Aldrich + Elliott
WATER RESOURCE ENGINEERS

TOWN OF HINESBURG, VERMONT

Wastewater Treatment Facility Upgrade/Expansion Study

Preliminary Engineering Report

RF1-229

July 2019

90% Submittal

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APPENDICES

FIGURES

1. PROJECT PLANNING

1.1. Location

The Town of Hinesburg is located in Chittenden County. The proposed Hinesburg Wastewater Treatment Facility Upgrade project will occur within the site of the current wastewater treatment facility (WWTF). The WWTF is located in the west of the Town center off of Charlotte Road, adjacent to the LaPlatte River, as shown in Figure 1 of Appendix A – Location Plan. This facility discharges to the LaPlatte River watershed which is part of the Lake Champlain Basin.

1.2. Environmental Resources Present

The proposed Hinesburg Wastewater Treatment Facility Upgrade project will occur on current WWTF property. A preliminary review of the ANR Natural Resources Atlas did not reveal any areas of environmental concern in the vicinity of the project location, but an Environmental Report will need to be completed for this project. The Vermont Department of Historical Preservation will need to determine if an Archeological Resource Assessment would be required for the proposed project.

There are no endangered or threatened species identified in the proposed project area. The proposed project would be completed within the existing wastewater treatment facility site off of Lagoon Lane and the existing Main Pump Station off VT 116. Areas have been previously disturbed for initial construction. A determination from the VT Department of Historical Preservation will be required for the proposed project.

The Hinesburg WWTF is located within the regulatory floodplain of the LaPlatte River. The WWTF is adjacent to the floodway, and within the 100 year floodplain, however, the top of the existing lagoons at elevation 335' are much higher than 100 year (BFE) flood elevation of 323.5'. The finish floor for the existing Blower/Chemical Feed Building and Small Garage are at approximate elevation 335', well above the BFE. The existing garage and chlorine tank are much lower and located within the floodway. The area shown around the lagoons is identified as FEMA Special Flood Hazard Area on the Town Zoning Maps. The Main Pump Station is not located within the floodplain. Appendix B contains the flood mapping.

1.3. Population Trends

The American Community Survey census information for the Town of Hinesburg Census Designated Place (CDP) indicates that the Town of Hinesburg population has a population of 658 in 2010. This was the first year the Hinesburg CDP was designated. Therefore, specific population trends for the CDP cannot be determined. However, the CPD represents 15% of the Town of Hinesburg total population. The Town of Hinesburg had a population of 4,340 in 2000 and 4,396 in 2010. Assuming linear growth based on the change from 2000 to 2010, population projects were estimated for the Town of Hinesburg and the Hinesburg CDP. The projected population for 2020 and 2040 are shown in the Table 1.1, and indicate the percent increases.

Table 1.1 Hinesburg Population Projections

Year	**Town Population**	**% Increase**	**CDP Population**	**% Increase**
2000	4340	---	-	---
2010	4396	1.3	658	---
2020	*4452*	1.3	*667*	1.3
2040	*4564*	2.5	*684*	2.5

1.4. Community Engagement

The Town has a very active working group that is very engaged in the study. This working group is represented by Town staff, Selectbord members, and Planning Commission members. Multiple meetings have been conducted with the working group throughout the study. A project update is planned for the August 15, 2019, Selectboard meeting which will be a publicly warned meetings.

Prior to a bond vote, the Town plans to engage a public relations firm to help educate the public, distribute information on the project with press releases using digital and other media resources, and facilitate the public hearings.

2. EXISTING CONDITIONS

2.1. Location Map

The proposed project location for the Main Pump Station and Wastewater Treatment Facility is shown on Figure 1-Location Plan in Appendix A.

2.2. History

The Hinesburg Wastewater Treatment Facility (WWTF) operates under Discharge Permit No. 3-1172 with a permitted flow of 0.250 mgd, The facility was originally constructed in 1967. When the wastewater treatment facility was upgraded in 2009, the project included future plans for increase of the permitted flow from 0.250 to 0.308 mgd. However, at that time with the Saputo Cheese facility closure, the Town did not need this additional capacity, so the Discharge Permit was not amended to the 0.308 mgd permitting capacity. Design of the following equipment for the upgrade was based on the flow of 0.308 mgd:

- Main pump sewage pumps and controls
- Aerated lagoon air distribution piping and partial mix aeration system
- Alum feed and storage system
- Lagoon aeration blowers
- Chorine contact tank and disinfection feed and storage system

2.3. Description of Existing Facilities

2.3.1. Overview

The Hinesburg WWTF is an aerated lagoon treatment facility located west of the Village off Lagoon Road which is accessed by Charlotte Road. Wastewater flows by gravity from the sewer collection system to the Main Pump Station, located in the Village on US Route 116. From the Main Pump Station, flow is pumped west in an 8” forcemain to Lagoon #1. Wastewater continues through the aerated lagoon system for biological treatment. Chemical phosphorus removal is provided prior to Lagoon #3B. Lagoon effluent continues to the chlorine contact tanks for disinfection and dechlorination before discharging to the LaPlatte River. An existing site plan and hydraulic profile for the existing facility are provided on Figures 4 and 5 in Appendix A.

2.3.2. Main Pump Station

The Main Pump Station contains two (2) 20 HP dry pit centrifugal pumps each with a capacity of 700 gpm at 72 ft THD. A duplex control panel with variable frequency drives (VFD) is located on the first floor of the pump station. Level control is provided with a pressure transducer and back-up floats in the wet well. On-site standby power is provided with an automatic transfer switch and 50 KW generator located in a weatherproof enclosure. Table 2.1 describes the Main Pump Station. An existing site plan and plan views are provided on Figures 2 and 3 in Appendix A.

Table 2.1 Main Pump Station

Item	Description
Pumps	
Number	2
Type	Dry pit vertical centrifugal
Capacity, Each	
Minimum	450 gpm @ 45 ft TDH
Maximum	700 gpm @ 72 ft TDH
Motor Horsepower	20 HP
Drive Type	Variable speed
Level Control System	Level transducer with float back-up
Standby Power	
Type	Diesel
Capacity	50 KW
Transfer Switch	Automatic

2.3.3. Aerated Lagoons

The biological process consists of four (4) aerated lagoons with a total volume of 17.8 million gallons operating at a liquid depth of 10 ft. Air is provided to Lagoon #1, 2, and 3A by a floating lateral aeration system. A berm separates Lagoon #3A from #3B. Three (3) 20 HP aeration positive displacement blowers each with a capacity of 420 scfm at 5.5 psig. Variable frequency drives are provided for the blowers to provide operating flexibility and improve energy efficiency. Table 2.2 describes the aerated lagoons.

Table 2.2 Aerated Lagoons

Item	Description
Lagoons	
Number	4
Floor Area	
Lagoon #1	135 ft x 360 ft
Lagoon #2	125 ft x 360 ft
Lagoon #3	125 ft x 785 ft
Total Volume	17.8 MG
Water Depth	10 ft
Sideslope	1:2.5
Freeboard	3 ft
Aeration System	
Type	Diffused air/fine bubble
Dissolved Oxygen Maintained	> 2.0 mg/l
Air Supply	3.0 lbs oxygen per lb BOD removed
Aeration Blowers	
Number	3
Type	Positive displacement
Capacity, each	420 scfm @ 5.5 psig
Motors	20 HP
Drives	Variable frequency

2.3.4. Chemical Phosphorus Removal

Alum is used for chemical precipitation of phosphorus. The primary dosage point is prior to Lagoon #3B. Alum is injected directly into a transfer pipe located in a precast concrete manhole located in the berm between Lagoons #3A and #3B.

Chemical feed and storage equipment are located in the Blower/Chemical Building. One (1) 5,100 gallon polyethylene bulk storage tank is used for alum. Two (2) peristaltic metering pumps are provided. The pH is consistently above 7.5 S.U., so provisions for pH adjustment are not required. Table 2.3 describes the chemical phosphorus removal system.

Table 2.3 Chemical Phosphorus Removal System

Item	Description
Chemical	Liquid alum
Feed Pumps	
Number	2 (1 operating, 1 standby)
Type	Peristaltic
Storage Tank	
Number	1
Volume	5,100 gallons
Dosage Point	Between Lagoons #3A and #3B

2.3.5. Disinfection System

The disinfection chemical feed and storage are housed in the Blower/Chemical Building. Sodium hypochlorite for disinfection is stored in a 50 gallon polyethelyene day tank. Two (2) metering pumps are provided to pumping sodium hypochlorite to the chlorine contact tank. Sodium bisulfite for dechlorination is also stored in a 50 gallon polyethelyene day tank. Two (2) metering pumps are provided to pumping sodium bisulfite to the dechlorination structure. The chemicals are stored on spill containment pallets in 55 gallon drums and transferred to the day tanks.

The existing chlorine contact tank (CCT) was originally constructed in 1967 with upgrades and expansions done in the mid-1990s and 2009. The CCT has a volume of 10,015 gallons. Interior concrete baffles minimize short circuiting, and the minimum liquid depth is 5.0 ft.

At the outlet end of the CCT, a v-notch weir (primary device) and ultrasonic level sensor (secondary device) are provided for effluent flow measurement. The flow signal from the ultrasonic level sensor is used to flow pace the chemical feed pumps for chlorination and dechlorination. Table 2.4 describes the disinfection and dechlorination systems.

Table 2.4 Disinfection Systems

Item	Description
Chlorination	
Method	Liquid Sodium Hypochlorite
Feed Pumps	
Number	2 (1 operating, 1 standby)
Type	Metering
Dosage Location	Chlorine Contact Tank
Storage Tanks	
Number	1
Volume	50 gallons
Dechlorination	
Method	Liquid Sodium Bisulfite
Feed Pumps	
Number	2 (1 operating, 1 standby)
Type	Metering
Dosage Location	Dechlorination Structure
Chlorine Contact Tank	
Minimum Liquid Depth	5.0 ft
Total Volume	15,390 gallons
Contact Time at PDF	
Effluent Flow Measurement	
Primary Device	V-notch Weir
Secondary Device	Ultrasonic Level Sensor
Flow Range	0.0 to 1.0 MGD

2.3.6. Buildings

There are three existing buildings at the Hinesburg WWTF, the Blower/Chemical Building, Storage Building and Garage. The Storage Building was the original blower building. It was converted to storage in 2009 during the last facility upgrade. The Garage is a slab on grade structure used for cold storage of maintenance materials.

2.4. Financial Status of Any Existing Facilities

The Town of Hinesburg has been able to successfully fund wastewater infrastructure with the existing customer base. A copy of the Wastewater Rates, sewer units, and Wastewater Budget is provided in Appendix C. For metered properties, the base fee is $98.93 per quarter plus $0.044 per cubic feet of metered water usage. A typical residential customer pays about $650 per year for sewer. The current wastewater expenses are $363,304 and there are a total of 629 units.

2.5. Water/Energy/Waste Audits

There have not been any water or energy audits performed for the existing facilities, and Efficiency Vermont has not participated in this study process. It is anticipated that Efficiency Vermont staff will be involved in the final design phase of this process so they can provide technical input and incentivize energy efficiency measures for the new facilities.

3. OPERATING CONDITIONS

3.1. Original Design Criteria

The original design criteria are provided in Table 3.1 with comparison to current conditions based on operating data from January 2016 to December 2018. When the wastewater treatment facility was upgraded in 2009, the project included future plans for increase of the permitted flow from 0.250 to 0.308 mgd. However, at that time with the Saputo facility closure, the Town didn't need this additional capacity, so the Discharge Permit was not amended to the 0.308 mgd.

Table 3.1 Original Influent Design Criteria

Parameter	**Design Criteria(1)**	**Current(2)**
Average Daily Flow	0.308 MGD	0.161 MGD
Peak Daily Flow	0.600 MGD	0.465 MGD
Peak Hourly Flow	0.800 MGD	-
Biochemical Oxygen Demand (BOD_5)	157 mg/l 331 lbs/day	326 mg/l 422 lbs/day
Total Suspended Solids (TSS)	151 mg/l 319 lbs/day	204 mg/l 254 lbs/day
Total Phosphorus(3)	6.0 mg/l	5.7 mg/l

Notes:

1. Source: Operations and Maintenance Manual, Wastewater Treatment Facility Upgrade dated January 2008.
2. Based on operating data from January 2016 to December 2018
3. Based on influent sample from November 7, 2018

3.2. Flows

The Discharge Permit limits the effluent flow to 0.250 mgd for the annual average. As shown in Figure 3.1, from January 2016 through December 2018, the average flow was 0.161 mgd which is approximately 64% of the permitted annual average flow.

Four months during this period, April through July 2017, the effluent flow exceeded the monthly permitted average flow with a maximum monthly average flow of 0.312 mgd in April 2017. This was during a period of heavy rains. It is expected that inflow and infiltration affect the flows to the WWTF. To further support this, 2016 was a low rainfall year and flows to the WWTF were low relative to 2017 and 2018. Assessment of the collection system is outside the scope of this study.

Operating data from January 2016 to December 2018 showed the ratio of peak daily flow (PDF) to average daily flow (ADF) varied from 1.63 to 2.48, with an average ratio of 2.16. The 2008 design used a PDF to ADF factor of 2.4.

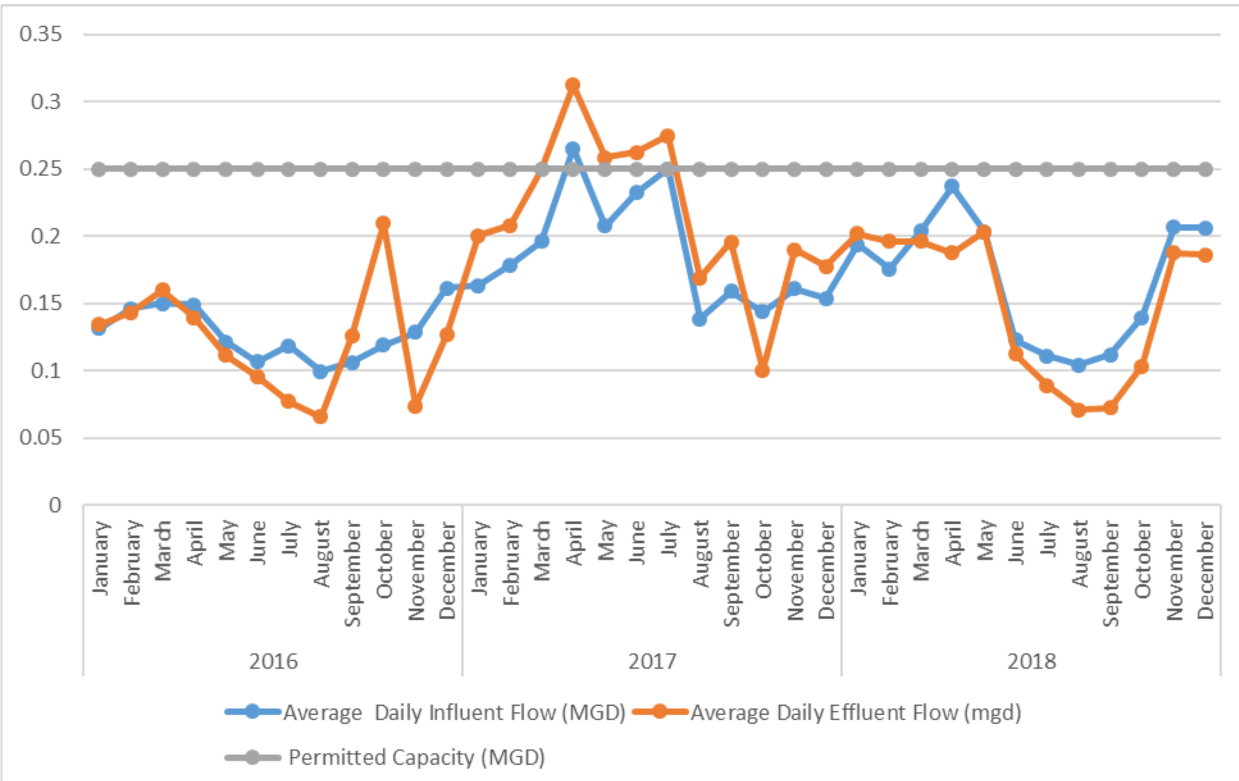


Figure 3.1: Average Influent and Effluent Monthly Flow (mgd)

3.3. Biochemical Oxygen Demand

3.3.1. Influent

The average influent biochemical oxygen demand (BOD) concentration and load from January 2016 through December 2018 was 326 mg/l and 422 lbs/day, respectively. The average BOD load over this period is 87% of the 2008 design load of 488 lbs BOD/day. The design influent BOD load was met or exceeded in March 2016, October 2017, and all months in 2018 except March, May and July. Figure 3.2 shows the historical influent BOD concentration and load.

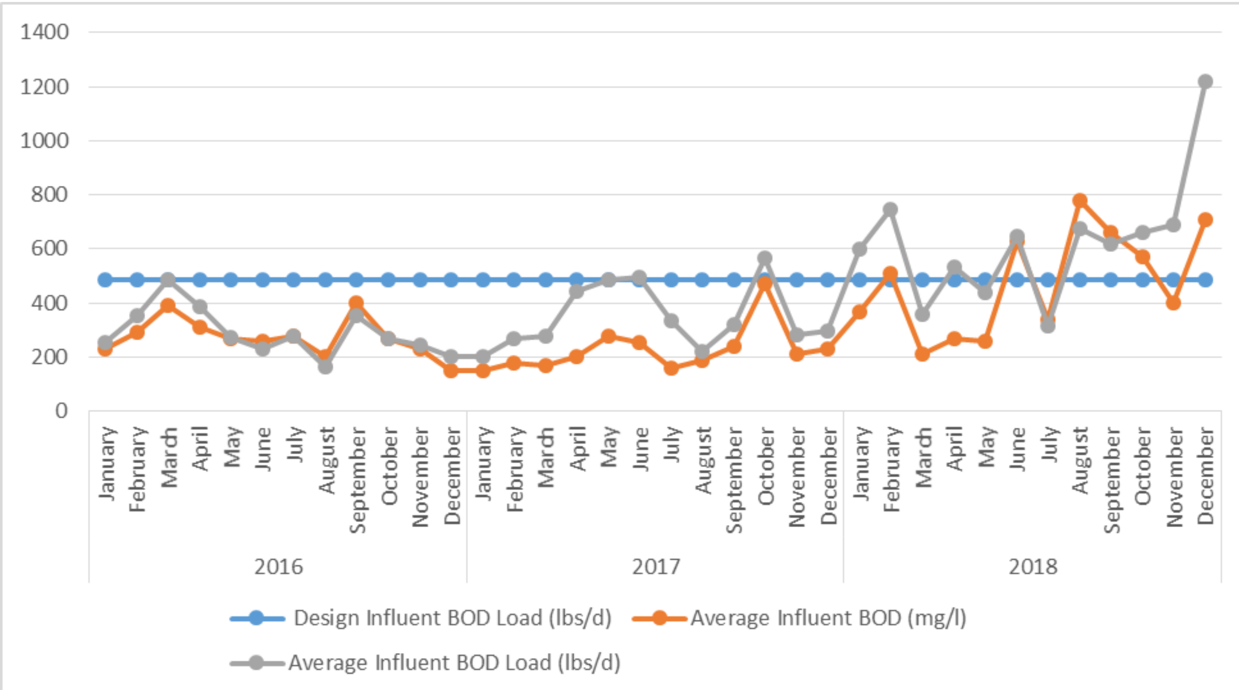


Figure 3.2 Influent BOD

Typical municipal wastewater has an average BOD concentration of 225 mg/l compared to the 326 mg/l for the Hinesburg WWTF. Higher strength industrial (breweries, food processing, etc) contributors to the collection system listed in Table 3.2 significantly increase the average BOD concentration. Sampling of the industrial dischargers is recommended for determining appropriate design loadings for the proposed WWTF upgrade, and also to encourage better internal housekeeping to reduce the impacts of their discharge to the Town WWTF. The Town has retained RAB Consulting and is performing additional investigation of these commercial and industrial sewer customers to gather more information. This includes better documentation of the organic strength of their actual discharges, and may include additional sampling and assessment of their internal housekeeping practives.

Table 3.2 Summary of Industrial Dischargers

Customer	Sewer Allocation (gpd)	Actual Usage (gpd)	%
Foam Brewers	1,170	561	48%
Frost Investment	2,000	1,427	71%
VT Smoke & Cure	6,050	3,290	54%
Green Mountain Organic	1,500	2,289	153%
Total	10,720		

3.3.2. Effluent

As shown in Figure 3.3, the average effluent BOD concentration from January 2016 through December 2018 was 7.4 mg/l. The average effluent BOD load during this period was 10.4 lbs/day. This is 17% of the permitted average BOD load discharge of 63 lbs/day. On average, 98% of BOD load flowing into the WWTF is removed through the treatment process.

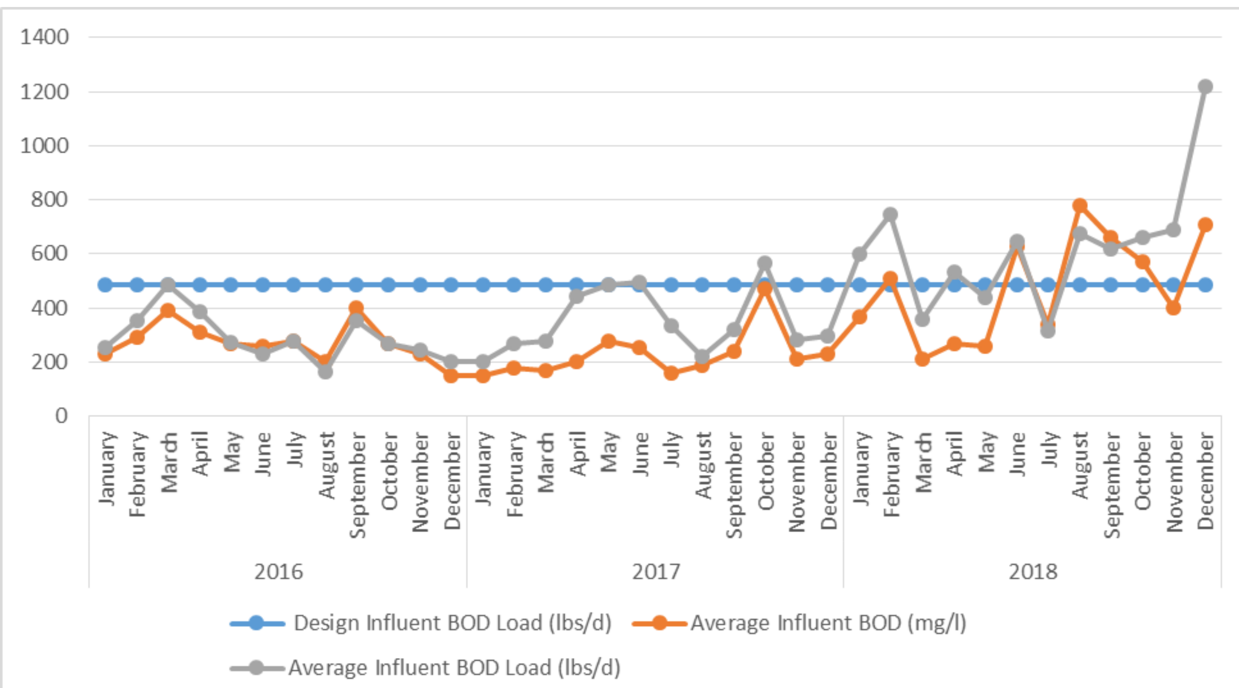


Figure 3.3 Effluent BOD

3.4. Total Suspended Solids

3.4.1. Influent

The average influent total suspended solids (TSS) concentration and load from January 2016 through December 2018 was 204 mg/l and 254 lbs/day, respectively. The average TSS load over this period is 52% of the 2008 design load of 488 lbs TSS/day and tracks closely with the flows. The average concentration of the TSS is consistent with that of a domestic strength wastewater. The design influent TSS load was exceeded twice during this period in October 2016 and December 2018. Figure 3.4 shows the historical influent TSS concentration and load.

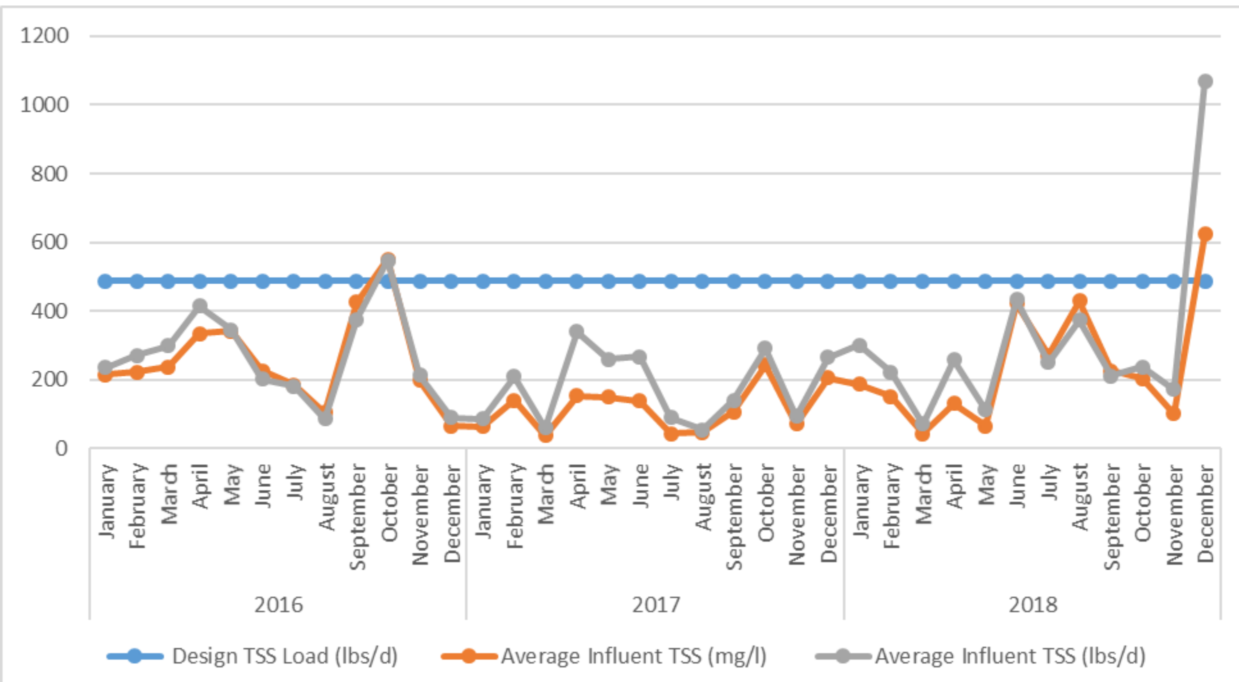


Figure 3.4 Influent TSS

3.4.2. Effluent

As shown in Figure 3.5, the average effluent TSS concentration from January 2016 through December 2018 was 12.9 mg/l. The average effluent TSS load during this period was 18.8 lbs/day. This is 20% of the permitted average TSS load discharge of 94 lbs/day. On average, 93% of TSS load flowing into the WWTF is removed through the treatment process.

