification Levels

a. The quantification levels (QL) shall be less than or equal to the following concentrations:

Characteristic	Quantification Level
Total Suspended Solids (TSS)	1.0 mg/L
Biochemical Oxygen Demand-5 day (BOD_5)	2 mg/L
Ammonia, as N	0.20 mg/L
Total Kjeldahl Nitrogen (TKN)	0.50 mg/L

b. The QL is defined as the lowest concentration used to calibrate a measurement system in accordance with the procedures published for the method. It is the responsibility of the permittee to ensure that proper quality assurance/quality control (QA/QC) protocols are followed during the sampling and analytical procedures. QA/QC information shall be documented to confirm that appropriate analytical procedures have been used and the required QLs have been attained. The permittee shall use any method in accordance with Part II.A of this permit.

2. Compliance Reporting for Parameters in Part I.A.

a. Monthly Average – Compliance with the monthly average limitations and/or reporting requirements for the parameters listed in Part I.B.1.a. of this permit condition shall be determined as follows: All concentration data below the QL used for the analysis (QL must be less than or equal to the QL listed in Part I.B.1.a above) shall be treated as zero. All concentration data equal to or above the QL used for the analysis shall be treated as it is reported. An arithmetic average shall be calculated using all reported data for the month, including the defined zeros. This arithmetic average shall be reported on the Discharge Monitoring Report (DMR) as calculated. If all data are below the QL used for the analysis, then the average shall be reported as "< QL". If reporting for quantity is required on the DMR and the reported monthly average concentration is < QL, then report "< QL" for the quantity. Otherwise, use the reported concentration data (including the defined zeros) and flow data for each sample day to determine the daily quantity and report the monthly average of the calculated daily quantities.

b. Weekly Average – Compliance with the weekly average limitations and/or reporting requirements for the parameters listed in Part I.B.1.a. of this permit condition shall be determined as follows: All concentration data below the QL used for the analysis (QL must be less than or equal to the QL listed in Part I.B.1.a. above) shall be treated as zero. All concentration data equal to or above the QL used for the analysis shall be treated as reported. An arithmetic average shall be calculated using all reported data, including the defined zeros, collected within each complete calendar week and entirely contained within the reporting month. The maximum value of the weekly averages thus determined shall be reported on the DMR. If all data are below the QL used for the analysis, then the weekly average shall be reported as "< QL". If reporting for quantity is required on the DMR and the reported weekly average concentration is < QL, then report "< QL" for the quantity. Otherwise use the reported concentration data (including the defined zeros) and flow data for each sample day to determine the daily quantity and report the maximum weekly average of the calculated daily quantities.

c. Single Datum – Any single datum required shall be reported as "< QL" if it is less than the QL used in the analysis (QL must be less than or equal to the QL listed in Part I.B.1.a above). Otherwise the numerical value shall be reported.

d. Significant Digits – The permittee shall report at least the same number of significant digits as the permit limit for a given parameter. Regardless of the rounding convention used by the permittee (i.e. 5 always rounding up or to the nearest even number), the permittee shall use the convention consistently and shall ensure that consulting laboratories employed by the permittee use the same convention.

(Remainder of page intentionally left blank)

3. Nutrient Reporting Calculations for Part I.A.

a. For each calendar month, the DMR shall show the calendar year-to-date average concentration (mg/L) calculated in accordance with the following formulae:

$MC_{avg}\text{-YTD} = (\Sigma_{(Jan\text{-}current\ month)} MC_{avg}) \div (\#\ of\ months)$

where: MC_{avg}-YTD = calendar year-to-date average concentration (mg/L)
MC_{avg} = monthly average concentration (mg/L) as reported on DMR

b. The total nitrogen and phosphorus average concentrations (mg/L) for each calendar year (AC) shall be shown on the December DMR due January 10th of the following year. These values shall be calculated in accordance with the following formulae:

$AC_{avg} = (\Sigma_{(Jan\text{-}Dec)} MC_{avg}) \div 12$

where: AC_{avg} = calendar year average concentration (mg/L)
MC_{avg} = monthly average concentration (mg/L) as reported on DMR

c. For total phosphorus, all daily concentration data below the quantification level (QL) for the analytical method used should be treated as half the QL. All daily concentration data equal to or above the QL for the analytical method used shall be treated as it is reported.

d. For total nitrogen (TN), if none of the daily concentration data for the respective species (i.e. TKN, Nitrates/Nitrites) are equal to or above the QL for the respective analytical methods used, the daily TN concentration value reported shall equal one half of the largest QL used for the respective species. If one of the data is equal to or above the QL, the daily TN concentration value shall be treated as that data point is reported. If more than one of the data is above the QL, the daily TN concentration value shall equal the sum of the data points as reported.

C. Pretreatment Requirements

Within 180 days of the effective date of this permit, the permittee shall submit written verification to the Department of Environmental Quality, Northern Regional Office (DEQ-NRO) that the Industrial User Survey (IU Survey) is current and no potential significant industrial users (SIUs) discharge to the POTW.

1. If potential SIUs are not identified, the permittee is not required to implement a pretreatment program. The requirements for program development described below may be suspended by the DEQ.

2. If Categorical Industrial User(s) (CIUs) are identified, or if the permittee or DEQ determines that any IU has potential to adversely affect the operation of the POTW or cause violation(s) of federal, state, or local standards or requirements, the permittee shall develop and submit to DEQ-NRO within one year of written notification by DEQ a pretreatment program for approval. The program shall enable the permittee to control by permit the SIUs discharging wastewater to the treatment works.

3. The approvable pretreatment program submission shall at a minimum contain the following parts:

   a. The legal authority;

   b. Program procedures;

   c. Funding and resources;

   d. A local limits evaluation and local limits if needed;

   e. An Enforcement Response Plan, and

f. A list of SIUs.

A SIU is defined as an IU that:

1) Has an average flow of 25,000 gallons or more per day of process wastewater to exclude sanitary, non-contact cooling water and boiler blowdown;

2) Contributes a process wastestream which makes up 5.0% or more of the average dry weather hydraulic or organic capacity of the POTW;

3) Is subject to the categorical pretreatment standards; or

4) Has significant impact, either singularly or in combination with other significant dischargers, on the treatment works or the quality of its effluent.

4. Where the permittee is required to develop a pretreatment program, they shall submit to DEQ-NRO an annual report no later than January 31 of each year that includes:

a. An updated list of the SIUs noting all of the following:

1) Facility address, phone and contact name;

2) An explanation regarding SIUs deleted from the previous year's list;

3) Identification of IUs subject to Categorical Standards and notation of application standard (e.g., metal finishing);

4) Specification of applicable 40 CFR Part(s);

5) Indication of IUs subject to local standards that are more stringent than Categorical Pretreatment Standards;

6) Indication of IUs subject only to local requirements

7) Identification of IUs subject to Categorical Pretreatment Standards that are also subject to reduced reporting requirements under 9VAC25-31-840 E.3.; and

8) Identification of IUs that are non-significant CIUs.

b. A summary of the compliance status of each SIU with pretreatment standards and permit requirements;

c. A summary of the number and types of SIU sampling and inspections performed by the POTW;

d. All information concerning any interference, upset, VPDES permit or water quality standards violations directly attributable to SIUs and enforcement actions taken to alleviate said events;

e. A description of all enforcement actions taken against SIUs over the previous 12 months;

f. A summary of any changes to the submitted pretreatment program that have not been previously reported to DEQ-NRO;

g. A summary of the permits issued to SIUs since the last annual report;

h. POTW and self-monitoring results for SIUs determined to be in significant non-compliance during the reporting period;

i. Results of the POTW's influent/effluent/sludge sampling that have not been previously submitted to DEQ;

j. Copies of newspaper publications of all SIUs in significant non-compliance during the reporting period to be due no later than March 31 of each year; and

k. The signature of an authorized representative.

5. The DEQ may require the POTW to institute changes to the legal authority regarding SIU permit(s):

a. If the legal authority does not meet the requirements of the Clean Water Act, Water Control Law or State regulations;

b. If problems such as interferences, pass-through, violations of water quality standards or sludge contamination develop or continue; and

c. If federal, state or local requirements change.

D. Whole Effluent Toxicity Program Requirements

1. Biological Monitoring

a). In accordance with the schedule in Part I.D.2. below, the permittee shall conduct annual chronic toxicity tests during this permit term. The permittee shall collect 24-hour flow-proportioned composite samples of final effluent at Outfall 001.

The chronic tests to use are:

Chronic 3-Brood Static Renewal Survival and Reproduction Test using *Ceriodaphnia dubia*

Chronic 7-Day Static Renewal Survival and Growth Test using *Pimephales promelas*

These chronic tests shall be conducted in such a manner and at sufficient dilutions (minimum of five dilutions) to determine the "No Observed Effect Concentration" (NOEC) for survival and reproduction or growth. Results which cannot be quantified (i.e. a "less than" NOEC value) are not acceptable and a retest shall be performed. The NOEC, as determined by hypothesis testing, shall be converted to TU_c (Chronic Toxic Units) for Discharge Monitoring Report (DMR) reporting where $TU_c = 100/NOEC$. Report the LC_{50} at 48 hours and the IC_{25} with the NOEC's in the test report.

b). The permittee may provide additional samples to address data variability. These data shall be reported. Test procedures and reporting shall be in accordance with the WET testing methods cited in 40 CFR 136.3.

c). The test dilutions shall be able to determine compliance with the following endpoints:

Chronic NOEC $\geq$ 69%; equivalent to a $TU_c \leq 1.44$

d). The test data will be evaluated statistically for reasonable potential at the conclusion of the test period. The data may be evaluated sooner if requested by the permittee or if toxicity has been noted. Should evaluation of the data indicate that a limit is warranted, a WET limit and compliance schedule will be required.

e). The permit may be modified or revoked and reissued to include pollutant specific limits in lieu of a WET limit should it be demonstrated that toxicity is due to specific parameters. The pollutant specific limitation shall control the toxicity of the effluent.

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2. Reporting Schedule

The permittee shall monitor during the specified period; shall report the results on the DMR; and shall supply one copy of the toxicity test report specified in this Whole Effluent Toxicity Program in accordance with the following schedule:

Period	Sampling Period	DMR/Report Submission Dates
Annual 1	April 1, 2017 – June 30, 2017	January 10, 2018
Annual 2	January 1, 2018 – March 31, 2018	January 10, 2019
Annual 3	July 1, 2019 – September 30, 2019	January 10, 2020
Annual 4	October 1, 2020 – December 31, 2020	January 10, 2021

E. Other Requirements and Special Conditions

1. 95% Capacity Reopener

A written notice and a plan of action for ensuring continued compliance with the terms of this permit shall be submitted to the DEQ-Northern Regional Office (DEQ-NRO) when the monthly average flow influent to the sewage treatment plant reaches 95% of the design capacity authorized in this permit for each month of any three consecutive month period. The written notice shall be submitted within 30 days and the plan of action shall be received at the DEQ-NRO no later than 90 days from the third consecutive month for which the flow reached 95% of the design capacity. The plan shall include the necessary steps and a prompt schedule of implementation for controlling any current or reasonably anticipated problem resulting from high influent flows. Failure to submit an adequate plan in a timely manner shall be deemed a violation of this permit.

2. Indirect Discharges

The permittee shall provide adequate notice to the Department of the following:

a. Any new introduction of pollutants into the treatment works from an indirect discharger which would be subject to Section 301 or 306 of Clean Water Act and the State Water Control Law if it were directly discharging those pollutants; and

b. Any substantial change in the volume or character of pollutants being introduced into the treatment works by a source introducing pollutants into the treatment works at the time of issuance of this permit.

Adequate notice shall include information on (i) the quality and quantity of effluent introduced into the treatment works, and (ii) any anticipated impact of the change on the quantity or quality of effluent to be discharged from the treatment works.

3. Operations and Maintenance Manual Requirement

The permittee shall maintain a current Operations and Maintenance (O&M) Manual for the treatment works that is in accordance with Virginia Pollutant Discharge Elimination System Regulations, 9VAC25-31 and Sewage Collection and Treatment Regulations, 9VAC25-790.

The O&M Manual and subsequent revisions shall include the manual effective date and meet Part II.K.2 and Part II.K.4 Signatory Requirements of the permit. Any changes in the practices and procedures followed by the permittee shall be documented in the O&M Manual within 90 days of the effective date of the changes. The permittee shall operate the treatment works in accordance with the O&M Manual and shall make the O&M manual available to Department personnel for review during facility inspections. Within 30 days of a request by DEQ, the current O&M Manual shall be submitted to the DEQ-NRO for review and approval.

The O&M Manual shall detail the practices and procedures which will be followed to ensure compliance with the requirements of this permit. This manual shall include, but not necessarily be limited to, the following items, as appropriate:

a. Permitted outfall locations and techniques to be employed in the collection, preservation and analysis of effluent, storm water and sludge samples;

b. Procedures for measuring and recording the duration and volume of treated wastewater discharged;

c. Discussion of Best Management Practices, if applicable;

d. Procedures for handling, storing and disposing of all wastes, fluids and that will prevent these materials from reaching state waters. List type and quantity of wastes, fluids and pollutants (e.g. chemicals) stored at this facility;

e. Discussion of treatment works design, treatment works operation, routine preventative maintenance of units within the treatment works, critical spare parts inventory and record keeping;

f. Plan for the management and/or disposal of waste solids and residues;

g. Hours of operation and staffing requirements for the plant to ensure effective operation of the treatment works and maintain permit compliance;

h. List of facility, local and state emergency contacts; and

i. Procedures for reporting and responding to any spills/overflows/treatment works upsets.

4. Certificate to Construct/Certificate to Operate Requirements

In accordance with *Sewage Collection and Treatment* regulation (9VAC25-790), the permittee shall obtain a Certificate to Construct (CTC) and a Certificate to Operate (CTO) from the Department of Environmental Quality prior to constructing wastewater treatment works and operating the treatment works, respectively. Non-compliance with the CTC or CTO shall be deemed a violation of the permit.

5. Licensed Operator Requirement

The permittee shall employ or contract at least one Class I licensed wastewater works operator for this facility. The license shall be issued in accordance with Title 54.1 of the Code of Virginia and Board for Waterworks and Wastewater Works Operators and Onsite Sewage System Professionals Regulations. The permittee shall notify the Department in writing whenever he is not complying, or has grounds for anticipating he will not comply with this requirement. The notification shall include a statement of reasons and a prompt schedule for achieving compliance.

6. Reliability Class

The permitted treatment works shall meet Reliability Class I.

7. Water Quality Criteria Reopener

Should effluent monitoring indicate the need for any water quality-based limitations, this permit may be modified or alternatively revoked and reissued to incorporate appropriate limitations.

8. E3/E4

The annual average concentration limitations for total nitrogen and/or total phosphorus are suspended during any calendar year in which the facility is considered by DEQ to be a participant in the Virginia Environmental Excellence Program in good standing at either the Exemplary Environmental Enterprise (E3) level or the Extraordinary Environmental Enterprise (E4) level, provided that the following conditions have also been met:

a. The facility has applied for (or renewed) participation, been accepted, maintained a record of sustained compliance and submitted an annual report according to the program guidelines;

b. The facility has demonstrated that they have in place a fully implemented environmental management system (EMS) with an alternative compliance method that includes operation of installed nutrient removal technologies to achieve the annual average concentration limitations; and

c. The E3/E4 designation from DEQ and implementation of the EMS has been in effect for the full calendar year.

The annual average concentration limitations for total nitrogen and/or total phosphorus, as applicable, are not suspended in any calendar year following a year in which the facility failed to achieve the annual average concentration limitations as required by b. above.

9. <u>Nutrient Reopener</u>

This permit may be modified or, alternatively, revoked and reissued:

a. If any approved wasteload allocation procedure, pursuant to Section 303(d) of the Clean Water Act, imposes wasteload allocations, limits or conditions on the facility that are not consistent with the permit requirements;

b. To incorporate technology-based effluent concentration limitations for nutrients in conjunction with the installation of nutrient control technology, whether by new construction, expansion or upgrade, or

c. To incorporate alternative nutrient limitations and/or monitoring requirements, should:

   1) the State Water Control Board adopt new nutrient standards for the water body receiving the discharge, including the Chesapeake Bay or its tributaries; or

   2) a future water quality regulation or statute require new or alternative nutrient control.

10. <u>Effluent Monitoring Frequency</u>

If the facility permitted herein is issued a Notice of Violation for BOD_5, TSS or ammonia the effluent monitoring frequencies shall become revert back to 5D/W effective upon written notice from DEQ and remain in effect until permit expiration.

No other effluent limitations or monitoring requirements are affected by this special condition.

11. <u>Collection System</u>

The Town of Warrenton shall develop and implement a capacity, management, operation and maintenance (CMOM) program, or its equivalent, designed to maintain and operate Town owned collection system assets in accordance with industry accepted practices relating to sewer inspection, evaluation, repair and that all feasible steps are taken to eliminate excessive infiltration and inflow from the system.

The CMOM, or its equivalent, shall be submitted to DEQ-NRO staff for review and approval on or before 1 August 2017. Upon approval of the program and written notification from DEQ-NRO, an annual report shall be submitted thereafter on or before the 10th of August of every year detailing the previous fiscal year's activities/operations. The annual reports shall, at a minimum, provide the total amount funded to this program, studies/surveys conducted, completed rehabilitation projects and planned/proposed course of actions for the upcoming fiscal year.

12. <u>Total Maximum Daily Load (TMDL) Reopener</u>

This permit shall be modified or alternatively revoked and reissued if any approved wasteload allocation procedure, pursuant to Section 303(d) of the Clean Water Act, imposes wasteload allocations, limits or conditions on the facility that are not consistent with the permit requirements.

CONDITIONS APPLICABLE TO ALL VPDES PERMITS

A. Monitoring

1. Samples and measurements required by this permit shall be taken at the permit designated or approved location and be representative of the monitored activity.

   a. Monitoring shall be conducted according to procedures approved under Title 40 Code of Federal Regulations Part 136 or alternative methods approved by the U.S. Environmental Protection Agency, unless other procedures have been specified in this permit.

   b. The permittee shall periodically calibrate and perform maintenance procedures on all monitoring and analytical instrumentation at intervals that will insure accuracy of measurements.

   c. Samples taken shall be analyzed in accordance with 1VAC30-45, Certification for Noncommercial Environmental Laboratories, or 1VAC30-46, Accreditation for Commercial Environmental Laboratories.

2. Any pollutant specifically addressed by this permit that is sampled or measured at the permit designated or approved location more frequently than required by this permit shall meet the requirements in A 1 a through c above and the results of this monitoring shall be included in the calculations and reporting required by this permit.

3. Operational or process control samples or measurements shall not be taken at the designated permit sampling or measurement locations. Operational or process control samples or measurements do not need to follow procedures approved under Title 40 Code of Federal Regulations Part 136 or be analyzed in accordance with 1VAC30-45, Certification for Noncommercial Environmental Laboratories, or 1VAC30-46, Accreditation for Commercial Environmental Laboratories.

B. Records

1. Records of monitoring information shall include:

   a. The date, exact place, and time of sampling or measurements;

   b. The individual(s) who performed the sampling or measurements;

   c. The date(s) and time(s) analyses were performed;

   d. The individual(s) who performed the analyses;

   e. The analytical techniques or methods used; and

   f. The results of such analyses.

2. Except for records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years, the permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report or application. This period of retention shall be extended automatically during the course of any unresolved litigation regarding the regulated activity or regarding control standards applicable to the permittee, or as requested by the Board.

C. Reporting Monitoring Results

1. The permittee shall submit the results of the monitoring required by this permit not later than the 10th day of the month after monitoring takes place, unless another reporting schedule is specified elsewhere in this permit.

Monitoring results shall be submitted to:

Department of Environmental Quality – Northern Regional Office (DEQ-NRO)
13901 Crown Court
Woodbridge, VA 22193

2. Monitoring results shall be reported on a Discharge Monitoring Report (DMR) or on forms provided, approved or specified by the Department.

3. Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified in this permit.

D. Duty to Provide Information

The permittee shall furnish to the Department, within a reasonable time, any information which the Board may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Board may require the permittee to furnish, upon request, such plans, specifications, and other pertinent information as may be necessary to determine the effect of the wastes from this discharge on the quality of state waters, or such other information as may be necessary to accomplish the purposes of the State Water Control Law. The permittee shall also furnish to the Department upon request, copies of records required to be kept by this permit.

E. Compliance Schedule Reports

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date.

F. Unauthorized Discharges

Except in compliance with this permit, or another permit issued by the Board, it shall be unlawful for any person to:

1. Discharge into state waters sewage, industrial wastes, other wastes, or any noxious or deleterious substances; or

2. Otherwise alter the physical, chemical or biological properties of such state waters and make them detrimental to the public health, or to animal or aquatic life, or to the use of such waters for domestic or industrial consumption, or for recreation, or for other uses.

G. Reports of Unauthorized Discharges

Any permittee who discharges or causes or allows a discharge of sewage, industrial waste, other wastes or any noxious or deleterious substance into or upon state waters in violation of Part II.F.; or who discharges or causes or allows a discharge that may reasonably be expected to enter state waters in violation of Part II.F., shall notify the Department of the discharge immediately upon discovery of the discharge, but in no case later than 24 hours after said discovery. A written report of the unauthorized discharge shall be submitted to the Department, within five days of discovery of the discharge. The written report shall contain:

1. A description of the nature and location of the discharge;

2. The cause of the discharge;

3. The date on which the discharge occurred;

4. The length of time that the discharge continued;

5. The volume of the discharge;

6. If the discharge is continuing, how long it is expected to continue;

7. If the discharge is continuing, what the expected total volume of the discharge will be; and

8. Any steps planned or taken to reduce, eliminate and prevent a recurrence of the present discharge or any future discharges not authorized by this permit.

Discharges reportable to the Department under the immediate reporting requirements of other regulations are exempted from this requirement.

H. Reports of Unusual or Extraordinary Discharges

If any unusual or extraordinary discharge including a bypass or upset should occur from a treatment works and the discharge enters or could be expected to enter state waters, the permittee shall promptly notify, in no case later than 24 hours, the Department by telephone after the discovery of the discharge. This notification shall provide all available details of the incident, including any adverse affects on aquatic life and the known number of fish killed. The permittee shall reduce the report to writing and shall submit it to the Department within five days of discovery of the discharge in accordance with Part II.I.2. Unusual and extraordinary discharges include but are not limited to any discharge resulting from:

1. Unusual spillage of materials resulting directly or indirectly from processing operations;

2. Breakdown of processing or accessory equipment;

3. Failure or taking out of service some or all of the treatment works; and

4. Flooding or other acts of nature.

I. Reports of Noncompliance

The permittee shall report any noncompliance which may adversely affect state waters or may endanger public health.

1. An oral report shall be provided within 24 hours from the time the permittee becomes aware of the circumstances. The following shall be included as information which shall be reported within 24 hours under this paragraph:

   a. Any unanticipated bypass; and

   b. Any upset which causes a discharge to surface waters.

2. A written report shall be submitted within 5 days and shall contain:

   a. A description of the noncompliance and its cause;

   b. The period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and

   c. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

   The Board may waive the written report on a case-by-case basis for reports of noncompliance under Part II.I. if the oral report has been received within 24 hours and no adverse impact on state waters has been reported.

3. The permittee shall report all instances of noncompliance not reported under Parts II, I.1.or I.2., in writing, at the time the next monitoring reports are submitted. The reports shall contain the information listed in Part II.I.2.

NOTE: The immediate (within 24 hours) reports required in Parts II, G., H. and I. may be made to the Department's Northern Regional Office at (703) 583-3800 or online at http://www.deq.virginia.gov/Programs/PollutionResponsePreparedness/MakingaReport.aspx.

For reports outside normal working hours, leave a message and this shall fulfill the immediate reporting requirement. For emergencies, the Virginia Department of Emergency Services maintains a 24-hour telephone service at 1-800-468-8892.

J. Notice of Planned Changes

1. The permittee shall give notice to the Department as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:

   a. The permittee plans alteration or addition to any building, structure, facility, or installation from which there is or may be a discharge of pollutants, the construction of which commenced:

      1) After promulgation of standards of performance under Section 306 of Clean Water Act which are applicable to such source; or

      2) After proposal of standards of performance in accordance with Section 306 of Clean Water Act which are applicable to such source, but only if the standards are promulgated in accordance with Section 306 within 120 days of their proposal;

   b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations nor to notification requirements specified elsewhere in this permit; or

   c. The alteration or addition results in a significant change in the permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan.

2. The permittee shall give advance notice to the Department of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

K. Signatory Requirements

1. Applications. All permit applications shall be signed as follows:

   a. For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

      1) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or

      2) The manager of one or more manufacturing, production, or operating facilities, provided the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

   b. For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

   c. For a municipality, state, federal, or other public agency: by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a public agency includes:

      1) The chief executive officer of the agency, or

      2) A senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency.

2. Reports, etc. All reports required by permits, and other information requested by the Board shall be signed by a person described in Part II.K.1., or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described in Part II.K.1.;

   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.); and

   c. The written authorization is submitted to the Department.

3. Changes to authorization. If an authorization under Part II.K.2. is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Part II.K.2. shall be submitted to the Department prior to or together with any reports, or information to be signed by an authorized representative.

4. Certification. Any person signing a document under Parts II, K.1. or K.2. shall make the following certification:

   "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

L. Duty to Comply

The permittee shall comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the State Water Control Law and the Clean Water Act, except that noncompliance with certain provisions of this permit may constitute a violation of the State Water Control Law but not the Clean Water Act. Permit noncompliance is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants and with standards for sewage sludge use or disposal established under Section 405(d) of the Clean Water Act within the time provided in the regulations that establish these standards or prohibitions or standards for sewage sludge use or disposal, even if this permit has not yet been modified to incorporate the requirement.

M. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee shall apply for and obtain a new permit. All permittees with a currently effective permit shall submit a new application at least 180 days before the expiration date of the existing permit, unless permission for a later date has been granted by the Board. The Board shall not grant permission for applications to be submitted later than the expiration date of the existing permit.

N. Effect of a Permit

This permit does not convey any property rights in either real or personal property or any exclusive privileges, nor does it authorize any injury to private property or invasion of personal rights, or any infringement of federal, state or local law or regulations.

O. State Law

Nothing in this permit shall be construed to preclude the institution of any legal action under, or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any other state law or regulation or under authority preserved by Section 510 of the Clean Water Act. Except as provided in permit conditions on "bypassing" (Part II.U.), and "upset" (Part II.V.) nothing in this permit shall be construed to relieve the permittee from civil and criminal penalties for noncompliance.

P. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Sections 62.1-44.34:14 through 62.1-44.34:23 of the State Water Control Law.

Q. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes effective plant performance, adequate funding, adequate staffing, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by the permittee only when the operation is necessary to achieve compliance with the conditions of this permit.

R. Disposal of Solids or Sludges

Solids, sludges or other pollutants removed in the course of treatment or management of pollutants shall be disposed of in a manner so as to prevent any pollutant from such materials from entering state waters.

S. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

T. Need to Halt or Reduce Activity not a Defense

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

U. Bypass

1. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of Parts II, U.2. and U.3.

2. Notice

   a. Anticipated bypass. If the permittee knows in advance of the need for a bypass, prior notice shall be submitted, if possible at least ten days before the date of the bypass.

   b. Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in Part II.I.

3. Prohibition of bypass.

   a. Bypass is prohibited, and the Board may take enforcement action against a permittee for bypass, unless:

      1) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

2) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

3) The permittee submitted notices as required under Part II.U.2.

b. The Board may approve an anticipated bypass, after considering its adverse effects, if the Board determines that it will meet the three conditions listed above in Part II.U.3.a.

V. Upset

1. An upset constitutes an affirmative defense to an action brought for noncompliance with technology based permit effluent limitations if the requirements of Part II.V.2. are met. A determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is not a final administrative action subject to judicial review.

2. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

   a. An upset occurred and that the permittee can identify the cause(s) of the upset;

   b. The permitted facility was at the time being properly operated;

   c. The permittee submitted notice of the upset as required in Part II.I.; and

   d. The permittee complied with any remedial measures required under Part II.S.

3. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

W. Inspection and Entry

The permittee shall allow the Director, or an authorized representative, upon presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

4. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act and the State Water Control Law, any substances or parameters at any location.

For purposes of this section, the time for inspection shall be deemed reasonable during regular business hours, and whenever the facility is discharging. Nothing contained herein shall make an inspection unreasonable during an emergency.

X. Permit Actions

Permits may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

Y. Transfer of permits

1. Permits are not transferable to any person except after notice to the Department. Except as provided in Part II.Y.2., a permit may be transferred by the permittee to a new owner or operator only if the permit has been modified or revoked and reissued, or a minor modification made, to identify the new permittee and incorporate such other requirements as may be necessary under the State Water Control Law and the Clean Water Act.

2. As an alternative to transfers under Part II.Y.1., this permit may be automatically transferred to a new permittee if:

   a. The current permittee notifies the Department at least 30 days in advance of the proposed transfer of the title to the facility or property;

   b. The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them; and

   c. The Board does not notify the existing permittee and the proposed new permittee of its intent to modify or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in Part II.Y.2.b.

Z. Severability

The provisions of this permit are severable, and if any provision of this permit or the application of any provision of this permit to any circumstance is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

BIOSOLIDS CONDITIONS AND REQUIREMENTS

A. Biosolids Limitations and Monitoring Requirements

During the period beginning with the permit's effective date and lasting until the permit expiration date, the permittee is authorized to manage biosolids in accordance with 9VAC25-31-420 through 720 and 9VAC25-32-303 through 358, the limitations, conditions and requirements set forth in this permit and the approved Biosolids Management Plan.

All biosolids samples shall be collected and analyzed in accordance with Title 40 of the Code of Federal Regulations, Part 503 and 136, and the approved Biosolids Management Plan. The permittee shall ensure that all biosolids generated under authority of this permit and distributed for the purpose of land application, blending or further treatment are monitored in accordance with the monitoring requirements as specified herein.

Class B Biosolids

1. Biosolids Annual Production Monitoring (SP1)

   The permittee shall report the annual total amount of biosolids produced (in dry metric tons) and annual amount of Class B biosolids (in dry metric tons) distributed for land application.

   Data shall be reported on the Discharge Monitoring Report (DMR) for discharge number SP1.

2. Biosolids Chemical Limitations and Monitoring Requirement (S01)

   Pollutants in Class B biosolids that are generated and provided to a land applier under the authority of this permit shall be monitored and limited as specified below. Biosolids shall not be provided for land application if the concentration of any pollutant in the biosolids exceeds the ceiling limitation of that pollutant.

Biosolids Characteristic (1)	PC / CPLR Limitations (1)	Ceiling Limitations (1)	Monitoring Requirements	
	Monthly Average (2)	Concentration Maximum (2)	Frequency	Sample Type
Percent Solids (%)	NL	NA	1/3M	Composite
Arsenic, Sludge	41 mg/kg	75 mg/kg	1/3M	Composite
Cadmium, Sludge	39 mg/kg	85 mg/kg	1/3M	Composite
Copper, Sludge	1500 mg/kg	4300 mg/kg	1/3M	Composite
Lead, Sludge	300 mg/kg	840 mg/kg	1/3M	Composite
Mercury, Sludge	17 mg/kg	57 mg/kg	1/3M	Composite
Molybdenum, Sludge	NL	75 mg/kg	1/3M	Composite
Nickel, Sludge	420 mg/kg	420 mg/kg	1/3M	Composite
Selenium, Sludge	100 mg/kg	100 mg/kg	1/3M	Composite
Zinc, Sludge	2800 mg/kg	7500 mg/kg	1/3M	Composite

NA = Not applicable.
NL = No limit; monitor and report.

1/3M = Once every calendar quarter.
mg/kg = Milligrams per kilogram, dry weight.

(1) All parameters are subject to pollutant concentrations (PC), cumulative pollutant loading rates (CPLR), and ceiling limits. PC biosolids contain the constituents identified above at concentrations below the monthly average specified herein. CPLR biosolids contain the constituents identified above at concentrations above the monthly average and each sample must be below the maximum concentration specified herein.

(2) All limits and criteria are expressed on a dry weight basis.

(The remainder of this page intentionally left blank)

3. Pathogen Reduction and Vector Attraction Reduction (VAR) Requirements (S01)

Biosolids generated and provided to a land applier under this permit shall be treated to meet a Class B Pathogen Reduction Alternative and one VAR Option 1 - 8 prior to delivery to the land application site. The Class B Biosolids shall be monitored and limited in accordance with the treatment options selected and used by the generator, as identified in the table below.

Treatment Option			
Pathogen Reduction Alternative	Process to Significantly Reduce Pathogens (PSRP) Option	Class B Pathogen Reduction & Vector Attraction Reduction (VAR) Treatment and Standards	Monitoring Requirements
2	3	PSRP: Anaerobic digestion for a mean cell residence time between 15 days at 35° C – 55° C up to 60 days at 20° C. (9VAC25-31-710.D.3.)	1/3M (1) (2)
VAR Option 1		The mass of volatile solids in the sewage sludge shall be reduced by a minimum of 38%, calculated according to the method in 9VAC25-31-490.B.8.	1/3M (1) (2) (3)

1/3M = Once every calendar quarter.

(1) Between sampling events, operating records must demonstrate that the Wastewater Treatment Plant (WWTP) is operating at a performance level known to meet pathogen reduction and VAR standards.

(2) Process monitoring must be sufficient to demonstrate compliance with PSRP and VAR treatment requirements.

(3) If the selected VAR option 1- 8 is not met, the permittee shall provide notification to the land applier at the time the biosolids are delivered that the biosolids did not meet VAR at the WWTP and that the biosolids must be injected below the surface of the land (9VAC25-31-720.B.9) or incorporated into the soil within 6 hours after application (9VAC25-31-720.B.10). The Permittee shall obtain verification from the land applier that injection or incorporation occurred.

(The remainder of this page intentionally left blank)

B. Biosolids Management and Reporting Requirements

1. <u>Approved Biosolids Source Requirement</u>

Only biosolids from a source that has been approved by the DEQ, as identified on the DEQ's *Sources of Biosolids, Industrial Sludges, WTP Residuals* list and treated to meet metals limits, pathogen reduction and VAR standards as set forth in Part III of this permit, shall be given to any person for the purpose of blending or land application.

2. <u>Biosolids Monitoring Frequency and Reporting Requirements</u>

a. Monitoring Frequency

The monitoring frequency shall be once per calendar quarter (1/3M). The monitoring frequency may be increased during this permit term upon written notification by DEQ if deemed necessary.

b. Annual Report

The permittee shall submit an Annual Report not later than February 19th of each year to the DEQ-Northern Regional Office. Each report is for the previous calendar year's activity. If no biosolids were generated and provided to a land applier under this permit during the reporting year, a report shall be submitted stating that no biosolids were generated or delivered during the year.

The report shall include at minimum:

1) Part III.A.1. Sewage Sludge Annual Production Monitoring;

2) Biosolids Monitoring Data:

a) Part III.A.2. Biosolids – Metals Limitations;

b) Part III.A.3. Biosolids – Pathogen Reduction and Vector Attraction Reduction (VAR) Requirements; and

c) Supporting documentation, including laboratory chain of custody forms and certificates of analyses, shall be submitted with the report;

3) A summary of biosolids disposal contracts, if any, currently held with other generators, as well as any other biosolids or sludges currently being handled through subcontracts or other agreements. Include biosolids or sludges given to other generators, contractors or land filled and biosolids or sludges accepted from other generators for treatment or land application;

4) Identify other methods used to dispose of or use biosolids or sludge produced during the previous calendar year. Report the annual total amount of biosolids or sludge (in dry metric tons) disposed of or used by each method identified; and

5) The annual report shall be certified and signed in accordance with Part II.K.

3. <u>Record Keeping</u>

The permittee is required to retain the following information for at least five years:

a. The concentrations of each pollutant in Parts III.A.2.;

b. A description of how the pathogen reduction requirements in Parts III.A.3. are met;

c. A description of how the vector attraction reduction requirements in Parts III.A.3. are met;

d. A description of how the management practices specified in the approved Biosolids Management Plan and this permit are met;

e. The Notice and Necessary Information required in Part III.B.4; and

f. The following certification statement:

"I certify, under penalty of law, that the information that will be used to determine compliance with the Class B pathogen requirements in 9VAC25-31-710.B.6 and the vector attraction reduction requirements in 9VAC25-31-720.B.6 was prepared under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate this information. I am aware that there are significant penalties for false certification including the possibility of fine and imprisonment".

4. Notice and Necessary Information (NANI)

A NANI shall be provided to any person to whom biosolids are provided for the purpose of further treatment, blending or land application. The NANI shall be provided at the time the biosolids are provided if available, but no later than 45 days after the last day of the month in which biosolids were provided. The NANI shall represent the most recent monitoring period.

The NANI shall include at a minimum:

a. A statement that Class B pathogen requirements in 9VAC25-31-710.A – B were met and the alternative used;

b. A statement that one of the VAR requirements in 9VAC25-31-720.B.1 through B.8 was met and the alternative used; or

c. A statement that one of the VAR requirements in 9VAC25-31-720.B.1 through B.8 was not met and incorporation or injection was required;

d. The notice(s) provided to the land applier when biosolids provided did not meet VAR and required incorporation or injection;

e. The concentration of total nitrogen (as N on a dry weight basis) of the biosolids; and

f. The following certification statement:

"I certify, under penalty of law, that the information that will be used to determine compliance with the Class B pathogen requirements in 9VAC25-31-710.B and the VAR requirement in 9VAC25-31-720.B.6 was prepared under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate this information. I am aware that there are significant penalties for false certification, including the possibility of fine and imprisonment".

5. Biosolids Management Plan (BSMP)

a. The permittee shall conduct all biosolids/sewage sludge use or disposal activities in accordance with the Biosolids Management Plan approved with the issuance of this permit. The permittee shall maintain the BSMP which consists of the following components:

1) The materials developed and submitted at the time of permit application or permit modification in accordance with 9VAC25-31-100.Q;

2) The Operations and Maintenance (O&M) Manual (sections regarding solids handling and biosolids production and management, etc); and

3) The Odor Control Plan (OCP).

b. Odor Control Plan (OCP) Requirement – If an OCP is not on file at DEQ, an OCP shall be submitted to DEQ within 90 days of the effective date of this permit.

The OCP shall include at a minimum:

1) Methods used to minimize odor in producing biosolids;

2) Methods used to identify malodorous biosolids before delivery to the land applier (at the generating facility);

3) Methods used to identify and abate malodorous biosolids if delivered to the field, prior to land application; and

4) Methods used to abate malodor from biosolids if land applied.

c. The BSMP and all of its components shall be incorporated by reference and is an enforceable part of this permit.

d. Any proposed changes in the biosolids/sewage sludge use or disposal practices or procedures followed by the permittee shall be documented and submitted for DEQ-Northern Regional Office (DEQ-NRO) approval 90 days prior to the effective date of the changes. Upon approval, the revised Biosolids Management Plan becomes an enforceable part of the permit. The permit may be modified or alternatively revoked and reissued to incorporate limitations or conditions necessitated by substantive changes in biosolids/sewage sludge use or disposal practices.

6. Biosolids/Sludge Reopener

The Board may promptly modify or revoke and reissue this permit if any applicable standard for biosolids and/or sewage sludge use or disposal promulgated under Section 405(d) of the Clean Water Act is more stringent than any requirements for biosolids/sludge use or disposal in this permit, or controls a pollutant or practice not limited within this permit.

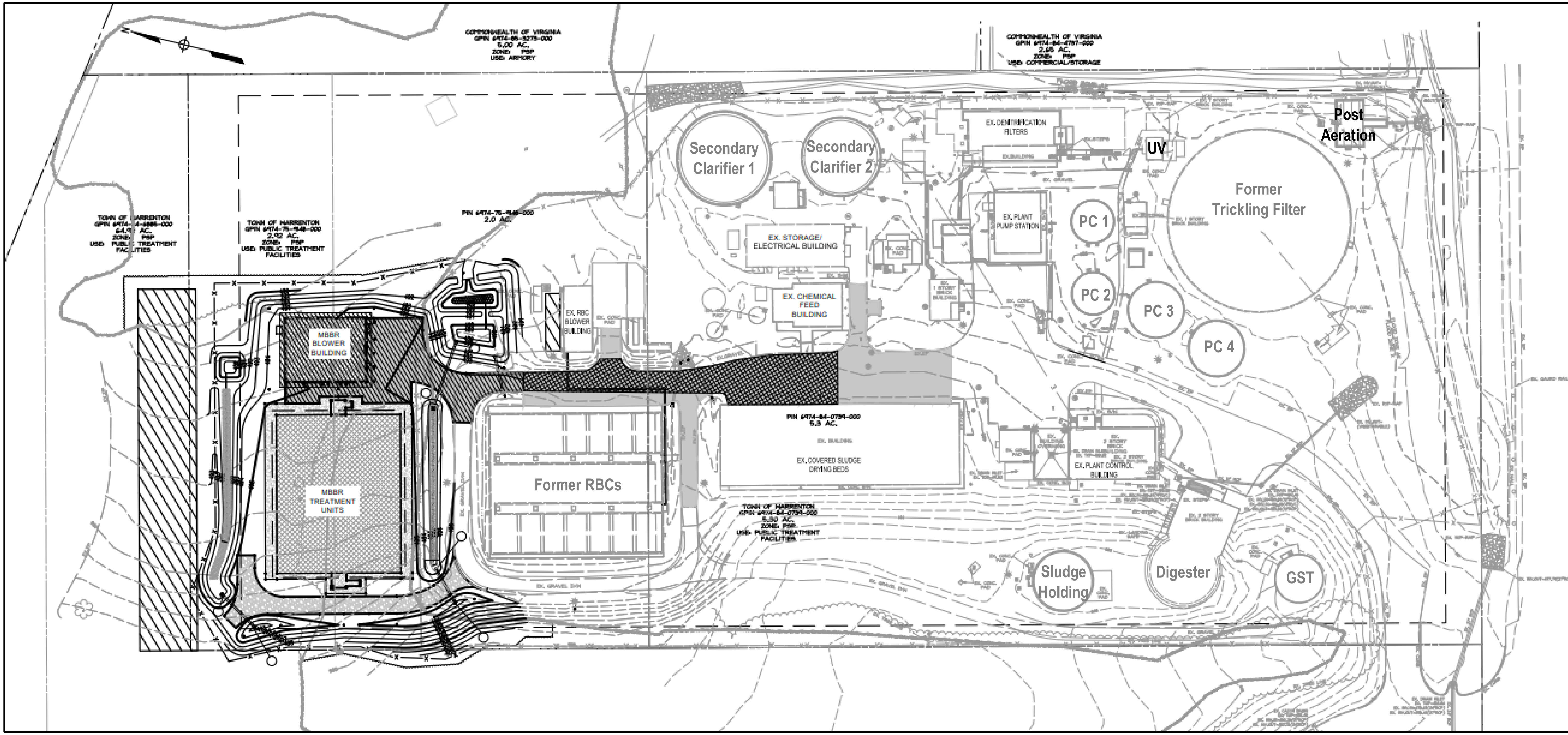
7. Biosolids Use and Disposal

The permittee shall conduct all biosolids use or disposal activities in accordance with the Biosolids Management Plan approved with the issuance of this permit. Any proposed changes in the biosolids use or disposal practices or procedures followed by the permittee shall be documented and submitted for DEQ-Northern Regional Office (DEQ-NRO) approval 90 days prior to the effective date of the changes. Upon approval, the revised Biosolids Management Plan shall be incorporated by reference and becomes an enforceable part of the permit. The permit may be modified or alternatively revoked and reissued to incorporate limitations or conditions necessitated by substantive changes in biosolids use or disposal practices.

Appendix B

Existing Site Plan (aerial and topo)

WRA	TOWN OF WARRENTON	WWTP UPGRADE AND EXPANSION	EXISTING SITE PLAN SCALE: DATE: DECEMBER 2021



	TOWN OF WARRENTON	WWTP UPGRADE AND EXPANSION	EXISTING SITE PLAN
			SCALE:
			DATE: DECEMBER 2021

Appendix C

Wastewater Sampling Data (2016 and 2006 data)

WARRENTON WWTP - WASTEWATER SAMPLING DATA (MARCH 2016)

Plant Influent

Date	Rainfall (inches)	Flow Avg (MGD)	Flow Max (MGD)	WW Temp (C)	BOD_5 (mg/L)	TSS (mg/L)	Ammonia (mg/L)	TKN (mg/L)	TP (mg/L)	Alkalinity $CaCO_3$ (mg/L)
2/29/2016	0	2.36	3.8	14.6	123	61	15	24	3.1	140
3/1/2016	0	2.23	3.6	13.1	134	66				
3/2/2016	0	2.14	2.9	14.2	295	137	17	24	2.2	
3/3/2016	0	2.17	3.2	13.3	191	105				
3/4/2016	0	2.10	2.9	13.4	125	45	21	29	3.2	152
3/5/2016	0	1.98	3.7	13.6	256	71				
3/6/2016	0	2.02	3.8	14.0	217	71	20	27	3.4	
3/7/2016	0	2.08	3.6	14.8	190	86				
3/8/2016	0	2.00	3.6	15.1	184	130	24	31	4.0	142
3/9/2016	0	1.94	3.5	15.6	181	62				
3/10/2016	0	1.94	3.7	17.1	250	144	21	34	4.4	
3/11/2016	0	1.81	3.3	17.1	158	81				
3/12/2016	0	1.80	3.2	16.5	204	89	15	31	4.1	144
3/13/2016	0.4	1.76	3.5	15.4	191	86				
Average		2.02	3.5	14.8	193	88	19	29	3.5	145

BFP Filtrate Holding Tank (ammonia sidestream)

Date	BOD_5 (mg/L)	TSS (mg/L)	Ammonia (mg/L)	TKN (mg/L)
2/29/2016	25	33	287	307
3/4/2016	36	44	276	298
3/8/2016	49	823	336	412
3/12/2016	32	67	276	316
Average	36	242	294	333

Avg side stream flow (gpm): 20

Primary Influent (influent + filtrate)

Ammonia (mg/L)	TKN (mg/L)
23.2	33.3

WARRENTON WWTP - WASTEWATER SAMPLING DATA (MARCH 2016)

Influent ammonia sampling (plant lab analysis)

Date	Plant Lab*) NH3-N (mg/L)	Flow Avg (MGD)	Flow Max (MGD)	ESS Lab **) NH3-N (mg/L)
2/22/2016	18.3	2.32	3.5	
2/23/2016	18.2	2.51	3.6	
2/24/2016	13.0	3.21	6.0	
2/25/2016	11.0	3.32	4.2	
2/26/2016	11.1	2.90	3.3	
2/27/2016	13.1	2.44	3.5	
2/28/2016	11.0	2.36	3.8	
2/29/2016	18.4	2.36	3.8	15
3/1/2016	17.6	2.23	3.6	
3/2/2016	19.6	2.14	2.9	17
3/3/2016	18.6	2.17	3.2	
3/4/2016	20.3	2.10	2.9	21
3/5/2016	23.4	1.98	3.7	
3/6/2016	18.2	2.02	3.8	20
3/7/2016	18.6	2.08	3.6	
3/8/2016	17.2	2.00	3.6	24
3/9/2016	23.5	1.94	3.5	
3/10/2016	24.7	1.94	3.7	21
3/11/2016	27.4	1.81	3.3	
3/12/2016	15.7	1.80	3.2	15
3/13/2016	14.0	1.76	3.5	

High flow period

*) Grab samples. Analysis completed daily at 5 PM.

**) Composite sample based on three (3) daily grab samples

Town of Warrenton WWTP
Influent Wastewater Sampling Plan – 2016

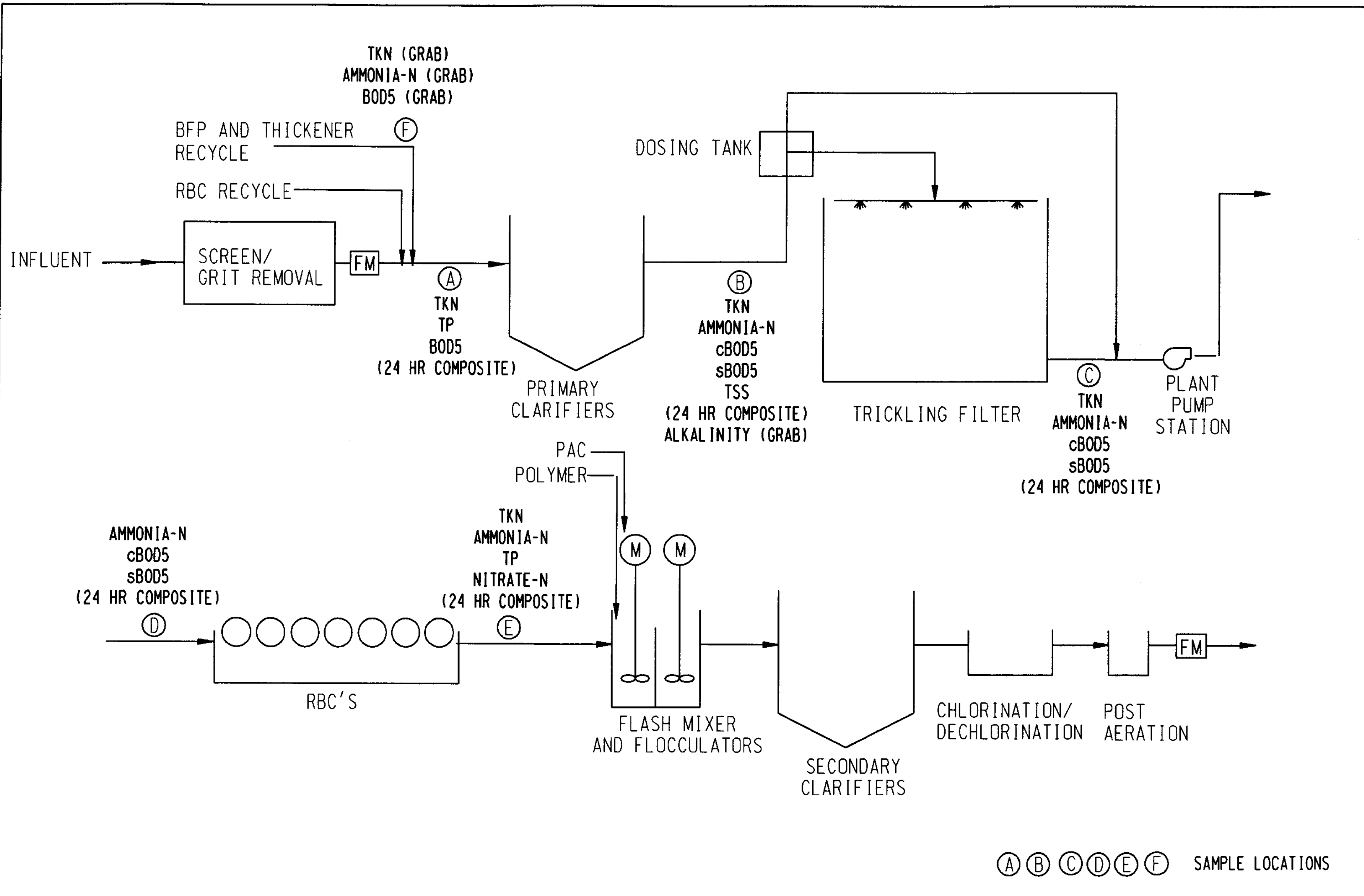
	Plant Influent[1]							BFP Filtrate Tank Ammonia Sidestream[2]			
	BOD_5	**TSS**	**TKN**	**NH_3**	**TP**	**Alka[3]**	**pH**	**BOD_5**	**TSS**	**TKN**	**NH_3**
Day Date											
1	X	X	X	X	X	X	X	X	X	X	X
2	X	X									
3	X	X	X		X						
4	X	X									
5	X	X	X	X	X	X	X	X	X	X	X
6	X	X									
7	X	X	X		X						
8	X	X									
9	X	X	X	X	X	X	X	X	X	X	X
10	X	X									
11	X	X	X		X						
12	X	X									
13	X	X	X	X	X	X	X	X	X	X	X
14	X	X									
Total Samples	14	14	7	4	7	43	4	4	4	4	4

Notes:

1. Influent Sampling: One composite sample for analysis, based on three (3) discrete manual grab samples collected at 8AM, 4PM and 10PM. Influent samples shall be collected after the screen and grit removal, but before the influent flow meter (i.e. upstream of the location where the RBC recycle flows enters).
2. Holding Tank Sampling: One manual grab sample (no composite needed) when the tank is in draining mode.
3. Alkalinity measurements can be performed in-house at the WWTP lab.

WRA

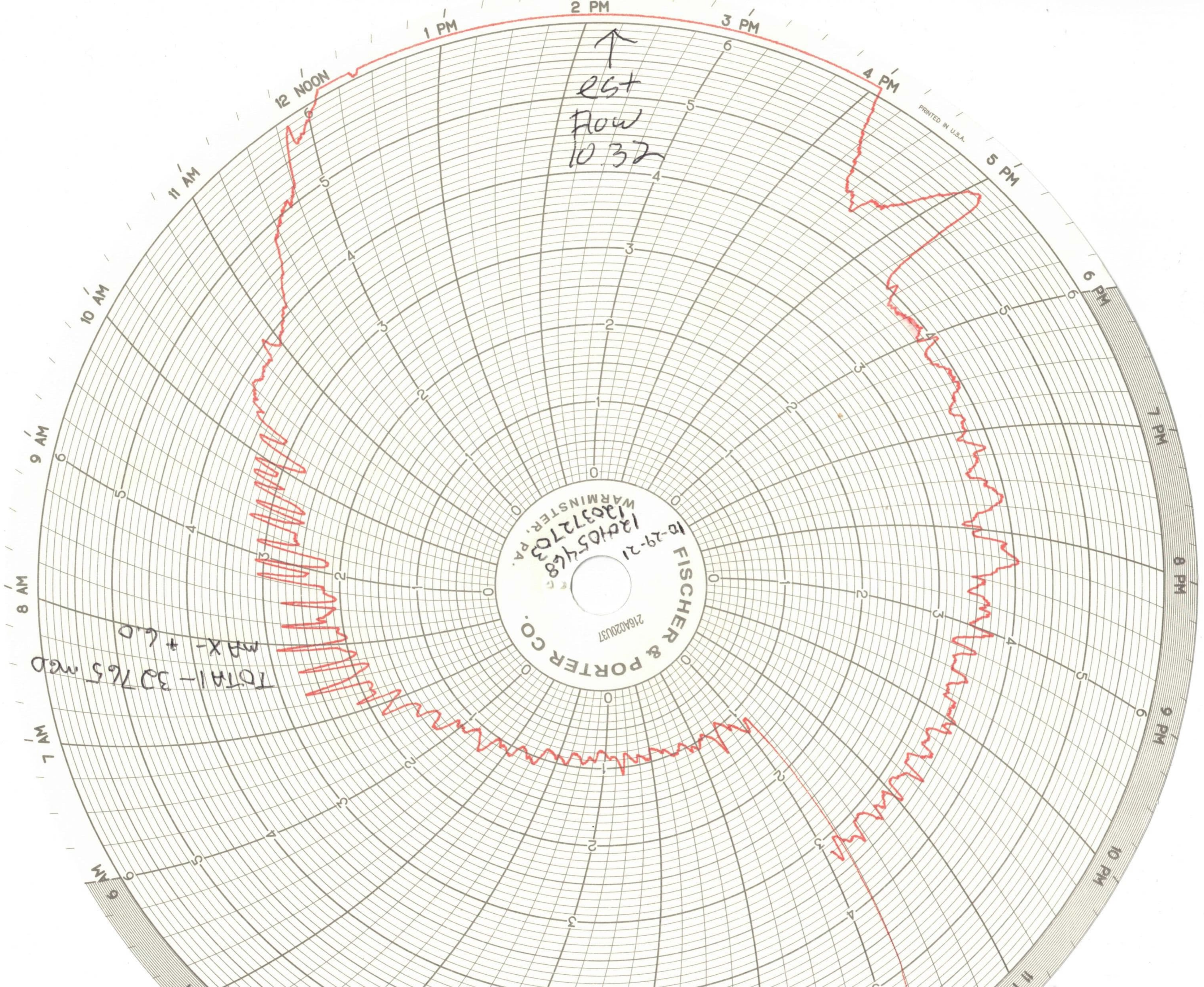
Warrenton WWTP - Supplemental WW Sampling/Characterization (March 2006)																
Date March 2006	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Units	Average
Centrate TKN	215	206	183	173	174	156	145	202	197	183	181	193	187	192	mg/L	185
Centrate NH3-N	180	160	120	120	110	130	120	110	110	120	110	100	100	120	mg/L	122
Centrate BOD	LE	LE	LE	LE	LE	LE	LE	LE	LE	22	7	4	6	7	mg/L	9
Primary Influent TKN	25	29.2	29.8	30.9	25.3	28.1	29	30.3	28.7	30.5	32.7	40	28.2	30.5	mg/L	30
Primary Influent TP	5.44	5.47	6.11	7.8	5.53	6.11	7.15	7.28	6.25	6.12	7.63	6.46	6.73	6.73	mg/L	6.5
Primary Influent BOD	182	157	92	LE	200	50	250	99	105	117	172	155	159	168	mg/L	147
Primary Effluent TKN	23.7	24.5	25.3	22.8	23.6	24.2	24.7	25	25.3	25.4	24	27.4	24	24.8	mg/L	25
Primary Effluent NH3-N	19	18	18	17	17	18	16	15	16	17	15	15	16	18	mg/L	17
Primary Effluent cBOD	111	126	91	116	117	113	119	117	106	121	119	119	81	101	mg/L	111
Primary Effluent sBOD	34	48	40	46	44	49	46	67	48	44	34	52	45	60	mg/L	47
Primary Effluent TSS	95	69	79	93	79	100	95	89	82	92	88	87	89	80	mg/L	87
Primary Effluent ALK	142	128	114	142	174	180	268	130	190	200	140	136	160	160	mg/L	162
Trickling Filter Effluent TKN	11.5	12.5	11.1	11.4	12.1	12.4	12.6	14.6	13.8	13.8	12.7	12.4	18	13.3	mg/L	13.0
Trickling Filter Effluent NH3-N	8.6	8.8	8.3	7	6.7	8	7.3	7.5	8	7.8	6.8	6.5	7.1	8	mg/L	7.6
Trickling Filter Effluent cBOD	15	15	11	24	36	16	23	47	17	19	19	17	13	13	mg/L	20
Trickling Filter Effluent sBOD	4	6	3	< 3	3	< 4	5	18	< 3	< 3	< 4	< 4	< 4	< 4	mg/L	6.5
RBC Influent NH3-N	10	10	10	8.8	7.6	8.9	9.2	8.6	8.8	8.6	7.6	7.8	7.1	8.2	mg/L	8.7
RBC Influent cBOD	24	23	7	25	19	20	25	36	11	21	22	19	11	15	mg/L	20
RBC Influent sBOD	4	< 3	3	< 3	< 3	< 4	< 3	10	< 3	< 3	< 4	< 4	< 4	< 4	mg/L	5.7
RBC Effluent TKN	5	5.96	5.73	6.74	6.46	5.34	6.18	8.15	5.62	8.17	7.05	6.77	7.05	7.31	mg/L	6.5
RBC Effluent NH3-N	0.17	0.16	0.16	0.17	0.15	0.12	0.16	0.15	0.2	0.21	0.14	0.11	0.11	0.1	mg/L	0.2
RBC Effluent TP	4.5	4.95	5.18	4.57	4.88	4.82	5.14	4.95	5.36	5.58	5.38	5.36	4.9	5.1	mg/L	5.0
RBC Effluent Nitrate-N	0.67	15.8	15.9	14.1	0.67	12.7	14.8	15.4	15.4	16.7	15.8	13.9	13.8	16.7	mg/L	13.0
LE Lab Error																



WR&A WHITMAN, REQUARDT AND ASSOCIATES, LLP 801 SOUTH CAROLINE STREET BALTIMORE, MARYLAND 410 - 235 - 3450	WARRENTON WASTEWATER TREATMENT PLANT	W.O.: 18245	DATE: FEB 2006
	SAMPLING PLAN	SCALE: NONE	DWG. NO.:
		FILE NAME n:\18245\CADD\Process\process schemat Thu Feb 16 08:54:38 2006	

Appendix D

Flow Chart – October 29, 2021



est
flow
10.32
FISCHER & PORTER CO.
WARMINSTER, PA.
10-29-21
PRINTED IN U.S.A.

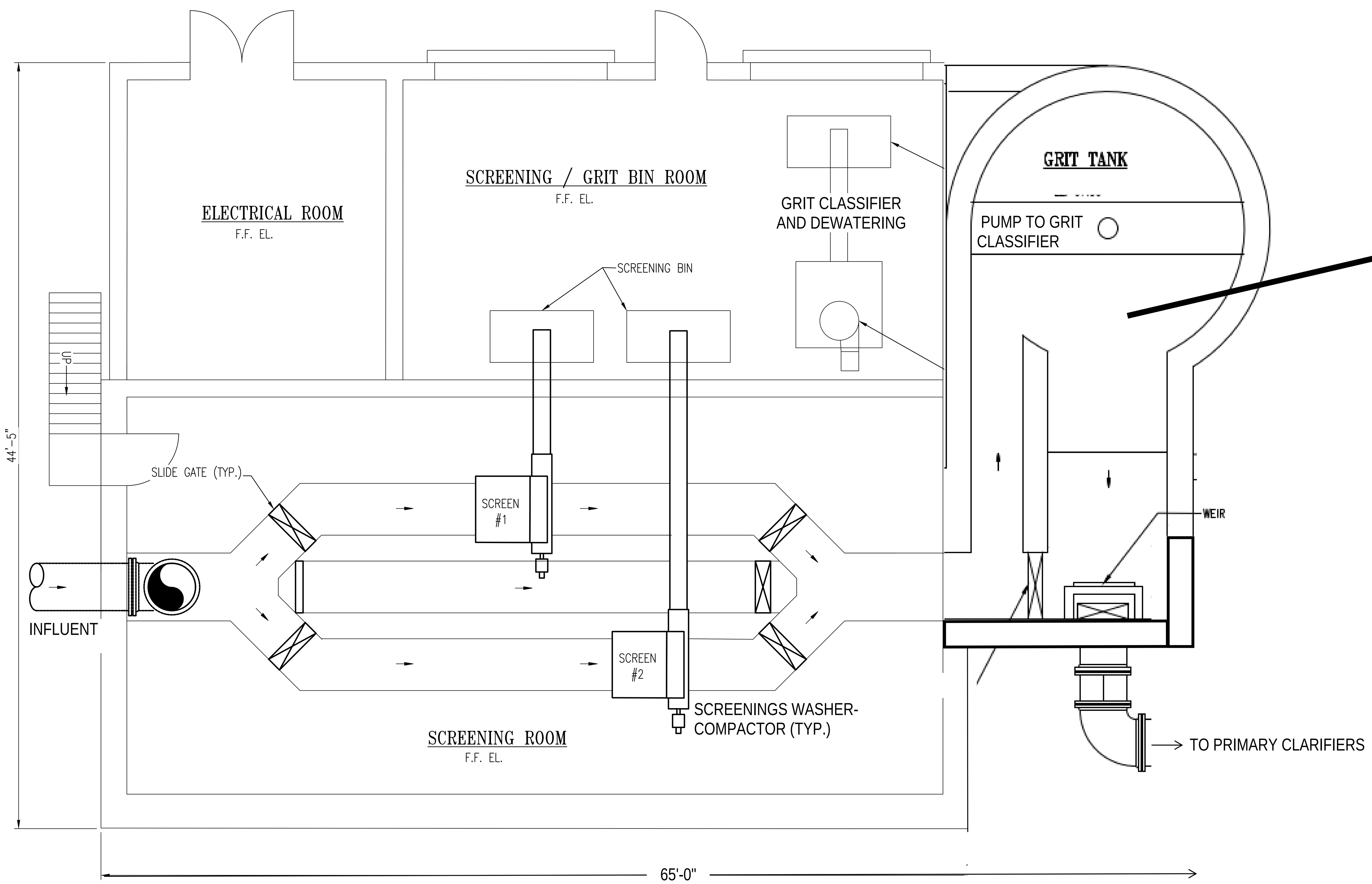
R RUN PUMPING STATION

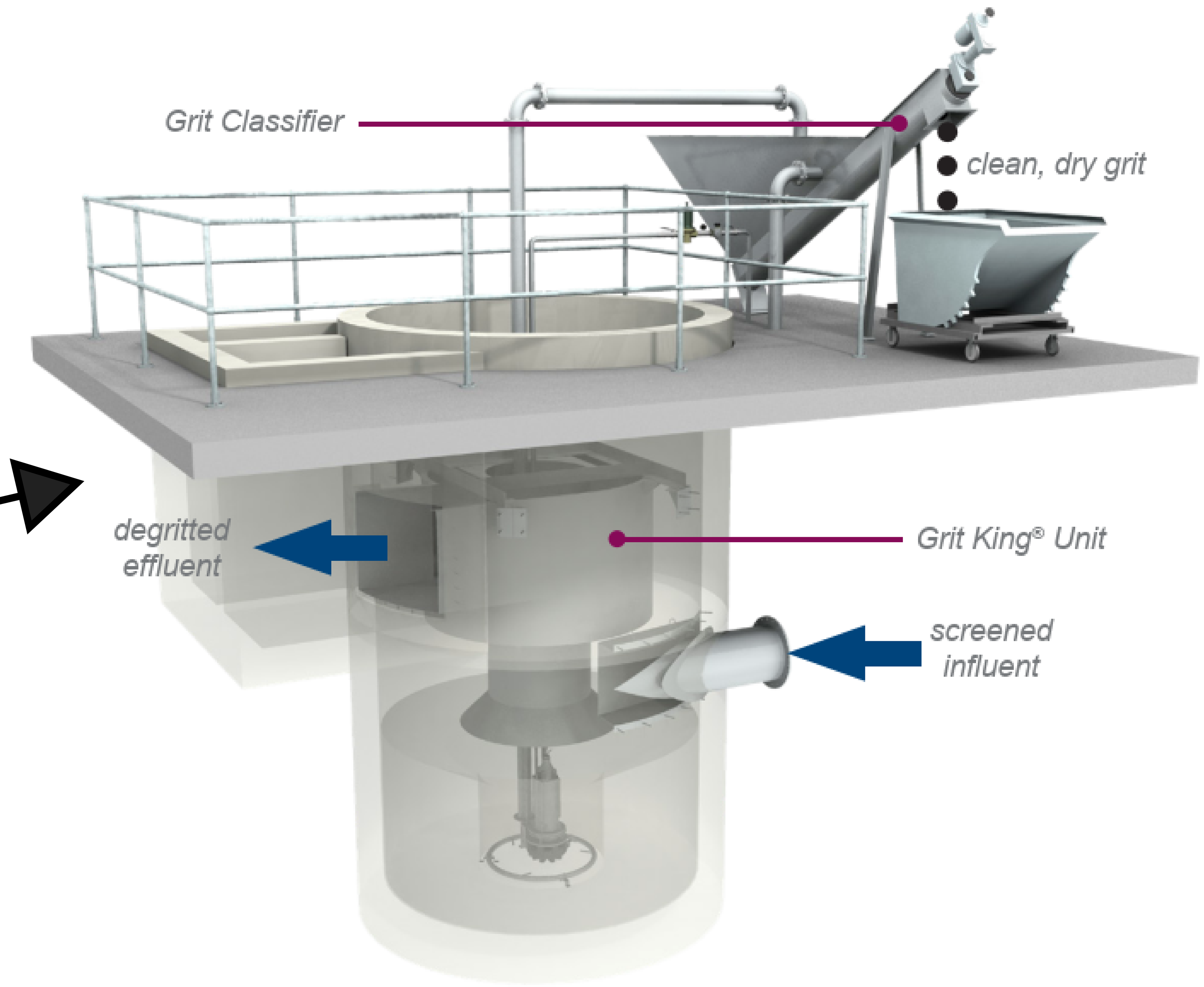
Total GALS. - 22,115,700

ONTH	Oct	YEAR 2021				
		51007300				
ATE	INITIALS	TOTALIZER READING	FLOW PUMPED	PUMP NUMBER	COMMINUTOR	POND LEVE
1	RL	51745800	738500	~~3,1,2~~ 1,23	on	E
2	MJ	52623000	877,200	123	"	"
3	MJ	53516400	893400	123	"	"
4	DP	53891800	374900	1,2,3	ON	E
5	RL	54626600	734800	1,2.3	on	E
6	DP	55245300	618700	1,2,3	ON	E
7	RL	55935800	690500	1,2,3	ON	E
8	DP	56669800	734000	1,2,3	ON	E
9	RS	57273300	603500	123	"	"
10	RS	57972600	699300	123	"	"
11	DP	58829900	857300	1,2,3	ON	E
12	RL	59554400	724500	1,2,3.	on	E
13	DP	60304000	749600	1,2,3	ON	E
14	RL	60992700	688700	1,2,3	on	E
15	DP	61643600	650900	321	ON	E
16	RL	62466500	1022900	3,21	on	E
17	RL	63314400	647900	3,21	on	E
18	DP	63879600	565200	3,2,1	ON	E
19	Jike	64581400	701800	321	"	"
20	DP	65282900	701500	3,2,1	ON	E
21	Jike	66025700	742800	132	"	"
22	DP	66640400	614700	132	ON	E
23	MJ	67483600	843200	132	"	"
24	MJ	68191900	708300	1,3.2	"	"
25	DP	68713700	521800	1,3,2	ON	E
26	RS	69651100	937400	132	"	"
27	RL	70296300	645200	1,3,2	"	"
28	RL	70959800	662600	1,3,2	"	"
29	SV	72257600	1297800	3,1,2	on	2ft
30	JT	72927600	670,000	3,1,2	ON	E@090
31	RS	73861500	933900	312	"	empty
TAL						

Appendix E

Headworks Facility – Concept Plan
Influent Screen
Washer-Compactor
Vortex Grit Removal





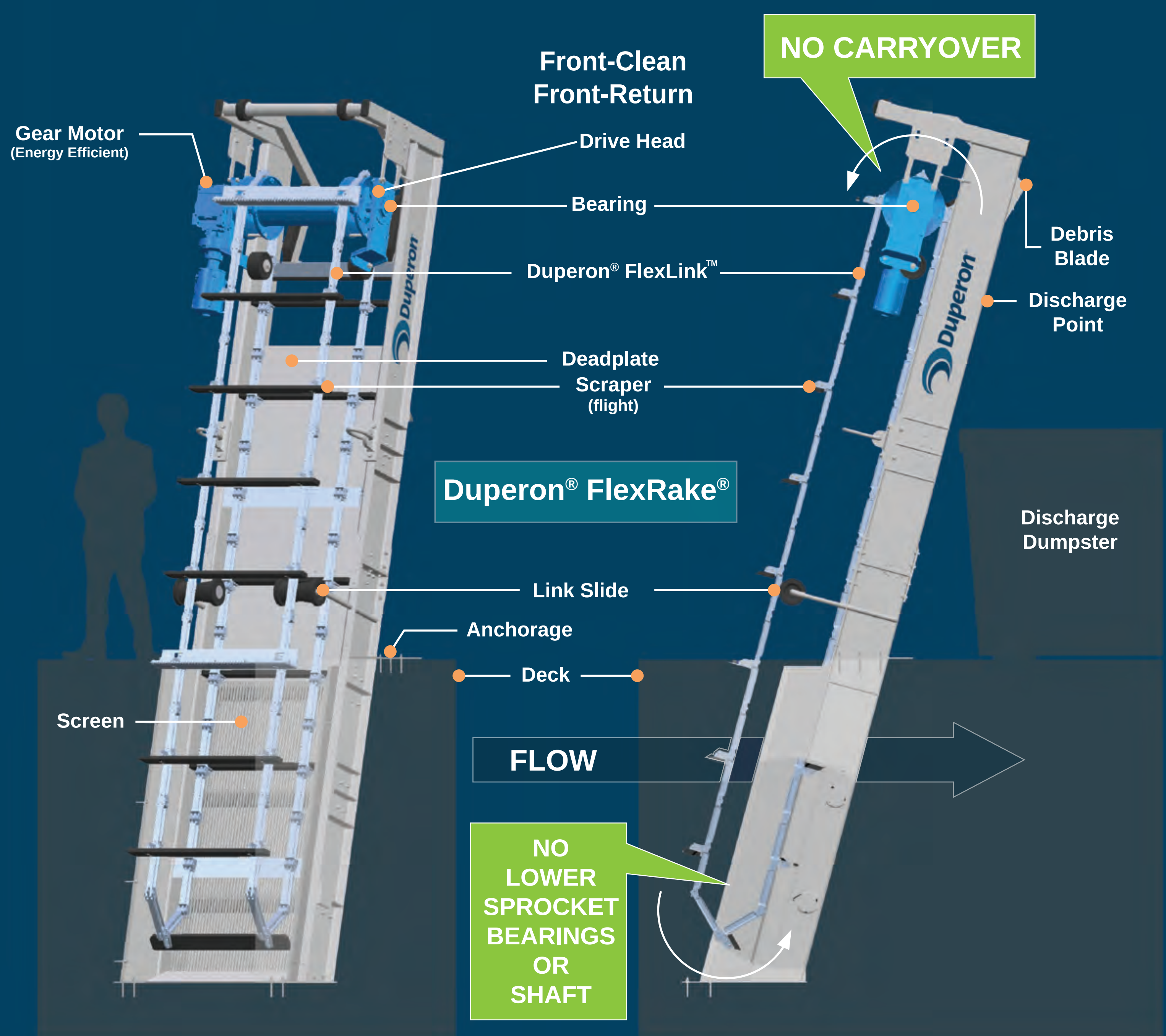
In-Situ Grit King® and Classifier System

WRA	TOWN OF WARRENTON	WWTP UPGRADE AND EXPANSION	HEADWORKS FACILITY SCALE: DATE: DECEMBER 2021

Duperon® ADAPTIVE TECHNOLOGY™
PRELIMINARY LIQUIDS/SOLIDS SEPARATION TECHNOLOGIES

The Duperon® FlexRake®

Duperon®
PRELIMINARY LIQUIDS/SOLIDS SEPARATION TECHNOLOGIES



Shown without enclosure

The Duperon® FlexRake®

Only three basic components:

1. A powerful drive head
2. A durable raking device
3. A rugged bar screen

Duperon® simplicity of design solves many headaches associated with preliminary liquids/solids separation

ENGINEERED FOR DURABLE, RELIABLE OPERATION

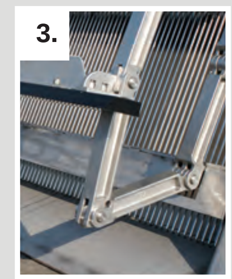
The achievement of mechanical simplicity requires the design of one part doing more. The simplicity of the Duperon® FlexRake® is possible through the multi-functioning action of one part: the FlexLink™. This innovative design allows the link to function as a frame, lower sprocket, and connection point for scrapers, and be driven by a single sprocket. The rugged bar screen has a frame which guides the chain and relocates it in the screen. Bottom line: simplicity works when it achieves a simple cleaning mechanism with trouble-free longevity.

The design of the Duperon® FlexRake® solves many of the headaches associated with liquids/solids separation equipment: complex gear mechanisms and controls; high maintenance components subject to regular lubrication, wear or fouling; confined space entries; reversal of mass in systems that must travel in one direction and then auto-reverse; carryover; shutdown due to unexpected debris volumes or conditions; inability to remove accumulation at the bottom of the channel…

How the Duperon® FlexRake® works...

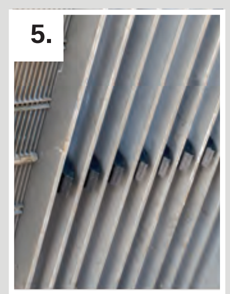
1. The FlexLink™ articulates to a 90 degree angle, closing on the drive pin. Once closed, the sprocket drives the link system forward.

2. As it leaves the drive sprocket, the FlexLink™ locks into a solid bar, forming its own frame. (It works similarly to a knee or elbow.)



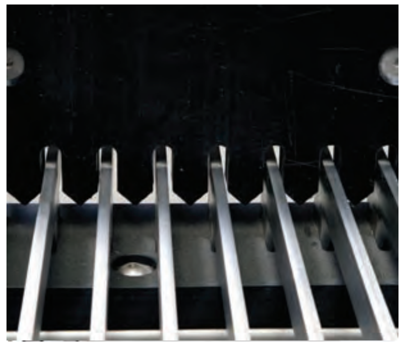
3. As the FlexLink™ chain and attached scrapers reach the bottom of the screen, the FlexLink™ forms its own rotating framework.

4. Once the links turn to travel slowly up the screen, they are engineered to allow clearance around the pin and water lubrication, allowing stainless on stainless movement without gouging or wear.



5. Industry-exclusive Thru-Bar™ technology features scrapers designed to clean 3 sides of the bar, as well as horizontal cross members.

6. Multiple scrapers placed every 21 inches continuously rake the bar screen. With screen head-loss minimized, some sites report a 3x greater capture rate than with their previous machines.



DEBRIS ACCUMULATION ELIMINATED

The Duperon® FlexRake® wastewater product line offers industry-exclusive Thru-Bar™ Technology with a scraper designed to clean 3 sides of the bar – as well as cross support members – so debris simply cannot accumulate. Assembly/disassembly is simple… just 4 bolts, from the deck. This Duperon® technology leaves nothing to chance.

ELIMINATES FOULING POINTS

The Duperon® FlexLink™ system is an innovative solution to complex gear sprocket mechanisms - simple 90 degree articulation drives the unit. No tight clearances to bind or jam; no close tolerances to foul due to corrosion or wear.

UNHAMPERED BY LARGE DEBRIS

As the Duperon® FlexRake® flexes and pivots around large debris, rigid side fabrications are angled to guide the scrapers to return engagement. This simple method for positive location, along with the scraper's lateral containment by that same rigid frame, ensures the continuous engagement of each successive scraper.