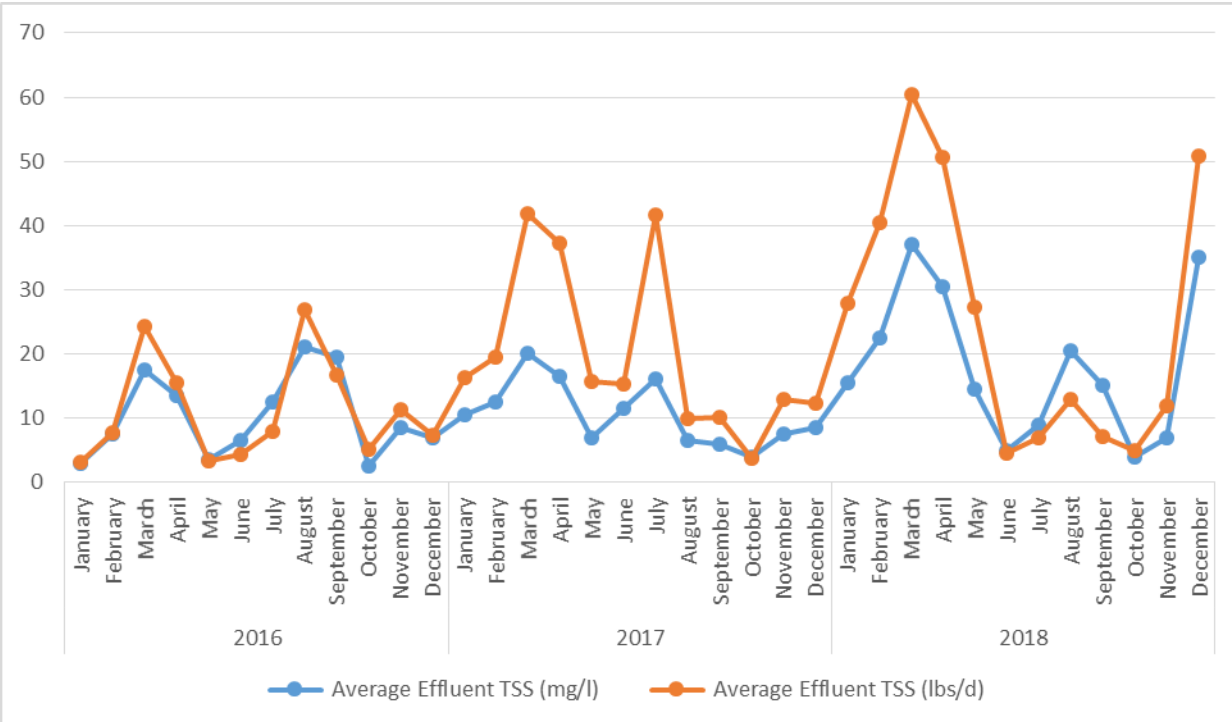


Figure 3.5 Effluent TSS

3.5. Total Phosphorus

3.5.1. Influent

The Hinesburg WWTF does not regularly sample influent for total phosphorus (TP) concentration. Operators collected samples on November 7, 2018 for testing. Results indicated an influent TP concentration of 5.7 mg/l which is consistent with that of a domestic strength wastewater. The 2008 Basis for Final Design used 6.0 mg/l TP for the influent design criteria. Additional sampling should be completed to verify the influent TP design criteria.

3.5.2. Effluent

As shown in Figure 3.6, from January 2016 to December 2018, effluent TP concentrations varied from 0.11 mg/l to 2.36 mg/l with an average of 0.41 mg/l. Average annual loads varied from 89 lbs TP in 2016 to 306 lbs TP in 2018. The discharge permit issued March 1, 2018 allows for a total annual discharge of 152 lbs TP which cannot be consistently met with the current treatment process.

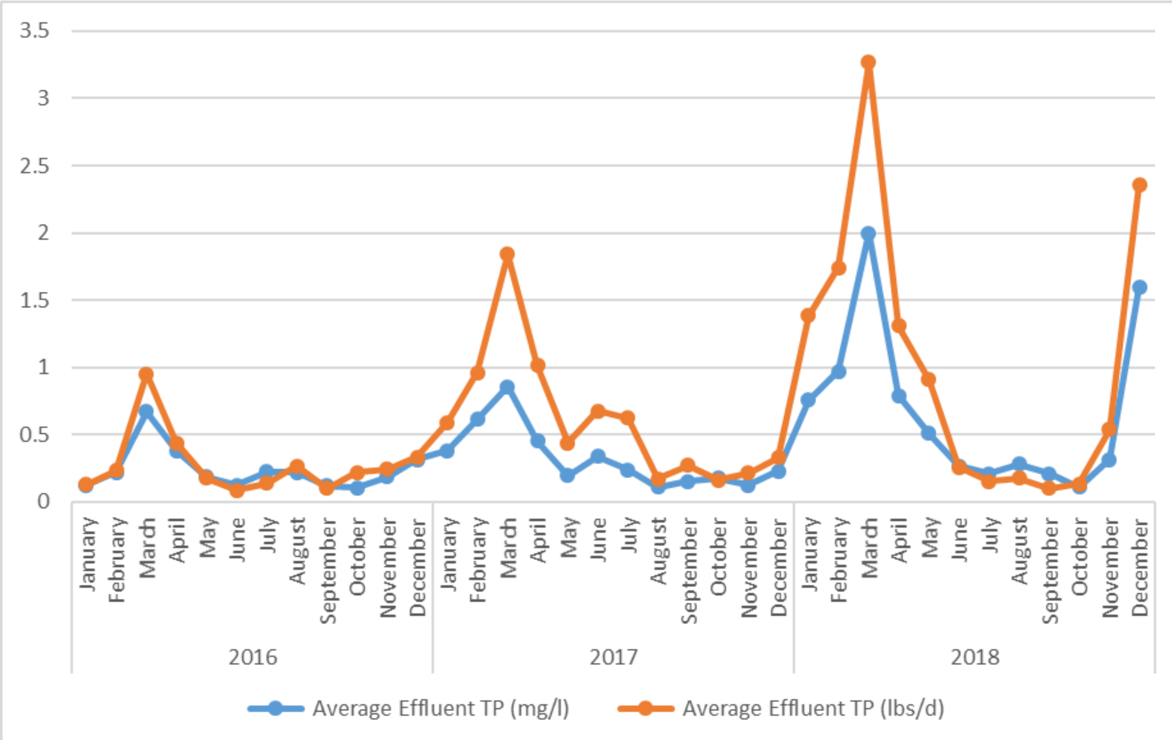


Figure 3.6 Effluent TP

3.6. Nitrogen

3.6.1. Influent

The Hinesburg WWTF does not regularly sample influent for total ammonia nitrogen (TAN) concentration. Operators collected an influent sample on November 7, 2018 for testing and additional sampling should be performed. Initial results indicated an influent ammonia concentration of 22 mg/l which is consistent with the strength of a domestic wastewater.

3.6.2. Effluent

Historically, effluent total Kjeldahl nitrogen (TKN) and ammonia were monitored only June through September. TKN is the sum of ammonia and organic nitrogen. Figure 3.7 summarizes the available effluent data from January 2016 through December 2018. Effluent TKN concentrations ranged from 1.5 mg/l in October 2018 to 25 mg/l in December 2018. Effluent ammonia ranged from 0.6 mg/l in November 2017 to 19 mg/l in March 2018.

The new Discharge Permit issued March 1, 2018 has effluent monthly average total ammonia nitrogen (TAN) limits of 7.3 mg/l for June 1 to September 30 and 42.1 mg/l for October 1 to May

31. As shown in Figure 3.8, the historical summer effluent ammonia concentrations consistently exceed the new effluent TAN limit.

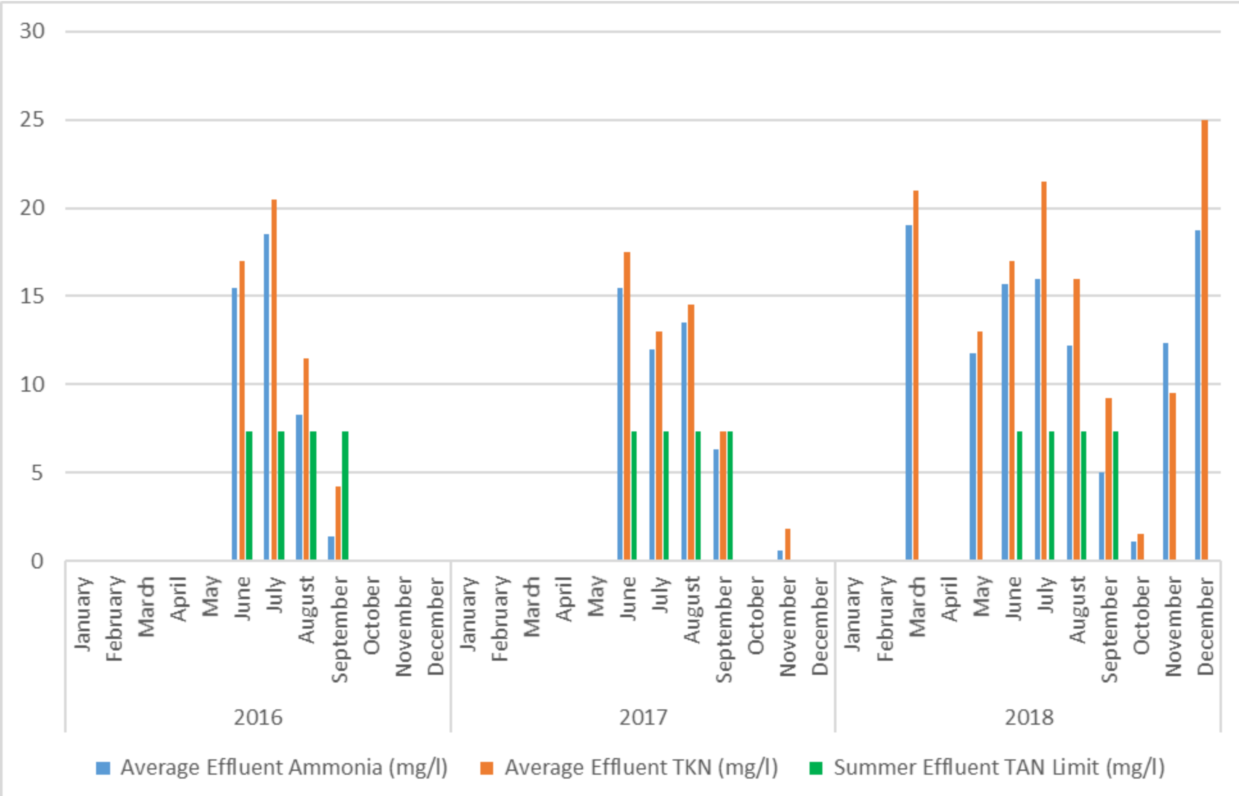


Figure 3.7 Effluent Ammonia and TKN

4. NEED FOR PROJECT

4.1. Health, Sanitation, and Security

The Town of Hinesburg operates a 0.250 mgd aerated lagoon wastewater treatment facility (WWTF) that is regulated under the State Discharge Permit No. 3-1172, provided in Appendix D. As a condition of the Lake Champlain Phosphorus Total Maximum Daily Load (TMDL) issued June 17, 2016, effluent phosphorus limits were significantly reduced for the Hinesburg WWTF. This Discharge Permit, effective March 1, 2018, reduces the effluent phosphorus waste load allocation (WLA) from an annual limit of 608 lbs to the new limit of 152 lbs based on an average concentration of 0.2 mg/l at the permitted flow of 0.250 mgd. In 2018, the Hinesburg WWTF discharged approximately 305 lbs TP. Phosphorus removal improvements at the WWTF are required to consistently meet the new effluent TP limit.

To meet Vermont Water Quality Standards for the LaPlatte River, the new Discharge Permit also contains water quality-based effluent limitations for Total Ammonia Nitrogen (TAN). Previously, the discharge permit only required seasonal monitoring of TAN, so no effluent limits were included in the previous permit. Based on historical operating data, it would be difficult for the Hinesburg WWTF to consistently comply with the new effluent TAN limits. Additionally, aerated lagoons are not designed to remove ammonia nitrogen year round. It is expected that nitrification, the process which removes ammonia nitrogen from wastewater, would be inhibited or suspended during cold weather months when the wastewater temperature is too low for nitrifying bacteria to function. Biological process improvements at the WWTF are required to consistently meet the new effluent TAN limits.

The new Discharge Permit includes compliance deadlines for addressing improvements at the WWTF as follows:

- As soon as possible, but by no later than February 28, 2019, the Permittee shall develop and submit a plan to the Secretary for review and approval to ensure the WWTF is brought into compliance with its TP WLA and TAN limits. The plan shall be developed by qualified professionals with experience in the operation and design of WWTFs in consultation with the Chief Operator of the WWTF. The plan shall include:
    - Plans and specifications necessary to implement needed facility modifications;
    - An engineer approved design and construction schedule, that shall ensure the WWTF's compliance with its WLA as soon as possible but no later than by December 31, 2022; and

    - A financing plan that estimates the costs for implementing the plan and describes a strategy for financing the projects.

- As soon as possible, but by no later than December 31, 2022, the Permittee shall achieve compliance with the TP limitations specified in Condition I.A.1.

A draft of this document was submitted to meet the February 28, 2019 deadline, but did not include the proposed project. The issues encountered with the geotechnical investigation has delayed the study and more time was needed to evaluate the treatment alternatives and develop a proposed project in conjunction with addressing the subgrade improvements required.

4.2. Aging Infrastructure

The WWTF was last upgraded in 2008. Therefore, the existing facilities continue to operate within the minimum expected useful life of 20 years.

4.3. Reasonable growth

The WWTF upgrades proposed by this project will need to be adequately sized for the Town of Hinesburg's current and future sewer service area. Reasonable growth will be considered when finalizing design conditions and sizing influent flow structures.

To estimate the 20 year (2040) wastewater demands, the following were considered:

- Current wastewater flows based on operating records
- Wastewater allocations that have been allocated, but currently have not been connected to the collection system
- Proposed wastewater allocation, estimated based on Town input

The Town staff provided information on pending development projects and this data was used to estimate the additional flows. The majority of this new flow will be contributed from these new developments; Haystack Crossing, Wind Energy Associates, Hinesburg Center Phase 2, and Quinn property. Table 4.1 summarizes the estimated 20 year flow projection based on the EPR design flows, and a more detailed summary is provided in Appendix E. Separate from residential and enterprise flow that has been allocated but not connected, a projected 20 year flow of 135,139 gpd was estimated. For the design year, an increase in the permitted capacity from 250,000 to 325,000 gpd is proposed for evaluation.

Table 4.1 2040 Design Year Wastewater Flow Projection

Item	Flows (gpd)
Current Allocated Flow	
Average Daily Flow (2016-2018)	163,000
Unconnected residential	7,532
Unconnected enterprise	7,745
Subtotal	**178,277**
Projected 20 Year Flow	
Proposed	135,139
Total	**313,416**
Use	**325,000**

5. ALTERNATIVES CONSIDERED AT 0.250 MGD

5.1. Alternatives to Meet New Permit Requirements (0.250 MGD)

These alternatives are evaluated to meet the new discharge permit requirements at the current permitted flow. The current permit is for an annual average flow of 0.250 mgd. The focus of this alternative is to identify an option for retrofitting the existing lagoons for enhanced ammonia and phosphorus removal with tertiary phosphorus removal at the current permitted capacity which includes the following approach:

- Alternative No. 1 – Lagoon Upgrade with LEMNA plus Ballasted Flocculation

This approach and the related preliminary design criteria are discussed in further detail in the following sections and will be compared to the alternatives developed in Section 6 at the higher flow capacity of 0.325 mgd.

5.2. Preliminary Design Criteria

The current facility operates under Discharge Permit No. 3-1172 with an expiration date of December 31, 2022 and defines the effluent limitations based on the permitted flow of 0.250 mgd. Under Section I.A. of the Discharge Permit, the Town is allowed to discharge from the treatment facility outfall (S/N 001) to the LaPlatte River an effluent whose characteristics do not exceed the values presented in the Permit. A summary of the permitted effluent limitations are provided in Table 5.1. At the design flow of 0.250 mgd, an annual average effluent TP concentration of 0.2 mg/l is required to meet the annual 152 lbs TP per year. Upgrades to the existing treatment process are required to meet the new effluent ammonia and total phosphorus limits included in this permit.

Table 5.1 Current Discharge Permit Limits

Effluent Characteristics	Annual Limits	Monthly Average	Weekly Average	Maximum Day	Instantaneous Maximum
Flow (Annual Average)	0.250 mgd	---	---	---	---
Ultimate Oxygen Demand (June 1 – September 30)	---	---	---	400 lbs/day	---
Biochemical Oxygen Demand (BOD_5)	---	30 mg/l 63 lbs/day	45 mg/l 94 lbs/day	50 mg/l	---
Total Suspended Solids (TSS)	---	45 mg/l 94 lbs/day	45 mg/l 94 lbs/day	50 mg/l	---
Total Phosphorus (TP)	152 lbs/year	0.8 mg/l	---	---	---
Total Ammonia Nitrogen (June 1 – September 30)	---	3.5 mg/l 7.3 lbs/day	---	34.6 lbs/day	16.6 mg/l
Total Ammonia Nitrogen (October 1 – May 31)	---	20.2 mg/l 42.1 lbs/d	---	175 lbs/day	84.0 mg/l
Total Kjeldahl Nitrogen (TKN)	---	---	---	Monitor only	---
Nitrate/Nitrite Nitrogen (NO_x)	---	---	---	Monitor only	---
Total Nitrogen				Monitor only	---
Settleable Solids	---	---	---	---	1.0 ml/l
E. Coli	---	---	---	---	77/100 ml
Total Residual Chlorine (TRC)(1)	---	---	---	---	0.02 mg/l
pH	---	Between 6.5 and 8.5 Standard Units			

Notes:

1. For the purposes of this permit, TRC analysis shall be completed using a test method in 40 C.F.R. § 136 that achieves a minimum level no greater than 0.05 mg/l. The compliance level for TRC is 0.05 mg/l.

The influent design criteria is summarized in Table 5.2. Historical influent wastewater quality was discussed in detail in Section 3.

Table 5.2 Influent Design Criteria

Parameter	Design Criteria
Flow (mgd)	
Average Daily Flow (ADF)	0.250 mgd
Peak Daily Flow (PDF) (PF = 2.4)	0.600 mgd
Peak Hourly Flow (PHF) (PF = 3.2)	0.800 mgd
Biochemical Oxygen Demand (BOD_5)	326 mg/l 680 lbs/day
Total Suspended Solids (TSS)	204 mg/l 425 lbs/day
Total Phosphorus (TP)	6.0 mg/l
Ammonia (NH_3)	25 mg/l

5.3. Environmental Impacts

This alternative is anticipated to have limited environmental impacts beyond an improvement in water quality to the receiving water. The permitted capacity will remain unchanged but the upgraded facility will comply with the new Discharge Permit limits, thereby improving the water quality in the LaPlatte River.

All of the proposed improvements are planned within the existing Main pump station and wastewater treatment facility sites. The new construction at the WWTF site is anticipated within previously disturbed areas to minimize any archeological impacts and most of the work is planned within the area of the existing lagoons to minimize impacts to the regulatory floodway. For abandonment of lagoons #2 and #3A, the plan is to restore these areas by returning to floodway.

5.4. No. 1 - Lagoon Upgrade with LEMNA plus Ballasted Flocculation

5.4.1. Description

Alternative No. 1 at 0.250 mgd includes the following components:

- New Headworks structure with rotary drum screening
- Abandon and demolish existing Lagoons #2 and #3A
- Install a LEMNA system in Lagoons #1 and #3B with a complete mix cell, flocculation zone, and settling pond
- New HDPE lagoon liner for Lagoons #1 and #3A
- New LEMNA Polishing Reactor (LPR) for ammonia removal

- New tertiary TP removal with ballasted flocculation
- Maintain existing chemical feed/storage and chlorine contact tank for disinfection
- New Sludge Storage Tanks
- New Control Building for operator office, laboratory, electrical/controls, workshop, and appurtenant equipment

A preliminary layout of this alternative is provided on Figure 7 in Appendix A. On February 27, 2019, a site visit was conducted with the working group to the Waterbury, Vermont facility to view the Evoqua CoMag ballasted flocculation system.

Currently, the Hinesburg WWTF does not have a headworks. New screening installations typically fall into two types: rotary drum screens and mechanically raked bar screens. Both screen types also typically incorporate a means to wash and compact dewater the captured screenings. This greatly reduces the amount of hazardous and putrescible biological waste in the screenings which simplifies handling and disposal considerations. A new 700 sf Headworks building would be constructed containing a rotary screen with ¼" openings, and bypass channel with coarse bar rack. The internal space for this structure is classified as Class I, Division 1 for hazardous locations. Technical information on the Headworks Equipment is provided in Appendix F.

Flow from the headworks enters the LEMNA system retrofitted into Lagoon #1 and Lagoon #3A. Lagoons #2 and #3A would be decommissioned and abandoned. For meeting the redundancy requirements, the State requested some modifications to the proposed lagoon upgrades. This required upgrading Lagoons #1 and #3B, so that if one lagoon was out of service, the other would remain in operation. The first step in the LEMNA system is the complete mix and partial mix zones, which would have diffusers providing air for the biological process and mixing. Both Lagoons #1 and #3B will be operated in parallel. Air would be provided by three (3) 60 HP blowers. Following the complete mix, flow will enter a rapid mixer for chemical addition for phosphorus removal. After mixing, flow enters the flocculation zone where gentle mixing provided by surface mixers allows for larger particles to form. Flow would continue under a baffle wall to the settling zone where the larger particles formed in the flocculation zone are allowed to settle to the lagoon floor. The complete and partial mix, flocculation, and settling zones would be covered with a floating insulating cover. Technical information on the LEMNA Lemtec biological system is provided in Appendix G.

A new 16 ft by 32 ft X 12 ft LemTec Polishing Reactor (LPR) would be constructed to provide additional BOD and ammonia treatment. The LPR contains submerged, attached growth media modules. Aeration is provided with coarse bubble diffusers.

Lagoon liner replacement is required for Lagoon #1 and #3B, and sludge removal would be required for all existing lagoon cells prior to the upgrades.

A new Control Building will house the operator functions, laboratory, chemical feed/storage systems, and controls. The existing 24 ft by 30 ft Blower/Chemical Feed Building would be upgraded and expanded as new blowers are required for the LEMNA system. Currently, the blower room fits three (3) blowers. For chemical feed and storage, there is an existing 5,100 gallon HDPE tank used for alum. Spill pallets are provided for two (2) 55 gallon drums for sodium hypochlorite used for disinfection and two (2) 55 gallon drums for sodium bisulfite used for dechlorination. With improved nitrification as required to meet the new TAN limits, it is expected that pH adjustment will be required. Typically, sodium hydroxide is used.

Estimated LEMNA effluent quality is:

- BOD = < 15 mg/l
- TSS = < 15 mg/l
- TAN = 2.7 mg/l (June 1 – Sept. 30), 20.2 mg/l (Oct. 1 – May 31)
- TP = 1.0 mg/l

Note that the effluent TP concentration for the upgraded lagoon is well above the required 0.2 mg/l, therefore, tertiary phosphorus removal is required. Filtration is not recommended for TP removal for lagoon effluent, but ballasted flocculation has been shown to be effective treating lagoon effluent for TP removal to low levels.

Ballasted flocculation is a high-rate wastewater clarification process in which secondary influent is flocculated with microsand or magnetite and polymer. The microsand or magnetite enhances the formation of robust flocs and acts as ballast, increasing their settling velocities. Appendix H contains technical information on ballasted flocculation equipment. For redundancy purposes, the State is satisfied that a single train for the ballasted flocculation process is sufficient.

The wastewater enters at a point along with a coagulant (for example, ferric chloride or alum) to the injection tank where microsand or magnetite and polymer are added. In the maturation tank, formation of strong flocs around the microsand or magnetite is promoted. The flocculated solids flow to the clarification zone. Most of the solids settle at the bottom of this compartment, but this zone also has lamella settling modules to enhance removal of suspended solids that may be present in the wastewater. The solids accumulated at the bottom of the clarification compartment are recycled to a separation zone, where the sludge is separated from the microsand or magnetite. The microsand or magnetite is recycled back to the injection tank, and the sludge is wasted from the system.

Disinfection would be provided by the existing chlorine contact tank (CCT) using sodium hypochlorite. Dechlorination would be continue to be provided with sodium bisulfite chemical addition.

5.4.2. Technical Assessment

A summary of the technical assessment for this alternative is provided in the narrative below.

Advantages

- Allows for reuse of Lagoon No. 1 and No. 3B and building new components above floodway
- Makes sequencing of construction easier to maintain operations of existing facility during construction as Lagoon #1 can be placed on-line first, the Lagoon #3B can be completed.
- Provides for preliminary treatment with new Headworks structure.
- Smallest footprint of new structures required (new headworks, LemTec Polishing Reactor, ballasted flocculation)
- Reuses existing disinfection system.
- Reduces amount of fill required in lagoons to build new structures.

Disadvantages

- Limited flexibility to increase treatment capacity beyond 0.250 mgd once constructed and placed into operation.
- Covering of the lagoons are necessary to maintain wastewater temperatures for optimizing the ammonia removal.
- One of the other lagoons may have to remain in operation to provide redundancy for the ballasted flocculation system. The State requested that a 2nd lagoon remain in operation, so Lagoon #3B will be converted to a complete and partial mix zone.
- TSS effluent from the biological process is estimated at a maximum of 15 mg/l, which is significantly higher than processes that include secondary settling. This can make tertiary TP removal to low levels more difficult.
- Tertiary TP removal to low levels following attached growth processes is less proven.
- Pilot testing of the ballasted flocculation technology will be required.
- Doesn’t provide daily removal of sludge from the settling pond, so this settling pond will require periodic sludge removal.

5.4.3. Constructability

A copy of the geotechnical report is provided in Appendix M for reference purposes, and the subgrade improvements are evaluated separately in Section 7.0 for each of the treatment alternatives.

5.5. Estimated Cost

5.5.1. Estimated Construction Cost

A breakdown of the estimated construction cost for this alternative is provided below in Table 5.3 and further detail of the costs is provided in Appendix R. The estimated construction cost is $7,990,000.

Some of the assumptions for this cost estimate are as follows:

- The cost for sludge removal from existing Lagoons #1, 2, and 3 is not included.
- No upgrades or expansion of the Main pump station are required.
- The sizing and costs for the new headworks, sludge storage tanks, and Control Building are similar for all treatment alternatives.
- The existing chlorine contact will continue to be used.

Table 5.3 Alternative No. 1 at 0.250 MGD - Estimated Construction Cost

Item Description	**Alternative No. 1**
Main Pump Station	$0
Lagoon Retrofits	$403,700
Headworks	$861,300
Biological/Clarification	$2,389,200
Tertiary	$2,643,300
Disinfection	$100,980
Sludge Storage	$449,240
Control Building	$1,134,100
Total	$7,981,820
Use	$7,990,000

Notes:

1. ENR 11200 = April 2019

5.5.2. Annual Operation and Maintenance Costs

For the initial year, the estimated annual operation and maintenance costs were developed. This is based on the current wastewater expenses of $363,304 and follows the same format as the existing budget.

For this alternative, the O&M budget was projected for the initial year and incorporates the following changes:

- Staffing
  - One (1) additional FTE employee with benefits split between the water and wastewater.
- Operating Supplies
  - Chemicals for phosphorus removal for the ballasted flocculation
- Utilities
  - Polishing Reactor/Ballasted Flocculation and Control Building heat
- Sludge removal
  - Hauling of sludge from the Settling Pond at <1 % to the Burlington Main Plant for dewatering and disposal. Burlington charges approximately $0.075 per gallon plus $0.075 per gallon is budgeted for hauling.

It should be noted that no cost is shown under the phosphorus removal line item for current or the initial year projections. The increased operating costs to comply with the phosphorus limit are split between the operating supplies (chemicals), utilities, and sludge removal. For the initial year, the annual operation and maintenance budget is anticipated to increase from $363,304 to approximately $490,000. The increases in the budget for each line item are shown in Table 5.4.

Table 5.4 Alternative No. 1 Projected O&M Costs – Initial Year

Item	FY 19 Budget	WW Expenses	Initial Year Projections
Shared Water-Wastewater – 5331			
Salary	$175,382	$87,691	$113,000
Accounting	$2,500	$1,250	$1,250
FICA	$15,173	$7,587	$9,500
Health Insurance	$22,000	$11,000	$19,000
Dental Insurance	$2,234	$1,117	$1,117
Vision	$360	$180	$180
Retirement	$10,374	$5,187	$6,437
Health Insurance Op-Out	$10,000	$5,000	$5,000
Office Supplies	$800	$400	$400
Vehicle Repair and Maintenance	$1,700	$850	$850
Postage	$1,150	$575	$575
Vehicle Insurance	$0	$0	$0
Trash Removal	$900	$450	$450
Uniforms	$1,050	$525	$525
Telephone	$3,850	$1,925	$1,925
Vehicle Fuel	$4,300	$2,150	$2,150
Capital Transfers	$21,322	$10,661	$10,661
5331 Subtotal	$273,095	$136,548	$173,421
Wastewater – 5480			
Operating Supplies		$13,500	$20,000
Repair & Maintenance Supplies		$3,000	$5,000
Small Tools & Equipment		$2,000	$2,500
Advertising		$0	$0
Development		$1,000	$1,000
PACIF		$7,056	$7,056
Worker’s Compensation		$9,000	$9,000
Testing		$4,000	$5,000
Repair & Maintenance Labor		$5,000	$5,000
Permits & Licenses		$1,200	$1,500
Miscellaneous		$0	$0
Utilities		$29,000	$40,000
Phosphorus Removal		$0	$0
2032 Bond		$50,000	$50,000
Capital Transfer		$20,000	$20,000
Sludge Removal		$82,000	$150,000
5480 Subtotal		$226,756	$316,056
Total		$363,304	$489,477

6. ALTERNATIVES CONSIDERED AT 0.325 MGD

6.1. Alternatives to meet Permit Requirements at 0.325 MGD

These alternatives are evaluated to provide an increased treatment capacity of 0.325 mgd as the current permit is for annual average flow of 0.250 mgd. The focus of these alternatives is to identify options for replacing the existing aerated lagoon process with an activated sludge process designed for enhanced ammonia and phosphorus removal with tertiary treatment at the increased design capacity of 0.325 mgd, which includes the following approaches:

- Alternative No. 2 – Sequencing Batch Reactor (SBR) with Filtration
- Alternative No. 3 - A/O with Filtration

These approaches and the related preliminary design criteria are discussed in further detail in the following sections.

6.2. Preliminary Design Criteria

The current facility operates under Discharge Permit No. 3-1172 with an expiration date of December 31, 2022 and defines the effluent limitations based on the permitted flow of 0.250 mgd. For the increased flow capacity at 0.325 mgd, the annual discharge load of total phosphorus in pounds does not change. Amendment of the Discharge Permit will be required to increase the permitted flow capacity but will not change the loadings for BOD, TSS, etc. To achieve the same annual discharge TP load, the average discharge concentration would be reduced to 0.15 mg/l TP. Additionally, the effluent TAN concentration would be reduced from the current permit with an increase in permitted flow. A summary of the permitted effluent limitations are provided in Table 6.1. Upgrades to the existing treatment process are required to meet the new effluent ammonia and total phosphorus limits included in this permit.

Table 6.1 Proposed Discharge Permit Limits at 0.325 mgd

Effluent Characteristics	Annual Limits	Monthly Average	Weekly Average	Maximum Day	Instantaneous Maximum
Flow (Annual Average)	0.325 mgd	---	---	---	---
Ultimate Oxygen Demand (June 1 – September 30)	---	---	---	400 lbs/day	---
Biochemical Oxygen Demand (BOD_5)	---	30 mg/l 63 lbs/day	45 mg/l 94 lbs/day	50 mg/l	---
Total Suspended Solids (TSS)	---	45 mg/l 94 lbs/day	45 mg/l 94 lbs/day	50 mg/l	---
Total Phosphorus (TP)	152 lbs/year	0.8 mg/l	---	---	---
Total Ammonia Nitrogen(1) (June 1 – September 30)	---	<3.5 mg/l, ~2.5 mg/l 7.3 lbs/day	---	34.6 lbs/day	16.6 mg/l
Total Ammonia Nitrogen(1) (October 1 – May 31)	---	<20.2 mg/l, ~14.4 mg/l 42.1 lbs/d	---	175 lbs/day	84.0 mg/l
Total Kjeldahl Nitrogen (TKN)	---	---	---	Monitor only	---
Nitrate/Nitrite Nitrogen (NO_x)	---	---	---	Monitor only	---
Total Nitrogen				Monitor only	---
Settleable Solids	---	---	---	---	1.0 ml/l
E. Coli	---	---	---	---	77/100 ml
Total Residual Chlorine (TRC)(2)	---	---	---	---	0.02 mg/l
pH	---	Between 6.5 and 8.5 Standard Units			

Notes:

1. Total ammonia nitrogen effluent limits for a flow of 0.325 mgd are estimated based on maintaining pounds per day established in current permit.
2. For the purposes of this permit, TRC analysis shall be completed using a test method in 40 C.F.R. § 136 that achieves a minimum level no greater than 0.05 mg/l. The compliance level for TRC is 0.05 mg/l

The influent design criteria is summarized in Table 6.2. Historical influent wastewater quality was discussed in detail in Section 3.

Table 6.2 Influent Design Criteria

Parameter	Design Criteria
Flow (mgd)	
Average Daily Flow (ADF)	0.325 mgd
Peak Daily Flow (PDF) (PF = 2.4)	0.780 mgd
Peak Hourly Flow (PHF) (PF = 3.2)	1.040 mgd
Biochemical Oxygen Demand (BOD_5)	325 mg/l 885 lbs/day
Total Suspended Solids (TSS)	205 mg/l 550 lbs/day
Total Phosphorus (TP)	6.0 mg/l
Ammonia (NH_3)	25 mg/l

6.3. Environmental Impacts

This alternative is anticipated to have limited environmental impacts beyond an improvement in water quality to the receiving water. The permitted capacity will increase, but the upgraded facility will comply with the new Discharge Permit limits, thereby improving the water quality in the LaPlatte River.

All of the proposed improvements are planned within the existing Main pump station and wastewater treatment facility sites. The new construction at the WWTF site is anticipated within previously disturbed areas to minimize any archeological impacts and most of the work is planned within the area of the existing lagoons to minimize impacts to the regulatory floodway. For abandonment of lagoons #2, #3A, and #3B, the plan is to restore these areas by returning to floodway.

6.4. No. 2 - Sequencing Batch Reactor (SBR) with Filtration

6.4.1. Description

This Alternative No. 2 includes the following components:

- New Headworks with rotary screening
- Abandon and demolish all existing lagoons
- Two (2) new cast-in-place concrete SBR reactor tanks with pre and post-equalization tanks

- New flocculation tank
- New tertiary cloth media filtration
- Ultraviolet disinfection
- New sludge storage tanks
- New Control Building for operator office, laboratory, electrical/controls, workshop and appurtenant equipment

A preliminary layout of this alternative is provided on Figure 8 in Appendix A. On February 21, 2019, a site visit was conducted with the working group to the Town of Hartford Quechee facility to view the operation of a sequential batch reactor and cloth media filters.

Currently, the Hinesburg WWTF does not have a headworks. New screening installations typically fall into two types: rotary drum screens and mechanically raked bar screens. Both screen types also typically incorporate a means to wash and compact (and thereby dewater) the captured screenings. This greatly reduces the amount of hazardous and putrescible biological waste in the screenings which simplifies handling and disposal considerations. The headworks would be located in a new 700 sf building containing a rotary screen with ¼" openings and bypass channel with coarse bar rack. The internal space for this structure is classified as Class I, Division 1 for hazardous locations. Technical information on headworks equipment is provided in Appendix F.

A sequencing batch reactor (SBR) system is timed operation of aerobic, anoxic and anaerobic biological processes within each reactor tank with the addition of equalization and clarification. There are five possible phases of operation to meet advanced wastewater treatment objectives:

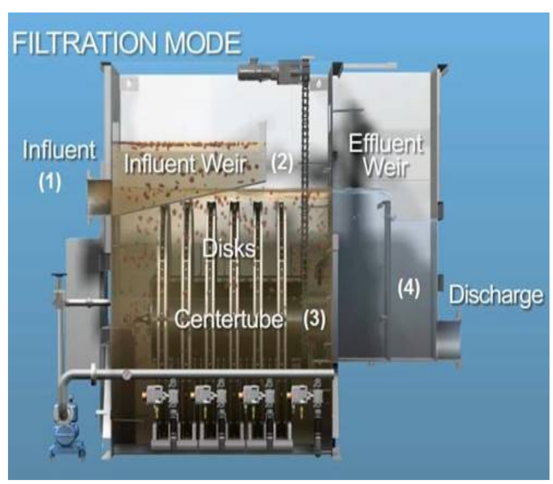
1. Mix-Fill: Influent flow enters the reactor tank and contents are completely mixed in the absence of aeration creating anoxic conditions allowing for potential denitrification (conversion of nitrites/nitrates formed in nitrification to nitrogen gas). In systems incorporating phosphorus removal, the Mix-Fill phase is extended to create anaerobic conditions (absence of oxygen and nitrites/nitrates) where phosphorus accumulating organisms (PAO) release phosphorus then ready for subsequent uptake under aerobic conditions.
2. React-Fill: Influent flow continues under continued mixed and now aerated conditions. Intermittent aeration can be incorporated to alternate between aerobic or anoxic conditions. Biological/chemical oxygen demand (BOD/COD) reduction and nitrification, the conversion of ammonia nitrogen (NH_3) to nitrite/nitrate, occur under aerated conditions. Uptake of phosphorus as part of biological phosphorus removal is achieved during aerated conditions. Additional denitrification occurs under anoxic conditions.

3. React: Influent no longer flows into the reactor tank during the react phase. Mixing and aeration continue for BOD/COD reduction and to support nitrification with aerated conditions.
4. Settle: Mixing and aeration are terminated to allow for solids settling forming a sludge blanket at the bottom of the reactor tank.
5. Decant/Sludge Waste: Mixing and aeration remain off. The floating decanter removes liquid from the reactor surface. Waste activated sludge (WAS) is wasted as near the end of decant/sludge waste phase.

For the Hinesburg WWTF, the SBR process would include two (2) cast-in-place concrete reactor tanks plus an interior pre-equalization tank. Addition of the pre-equalization tank was requested by the State for redundancy purposes. Each SBR tank will be 40 ft by 35 ft with an operating liquid level of 13.6 to 21.0 ft. Mixing is provided in each tank by a 5 HP floating mixer. Aeration would be provided by retrievable fine bubble diffusers supplied by three (3) 25 HP blowers (2 operating, 1 standby). Each reactor tank would have a decanter assembly. Additional equipment information for the SBR system is provided in Appendix I.

The SBR process would be followed by one (1) 40 ft by 15 ft post-equalization tank. Maximum liquid depth in the tank would be 12.4 ft. This will provide 55,460 gallons of equalization volume to maintain continuous flow to the downstream components. Retrievable fine bubble diffusers would provide aeration in the tanks supplied by one (1) 7.5 HP positive displacement blower. Two (2) 5 HP submersible pumps would provide effluent pumping. Flow control would be provided to control the discharge rate to the downstream treatment processes.

Tertiary total phosphorus (TP) removal would be achieved by chemical addition with coagulation and flocculation followed by cloth media filtration for solids separation. A coagulant would be added to a new rapid mix tank that would be followed a flocculation tank. Cloth media filtration requires a 5 minute hydraulic retention time (HRT) for average daily flow (ADF) to achieve the required effluent TP limits. Therefore, a design ADF of 0.325 mgd requires flocculation tank volume of 1,129 gallons (151 cf).



For the cloth media filter, the influent pipe (1) routes flow to the filter basin (2), where filtration occurs. The filter basin contains a series of circular disks covered with a pile cloth media. As water passes through the media via an outside-in flow path, some particulates are removed and stored within the pile cloth media while others are deposited on the pile cloth media surface. Filtered water, or filtrate, is collected in a centertube (3) and flows, via gravity, over the effluent weir and into the effluent chamber (4) prior to discharge. The disks do not rotate during filtration. Additional technical information on cloth media filters is provided in Appendix I.

As more particulates are deposited on and within the pile cloth media, the pressure required to drive water through the pile cloth media (headloss) increases. This results in a rise in the water level within the filter basin and increased differential pressure on the pile cloth media. Upon reaching a specific basin water level set point, the PLC automatically initiates the backwash mode to clean the pile cloth media.

Solids are backwashed from the pile cloth media surface by liquid suction through backwash shoes positioned on both sides of each disk. These spring loaded backwash shoes contact the pile cloth media to provide the necessary suction for cleaning. During backwash, disks are cleaned in multiples of two, unless the filter has only one disk. The disks rotate slowly while a backwash/waste pump draws filtered water from the centertube through the pile cloth media on an inside-to-outside, or reversed, flow path. This provides cleaning of the pile cloth media over the entire disk. By the end of the backwash cycle, the basin water level returns to its normal operating level. Backwash water is typically directed to the headworks. Filtration continues while the filter is in backwash mode. This allows for continuous filtration.

For the Hinesburg WWTF, the PES-14 cloth media is recommended. This material provides an effective pore size of 5 microns.

The cloth media filter would consist of two (2) filter units, each capable of treating the maximum daily flow. Each filter unit would contain eight (8) Minidisks in a painted carbon steel tank. Each filter unit would have 86.4 sf of filter area. The cloth media filter system would include the filter assemblies, two (2) backwash pumps, two (2) actuated solids waste valves, two (2) actuated backwash valves, and controls. The filtration system would be located in a new approximately 1,700 sf building.

Disinfection would be provided by an ultraviolet (UV) disinfection system. Additional equipment information for the UV disinfection system is provided in Appendix J. The following describes the proposed system:

- Channel design
    - Number of Channels: 1
    - Approximate Channel Length Required: 30 ft
    - Channel Width Based on Number of UV Modules: 0.7 ft

    - Channel Depth Recommended for UV Module Access: 3.8 ft
- UV Modules
    - Total Number of Banks: 2
    - Number of Modules per Bank: 2
    - Number of Lamps per Module: 4
    - Total Number of UV Lamps: 16
    - Maximum Power Draw: 4 kW

A new 2,000 sf Control Building with partial basement would contain; the operator office, PLC controls/SCADA, motor control center (MCC), laboratory, workshop, and sludge pumps.

6.4.2. Technical Assessment

A summary of the technical assessment for this alternative is provided in the narrative below.

Advantages

- Allows for use of Lagoon #1 for construction of the new treatment components.
- Makes sequencing of construction easier to maintain operations of existing facility during construction.
- Provides for preliminary treatment with new Headworks structure.
- Smallest footprint of new structures required at increased flow capacity.
- Performs very well at biological and chemical phosphorus removal and consistently achieves low ammonia levels.
- Provides much flexibility for varying flows and loadings, especially at the initial year of operations.
- An SBR tank provides ammonia removal and clarification within a single tank.
- The SBR and cloth media filtration are both reliable technologies that have been in use for many years.
- UV disinfection requires less operator attention and is more environmentally beneficial to the receiving water.
- Doesn’t require separate sludge return.
- Automatic operation and monitoring is provided through a plant PLC/SCADA system.

Disadvantages

- Requires significant fill be placed in Lagoon No. 1 to construct the new structures.
- Screening is required in the Headworks for an SBR treatment system.
- The State required the addition of pre-equalization for redundancy.
- Scum removal is not provided in the SBR tanks.

- Upgrade of the disinfection system to ultraviolet disinfection is required to meet the higher flow conditions.
- On-site emergency power is required to maintain continuous operation of the UV disinfection system during a power outage.
- Requires increased wasting and disposal of sludge.

6.4.3. Constructability

A copy of the geotechnical report is provided in Appendix M for reference purposes, and the subgrade improvements are evaluated separately in Section 7.0 for each of the treatment alternatives.

6.5. No. 3 - Anaerobic/Oxic (A/O) with Filtration

6.5.1. Description

This Alternative No. 3 includes the following components:

- New Headworks with rotary screening
- Abandon and demolish all existing lagoons
- Construct two (2) A/O tanks with anaerobic selectors
- Construct two (2) 35-foot diameter secondary clarifiers
- New tertiary flocculation tank
- New tertiary cloth media filtration
- UV disinfection
- New sludge storage tank
- Control Building upgrades for chemical feed and storage, blowers, pumps, and controls

A preliminary layout of this alternative is provided on Figure 9 in Appendix A. On February 7, 2019, a site visit was conducted with the working group to the City of South Burlington Bartlett's Bay facility to view the operation of an A/O process and cloth media filters.

Currently, the Hinesburg WWTF does not have a headworks. New screening installations typically fall into two types: rotary drum screens and mechanically raked bar screens. Both screen types also typically incorporate a means to wash and compact (and thereby dewater) the captured screenings. This greatly reduces the amount of hazardous and putrescible biological waste in the screenings which simplifies handling and disposal considerations. The headworks would be located in a new 700 sf building containing a rotary screen with ¼" openings and a bypass channel with coarse bar screen. The internal space for this structure is classified as Class I, Division 1 for hazardous locations. Equipment information for the headworks is provided in Appendix F.

The anaerobic/oxic (A/O) biological process consists of an anaerobic selector reactor and oxic reactor. Additional technical information on the A/O system is provided in Appendix K. The anaerobic reactor is divided into three (3) zones to achieve anaerobic conditions, absence of nitrate/nitrite and dissolved oxygen (DO), which support biological phosphorus removal. Return activated sludge (RAS) enters the first zone and influent flow enters the second zone. A 1.0 hp mixer is provided in each of the three (3) anaerobic zones.

The oxic reactor completes the biological process. Air is provided to the oxic zone with fine bubble diffusers using three (2 duty, 1 standby) 20 HP blowers, each rated for 280 scfm at 7.9 psig to maintain a DO concentration of 2.0 mg/l.

For the Hinesburg WWTF, there would be two (2) parallel A/O trains. Each train would contain three (3) 11 ft by 10 ft anaerobic selector zones, each with an 11 ft surface water depth. Each train would contain a 48 ft by 35 ft oxic reactor with a surface water depth of 16 ft. The A/O process effluent TP will range between 0.5-2.0 mg/l TP, depending on influent characteristics and achieving anaerobic conditions in the anaerobic reactor.

Flow from the oxic reactor would continue to the two (2) 35-foot diameter secondary clarifiers. Equipment information for the secondary clarifiers is provided in Appendix L. Mixed liquor from the oxic tanks is clarified and an activated sludge blanket forms at the bottom of the tank. Return activated sludge (RAS) is pumped to the Anaerobic Reactor using the RAS pumps. Excess sludge, waste activated sludge (WAS), is pumped using the WAS pumps to the new Sludge Holding Tank. Clarified effluent continues from the secondary clarifiers to tertiary phosphorus removal.

Tertiary phosphorus removal would be the same as described in the SBR alternative:

- Rapid mix tank with chemical addition
- Coagulation and flocculation tank
- Cloth media filtration
- New 1,700 sf Filtration Building

Disinfection would be provided by an ultraviolet (UV) disinfection system as described in the SBR alternative. Equipment information on the UV disinfection system is provided in Appendix J.

6.5.2. Technical Assessment

A summary of the technical assessment for this alternative is provided in the narrative below.

Advantages

- Allows for use of Lagoon #1 for construction of the new treatment components.
- Makes sequencing of construction easier to maintain operations of existing facility during construction.
- Provides for preliminary treatment with new Headworks structure, and screening is not required for this treatment process.
- Performs very well at biological and chemical phosphorus removal and consistently achieves low ammonia levels.
- Provides much flexibility for varying flows and loadings, especially at the initial year of operations.
- The A/O process and cloth media filtration are both reliable technologies that have been in use for many years.
- Redundancy is provided with multiple A/O tanks and secondary clarifiers.
- UV disinfection requires less operator attention and is more environmentally beneficial to the receiving water.
- Automatic operation and monitoring is provided through a plant PLC/SCADA system.

Disadvantages

- Requires significant fill be placed in Lagoon #1 to construct the new structures.
- More new structures are required for the selector, oxic reactor, and secondary clarification.
- Continuous recycle of sludge (RAS) is required.
- Upgrade of the disinfection system is required at the higher flow capacity.
- On-site emergency power is required to maintain continuous operation of the UV disinfection system during a power outage.
- Requires increased wasting and disposal of sludge.

6.5.3. Constructability

A copy of the geotechnical report is provided in Appendix M for reference purposes, but the subgrade improvements were not evaluated for this treatment alternative as the costs would be similar or greater than Alternative No. 2.

6.6. Cost Estimates

6.6.1. Estimated Construction Cost

A breakdown of the estimated construction cost for these alternatives is provided below in Table 6.3 and further detail of the costs is provided in Appendix R. Alternative No. 2 for the SBR and Filtration has a lower estimated construction cost at $6,729,580.

Table 6.3 Comparison of Estimated Construction Cost

Item Description	Alternative No. 2	Alternative No. 3
Main Pump Station	$243,540	$243,540
Lagoon Retrofits	$403,700	$403,700
Headworks	$861,300	$861,300
Biological/Clarification	$2,061,400	$2,744,280
Tertiary	$1,012,000	$1,012,000
Disinfection	$564,300	$564,300
Sludge Storage	$449,240	$449,240
Control Building	$1,134,100	$1,134,100
Total Use	$6,729,580	$7,412,460

Notes:
1. ENR 11200 = April 2019

6.6.2. Annual Operation and Maintenance Costs

For the initial year, the estimated annual operation and maintenance costs were developed for these alternatives. This is based on the current wastewater expenses of $363,304 and follows the format of the existing budget. Also for these alternatives, the design flow is based on the 325,000 gpd. Since both of these approaches have very similar components (headworks, filtration, UV disinfection, Control Building) and the biological treatment processes are similar the increase in annual O&M costs was assumed to be the same.

For these alternatives, the O&M budget was updated for the initial year and incorporates the following changes:

- Staffing
  - One (1) additional FTE employee with benefits split between the water and wastewater.

- Operating Supplies
  - Chemicals for phosphorus removal
- Repair and Maintenance Supplies
  - UV bulb replacement
  - Filter cloth replacement
- Utilities
  - UV system electric
  - Filtration/Disinfection and Control Building heat
- Sludge removal
  - Hauling of sludge at 1.5% to the Burlington Main Plant for dewatering and disposal. Burlington charges approximately $0.075 per gallon plus $0.075 per gallon is budgeted for hauling.

It should be noted that no cost is shown under the phosphorus removal line item for current or the initial year projections. The increased operating costs to comply with the phosphorus limit are split between the operating supplies (chemicals), utilities, and sludge removal. For the initial year, the annual operation and maintenance budget is anticipated to increase from $363,304 to approximately $450,000. The increases in the budget for each line item are shown in Table 6.4.

Table 6.4 Alternatives No. 2 and 3 Projected O&M Costs – Initial Year

Item	FY 19 Budget	WW Expenses	Initial Year Projections
Shared Water-Wastewater – 5331			
Salary	$175,382	$87,691	$113,000
Accounting	$2,500	$1,250	$1,250
FICA	$15,173	$7,587	$9,500
Health Insurance	$22,000	$11,000	$19,000
Dental Insurance	$2,234	$1,117	$1,117
Vision	$360	$180	$180
Retirement	$10,374	$5,187	$6,437
Health Insurance Op-Out	$10,000	$5,000	$5,000
Office Supplies	$800	$400	$400
Vehicle Repair and Maintenance	$1,700	$850	$850
Postage	$1,150	$575	$575
Vehicle Insurance	$0	$0	$0
Trash Removal	$900	$450	$450
Uniforms	$1,050	$525	$525
Telephone	$3,850	$1,925	$1,925
Vehicle Fuel	$4,300	$2,150	$2,150
Capital Transfers	$21,322	$10,661	$10,661
5331 Subtotal	$273,095	$136,548	$173,421
Wastewater – 5480			
Operating Supplies		$13,500	$15,000
Repair & Maintenance Supplies		$3,000	$5,000
Small Tools & Equipment		$2,000	$2,500
Advertising		$0	$0
Development		$1,000	$1,000
PACIF		$7,056	$7,056
Worker's Compensation		$9,000	$9,000
Testing		$4,000	$5,000
Repair & Maintenance Labor		$5,000	$5,000
Permits & Licenses		$1,200	$1,500
Miscellaneous		$0	$0
Utilities		$29,000	$40,000
Phosphorus Removal		$0	$0
2032 Bond		$50,000	$50,000
Capital Transfer		$20,000	$20,000
Sludge Removal		$82,000	$120,000
5480 Subtotal		$226,756	$281,056
Total		$363,304	$450,000

7. GEOTECHNICAL SUBGRADE IMPROVEMENT ALTERNATIVES

7.1. Results of Subsurface Investigation

Since there were concerns about the layout of the process elements and existing soils, geotechnical investigation was performed during evaluation of the treatment alternatives. In January 2019, four (4) soil borings were performed at the wastewater treatment facility site, and the borings ranged in depth from 42 to 78 feet.