- ENERGY EFFICIENT
- LONG PRODUCT LIFE

REDUCES HEADLOSS, IMPROVES CAPTURE

Multiple scrapers on the screen operating at a speed of 0.5 rpm discharge debris once per minute. The slow operating speed provides long product life. Multiple scrapers minimize debris accumulation, resulting in reduced headloss and slot velocity, as well as greater capture rates.

KEEPS YOU IN CONTROL

Start it up… let it run. In their simplest form, controls are designed for continuous operation. Duperon offers pre-engineered packages that range from basic (continuous operation) to complex (level control with complete SCADA integration).

ELIMINATES ALL SPROCKET-RELATED PROBLEMS

The exclusive flex/pivot action of the Duperon® FlexRake® allows all types of debris to be removed, all at the same screen – regardless of coarse or fine screen openings. With the rugged durability of Duperon equipment, prescreening is no longer a necessity. The design of the Duperon® FlexRake® eliminates the need for a lower sprocket and the common problems that come with it. No lower sprocket means no drive shaft, drive sprockets, or bearings requiring in-channel lubrications. No tracks, gaskets, seals or other close tolerances prone to wear due to grit. Most importantly: NO confined space entries.

STRONGEST IN THE INDUSTRY

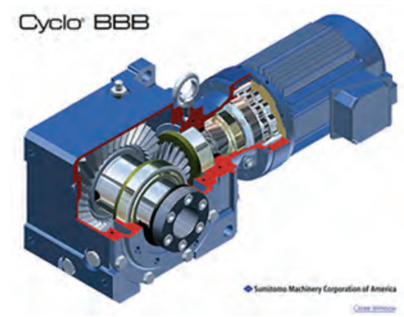
THE DUPERON® SOLUTION TO

- *LOWER SPROCKETS*
- *BEARINGS*
- *SHAFTS*
- *LUBRICATION POINTS*
- *CONFINED SPACE ENTRIES*
- *TRACKS...*

THE DUPERON® LINK SYSTEM: The Duperon® FlexLink™ design utilizes a stainless steel cast link system to create its own in-channel rigid framework and scraper connection point. With a 33,000 lb yield and 60,000 lb break point, it forms a chain that is stronger and more hard-wearing than any other in the industry. That's strength where it's needed most!

VIRTUALLY INDESTRUCTIBLE

State-of-the-art materials such as UHMW and stainless steel are used for all wetted parts, eliminating corrosion in the harsh wastewater environment. Such materials ensure the highest duty of performance, designed such that the pressures and velocities exerted by the equipment and environment will assure a long life cycle.



MAINTENANCE AT FIVE-YEAR INTERVALS

This powerful drive lifts up to 1,000 lbs. The Duperon use of premium efficiency Sumitomo Cyclo gear motors eliminates abrasive sliding contact. Unique rolling contact, low operating speeds and the grease-filled non-vented gearbox allow for five-year maintenance schedules.

FIVE-YEAR WARRANTY

With more than 25 years in the industry and over 1000 machines worldwide… Duperon has the experience to assure excellence with the industry's first Five-Year Warranty. Duperon® technology leaves nothing to chance… we guarantee it.

EASIER TO INSTALL

The Duperon® FlexRake® ships fully assembled to sites without space or handling constraints, creating installation as simple as pick, place, anchor, wire and run.

When site constraints such as limited access doors, multiple floors, and handling constraints exist, the Duperon® FlexRake® ships fully factory-tested to be disassembled on site. The Duperon simplicity of design makes re-assembly easy, with sites often accomplishing re-assembly and installation in one day – sometimes using an on-site maintenance crew.

LESS MAINTENANCE

	Maintenance Schedule
Daily	None
Monthly	None
Semi-Annually	Check drive and bearing for any apparent leakage or damage. Lubricate bearing.
Annually	Check drive and bearing for any apparent leakage or damage. Verify unit condition.
5 year	Change grease in gearbox.

NOTE: Maintenance is reduced by the simple design of the Duperon® FlexLink™, which is engineered for water lubrication. Slow operating speeds of 0.5 rpm allow for lubrication of the gear motor to occur every 5 years or 20,000 hours.

SIGNIFICANTLY LOWER COST OF OWNERSHIP

Maintenance Schedule and Estimated Labor Hours				
		1 year	5 year	20 years
Daily	None	0.0	0.0	0.0
Monthly	None	0.0	0.0	0.0
Semi-Annually	Visual inspection/lubrication of bearing and seals.	0.5	2.5	10.0
Annually	Visual inspection for general mechanical condition.	0.5	2.5	10.0
	Check grease in gearbox.	0.5	2.5	10.0
	Visual inspection of snap rings.	2.0	10.0	40.0
	Total Labor Hours	3.5	17.5	70.0

1. Lifting units with use of spreader bar
2. Placing unit at installation angle
3. Use of lifting brackets (for units >4500 lbs.)

LOW PROFILE MEANS REDUCED CONSTRUCTION COSTS

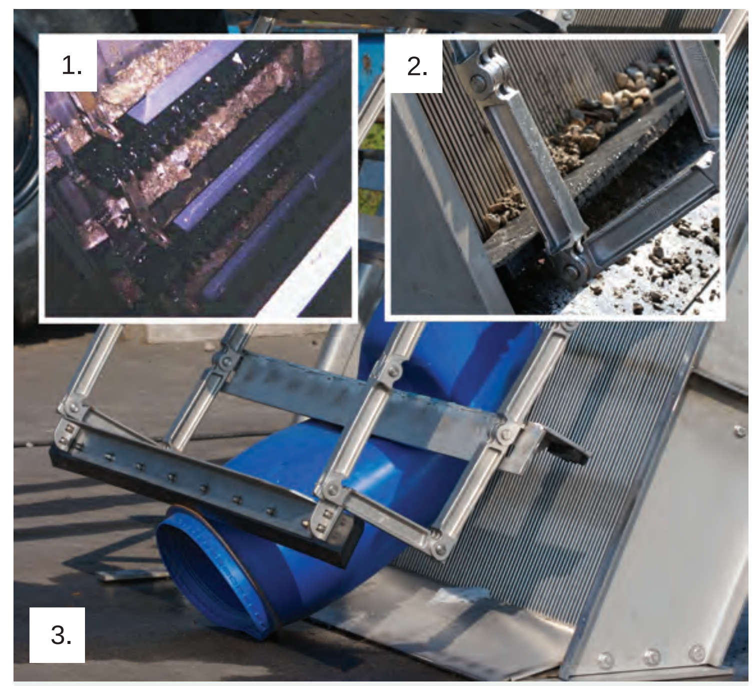
The tougher functionality of the Duperon® FlexRake®, proven through repeated grease attacks and high I & I, was just one benefit of the equipment's installation in Phoenix, Arizona. During plant upgrades, the low profile of the Duperon® FlexRake® saved over $1M in construction costs when compared to previous equipment.

UNINTERRUPTED BY GREASE AND GRIT ATTACK

In 2004, the City of Monroe, Michigan participated in a "cleaning project" initiated for the purpose of raising awareness of the grease problem within commercial business concerns such as car washes (wax) and restaurants (grease). Prior to the project, influent sewer lines were chemically treated to break down the accumulation of grease, wax and similar solids in successive stages. As was typical, one Duperon® FlexRake® in the City's 6 foot channel was in operation for the project.

Unexpectedly, grease, wax and other solids hit the plant nearly at once, creating a "grease attack" at the headworks. This "attack" overwhelmed the conveyor, but the Duperon® FlexRake® continued as normal, removing several inches of grease and debris with each pass at the screen. The Duperon® FlexRake® maintained headworks operations; when the crew returned the following morning, they found plant processes continuing uninterrupted.

"Ingenious...screenings are 50% drier than what I was seeing before..."
-Michigan installation



1. City of Monroe grease attack
2. Stones/grit easily lifted
3. Duperon® FlexRake® flexing around a barrel

PROVEN STANDARD OF EXCELLENCE

In 2006, Duperon® was the first to offer a Five-Year Warranty in wastewater–the industry's toughest standard for equipment excellence.

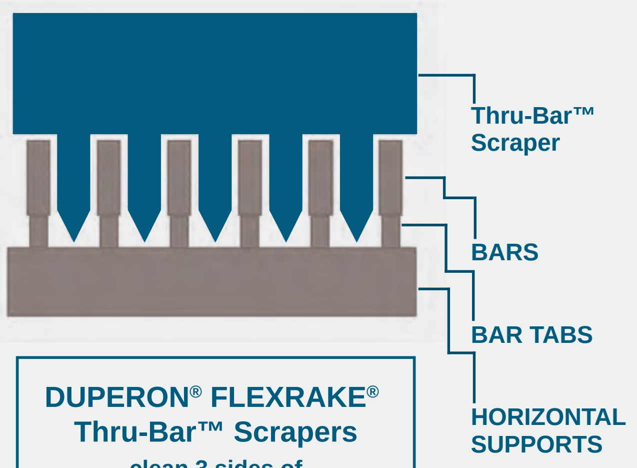
New Mexico

2/3 reduction in disposal volume!
-Pennsylvania installation

DUPERON® SYSTEM OPTIMIZES SAVINGS

An installation in Pennsylvania has reported satisfaction exceeding expectations. Historically, the Authority had disposed of one 3 cubic yard dumpster each week. The dumpster contained extremely wet organic screening waste. The combined installation of a Duperon® FlexRake® and a Duperon® Washer Compactor has reduced this disposal to one 2 cubic yard dumpster every two weeks. With no standing water, there has been significant reduction of weight, thereby reducing trucking and disposal costs. Odor has been considerably reduced, and the dryness of the compacted screenings has improved appearance on disposal. The combined efforts of the Duperon® FlexRake® and the Duperon® Washer Compactor have also had a very favorable impact on maintenance processes downstream.

The Duperon® FlexRake® FP



DUPERON® FLEXRAKE®
Thru-Bar™ Scrapers
clean 3 sides of bar and horizontal cross members - leaving nothing to chance!

DUPERON® FLEXRAKE® FP FOR GREATER THAN 1/2 INCH OPENINGS

The Duperon® FlexRake® FP is typically used in wastewater or other applications where debris can accumulate or wrap around the bars. The scraper is designed to clean 3 sides of the bar. The Duperon® FlexRake® FP model is available in bar spacings greater than .5 – 4 inches. If the site allows, this model ships fully assembled. All components are serviceable above the deck, eliminating confined space entries. The FlexLink™ system flexes and pivots around large debris and removes it. Virtually maintenance free!

CONTINUOUS OPERATION ASSURED

The Duperon® FlexRake® handles grease and grit without difficulty, as well as large or unusual debris conditions ranging from sewer plugs to 2" x 4"s. Varied flow and influx of debris are no longer an issue. The Duperon® FlexRake® is designed to continue running through all conditions – assuring that the plant will continue to function without shutdown or operator intervention.

Grease attack? No problem!

Factory demonstration of 4"x4" entering screen at bottom of channel.

WIDTH-LENGTH	18 inches to 12 feet wide. 10 feet to 100 feet long. (Optional: Units wider than 10 feet are considered dependent on site specifications and should be discussed with Duperon Corporation.)
SINGLE-STRAND WIDTH	Also available for channels 18 inches - 24 inches.
ANGLE OF INSTALLATION	Range from vertical to 45 degrees dependent on site conditions.
MATERIAL OF CONSTRUCTION	Standard: 304 SSTL. Alternative: 316 SSTL.
BAR OPENING	.63 inches to 4 inches.
SCRAPER CONFIGURATION	Spacing: Every 2nd link or 21 inches. UHMW Thru-Bar™ scrapers.
TYPICAL MOTOR/SPEED	1/2 HP, explosion proof, inverter duty - operating speed of .5 - 2 rpm.

The Duperon® FlexRake® FPFS

DUPERON® FLEXRAKE® FPFS, FINE SCREEN MODEL 1/4, 3/8, 1/2 INCH BAR OPENINGS

The smaller the slot opening, the more critical it becomes to keep the bar screen open. The Duperon® FlexRake® FPFS combines the rugged reliability of the Duperon® FlexRake® FP with fine screen openings. Utilizing staging scrapers that clean the face of the bar screen and stainless steel teeth that fully penetrate the bar, the Duperon® FlexRake® FPFS offers precision technology with the ability to adapt to large debris. Duperon has eliminated the need for pre-screening… the powerful combination of stainless steel and UHMW scrapers allows for the best in redundancy and unit performance.

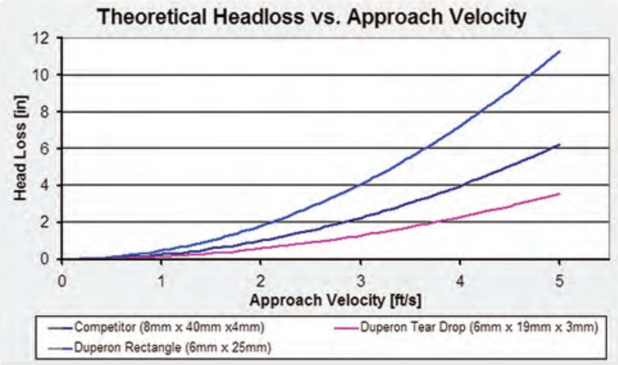
THE BEST SCREENING EFFICIENCY IN THE MARKET

The Duperon® FlexRake® FPFS utilizes custom tear-shaped bars with a 50% screening efficiency for .25 inch bar openings, resulting in more favorable flow characteristics and less headloss. The unique teardrop shape keeps large debris on the surface of the screen for removal by scrapers. Small debris flows right through, and Thru-Bar™ scrapers assure that no debris can accumulate, even on horizontal cross members.

Bar Type	
Sharp-edged rectangular	2.42
Rectangular with semicircular face	1.83
Circular	1.79
Rectangular with semicircular upstream and downstream face	1.67
Tear Drop shape	**0.76**

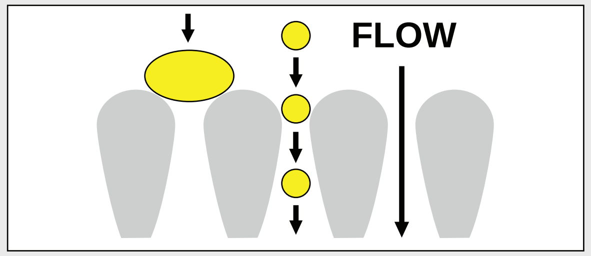
Lin, Shundar. Water and Wastewater Calculations Manual. New York, New York. McGraw-Hill, 2001.

MOST EFFICIENT



EXCLUSIVE ABILITY TO CLEAN THE BOTTOM OF THE CHANNEL

Due to the "square" sprocket action of the FlexLink™, the Duperon® FlexRake® has the unique ability to hit the base plate of the frame with a scraping, shoveling action that moves debris up the screen, eliminating accumulation at the channel bottom plate.

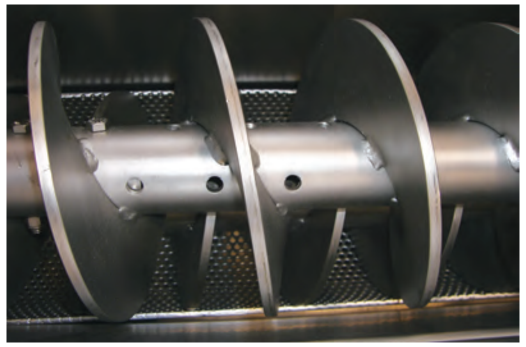


TEAR DROP BARS ARE THE MOST EFFICIENT BARS IN THE INDUSTRY

WIDTH-LENGTH	2 feet to 12 feet wide. 10 feet to 100 feet long.
SINGLE-STRAND WIDTH	Also available for channels 18 inches - 24 inches.
ANGLE OF INSTALLATION	Range from vertical to 45 degrees dependent on site conditions.
MATERIAL OF CONSTRUCTION	304 SSTL. Alternative: 316 SSTL.
BAR OPENING	.25 inch, .38 inch, .5 inch.
SCRAPER CONFIGURATION	Spacing: Every 2nd link or 21 inches. UHMW staging scrapers/stainless steel Thru-Bar™ teeth positioned at maximum ratio of 3:1.
TYPICAL MOTOR/ SPEED	1/2 HP, explosion proof, inverter duty-operating speed .5-2 rpm.

Duperon® ADAPTIVE TECHNOLOGY™

Your Path to the Future℠



DUPERON® WASHER COMPACTOR

Continuing the tradition of simple, efficient, effective products... Exclusive patent-pending positive displacement technology adapts to variations in influent debris. Unique dual-auger design eliminates the need for additional agitation. Flood washing saturates screenings, eliminating clogging issues inherent in fine spray nozzles. Resulting compacted debris is light grey in color, with volume reduction of up to 82%.

DUPERON® AUGER CONVEYOR

The Duperon® Auger Conveyor is flexible (can bend up to 30º) and scalable to site constraints, with modular components that make assembly – and additions – simple. Constructed of abrasion-resistant UHMW and built to uphold the Duperon® tradition of tough durability; powered by the energy-efficient Sumitomo Hyponic drive. A multitude of accessories are available, such as splicing kits, legs, standard mounting holes, and more.

DUPERON® ENCLOSURES

For added convenience and cleanliness, Duperon® enclosures are built to site specifications. Each is available in rugged 304 or 316 stainless steel. Front access panels with options available for SSTL or polycarbonate materials. Rear has lift-off hinged doors with viewing windows. Units without enclosures are optional dependent on site, and should be discussed with Duperon Corporation.

DUPERON® CONTROLS

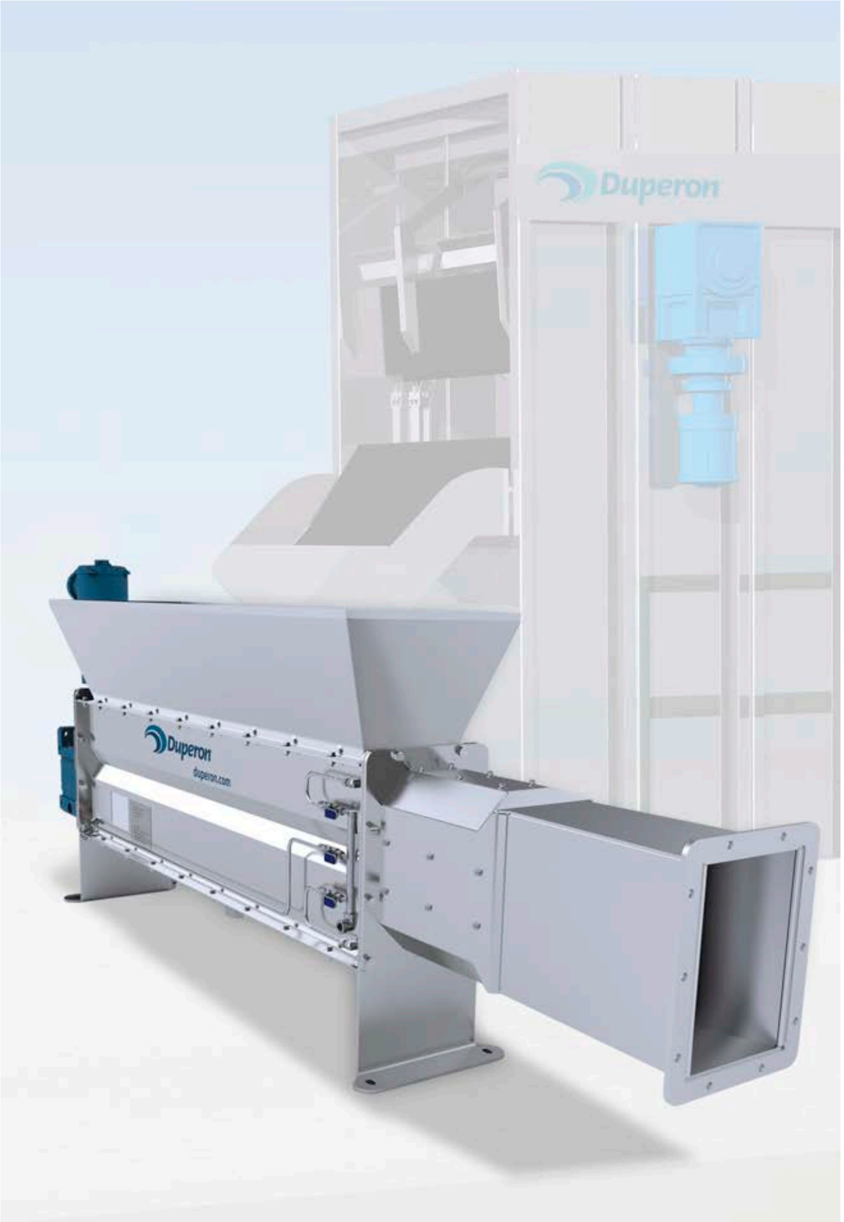
Duperon offers economical standard control packages as well as PLC, enhanced VFD with differential level controls and completely custom packages, to suit your needs. Please contact us for available options.

Duperon®
PRELIMINARY LIQUIDS/SOLIDS SEPARATION TECHNOLOGIES

1200 Leon Scott Court | Saginaw, MI 48601 | P 989.754.8800 | F 989.754.2175 | TF 800.383.8479 | www.duperon.com

WASHING COMPACTING

Self-Regulating Compaction Provides a Reliable, Hassle-Free Way to Reduce Landfill Costs



Washer Compactor

Positive Displacement, Dual-Auger System

Robustly simple, high-efficiency, non-batching process machine that cleans and compacts screenings up to 4 inches. Standard discharge lengths up to 20 feet.

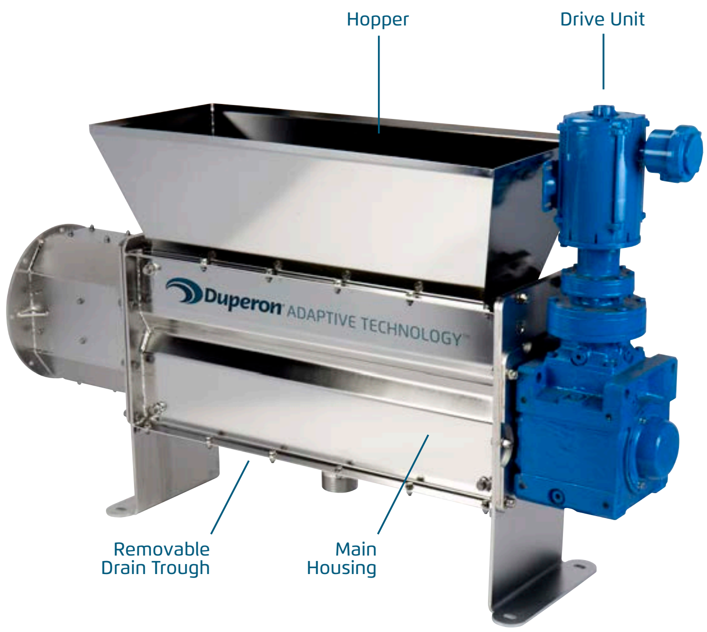
- Consistent Compaction Regardless of Debris Size or Volume (Using Proprietary Compaction Zone*)
- Positive Displacement: What Goes In Comes Out
- Up To 84% Volume Reduction, Up To 60% Dry Solids; Reduces Landfill Costs
- Accepts Non-Standard Wastewater Debris (Rocks, Clothing, Concrete, Metal) up to 4 inches
- Immediate Debris Processing: Low Odor
- Self-Cleaning Strainer: No Brushes Needed

Duperon® ADAPTIVE TECHNOLOGY™
PRELIMINARY LIQUIDS/SOLIDS SEPARATION SYSTEMS

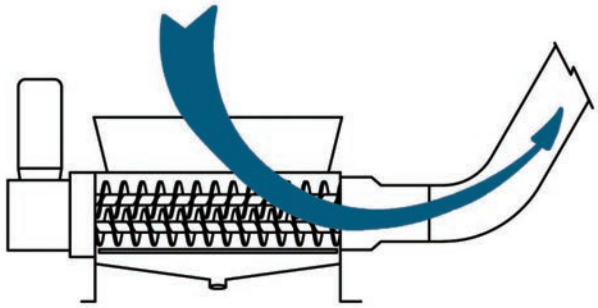
*Patent Pending

The Duperon® Washer Compactor

- Housing Geometry Controls Potential for "Slip Flow" When Processing Grease, Septage and Similar Debris
- Self-Centering Dual Augers Mean No Debris Wrapping
- Non-Clogging Flood Wash Port—Ideal for Non-Potable Water
- Removable Drain Trough Provides Simple Access to Strainer



Washer Compactor shown without Compaction Housing for use with Discharge Extension Option



Non-Batch Operation

WATER
- Utilizes filtered effluent or municipal water
- Washer consumes 3-10 gallons per minute
- Requires 40 PSI-60 PSI
- Drain connection 3" NPT
- Supply connection 1/2" NPT

UTILITY
- 120/240 volt, single phase
- 240/480 volt, three phase (0.6 kW/2.3 kW/3.8kW)

DRIVE
3/4 HP, 3 HP, 5 HP inverter duty motors available

HOPPER
Available in 27", 43" and 67" widths

DISCHARGE CHUTE
Chutes of up to 20' available

MATERIALS OF CONSTRUCTION
- 304 SSTL or 316 SSTL
- SSTL spur gears (17 - 4 PH)

TYPICAL PERFORMANCE
- 30% - 60% dry solids
- 60% - 70% weight reduction
- Significantly decreases odor and fecal content

CAPACITY
Available from: 30 ft^3/hour to 150 ft^3/hour

MAINTENANCE
Application Specific:
Refer to Duperon® Life Cycle Cost Sheet

DISCHARGE EXTENSION OPTION
Transports debris up to 40' in any direction, without the use of a conveyor

To Learn more about Duperon® Adaptive Technology,™ scan this QR code or visit www.duperon.com

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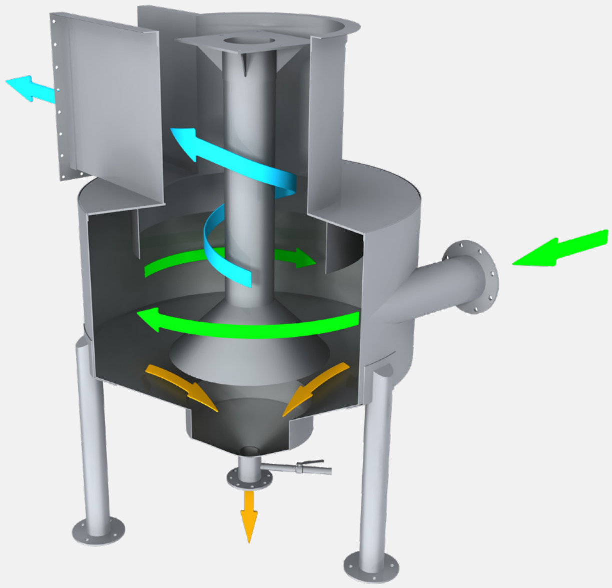
Grit King®

All Hydraulic Grit Separation

Grit King® Flow Pattern



Product Summary

Low headloss with phenomenal performance

The Grit King® is an advanced hydrodynamic separator that augments gravitational forces to separate grit from water. The Grit King® is an economical choice for new or existing municipal or industrial wastewater applications.

Performance

» Removes 95% of particles equal to or greater than 75 microns at the design flow rate

» Less than 20% volatile solids and greater than 60% total solids when paired with a Hydro washing and dewatering system

» Typically less than 12 inches (30 cm) headloss at peak flow and less than 6 inches (15 cm) at average daily flow

Capacity

» Single units can handle flows as low as 0.25 Mgal/d (11 L/s) and multiple units can be provided to handle virtually any flow

» Turndown ratios for a standard design unit are 4:1 from peak to average flow. Note: ratios in excess of 15:1 can be accommodated

» For larger applications, typically flows over 10 Mgal/d (440 L/s), the specialized internal components can be mounted in a concrete chamber

How it Works

Flow is introduced into the Grit King® via a tangentially positioned inlet causing a rotational flow path around the dip plate. The flow spirals down the wall of the chamber as solids settle out by gravitational forces and forces created by the rotating flow (green arrow). The grit collects in the grit pot as the center cone directs flow away from the base, up and around the center shaft into the inside of the dip plate (blue arrow).

The upward flow rotates at a slower velocity than the outer downward flow. The resulting “shear” zone scrubs out the finer particles. The concentrated grit underflow is pumped or gravity fed to a grit classifier for dewatering (yellow arrow). The result is clean dewatered grit with low organic content.

Applications

» New wastewater treatment plants

» Treatment plant retrofits

» Sediment removal pretreatment for potable water

» Grit removal for industrial effluent

» Pre-treatment for MBR and many other process upgrades

» Grit separation in collection system

Benefits

» No moving parts

» No external power source

» Economical to own and operate

» Compact design

» Minimal headloss

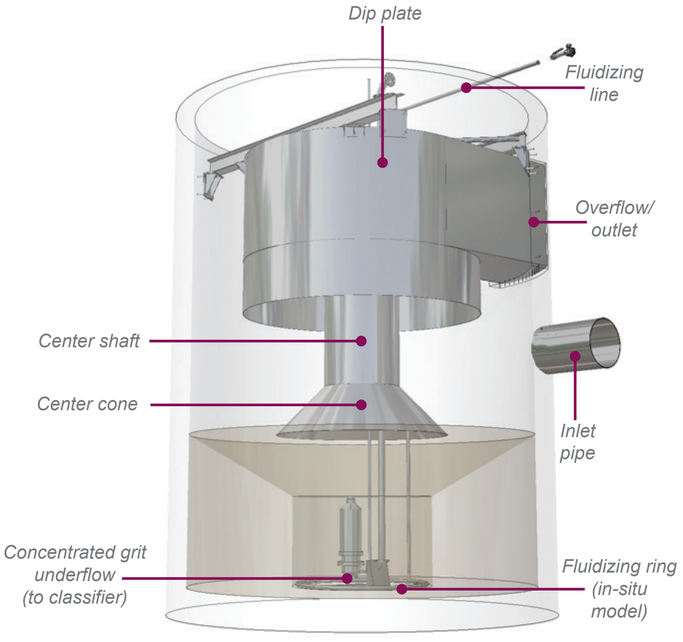
Water & Wastewater Solutions

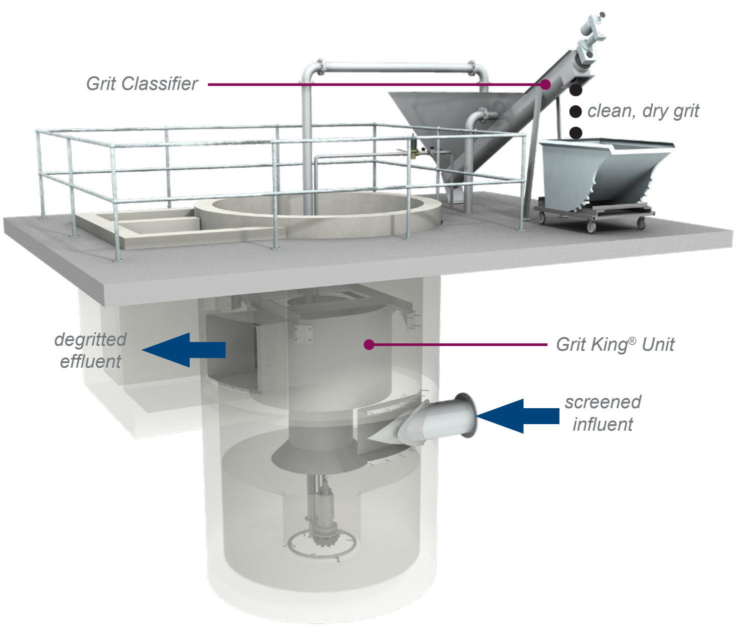
→ hydro-int.com/GritKing

Configurations

» The Grit King® is available as either a free standing or in-situ unit for versatile installation.

» Multiple inlet and outlet configurations are available. The inlet and overflow channel may be rotated 360 degrees about the central axis. Overall elevations can be varied to accommodate local site conditions.





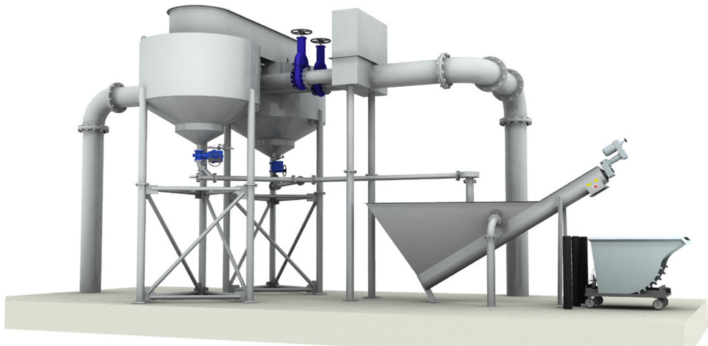
In-Situ Grit King® and Classifier System

Design Notes

» All-hydraulic design with no moving parts ensures a long product life

» Internal flow structuring components create a long flow path aiding settlement and maximizing grit capture

» 304 or 316 stainless steel



Free Standing Grit King® and Classifier System

Hydro International

Hydro International
2925 NE Aloclek Suite 140 | Hillsboro, OR 97124
Tel: (866) 615-8130
Email: questions@hydro-int.com
Web: www.hydro-int.com

Learn more

Visit our website to learn how Grit King® grit separation will protect your plant, reduce your operational costs, and improve the performance of your entire plant.

→ hydro-int.com

V21.1

Appendix F

Primary Clarifier Information Sheets

COP™ Spiral Blade Clarifier

Rapid Solids Removal

ISO 9001 WesTech CERTIFIED QUALITY SYSTEM

WesTech®

Clarifier Optimization Package

The WesTech Clarifier Optimization Package (COP™) is the result of research and design focused on building a better clarifier. Each COP™ is designed for the specific process requirements of each plant. Proprietary algorithms are utilized to result in a clarifier that provides high performance.

Why Choose a COP™ Clarifier?

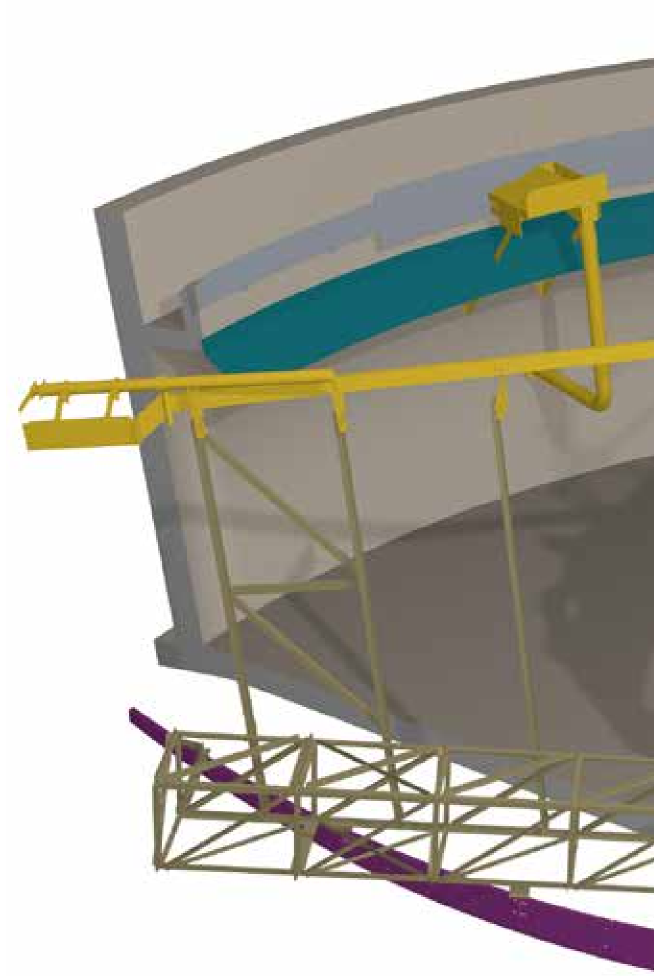
For nearly 30 years, with more than 1,500 installations, WesTech has been improving the performance of both primary and secondary clarifiers with our Clarifier Optimization Package (COP™). WesTech COP™ clarifiers:

- **optimize the clarification process**
- **produce the cleanest possible effluent**
- **maximize underflow concentration**

The influent center column of the COP™ clarifier is sized and ported to both prevent settling and to systematically reduce incoming velocities. WesTech's unique Dual-Gate™ EDI nearly eliminates hydraulic energy as the flow enters the feedwell. Flow enters at the water surface, ensuring that the full volume of the flocculation well is used for gentle mixing and flocculation of the biological solids. Opposing adjustable gates are arranged so that incoming flow impinges on itself, effectively dissipating incoming energy and eliminating focused flow streams that could carry into the clarification zone. The result is a well-flocculated mixed liquor that spreads gently and evenly into the clarifier without disturbing settled solids on the basin floor.

Side-by-side studies show a 27% reduction in effluent suspended solids when using the new Dual-Gate™ EDI versus a conventional EDI in shallow secondary clarifiers.

WesTech's Dual-Gate™ EDI is just one of many benefits provided by the Clarifier Optimization Package. Contact WesTech to find out more about why the COP™ may be a perfect fit for your plant.



Premium Drive Unit

Designed for torque requirements from 1,000 ft-lbs to 6,000,000 ft-lbs, the Premium Drive Unit provides rotational force to the clarifier mechanism while resisting torque loads and overturning moments.

Spiral Rake Blades

Increase sludge transport capacity, providing rapid solids removal, and lower sludge blankets. Eliminate septicity and denitrification.

Density Current Baffle

Eliminates wall currents and prevents short-circuiting. The wall-mounted baffle is low in cost and requires no maintenance.