A very soft clay was encountered at a depth of 35' to 65' and start below approximate elevation 319'. For Boring B-2, refusal was confirmed at a depth of approximately 70'. Consolidation testing was performed on the soft gray clays, and indicated that approximately 3' to 3.5' of long-term consolidation settlements are expected to result from the 1960's lagoon construction.

For Treatment Alternative No. 1, the potential impacts of new construction in the Sludge Lagoon could expect total settlement of 18" to 42" based on a 50-year design life. This is an excessive amount of settlement for most structures, and would make it difficult to maintain critical elevations.

For Treatment Alternative No. 2, the new construction in Lagoon #1 could expect consolidation settlements of approximately 12" (ultimate) based on a 50-year design life.

Subgrade improvements to address the excessive consolidation were discussed for a more detailed analysis. These were preloading and use of wick drains, and steel pile foundations.

A copy of the preliminary geotechnical summary is provided in Appendix M .

7.2. Preliminary Geotechnical Analysis

To address the concerns about the potential settlement from the new structures, additional analysis was performed. For a design life of 50 years, about 18" to 42" of total consolidation could be anticipated which is an excessive amount for most structures. So that normal construction could occur, the following subgrade improvements were evaluated in detail:

- Wick Drains
- Steel Piles

7.3. Wick Drains

7.3.1. Description

Wick drains, also called prefabricated vertical drains (PVD) are used to accelerate the consolidation of compressible soils. The drains consist of a geotextile filter-wrapped plastic strip with extruded channels that allow water to drain from the soft soil as it consolidates under a surcharged load. The time required for the consolidation to occur depends on the permeability of the soft strata, weight of the surcharge, and spacing of the wicks. Closer spacing of the wicks can be done to shorten the consolidation time if needed and layout is typically a square grid pattern out.

Applications for wick drains are to rapidly consolidate soft soils in conjunction with a preloaded fill and accelerated construction schedule for staged loading. A level working surface must be provided for installation of the wick drains, and a sand or gravel blanket needs to be constructed to act as the drainage blanket and direct groundwater away from the treatment area. Drains can be installed up to 140’ deep with a track-mounted excavator using specialized equipment called a stitcher.

Additional Information on wick drains is provided in Appendix N.

For Treatment Alternative No. 1, the following work is proposed for these improvements:

- Consolidate all of the new buildings and structures within the fill area.
- Remove the south and west berms for the sludge lagoon and cut back the north and east berm.
- Excavate material to lower footprint of sludge storage lagoon area to approximate ground elevation 317.5’.
- Replace excavated material with a granular material for wick drain relief.
- Install the wick drains to approximate elevation 263’.

- Fill in the interior of the sludge lagoon to approximate elevation 335’ plus an additional 5’ of material to account for total settlement.

For Treatment Alternative No. 2, the following work is proposed for these improvements:

- Slide all buildings to be approximately 25 north of the toe of the southerly berms in Lagoon #1.
- Remove the berm between sludge lagoon and Lagoon #1.
- Lower footprint of sludge lagoon and Lagoon #1 down to approximate elevation 317.5’.
- Replace excavated material with a granular material for wick drain relief.
- Install the wick drains to approximate elevation 277.5’ in Lagoon #1.
- Fill up to approximate elevation 336’ plus an additional 5’ of material for total settlement.

7.3.2. Technical Analysis

A discussion of the advantages and disadvantages of this improvement is provided below:

Advantages

- A simpler approach compared to constructing new buildings and structures on piles.
- The time required for consolidation can be accelerated by closer spacing of the wick drains.
- Wick drains are fast mobilization and installation.
- Minimal post construction settlement.

Disadvantages

- Work must be performed by an out of state specialty contractor.
- The wick drains must be installed well in advance of the overall construction so that the consolidation and settlement can occur.

7.3.3. Estimated Costs

A summary of the estimated construction cost is provided in Tables 7.1 and 7.2 for the wick drains. These costs are provided separately for Treatment Alternatives No.1 and 2 presented in Sections 5.0 and 6.0.

Some of the assumptions on the estimated costs are provided below:

- The structures need to all be located within the fill area.
- Wick drain spacing is 3’ to 5’ and 0’ of additional surcharge is provided.

- A minimum 10 month consolidation period is required.

A summary of the estimated construction cost for the subsurface improvements required to construct Treatment Alternative No. 1 is provided below in Table 7.1. These costs are in addition to the construction costs presented in Section 5.0.

Table 7.1 Wick Drains for Treatment Alternative No. 1 - Estimated Construction Cost

Item Description	**Estimated Cost**
Sludge lagoon - Remove south and west berms	$50,000
Sludge lagoon – Cut into north berm	$29,000
Sludge lagoon - Remove 3.5' clay overburden	$37,000
Replace excavated soil with granular fill	$184,000
Fill interior of sludge lagoon	$65,000
Wick drains(2)	$272,000
Subtotal	$637,000
15% Contingency	95,000
Total	$732,000

Notes:
1. ENR 11200 = April 2019
2. Wick drain cost is based on 10 month consolidation period (3' grid and 0' surplus)

A summary of the estimated construction cost for the subsurface improvements required to construct the Treatment Alternative No. 2 is provided in Table 7.2. These costs are in addition to the construction costs presented in Section 6.0.

Table 7.2 Wick Drains for Treatment Alternative No. 2 - Estimated Construction Cost

Item Description	Estimated Cost
Sludge lagoon/Lagoon #1 - Remove dividing berm	$28,000
Sludge lagoon – Remove 2.5' clay overburden	$4,000
Sludge lagoon/dividing berm – Remove clay overburden	$11,000
Lagoon #1 - Remove clay overburden	$100,000
Replace excavated soil with granular fill	$230,000
Fill interior of sludge lagoon	$65,000
Partial fill of lagoon #1	$310,000
Wick drains	$477,000
Subtotal	$1,225,000
15% Contingency	$184,000
Total	$1,409,000

Notes:
1. ENR 11200 = April 2019
2. Wick drain cost is based on 9.5 month consolidation period (3' grid and 0' surplus)

7.4. Steel Piles

7.4.1. Description

This approach is based on placing the quantity of fill required and supporting the new structures on end-bearing piles. These piles are driven and sunk into the ground, the pile heads are cut square, and a steel plate is welded to each pile. The pile caps are then embedded in a thickened e cast-in-place concrete base slab for the new structure. Because the ground around the structures is expected to settle, the piles will need to be designed for down-drag forces which will likely increase the required capacity or number of piles.

7.4.2. Technical Analysis

A summary of the advantages and disadvantages for this improvement are discussed below.

Advantages

- The new buildings and structures are fixed by construction on the piles driven to refusal.
- A local contractor can install the piles.
- This work can be done in conjunction with the overall construction project as the new buildings and structures are being built.

- This option can provide a bit more flexibility on the layout of the new buildings and structures.

Disadvantages

- Due to the poor subsurface conditions, settlement will still occur in the fill areas between the new structures. This consolidation and settlement could impact new yard piping, electrical conduits, etc. requiring special design requirements that will accommodate this excessive settlement.
- The new structures will be fixed, but the long-term settlement of the fill may require periodic filling around the buildings and tanks.
- Recent changes in the tariffs will likely increase the material costs.
- Increase in the thickness of the concrete base slabs is required for the new buildings and tanks.

7.4.3. Estimated Costs

A summary of the estimated construction cost is provided in Tables 7.3 and 7.4 for the piles. These costs are provided separately for treatment alternatives No. 1 and 2 presented in Sections 5.0 and 6.0.

Some of the assumptions on the estimated costs are provided below:

- Drive piles to refusal, approximately 70' deep.
- Base slabs of new structures need to be thickened to 24" to act as pile cap.
- 80-ton piles de-rated to 60 tons are proposed using HP12 X 53.

Using piles, a summary of the estimated construction cost for the subsurface improvements required to construct Treatment Alternative No. 1 is provided below in Table 7.3. These costs are in addition to the construction costs presented in Section 5.0.

Table 7.3 Steel Piles for Treatment Alternative No. 1 – Estimated Construction Cost

Item Description	Estimated Cost
Sludge lagoon – Fill interior	$65,000
Mobilization	$15,000
Pipe piles	$380,000
Fill pipe piles with Concrete	$25,000
Pile load test	$40,000
Additional concrete for base slab	$75,000
Subtotal	$600,000
15% Contingency	$90,000
Total	$690,000

Notes:
1. ENR 11200 = April 2019

Using piles, a summary of the estimated construction cost for the subsurface improvements required to construct Treatment Alternative No. 2 is provided below in Table 7.4. These costs are in addition to the construction costs presented in Section 6.0.

Table 7.4 Steel Piles for Treatment Alternative No. 2 – Estimated Construction Cost

Item Description	Estimated Cost
Sludge lagoon – Fill interior	$65,000
Partial fill of Lagoon #1	$310,000
Mobilization	$15,000
Pipe piles	$760,000
Fill pipe piles with concrete	$51,000
Pile load test	$40,000
Additional concrete for base slab	$150,000
Subtotal	$1,391,000
15% Contingency	$209,000
Total	$1,600,000

Notes:
1. ENR 11200 = April 2019

7.5. Comparison of Costs

A summary of the estimated construction costs for the subgrade improvement alternatives is provided below in Table 7.5. As the subgrade alternatives were prepared for the preliminary layout of each treatment alternative, the costs shown below are specific to each of the treatment alternatives. For example, if Treatment Alternative No. 2 is selected, and wick drains are the preferred subgrade improvement, then the additional cost is $1,409,000.

Table 7.5 Subgrade Improvements – Comparison of Estimated Construction Costs

Subgrade Improvements	Treatment Alternative No. 1	Treatment Alternative No. 2
Wick Drains	$732,000	$1,409,000
Steel Piles	$690,000	$1,600,000

Notes:

1. ENR 11200 = April 2019

8. SELECTION OF ALTERNATIVES

The selection of the alternatives presented in Sections 5, 6, and 7 are based on evaluation of costs and non-monetary factors. The following sections outline the evaluation and selection of the alternatives.

8.1. Life Cycle Cost Analysis

The Town requested that treatment alternatives be evaluated at the current treatment capacity of 250,000 gpd, and with expansion to 325,000 gpd. The reason for this is that they wanted to understand what the incremental cost would be to also expand the existing treatment facility while still complying with the lower effluent permit limits. In Section 5.0, a treatment alternative was evaluated at the 250,000 gpd capacity that can also meet the lower permit limits for ammonia and total phosphorus. The estimated construction cost for this Alternative No. 1 – Lagoon Upgrade with LEMNA was $7,990,000.

In Section 6.0, Alternatives No. 2 and 3 were evaluated to include an increase in the treatment capacity to 325,000 gpd. Alternative No. 3 – A/O with Filtration was dropped from further evaluation as the estimated construction cost was higher than Alternative No. 2 and both of these approaches have similar annual O&M costs. The estimated construction cost for Alternative No. 2 – SBR with Filtration is $6,729,580.

In addition to evaluating the treatment alternatives, constructability became an issue after completion of the geotechnical investigation. Due to the poor subsurface conditions, subgrade improvements are required to build the new treatment facility, so the wick drain and steel pile alternatives were evaluated in Section 7.0. These approaches had to be evaluated separately for the different layout of each treatment alternative. Even though the wick drains were more costly, benefits are provided over the steel piles. Consolidation is provided over the entire area versus only addressing the new structure foundations for the steel piles.

A summary of the estimated construction cost is provided below in Table 8.1 for Alternatives No. 1 and 2 to include the subgrade improvements using the wick drains. Alternative No. 2 – SBR with Filtration has the lowest estimated construction cost at $8,138,580.

Table 8.1 Alternatives – Comparison of Estimated Construction Costs

Treatment Alternative	WWTF Upgrade/ Expansion	Wick Drains	Total Estimated Construction Cost
No. 1 - Lagoon Upgrade with Lemna	$7,990,000	$732,000	$8,722,000
No. 2 – SBR with Filtration	$6,729,580	$1,409,000	$8,138,580

Notes:
1. ENR 11200 = April 2019

Using both the estimated construction cost and projected annual operation and maintenance costs, the present worth analysis was used to compare the 20 year life cycle cost. The comparison of these alternatives is provided below in Table 8.2. Based on the present worth analysis, Alternative No. 2 – SBR with Filtration has the lowest total present worth of $15.6 M, so this approach was selected for inclusion into the proposed project.

Table 8.2 Alternatives – Present Worth Analysis

Item	Alternative No. 1	Alternative No. 2
Annual Operating Cost	$490,000	$450,000
Present Worth Operations	$8,330,000	$7,650,000
Total Capital Cost	$8,722,000	$8,138,580
Total Present Worth	$17,052,000	$15,788,580

Notes:
1. The present worth analysis is based on 20 years.
2. The discount rate is 1.6%.
3. No salvage value was assumed in the analysis.

8.2. Non- Monetary Factors

When evaluating the alternatives, non-monetary factors were also considered. The Town will require more treatment capacity for future growth within the sewer service area, so implementing an approach with additional treatment capacity is desirable. Alternative No. 2 – SBR with Filtration meets the objective as it provides 325,000 gpd of capacity.

This treatment Alternative No. 2 provides further non-monetary benefits with simplified operations and improved operating efficiency in the early years. This treatment technology has an extensive operating history in the ability to consistently meet the lower permit limits, but the

PLC/SCADA and automated operation provides the ability to efficiently operate the plant and minimize the increase in operations cost in the early years.

For the subgrade alternatives, extensive discussion was had on the wick drains versus the steel piles. Even thought the wick drains are more costly and more time is required for the consolidation to occur, the non-monetary benefits outweigh the costs. If the steel piles are used, only the new structures are fixed and will not be subject to the settlement. With the wick drains, the entire building envelope is preloaded and will settle uniformly. This approach is not only better long-term for the new buildings and structures, but will not cause future issues with excessive settlement of fill areas, breaking of interconnecting pipes, utility conduits, and settlement of smaller structures.

9. PROPOSED PROJECT

9.1. Project Description

The proposed project includes the upgrade and expansion of the existing wastewater treatment facility and is split into two (2) phases as described in the narratives below.

- Phase I – Subgrade Improvements
- Phase II – WWTF Upgrade/Expansion

9.1.1. Phase I - Subgrade Improvements

For the proposed project, subgrade improvements need to be completed prior to the overall WWTF upgrade and expansion under Phase II. This advance work is required to accelerate the soil consolidation and achieve the total settlement in the areas shown on Figure 10 in Appendix A. Wick drains will be installed and the area preloaded with fill to accelerate the construction schedule. Lagoon #1 will be taken out of service, drained, and the sludge will be removed (pumped) to the other lagoons or the existing sludge storage lagoon. The influent flow will be directed to Lagoon #2 throughout the construction process.

Sitework will begin in preparation for the installation of the wick drains. The existing berm between the sludge storage and Lagoon #1 will remain. Based on discussions with the Town, the preference is to leave the sludge storage lagoon in operation during construction. Within the area of the new tanks and buildings, the native material will be excavated down to approximate elevation 317.5’. This excavated area will be replaced with a granular material for wick drain relief back to approximate elevation 324.0’ (bottom of the existing lagoon). The placement of this fill will provide a flat and stable area for installation of the wick drains. The wick drains will be installed to a depth of about 50 to 60 feet to approximate elevation 278’, and a spacing on a 3’ grid. Additional information on the wick drains is provided in Section 7.3.

Once the wick drains are installed, this area will be preloaded by filling to approximate elevation 336’. Monitoring of the rate of settlement will occur for about 12 months prior to the start of construction for Phase II.

9.1.2. Phase II - WWTF Upgrade/Expansion

The WWTF upgrade/expansion under Phase II includes the following components and more detail is provided in the following narratives. A proposed WWTF site plan is shown on Figure 11 and a hydraulic profile is shown on Figure 12 in Appendix A. The Town wantsto maintain the use of the existing Sludge Storage Lagoon during construction, so the new structures were shifted to the east to be located within Lagoon #1.

- Main Pump Station
- Headworks with rotary screening
- Abandon and regrade existing Lagoons #2 and #3 while restoring to floodplain
- Two (2) cast-in-place concrete SBR reactor tanks with pre and post-equalization tanks
- Flocculation tank and tertiary cloth media filtration
- Ultraviolet disinfection
- Sludge storage tanks
- Control Building for operator office, laboratory, electrical/controls, workshop and appurtenant equipment

Main Pump Station

The three (3) existing pumps will be replaced with three (3) new 25 hp vertical non clog centrifugal pumps in the same location in the dry pit. Each pump will have a maximum capacity of approximately 550 gpm to handle 50% of the design flow conditions with the third pump dedicated as a back-up unit. Modification and replacement of the existing piping and valves will be required to install the new pumps.

A new duplex pump control panel will be provided in the existing dry pit structure. The control panel will include PID based control with variable frequency drives and level control system. The Main pump station controls will be interconnected to the new SCADA/telemetry system at the WWTF site. Standby power with an automatic transfer switch will continue to be provided on-site to maintain continuous operation during a power outage.

The existing 8” forcemain will continue to be used for transport of the flow to the wastewater treatment facility site.

New Headworks

Influent from the Main pump station will continue to be pumped to the treatment facility site. The existing forcemain will discharge to a new Headworks structure located at the southerly edge of Lagoon #1. The headworks structure will be about 700 s.f. with an at-grade building constructed of non-combustible materials to include; masonry block walls with exterior insulated metal panels, and standing seam metal roof.

The headworks will house a rotary fine screen located in the influent channel. The rotary screen has ¼" openings and will include a bypass channel with coarse bar rack. Screening greatly reduces the amount of hazardous and putrescible biological waste in the screenings which simplifies handling and disposal. The screenings will be washed, and discharged into a dumpster for disposal. Refer to Appendix F for additional information on the screening system. Providing screening upstream of the sequential batch reactor (SBR) tanks is a process requirement.
The internal space for this structure is classified as Class I, Division 1 for hazardous locations, so all of the mechanical and electrical functions will be suitable for this environment.

An addition with a separate exterior entrance will be provided on the west end of the building. This unclassified space will house the control and electric panels, and SBR influent valves.

Sequential Batch Reactors/Post Equalization

The SBR process will include two (2) cast-in-place concrete tanks plus an interior pre-equalization tank and post equalization tank. The pre-equalization tank will be approximately 30 ft X 20 ft and provide a total volume of about 94,000 gallons. Each SBR tank will be 40 ft by 35 ft with an operating liquid level of 13.6 ft (minimum) to 21.0 ft (maximum) plus 2 ft of freeboard. Mixing is provided in each SBR tank by a 5 HP floating mixer and aeration will be provided by retrievable fine bubble diffusers supplied by three (3) 25 HP blowers (2 operating, 1 standby) with variable frequency drives located in the Filtration/Disinfection Building. Each reactor tank will have a floating decanter assembly to provide gravity discharge to the adjacent post equalization tank. Additional equipment information for the SBR system is provided in Appendix I.

The SBR process will be followed by one (1) 30 ft by 20 ft post-equalization tank with a maximum liquid depth in the tank of 12.4 ft. This will provide 55,500 gallons of equalization volume to reduce the peak decant rate and discharge at a constant flow rate that mirrors the influent design flows. Retrievable fine bubble diffusers will provide aeration in the tanks supplied by one (1) 7.5 HP positive displacement blower. Two (2) 5 HP submersible pumps will provide effluent pumping and flow control will be provided to control the discharge rate to the downstream treatment processes. The post equalization pumps will be mounted on slide rails for ease of removal. Platform grating will be provided over the post equalization tanks.

At the influent end, automatic valves will be provided for each SBR tank and these will be housed in the electric room (unclassified, heated space) for the Headworks building. One (1) valve will be closed at all times, allowing only one (1) SBR tank to fill at a time.

The Sequential Batch Reactor (SBR) process is a type of activated sludge process. The SBR system operates as a batch treatment process which provides treatment and clarification in sequential batches in each tank. The SBR system requires a multiple tank system with a minimum of two (2) parallel tanks to accommodate continuous inflow. This arrangement allows for one tank to fill while the other tank is treating and settling. Each single tank is an independent batch reactor which accepts the raw wastewater, has its own mixing/aeration system, sludge draw-off mechanism, a decant unit to remove the treated supernatant, and automatic control system. An inlet baffle will be provided at the inlet pipe of each tank to provide the capability to operate a single tank in the continuous flow mode if one tank is out of service.

A sequencing batch reactor (SBR) system is timed operation of aerobic, anoxic, and anaerobic biological processes within each reactor tank with the addition of equalization and clarification. For each 4.8 hour cycle, there are five phases of operation to meet advanced wastewater treatment objectives:

- Mix-Fill
- React-Fill
- React
- Settle
- Decant/Sludge Waste

Two (2) double disc sludge waste pumps will be provided in the basement of the Control Building for transfer of sludge to the aerated sludge storage tanks. Wasting will be performed automatically during each SBR cycle utilizing the PLC controls, or can be performed manually on a daily basis by the operator.

A PLC (programmable logic controller) will monitor the process and equipment information for the entire treatment process, and will be housed in the Control Building. The supervisory control and data acquisition (SCADA) will include central monitoring and control and will include telemetry to transmit remote alarms for all critical treatment units to the operator on call. The PLC will continue to remain operable during a power outage, in addition to the entire treatment process.

Filtration

Effluent from the SBR's will be discharged from the post equalization tank to the rapid mix and flocculation tank located upstream of the filter units. Flow will then continue through one or both of the package filtration units located inside the building. Information on the filters is provided in Attachment I. Two (2) new package cloth media filter units will be installed in this process equipment area within the building. Each mini disc filter unit in a steel tank will contain 8 disks and the following appurtenances:

- Centertube assembly with 2 disks utilizing pile cloth media
- Drive system assembly with gear reducer, drive motor, and drive chain
- Backwash assembly with backwash and sludge pumps
- Instrumentation with level sensing transducers
- Influent, backwash, and sludge valves
- Controls package with NEMA 4X enclosure, panel view display, and programmable controller.

Solids wasted from the filter backwash will be discharged to the in-plant pump station and returned to the headworks structure.

Tertiary total phosphorus (TP) removal will be achieved by chemical addition with coagulation and flocculation followed by cloth media filtration for solids separation. A coagulant will be added to a new rapid mix tank that would be followed a flocculation tank. Cloth media filtration requires a 5 minute hydraulic retention time (HRT) for average daily flow (ADF) to achieve the required effluent TP limits. Therefore, a design ADF of 0.325 mgd requires flocculation tank volume of 1,129 gallons (151 cf).

For the cloth media filter, the influent pipe routes flow to the filter basin, where filtration occurs. The filter basin contains a series of circular disks covered with a pile cloth media. As water passes through the media via an outside-in flow path, some particulates are removed and stored within the pile cloth media while others are deposited on the pile cloth media surface. Filtered water, or filtrate, is collected in a centertube and flows, via gravity, over the effluent weir and into the effluent chamber prior to discharge. The disks do not rotate during filtration. Additional technical information on cloth media filters is provided in Appendix I.

As more particulates are deposited on and within the pile cloth media, the pressure required to drive water through the pile cloth media (headloss) increases. This results in a rise in the water level within the filter basin and increased differential pressure on the pile cloth media. Upon reaching a specific basin water level set point, the PLC automatically initiates the backwash mode to clean the pile cloth media.

Solids are backwashed from the pile cloth media surface by liquid suction through backwash shoes positioned on both sides of each disk. These spring loaded backwash shoes contact the pile cloth media to provide the necessary suction for cleaning. During backwash, disks are cleaned in multiples of two, unless the filter has only one disk. The disks rotate slowly while a backwash/waste pump draws filtered water from the centertube through the pile cloth media on an inside-to-outside, or reversed, flow path. This provides cleaning of the pile cloth media over the entire disk. By the end of the backwash cycle, the basin water level returns to its normal operating level. Backwash water is typically directed to the headworks. Filtration continues while the filter is in backwash mode. This allows for continuous filtration.

For the Hinesburg WWTF, the PES-14 cloth media is recommended. This material provides an effective pore size of 5 microns.

Chemical/Feed Storage

A chemical feed/storage system will be provided in the Filtration/Disinfection Building. This chemical treatment system will be used to supplement the biological removal processes occurring in the SBR system. Feed systems will be provided for the addition of the following coagulants: liquid alum and polymer. For the liquid alum, a new 5,000 gallon bulk storage tank with two (2) peristaltic feed pumps will located within a secondary containment area. The primary dosage point will be to the SBR tanks but a secondary dosage point will be included upstream of the filters to the rapid mix tank.

UV Disinfection

The ultraviolet (UV) disinfection system will be located in the Filtration/Disinfection Building, and will be a poured-in-place concrete structure to house the UV equipment. The UV system will be a low-pressure high-output open channel unit consisting of two (2) horizontal banks in series with a perforated inlet baffle to provide equal flow distribution. Additional information on the on the UV system is provided in Appendix J. A fixed weir at the outlet end will maintain a constant water level and maintain submergence of the lamps. Spare replacement lamps equaling at least 15% of the total will be provided as specified in the State design guidelines. In addition to the spare lamps, one (1) spare module, one (1) replacement quartz sleeve, and one (1) spare electronic ballast will be provided. Continuous disinfection will be provided by the UV system with back-up power provided by the emergency generator. Additional information on the UV system is provided in Attachment J.

Sludge Storage Tanks

A new 90,000 gallon cast-in-place concrete sludge storage tank will be constructed with a maximum water level of 12’. The new tank will consist of 2 individual cells and a concrete cover. Full floor coverage fine bubble aeration for mixing will be provided in each cell. The two (2) lagoon aeration blowers located in the existing Blower Building will supply air to the sludge storage tanks.

Disposal of sludge can be performed by several different approaches depending on which is more cost effective, but for this situation, the liquid sludge will be trucked off-site by a private contractor to the Burlington Main WWTF for dewatering and disposal.

Process Water Storage Tank

The existing chlorine contact tank will be converted to process water storage to supply the non potable water needs at the facility. Effluent flow metering will continue to be provided at the process water storage tank (existing chlorine contact tank) prior to discharge. The existing primary device will continue to be used and effluent sampling will be performed at this location as requested by the State.

Control Building

A Control Building will be constructed in the west end o the existing sludge storage lagoon. The building will be approximately 40 ft X 50 ft (2,000 sf) with a first floor at grade and a partial lower basement area. Building construction will consist of cement board exterior and standing seam metal roof. The first floor will include; electric/control room, lab, operator office, mechanical room, lockers/restroom, and workshop area. The basement area will be contain the waste sludge pumps and process water pumping system.

In-Plant Pump Station

A new in-plant pump station will be constructed on-site. The package self priming pump station will be installed on top of a 6’ diameter precast concrete wet well. A 4” diameter forcemain will be constructed and will discharge to the headworks structure. This station will accept the building waste, supernatant from the sludge storage tanks, and filter backwash.