Scum Removal

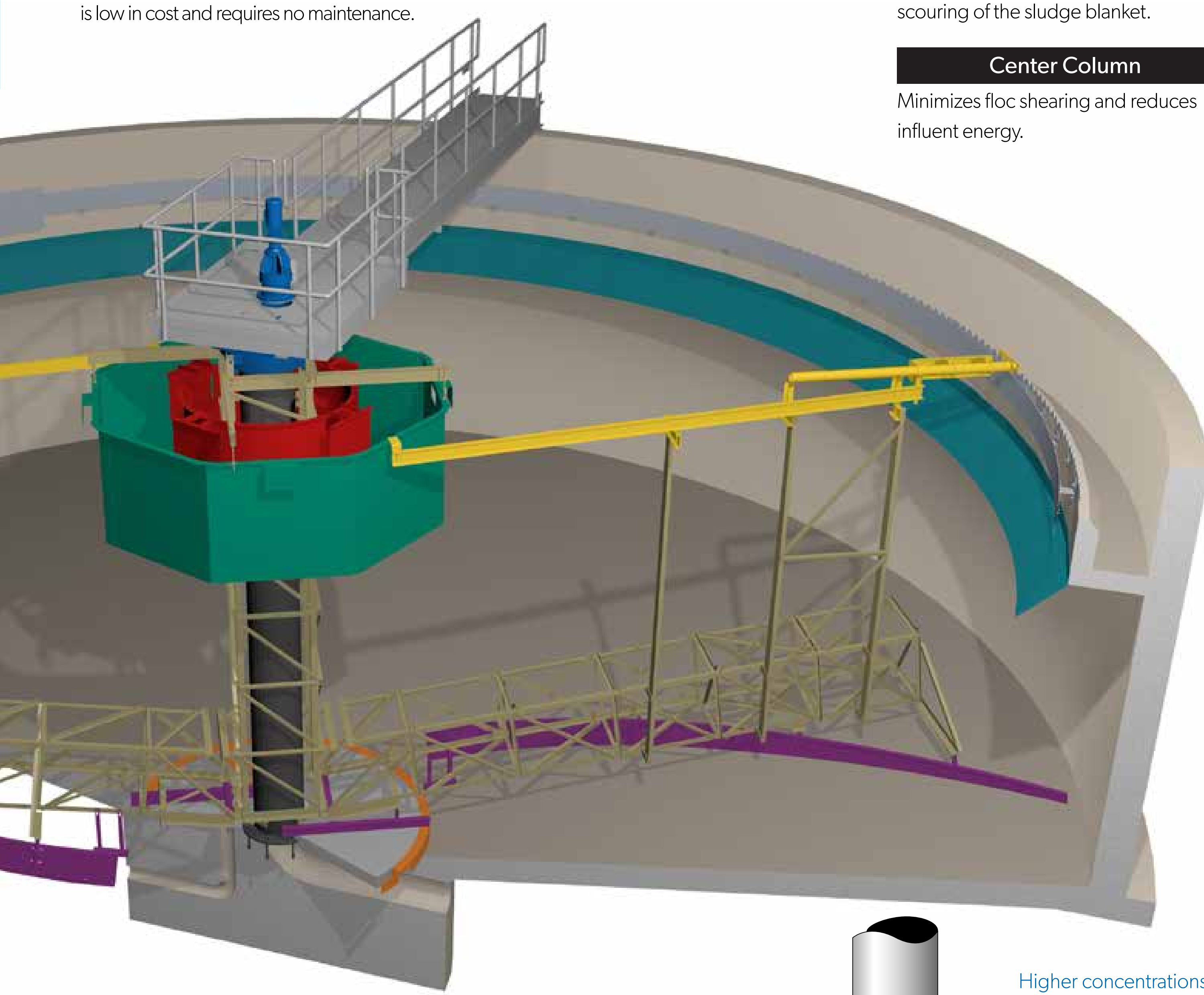
Removes scum build-up from within the feedwell and from the clarifier surface.

Flocculating Feedwell

Promotes hydraulic flocculation in the inlet area and is designed to eliminate scouring of the sludge blanket.

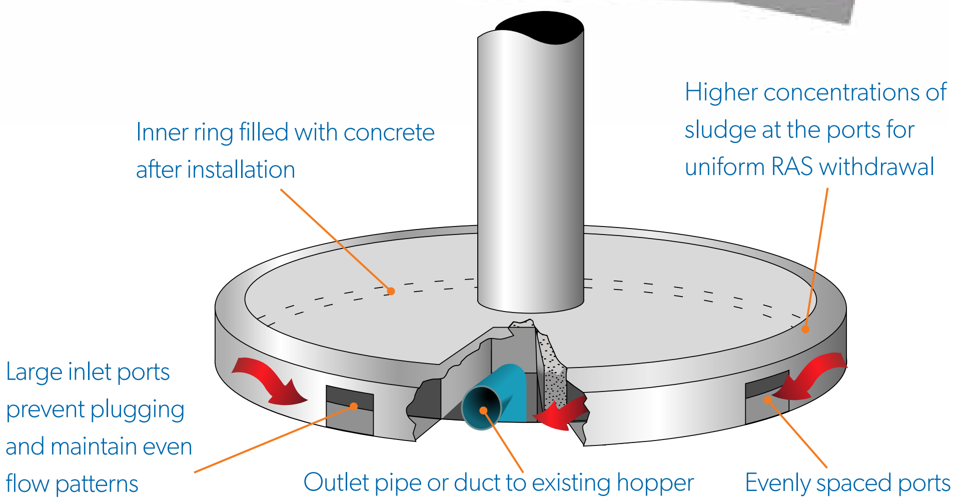
Center Column

Minimizes floc shearing and reduces influent energy.



Sludge Withdrawal Ring

Reduces the depth of the sludge blanket in a secondary clarifier – decreasing sludge scour and increasing hydraulic capacity, as well as reducing the possibility of denitrification and phosphorus removal in BNR processes. The Sludge Withdrawal Ring provides rapid solids removal in conjunction with Spiral Rake Blades.



Represented by:

Tel: 801.265.1000
westech-inc.com
info@westech-inc.com
Salt Lake City, Utah, USA

Appendix G

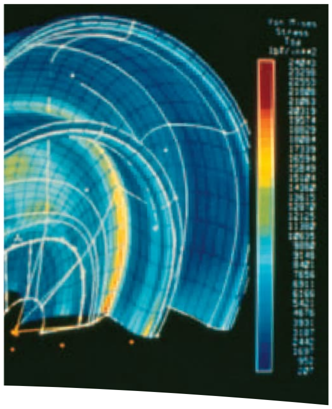
Vertical Solids Handling Pumps (plant pump station)

MVX

Solids-Handling, Wet-Pit Pump

Experience In Motion






Pump Supplier to the World

Flowserve is the driving force in the global industrial pump marketplace. No other pump company in the world has the depth or breadth of expertise in the successful application of pre-engineered, engineered and special purpose pumps and systems.

Life Cycle Cost Solutions

Flowserve is providing pumping solutions which permit customers to reduce total life cycle costs and improve productivity, profitability and pumping system reliability.

Market Focused Customer Support

Product and industry specialists develop effective proposals and solutions directed toward market and customer preferences. They offer technical advice and assistance throughout each stage of the product life cycle, beginning with the inquiry.

Broad Product Lines

Flowserve offers a wide range of complementary pump types, from pre-engineered process pumps, to highly engineered and special purpose pumps and systems. Pumps are built to recognized global standards and customer specifications.

Pump designs include:
- Single-stage process
- Between bearing single-stage
- Between bearing multistage
- Vertical
- Submersible motor
- Rotary
- Reciprocating
- Nuclear
- Specialty

Product Brands of Distinction

ACEC™ Centrifugal Pumps

Aldrich™ Pumps

Byron Jackson® Pumps

Calder™ Energy Recovery Devices

Cameron™ Pumps

Durco® Process Pumps

Flowserve® Pumps

IDP® Pumps

Lawrence Pumps®

Niigata Worthington™ Pumps

Pacific® Pumps

Pleuger® Pumps

Scienco™ Pumps

Sier-Bath® Rotary Pumps

TKL™ Pumps

United Centrifugal® Pumps

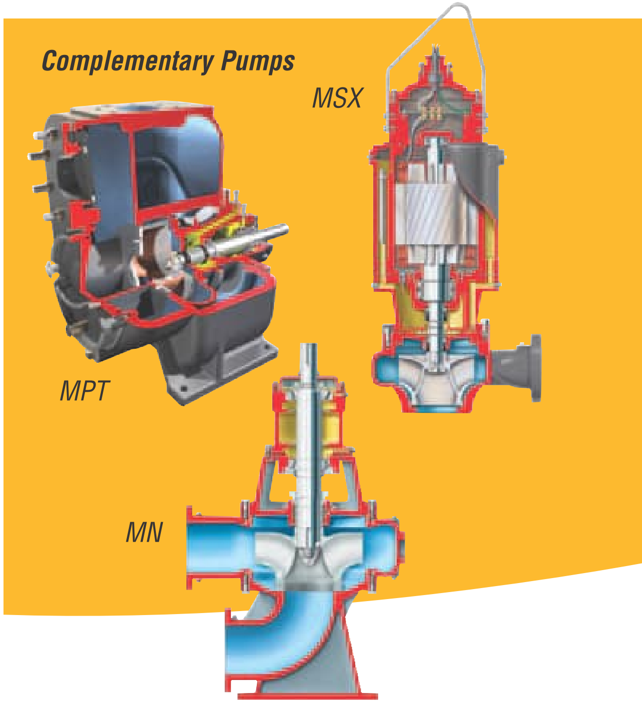
Western Land Roller™ Irrigation Pumps

Wilson-Snyder® Pumps

Worthington® Pumps

Worthington Simpson™ Pumps

MVX Solids-Handling, Wet-Pit Pump



Robust and Dependable

The Flowserve MVX is a rugged wet-pit pump designed for use in solids-handling applications and other wet-pit services. Built and tested in conformance with the standards of the Hydraulic Institute, the MVX non-clog pump boasts numerous reliability and performance enhancing benefits:

- *Large waterways to minimize clogging*
- *The absence of a bearing below the impeller allows unrestricted intake of large solids*
- *Smallest model passes spherical solids up to 76 mm (3 in) diameter; larger models pass spherical solids up to 152 mm (6 in) diameter*
- *Multi-volute design with perfect balance of radial reactive forces for smooth performance*
- *Specially designed solids-handling impeller*
- *Splitter vane to prevent solids from wrapping around the enclosing tube*
- *Enclosed lineshaft to protect bearing surfaces from abrasives*

Typical Applications

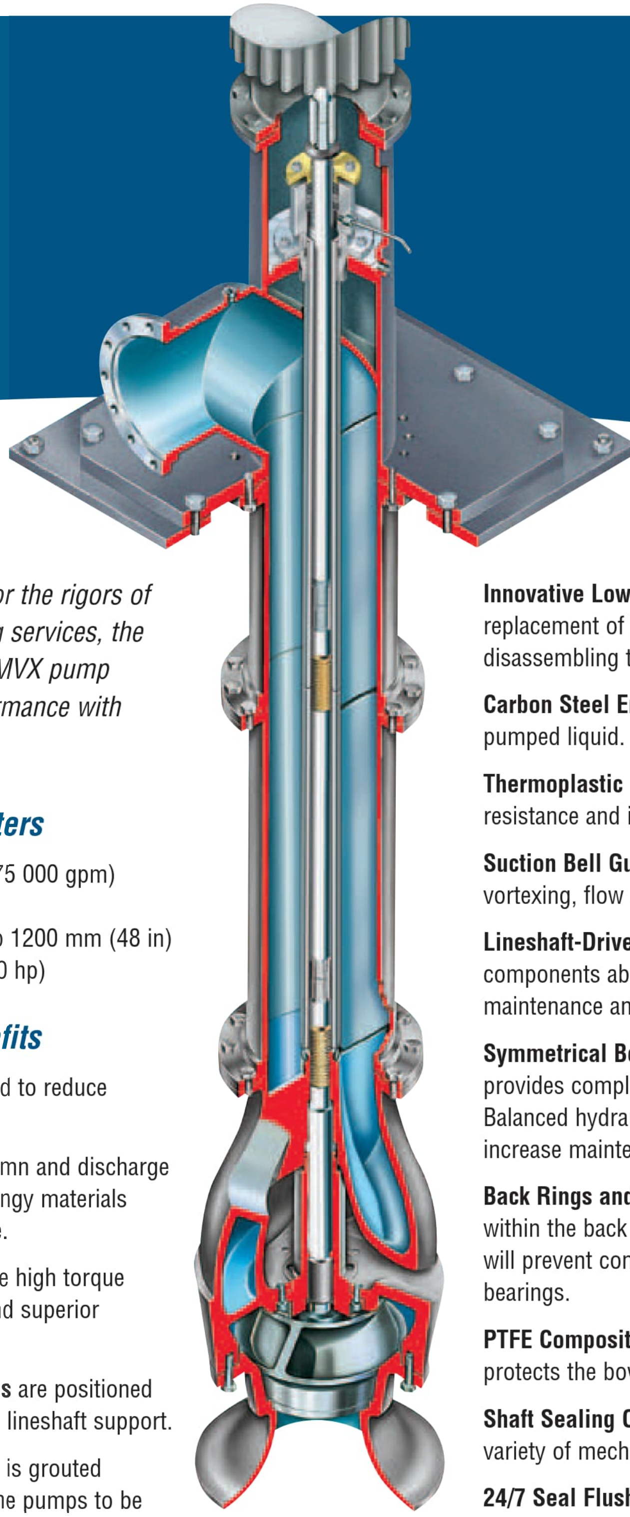
- Raw Sewage
- Return Activated Sludge
- Waste Activated Sludge
- Effluent
- Mixed Liquor
- Filter Backwash
- Industrial Wastewater
- Irrigation
- Flood Protection
- Dewatering
- Leachate
- Trash Pumping
- Raw Water

Complementary Pump Designs

Flowserve also provides the following non-clog, solids-handling pump models:

- MF and MN dry-pit pumps with side or bottom suction
- MPT self-priming pump
- MSX submersible pump

MVX Solids-Handling, Wet-Pit Pump



Specifically designed for the rigors of wet-pit, solids-handling services, the heavy-duty Flowserve MVX pump provides reliable performance with minimal maintenance.

Operating Parameters

- Flows to 17 000 m^3/h (75 000 gpm)
- Heads to 40 m (130 ft)
- Sizes 250 mm (10 in) to 1200 mm (48 in)
- Drivers to 950 kW (1250 hp)

Features and Benefits

Discharge Head is mitered to reduce friction losses.

Splitter Vanes in the column and discharge head guide solids and stringy materials around the enclosing tube.

416 SS Lineshafts provide high torque transmission capability and superior corrosion resistance.

Bronze Lineshaft Bearings are positioned every 1.5 m (5 ft) for firm lineshaft support.

Separate Steel Soleplate is grouted and leveled. This allows the pumps to be removed for service without disturbing the grout.

Column Pipe is constructed in interchangeable 3 m (10 ft) sections and is connected by registered flanged joints to ensure proper alignment.

Innovative Lower Bearing Cartridge design allows replacement of the bottom bowl bearing without disassembling the entire pump.

Carbon Steel Enclosing Tube protects lineshaft from pumped liquid.

Thermoplastic Bowl Bearing offers superior abrasion resistance and increases load carrying capability.

Suction Bell Guide Vanes provide straight, non-vortexing, flow into impeller eye.

Lineshaft-Driven Impeller places all electrical components above flood levels, simplifying maintenance and increasing personnel safety.

Symmetrical Bowl with its multi-volute design provides complete balance of radial reactive forces. Balanced hydraulic forces reduce bearing load and increase maintenance intervals.

Back Rings and Relief Ports reduce the pressure within the back rings to submergence pressure. This will prevent contaminants from freely flowing into the bearings.

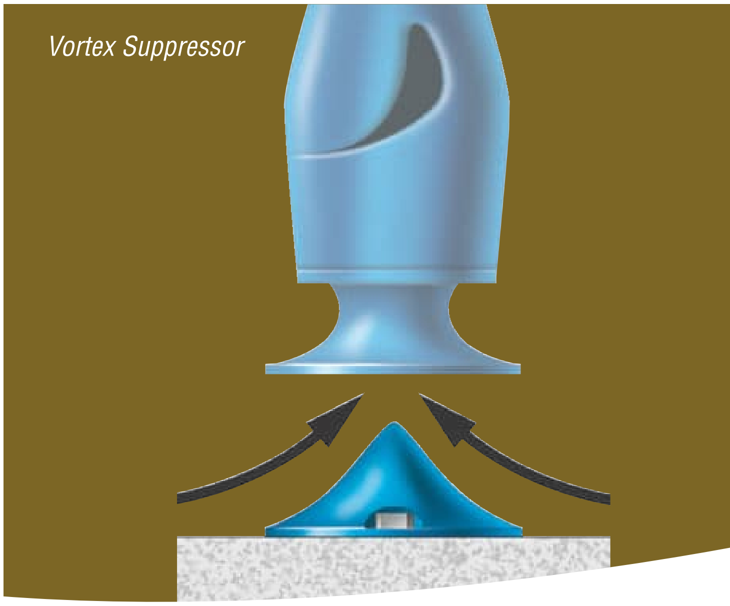
PTFE Composite Lip Seal resists abrasion and protects the bowl bearing.

Shaft Sealing Options include soft packing or a variety of mechanical seal types and mountings.

24/7 Seal Flush System increases pump reliability.

High-efficiency Enclosed Non-Clog Impeller is designed with a minimum number of vanes for maximum capability to pass solids.

Standard Suction Bell Wear Ring and optional impeller wear ring enable renewal of clearances and hydraulic efficiency.



Heavy-Duty Discharge Head Provides Motor Flexibility and Flow Guidance

The MVX's three-section mitered discharge head provides rigid and stable support for solid or hollow shaft P-base motors. The discharge head also incorporates a splitter vane which is blended with the column splitter vane. Together, these splitter vanes guide solids and stringy materials around the pump's enclosing tube and into the discharge without clogging. This design serves to maintain hydraulic efficiency and increase pump reliability.

Enclosed, Mixed Flow Impeller Minimizes Clogging

Designed with a minimum number of vanes and wide passageways to prevent clogging, the MVX impeller is well-suited for solids-handling applications. Vane tips are rounded to prevent the accumulation of stringy materials at the impeller eye. All MVX pumps pass 76 mm (3 in) spherical solids at a minimum.

Back rings and a relief port reduce the pressure at the rear of the impeller to prevent contaminants from flowing into the lower bearings.

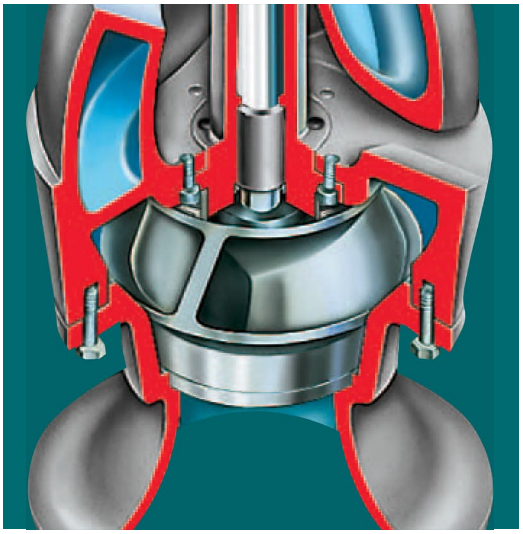
Each impeller is dynamically balanced prior to assembly and positively secured to the shaft with a key, a contoured washer and a locking cap screw.

Self-Cleaning Trench Wet Well

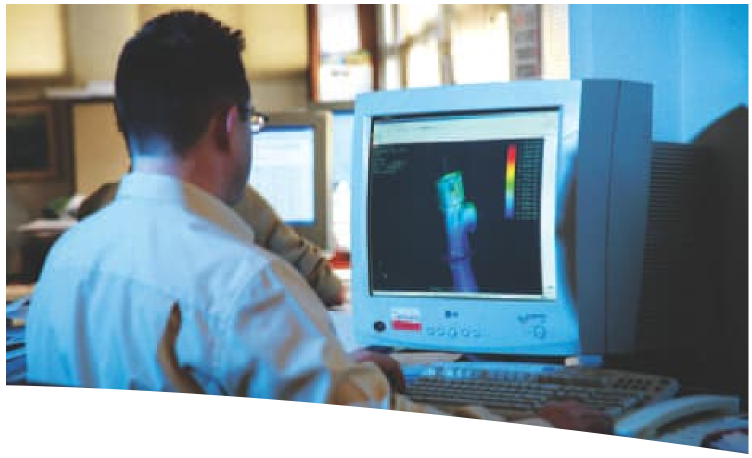
The MVX pump is ideally suited for use in self-cleaning trench wet well applications.

Available Vortex Suppressor Ensures Hydraulic Efficiency

The MVX pump is available with a vortex suppressor to ensure maximum hydraulic efficiency. Constructed of either cast iron or fabricated steel, the suppressor is installed at the bottom of the sump under the pump suction to minimize vortex formation and guide the flow uniformly into the suction bell.



Options and Technical Data



Available Materials of Construction

Stationary Parts	
Pump Head	Steel
Bowl	Cast Iron
Suction Bell	Cast Iron
Lineshaft Bearings	Bronze
Bowl Bearing	Thermoplastic
Lower Lip Seal	PTFE Composite
Shaft Plating	Nickle, Tungsten, Chromium Alloy
Packing Box	Cast Iron
Wear Ring	Stainless Steel
Rotating Parts	
Impeller	Cast Iron
Lineshaft	Stainless Steel
Wear Ring	Stainless Steel

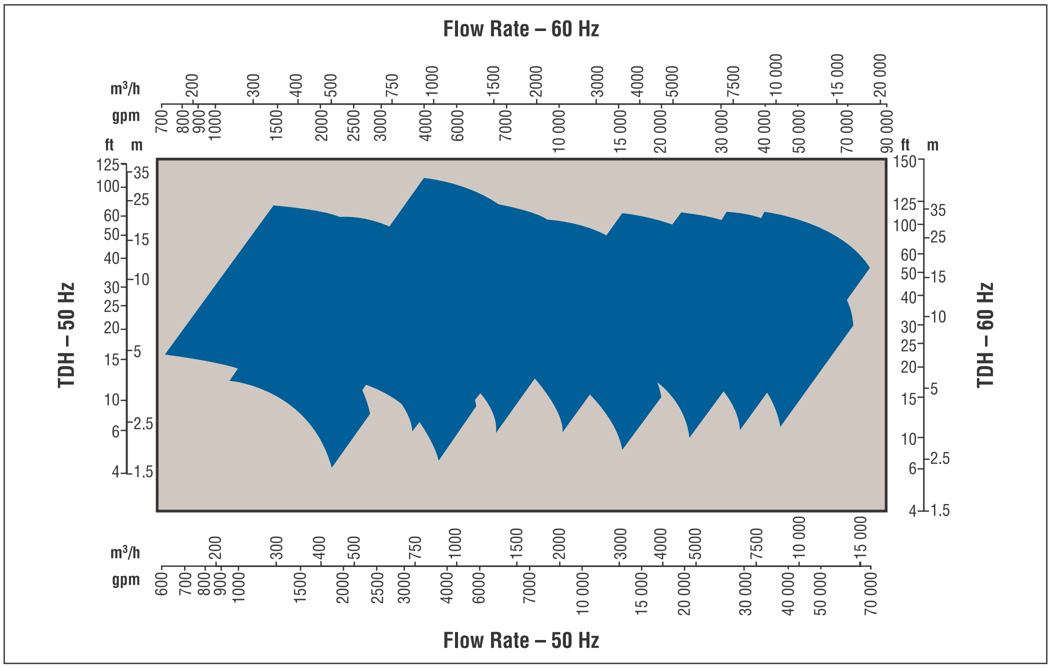
Available Discharge Configurations

MVX pumps are available with above or below ground discharge flanges to suit site conditions.

FEA Ensures Stability

A finite element analysis is performed on all MVX pumps to ensure vibration damage will not negatively impact pump performance. By identifying and rectifying potential vibration sources, maintenance is reduced and pump life is prolonged.

MVX Range Chart



Global Service and Technical Support

Life Cycle Cost Solutions

Typically, 90% of the total life cycle cost (LCC) of a pumping system is accumulated after the equipment is purchased and installed. Flowserve has developed a comprehensive suite of solutions aimed at providing customers with unprecedented value and cost savings throughout the life span of the pumping system. These solutions account for every facet of life cycle cost, including:

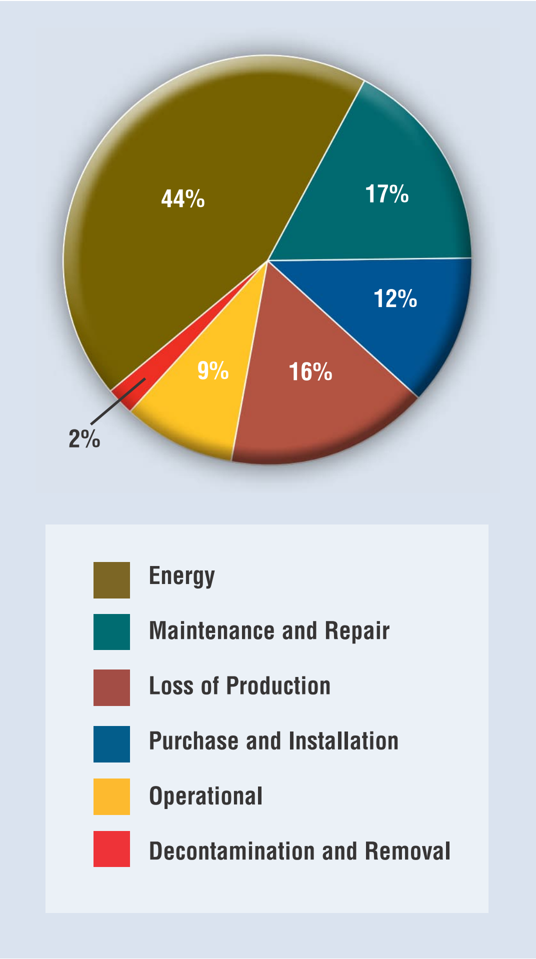
Capital Expenses
- Initial purchase
- Installation

Operating Expenses
- Energy consumption
- Maintenance
- Production losses
- Environmental
- Inventory
- Operating
- Removal

Innovative Life Cycle Cost Solutions

- New Pump Selection
- Turnkey Engineering and Field Service
- Energy Management
- Pump Availability
- Proactive Maintenance
- Inventory Management

Typical Pump Life Cycle Costs[1]



[1] While exact values may differ, these percentages are consistent with those published by leading pump manufacturers and end users, as well as industry associations and government agencies worldwide.

FLOWSERVE

USA and Canada
Flowserve Corporation
5215 North O'Connor Blvd.
Suite 2300
Irving, Texas 75039-5421 USA
Telephone: +1 937 890 5839

Europe, Middle East, Africa
Flowserve Corporation
Parallelweg 13
4878 AH Etten-Leur
The Netherlands
Telephone: +31 76 502 8100

Latin America
Flowserve Corporation
Martín Rodriguez 4460
B1644CGN-Victoria-San Fernando
Buenos Aires, Argentina
Telephone: +54 11 4006 8700
Telefax: +54 11 4714 1610

Asia Pacific
Flowserve Pte. Ltd.
10 Tuas Loop
Singapore 637345
Telephone: +65 6771 0600
Telefax: +65 6779 4607

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To find your local Flowserve representative:

For more information about Flowserve Corporation, visit www.flowserve.com or call +1 937 890 5839.

flowserve.com

Appendix H

Secondary Rectangular Clarifier Information Sheets

ENVIREX® CHAIN & SCRAPER SLUDGE COLLECTOR SYSTEMS & COMPONENTS

EVOQUA IS THE TECHNOLOGY LEADER IN SLUDGE COLLECTORS

Envirex® rectangular sludge collector systems and components are made of advanced materials and designed for long life and reduced wear. They offer more options, material choices and sizes than anyone else in the industry. All systems and components are designed to meet the specific requirements of each installation, whether for new construction or when retrofitting existing collectors.

❶ Carrier Chains

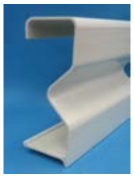
Envirex® NCS720S Chain: This is the worldwide standard for molded collector chain. Lightweight and easy to install, it provides wear resistance, chemical resistance, and long service life. Some of the original installations have over 20 years of successful operation.

Envirex® HS730 Chain: Constructed out of high-strength composite materials, Loop Chain is suited for collectors that are heavily loaded or are over 300 ft (90 m) in length. It is the only non-metallic collector chain that offers strength nearly equal to cast and stainless steel chain at a fraction of the weight.

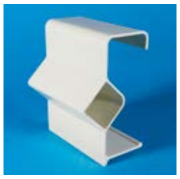
Envirex® ENV715 Chain: Manufactured out of Series 400 stainless steel with hardened pins and bushings, ENV715 collector chain provides excellent strength and corrosion resistance. This chain is suitable for applications with elevated grit levels or sludge loads where a stronger, more robust chain is required. It is especially suited for plants using stacked (double deck) collectors where the collectors can't be visually inspected or easily accessed.

❷ Fiberglass Scraper Flights

Envirex scraper flights are pultruded out of fiberglass for consistent shape, quality and performance. The fiberglass is totally encapsulated in a water resistant resin to prevent wicking, ensuring the flights remain strong and stiff throughout their service life. The standard size is 3 inch by 8 inch (76 mm x 203 mm) and will fit existing F28 attachment mounting hole patterns.

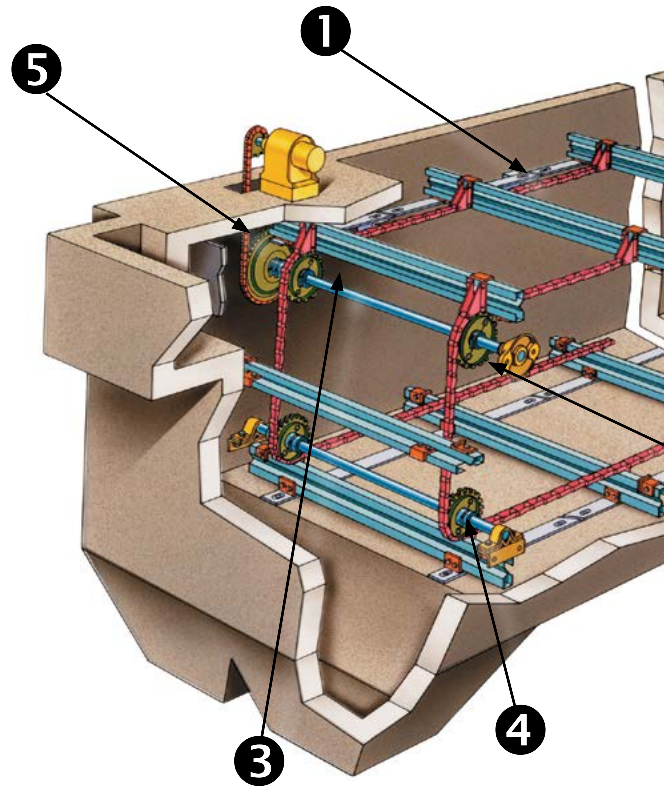


Sigma Plus Flights: This flight is an improvement over conventional channel flights due to its transverse concave indentation. With 60% greater structural support compared to a channel flight, it can be installed in collectors up to 25 feet (7.6 m) wide.



Diamond Flights: This high strength flight can handle heavy sludge loads or be used in tanks up to 32 feet (10 m) in width. This special design gives it exceptional resistance to deflection and twist.

Extensions: Envirex flights can be provided with an integral face extension to permit more effective movement of lighter secondary or alum sludge, which can flow over shorter flights. It also provides added stiffness and strength for challenging applications. Sigma Plus extensions are available in 3 inch (76 mm) and 7 inch (178 mm) heights, and the Diamond is available with a 4.5 inch (114 mm) extension.



❸ Shafting - Head

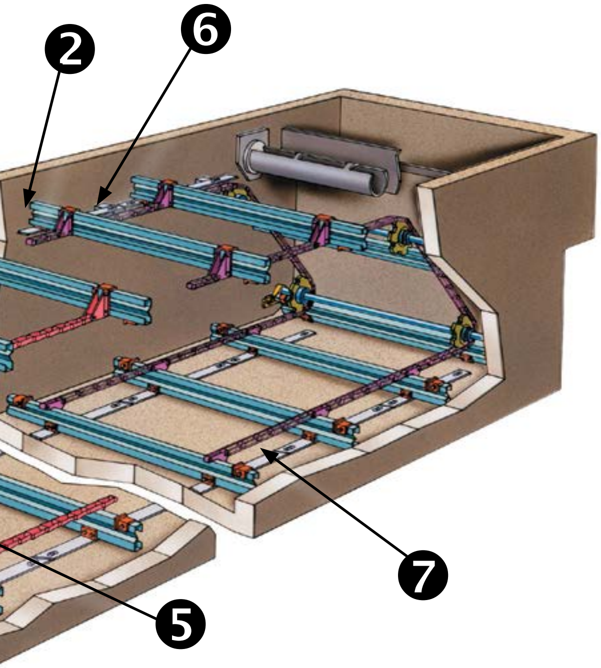
Metallic: Solid construction up to 25 ft (7.6 m) or torque tub to 30 ft (10 m), keyed to suite. Available in carbon or stainless steel.

Non-metallic: This new assembly consists of a filament wound fiberglass unitube with UHMW PE end bearings. The tube rotates over fabricated stainless steel wall supports to provide proper load absorption. The result is a headshaft that is lightweight, corrosion resistant, and doesn't require additional external lubrication.

❹ Shafting - Corners

Full width: Solid construction for use in either live (in bearings) or static (fixed, not rotating) applications. Available in carbon or stainless steel.

Stub shaft: Cast iron tripod with extendable metallic stub end to accommodate tank wall irregularities.



❺ Sprockets

Collector: Non-metallic and split construction for easy installation. Integrally molded hubs, tooth profile and chain saver rim for optimum integrity and strength. Captured keyway or set screwed for headshaft sprockets to ensure accurate location.

Driver: Non-metallic teeth on a metallic hub with torque overload protection.

Driven: Non-metallic and split construction for easy installation. Dished to accommodate wall bearings and to avoid contact with flights. Replaceable or integral teeth are available.

Materials: Teeth in polyurethane or cast nylon. Bodies in polyurethane, cast nylon or cast iron.

❻ Return Tracks

Angles: Wall mounted supports with replaceable UHMW PE wear strip for low friction and extended service life for flight wear shoes and support rails. Non-metallic wall brackets that are adjustable in the field to ensure proper flight tracking along the collector. Available in fiberglass, carbon or stainless steel.

J-Track: Named for the unique shape of the main fiberglass structural member, this special configuration eliminates twisting and bowing for track support spacing greater than 20 ft (3 m). A UHMW PE wear strip slides on top of the J, eliminating the need for mounting hardware, maximizing the effective wearing thickness.

❼ Wearing Strips

Floor: The Envirex wear strip system is attached directly to the tank floor to conform to rough concrete surfaces and uneven expansion joints. Manufactured out of UHMW PE material for low friction.

C-Rail: The floor-mounted version of the wear strip used with the J-Track. T-shaped cleats accommodate the special wear strip, eliminating mounting hardware and maximizing the effective wear shoe.

Return Track: Same as the floor wear strips, but attached to fiberglass return track with self-tapping screws to reduce installation time. Can also be attached to metallic return tracks with weldable washers.

We offer complete installation and after-sales services to help you protect your investment.

- Our experienced field service personnel—the largest group in the industry—can handle a complete upgrade, or do portions of it assisted by your personnel.
- We can handle the installation of new collectors, as well, working with your contractors or others. They can perform annual inspections, advise on inventory requirements and, of course, be on-site for emergencies.
- We can upgrade or retrofit any manufacturer's sludge collector with new, non-metallic components. The renovated collector will run smoother and require far less maintenance than the original.
- For replacement parts, we have the most extensive inventory in the business, and can ship from stock immediately when required.