Emergency Generator

An emergency generator and automatic transfer switch will be provided to maintain operation of the computer (PLC) during a power outage, and will also operate the SBR system (automatic valve, blowers, and decanters), filtration and UV disinfection system.

Existing Sludge and Aerated Lagoons

Once the new treatment process is operable, the Sludge Lagoon, and Lagoons #2 and #3 will be drained and cleaned, and the accumulated sludge will need to be removed and disposed of. The berms will be removed and the areas regraded so there is a gentle slope in the north direction to restore this area to floodplain.

9.2. Preliminary Design Criteria

Additional detail on the proposed project elements are provided for the preliminary design criteria in Appendix O. The format of this document follows the State of Vermont Basis for Final Design.

9.3. Project Schedule

A proposed project schedule was developed and is presented in Table 9.1 for the Phase I – Subgrade Improvements, and Table 9.2 for Phase II – WWTF Upgrade/Expansion. The proposed schedules are based on a positive bond vote on March 3, 2020. To accelerate the work required under Phase I for the wick drains, the Town suggested starting the related engineering work sooner so that more time can be provided to obtain the permits. The schedule was revised to accommodate this change, so engineering would begin in the fall of 2019, and allows start of the wick drain construction sooner once all permits are obtained.

A more detailed project schedule is provided in Appendix P which combines both phases and shows more detail.

Deadlines are also specified in the Discharge Permit and a copy is provided in Appendix D. Based on their timeline, the facility upgrade is to be completed by December 31, 2022 to comply with the new permit limitations.

Table 9.1 Project Schedule – Phase I Wick Drains

Projected Date		Task
2019	October	Begin final design (Step II)
	December	30% review meeting
2020	February	60% review meeting
	April	90% submittal
	March - June	Permits
	July	Issue final documents
		Advertise for bids
	August	Open bids
	September	Start construction
	December	Complete construction
2021	January - December	Monitor settlement

Table 9.2 Project Schedule – Phase II

Projected Date		Task
2020	November	Begin final design (Step II)
2021	March	30% review meeting
	June	60% review meeting
	September	90% submittal
	August – November	Permitting
	December	Issue final documents
		Advertise for bids
2022	January	Open bids
	May	Start construction
	December	State Compliance deadline
2023	December	Complete construction/ Substantial completion

9.4. Permit Requirements

A list of potential permits required for the wastewater treatment facility upgrade/expansion is provided below:

- **State of Vermont Discharge Permit**: Since the permitted flow capacity is increased, amendment of the Discharge Permit will be required. The approach will be to comply with the mass loadings specified, so the concentrations will be adjusted proportionally, but the mass loadings will remain unchanged. This amendment will need to include an extension of the waste management zone and some previous work has been done on documenting the downstream public uses. The Basis of Final Design document will be submitted to the Facilities Engineering Division for review and concurrence.
- **Environmental Review**: An Environmental Report will need to be prepared for the proposed project to comply with the NEPA requirements. Due to the scope of this project, a Finding of No Significant Impact will need to be issued and will require a warned public hearing to receive public input and comments.
- **State of Vermont Land Use (Act 250) Permit:** Since the treatment facility hydraulic capacity is being increased more than 10%, an Act 250 Land Use Permit will be required. The plan is to request a Master Permit so that the Phase I work can proceed. A request for a determination was submitted to Act 250 on June 13, 2019, and the response is provided in Appendix Q.
- **Department of Public Safety Construction Permit:** This application will be submitted for each of the new buildings at the 90% stage of the final design process.

- **Local**: Applicable Town approvals for new buildings and structures.

9.5. Constructability

The major constructability issue will be the subgrade improvements and monitoring under Phase I. This advance work will consist of installing the wick drains and preloading the work area. This will need to occur so that the consolidation can be accelerated prior to the construction of the overall WWTF upgrade/expansion under Phase II.

Excavation for the new SBR tanks will be relatively deep compared to the bottom of the existing lagoons, and there is flexibility to shallow these tanks up with increasing the footprint. This change has the potential to save some construction cost and can be evaluated early in the final design process.

9.6. Cost Estimates

9.6.1 Estimated Construction Cost

The construction cost is estimated to be $1,485,000 for the Phase I - Subgrade Improvements, based on a start construction date of November 2020. The general breakdown of this cost is shown below in Table 9.3.

Table 9.3 Phase I Subgrade Improvements - Estimated Construction Cost

Item Description	Cost Estimate (ENR 11200)	Cost Estimate (ENR 11815)
Sludge lagoon/Lagoon #1 - Remove dividing berm	$28,000	$29,500
Sludge lagoon – Remove 2.5’ clay overburden	$4,000	$4,200
Sludge lagoon/dividing berm – Remove clay overburden	$11,000	$11,600
Lagoon #1 - Remove clay overburden	$100,000	$105,500
Replace excavated soil with granular fill	$230,000	$242,600
Fill interior of sludge lagoon	$65,000	$68,600
Partial fill of lagoon #1	$310,000	$327,000
Wick drains	$477,000	$503,000
Subtotal	$1,225,000	$1,292,000
15% Contingency	$184,000	$194,000
Total		$1,485,000

Notes:
1. ENR 11200 = April 2019
2. ENR 11815 = November 2020
3. Wick drain cost is based on 9.5 month consolidation period (3’ grid and 0’ surplus)

The construction cost is estimated to be $7,330,000 for the wastewater treatment facility upgrade/expansion project under Phase II, based on a start construction date of January 2022. The general breakdown of this cost is shown below in Table 9.4.

Table 9.4 Phase II WWTF Upgrade/Expansion – Estimated Construction Cost

Item Description	Cost Estimate (ENR 11200)	Cost Estimate (ENR 12200)
Main Pump Station	$243,540	$265,200
Lagoon Retrofits	$403,700	$439,600
Headworks	$861,300	$938,000
Biological/Clarification	$2,061,400	$2,245,000
Tertiary	$1,012,000	$1,102,000
Disinfection	$564,300	$614,500
Sludge Storage	$449,240	$489,200
Control Building	$1,134,100	$1,235,000
Total	$6,729,580	$7,328,500
Use		$7,330,000

Notes:
1. ENR 11200 = April 2019
2. ENR 12200 = January 2022

9.6.2 Total Project Cost

The estimated total project cost for the proposed project is estimated to be $11,700,000. This amount includes; construction, construction contingency, engineering services, administration, legal, permit fees, and other related costs. A breakdown of the total project cost summary is shown below in Table 9.5.

Table 9.5 Total Project Cost Summary

Item Description	Total Estimated Cost	CWSRF Eligible Cost
Construction		
Subgrade Improvements(1)	$1,485,000	$1,485,000
WWTF Upgrade/Expansion(2)	$7,330,000	$7,330,000
Sludge Disposal Allowance	$250,000	$250,000
Subtotal	$9,065,000	$9,065,000
Construction Contingency		
10% Construction Contingency	$906,500	$906,500
Subtotal	$906,500	$906,500
Step I – Preliminary Engineering		
Preliminary Engineering(3)	$57,000	$57,000
Geotechnical Investigation(3)	$18,000	$18,000
Pre-design Allowance	$50,000	$50,000
Subtotal	$125,000	$125,000
Steps II – Final Design(4)		
Final Design Allowance	$480,000	$480,000
Lead Paint/Asbestos Inspection	$5,000	$5,000
Special Services – Permitting Allowance	$50,000	$50,000
Subtotal	$530,000	$530,000
Step III – Construction Phase Engineering (4)		
Construction Phase Services Allowance	$950,000	$950,000
Subtotal	$950,000	$950,000
Other Costs		
Administration	$3,000	$3,000
Bond Vote Assistance/PR Firm	$20,000	$20,000
Income Survey	$10,000	$10,000
Legal	$10,000	$10,000
Permit Fees	$20,000	$20,000
Short Term Interest	$25,000	$25,000
Subtotal	$62,000	$62,000
Estimated Total Project Cost	$11,638,500	$11,638,500
Use	**$11,700,000**	**$11,700,000**

Notes:
1. ENR 11815 = November 2020
2. ENR 12200 = January 2022
3. Fees are based on the current engineering agreement.
4. Based on State curve allowance.

9.6.3. Annual O&M Budget

The FY 19 budget is shown in Table 8.6. Under 5331, the water-wastewater expenses are shared between the budgets, and the costs are split 50/50. For FY19, the wastewater portion was $136,548, and the total wastewater expenses shown are $363,304.

For the WWTF upgrade/expansion, the O&M budget was updated for the initial year and incorporates the following changes:

- Staffing
  - One (1) additional FTE employee with benefits split between the water and wastewater.
- Operating Supplies
  - Chemicals for phosphorus removal
- Repair and Maintenance Supplies
  - UV bulb replacement
  - Filter cloth replacement
- Utilities
  - UV system electric
  - Filtration/Disinfection and Control Building heat
- Sludge removal
  - Hauling of sludge at 1.5% to the Burlington Main Plant for dewatering and disposal. Burlington charges approximately $0.075 per gallon plus $0.075 per gallon is budgeted for hauling.

It should be noted that no cost is shown under the phosphorus removal line item for current or the initial year projections. The increased operating costs to comply with the phosphorus limit are split between the operating supplies (chemicals), utilities, and sludge removal. For the initial year, the annual operation and maintenance budget is anticipated to increase from $363,304 to approximately $450,000. The increases in the budget for each line item are shown in Table 9.6.

Table 9.6 Projected O&M Costs – Initial Year

Item	FY 19 Budget	WW Expenses	Initial Year Projections
Shared Water-Wastewater – 5331			
Salary	$175,382	$87,691	$113,000
Accounting	$2,500	$1,250	$1,250
FICA	$15,173	$7,587	$9,500
Health Insurance	$22,000	$11,000	$19,000
Dental Insurance	$2,234	$1,117	$1,117
Vision	$360	$180	$180
Retirement	$10,374	$5,187	$6,437
Health Insurance Op-Out	$10,000	$5,000	$5,000
Office Supplies	$800	$400	$400
Vehicle Repair and Maintenance	$1,700	$850	$850
Postage	$1,150	$575	$575
Vehicle Insurance	$0	$0	$0
Trash Removal	$900	$450	$450
Uniforms	$1,050	$525	$525
Telephone	$3,850	$1,925	$1,925
Vehicle Fuel	$4,300	$2,150	$2,150
Capital Transfers	$21,322	$10,661	$10,661
5331 Subtotal	$273,095	$136,548	$173,421
Wastewater – 5480			
Operating Supplies		$13,500	$15,000
Repair & Maintenance Supplies		$3,000	$5,000
Small Tools & Equipment		$2,000	$2,500
Advertising		$0	$0
Development		$1,000	$1,000
PACIF		$7,056	$7,056
Worker’s Compensation		$9,000	$9,000
Testing		$4,000	$5,000
Repair & Maintenance Labor		$5,000	$5,000
Permits & Licenses		$1,200	$1,500
Miscellaneous		$0	$0
Utilities		$29,000	$40,000
Phosphorus Removal		$0	$0
2032 Bond		$50,000	$50,000
Capital Transfer		$20,000	$20,000
Sludge Removal		$82,000	$120,000
5480 Subtotal		$226,756	$281,056
Total		$363,304	$450,000

9.7. Available Funding Sources

For the WWTF upgrade project, there are two (2) major funding sources available, State of Vermont CWSRF Revolving Loan and USDA/Rural Development. Both of these funding sources are described in the following narratives. Other funding sources are being explored, such as, the Northern Borders Regional Commission, and will be updated as more information becomes available.

9.7.1. State of Vermont Department of Environmental Conservation (VT DEC)

The State offers loan funding for planning, design, and construction through the Clean Water State Revolving Fund (CWSRF). Loan subsidy up to 50% is offered for the preliminary (Step I) and final design (Step II) engineering services, capped at $100,000 per project for each fiscal year. The CWSRF program offers an interest free loan with a 2% administrative fee for 100% of the eligible costs. Local funds or a separate loan can be used to cover the non-eligible costs. This project is currently on the 2020 Pollution Control Priority and Planning List as a Priority List application was submitted in January 2019. Submittal of Priority List applications is required annually until construction is complete.

Since the Qualifications Based Selection process was followed for this project, engineering and other related project costs shown in the total project cost are eligible for the 50% loan subsidy up to a maximum of $100,000 annually. These costs are summarized below in Table 9.7. Loan subsidy is only credited after loan closes for repayment.

Table 9.7 CWSRF Loan Subsidy Eligible Costs

Item Description	Estimated Costs	Costs Eligible for Loan Subsidy	50% Loan Subsdy
Steps I – Preliminary Engineering			
Preliminary Engineering	$57,000	$57,000	$28,500
Geotechnical Investigation/Assessment	$18,000	$18,000	$9,000
Pre-Design Allowance	$50,000	$50,000	$25,000
Step I Subtotal	$125,000	$125,000	$62,500
Step II – Final Design and Permitting			
Final Design Allowance	$480,000	$480,000	$240,000
Special Services Allowance	$50,000	$50,000	$25,000
Step II Subtotal	$530,000	$530,000	$265,000
Total **Use**			$327,500 **$300,000**

The State has recently revised their grant programs, so this project qualifies for eligibility for the PC grant as of July 1, 2019.

- Criterion 2 Public Health: The scope of this project does not qualify it for any points under this criteria.
- Criterion 3 Water Quality: As this project is required to comply with more stringent water quality standards with the new permit limits, it qualifies for the maximum 20 points under this criteria.
- Criterion 4 Refurbishment: This project addresses age related issues so it qualifies for the maximum 5 points under this criterion.
- Criterion 5 Environmental Resiliency & Sustainability: This project is determined to qualify for the max 5 points under this criterion.
- Criterion 6 Designated Center & Regional Benefits: Hinesburg has received designation Village Center Designation from the VT Downtown Board on 6/24/19, so points are received under this criteria.

A summary of the eligible priority points for the PC grant is provided below in Table 9.8 following the criteria in Section 440 (a) Grants. The total PC grant percentage is estimated at 16 to 17% for this project.

Table 9.8 State PC Grant Percentage Calculations

Criterion		Points Awarded	Total Points	%
(1) (A)	Criterion 7 - Affordability	20	10(1)	10
(1) (B)	Criterion 2 – Public Health	0		
	Criterion 3 – Water Quality	20		
	Criterion 4 - Refurbishment	5		
	Criterion 5 – Environmental Resiliency	4 - 5		
	Criterion 6 – Designated Centers	2	32(2)	6
			Total Grant %	16 - 17

Notes:

1. Under (1)(A) points awarded under Criterion 7 are total minus 10.
2. Under (1)(B) points awarded under Criterion 2, 3, 4, 5, 6 are the total minus 25.

9.7.2. USDA Rural Development (RD)

The USDA RD program includes both grants and loans, depending on the project and the community's ability to pay. Based on preliminary inquiries, the Town of Hinesburg Median Household Income (MHI) in combination with existing user costs could likely makes the Village eligible for a grant up to 45% and loan package with a market based interest rate which varies. Historically, typical grant percentages range from 25 to 40%. The 2010 Census American Community Survey information for Hinesburg is summarized below:

- MHI: $51,339
- Population: 658
- USDA RD Water and Environmental Programs (WEP) Grant Eligibility: Up to 45%

A positive bond vote for the recommended project, preliminary engineering report, and environmental report are required for submission of an application for USDA RD funding. Funding offers from USDA RD typically are received an average of 6 months from application submission.

An income survey will need to be done for the sewer service area and is being coordinated with RCAP to determine if USDA is eligible for grant funding.

9.7.3. Funding Sources

A summary of the potential funding sources for this project is provided below in Table 9.9, and the assumptions are as follows:

- CWSRF Loan Subsidy: This project is eligible for up to a maximum of $100,000 for each project per year for a total of $300,00.
- State PC Grant: The initial calculations show that this project is eligible for up to a 16 to 17% grant on the total project cost.
- USDA Grant: This project could be eligible for up to a 45% grant, however, after accounting for the State PC grant and estimating the grant received based on offers for similar projects, a 25% grant is assumed. Eligibility for a USDA grant needs to be confirmed through an income survey of the sewer service area.
- USDA Loan: The balance of the project cost is assumed to be USDA loan.

Two different funding scenarios are presented in Table 9.9, one shows a joint funded project between the State and USDA, and the other option shows only State funding.

Table 8.9 Funding Summary

Funding Source	Joint Funded	State Only
State of Vermont		
CWSRF Loan Subsidy	$300,000	$300,000
PC (Pollution Control Grant)	$1,755,000	$1,755,000
CWSRF Revolving Loan	$0	$9,645,000
USDA		
Grant (25%)	$2,925,000	$0
Loan	$6,720,000	$0
Northern Borders Grant	tbd	tbd
Total	**$11,700,000**	**$11,700,000**

9.8. Recommended Bond Amount

The recommended bond amount is the total project cost of $11,700,000 irregardless of the funding package. Even though loan subsidy will be received for the CWSRF funding, this loan amount must still be included in the bond vote amount.

9.9. Impact on Sewer Rates [to be completed]

This section will be completed as more work is being done to explore funding sources and define other sources for revenue. At a loan amount of $6,720,000, the annual loan payment will be about $365,000 based on a USDA loan at a 30 year term, 3 1/4% interest rate. A typical residential customer currently pays about $650 per year for sewer, and will see a projected increase of about $__ per year in the base rate.

9.10. Next Steps

A presentation to the Hinesburg Selectboard is planned on August 15, 2019. Once the proposed project is accepted, then the following next steps can proceed:

- August – September: Coordinate the income survey of the sewer service with RCAP to confirm if Hinesburg qualifies for a USDA grant.
- October: Hire a public relations firm to assist with the March 2020 bond vote preparation.

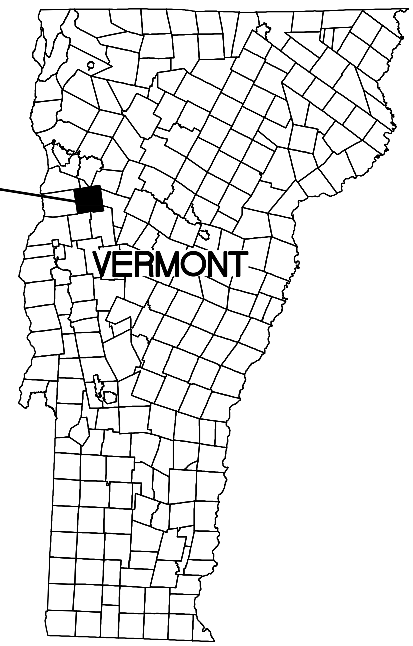
- November: Begin the engineering, geotechnical, and field work for the Phase I – wick drain project.
- December: If it is determined that the Town qualifies for a USDA grant, submit an RD Apply application

APPENDICES

APPENDIX A

FIGURES

PROJECT AREAS



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PLAN

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GRAPHIC SCALE

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(IN FEET)

Aldrich + Elliott
WATER RESOURCE ENGINEERS

6 Market Place, Suite 2
Essex Jct., VT 05452

P: 802.879.7733
AEengineers.com

LOCATION PLAN

WASTEWATER TREATMENT FACILITY UPGRADE/EXPANSION
PRELIMINARY ENGINEERING REPORT

TOWN OF HINESBURG

HINESBURG VERMONT

DESIGNED	
DRAWN	JEB
CHECKED (PM)	WAE
CHECKED (PE)	WAE
SCALE	AS NOTED
DATE	JULY, 2019
PROJECT NO.	18049
FIGURE NO.	1

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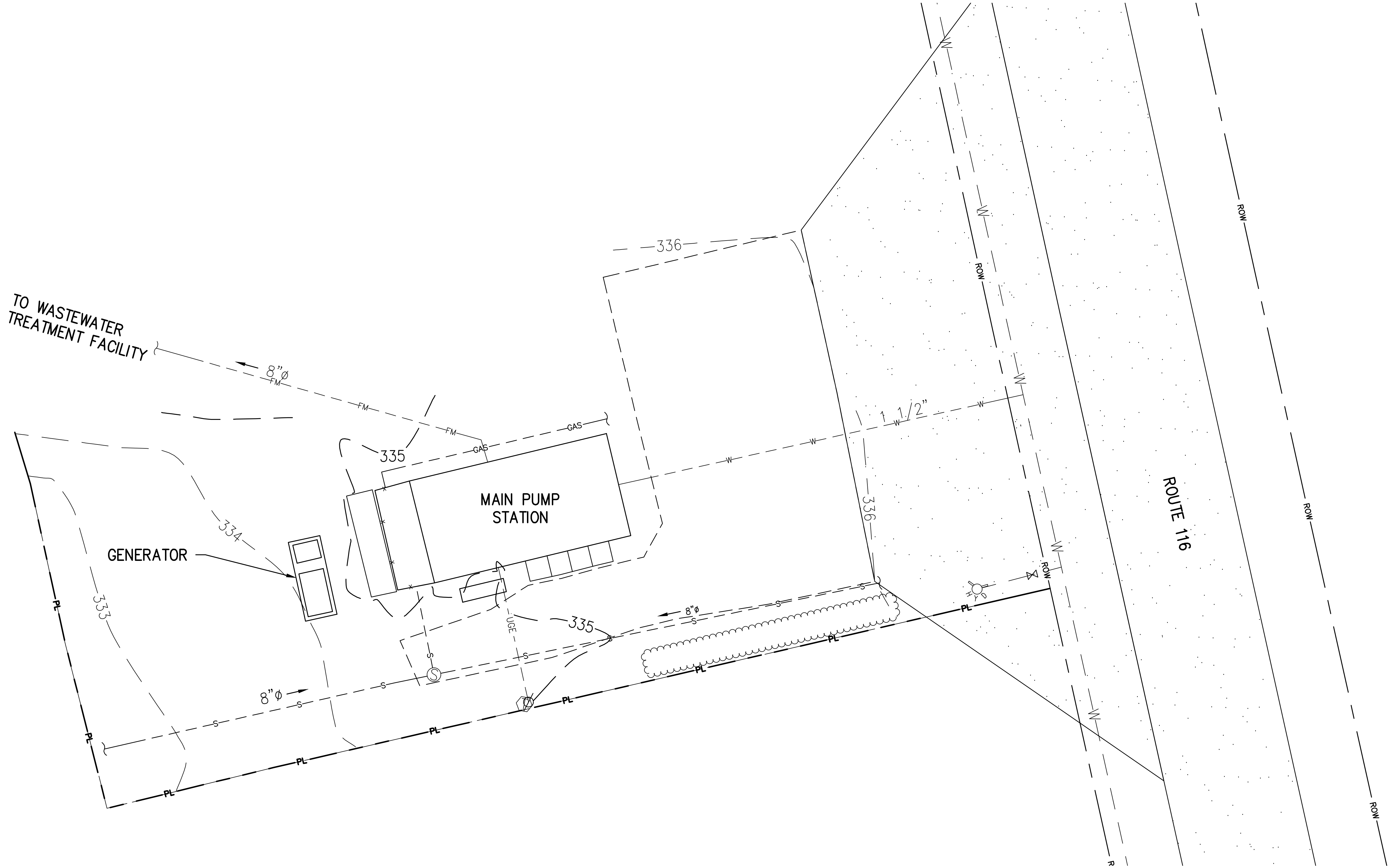

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Aldrich + Elliott WATER RESOURCE ENGINEERS 6 Market Place, Suite 2 Essex Jct., VT 05452 P: 802.879.7733 AEengineers.com	MAIN PUMP STATION EXISTING SITE PLAN	DESIGNED DRAWN JEB CHECKED (PM) WAE	PROJECT NO. 18049
	WWTF UPGRADE/EXPANSION STUDY PRELIMINARY ENGINEERING REPORT	CHECKED (PE) WAE SCALE AS NOTED	FIGURE NO. 2
	TOWN OF HINESBURG HINESBURG VERMONT	DATE JULY, 2019	

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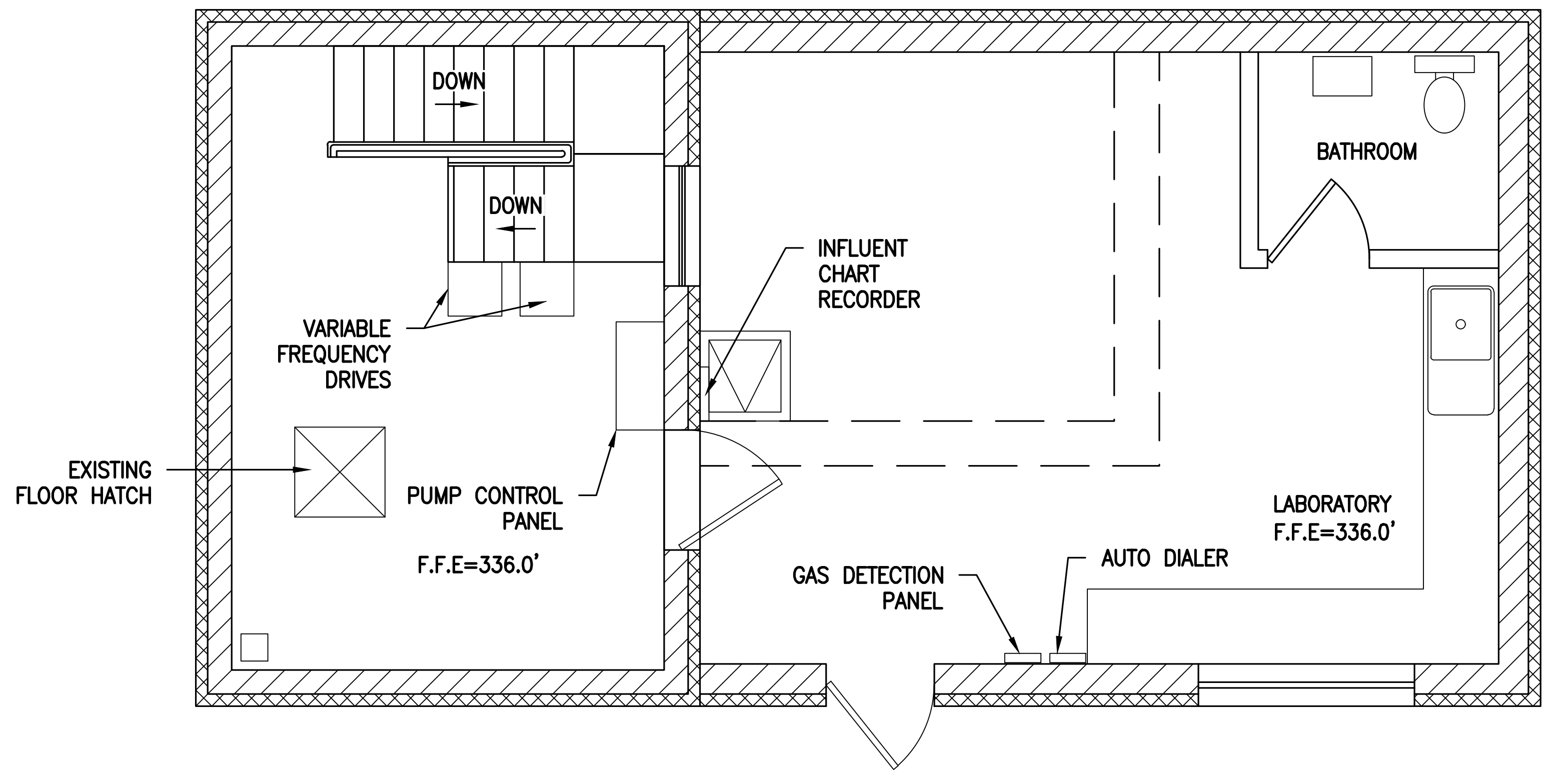