Envirex®
an EVOQUA brand

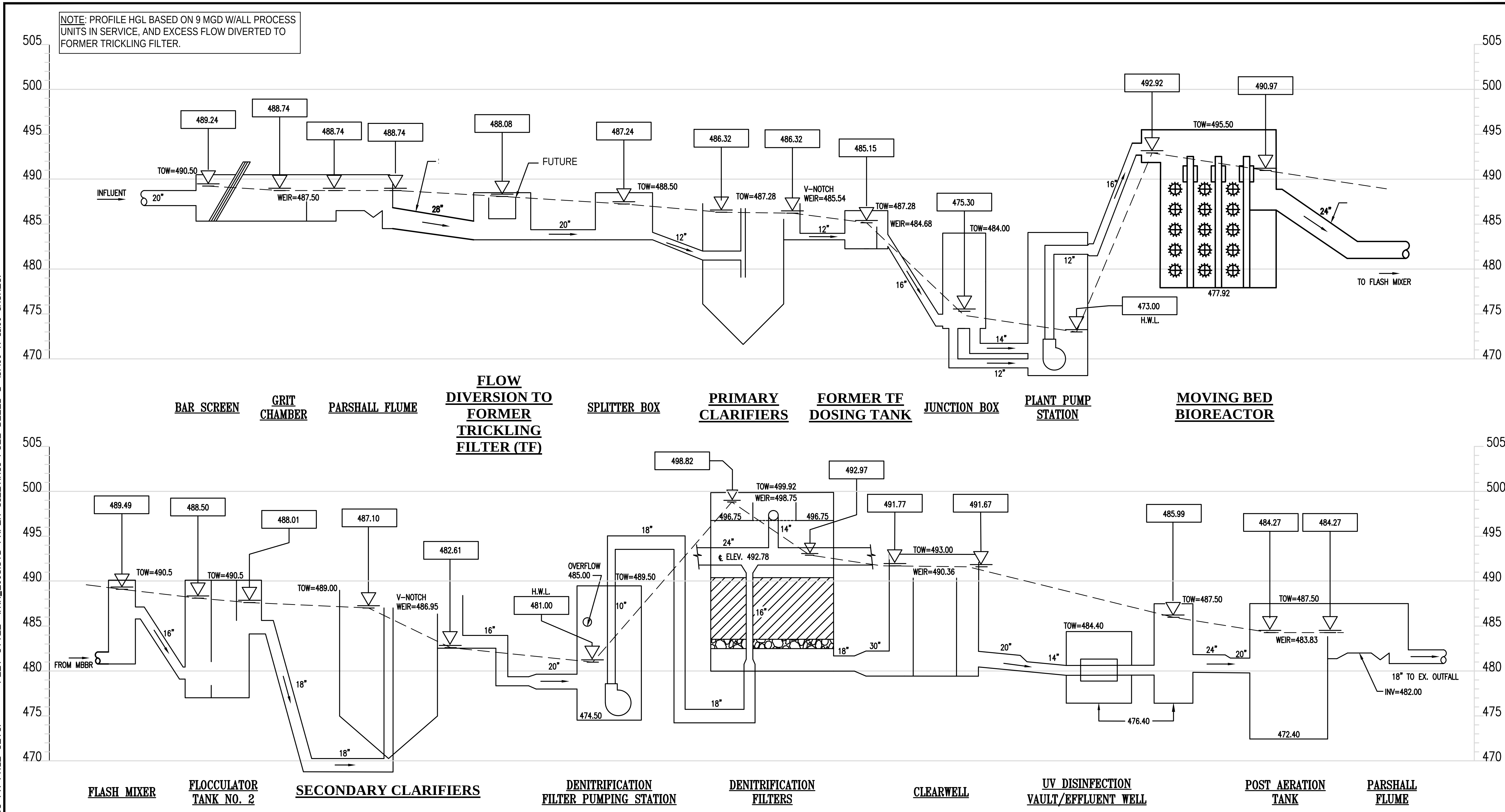
EVOQUA
WATER TECHNOLOGIES

2607 N. Grandview Blvd, Suite 130, Waukesha, Wisconsin 53188

+1 (866) 926-8420 (toll-free) **+1 (978) 614-7233** (toll) **www.evoqua.com**

Appendix I

Preliminary Plant Hydraulic Profile



TOWN OF WARRENTON

WWTP UPGRADE AND EXPANSION

PRELIMINARY HYDRAULIC PROFILE

SCALE:

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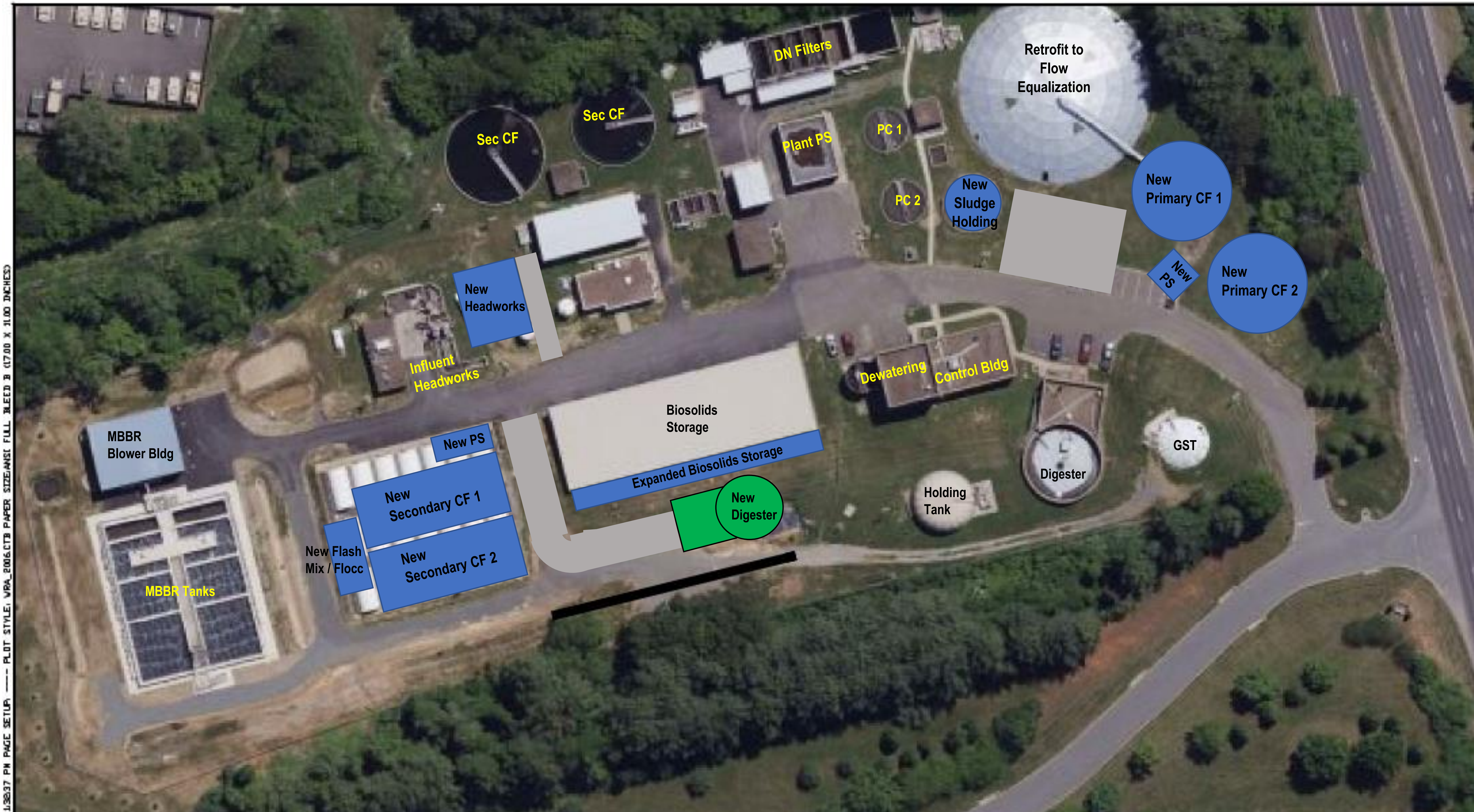
Appendix J

Proposed Facility Layouts (A & B) – Plant Expansion



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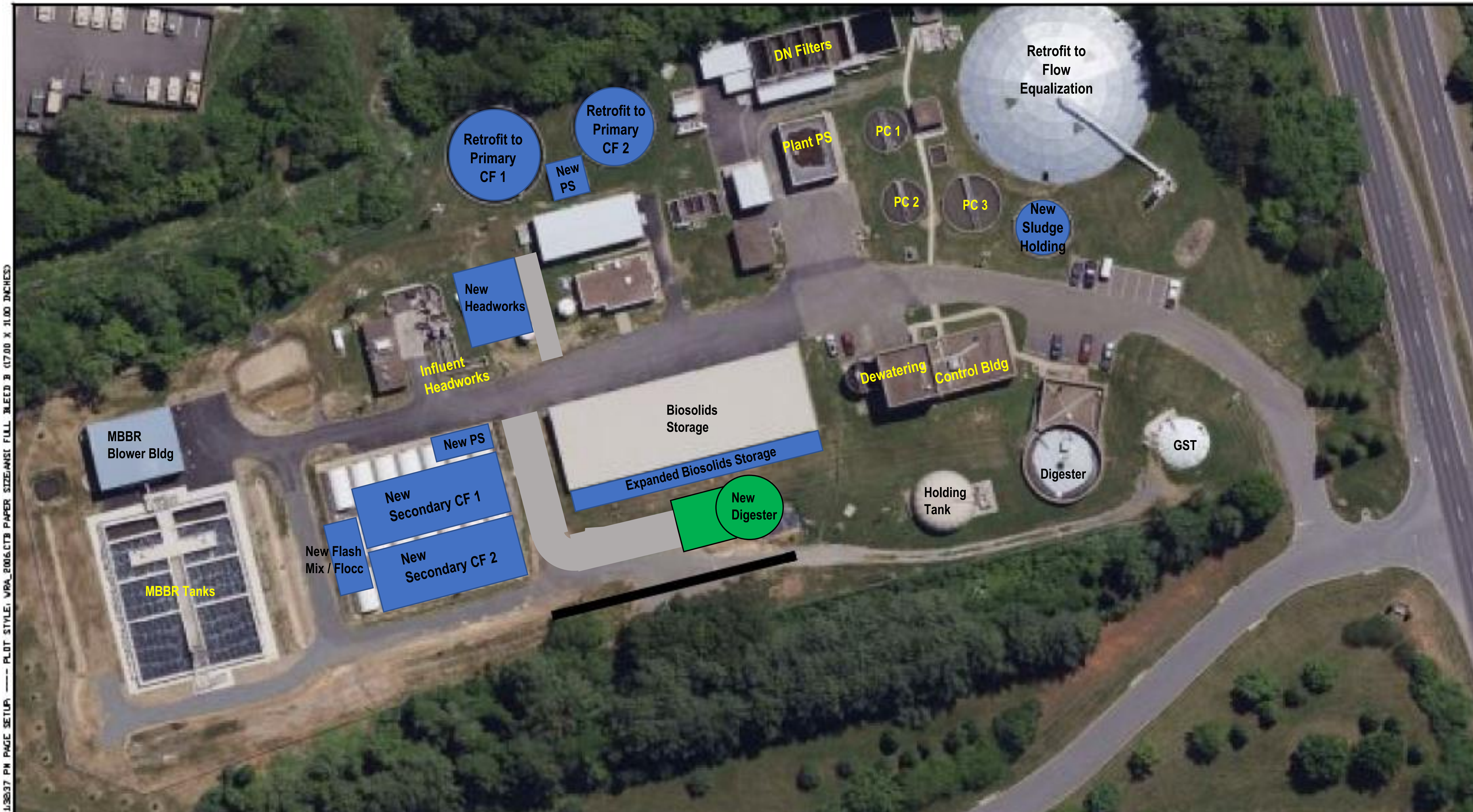
			DATE: DECEMBER 2021



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Appendix K

Solids Handling Facilities Report (February 2020)

Wastewater Treatment Plant

Solids Handling Facilities Upgrade and Expansion

Facility Plan

Town of Warrenton, VA

Department of Utilities

February 2020 *(rev March 2022)*

WRA

WRA WO 18560.000 & 18667.000

TOWN OF WARRENTON WASTEWATER TREATMENT PLANT
SOLIDS HANDLING FACILITIES UPGRADE AND EXPANSION

EXECUTIVE SUMMARY

The Town of Warrenton owns and operates an advanced wastewater treatment plant (WWTP) permitted for 2.5 million gallons per day (MGD) average daily flow (ADF). As plant flows have gradually increased in recent years, the Town recognizes the need to assess the reliable treatment capacity of the existing facilities and what upgrades would be required if the treatment capacity were to be expanded. In May 2017, WRA prepared a Plant Capacity Evaluation report identifying the facility improvements needed to expand the plant capacity by 20%, to an ADF of 3.0 MGD. A subsequent Plant Capacity Evaluation Summary considered potential expansion of the plant to 3.5 MGD and ultimately to 4.0 MGD.

The Town has requested a further evaluation specific to the existing solids handling processes, and alternatives for upgrading and expanding the solids handling capacity in step with the plant's liquid treatment capacity from the current 2.5 MGD to 3.0 MGD and 3.5 MGD.

This Report identifies the condition of the existing infrastructure, the solids process upgrade and expansion needs. Based the recent historical solids produced and the projected amounts at future flows, along with an assessment of the existing solids handling facilities, the following phasing of upgrades is recommended.

Phase I: Near-term at current flows:

- Refurbish existing gravity sludge thickener (GST) including replacement of sludge mechanism, bridge, and cover, and repair concrete as needed. Consider provisions to add diluting water and/or chlorine to the GST feed.
- Consider replacing existing digester plug valves to improve operability. Regrade around the digester tank.
- Expand the dewatered sludge storage area as needed.

Phase II: Plant flows near 2.5 MGD Permitted Capacity:

- Begin planning for and design a new second 50 ft diameter primary digester and associated facility in anticipation of a plant capacity expansion to 3.0 MGD as flows near the current permitted capacity.
- A new electrical service will be required for the second digester facility.
- Upgrade and replace process equipment (heat exchanger and pumps) and electrical MCC for the existing digester. This work maybe required earlier as part of Phase I.
- Consider increasing dewatering capacity; replace existing BFP with large unit or replace with dewatering screw press

Phase III: Plant Expansion to 3.0 MGD and 3.5 MGD:

- Assuming a new second digester is implemented in Phase II and depending on the performance of the existing Gravity Sludge Thickener (GST) when flows approach 3.0 MGD, consider replacing with a larger GST.
- Further expand the sludge storage area as needed.

Preliminary planning level construction costs are included in **Table 1**.

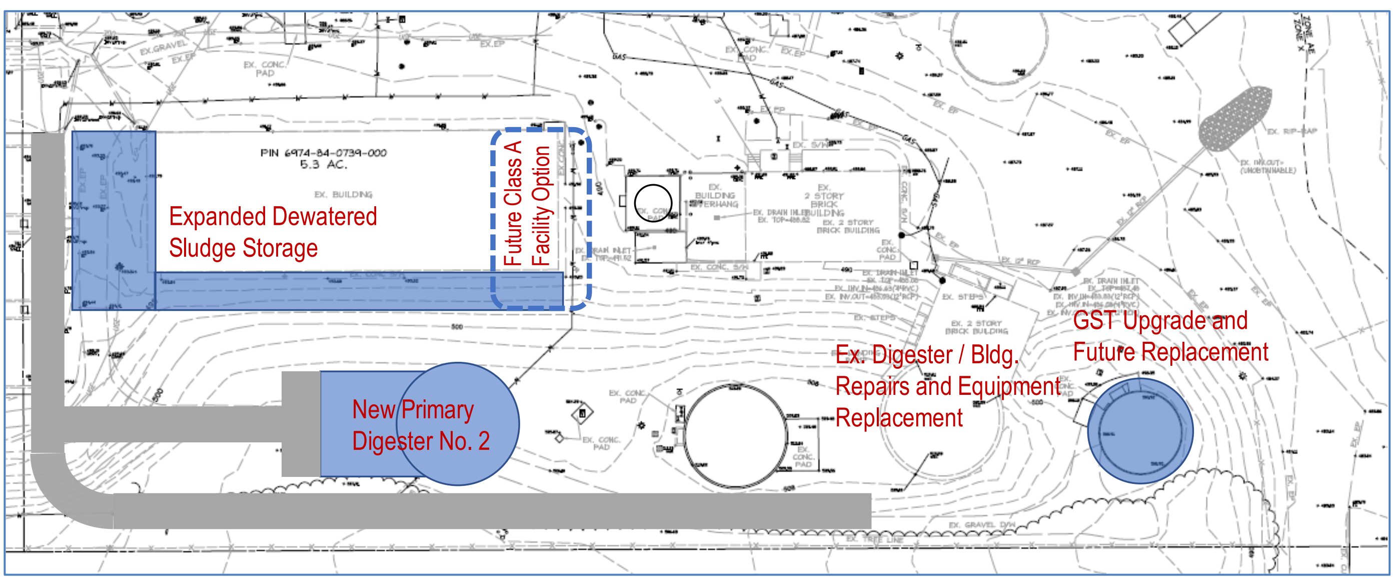
Table 1: Solids Facility Improvements Planning Level Construction Costs

Phase	Upgrades	Planning Level Construction Costs[1]
I	Refurbish Existing GST Replace Existing Digester Valves and Regrade Expand Dewatered Sludge Storage	$1.0M - $1.5M
II	Add New Primary Digester Replace Existing Digester Equipment Provide New Electrical Service	$7.5M - $8.5M
III	Replace GST (with larger unit) Further Expand Dewatered Sludge Storage	$1.25M - $1.75M

[1] Costs do not include Engineering and Administration (2021 dollars)

As discussed in **Section 3**, depending on biosolids management and future regulations, the Town may plan for and possibly build a new Class A biosolids facility. The facility would include a new sludge dryer, building and associated process equipment and would involve a substantial capital cost (in the range of $10M - $12M).

A schematic site plan is shown below for the areas of solids handling facility improvements.



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APPENDICES

1 BACKGROUND

The Town of Warrenton owns and operates an advanced wastewater treatment plant permitted for 2.5 million gallons per day (MGD) average daily flow (ADF). The original plant was constructed in the late 1950's followed by capacity expansions in the 1970's and early 1990's to its current capacity. The existing facilities include preliminary treatment (screenings and grit removal) and primary treatment. Secondary biological treatment and ammonia removal is provided by a conventional trickling filter (TF) and a Rotating Biological Contractor (RBC) process which also provides for the required ammonia removal. Construction is currently underway to replace these aging units with a "Moving Bed Bio-Reactor" (MBBR) treatment process. The MBBR process is a newer and more efficient technology that combines the treatment functions of the trickling filter and RBCs into one process tank. In the late 2000's the plant was upgraded to provide for enhanced nutrient removal (total nitrogen and phosphorus) through post-denitrification filters and chemical addition. Tertiary effluent is disinfected through a UV-system and aerated before final discharge.

As plant flows have gradually increased in recent years, the Town recognizes the need to assess the reliable treatment capacity of the existing facilities and what upgrades would be required if the treatment capacity were to be expanded. In May 2017, WRA prepared a Plant Capacity Evaluation report identifying the facility improvements needed to expand the plant capacity by 20%, to an ADF of 3.0 MGD. In July 2019 WRA prepared a Plant Capacity Evaluation Summary that considered potential expansion of the plant up to an ADF capacity of 4.0 MGD.

The Town has requested a further evaluation of the existing solids handling processes, and alternatives for upgrading and expanding the solids handling capacity. For planning level purposes, the solids process will consider a corresponding liquid side treatment expansion from the current 2.5 to 3.5 MGD.

This Report identifies the condition of the existing infrastructure, the solids process expansion needs, and provides a basis of design for an upgrade with provisions for expansion of the plant's solids handling facilities.

2 EXISTING SOLIDS HANDLING FACILITIES AND OPERATION

2.1 Existing Facilities

The plant produces primary sludge, secondary sludge from the RBCs and tertiary sludge from the DN filters. Metal salt (poly-aluminum chloride, PACL) is added to the secondary clarifiers for improved solids and chemical phosphorus removal. Sludge is also received from the Town's water treatment plant as it is discharged through the sanitary sewer system.

Settled primary and secondary sludges are withdrawn intermittently from the clarifiers through telescoping valves into separate sludge sight wells. Primary sludge is withdrawn between 8:00 AM and 12:00 AM (16 hours over two shifts). The primary sludge sight well (3,000 gallons) is filled 4-5 times during this period and pumped to the gravity sludge thickener (GST). It takes about one hour to pump out the well. Secondary sludge is withdrawn and pumped to the GST for 15 minutes each hour, 24/7. The pumping rate for both the primary and secondary sludge pumps is about 50 gallons per minute (gpm). The total daily sludge flow (primary + secondary) to the GST is about 30,000 – 35,000 gallons. The mixed solids content average about 1.0-1.5%, and the estimated daily dry solids feed to the GST is about 3,700 lbs.

Underflow from the GST is pumped intermittently (15 minutes each hour) to a mesophilic anaerobic digester with a floating cover. The digester temperature is maintained by sludge recirculation through a "tube-in-a-tube" heat exchanger. Digester mixing is done with a Pearth™ gas mixing system integral with the floating cover. Digested sludge is pumped intermittently to a sludge holding tank with a flexible membrane cover for gas storage. Sludge is pumped from the sludge holding tank to a belt filter press for dewatering, operating 7-10 hours per day, 5 days per week. Dewatered cake drops into a dump truck below the dewatering building and is unloaded and stored on site on a covered sludge storage pad. Stored sludge is hauled and disposed off-site through contract operations. Dewatering filtrate is stored and equalized in a buffer tank, and then metered into the primary influent.

Figure 1 shows an aerial view of the solids handling facilities and **Figure 2** depicts the solids handling flow schematic.

Figure 1: Existing Solids Handling Facilities

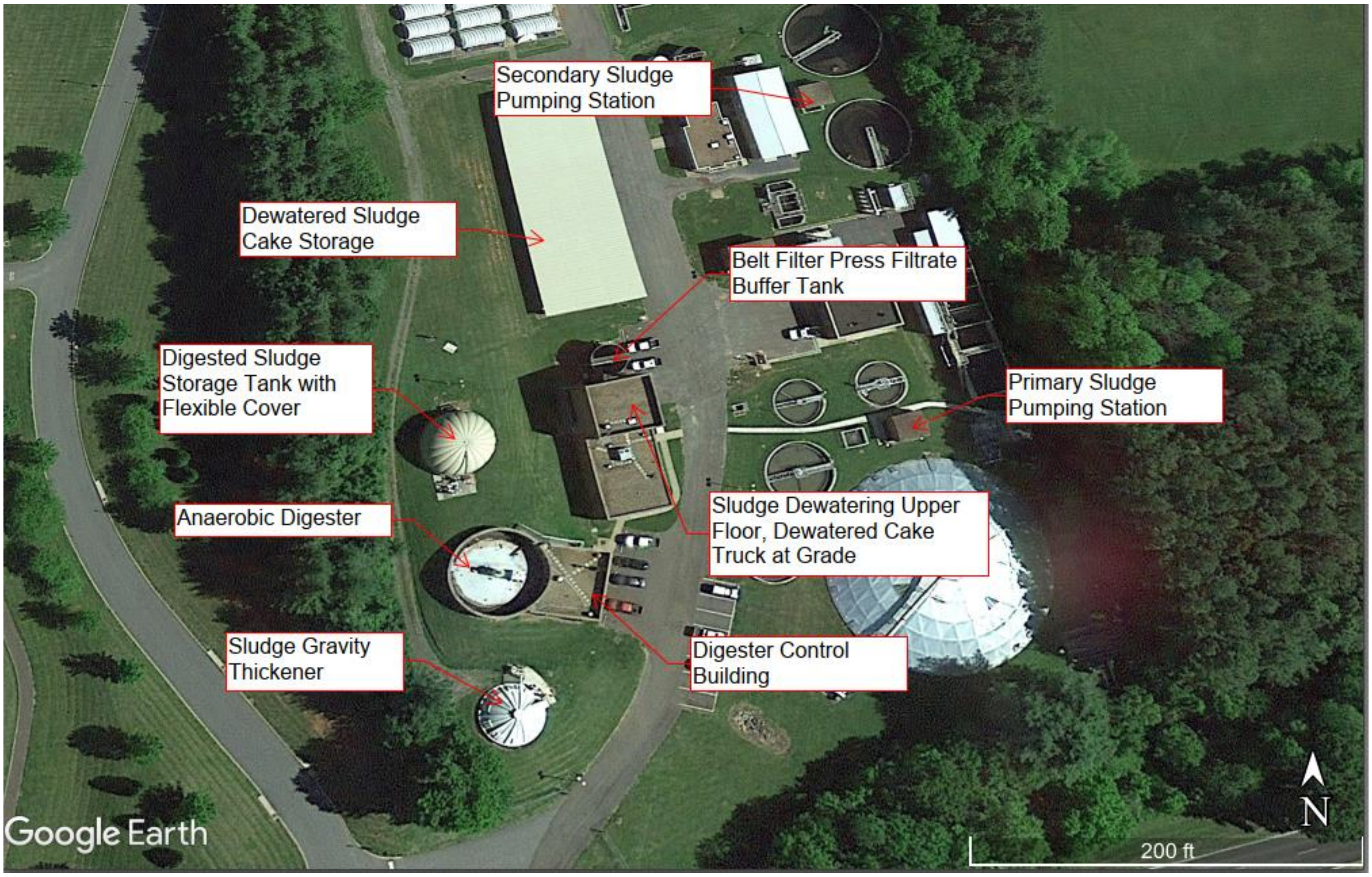
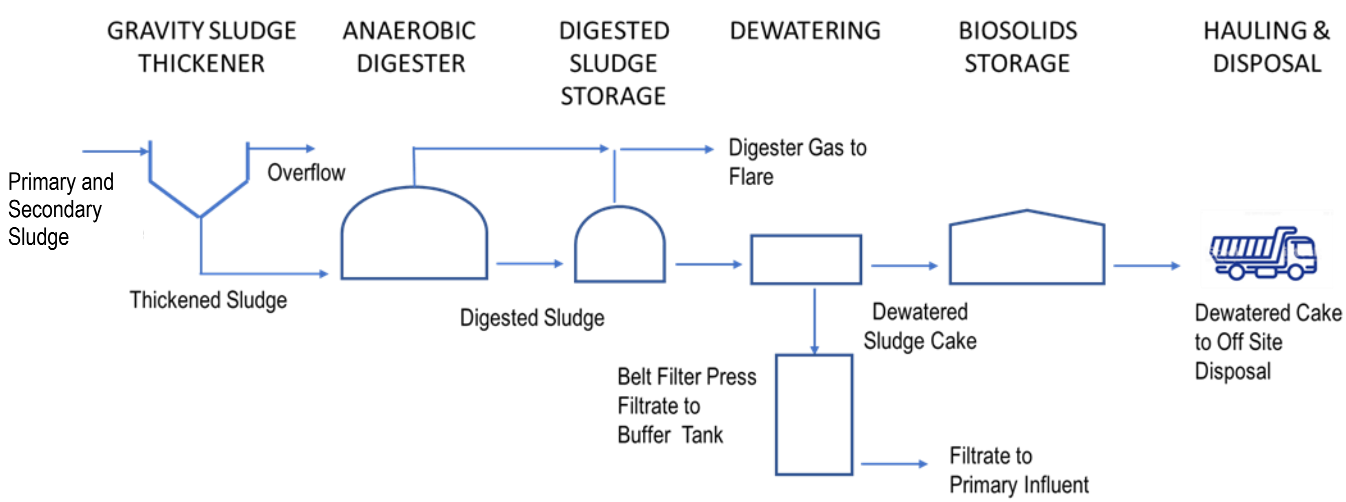


Figure 2: Existing Solids Handling Flow Schematic



Key design information for the solids handling process tankage and equipment is summarized in **Table 2**.

Table 2: Existing Solids Handling Facilities and Equipment

Equipment	Year Installed	Design Parameter	Value
Primary Sludge Wet Well	1989	Volume	3,000 gallons
Primary Sludge Pumps	1989	Flowrate	50 gpm (piston pumps)
Secondary Sludge Wet Well	1989	Volume	3,000 gallons
Secondary Sludge Pumps	1989	Flowrate	50 gpm (piston pumps)
Gravity Thickener	1989	Diameter	28 ft
		Side Water Depth	12 ft
Anaerobic Digester	1989	Diameter	50 ft
		Side Water Depth, Maximum Straight	20 ft
		Maximum Operating Volume	293,000 gallons
		Working Volume, 85%	250,000 gallons
		Cover	Floating
		Mixing	Pearth™ Gas Mixing
		Boiler	Envirex 560,000 BTU/hr
		Heat Exchanger	Tube in Tube with hot water recirculation 42.21 sq ft HEX area
		Recirculation Pumps (2)	WEMCO Model 3 Size 4 X 3 Recessed Impeller Centrifugal 150 gpm @ 34 ft head
		Sludge Transfer Pumps - 6 Total: Transfer from GST underflow to Digester (2); Transfer from Digester to Sludge Storage (2); Transfer from Sludge Storage to Belt Filter Press (2)	ITT Marlow Model BE82W Plunger Pump 240 gpm @ 45 ft head
		Waste Gas Flare	Open style with manual ignition Mounted at grade 6-inch diameter
Sludge / Gas Holding Tank	1970	Diameter	40 ft
		Side Water Depth	20 ft
		Volume	185,000 gallons
	2010	Cover	Flexible Gas Holding
Belt Filter Press	2012	Belt Width	1 meter
		Hydraulic Capacity, current operation	30-35 gpm
Filtrate Buffer Tank	2000	Volume	30,000 gallons
Dewatered Sludge Storage (covered)	1970	Length, Width Area	165 ft, 55 ft (8 bays) 9,330 sq ft

A multidiscipline field visit was conducted in November 2019, including the following tasks:

- Discussing the current operations and condition of the solids processes
- Discussing available power within the WWTP
- Review of major solids equipment Manufacturer's Operations and Maintenance Manuals
- Visually inspection of the solids handling equipment and facilities

Other than the belt filter press, which was replaced in 2012, the solids handling equipment has been in operation for 30 or more years and has exceeded its expected service life. However, with the plant's ongoing maintenance and repairs of the equipment, the majority of the solids handling processes and equipment are generally functioning and operating satisfactorily.

<u>Field Visit Observations – Process Mechanical</u>

Primary sludge flows from the underflow of the four (4) primary clarifiers into a wet well. It is then pumped to the gravity sludge thickener by the primary sludge pumping station. Sludge from the underflow of each the two (2) secondary clarifiers flow through telescoping valves into a wet well. Secondary sludge is then pumped to the gravity sludge thickener by the secondary sludge pumping station. One of the secondary sludge telescoping valves is leaking and needs to be repaired to allow for control of sludge flow from each clarifier.

The gravity sludge thickener is covered with a fiberglass dome. The interior head space is ventilated, and the exhaust is directed through an adjacent activated carbon filter for odor control. The thickener mechanism and bridge are heavily deteriorated, with significant visible metal loss. The Town has budgeted for a planned replacement of the mechanism and access bridge.

The anaerobic digester, piping, valves, gas mixing system, sludge transfer and recirculation pumps, combination boiler/ sludge heat exchanger were all in fair condition. Plant operations reported no issues with the process equipment and only expected routine maintenance to be performed.

The sludge valves in the digester control building were reported as very difficult to actuate, which is expected for valves of the tapered plug type and their current age.

A new one-meter belt filter press was installed in 2012 replacing the existing one-meter unit from the 1990 plant upgrade. It is reported to be limited to 25 to 35 gpm sludge feed rate and produces cake with an average of 13-14% dry solids. Feed rates to belt filter presses vary depending on sludge type, solids contents and plant specific conditions, with a typical design feed rate in the range of 30 to 100 gpm for a 1-meter wide belt filter press. Operating near the low end of this range, the plant has made several operational changes in an attempt to improve throughput, but with little success. To keep up with sludge production, the dewatering process is operated between 7 to 10 hours per day, 5 days a week.

Dewatered cake is transferred via a small dump truck to the adjacent covered sludge storage pad that has eight (8) individual bays, each approximately 20' by 55' size. The higher amounts of annual precipitation in recent years has challenged off-site sludge management and disposal. In turn, this has resulted in less frequent cake haul-off and longer on-site sludge cake storage times. Therefore, there is a need to expand the current storage capacity at the plant.

Field Visit Observations – Structural

A structural condition assessment was performed for the existing digester building, control building, sludge storage area, and gravity thickener. This assessment was limited to conditions readily visible on the exterior and interior areas of the facility, and the exterior of the digester and the gravity thickener. The assessment did not include structural observations of the interior of the digester tank or the floating cover. Details of the condition assessment are included in **Appendix A**.

Several minor structural and architectural deficiencies were observed during the site visit. No deficiencies were observed that would be considered critical to the overall structural integrity of these elements. The deficiencies generally fall into one of two categories, (1) issues that could have a negative impact on the operator safety or serviceability of the building or (2) maintenance issues that could continue to worsen over time if observed deficiency is not mitigated or repaired.

Digester Building – Several hairline cracks were observed throughout the structure, including horizontal and vertical cracks in the digester tank walls, cracks in the Upper Level floor, and cracks in the concrete masonry wall. These cracks can generally be efficiently repaired by injecting epoxy adhesive into the cracks. The other primary issue observed for this building is apparent soil erosion of the adjacent grading around the perimeter of the building which has led to a significant change in grading elevation around the perimeter of the building. Brick corbels around the perimeter of the building which should be below grade were exposed to view and a ramp footing that is undermined and almost entirely exposed to view indicate that over a foot of grading elevation may have been lost to erosion around the perimeter of the building.

Control Building – Structural issues observed for this building include rusty brick support lintels, rusty maintenance platforms, and spalled concrete elements. Architectural issues include cracked and spalled façade bricks; rusty downspouts, flashing, louvers, roof hatch hardware and gas pipes; loose handrails; and stained ceiling tiles. Most of these deficiencies would classify as maintenance issues and can be resolved by replacing the deficient item in kind.

Dewatered Sludge Storage Area – The steel members supporting the canopy roof generally have worn-off paint and moderate rust in several locations. In a few locations, section loss was observed for the steel columns, reducing their load-carrying capacity. The existing metal roof deck was observed to be in good condition. The deck did not exhibit the same level of rust as the supporting structure. Personnel at the WWTP indicated that the roof deck had been replaced previously. The biggest issue with this structure is its inadequate roof height and storage capacity. The existing roof height prevents full operation of a CAT 926 Loader (or comparable equipment) within the space. The roof will need to be raised to a minimum clear height of 18 feet for full operation of the loading equipment. The footprint of the storage area will need to be increased to increase its storage capacity. If the width of this area is increased by 15 feet for its entire length, the storage capacity will increase by approximately 25 percent. A new canopy roof structure will be required to increase the roof height and building footprint, and a new concrete retaining wall and slab extensions will be required to increase the building footprint. The new roof structure will likely be pre-engineered metal building framing supporting either a new roof deck or a fabric membrane roof as discussed later in this report.

Gravity Sludge Thickener – The existing gravity thickener structure consists of a fiberglass dome supported by concrete walls supported by a concrete mat foundation. We observed the above-grade exterior of the existing gravity thickener. Since most of the structure is located underground, only a small portion of the structure was visible and the observed portion of this structure was unremarkable. No deficiencies were observed.

Field Visit Observations – Electrical

Power for the solids handling process equipment at the Warrenton WWTP which is comprised of the Plant Control Building, the Digester Building, both Digesters and the Gravity Sludge Thickener emanates from a 400-amp fused switch in the 480-volt, 3 phase, 3 wire “DS” Switchboard located across the treatment plant site in the RBC Blower Building.

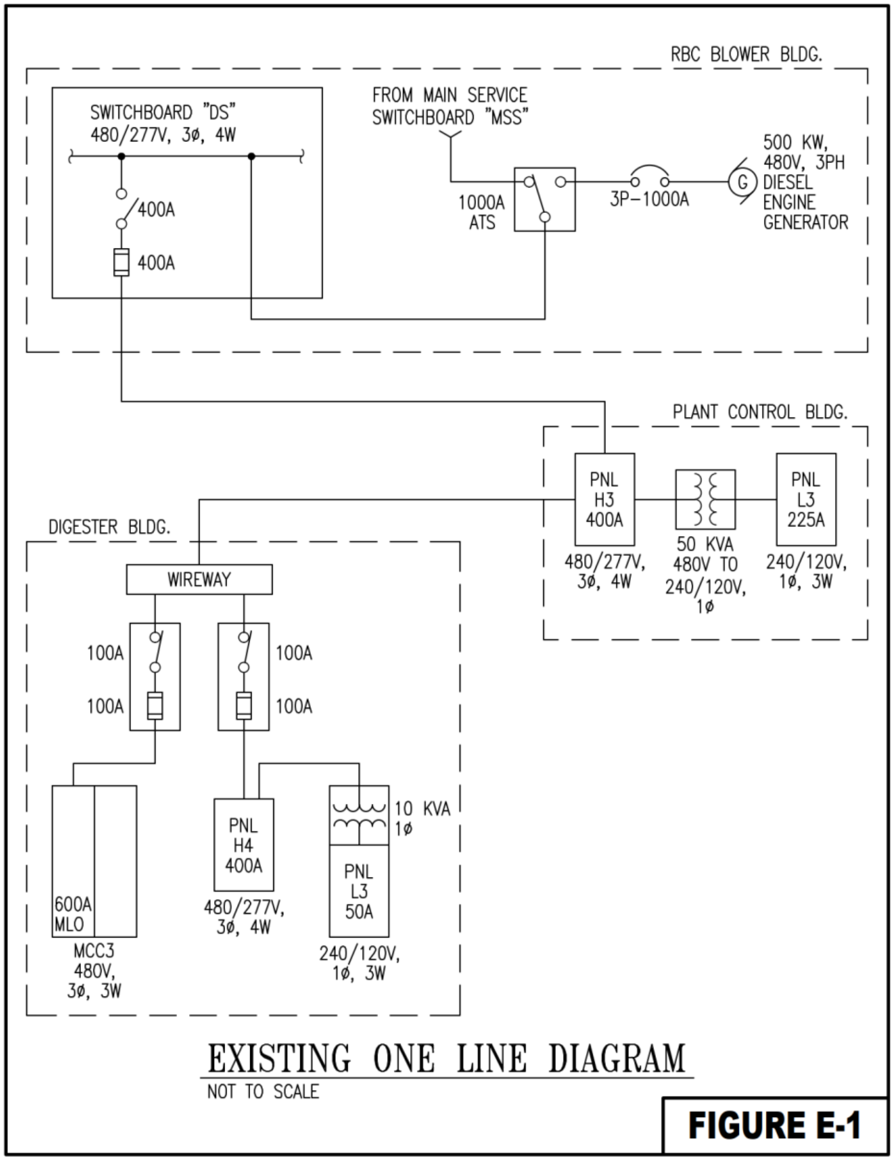
Switchboard “DS” feeds Panel H3, located in the Plant Control Building. Panel H3 is a 480/277volt, 3 phase – 4 wire General Electric A Series branch circuit breaker panelboard. Panel H3 feeds Panel L3, a 240/120-volt, 1 phase – 3 wire General Electric branch circuit breaker panelboard through a 50 kVA, 480-volt to 240/120-volt, 1 phase dry type transformer. Panel H3 and Panel L3 feed all the electrical loads in the Plant Control Building.

Panel H3 also feeds power to MCC3 and Panel H4, through two 100 amp fused disconnect switches located in the Digester Building. MCC3 is a 480-volt, 3 phase – 3 wire General Electric 8000 Line motor control center and Panel H4 is a 480/277-volt, 3 phase – 4 wire General Electric branch circuit breaker panelboard. Panel H4 feeds Panel L4, a 240/120-volt, 1 phase – 3 wire General Electric branch circuit breaker panelboard through a 10-kVA dry type transformer “Servicenter” mini-unit substation. MCC3, Panel H4 and Panel L4 feed all the electrical loads in the Digester Building and the Gravity Sludge Thickener.

The electrical equipment is original equipment that was installed when the Plant Control Building, Digester, Digester Building and the Gravity Thickener were constructed circa 1987. The electrical equipment is over 30 years old. A general rule of thumb for electrical systems equipment is a life expectancy of 20 to 30 years based on well-maintained equipment. As the electrical equipment has exceeds its life expectancy, replacement parts for equipment become more difficult to find.

The existing electrical equipment, described above, is operating at maximum capacity and is not capable of accepting any new loads. Any additional loads associated with new or expanded solids handling facilities will require new electrical service. Refer to **Figure 3 (E-1)**, Existing One Line Diagram, for existing conditions.

Figure 3: Existing Electrical One-Line Diagram



2.2 Existing Solids Process Operations

The following section reviews the plant's current solids load and solids process / digestion operations.

The annual average influent flow to the plant for the period from 2014 to 2020 was about 1.9 MGD, as summarized in **Table 3**.

Table 3: Annual Average Plant Influent Flow

Year	Annual Average Inf flow (MGD)
2014	2.0
2015	1.9
2016	1.7
2017	1.7
2018	2.2
2019	2.0
2020	1.9
Average	**1.9**

The annual average biosolids produced (after digestion and dewatering) for the period from 2010 to 2020 was about 400 dry metric tons per year (based on the plant's hauling data), as summarized in **Table 4**.

Table 4: Total Annual Biosolids Quantities

Year	Biosolids (Dry Metric Tons)
2010	363
2011	266
2012	379
2013	312
2014	549
2015	343
2016	589
2017	314
2018	555
2019	294
2020	395
Average (2015-2020)	**408**

In review of the in-plant operating data, there is considerable variability in sampling and analyzing percent solids in the solids processes (thickening and digestion processes). However, since the quantities of final cake solids are typically more representative of the solids produced at a WWTP the data in **Table 4** will be used as the basis for estimating the solids loadings through the plant.

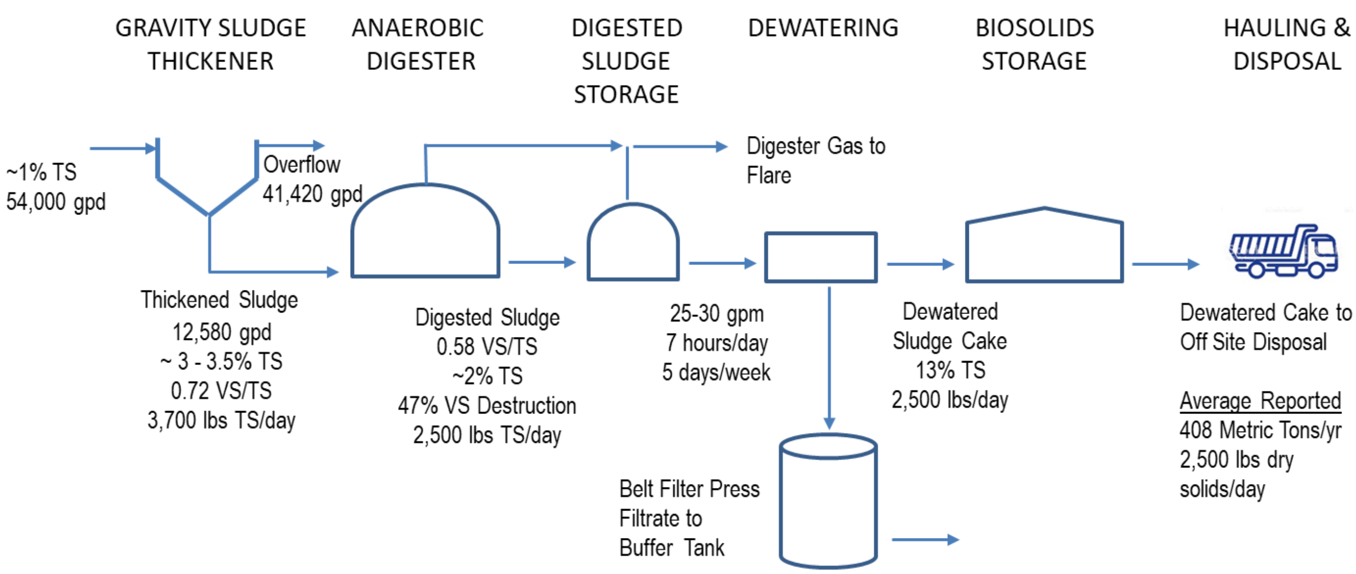
The estimated solids loading to the thickening and digestion processes considers the volatile solids (VS) reduction in the digester. **Table 5** summarizes the sludge feed and VS reduction data for 2018-2019.