FIRST FLOOR PLAN
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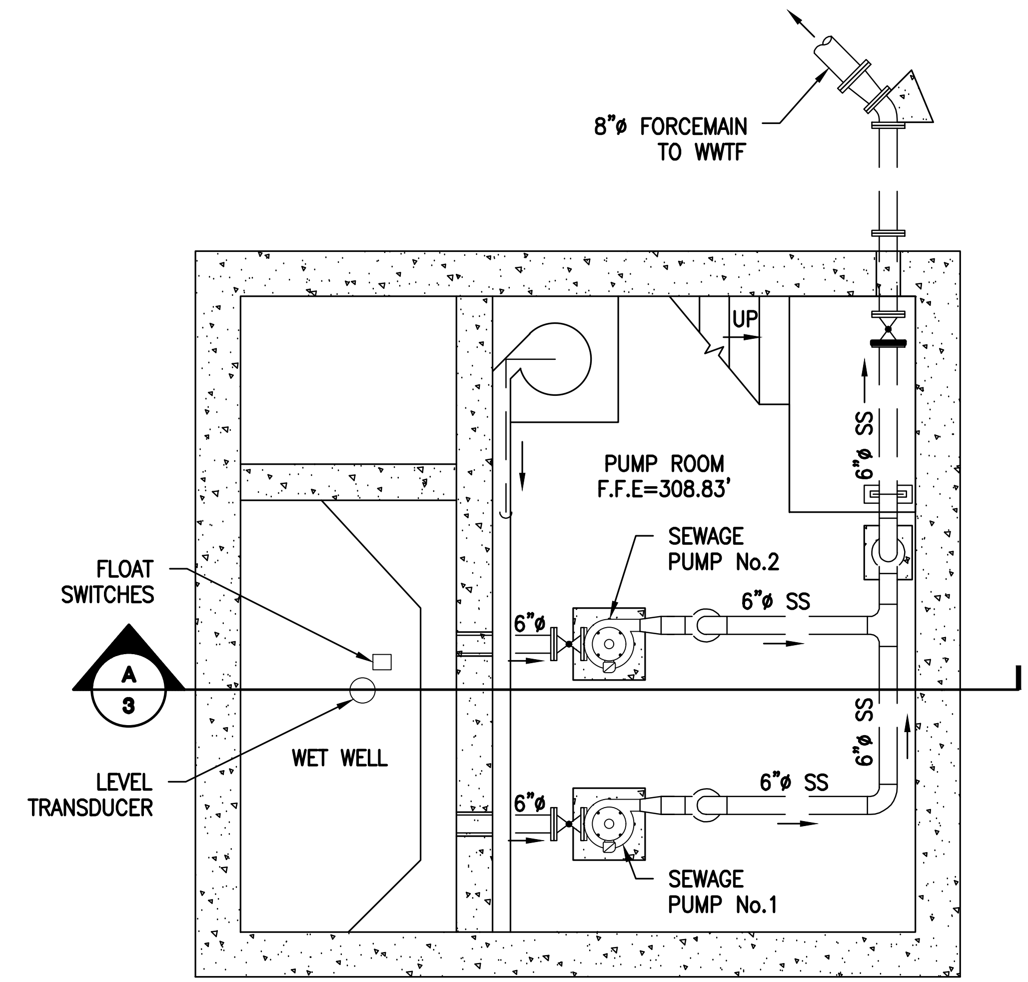

LOWER LEVEL PLAN
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MAIN PUMP STATION
EXISTING
PLANS

WWTF UPGRADE/EXPANSION STUDY
PRELIMINARY ENGINEERING REPORT

TOWN OF HINESBURG

HINESBURG VERMONT

DESIGNED	
DRAWN	JEB
CHECKED (PM)	WAE
CHECKED (PE)	WAE
SCALE	AS NOTED
DATE	JULY, 2019
PROJECT NO.	18049
FIGURE NO.	3

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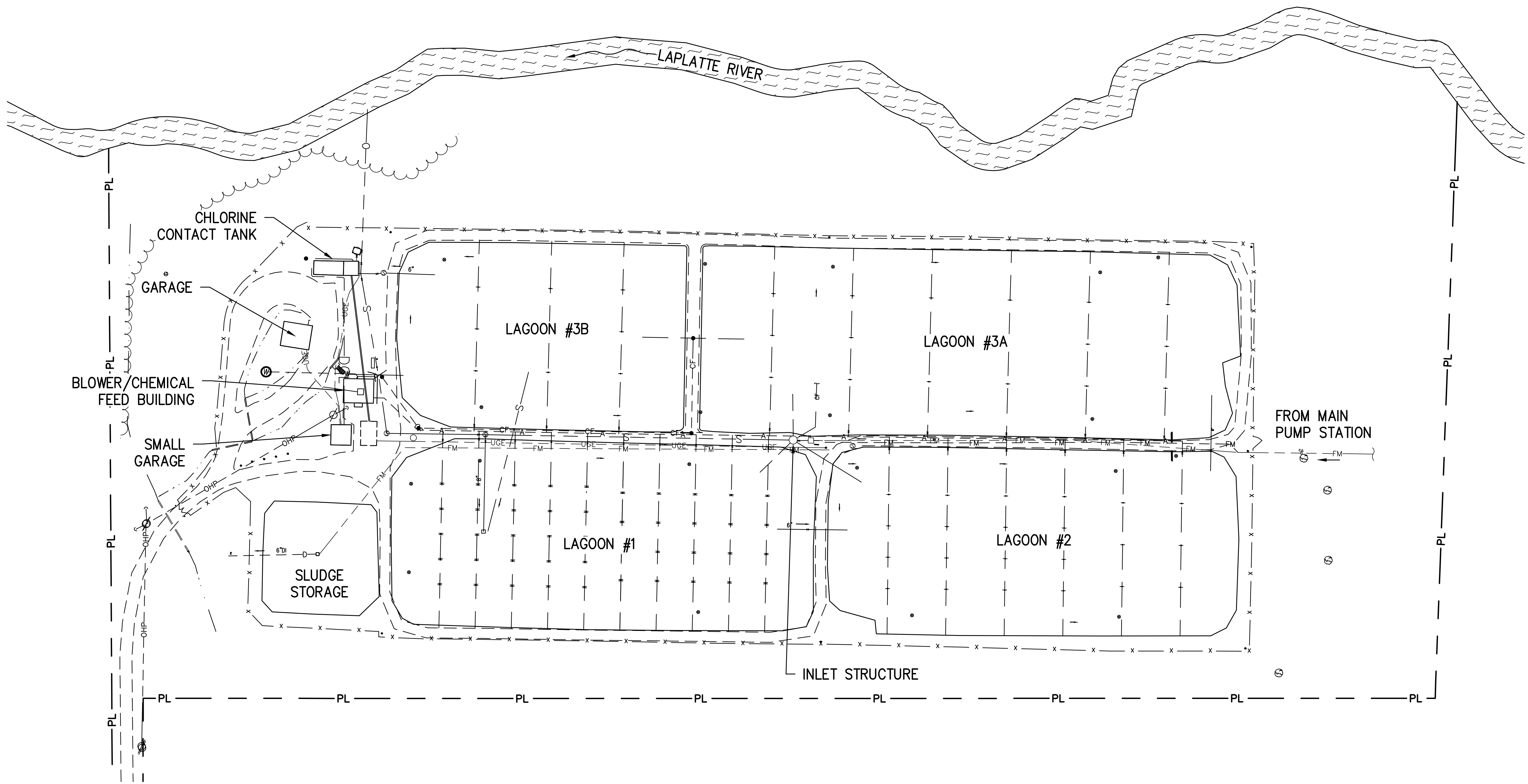

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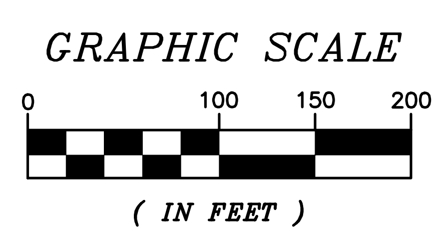

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WWTF EXISTING SITE PLAN	DESIGNED	PROJECT NO.	18049
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	CHECKED (PM) WAE		
WWTF UPGRADE/EXPANSION STUDY PRELIMINARY ENGINEERING REPORT	CHECKED (PE) WAE	FIGURE NO.	4
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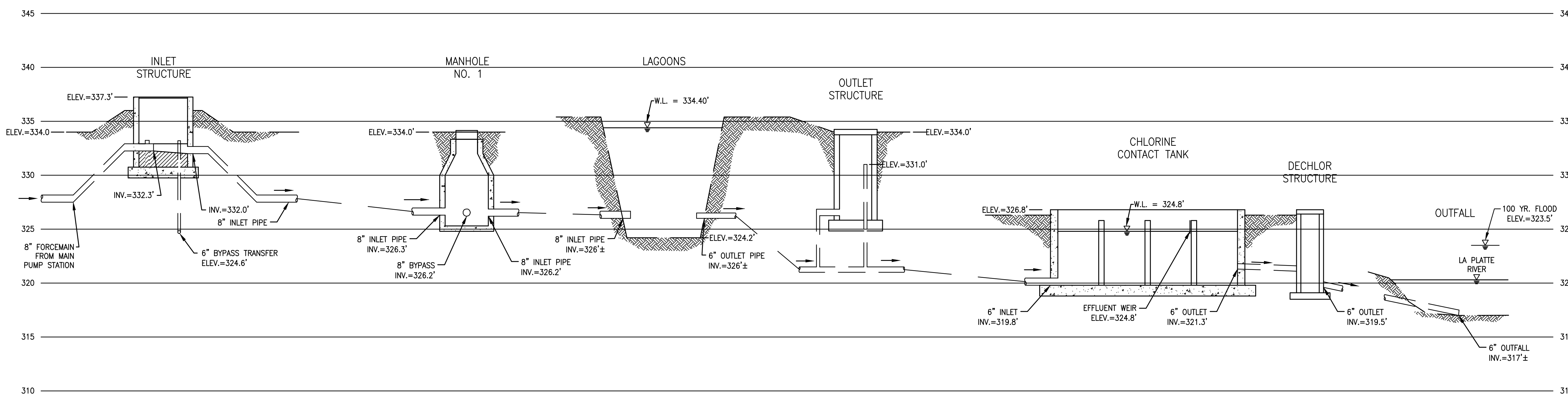
HINESBURG VERMONT	DATE JULY, 2019		



HYDRAULIC PROFILE

SCALE: VERT. NONE
HORZ. NONE

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WWTF
EXISTING
HYDRAULIC PROFILE

WWTF UPGRADE/EXPANSION STUDY
PRELIMINARY ENGINEERING REPORT

TOWN OF HINESBURG

HINESBURG VERMONT

DESIGNED	
DRAWN	JEB
CHECKED (PM)	WAE
CHECKED (PE)	WAE
SCALE	AS NOTED
DATE	JULY, 2019
PROJECT NO.	18049
FIGURE NO.	5

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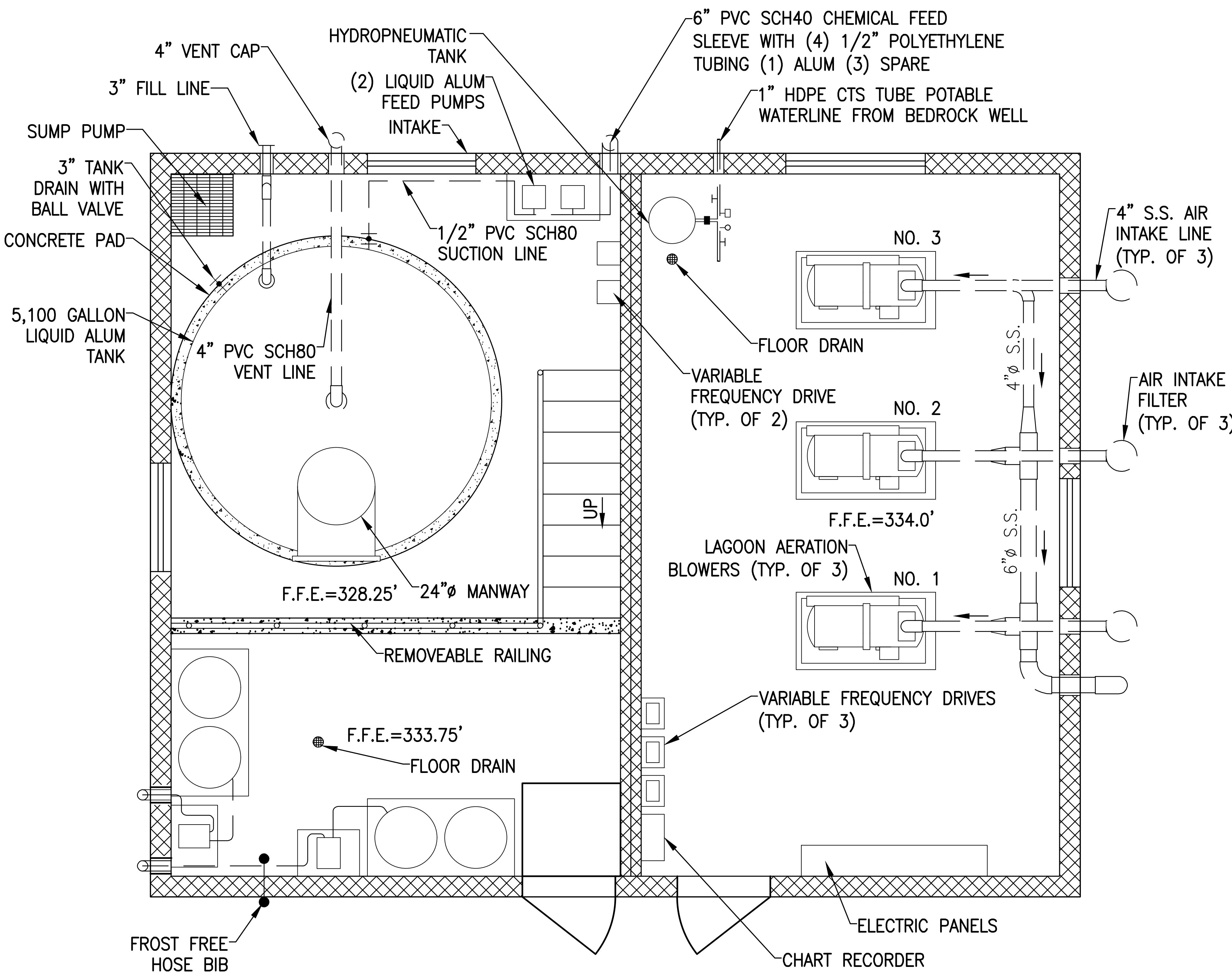

BLOWER/CHEMICAL FEED EXISTING PLAN

SCALE: 1/4"=1'-0"

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Essex Jct., VT 05452

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EXISTING BLOWER/CHEMICAL FEED BUILDING PLAN	DESIGNED		PROJECT NO.
	DRAWN JEB		18049
WWTF UPGRADE/EXPANSION STUDY PRELIMINARY ENGINEERING REPORT	CHECKED (PM) WAE		FIGURE NO.
TOWN OF HINESBURG	CHECKED (PE) WAE		6
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	DATE JULY, 2019		

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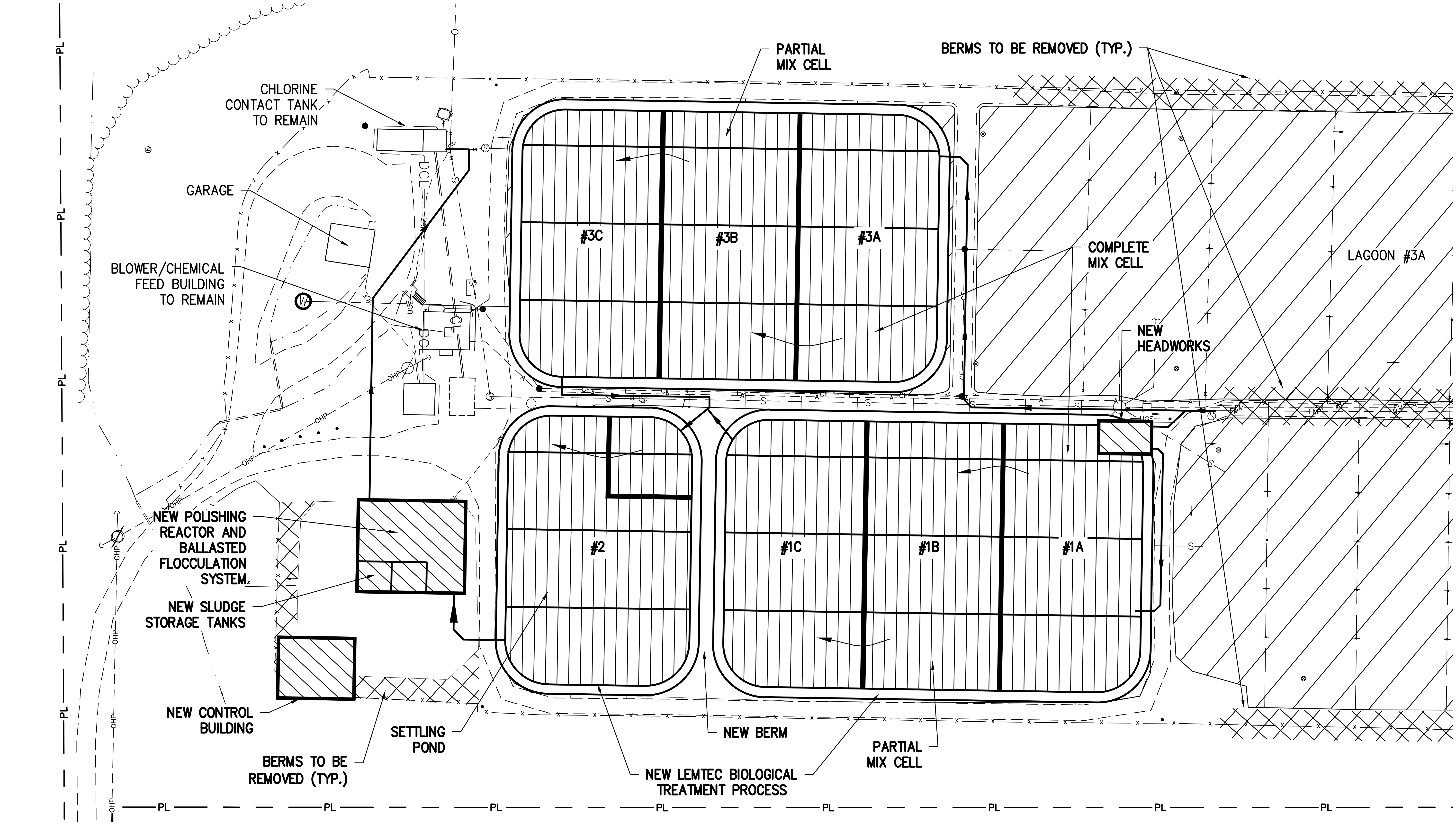

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(IN FEET)

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P: 802.879.7733
AEengineers.com

ALTERNATIVE NO.1 LAGOON UPGRADE WITH LEMNA PLUS BALLASTED FLOC	DESIGNED DRAWN JEB CHECKED (PM) WAE	PROJECT NO. 18049
WWTF UPGRADE/EXPANSION STUDY PRELIMINARY ENGINEERING REPORT	CHECKED (PE) WAE SCALE AS NOTED	FIGURE NO. 7
TOWN OF HINESBURG HINESBURG VERMONT	DATE JULY, 2019	

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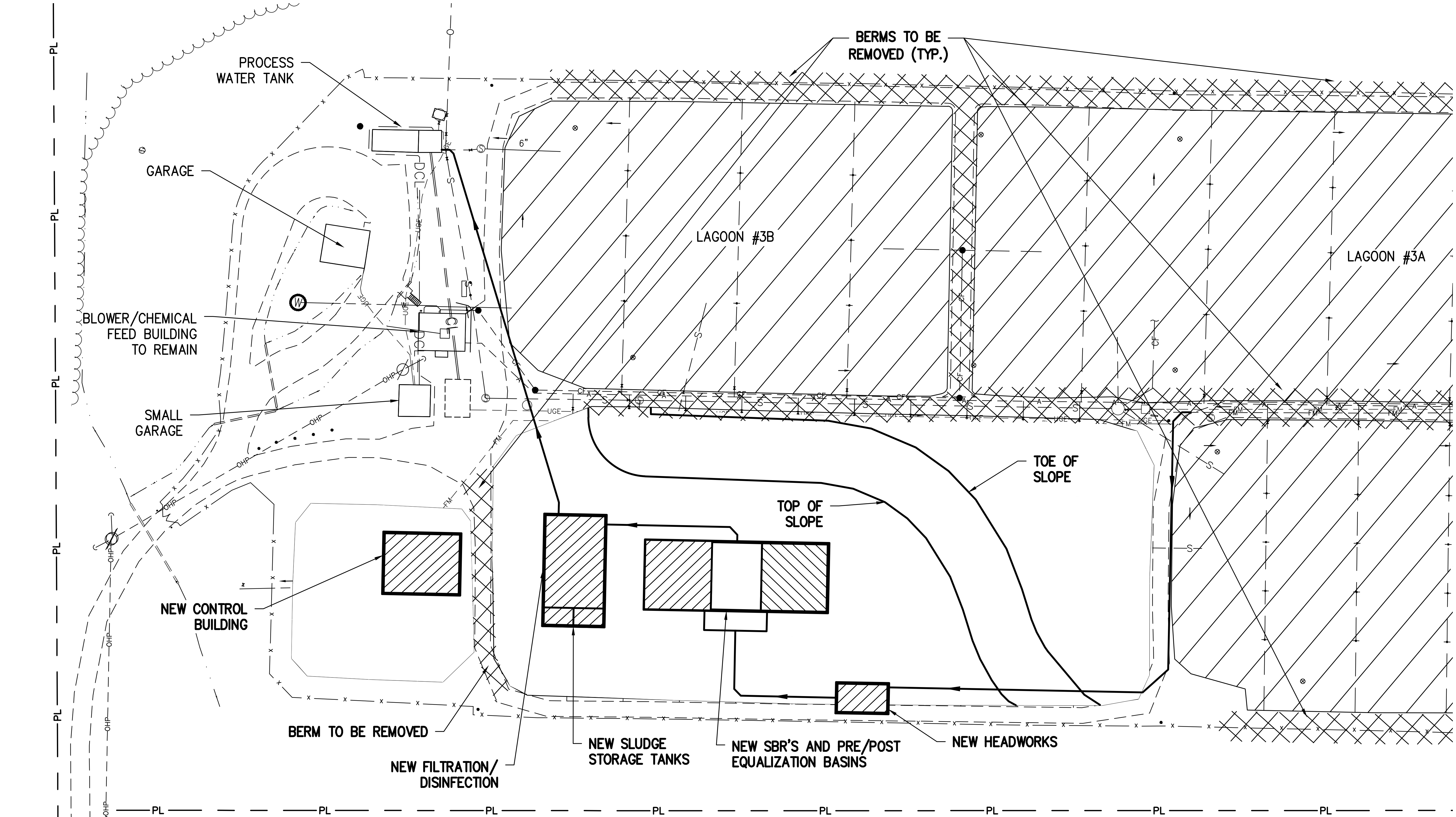


PLAN
SCALE: 1"=60'

GRAPHIC SCALE
0 60 90 120
(IN FEET)

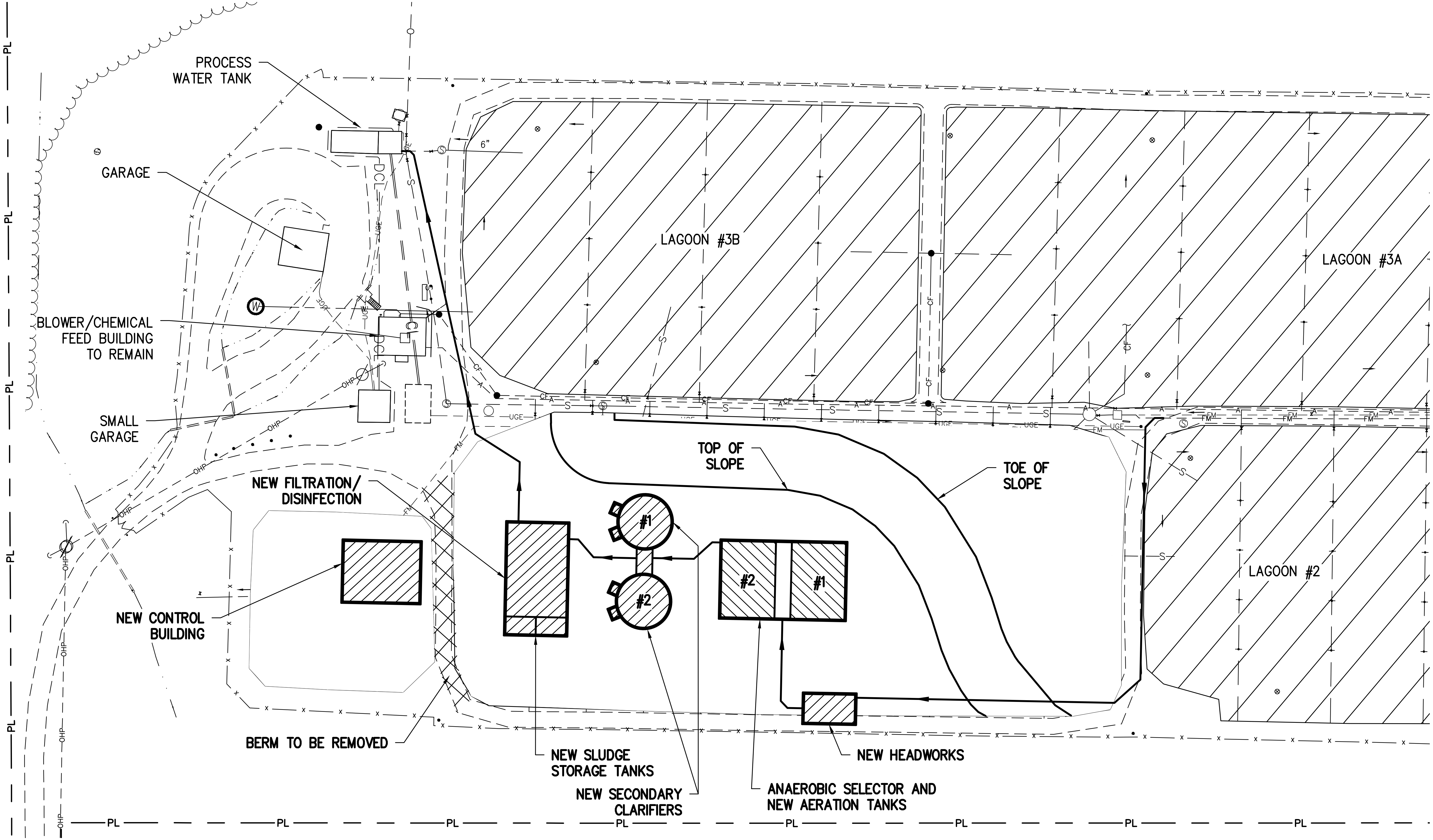
Aldrich + Elliott
WATER RESOURCE ENGINEERS
6 Market Place, Suite 2
Essex Jct., VT 05452
P: 802.879.7733
AEengineers.com