Table 5: Recent Solids Digestion Values

Year	Units	Average Value 2018-2019
Digester Average Feed Volume	gallons per day	12,580
Digester Feed Volatile Solids	% VS	72
Digested Sludge Volatile Solids	% VS	58
% Volatile Solids Reduction	% VS Reduction	47

Based on the values in **Tables 4** and **5** the loading through the solids handling processes is shown in **Figure 4**, representing current operations.

Figure 4: Recent Average Solids Loading



Gravity Sludge Thickener (GST) Performance

Based on the solids loadings in **Figure 2**, the existing gravity sludge thickener loading was reviewed. Typical gravity sludge thickener (GST) design loading when thickening co-mingled primary sludge and rotating biological contactor (RBC) waste sludge are shown in **Table 6**, along with the recent GST loading.

Table 6: Typical and Recent Gravity Sludge Thickener (GST) Loading

Parameter	Typical Values[1]	Current (1.9 MGD)
Solids Loading (lbs TS / sq ft / day)	10 – 15	6
Hydraulic Loading (gpd / sq ft / day)	150 – 300	72[2]
Thickened Solids	3 – 5%[3]	~3%

[1] WEF MOP-8 Design of Water Resource Recovery Facilities, 6th Edition
[2] Average loading based on daily total flow; loading during sludge pumping rates, when either primary or secondary (or both) sludges are pumped intermittently to the GST, is 115 – 230 gpd/sf
[3] Based on co-mingled primary/secondary sludge GST performance

As can be seen in **Table 6**, the existing GST loading is below typical design range. The GST performance in thickening the sludge (at about 3%) is consistent with the observed loading.

Typically, GSTs use diluting water and/or an oxidant (commonly chlorine) to improve the performance of the GST and increase the volume of thickened sludge held in the GST i.e. increase the solids retention time, by keeping the sludge from becoming septic and gasifying. Warrenton is not utilizing diluting water nor an oxidant in the GST influent. A metal salt (alum, ferric or PACl), as well as polymer, can also be added to improve settling and solids underflow concentration.

Table 7 shows the current and projected GST solids loading as the plant flows reach the permitted capacity (2.5 MGD), and at plant expansions to 3.0 MGD and 3.5 MGD, respectively. The projected feed solids values (lbs/day) shown in the first row of Table 7 assumes a flow-proportional increase in solids quantities over the recent average solids production at the plant (based on about 1.9-2.0 MGD ADF).

Table 7: Projected GST Loadings

	Annual Average Daily Influent Flow (MGD)			
Parameter	Current (1.9)	2.5	3.0	3.5
Total Feed Solids (lbs total solids / day)	3,700	4,900[1]	5,900[1]	6,900[1]
GST Volumetric Feed Rate[2] (gpd)	45,000	59,000	70,500	82,700
Solids Loading (lbs TS / sq ft / day)	6	8	9.5	12
Hydraulic Loading[2] (gpd / sq ft)	72 (115 – 230)	96 (150 – 300)	115 (180 – 360)	134 (210 – 410)

[1] Proportional to plant flows from current solids at an AAF of 1.9 MGD
[2] Using annual avg 1% combined total solids feed to the GST; values in ( ) are during intermittent sludge pumping to GST

Although the plant experiences some difficulty with the current GST performance (excess solids in the GST overflow to plant recycle, i.e. low solids capture, as well as more dilute underflow than desired), **Table 7** indicates the existing GST would be appropriately sized (in terms of diameter and sidewater depth) for the projected solids production up to 3.5 MGD based on the loading criteria in **Table 6**. Additionally, a thickened underflow solids performance of ~3 % is reasonable to expect at the current and projected solids loading rates given a blended primary and secondary sludge. To maintain, or slightly improve, the GST performance, dilution water should be considered. Typically, a total hydraulic loading rate (sludge flow + dilution water) should be about 200 gpd/sf, thus at current loadings, the dilution water rate should be around 50 gpm but can be decreased as the sludge flows increase. To raise the thickened sludge underflow concentration reliably above 3-4%, mechanical thickening technology would be required (gravity belt; centrifuge; rotary drum screen).

Digester Performance

Digester volume requirements are based on volatile solids loading (solids applied per unit volume) and solids retention time (SRT) in the digester. Typical "high rate" anaerobic digester loading criteria and the current loadings are included in **Table 8**. "High rate" operation assumes sufficient digester heating (mesophilic temperature range) is maintained and complete mixing is provided.

Table 8: Typical and Recent Digester Loading

Parameter	Typical Values[1]	Current (1.9 MGD)
Digester Design Loading (lbs VS / cu ft / day)	0.12 – 0.16	0.08
Digester Solids (Hydraulic) Retention Time (days)	15 – 20	19.8

[1]WEF MOP-8 Design of Water Resource Recovery Facilities, 6th Edition

Table 8 indicates that the digester volatile solids loading is currently lightly loaded, and a solids retention time (SRT) of about 20 days. The plant must comply with Class B biosolids requirements. This includes treatment through anaerobic digestion (PSRP process), maintaining minimum 15 days SRT; and vector attraction reduction through minimum 38% volatile solids reduction. These requirements are met under the current operating conditions. The digester SRT is directly affected by the percent solids of the thickened feed sludge to the digester: to increase the digester SRT, the sludge flow rate needs to be reduced by increasing the percent solids, i.e., improve thickening performance.

Table 9 shows the projected solids loading to the existing digester as the plant flows reach the permitted capacity (2.5 MGD), and at plant expansions to 3.0 MGD and 3.5 MGD, respectively. Similar to **Table 7** for the GST, the total feed solids values (lbs/day) shown in the first row of **Table 9** assumes a flow-proportional increase in solids quantities over the recent average solids production at the plant (based on about 1.9-2.0 MGD ADF).

Table 9: Projected Digester Loadings w/Existing Digester

	Annual Average Daily Influent Flow (MGD)			
Parameter	**Current (1.9)**	**2.5**	**3.0**	**3.5**
Total Feed Solids[1] (lbs total solids / day)	3,700	4,900	5,900	6,900
Volatile Feed Solids (lbs VS / day)	2,600	3,500	4,200	4,900
Digester Volumetric Feed Rate[2] (gallons per day)	14,700	19,600	23,500	27,400
Digester Solids Loading (lbs VS / cu ft / day)	0.08	0.11	0.13	0.15
Digester Solids (Hydraulic) Retention Time (days)	17	13	11	9

[1] Proportional to plant flows from current solids at an AAF of 1.9 MGD

[2] Using annual average 3% total solids in the thickened sludge feed to digester

From **Table 9** the existing digester volatile solids loading would remain within a typical design range up to a plant design flow of 3.5 MGD; however, the SRT would be well below the 15-day minimum requirement. Also, as flows approach the current permitted design of 2.5 MGD the SRT would likely be close to, or below, 15 days. As mentioned above, the digester SRT could be increased by improving sludge thickening, or additional digester volume could be provided. This is discussed further in **Section 3**.

Sludge Dewatering Performance

Digested sludge is transferred and stored in the sludge holding tank ("secondary digester") before dewatering. A new 1-meter belt filter press was installed in 2012 to replace the previous unit. While the expected sludge flow to the new press was in the range of 50-100 gpm, the plant has not been able to feed more than about 30 gpm without compromising on the final cake dryness. Currently, the belt filter press is operated 7-10 hours per day, 5 days per week. As plant flows increase and additional digested solids have to be dewatered, the dewatering operations will need to go to two (2) full shifts, and/or operate on weekends. At a plant expansion to 3.0 MGD and 3.5 MGD, the Town may consider upgrading to a 2-meter belt filter press to increase throughput capacity and reduce the operating time.

3 SOLIDS HANDLING UPGRADE EVALUATIONS

Near-term and future upgrades to the solids handling facilities are discussed in this Section.

3.1 Gravity Sludge Thickening

From **Section 2**, the existing GST was found to be performing as expected and is appropriately sized for solids loading projections up to 3.5 MGD. However, the plant has recently experienced difficulty in settling the sludge in the GST resulting in diluted sludge to the digester and causing excessive carry-over solids in the GST overflow. This reduces the solids capture and results in increased levels of in-plant solids recycle. This in turn has caused poor settling in the primary clarifiers and thus exacerbating the problem. The plant has started to add polymer to primary clarifiers and the GST influent and is considering also adding metal salt (PACl).

There is significant buildup of floatable debris which blinds the overflow weirs and traps solids. On a quarterly basis the cover is removed, and the debris is cleaned out (contract operation). Improving the influent screening could alleviate some of this and sludge screening (both primary and secondary sludges) is another option. The sludge screen would be housed in an adjacent building and tie into the GST sludge feed line. Example of sludge screen equipment is included in **Appendix B**. Currently the primary and secondary sludges are pumped intermittently to the GST. Ideally, the sludges would be blended and then pumped at a constant rate continuously to the GST. At the future plant expansion new primary clarifiers would replace the existing four (4) units and one of the existing units could be converted to a sludge blending and holding tank.

Due to its age and the plant's operating experience, the GST needs a complete refurbishment including replacement of the sludge collection mechanism, center access bridge, cover, and concrete repairs, where needed. The ability to add dilution water should be considered, as well as provisions for chlorine addition. The Town has recently issued a construction contract to perform this work and should be completed in 2023.

3.2 Sludge Thickening and Digestion

As shown in the previous **Table 8**, the digester solids retention time (SRT) is estimated at 20 days at the current solids loading based on the current average plant flow of about 1.9 MGD, which provides for reliable operation for Class B sludge stabilization. As plant flows gradually approach the permitted average design flow of 2.5 MGD, the solids loading and sludge flow to the digester will increase. As a result, the SRT in the existing digester will decrease and will likely be below the minimum 15 days required by the permit for Class B anaerobic digestion. For a plant expansion scenario to 3.0 MGD and above, the SRT in the existing digester will be inadequate (10 days or less, per **Table 9**).

There are two options to increase the digester SRT:

- Reduce the sludge flow rate (volume) by increasing the thickened sludge underflow % solids
- Provide additional digester volume

<u>Sludge Thickening:</u> As discussed in **Section 2**, the existing GST appears to be performing as well as comparable GSTs that thicken co-mingled primary and secondary sludges, producing about 3% underflow total solids (TS). Based on the size of the existing GST, the solids and hydraulic loadings both at current operations and even under future expansion scenarios, are within typical design ranges (**Tables 6** and **7**). The existing GST performance could be improved step wise, possibly achieving 4% TS in the thickened solids, by adding diluting water and possibly chlorine.

Also, adding diluting water and/or chlorine could reduce the overflow solids in the GST, thereby reducing the solids that recycle through the plant. If 3.5 to 4% thickened sludge can be achieved, the minimum SRT of 15 days could be met in the existing digester at the permitted design flow of 2.5 MGD. However, thickening to 4% TS would not be sufficient to meet the minimum 15 days SRT in the existing digester at projected solids loadings above 3.0 MGD. At least 5% and 6% TS thickened sludge would be needed to provide only marginally more than 15 days of SRT in the existing digester at 3.0 MGD and 3.5 MGD, respectively. Thickening the sludge to an average of 6% TS could be problematic for the existing digester gas mixing system.

To reliably improve thickened solids above 4% TS, mechanical sludge thickening would be needed along with chemical (polymer) conditioning. Gravity belt thickeners (GBT) and rotating drum thickeners (RDT) are two mechanical thickeners that could produce 5-6% TS thickened sludge with blended primary and secondary sludges, and likewise for a centrifuge. Examples of sludge thickening equipment (GBT and RDT) is included in **Appendix B**.

The main advantage of mechanical thickening over a GST is more reliable thickening performance at higher percent solids. Disadvantages of mechanical thickening are higher cost (building, thickening equipment, pumps, chemicals, maintenance); and more operator attention. Another disadvantage is the need for sludge holding before and after thickening since the thickening equipment is typically not operated continuously, unlike a GST.

In general, conversion to mechanical thickening at Warrenton WWTP would require:

- Removal of the existing GST
- Redundant mechanical thickening units installed inside a new thickener building along with a polymer storage and feed system, and the necessary feed and transfer pumps
- A sludge holding tank to hold primary and secondary sludges when the thickener is not operating. Typically, the sludge holding tank would provide 2-3 days of holding capacity
- A thickened sludge holding tank to buffer the feed to the digester. Typically, the thickened sludge tank would provide 1-2 days of holding capacity

<u>Additional Digestion:</u> Alternatively, additional digester volume could be provided with the current sludge thickening process. This would leave the existing GST in operation, possibly with the addition of diluting water and chlorine to the GST influent, as well as the needed equipment replacements due to its current condition. The existing digested sludge holding tank ("secondary digester"), although it has a smaller volume, could be converted to a primary digester and upgraded with heating and mixing equipment. But adding a second primary anaerobic digester (similar size to the existing digester), and keeping the existing holding tank, would be preferred.

Table 10 shows the total digester loadings with a new second digester, similar in size to the existing, at the design permitted flow of 2.5 MGD and at plant expansions to 3.0 MGD and 3.5 MGD.

Table 10: Projected Warrenton WWTP Digester Loadings with Second Primary Digester

	Annual Average Daily Influent Flow (MGD)		
Parameter	**2.5**	**3.0**	**3.5**
Total Feed Solids[1] (lbs total solids / day)	4,900	5,900	6,900
Volatile Feed Solids (lbs VS / day)	3,500	4,200	4,900
Digester Volumetric Feed Rate[2] (gallons per day)	19,600	23,500	27,400
Digester Solids Loading (lbs VS / cu ft / day)	0.05	0.06	0.07
Digester Solids (Hydraulic) Retention Time (days)	25	21	18

[1] Proportional to plant flows from current solids at an AAF of 1.89 MGD

[2] Using annual average 3% total solids in thickened feed to digester

With the addition of a second 50-foot diameter primary anaerobic digester, **Table 10** indicates there would be enough digester SRT at the current thickened sludge concentration of about 3%, i.e. using the existing GST. From a long-term planning standpoint having a second digester provides more operational flexibility, redundancy, and robust capacity, without having to build new sludge thickening facilities, or push higher thickening performance that may not be reliable. The cost for a new digester with control building would be comparable to building new mechanical sludge thickening facilities that include thickening equipment and control building, sludge pumps, chemical feed, and sludge holding tankage.

3.3 Sludge Dewatering

The existing sludge dewatering belt filter press (BFP) is relatively new. Typical belt filter press design information and recent BFP performance are summarized in **Table 11**.

Table 11: BFP Design and Recent Performance

Parameter	Design Range	Current Operation
Effective Belt Width	1 - 3 meter	1 meter
Average Volumetric Feed Rate to BFP	30 - 100 gpm	30 gpm
Average Dry Solids throughput for BFP	300 - 800 lbs / hr / m	240 lbs / hr / m
Average Solids in BFP Feed	1 - 6% (depending on sludge type and thickening process)	1.6%
Average Daily Volume Feed to BFP	varies	12,600 gpd
Number of Hours Operated per Week	varies	50 hrs (10 hrs/day, 5 days /wk)
Dewatered Cake Solids	12 - 20% (depending on sludge type)	13-14%

Based on the recent BFP performance and the projected sludge volumes, **Table 12** includes the projected number of operating hours for the BFP up to a plant design capacity of 3.5 MGD.

Table 12: BFP Dewatering Projected Operating Hours

	Annual Average Daily Influent Flow (MGD)		
Parameter	**2.5**	**3.0**	**3.5**
Average Volumetric Feed Rate to BFP	30 gpm	30 gpm	30 gpm
Average Volume Feed to BFP	19,600 gpd	23,500 gpd	27,400 gpd
Number of Hours Operated per week	76	91	107
Number of Hours Operated per Day @ 5 days per week	16	19	22

At the current permitted design flow of 2.5 MGD, the BFP is expected to operate two (2) full shifts, 5 days per week. At 3.0 MGD and 3.5 MGD, the 1-meter BFP would operate almost continuously for 5 days per week. It is recommended at that time, or sooner if desired, to replace the existing belt filter press with a higher capacity (2-meter) unit to reduce the operating time. Alternatively, a dewatering screw press may be considered in replacing the BFP. The screw press is fully enclosed and has a compact footprint that would fit in the existing dewatering room. It also produces a dryer cake, from 18-24%, which would reduce the area required for cake storage and hauling costs. Technical information sheets for a typical dewatering screw press are included in **Appendix B**.

3.4 Dewatered Sludge Storage

Dewatered sludge cake is transferred to the sludge storage area before the cake is periodically hauled off site via third party contract operations. The existing storage area consists of an open-air rectangular structure with a mono slope canopy roof over a slab-on-ground area separated into 8 approximately equal bays by a series of short concrete walls. Each bay is approximately 20 ft wide and 60 ft long. The canopy roof is a steel deck supported by open-web steel joists and steel beams and columns. The columns bear on steel base plates with column bases set on top of the short concrete walls.

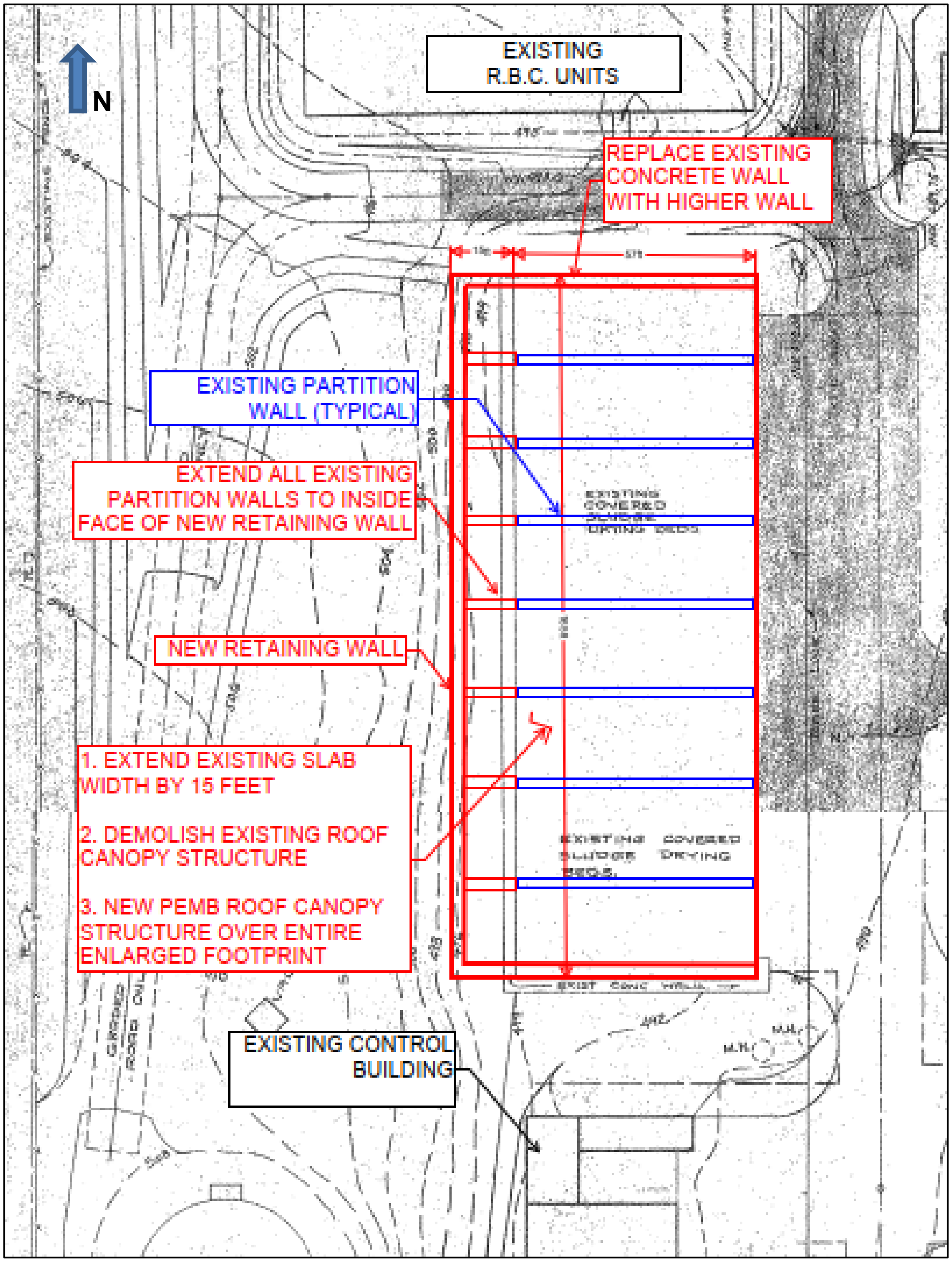
The existing floor slab area is approximately 9,330 square feet on a soil-supported slab-on-ground with perforations throughout the slab to allow drainage. The roof support column grid consists of 8 equal bays of approximate 20'-6" length each in the structure's long direction, and 3 equal bays of approximate 18'-4" length in the short direction.

The existing steel framing supporting the roof was observed to be in poor condition. Steel members generally have worn-off paint, and moderate rust was observed in several locations. In a few locations, section loss was observed for the steel columns, reducing their load-carrying capacity. The existing metal roof deck was observed to be in good condition. The roof deck appeared to be newer than the structural framing, and is understood to have been replaced, though the approximate date of replacement is not known.

There is a need to raise the roof to allow full access of equipment to load and unload the sludge. The current clear roof height is inadequate for full access and operation of the equipment. The plant uses a Caterpillar 926 wheel loader, or comparable equipment, within this space. This type of loader has a maximum height of 15.5 feet to the top of the bucket; therefore, the new roof will need to have a minimum clearance of 18 feet above the slab-on-ground to allow for all working conditions.

There is also a need to increase the sludge cake storage capacity by increasing the structure footprint. The existing sludge storage area is bounded by the existing plant road to its east, the existing control building to its south, and the R.B.C. treatment units to its north. Therefore, the most practical direction to expand the structure footprint is to the west, which abuts to an earthen hill and an existing gravel access road approximately 60 feet beyond the limits of the existing storage area. The width of the storage pad could reasonably be increased by 15 feet along its entire length, which would increase the overall storage capacity of the area by 20-25 percent. A new retaining wall along the entire west face of the storage area would be required to retain soil from the existing hill. The perforated slab-on-ground and the knee-walls separating the sludge bays would need to be extended to the new footprint. The retaining wall would serve as the new back wall of the sludge storage area. **Figure 5** illustrates the existing storage area and the proposed footprint expansion. Once the new MBBR treatment process is online, the existing adjacent RBC tankage will be abandoned. This would allow for one or two additional sludge storage bays to be constructed to the north.

Figure 5 : Existing Sludge Storage Area Site Plan and Proposed Modifications



It is not practical to reuse any part of the existing structural frame due to the condition of the existing framing, the unknown load capacity of the existing framing members, and the cost and complexity associated with adding column splices to raise an existing in-place roof and adding members to increase the canopy footprint. While the existing roof deck is generally in good condition, it is also not practical to attempt to reuse the roof deck.

The new canopy roof system will be supported by vertical columns that will likely be placed on their own new piers and footings, rather than setting the columns on the existing walls as they are currently. It would be difficult to get the bearing connection of the new column on the existing walls to work structurally, especially without base building drawings for the original walls. The canopy roof overhang dimensions should be extended to account for the increased height to prevent precipitation from reaching the sludge storage slab at an angle. Also, it is feasible and recommended to clear span the roof framing structure across the entire sludge storage area in the short direction to eliminate all interior columns within the space. This will increase maneuverability of the vehicles within the sludge storage area and prevent accidental impacts of the vehicles to the columns. Several replacement roof framing systems may be considered: a pre-engineered metal building (PEMB) system; a canvas-type roof structure, and conventional steel framing.

Pre-engineered metal building (PEMB) framing – PEMB's are often the most efficient systems for simple structures that have a rectangular footprint and a column grid with uniform spacing. PEMB framing members are designed to be optimized by using elements such as tapered columns in which the column cross-section changes along the length of the member where additional strength is needed. Members are designed to be optimized to be as close to the minimum sizes and material weights as possible while still meeting code requirements for strength and specified serviceability requirements. Another benefit of this system for this application is PEMB manufacturers perform their own engineered designs for their structures. The A/E structural engineer would design the new retaining wall, slab extension, and foundation elements supporting the PEMB columns. Although PEMB's typically use metal roof decks, the PEMB manufacturer may not permit the existing deck to be reused for their system or may not warranty the system if the existing deck is reused. Therefore, it is recommended to use new deck supplied by the PEMB manufacturer for the entire roof canopy. A traditional PEMB supplier for American Buildings, Whitener & Jackson, quoted a rough order of magnitude price of $250,000 for a 10,000 square foot roof canopy. By extrapolating the quote to account for the roof canopy footprint increase to approximately 12,500 square feet, the cost is estimated to be over $300,000.

Canvas-type roof structure – Similar to the PEMB option, canvas-type roof structures are often an economical choice for simple structures. This system differs from the other two options by using a fabric roof membrane rather than a metal roof deck. The structure typically consists of a series of I-shaped beams or truss-type frames designed to clear span across the space with bridging members between the frames. To maintain the simple monoslope roof layout similar to the existing roof, a series of frames comprised of I-shaped beams similar to the PEMB layout would be used. Therefore, the only major difference between this system and the PEMB is the use of a fabric membrane instead of the metal deck. Manufacturers of this product such as ClearSpan can work with a third-party engineer to produce stamped engineered drawings for the project. Again, the A/E structural engineer would design the new retaining wall, slab extension, and foundation elements supporting the PEMB columns. ClearSpan quoted a rough order of magnitude price of about $300,000 for a 10,000 square foot roof canopy, or about $370,000 to account for the roof canopy footprint increase to approximately 12,500 square feet.

Conventional steel framing – This system would be similar to the system currently in place. The roof would be a metal deck supported by open-web steel joists and structural steel beams on steel columns bearing on existing concrete stub walls. Typically, these members are selected from a catalog of pre-defined shapes and are not tapered; therefore, the material usage is not as efficient as that of the PEMB's. Typically, framing is designed by a third-party engineer and supplied by a steel fabricator. Since the steel shapes would not be as efficient as those designed by the PEMB or canvas-type roof structure to achieve the same structure, this option is not recommended.

All three roof framing options are viable solutions to increase the height of the roof over the sludge storage area. The pre-engineered metal building (PEMB) solution is the recommended option because it is anticipated to have the lowest cost of the three options and because mono slope canopy roofs for rectangular footprints is a common application for this system.

The heights of the perimeter walls along the sides and rear elevation of the sludge storage area should also be increased. The higher walls will keep the sludge in the storage area and will protect the sludge from the elements. Currently the concrete walls extend approximately 2'-6" above the ground-floor slab. Higher walls are currently created using loose-laid wood boards between small wide-flange steel posts. The required height of the side walls will be defined by the maximum desired height of the sludge piles. The required height of the back wall will be defined by the grade of the retained soil. Since the higher walls will be subject to greater lateral loads from wind forces and pressure from sludge piled against the walls, the best solution would be to demolish the existing perimeter walls and foundations and to build new walls and wall footings specifically designed for the new loads.

Alternatively, height could potentially be added to existing side walls by adding cast-in-place concrete or concrete masonry units (CMU) on top of the existing concrete walls. The existing concrete walls are typically 8 inches wide, so stacking 8" CMU on the concrete walls could be an effective and cost-efficient option if wall height will only increase by a few feet. However, the existing walls and their foundations would need to be structurally analyzed and possibly reinforced for the increased lateral forces from wind forces and lateral pressure from the higher sludge piles. If existing drawings for the sludge storage area are not available, then cost of testing required to determine existing conditions to justify re-use of the existing short walls and the cost of reinforcing the existing structure (if required) may be more expensive and time-consuming than simply building new walls.

3.5 Biosolids Management and Disposal

The current anaerobic digestion process at Warrenton WWTP is permitted as an EPA 503 Process to Significantly Reduce Pathogens (PSRP) that produces Class B biosolids for land application, with the requirement that the sludge in the anaerobic digester is held for at least 15 days (pathogen reduction) and achieving at least 38% volatile solids reduction (vector attraction reduction).

State biosolids regulations are likely to become more stringent in the future. There may be more reporting requirements, a higher quality of biosolids required for land application, reductions in land application rates, and restrictions on land available for application. With potentially more stringent biosolids disposal regulations in the future, the flexibility to produce Class A biosolids should be considered. Class A biosolids will have fewer restrictions on where they can be land applied. Allowable disposal areas include publicly accessible and residential lands.

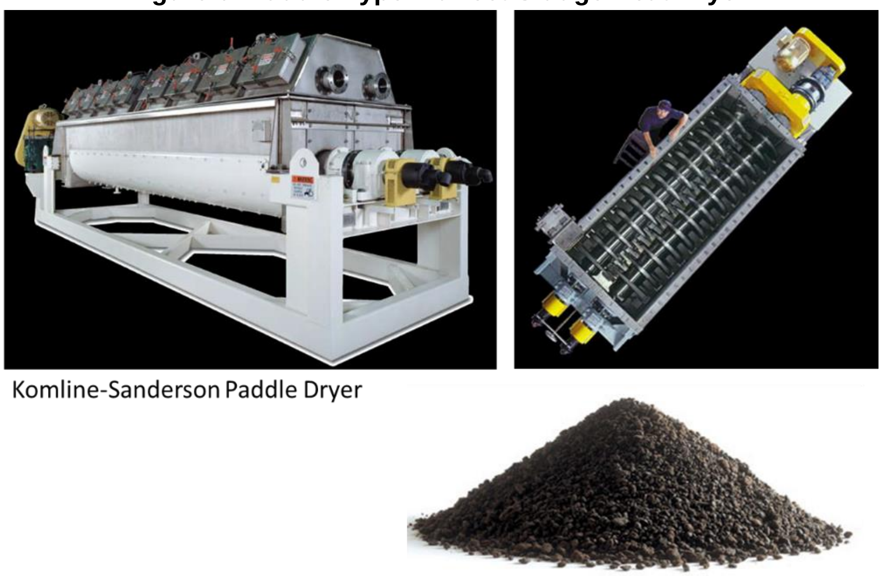
To achieve Class A quality, the biosolids must undergo one of the EPA 503 approved treatment Processes to Further Reduce Pathogen (PFRP) levels. While there are advanced digestion and pre-treatment alternatives that can achieve Class A, one of the common methods involves heat drying the (anaerobically digested) dewatered cake to greater than 90% dry solids. Heat drying will also reduce on-site storage requirements and transportation costs. Even though significant energy (from natural or digester gas) will be required, an evaluation including cost savings in disposal, i.e., through beneficial reuse compared to landfilling, could show benefits in Class A heat drying.

The higher the percent solids in the dewatered cake, the less heat energy that must be used to dry the cake. In fact, the capital and higher operating costs of new dewatering equipment can potentially be fully offset by subsequent fuel savings in the heat drying operation. Therefore, it is common to dewater sludge using centrifuges to increase the dewatered sludge solids. The centrifuge would replace the existing belt filter press in a future scenario.

There are several sludge dryers available, generally categorized into a direct and indirect type. The direct type dryer passes the hot combustion gases across the sludge in a low oxygen environment. The indirect type dryer separates the heating medium e.g. heat transfer oil, from the sludge. Indirect dryers are generally less efficient than direct dryers but have a better safety record than direct dryers.

A paddle type dryer, depicted on **Figure 6**, is an indirect dryer that would be appropriate for Warrenton WWTP. A heat transfer oil would be heated in a natural gas fired boiler, and the hot oil would be circulated through the hollow paddle mixer elements. The paddles rotate to mix the sludge, improving heat transfer characteristics, and to transport the sludge through the dryer. Dried biosolids would be conveyed to and stored on-site under cover before off-site hauling.

Figure 6: Paddle Type Indirect Sludge Heat Dryer



The dryer would be housed in a building adjacent to the dewatering process. Part of the existing sludge storage facility could be removed to make room for the heat drying facility since less storage area would be required for the dried cake. A heat drying facility could be implemented through a turn-key project where a third-party entity would design, build and operate the facility for a given contract period, say 20 years. The plant would still operate the anaerobic digester(s) with the flexibility to produce both Class B and Class A biosolids.

3.6 Electrical Service Improvements

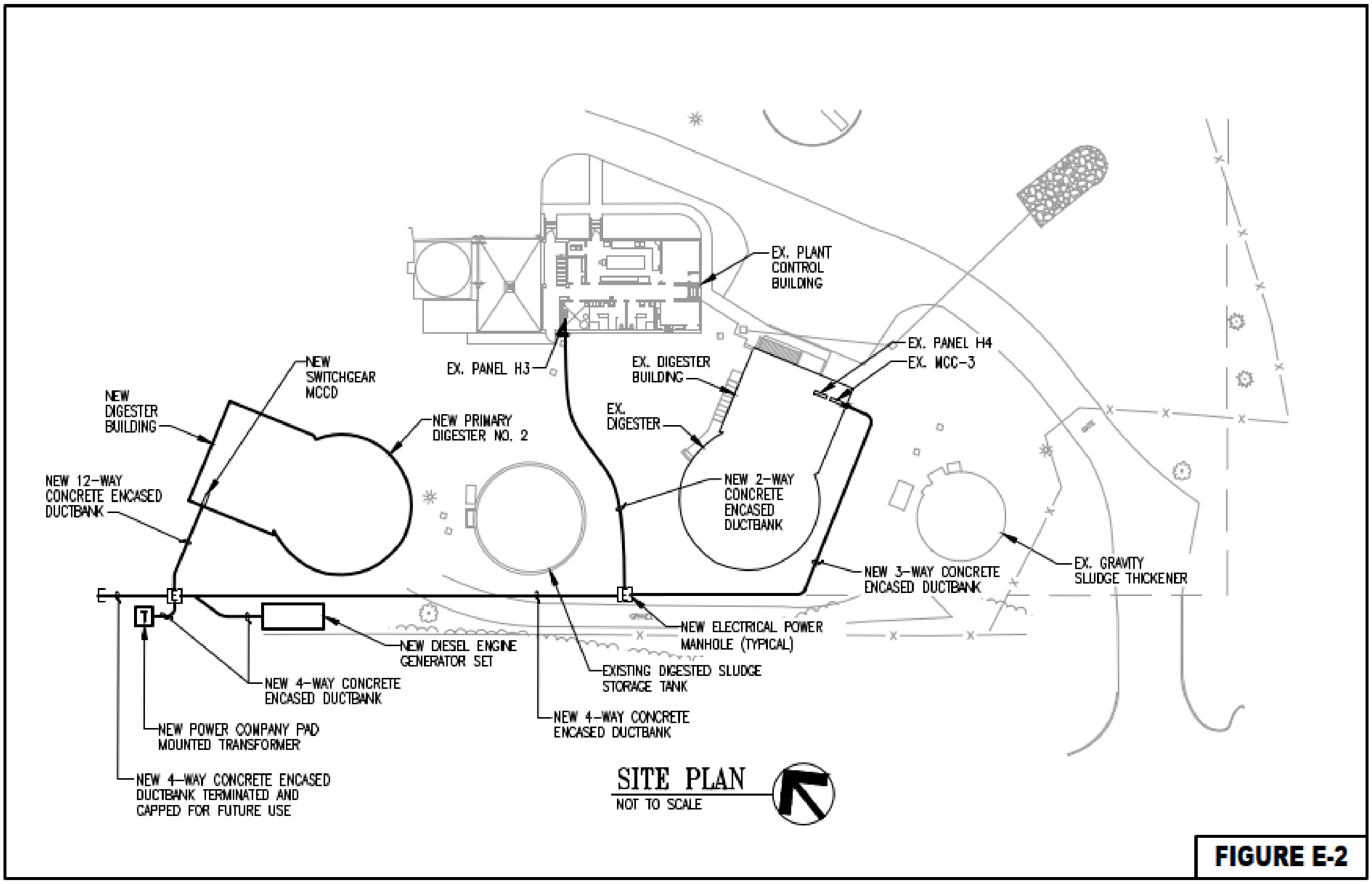
Since it is not feasible to add the new sludge processing equipment loads to the existing electrical distribution system, a new service will have to be extended to the treatment plant if a new digester facility is added in a future plant expansion scenario. This service should be sized sufficiently to provide power to the new process equipment loads as well as the existing solids handling process equipment loads and with some spare capacity for other future loads.

The nearest point of primary service appears to be located on Waterloo Road, to the north of the treatment plant site. From the Waterloo Road location, Dominion Power overhead primary service conductors would follow the treatment plant west property line to a power company pad mounted transformer located in the vicinity west of a future new digester building. This will need to be confirmed with Dominion Power. From the pad mounted transformer, 480/277-

volt, 3 phase secondary service conductors would be run underground in a concrete encased ductbank and manhole system to a 3,200-amp rated main circuit breaker switchgear located in the electrical room of the future digester building. It is anticipated that a new diesel-engine generator set will provide back-up power for the future solids handling facilities.

Refer to the electrical site layout on **Figure 7 (E-2)**, for facility and equipment locations.

Figure 7: Electrical Site Plan



The Switchgear will be equipped with electrically operated, draw-out type main and feeder circuit breakers. The normal service main circuit breaker and the backup power main circuit breakers will be electrically interlocked to prevent them from both being closed at the same time. The automatic throw-over scheme between the normal power and the backup power circuit breakers will be controlled by a programmable logic controller (PLC). In addition to opening and closing the normal and backup power circuit breakers, the PLC will also initiate the starting and stopping of the diesel engine generator. The PLC will have a battery backup battery uninterruptable power supply (UPS) to keep the PLC powered at all times. Protective relays, such as; under voltage, over voltage, lock-out, etc. will be part of the switchgear automatic throw-over scheme. A surge protective device, power meter and a touch screen HMI will also be included as part of the switchgear.

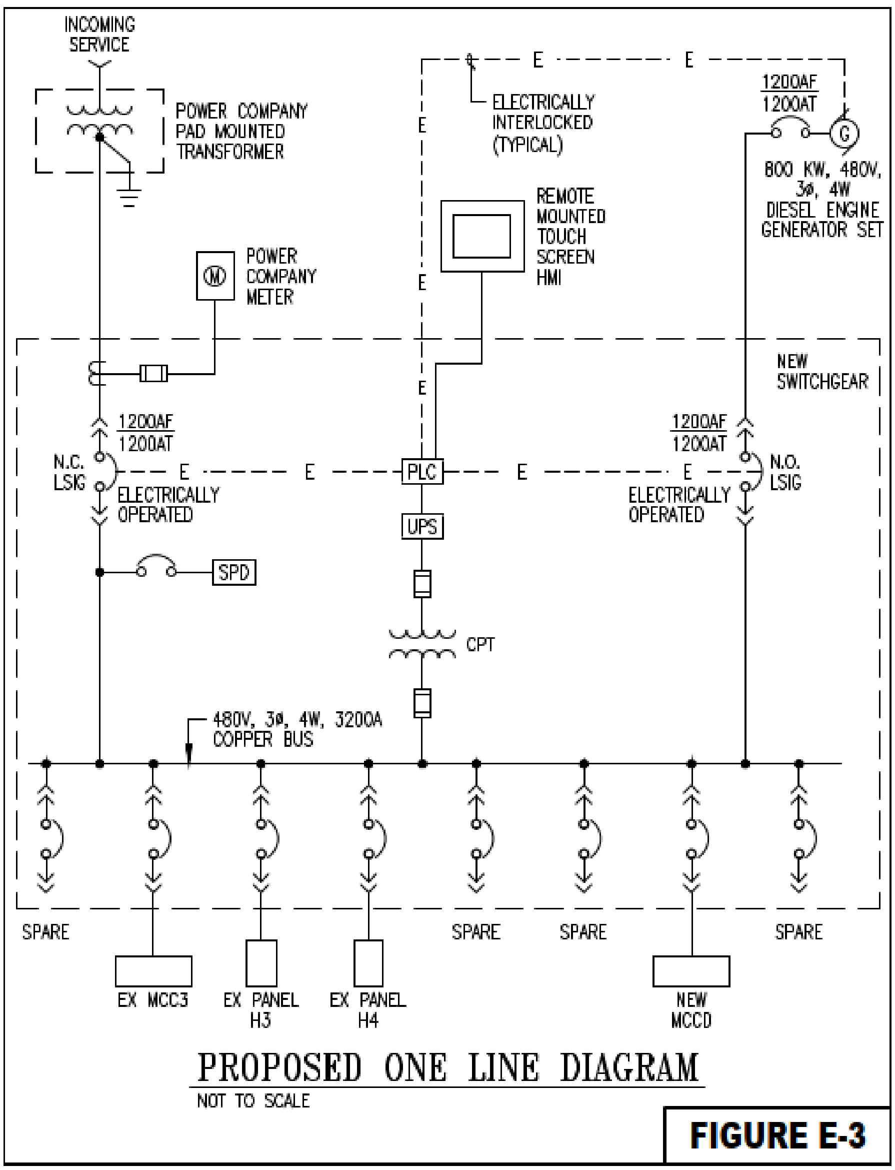
The electrically operated, draw-out type branch circuit breakers will feed the new Digester Building, the existing Digester Building and the existing Plant Control Building 480/277-volt, 3 phase power loads.

Dry type transformers will step-down the 480 volts to 208/120 volts and branch circuit breaker panelboards will be used for powering lights, receptacles and other miscellaneous single phase loads throughout the new digester building.

Backup power for the new sludge processing loads will be provided by an 800 KW, 480/277-volt diesel engine generator set. The generator set will be housed in a weather protective, sound attenuated metal enclosure, have a duel walled steel sub-base fuel tank and will be located outdoors adjacent to the Power company pad mounted transformer. The fuel tank will be of sufficient size to hold enough fuel for the generator set to provide a minimum of 24 usable operating hours at full load.

Refer to the proposed one-line diagram on **Figure 8 (E-3)**.

Figure 8: Proposed Electrical One-Line Diagram.



New lighting fixtures will be LED type, suitable for the area in which they are located. Exposed conduit will be rigid galvanized steel with a bonded-on PVC coating. Concrete encased ductbank conduits will be Schedule 40 PVC. All wire will be soft drawn copper with 600-volt insulation.

4 RECOMMENDED FACILITY PLAN

Based on the foregoing review of the existing solids handling facilities, operations and projected solids production as plant flows increase and the treatment plant capacity is expanded beyond the current permitted design of 2.5 MGD, the following phasing of solids process related upgrades is recommended.

Phase I: Near-term at current flows:

1.) Refurbish existing gravity sludge thickener (GST) including replacement of sludge mechanism, bridge, and cover, and repair concrete as needed. The Town is currently (2022) procuring a construction contract for this work.

2.) Consider provisions to add diluting water and/or chlorine to the GST feed.

3.) Replace existing digester plug valves to improve operability.

4.) Restore the grade around the perimeter of the building. Replace or repair loose handrails and corroded platforms.

5.) Expand the sludge storage area, if deemed needed, and replace the roof over the new and existing area.

Phase II: Plant flows approaching 2.5 MGD Permitted Capacity:

6.) Plan and design for an additional 50 ft diameter primary digester and associated facility.

7.) A new electrical service and standby power will be required for the second digester facility.

8.) Upgrade and replace process equipment (heat exchanger and pumps) and electrical MCC for the existing digester.

9.) Consider upgrading the dewatering BFP to a higher capacity unit, or select alternative dewatering technology such as a screw press.

Phase III: Plant Expansion to 3.0 MGD and 3.5 MGD:

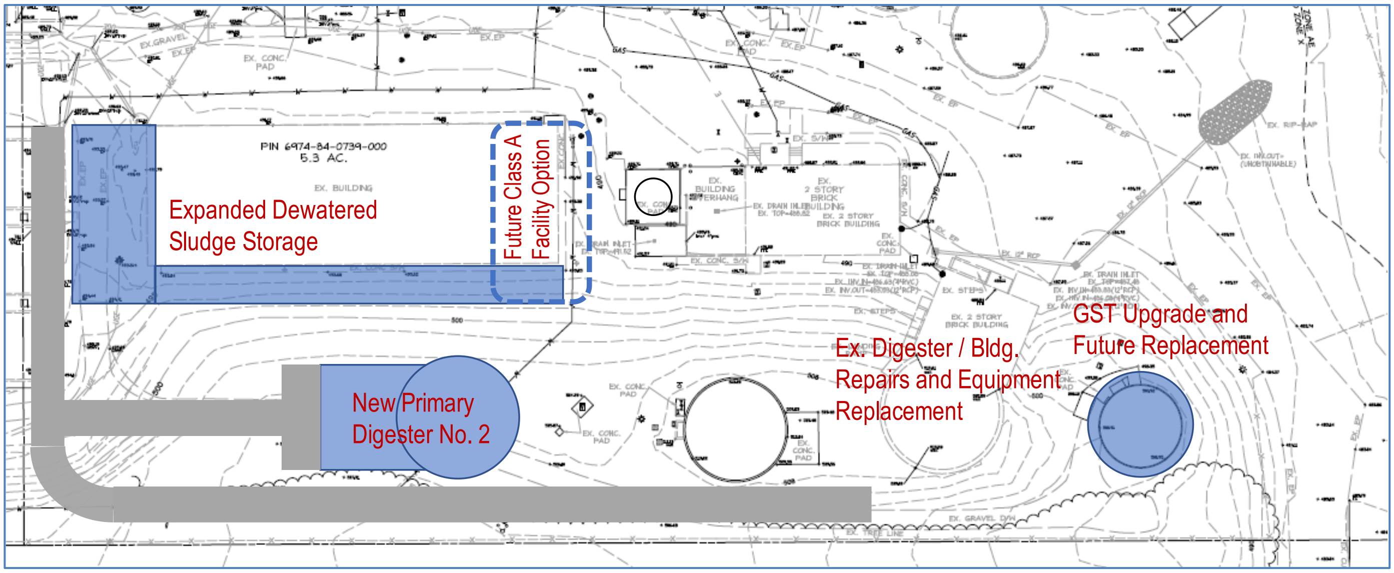
10.) Depending on the performance of the existing GST when flows exceed 3.0 MGD, consider replacing with a larger GST.

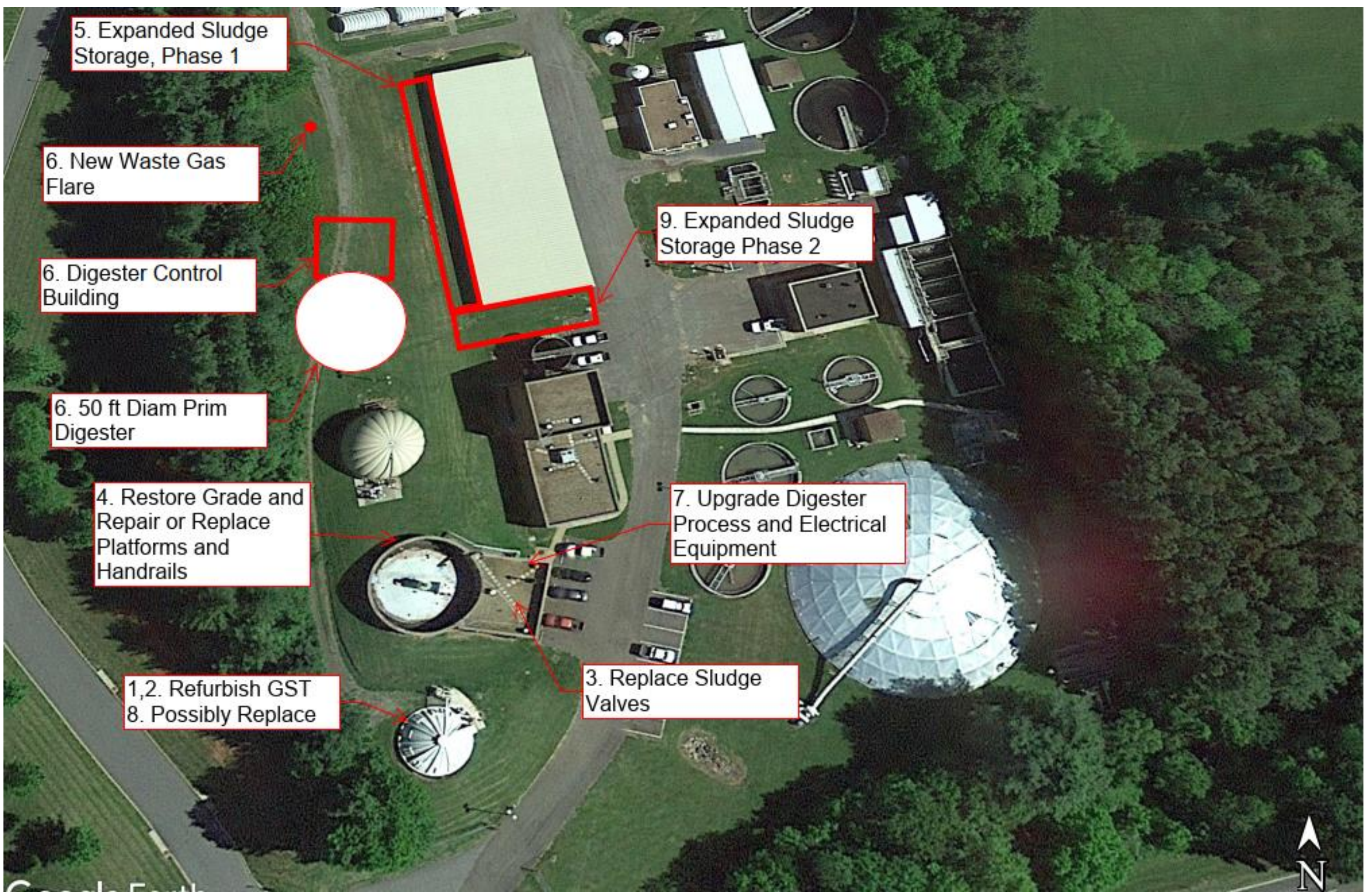
11.) Further expand the sludge storage area as needed.

12.) Depending on biosolids management and future regulations, plan or possibly build a new Class A biosolids facility.

Figure 9 shows a schematic site plan for the recommended solids handling improvements.

Figure 9: Solids Facility Site Plan





Preliminary planning level construction cost estimates are shown in **Table 13** for each of the recommended solids facility improvements based on phased implementation.

Table 13: Solids Facility Improvements Planning Level Construction Costs

Phase Item	Upgrades	Planning Level Construction Costs[1]
Phase I		$1.0M - $1.5M
1.	Refurbish Existing GST	$0.4M - $0.5M
2.	Add provisions for Diluting Water and Chlorine to GST	$0.1M - $0.15M
3.	Replace Existing Digester Valves	$0.15M - $0.2M
4.	Ex. Digester Building and Grade Repairs	$0.1M - $0.15M
5.	Expand Dewatered Sludge Storage	$0.35 - $0.45M
Phase II		$7.0M - $8.5M
6.	New Primary Digester No. 2	$4.5M - $5.0M
7A.	New Electrical Power Service	$0.9M - $1.1M
7B.	New Standby Power (Generator)	$0.5M - $0.75M
8.	Equipment Replacement for Existing Primary Digester	$0.75M - $1.0M
9.	Expand Dewatering Capacity (new BFP or Screw Press)	$0.5M - $0.75M
Phase III		$1.25M - $1.75M
10.	Replace GST with Larger GST	$1.0M - $1.4M
11.	Dewatered Sludge Storage Expansion	$0.25M - $0.35M
Phase III (beyond)		
12.	Future Class A Biosolids (heat drying facility)	$10M - $12M

[1] Costs do not include Engineering and Administration (2021 dollars)

Appendices

Appendix A

Structural Condition Assessment – Field Memo

Whitman, Requardt & Associates, LLP
Engineers · Architects · Environmental Planners Est. 1915

MEMORANDUM

Date: December 17, 2019

To: File

From: Brian Barna, PE

Subject: Warrenton WWTP – Structural Condition Assessment

CC:

Work Order Number: WRA 18560.000

Contract Number:

Project: Town of Warrenton WWTP – Solids Handling Facilities Upgrade PER

Background:

Whitman, Requardt and Associates, LLP (WRA) visited the Town of Warrenton Wastewater Treatment Plant site on November 20, 2019 to perform a structural condition assessment of the existing digester building, control building, sludge storage area, and gravity thickener. This assessment was limited to conditions readily visible on the exterior and interior areas of the facility, and the exterior of the digester and the gravity thickener. The assessment did not include structural observations of the interior of the digester tank or the floating cover.

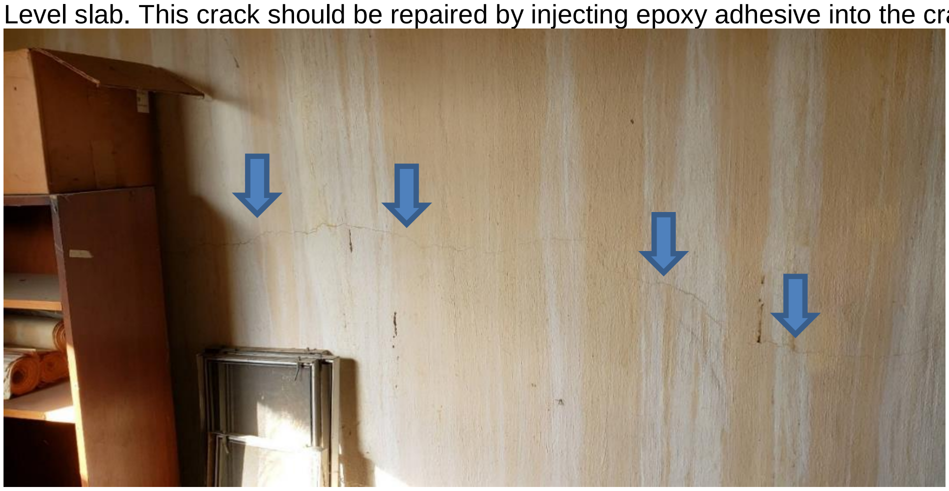
Several minor structural and architectural deficiencies were observed during our site visit. We did not observe any deficiencies that would be considered critical to the overall structural integrity of these elements. These deficiencies generally fall into one of two categories, (1) issues that could have a negative impact on the operator safety or serviceability of the building or (2) maintenance issues that could continue to worsen over time if observed deficiency is not mitigated or repaired.

Digester Building

The digester building consists of a two-story, cast-in-place concrete structure and a double-heighted digester tank extending from the foundation level to the roof. The first floor of the building and the base slab of the digester tank are concrete mat slab foundations. The concrete digester walls bear on a continuous wall footing at the digester tank perimeter.

See the attached floor plan for the approximate locations of each observed deficiency.

1. A long horizontal hairline crack observed along circular wall of digester tank, approximately 4' above Upper Level slab. This crack should be repaired by injecting epoxy adhesive into the crack.

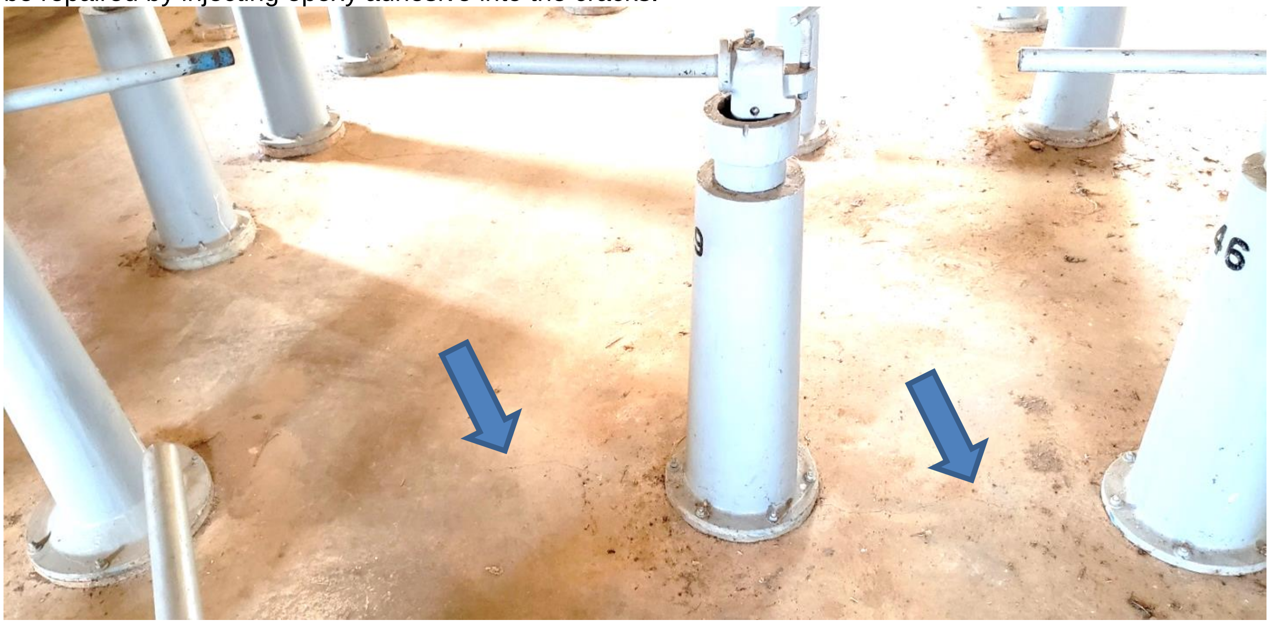


2. A long vertical hairline crack observed on circular wall of digester tank, extending from Upper Level slab to roof slab. This crack should be repaired by injecting epoxy adhesive into the crack.

3. A long horizontal hairline crack observed along circular wall of digester tank, approximately 2.5' above Upper Level slab. This crack should be repaired by injecting epoxy adhesive into the crack. (Similar to Photo #1)

4. Vertical cracks observed at intersections of masonry walls, extending from Upper Level slab to roof slab. These cracks should be repaired by injecting epoxy adhesive into the cracks.

5. Hairline cracks were observed in Upper Level slab between valve operator floor stands. These cracks should be repaired by injecting epoxy adhesive into the cracks.



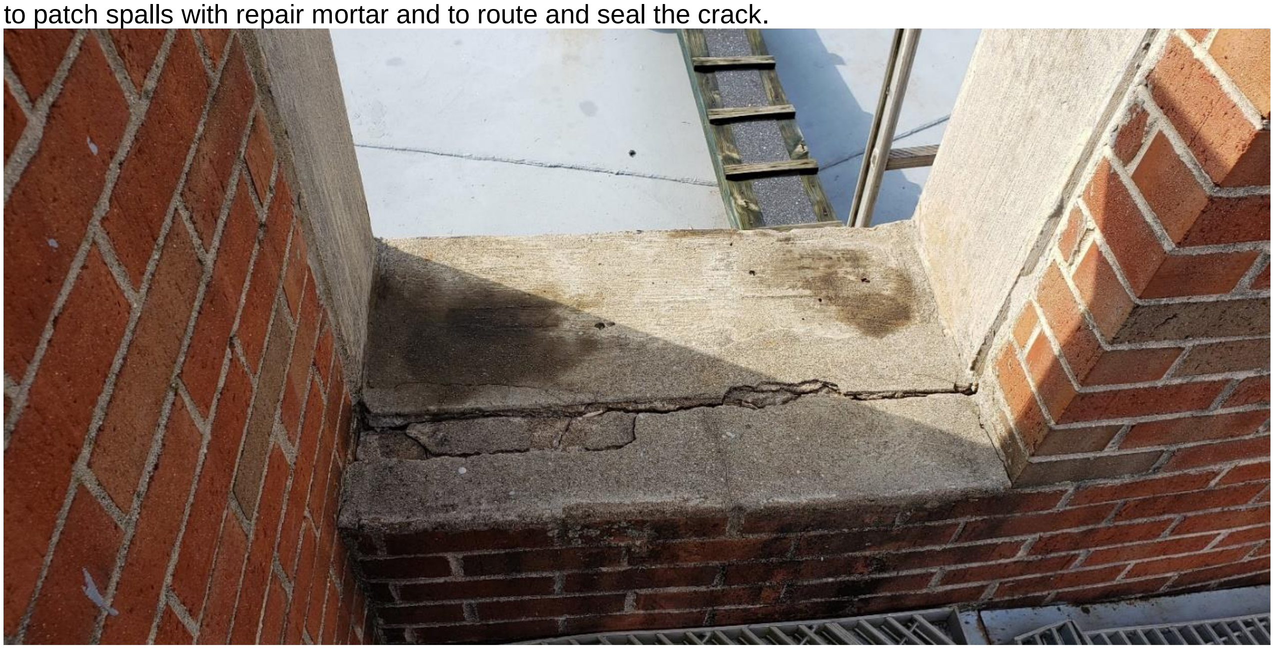
6. At concrete stair landing above main entrance, chains are used instead of guardrails. OSHA Standard 1910.29(b)(10) states, "[w]hen guardrail systems are used at hoist areas, a removable guardrail section, consisting of a top rail and midrail, are placed across the access opening between guardrail sections when employees are not performing hoisting operations. The employer may use chains or gates instead of a removable guardrail section at hoist areas if the employer demonstrates the chains or gates provide a level of safety equivalent to guardrails." We recommend to replace the chains with either a permanent or a removable guardrail, dependent on if this section needs to be removable for hoisting operations.

7. A severe horizontal mortar joint failure was observed along the entire north wall. A continuous steel relieving angle lintel is aligned with this joint. The lintel was observed through the joint and appears to be rusted and delaminated. The joint appears to be likely too wide to be repaired with mortar. Recommended repair is to route out the existing mortar joint, then insert a backer rod into the joint and seal the exterior of the joint with a flexible sealant.

8. The grating at the exterior ramp was loose and not attached to support structure. This creates a hazardous walking surface. The grating should be fastened to the structural supports on each side of the ramp.

9. The mortar joints between most of the precast concrete parapet cap units have failed, causing openings between the units and uneven elevations. Recommended repair is to repoint all mortar joints between precast concrete parapet caps.

10. Cracking and spalling was observed at the wall opening to access the top of the digester from the exterior. Crack aligns with the joint between the digester concrete wall and the brick façade. Recommended repair is to patch spalls with repair mortar and to route and seal the crack.



11. The concrete brick shelf corbel extending from digester walls was exposed in several locations around the perimeter of the building. Typically this brick shelf would be below grade so the bottom of the brick façade would terminate below grade where it would not be seen. The visible brick shelf is primarily a cosmetic deficiency; however, the fact that so much of the brick shelf is exposed could be evidence of grading erosion caused by slope stability issues of the steeply-sloped grade.

12. The bottom of footing supporting the exterior grating ramp was exposed. Also, there is an approximately 18" drop in elevation from the base of the metal ramp to the adjacent grading, which is a serviceability issue. The base building drawings indicate a design of a 2" elevation difference between top of footing and top of grade. The subgrade under the footing should be restored, and the soil at the end of the ramp should be re-graded to eliminate the elevation drop. These elevation issues are additional evidence of grading erosion in this area.

13. Spalls with exposed rebar were observed at two locations at the underside of the concrete beam. These spalls can be repaired with a patching mortar.

14. A temporary screw-jack shoring post was supporting the pipe fitting. This shoring post should not be used as a permanent support for the pipe. The pipe should either be hung from the structure above or supported by a permanent post supported by the first floor slab.

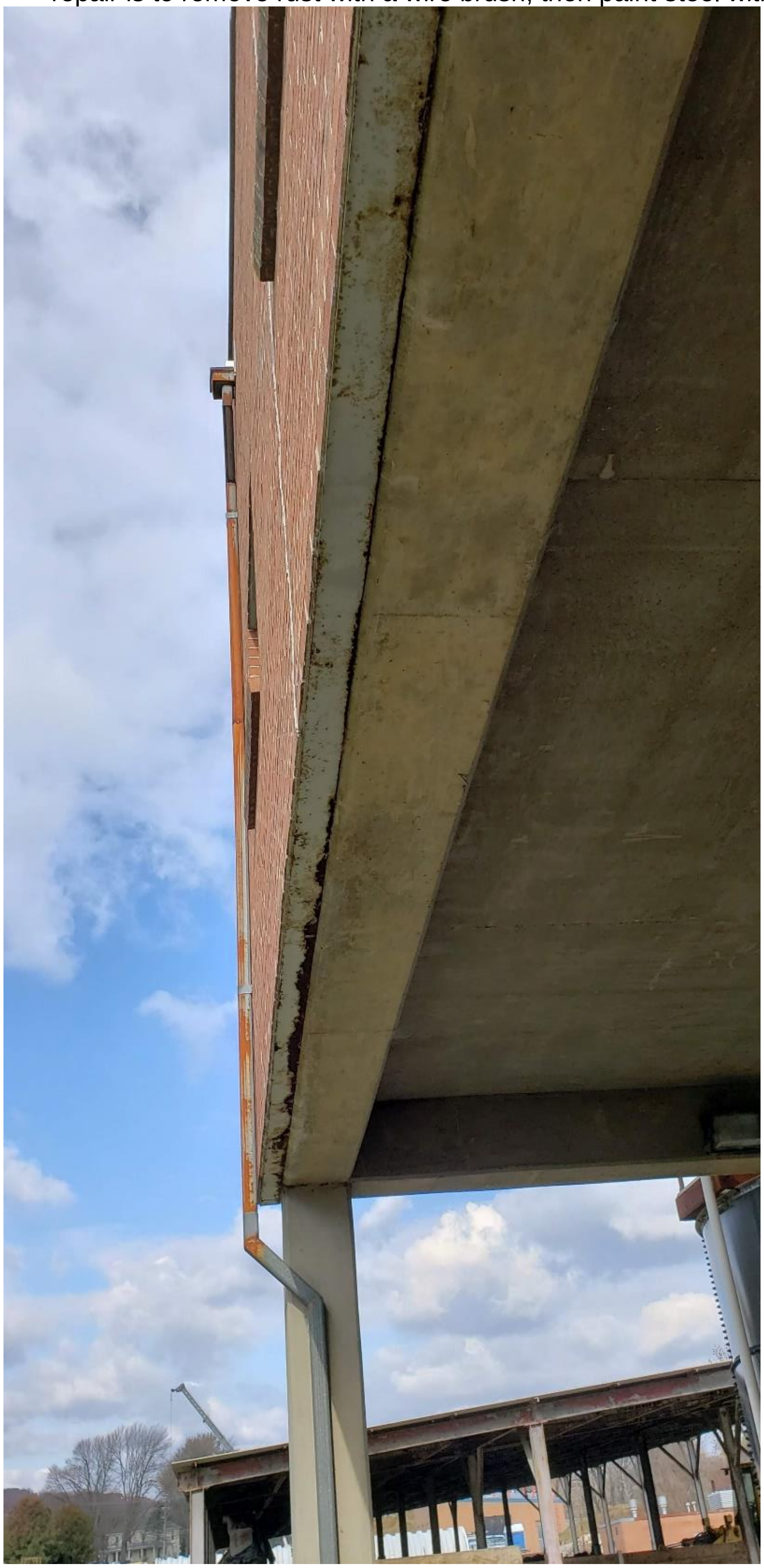
Control Building

The control building is a rectangular building with a two-story portion and a one-story portion. The roof of the two-story structure typically consists of metal deck on open-web steel joists on concrete masonry unit bearing walls. The second story framing supporting the sludge press equipment consists of a cast-in-place concrete slab supported by concrete beams and columns. The low roof area over the one-story portion consists of metal deck on open-web steel joists on concrete masonry unit bearing walls. The entire structure bears on shallow wall and column footings. The first floor is typically a soil-supported slab-on-ground.

See the attached floor plan for the approximate locations of each observed deficiency.

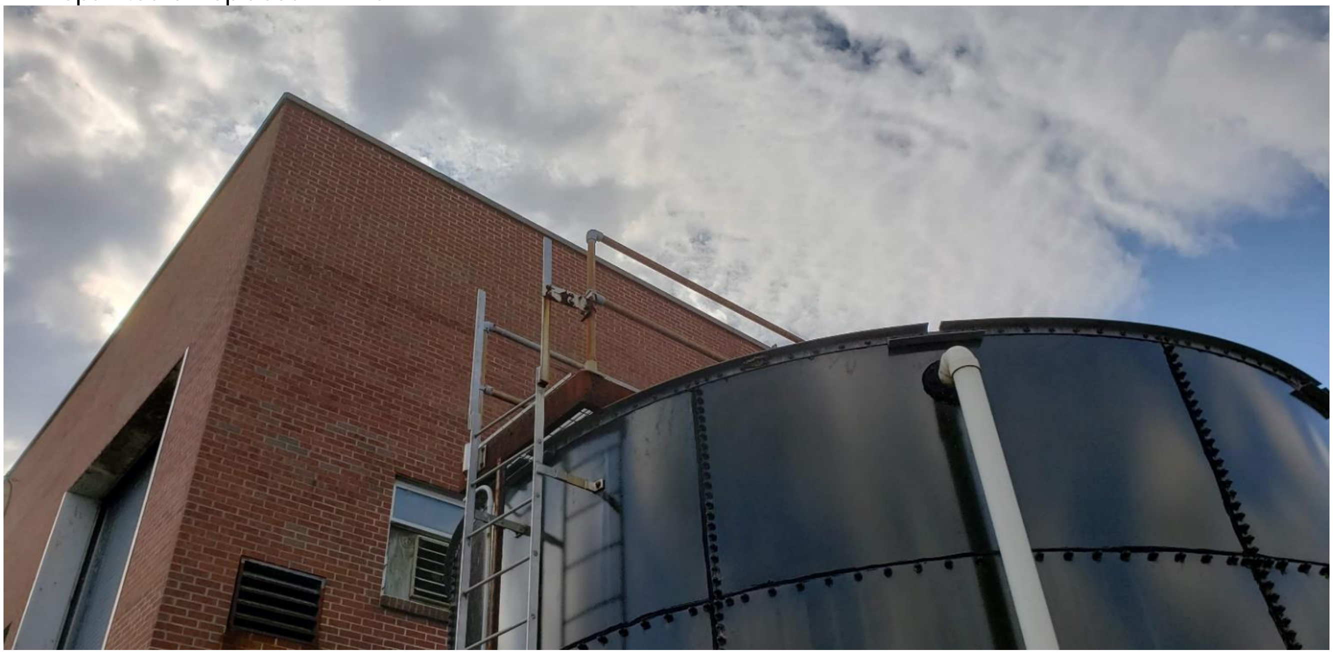
1. Cracks were observed through bricks at the window sill and vertical bricks near window jamb. Damaged bricks should be removed and replaced in kind.

2. The steel lintel on all three sides of open drive-in area for trucks to receive sludge is rusted. Recommended repair is to remove rust with a wire brush, then paint steel with a zinc-rich paint for protection.



3. The two downspouts from high roof scuppers are rusted. Recommended repair is to remove existing downspouts and replace in kind.

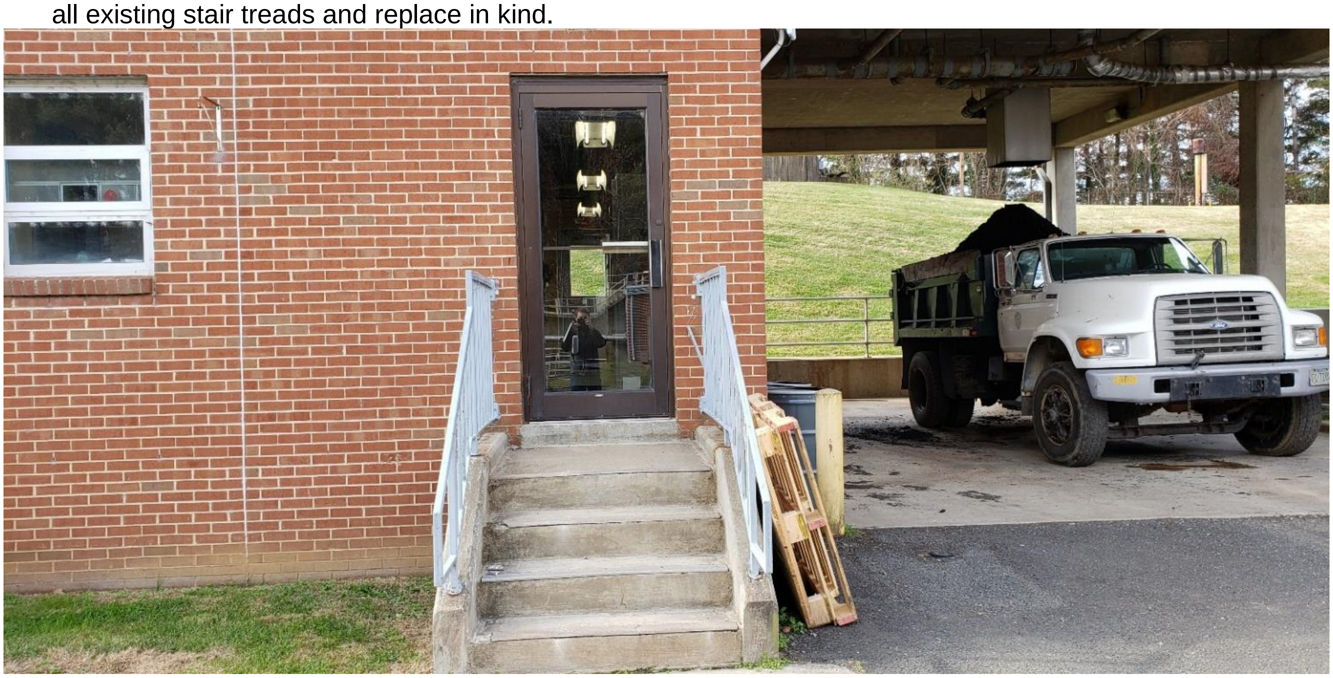
4. The structure supporting the maintenance platform above tank is severely rusted and should be replaced in kind. Handrails and top support for ladder are also rusted and should either be scraped with a wire brush and repainted or replaced in kind.



5. North Elevation: The louver on the north elevation is rusted. Recommended to remove louver and replace in kind. Clean rust stains from brick façade.

6. East Elevation: Top of brick veneer has spalled under concrete sill at Second Floor overhead door. Recommended to remove damaged bricks and replace in kind, then seal joint between concrete sill and brick below with a flexible joint sealant and backer rod.

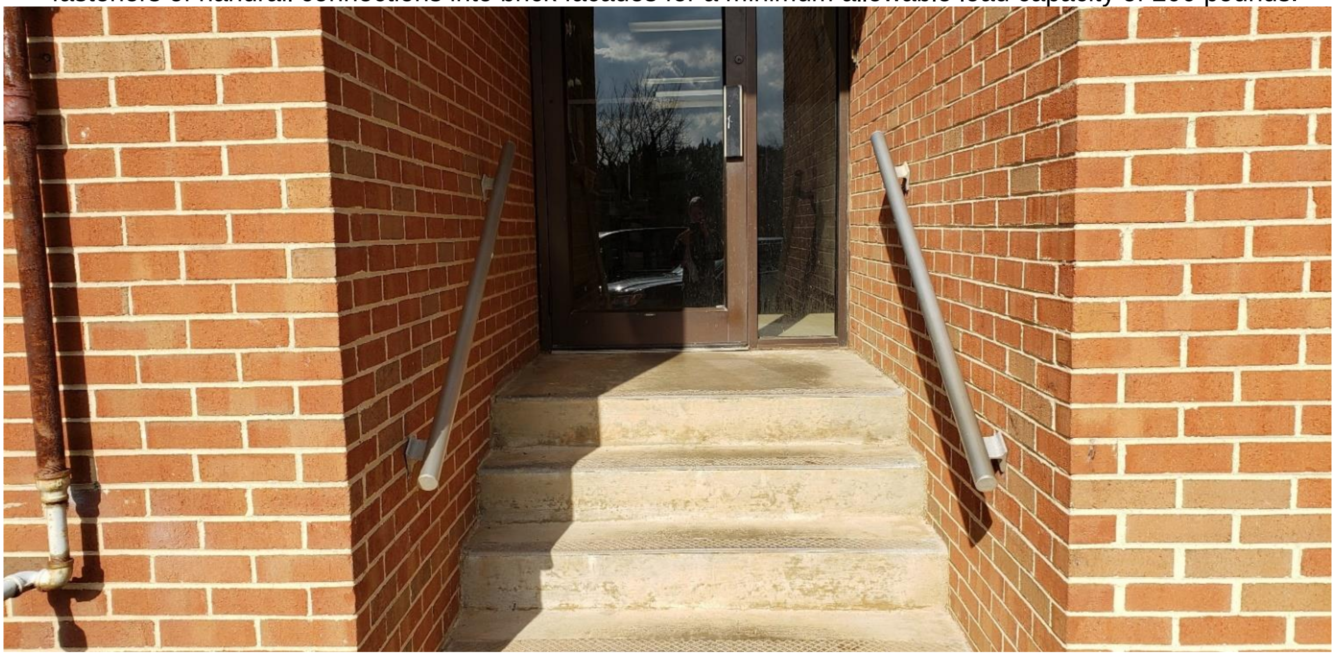
7. East Elevation: Anti-slip stair treads embedded in exterior concrete stairs have cracked and failed. Remove all existing stair treads and replace in kind.



8. East Elevation: The end of the concrete curb has completely detached from the structure, exposing the sleeve for embedded handrail pipe. Repair end of curb with new cast-in-place concrete formed in place and doweled into existing concrete structure.