ALTERNATIVE NO.2
SEQUENTIAL BATCH REACTOR WITH FILTRATION

WWTF UPGRADE/EXPANSION STUDY
PRELIMINARY ENGINEERING REPORT

TOWN OF HINESBURG
HINESBURG VERMONT

DESIGNED	
DRAWN	JEB
CHECKED (PM)	WAE
CHECKED (PE)	WAE
SCALE	AS NOTED
DATE	JULY, 2019
PROJECT NO.	18049
FIGURE NO.	8



PLAN
SCALE: 1"=60'

GRAPHIC SCALE
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(IN FEET)

Aldrich + Elliott
WATER RESOURCE ENGINEERS
6 Market Place, Suite 2
Essex Jct., VT 05452
P: 802.879.7733
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ALTERNATIVE NO.3
A/O WITH
FILTRATION

WWTF UPGRADE/EXPANSION STUDY
PRELIMINARY ENGINEERING REPORT

TOWN OF HINESBURG
HINESBURG VERMONT

DESIGNED	PROJECT NO.
DRAWN JEB	18049
CHECKED (PM) WAE	
CHECKED (PE) WAE	FIGURE NO.
SCALE AS NOTED	9
DATE JULY, 2019	

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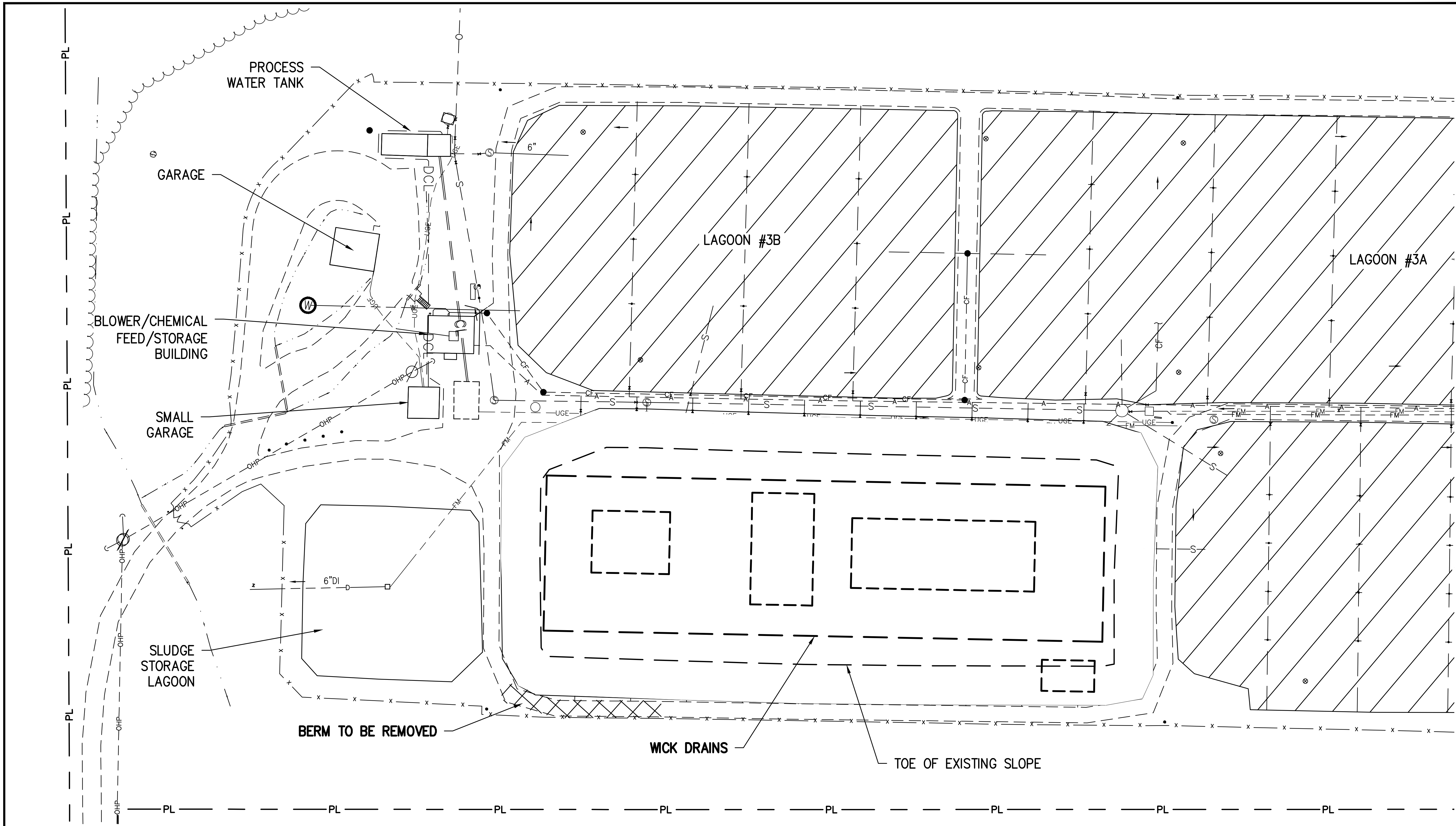

PLAN
SCALE: 1"=60'

GRAPHIC SCALE
0 60 90 120
(IN FEET)

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WATER RESOURCE ENGINEERS
6 Market Place, Suite 2
Essex Jct., VT 05452
P: 802.879.7733
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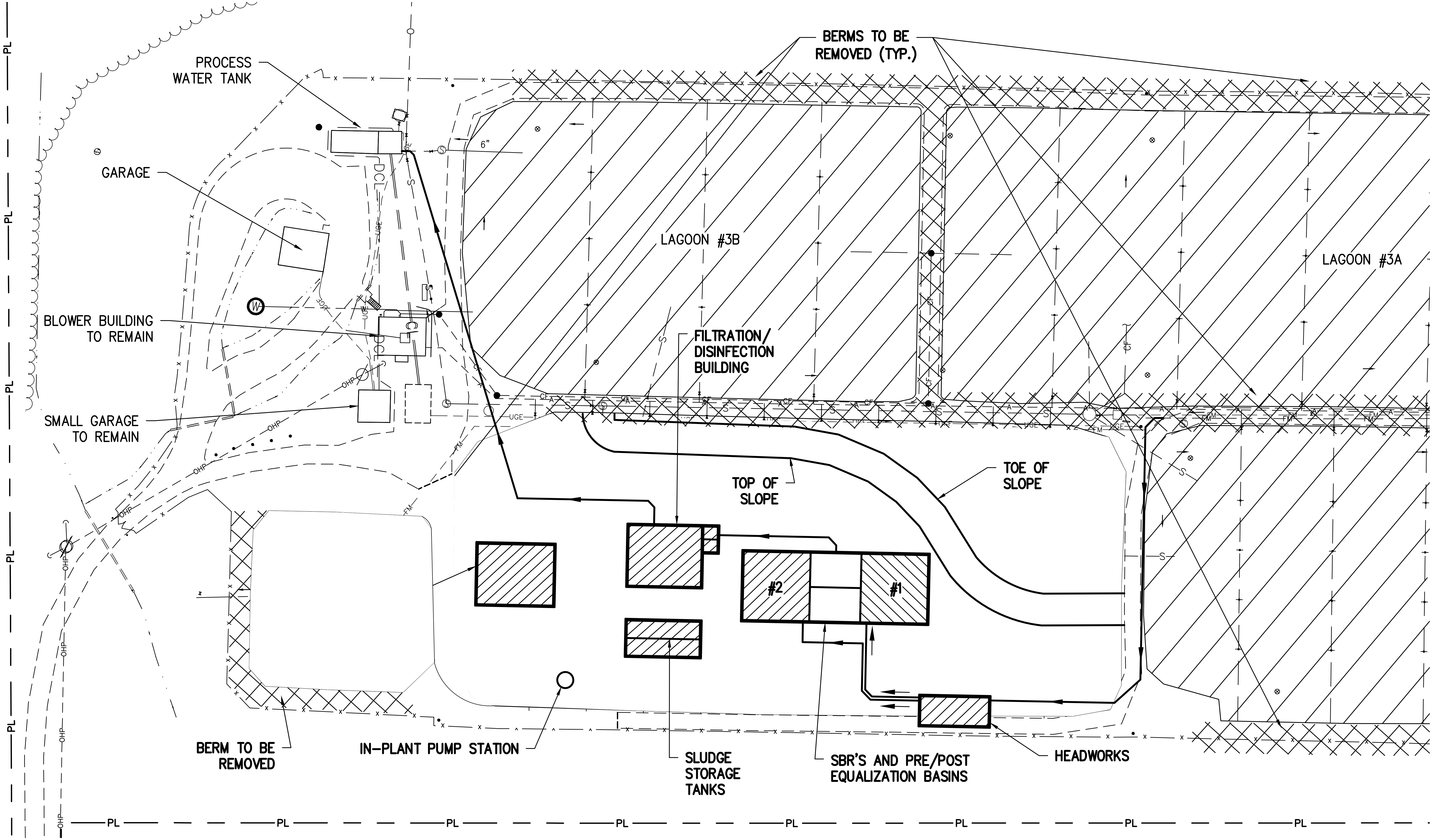
PROPOSED PROJECT SITE PLAN–PHASE I	
WWTF UPGRADE/EXPANSION STUDY PRELIMINARY ENGINEERING REPORT	
TOWN OF HINESBURG	
HINESBURG	VERMONT

DESIGNED	
DRAWN	JEB
CHECKED (PM)	WAE
CHECKED (PE)	WAE
SCALE	AS NOTED
DATE	JULY, 2019
PROJECT NO.	18049
FIGURE NO.	10



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WATER RESOURCE ENGINEERS

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Essex Jct., VT 05452

P: 802.879.7733
AEengineers.com

PROPOSED PROJECT
SITE PLAN–PHASE II

WWTF UPGRADE/EXPANSION STUDY
PRELIMINARY ENGINEERING REPORT

TOWN OF HINESBURG

HINESBURG VERMONT

DESIGNED	
DRAWN	JEB
CHECKED (PM)	WAE
CHECKED (PE)	WAE
SCALE	AS NOTED
DATE	JULY, 2019
PROJECT NO.	18049
FIGURE NO.	11

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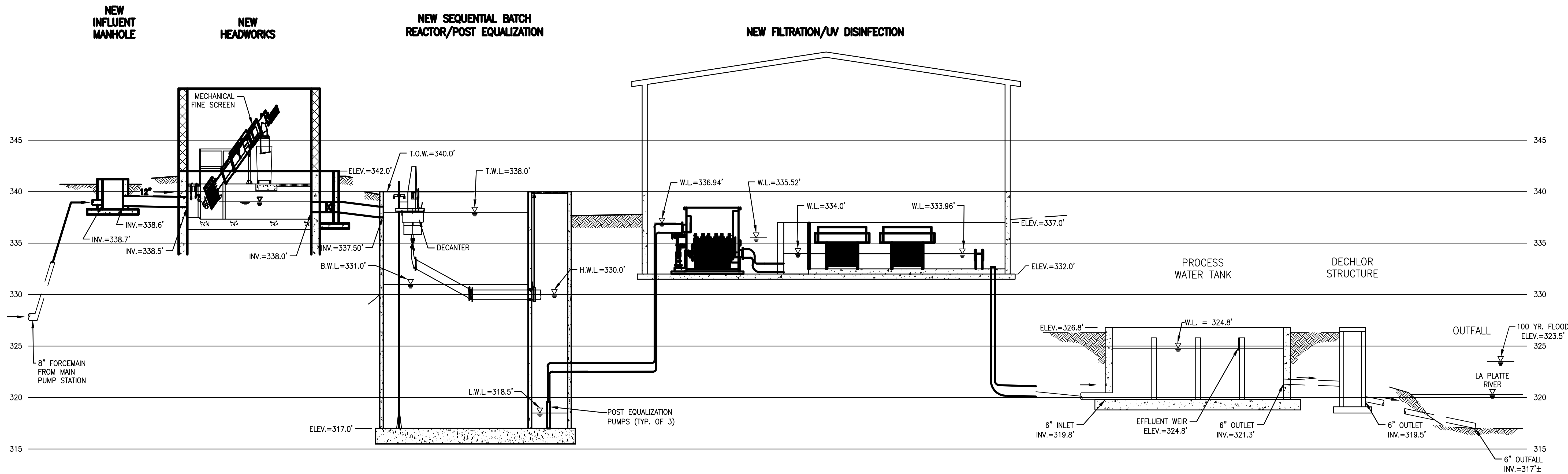

HYDRAULIC PROFILE

SCALE: VERT. NONE
HORZ. NONE

Aldrich + Elliott
WATER RESOURCE ENGINEERS
6 Market Place, Suite 2
Essex Jct., VT 05452
P: 802.879.7733
AEengineers.com

WWTF
PROPOSED
HYDRAULIC PROFILE

WWTF UPGRADE/EXPANSION STUDY
PRELIMINARY ENGINEERING REPORT

TOWN OF HINESBURG

HINESBURG VERMONT

DESIGNED		PROJECT NO.	18049
DRAWN	JEB		
CHECKED (PM)	WAE		
CHECKED (PE)	WAE	FIGURE NO.	12
SCALE	AS NOTED		
DATE	JULY, 2019		

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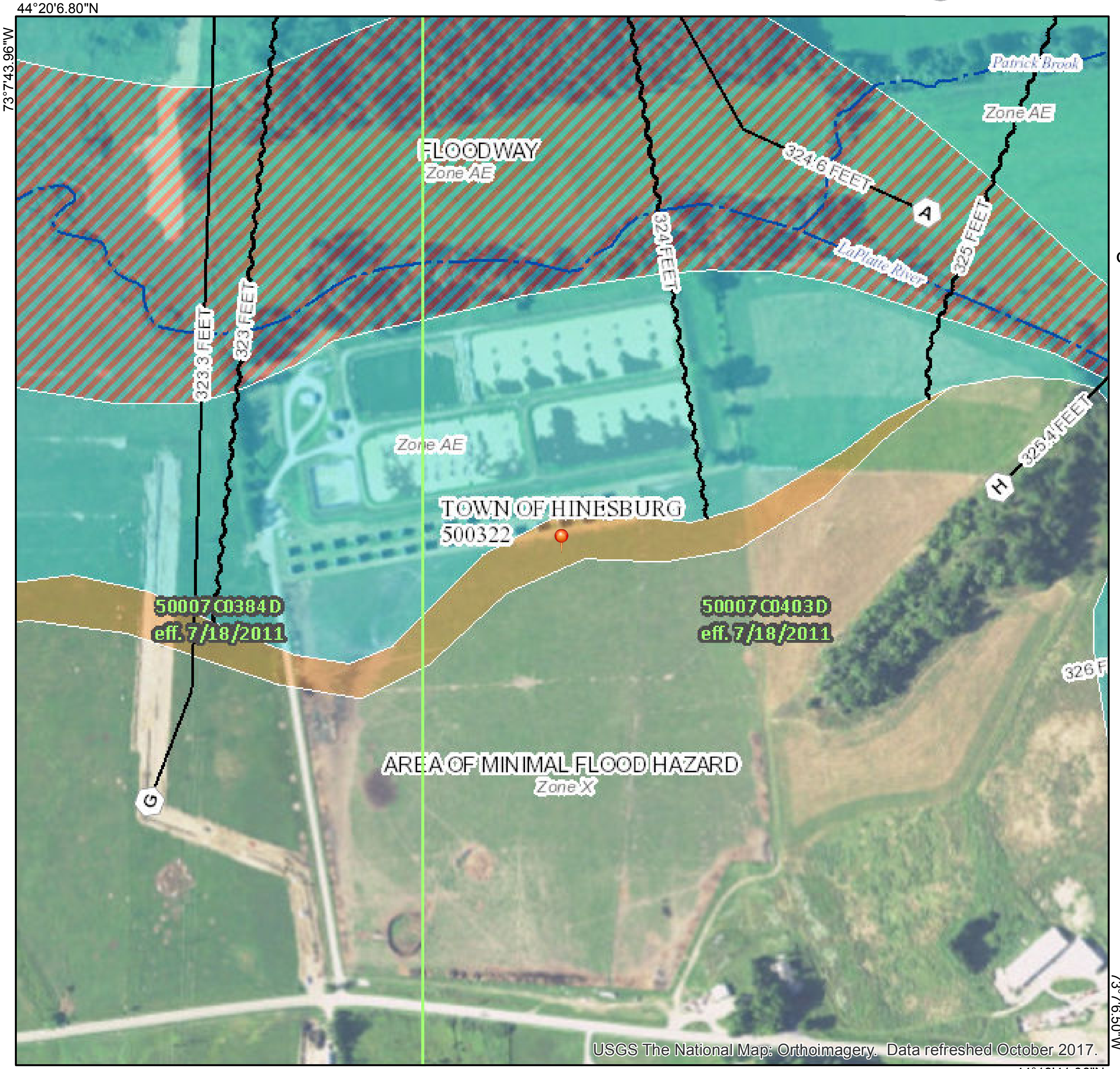
APPENDIX B

FLOOD MAP

National Flood Hazard Layer FIRMette

FEMA



1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) *Zone A, V, A99*
	With BFE or Depth *Zone AE, AO, AH, VE, AR*
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
	Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN Area of Minimal Flood Hazard *Zone X*
	Effective LOMRs
	Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
	8 Coastal Transect
	513 Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
MAP PANELS	Digital Data Available
	No Digital Data Available
	Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 10/19/2018 at 3:40:24 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX C

WASTEWATER BUDGET

Town of Hinesburg

10632 Route 116 Hinesburg, Vermont 05461

(802)482-2281

hinesburg.org

Wastewater Rates, Connection Fees, and Special Charges

Wastewater Rates:

1. **Metered Properties**
   $98.93per unit per quarter base fee
   $0.044 per cubic foot water usage (1 cubic foot =7.48 gallons)
2. **Unmetered Properties**
   $98.93 per quarter base charge
   $64.07 per unit per quarter unmetered usage charge

Connection Fee:	$1,000 per unit
Application Fee:	$2.80 per GPD
Allocation Fee:	$25.40 per GPD
Allocation Holding Fee:	$0.30 per GPD per quarter

Special Charges:

- **Disconnect Fee** $75.00
- **Reconnection Fee** $75.00
- **Deactivation Fee** $75.00
- **Activation Fee** $75.00
- **Meter Test Deposit** $75.00
- **Collection Fee** $25.00/trip

Disconnection and Reconnection Fees:

Charges for disconnection/reconnection resulting from delinquent accounts will be

According to Vermont State Statute Title 24 VSA § 5151.

Active Rates for Water & Sewer 10/22/2018

BOOK		SEWER FLAT	UNITS	Sewer Metered	Units		Water Flat	Units	Water Metered	Units
1		16	19	59	138.37		13	13	33	251
2				89	89				89	89
3				131	180.1				130	170
4				20	22.39				52	55
5									63	64
7				54	81				54	81
8				55	57				55	57
9				40	42				59	62
Totals		19	19	448	609.9		13	13	535	829

SEWER	**467**	**629**
WATER	**548**	**842**

Town of Hinesburg, VT
APPROVED FY19 Water-Wastewater Budget (06/07/2018 SB mtg)
Enterprise Fund - Expenditures

Town of Hinesburg, VT - Proposed FY18 Water-Wastewater (Enterprise Funds) Budget (v.02)

		Item	FY17 Budget	FY17 Actual	FY18 Budget	FY19 Budget	Change (FY18 to FY19)
	Expenditures						
1	**Water**						
2	330 - 5000 -	Operating Supplies	12,500	29,782	18,000	18,000	0
3	330 - 5000 -	Repair & Maint. Supplies	10,000	21,420	20,000	27,000	7,000
4	330 - 5000 -	Small Tools & Equipment	2,000	3,126	3,000	2,400	(600)
5	330 - 5000 -	Ads & Notices	0	0	0	0	0
6	330 - 5000 -	Professional Development	2,000	742	1,500	1,500	0
7	330 - 5000 -	PACIF	3,200	4,610	6,500	5,700	(800)
8	330 - 5000 -	Worker's Compensation	3,900	3,782	4,900	9,000	4,100
9	330 - 5000 -	Testing	3,500	5,380	5,000	5,000	0
10	330 - 5000 -	Repair & Maint. Labor	30,000	47,680	45,000	60,000	15,000
11	330 5000 -	Water Permit Fees	2,200	2,408	2,200	3,500	1,300
12	330 - 5000 -	Utilities	50,000	67,771	60,000	47,000	(13,000)
13	330 - 5000 -	Miscellaneous	0		0		0
14	330 - 5000 -	Principal - '96 Bond	70,000	0	70,000	70,000	0
15	330 - 5000 -	Interest - '96 Bond	45,484	38,675	39,000	27,000	(12,000)
16	330 - 5000 -	Principal WTF'18 Bond	0	0	0	67,674	67,674
17	330 - 5000 -	Interest WTF18 Bond	0	0	0	11,828	11,828
18	330 - 5000 -	Depreciation	0	162,317	0	0	0
19	330 - 5000 -	Capital Transfer	27,000	0	27,000	20,000	(7,000)
20		**TOTAL**	261,784	387,693	302,100	375,602	73,502
19	**Shared Water-Wastewater Expenses**						
20	330 - 5331 -	Salary	179,840	201,138	170,274	175,382	5,108
21	330 - 5331 -	Accounting Assistant	2,500	1,814	2,500	2,500	0
22	330 - 5331 -	FICA	13,760	15,388	13,217	15,173	1,956
23	330 - 5331 -	Health Insurancce	19,000	23,456	18,000	22,000	4,000
24	330 - 5331 -	Dental Insurance	3,210	2,987	2,500	2,234	(266)
25	330 - 5331 -	Vision	300	0	312	360	48
26	330 - 5331 -	Retirement	7,950	11,554	8,000	10,374	2,374
27	330 - 5331 -	Health Insurance Opt-Out	10,000	11,125	10,000	10,000	0
28	330 - 5331 -	Office Supplies	500	1,671	800	800	0
29	330 - 5331 -	Vehicle Repair & Maint.	2,500	3,359	1,700	1,700	0

Employee Benefits Aggregated on Lines 291-302

Town of Hinesburg, VT
APPROVED FY19 Water-Wastewater Budget (06/07/2018 SB mtg)
Enterprise Fund - Expenditures

					Item	FY17 Budget	FY17 Actual	FY18 Budget	FY19 Budget	Change (FY18 to FY19)
30	330	-	5331	-	Postage	1,000	21	100	1,150	1,050
31	330	-	5331	-	Vehicle Insurance	3,200	0	0		0
32	330	-	5331	-	Trash Removal	1,100	1,126	900	900	0
33	330	-	5331	-	Uniforms	1,800	425	1,800	1,050	(750)
34	330	-	5331	-	Telephone	3,200	4,340	4,000	3,850	(150)
35	330	-	5331	-	Vehicle Fuel	3,500	4,810	4,300	4,300	0
36	330	-	5331	-	Capital Transfers	15,000	14,572	15,000	21,322	6,322
37					**TOTAL**	268,360	297,786	253,403	273,095	19,691
38	**Wastewater**									
39	330	-	5480	-	Operating Supplies	5,500	13,215	5,500	13,500	8,000
40	330	-	5480	-	Repair & Maint. Supplies	5,000	5,704	4,000	3,000	(1,000)
41	330	-	5480	-	Small Tools & Equipment	2,500	2,418	2,500	2,000	(500)
42	330	-	5480	-	Advertising	200	0	200	0	(200)
43	330	-	5480	-	Developmment	2,000	48	1,500	1,000	(500)
44	330	-	5480	-	PACIF	5,000	6,658	6,500	7,056	556
45	330	-	5480	-	Worker's Compensation	6,500	4,280	4,900	9,000	4,100
46	330	-	5480	-	Testing	4,000	3,213	4,000	4,000	0
47	330	-	5480	-	Repair & Maint. Labor	7,000	934	4,000	5,000	1,000
48	330	-	5480	-	Permits & Licenses	1,200	750	1,200	1,200	0
49	330	-	5480	-	Miscellaneous	0	0	0		0
50	330	-	5480	-	Utilities	30,000	25,272	30,000	29,000	(1,000)
51	330	-	5480	-	Phosphorous Removal	20,000	3,482	0		0
52	330	-	5480	-	2032 Bond	47,495	13,395	50,000	50,000	0
53	330	-	5480	-	Capital Transfer	20,000	432	20,000	20,000	0
54	330	-	5480	-	Sludge Removal	70,000	67,119	76,000	82,000	6,000
55					**TOTAL**	226,395	146,920	210,300	226,756	16,456
56					**TOTAL**	756,539	832,399	765,803	875,453	109,649

Employee Benefits Aggregated on Lines 291-302

Town of Hinesburg, VT - Proposed FY2018 Water-Wastewater Budget (Revenue)

	Accounting Line				Item	FY17 Budget	FY17 Actual	FY18 Budget	FY19 Proposed	Change (FY17 to FY18)
1	**Accounting Line**				**Item**	**FY17 Budget**	**FY17 Actual**	**FY18 Budget**	**FY19 Proposed**	**Change (FY17 to FY18)**
2	**Revenue**									
3	**Water**									
4	330	-	2502	-	Water Charges	346,706	365,877	374,442	481,352	106,910
5	330	-	2502	-	Water Allocation Fee	22,860	980	0	51,113	51,113
8	330	-	2502	-	Water Holding Fee	2,000	3,005	2,000	3,300	1,300
9	330	-	2502	-	Water Hook-up Fee	5,000	7,000	0	16,146	16,146
10	330	-	2502	-	Water Application Fee	2,520	0	0	5,600	5,600
11	330	-	2502	-	Water Invest Interest	13,760	106	500		(500)
12					**TOTAL**	392,846	376,968	376,942	557,511	180,569
	Wastewater									
13	330	-	2501	-	Wastewater Charges	325,077	365,877	331,579	367,340	35,761
14	330	-	2501	-	Wastewater Allocation Fee	22,860	26,164	0	34,048	34,048
15	330	-	2501		Wastewater Holding Fee	2,000	15,497	2,000	3,800	1,800
16	330	-	2501	-	Wastewater Hook-up Fee	5,000	3,000	0	10,764	10,764
17	330	-	2501	-	WW Application Fee	2,520	1,134	0	3,780	3,780
					TOTAL	357,457	411,672	333,579	419,732	86,153
18	**Miscellaneous/Shared Income**									
19	330	-	2942	-	Late Charges/Interest	7,000	10,060	7,000		(7,000)
20	330	-	2943	-	Miscellaneous	0	391	300	500	200
21					**TOTAL**	7,000	10,451	7,300	500	(6,800)
22					**Total Revenues**	757,303	799,091	717,821	977,743	259,922

APPENDIX D

DISCHARGE PERMIT

AGENCY OF NATURAL RESOURCES
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
ONE NATIONAL LIFE DRIVE, MAIN BUILDING, 2nd FLOOR
MONTPELIER, VT 05620-3522

Permit No.:	3-1172
PIN:	EJ95-0286
NPDES No.:	VT0101028

Name of Applicant: Town of Hinesburg
PO Box 133
Hinesburg, VT 05461

Expiration Date: December 31, 2022

DISCHARGE PERMIT

In compliance with the provisions of the Vermont Water Pollution Control Act as amended (10 V.S.A. Chapter 47), the Vermont Water Pollution Control Permit Regulations as amended (Environmental Protection Rules, Chapter 13), and the federal Clean Water Act as amended (33 U.S.C. § 1251 *et seq.*) and implementing federal regulations, the Town of Hinesburg, Vermont (hereinafter referred to as the "Permittee") is authorized by the Secretary of the Agency of Natural Resources (Secretary) to discharge from the Hinesburg Wastewater Treatment Facility (WWTF) to the LaPlatte River in accordance with the following conditions.