9. South Elevation: Rusted exterior pipe at gas meter. Remove and replace in kind.

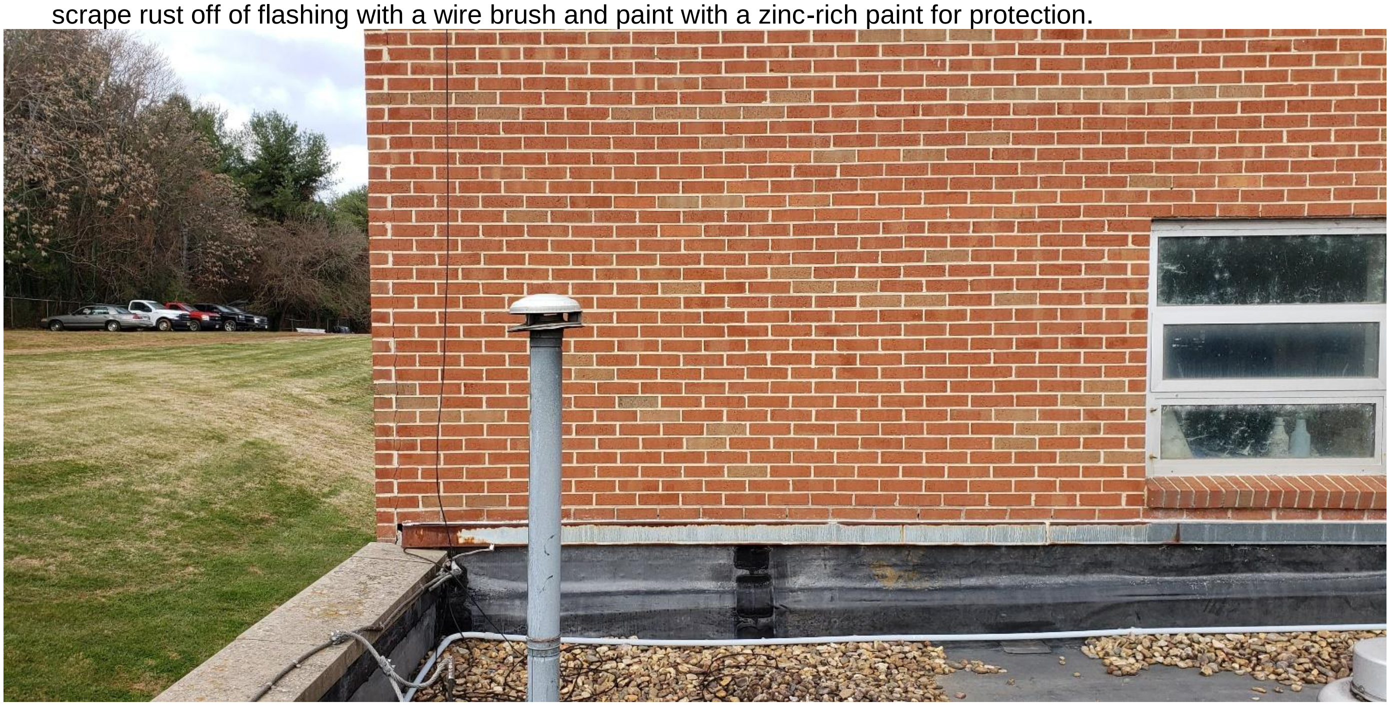
10. South Elevation: Handrails attached to brick walls at each side of entrance are loose. Replace post-installed fasteners of handrail connections into brick facades for a minimum allowable load capacity of 200 pounds.



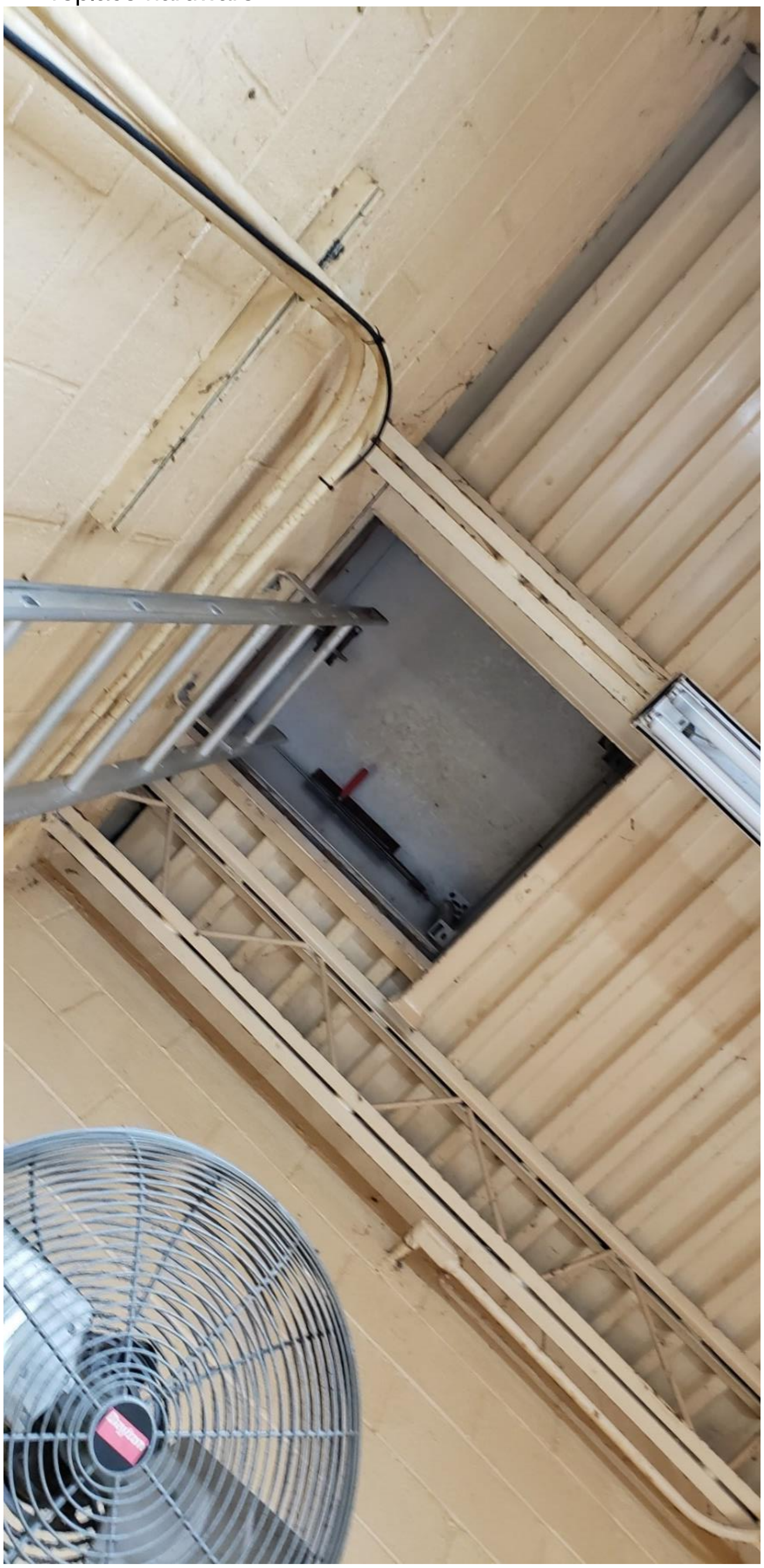
11. Building interior, First Floor: Water stains were observed on a few of the ceiling tiles. Recommended action is to confirm there are no active leaks above the stained ceiling tiles, then replace stained ceiling tiles in kind.

12. South Elevation: Vertical brick cracks were observed at intersections of east and west walls above low roof area. Recommended repair is to route out cracks and fill with flexible sealant.

13. South Elevation: Rusted flashing at base of brick veneer above low roof area. Recommended repair is to scrape rust off of flashing with a wire brush and paint with a zinc-rich paint for protection.



14. Building interior: The roof hatch hardware was rusted and difficult to operate. Recommended repair is to replace hardware.



Sludge Storage Area

The sludge storage area is an open-air rectangular structure with a monoslope roof sloping from its high point at the front of the building to its low point at the rear of the building. The slab area is approximately 9,330 square feet, separated into 8 approximately equal bays by short concrete walls. The roof is a steel deck supported by open-web steel joists and steel beams and columns. The columns bear on steel base plates on top of the concrete walls.

The structure is of the same typical layout and condition throughout, so observations will be made describing typical conditions for the structure. Base building drawings for this structure were not available for our condition assessment.

1. Above the short concrete walls, the two perimeter side walls and the back wall had higher walls comprised of loose-laid wood members between small wide-flange steel posts. A few intermediate walls also had the higher wood separation. These loose-laid members leave gaps where the sludge could escape the storage area, especially given the desire to increase storage capacity by piling sludge higher. Consider building higher walls out of concrete or masonry, especially for the perimeter walls.

2. Steel members generally had paint worn off and moderate rust in several locations. In a few locations, section loss was observed for the steel columns, reducing their load-carrying capacity. For the modification to raise the roof height, re-use of the existing steel should not be considered due to the condition of the existing steel and the complexity associated with raising the existing roof. Use a new structural frame to support the new raised canopy roof.

3. The existing metal roof deck was observed to be in good condition – it appeared to be newer than the supporting structure. Interviews with personnel at the WWTP confirmed that the roof deck had been replaced, though the date of replacement was unknown. One employee stated the roof was replaced in the late 1990's; a second employee stated the replacement occurred within the last 10 years. It is feasible that the metal deck could be re-used if a new steel structure is chosen to support the new higher roof.

4. Along the front of the sludge storage area, the openings for each bay of the short concrete wall were cut after the fact, based on observations of exposed rebar ends and aggregate at the edges of the walls. We recommend parging the cut ends of each wall with a patching mortar to smooth the wall edges and to protect the steel reinforcement.

Gravity Thickener

The existing gravity thickener structure consists of a fiberglass dome supported by concrete walls supported by a concrete mat foundation. We observed the above-grade exterior of the existing gravity thickener. Since most of the structure is located underground, only a small portion of the structure was visible and the observed portion of this structure was unremarkable. No deficiencies were observed.

Sincerely,

Brian Barna, P.E.

Appendix B

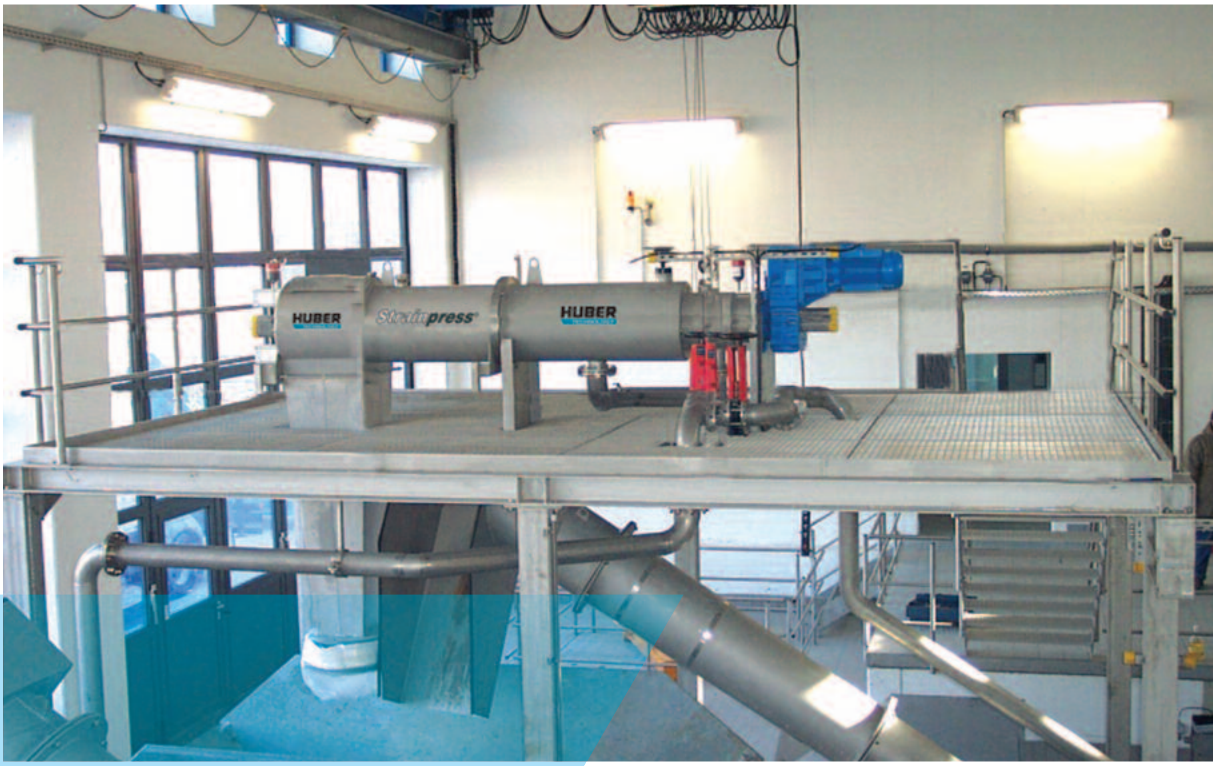
Solids Handling Process Equipment

Sludge Screen
Gravity Belt Thickener (GBT)
Rotary Drum Thickener (RDT)
Dewatering Screw Press

HUBER TECHNOLOGY
WASTE WATER Solutions

Sludge Screen

HUBER Sludgecleaner STRAINPRESS®



- Continuous screening, dewatering and transport of coarse material in one operation
- Removal of coarse material from municipal sludge and industrial process water

Design and function

The STRAINPRESS® is a horizontal cylindrical coarse material separator which consists of inlet and screening zone, press zone, and a discharge section.

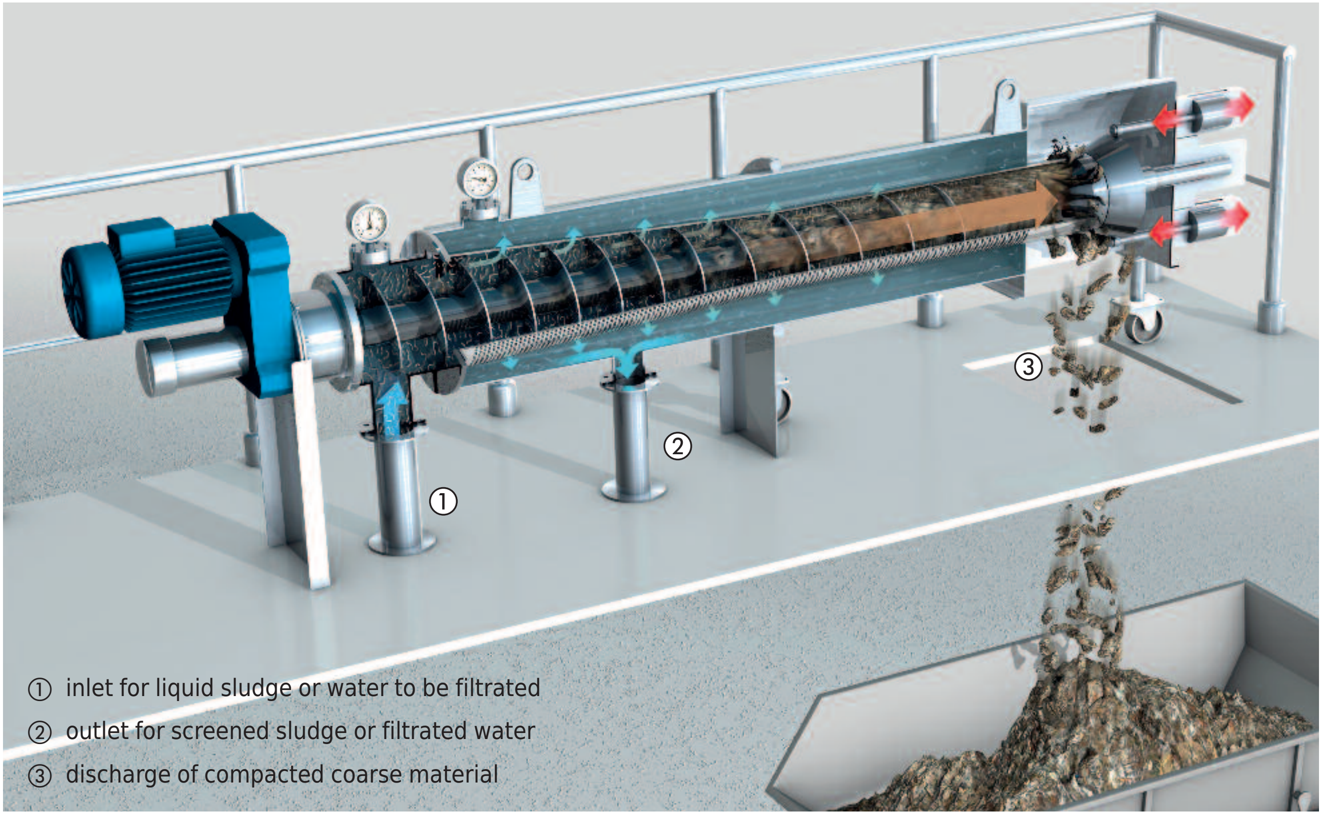
A pump presses the unscreened liquid through the screening zone and delivers the screened liquid to further process steps. The coarse material which is retained on the cylindrical screen is stripped off by a coaxial screw and pushed through the press zone where the material is extensively compacted and dewatered. The screw operates only when the pressure sensors detect a differential pressure caused by screen surface blinding. The compacted material is pressed through a gap around a hydraulically operated pressure cone which closes part of the pipe end and builds up counterpressure. The counterpressure of the cone is automatically regulated inversely proportional to the screw motor load.

The system does not need any wash water as backwashing of the screen is unnecessary.

The perforation and design of the screw shaft are individually adjusted to optimally suit specific requirements.

Features and benefits

- Pressure-fed (inline) system for process water and any type of sludge including highly viscous and grease containing sludge
- Increases the operating reliability of downstream sludge treatment systems, such as thickening, disinfection, stabilisation, dewatering, drying, and reduces maintenance requirements
- For various applications perforations of 2 to 10 mm, different screw geometries and different material qualities are available
- Reliable cleaning of the screen without any wash water
- Pressure-dependent control of the screw shaft combined with the pressure cone regulation system allows for unattended automatic operation even with varying flow rates
- Dewatering of separated coarse material to approx. 40% DR
- 2 sizes for throughput capacities up to 200 m³/h
- More than 1000 successful installations worldwide



Easy maintenance

The complete casing, perforated plate and screw shaft of the HUBER Sludgecleaner STRAINPRESS® are made of corrosion-resistant 1.4307 (AISI 304L) stainless steel. The screw flights are reinforced with tungsten carbide for wear protection. The machine can be split in the middle and one half of the machine moved for maintenance. This allows for example to replace the perforated plate and install a screen insert with a new perforation size.

Splittable casing

Examples

Sludge screening on WWTP Athens, Greece

Outdoor installation of a HUBER Sludgecleaner STRAINPRESS®

STRAINPRESS® with heatable casing pipe

Screen for the removal of fermentation residues

Throughputs

Screen size	**Throughput capacity [m³/h]** with 5 mm screen perforation and 3% DS	**Screenings volume [l/h] with** 35 - 45% DS	**Drive [kW]**	**Dimensions [m]** L x W x H
290	<=75	<=1000	2.2	3.6 x 0.7 x 1.0
430	<=160	<=2000	3	4.5 x 0.8 x 1.4

STRAINPRESS® applications

The STRAINPRESS® is used for liquid sludge screening or filtration of service or process water under pressure.

Examples for coarse material separation from:

- primary sludge
- secondary sludge
- mixed sludge
- septic sludge
- floating sludge
- grease sludge
- digested sludge
- production wastewater and industrial sludges
- circulation and process water

Discharge of the separated dewatered material

Separated material: paper, wood, plastic, foils, rubber, textiles, etc.

HUBER SE

Industriepark Erasbach A1 · D-92334 Berching
Phone: + 49 - 84 62 - 201 - 0 · Fax: + 49 - 84 62 - 201 - 810
info@huber.de · Internet: www.huber.de

Subject to technical modification
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Komline-Sanderson Gravity Belt Thickener

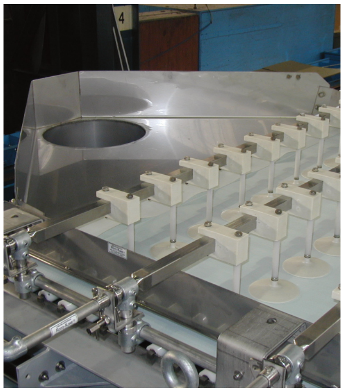
Gravabelt®
Gravity Belt Thickener

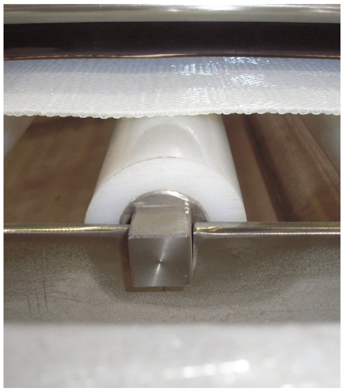
Komline-Sanderson's Gravabelt® gravity belt thickener is designed to obtain high volume reduction and high hydraulic throughput at a low polymer dose. The design provides for low maintenance costs and long operational life in the highly corrosive environment of sludge thickening.

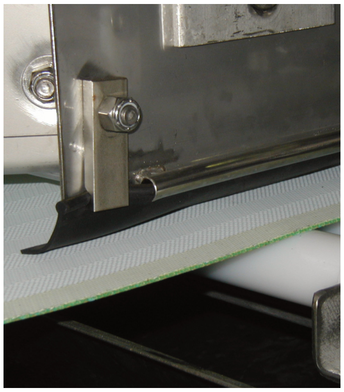
The Gravabelt delivers pumpable thickened sludge. Our flatbed design provides high capture rates using less polymer than rotary designs.

A fully enclosed Gravabelt, pictured right, is also available.

Gravabelt: Gravity Belt Thickener





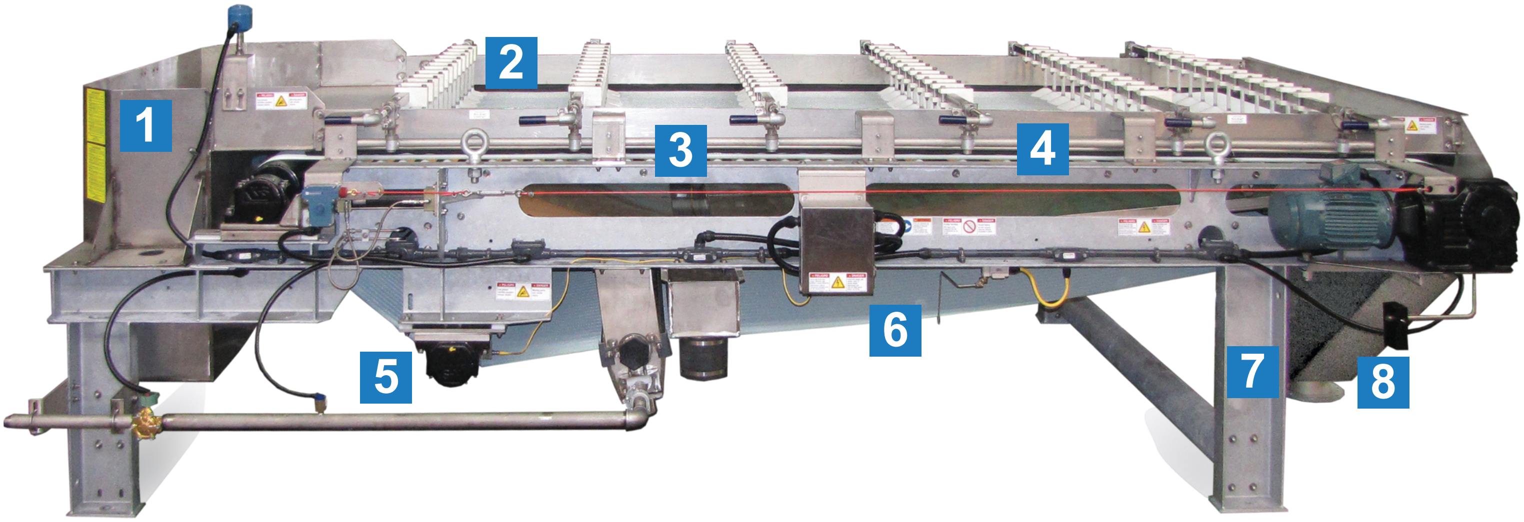


1 Feed Section - Polymer is injected through a multiport ring and mixed with the sludge via a non-clog variable orifice mixer in the feed line prior to entering the flocculation tank. Coagulated solids form in the flocculation tank and overflow onto the dewatering belt in a smooth, gentle stream, minimizing floc shear.

2 Roto-Kone® Elements - Roto-Kone elements lift and decelerate incoming sludge creating a head which turns the sludge to enhance separation. Roto-Kone stations are placed in several locations along the entire length of the belt. The elements rotate, reducing rag hang-up, and self adjust to maintain contact with the belt. They can be lifted to precisely control final cake solids.

3 Belt Support/Wiper Bars - The dewatering belt is supported on abrasion-resistant, replaceable polyethylene wipers to enhance dewatering by constantly breaking the liquid surface tension. Wipers can be rotated providing multiple wear surfaces.

4 Side Seals - Replaceable rubber side seals prevent sludge from spilling off the sides of the moving drainage belt. A clamp is used to hold these seals in place for easy removal and installation.



5 Bearings - All bearings are a split pillow block, double-row spherical roller design. They lie outboard of the process stream, are regreasable, and are nylon coated. For our standard two meter machine the minimum L-10 life is equivalent to over 135 years of continuous service.

6 Dewatering Belt - Expected belt life is 2000-3000 hours depending upon the feed material being processed. Replacement time is less than an hour and no machine disassembly is required.

7 Frame Construction and Corrosion-Resistant Features - The frame is heavy duty hot-dip galvanized carbon steel channel welded and/or bolted. Stainless steel is also available. All fasteners are stainless steel and the conduit is PVC coated. Cylinders are constructed of composite materials to eliminate corrosion.

8 Discharge Hopper - The discharge hopper can be directly connected to a thickened sludge pump eliminating the need for an intermediate storage tank with level sensors used to operate the thickened sludge pump.

Pump. Thicken. Dewater. Dry.

Komline-Sanderson
12 Holland Ave.
Peapack, NJ 07977-0257
www.komline.com
(908) 234-1000

KS-VFBD-2007

HUBER TECHNOLOGY
WASTE WATER Solutions

Rotary Drum Thickener

ROTAMAT®
Screw Thickener RoS 2

Screw thickener for municipal and industrial sludge

- compact and entirely enclosed
- efficient and reliable operation with minimum operator attendance
- low operation and maintenance costs
- made of stainless steel, pickled in acid bath

Features

Thin sludge is pumped to the flocculation reactor of the screw thickener. A polymer station prepares a polymer solution from powder or liquid polymer. The diluted polymer is introduced through a dosing ring into the feed sludge, and is intensively mixed with the sludge in a static inline mixer.

Strong sludge flocs are formed in the agitated flocculation reactor where the flocculated sludge overflows into the screw thickener.

The screw thickener is comprised of an inclined wedge section basket with a 0.01” (0.25 mm) spacing. A screw, slowly rotating with variable speed, conveys the sludge gently upward through the inclined basket. Water drains through the basket. The screw flights are provided with a brush for continuous internal cleaning of the wedge section basket. Periodically the wedge section basket is also cleaned with spray water from the outside. Spray bars rotate around the basket, but within the machine.

The screw pushes the thickened sludge to the upper end of the wedge section basket where it drops through a chute into the thickened sludge pump that forwards it to further treatment.

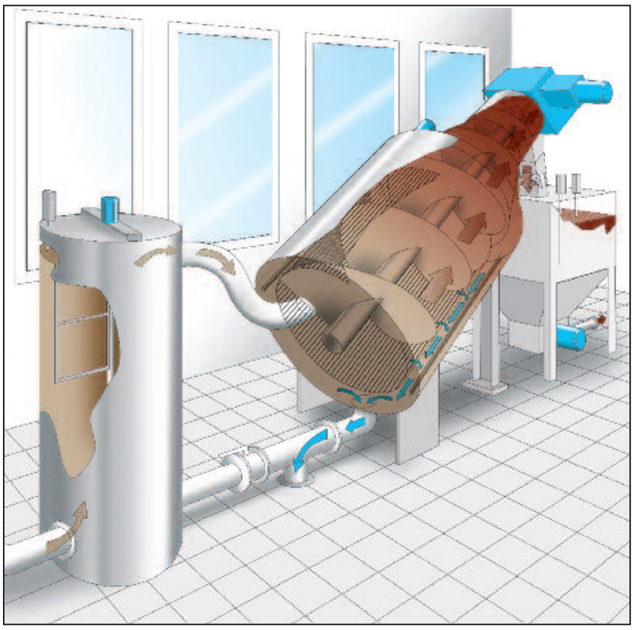
Benefits

- Coarse material does not impair the machine and its operation
- Fully enclosed system prevents odor nuisance and health & safety hazards
- No noise, no vibration
- No need for wash-down
- Little operator attendance due to fully automatic operation
- Polymer and wash water consumption
- Low operating costs
- Little wear and maintenance
- Made of stainless steel, pickled in an acid bath for perfect finishing and corrosion protection

Performance

- Thick sludge solids: 4 to 8 %*
- Hydraulic capacity: Up to 350 gpm (80 m^3/h)**
- Solids capacity: Up to 1,600 lb/h (720 kg/h)**
- Solids capture rate: > 95 %*

* common municipal wastewater sludge
** per screw thickener



HUBER TECHNOLOGY, Inc.

9735 NorthCross Center Court STE A · Huntersville, NC 28078
Phone: (704) 949 - 1010 · Fax: (704) 949 - 1020
huber@hhusa.net · http://www.huber-technology.com

Subject to technical modification
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Dewatering Screw Press

HUBER Screw Press Q-PRESS®

The new generation of our well-proven sludge dewatering press
– even more efficient
– increased reliability of operation
– optimized operating costs

Sludge dewatering

Flocculated sludge is pumped into a cylindrical screen basket wherein an auger slowly rotates. The diameter of the auger's shaft increases towards the end of the basket and the gap between its flights decreases. The volume between basket, shaft and flights continuously decreases, and the pressure thus increases, as the sludge is moved through the basket. Sludge water is pressed through the basket's screen.

The auger pushes the increasingly thicker sludge towards the annular clearance, defined by a circular opening and an adjustable discharge cone therein. The cone is pressed against the opening by pneumatic cylinders, thus maintaining a defined sludge pressure at the discharge end.

Scrapers on the screw shaft permanently clean the filter basket from the inside. A stationary spray bar backwashes it periodically and segment by segment from the outside without interrupting the dewatering process.

Innovation

Energy efficiency:

The screw drives exceed the current energy efficiency standards of electric motors. Due to maximised electrical efficiency the HUBER Screw Press Q-PRESS® can therefore be operated with higher solids throughputs.

Dewatering results:

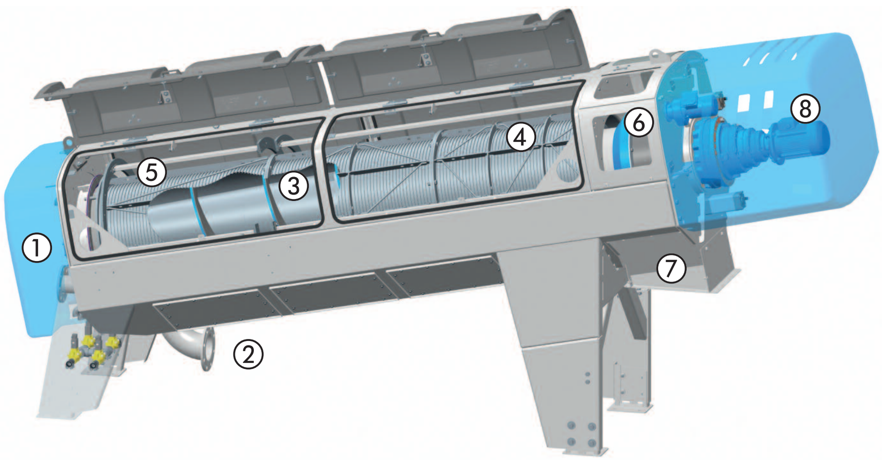
Unique scrapers on the screw shaft permanently and reliably clean the inner filter surface with every rotation of the screw. Additionally, the scrapers are optimally arranged to increase cleaning frequency. Free water can thus very easily run off. As a result, dewatering efficiency increases and flocculant consumption is reduced.

Due to the significantly enlarged open filter surface filter baskets with the same bar spacings are able to handle higher hydraulic loads without impairment of filtrate quality.

The outside of the filter is cleaned without interrupting the dewatering process. The predewatering and press zone can be washed independently of each other. Rewetting of press sludge through washing is reduced to a minimum especially in the press zone without neglecting the important washing in the predewatering zone.

Maintenance:

As an option, the three segments of the filter baskets are available as axially divided segments. Only the upper half of the basket needs to be removed for maintenance. The lower half of the filter basket can be removed from the screw shaft by means of a special mechanism but remains inside the filtrate chamber of the Q-PRESS® during maintenance. This saves a lot of time, reduces space requirements and the need for using lifting devices for maintenance.



① sludge inlet
② filtrate outlet
③ auger with increasing shaft diameter and decreasing gap between its flights
④ filter basket with decreasing bar spacings, axially dividable as an option
⑤ washing system with separately controllable spray nozzle areas
⑥ pneumatic cylinders for maintaining a continuously adjustable pressure of the discharge cone
⑦ press sludge discharge
⑧ energy-efficient drive 0.2 – 1.5 rpm

Partial section of a HUBER Screw Press Q-PRESS®

Advantages

High dewatering

- defined sludge volume reduction in the screw press
- continuously adjustable counterpressure at the discharge end
- filtrate discharge enhanced by gravity due to inclined installation
- unique scraper system for permanent cleaning of the inner filter surface
- significantly increased free filter surface
- continuous dewatering

Reliable operation with little downtime

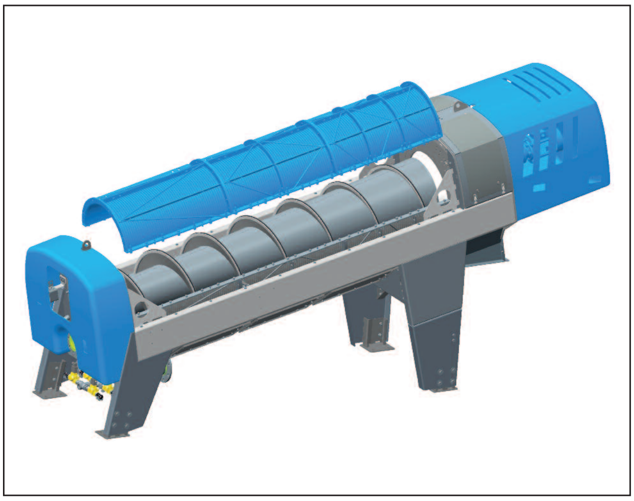
- virtually no wear because of < 1.5 rpm screw rotationspeed
- sturdy stainless steel design
- dividable filter baskets available as an option
- special filter dividing mechanism
- easy access through large inspection openings
- minimal space requirements for maintenance
- simple self-monitoring control strategy
- proven in hundreds of installations

Minimum operation costs

- outstanding energy efficiency
- specific power consumption < 8 kWh/t_{DR}
- little operator attention (< 20 min/day)
- high solids capture rate > 97%

Low total investment costs

- compact design and small footprint
- easy connection of the screw conveyor
- optional tube flocculator
- integrated support legs
- simple control system
- vibration-free, virtually noiseless operation
- fully enclosed design



HUBER Screw Press Q-PRESS® inclined installation with optionally dividable screen baskets

Sturdy wedge wire basket made of stainless steel

Stationary mounted screw press for 140 kgDS/h

Special applications of the Q-PRESS®

Dewatering of thin sludges

Due to pump feeding, large volumes of sludge water are removed already in the pre-dewatering zone. This permits cost-efficient dewatering of thin sludges with a solids concentration < 1%.

Benefits

- sludge dewatering without the need for prior thickening
- typical dewatering results of 18 – 25% DS
- sludge volume reduction up to > 97% in a single step
- saves investment and operation costs for preceding sludge thickening
- little operator attention required

Variable sludge characteristics

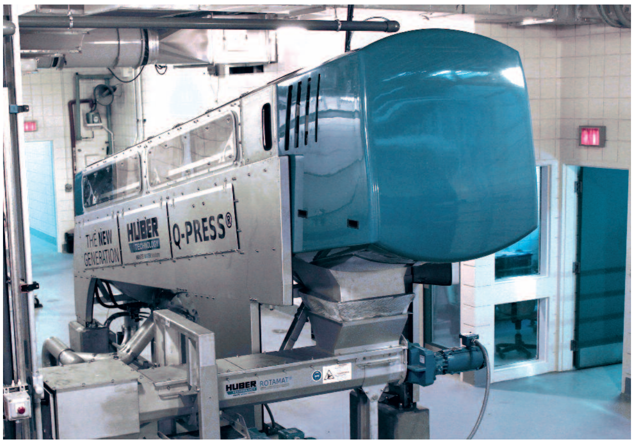
Dewatering performance is usually impaired and operator attention increased by frequently varying sludge quality.

Our HUBER Screw Press Q-PRESS® automatically selfadjusts to over- and underloading. A control loop makes sure that optimal operation is always maintained.

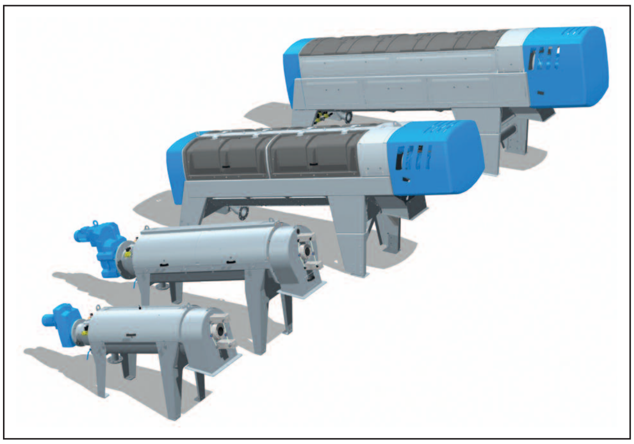
Benefits

- always optimum performance
- flexible with varying sludge qualities
- minimised operator attention
- reliable operation

Contract dewatering with a trailer-mounted HUBER Screw Press Q-PRESS®



HUBER Screw Press Q-PRESS® 800.2 for 20 m³/h



HUBER Screw Press Q-PRESS®

Unit sizes / performance

Size	Throughput [kg_{TR}/h]	Drive [kW]	Weight [t]
280	15 -90	0.37	0.7
440.2	30 - 180	1.5	1.5
620.2	60 - 350	2.3	2.7
800.2	90 - 540	4.1	3.5

HUBER TECHNOLOGY, Inc.

9735 Northcross Center Court STE A Huntersville, NC 28078
Phone: 704-949-1010 · Fax: 704-949-1020
Solutions@hhusa.net · http://www.huber-technology.com

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