This permit shall become effective on March 1, 2018

Emily Boedecker, Commissioner
Department of Environmental Conservation

By: ______________________ Date: January 26, 2018

Jessica Bulova, Wastewater Section Supervisor
Watershed Management Division

I. SPECIAL CONDITIONS

A. EFFLUENT LIMITS

1. During the term of this permit, the Permittee is authorized to discharge from outfall serial number S/N 001 of the Hinesburg WWTF to the LaPlatte River, an effluent for which the characteristics shall not exceed the values listed below:

EFFLUENT CHARACTERISTICS	**DISCHARGE LIMITATIONS**							
	Annual Average	Monthly Average	Weekly Average	Maximum Day	Monthly Average	Weekly Average	Maximum Day	Instantaneous Maximum
		Mass (**lbs/day**)			Concentration (**mg/L**)			
Flow	0.250 MGD[1]	Monitor Only						
Ultimate Oxygen Demand[2]				400				
Biochemical Oxygen Demand (5-day, 20° C) (BOD$_5$)		63	94		30	45	50	
Total Suspended Solids (TSS)		94	94		45	45	50	
Total Phosphorus (TP)[3,4,5] **Total Annual Pounds**	152 lbs/yr				0.8			
Total Phosphorus (TP)[3,4,6] **Total Annual Pounds**	608 lbs/yr				0.8			
Total Kjeldahl Nitrogen							Monitor Only	
Nitrate/Nitrite Nitrogen (NO$_x$)							Monitor Only	
Total Nitrogen (TN)[7]				Monitor Only			Monitor Only	
Total Ammonia Nitrogen (June 1-September 30)[3,5,8]		7.3		34.6	3.5			16.6 mg/L
Total Ammonia Nitrogen (October 1 – May 31)[3,5,8]		42.1		175.0	20.2			84.0 mg/L
Total Ammonia Nitrogen[6,8]							Monitor Only	
Settleable Solids								1.0 ml/L
Escherichia coli								77 CFU/100 ml
Total Residual Chlorine (TRC)[9]								0.02 mg/L
pH					Between 6.5-8.5 Standard Units			

[1] Monthly average flow calculated by summing daily effluent flow for each day in the given month and dividing the sum by the number of days of discharge in that month.
[2] The Ultimate Oxygen Demand shall only apply from June 1 to September 30
[3] The permittee shall operate the facility to meet the concentration limitations or pounds limitation, whichever is more restrictive.
[4] Total Phosphorus shall be reported as Total Monthly Pounds, Running Total Annual Pounds, and Percentage of Running Total Annual Pounds to Annual Permit Limitation. See Condition I.B.5.
[5] These limits are effective once the facility upgrade is complete.
[6] These limits are effective from permit issuance to facility upgrade completion.
[7] Total Nitrogen (TN) shall be reported as pounds, calculated as: *Average TN (mg/L) x Total Daily Flow x 8.34*; where, *TN (mg/L) = TKN (mg/L) +* NO_x *(mg/L)*
[8] Total Ammonia Nitrogen (TAN) = NH_3 + NH_4^+
[9] For the purposes of this permit, TRC analysis must be completed using a test method in 40 C.F.R. § 136 that achieves a minimum level no greater than 0.05 mg/L. The compliance level for TRC is 0.05 mg/L.

2. The effluent shall not have concentrations or combinations of contaminants including oil, grease, scum, foam, or floating solids which would cause a violation of the Vermont Water Quality Standards.

3. The effluent shall not cause visible discoloration of the receiving waters.

4. The monthly average concentrations of Biochemical Oxygen Demand (BOD_5) and Total Suspended Solids (TSS) in the effluent shall not exceed 15 percent of the monthly average concentrations of BOD_5 and TSS in the influent into the Permittee's WWTF. For the purposes of determining whether the Permittee is in compliance with this condition, samples from the effluent and the influent shall be taken with appropriate allowance for detention times.

5. If the effluent discharged for a period of 90 consecutive days exceeds 80 percent of the permitted flow limitation, the Permittee shall submit to the Secretary projected loadings and a program for maintaining satisfactory treatment levels consistent with approved water quality management plans.

6. For the purposes of this permit, TRC analysis must be completed using a test method in 40 C.F.R. § 136 that achieves a minimum level no greater than 0.05 mg/L. The compliance level for TRC is 0.05 mg/L. Samples with a TRC concentration of 0.05 mg/L and below will be considered in compliance.

7. **Annually, in September or October**, the Permittee shall measure the sludge depth throughout the treatment lagoons. The results of the sludge measurements and a copy of a plan depicting the grid location of the measurements shall be submitted with the October Discharge Monitoring Report (DMR) form WR-43.

8. Any action on the part of the Secretary in reviewing, commenting upon or approving plans and specifications for the construction of WWTFs shall not relieve the Permittee from the responsibility to achieve effluent limitations set forth in this permit and shall not constitute a waiver of, or act of estoppel against any remedy available to the Secretary, the State of Vermont, or the federal government for failure to meet any requirement set forth in this permit or imposed by state or federal law.

9. The Permittee shall not bypass or lower any treatment lagoon below the normal operating level of 8 feet without first obtaining approval from the Secretary.

10. The Permittee shall not bypass or lower any treatment lagoon at a frequency of greater than once every five years for sludge removal unless all limitations of Part I.A.1 of this permit can be met.

B. TOTAL PHOSPHORUS

1. Wasteload Allocation and Implementation Schedule

This permit includes a formal total phosphorus (TP) waste load allocation (WLA) of 0.069 metric tons per year (152 lbs/yr), as established by the U.S. EPA in the 2016 "Phosphorus TMDLs for Vermont Segments of Lake Champlain" (LC TMDL). The Secretary reserves the right to reopen and amend this permit, pursuant to Condition II.B.4 of this permit, to include an alternate total phosphorus (TP) limitation and/or additional monitoring requirements based on the monitoring data and/or the results of phosphorus optimization activities, or a reallocation of phosphorus wasteload allocations between the Permittee and another WWTF pursuant to the requirements of the LC TMDL and Vermont's "Wasteload Allocation Process" Rule (Environmental Protection Rule, Chapter 17).

The Permittee shall achieve compliance with the TP limit of 152 lbs (0.069 metric tons) annual load, as specified in Condition I.A.1 of this permit, in accordance with the following schedule:

a) **As soon as possible, but by no later than February 28, 2019**, the Permittee shall develop and submit a plan to the Secretary for review and approval to ensure the WWTF is brought into compliance with its WLA. The plan shall be developed by qualified professionals with experience in the operation and design of WWTFs in consultation with the Chief Operator of the WWTF. The plan shall include:

  i. Plans and specifications necessary to implement needed facility modifications;

  ii. An engineer approved design and construction schedule, that shall ensure the WWTF's compliance with its WLA as soon as possible but no later than by **December 31, 2022;** and

  iii. A financing plan that estimates the costs for implementing the plan and describes a strategy for financing the projects.

b) **As soon as possible, but by no later than December 31, 2022**, the Permittee shall achieve compliance with the TP limitations specified in Condition I.A.1. From the effective date of the permit until that time, the facility shall have **interim TP limits** from the previous discharge permit (**608 lbs., annually; 0.8 mg/L, monthly average**).

c) The Permittee shall notify the Secretary, in writing, within 30 days after completion of the facility modifications necessary to achieve compliance with the TP effluent limitations specified in Condition I.A.1.

d) The upgrade of the Hinesburg WWTF shall be considered complete when the Permittee notifies the Secretary, by means of an engineer's certification, that the new facility is operational and the Secretary issues a written acknowledgement of its operational status.

The Permittee shall submit project progress reports pertaining to facility modifications necessary to achieve compliance with the TP effluent limitations specified in Condition I.A.1, for review by the Secretary. Progress reports shall be submitted on the following dates: **November 30, 2019, August 31, 2020, May 31, 2021, February 28, 2022, and November 30, 2022**.

Progress reports shall include the following:

i. A description of the progress the Permittee has made toward making the facility modifications necessary to achieve compliance with the TP effluent limitations specified in Condition I.A.1;

ii. An assessment as to whether the Permittee is on schedule in its efforts to comply with the date specified in Condition I.B.1.b); and

iii. If the Permittee is not on-track with its original design and construction schedule, the progress reports shall detail the steps the Permittee will take to ensure compliance with the date specified in Condition I.B.1.b).

2. Phosphorus Optimization Plan

a) **Within 6 months of facility upgrades, or December 31, 2022, whichever occurs first**, the Permittee shall develop or update (as appropriate), and submit to the Secretary, a Phosphorus Optimization Plan (POP) to increase the WWTF phosphorus removal efficiency by implementing optimization techniques that achieve phosphorus reductions using primarily existing facilities and equipment. The POP shall:

i. Be developed by a qualified professional with experience in the operation and design of WWTFs in consultation with the WWTF;

ii. Evaluate alternative methods of operating the existing WWTF, including operational, process, and equipment changes designed to enhance phosphorus removal. The techniques to be evaluated may include operational process changes to enhance biological and/or chemical phosphorous removal, incorporation of anaerobic/anoxic zones, septage receiving policies and procedures, and side stream management.

iii. Determine which alternative methods of operating the existing WWTF, including operational, process, and equipment changes will be most effective at increasing phosphorus removal; and

iv. Include a proposed implementation schedule for those methods of operating the WWTF determined to be most effective at increasing phosphorus removal.

b) The Secretary shall review the POP. If the POP fails to meet the requirements of subsection (a) of this section, the Secretary may reject the POP. The Permittee shall commence implementation of the POP immediately.

c) The Permittee shall annually submit a report to the Secretary as an attachment to the monthly electronic Discharge Monitoring Report (DMR) form WR-43 that documents:

i. The optimization techniques implemented under the POP during the previous year.

ii. Whether the techniques are performing as expected.

iii. The phosphorus discharge trends relative to the previous year.

The first annual report shall include data collected during **the calendar year proceeding completion of the facility upgrade** and shall be attached to the appropriate year's December DMR form WR-43.

3. Phosphorus Elimination/Reduction Plan

a) The facility shall have until **18-months from facility upgrades, or until December 31, 2022, whichever occurs first,** to optimize removal of TP.

b) If, after the optimization period, the WWTF's actual TP loads reach or exceed 80% of the TMDL WLA for the WWTF, based on the WWTF's 12-month running annual load calculated using the Running Total Annual Pounds calculation (Condition I.B.4) the Permittee shall, within 90 days of reaching or exceeding 80% of the TMDL WLA for the WWTF, develop and submit to the Secretary a projection based on the WWTF's current operations and expected future loadings of whether it will exceed its WLA during the permit term.

c) If the facility is not projected to exceed its WLA within the permit term, the WWTF shall reassess when it is projected to reach its WLA prior to seeking permit renewal and submit that information with its next permit application.

d) If the facility is projected to exceed its WLA during the permit term, the Permittee shall submit a Phosphorus Elimination/Reduction Plan (PERP) within 6 months from the date of submittal of the projection submitted under Part I.B.3.b. The PERP shall be submitted to the Secretary to ensure the WWTF continues to comply with its WLA.

e) The PERP shall be developed by qualified professionals in consultation with the WWTF.

The PERP shall include:

i. An evaluation of alternatives to ensure the WWTF's compliance with its WLA; If a pilot study is proposed as part of the evaluation of alternatives, a schedule for testing shall be included;

ii. An identification of the chosen alternative or alternatives to ensure the WWTF's compliance with its WLA;

iii. A proposed schedule, including an engineer approved design and construction schedule and, if the chosen alternative or alternatives require a pilot study, a schedule for testing, that shall ensure the WWTF's compliance with its WLA as soon as possible; and

iv. A financing plan that estimates the costs for implementing the PERP and describes a strategy for financing the project

The PERP shall be treated as an application to amend the permit, and therefore, shall be subject to all public notice, hearing, and comment provisions, in place at the time the plan is submitted, that are applicable to permit amendments. The WWTF shall revise the PERP, if required by the Secretary.

4. Running Total Annual Pounds Calculation

Compliance with the annual TP limitation (as specified in Condition I.A.1.) will be evaluated each month, using the Running Total Annual Pounds Calculation. In order to calculate running annual TP loading relative to the TMDL WLA:

a) Calculate the average of results for all TP monitoring events conducted in a month (Monthly Average TP Concentration). Units = mg/L

b) For flow, use the average daily flow for the month as reported on the DMR. Units = MGD

c) Calculate Total Monthly Pounds = Monthly Average TP concentration × average daily flow from DMR × 8.34 × number of daily discharges in the month. Units = pounds.

d) Sum the results for the immediately preceding 12 months to derive the Running Total Annual Pounds.

5. Total Phosphorus Reporting

Total Phosphorus shall be reported monthly, via electronic Discharge Monitoring Report, in the following ways:

a. Monthly Average TP Concentration. See Condition I.B.4.a.

b. Total Monthly Pounds, meaning the total monthly pounds of TP discharged during the month. See Condition I.B.4.c.

c. Running Total Annual Pounds, meaning the 12-month running annual TP load, as specified by Condition I.B.4.d

d. Comparison (%) of Running Total Annual Pounds to Annual Permit Limitation, meaning the percentage of the Running Total Annual Pounds to the Annual Total Phosphorus Limitation.

The comparison shall be calculated as:

Percentage of Running Total Annual Pounds to Annual Permit Limitation, % = Running Total Annual Pounds / Annual TP Permit Limit × 100

C. TOTAL AMMONIA NITROGEN (TAN)

The Permittee shall achieve compliance with the TAN limits specified in Condition I.A.1 of this permit, in accordance with the following schedule:

1. **As soon as possible, but by no later than February 28, 2019**, the Permittee shall develop and submit a plan to the Secretary for review to ensure the WWTF is brought into compliance with its TAN limits. The plan shall be developed by qualified professionals with experience in the operation and design of WWTFs in consultation with the Chief Operator of the WWTF. The plan shall include:

   a. Plans and specifications necessary to implement needed facility modifications;

   b. An engineer approved design and construction schedule, that shall ensure the WWTF's compliance with its TAN limits as soon as possible but no later than by **December 31, 2022**; and

   c. A financing plan that estimates the costs for implementing the plan and describes a strategy for financing the projects.

2. **As soon as possible, but by no later than December 31, 2022**, the Permittee shall achieve compliance with the TAN limitations specified in Conditions I.A.1. From the issuance date of the permit until that time, the facility shall have interim 'monitor only' requirements for TAN. The facility shall monitor for TAN once weekly via grab sample as described in Condition I.I.2.

3. The Permittee shall notify the Secretary, in writing, within 30 days after completion of the facility modifications necessary to achieve compliance with the TAN effluent limitations specified in Condition I.A.1.

4. The upgrade of the Hinesburg WWTF shall be considered complete when the Permittee notifies the Secretary, by means of an engineer's certification, that the new facility is operational and the Secretary issues a written acknowledgement of its operational status.

5. The Permittee shall submit project progress reports pertaining to facility modifications necessary to achieve compliance with the TAN effluent limitations specified in Condition I.A.1, for review by the Secretary. Progress reports shall be submitted on the following dates: **November 30, 2019, August 31, 2020, May 31, 2021, February 28, 2022, and November 30, 2022.**

   Progress reports shall include the following:

a. A description of the progress the Permittee has made toward making the facility modifications necessary to achieve compliance with the TAN effluent limitations specified in Condition I.A.1;

b. An assessment as to whether the Permittee is on schedule in its efforts to comply with the date specified in Condition I.C.1.b; and

c. If the Permittee is not on-track with its original design and construction schedule, the progress reports shall detail the steps the Permittee will take to ensure compliance with the date specified in Condition I.C.1.b.

D. WASTE MANAGEMENT ZONE

In accordance with 10 V.S.A. § 1252, this permit hereby establishes a waste management zone that extends from the outfall of the Hinesburg Wastewater Treatment in the LaPlatte River downstream 1.4 miles.

E. REAPPLICATION

If the Permittee desires to continue to discharge after the expiration of this permit, the Permittee shall reapply on the application forms then in use at least 180 days before this permit expires.

Reapply for a Discharge Permit by: **June 30, 2022**

F. INSTREAM MONITORING

The Permittee shall perform instream water quality monitoring for turbidity, TP, and pH in the LaPlatte River above and below the Hinesburg WWTF outfall S/N 001. The Permittee shall submit a study plan, outlining the specific locations of the collection, sampling methodology, and analysis of the data, to the Secretary for approval by **March 30, 2019**.

Instream water quality samples shall be collected for TP, pH, and turbidity once per month, during the months of **June through October of 2019, 2020, and 2021**. Samples shall be collected upstream and downstream of outfall S/N 001 at river mile 12.5 and river mile 12.0, respectively. Streamflow characteristics shall be documented for each sample collection, and sampling should be targeted to low flow conditions, as determined using the relevant U.S. Geological Survey streamflow gauge. The results of the sampling shall be submitted by December 31 of 2019, 2020, and 2021 as an attachment to the appropriate DMR form WR-43.

The Secretary reserves the right to reopen and amend this permit, pursuant to Condition II.B.4 of this permit, to include additional monitoring or effluent limitations.

G. OPERATING FEES

This discharge is subject to operating fees as required by 3 V.S.A. § 2822.

H. TOXICITY TESTING

1. Whole Effluent Toxicity (WET) Testing

a) During **August or September 2018 and 2020**, the Permittee shall conduct two-species (*Pimephales promelas* and *Ceriodaphnia dubia*) modified acute/chronic WET test (48-hour acute endpoints within a 7-day chronic test) on a composite effluent sample collected from S/N 001. The results shall be submitted to the Secretary by **December 31, 2018 and December 31, 2020**.

b) During **January or February 2019 and 2021**, the Permittee shall conduct two-species (*Pimephales promelas* and *Ceriodaphnia dubia*) modified acute/chronic WET test (48-hour acute endpoints within a 7-day chronic test) on a composite effluent sample collected from S/N 001. The results shall be submitted to the Secretary by **June 30, 2019 and June 30, 2021**.

The WET tests shall be conducted according to the procedures and guidelines specified in "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms" and "Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms" (both documents U.S. EPA October 2002 or, if a newer edition is available, the most recent edition).

Based upon the results of these tests or any other toxicity tests conducted, the Secretary reserves the right to reopen and amend this permit, pursuant to Condition II.B.4 of this permit, to require additional WET testing or a Toxicity Reduction Evaluation be conducted.

I. MONITORING AND REPORTING

1. Sampling and Analysis

The sampling, preservation, handling, and analytical methods used shall conform to the test procedures published in 40 C.F.R. Part 136.

The Permittee shall use sufficiently sensitive test procedures (i.e., methods) approved under 40 C.F.R. Part 136 for the analysis of the pollutants or pollutant parameters specified in Condition I.A. above.

Samples shall be representative of the volume and quality of effluent discharged over the sampling and reporting period. All samples are to be taken during normal operating hours. The Permittee shall identify the effluent sampling location used for each discharge. A description of the effluent sample location is included in Condition I.I.2.

2. Effluent Monitoring

During the term of this permit, the Permittee shall monitor and record the quality and quantity of discharge(s) at outfall serial number S/N 001 of the Hinesburg WWTF, according to the following schedule and other provisions:

PARAMETER	**MINIMUM FREQUENCY OF ANALYSIS**	**SAMPLE TYPE**
Flow	Continuous	Daily Total, Max., Min.
Ultimate Oxygen Demand (UOD)	2 x month	calculated[1-2]
Biochemical Oxygen Demand (BOD_5)	2 × month	composite[3]
Total Suspended Solids (TSS)	2 × month	composite[3]
Total Phosphorus (TP)	2 × month	composite[3]
Total Kjeldahl Nitrogen (TKN)	2 × month/1 × quarter[4]	composite[1,3,4]
Total Ammonia Nitrogen (TAN)	1 × week	grab
Total Nitrogen	1 x quarter	[calculated][5]
Nitrate/Nitrite Nitrogen (NO_x)	1 x quarter	composite[3]
Settleable Solids	1 × day	grab[6]
Escherichia coli	2 × month	grab[7]
Total Residual Chlorine (TRC)	1 × day	grab[7-8]
pH	1 × day	grab
Temperature	1 x year	grab
Dissolved Oxygen	1 x year	grab
Oil & Grease	1 x year	grab
Total Dissolved Solids (TDS)	1 x year	composite[3]

Samples collected in compliance with the monitoring requirements specified above shall be collected at the downstream chamber of the dechlorination manhole. When sampling in this location isn't possible due to river water intrusion, samples may be collected directly below the effluent v-notch weir.

[1] *UOD shall be calculated using the following equation:*
UOD (lbs/day) = ((1.43 x BOD (lbs/day)) + (4.57 x TKN (lbs/day))
The BOD and TKN analysis must be conducted on the same effluent sample and the BOD and TKN results from the same sample used to calculate UOD.

[2] UOD monitoring is only required from June 1 through September 30

[3] Composite samples for BOD_5, TSS, TP, TDS, NOx, and TKN shall be taken during the hours 6:00 AM to 6:00 PM, unless otherwise specified. Eight hours is the minimum period for the composite, 24 hours is the maximum for the composite.

[4] TKN Monitoring is required once per quarter from Oct 1 to May 31 and twice a month from June 1 through September 30

[5] TN = TKN + NOx

[6] Settleable Solids samples shall be collected between 6:00 AM and 6:00 PM or during the period of peak flow.

[7] The twice-monthly *E. coli* sample shall be collected at the same time and location as a daily TRC sample. Samples shall be collected between the hours of 6:00 AM and 6:00 PM.

[8] TRC shall be monitored and recorded both prior to and following dechlorination.

3. Annual Constituent Monitoring

Annually, by December 31, the Permittee shall monitor S/N 001 and submit the results, including units of measurement, as an attachment to the DMR form WR-43 for the month in which the samples were taken for the following parameters:

Temperature
Dissolved Oxygen
Oil & Grease
Total Dissolved Solids

Grab samples shall be used for Temperature, Dissolved Oxygen, and Oil & Grease; all other parameters shall be composite samples. Samples shall be representative of the seasonal variation in the discharge.

The season in which samples are taken shall change chronologically from year to year. The sampling seasons are as follows: winter (January 1 – March 31), spring (April 1 – June 30), summer (July 1 – September 30), and fall (October 1 – December 31). The first samples under this permit should be taken during the **fall** season. The second samples should be taken during the summer, the third in fall, and so forth in chronological order. For easy reference regarding the season in which you should sample, please refer to the "The Secretary's Guidance for Annual Constituent Monitoring."

4. Influent Monitoring

During the term of this permit, the Permittee shall monitor the quality of the influent according to the following schedule and provisions:

PARAMETER	MINIMUM FREQUENCY OF ANALYSIS	SAMPLE TYPE
Biochemical Oxygen Demand (BOD_5)	1 × month	24-hour composite[1]
Total Suspended Solids (TSS)	1 × month	24-hour composite[1]

[1] Composite samples for BOD_5 & TSS shall be taken during the hours 6:00 AM to 6:00 PM, unless otherwise specified. Eight hours is the minimum period for the composite, 24 hours is the maximum for a composite.

5. Reporting

The Permittee is required to submit monthly reports of monitoring results on Discharge Monitoring Report (DMR) form WR-43 and WR-43-TP. Reports are due on the 15th day of each month, beginning with the month following the issuance date of this permit.

The Permittee shall electronically submit its DMRs via Vermont's on-line electronic reporting system. The Permittee shall electronically submit additional compliance monitoring data and reports specified by the Secretary. When the Permittee submits DMRs using an electronic system designated by the Secretary, which requires attachment of scanned DMRs in pdf format, it is not required to submit hard copies of DMRs. The link below shall be used for electronic submittals.

https://anronline.vermont.gov/

If, in any reporting period, there has been no discharge, the Permittee must submit that information by the report due date.

All reports shall be signed:

a) In the case of corporations, by a principal executive officer of at least the level of vice president, or his/her duly authorized representative, if such representative is responsible for the overall operation of the facility from which the discharge described in the permit form originates and the authorization is made in writing and submitted to the Secretary;

b) In the case of a partnership, by a general partner;

c) In the case of a sole proprietorship, by the proprietor; or

d) In the case of a municipal, State, or other public facility, by either a principal executive officer, ranking elected official, or other duly authorized employee.

In addition to the monitoring and reporting requirements given above, daily monitoring of certain parameters for operational control shall be submitted to the Secretary on the DMR form WR-43. Operations reports shall be submitted monthly.

6. Recording of Results

The Permittee shall maintain records of all information resulting from any monitoring activities required, including:

a) The exact place, date, and time of sampling or measurement;

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

c) The dates and times the analyses were performed;

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

e) The analytical techniques and methods used including sample collection handling and preservation techniques;

f) The results of such analyses;

g) The records of monitoring activities and results, including all instrumentation and calibration and maintenance records; and

h) The original calculation and data bench sheets of the operator who performed analysis of the influent or effluent pursuant to requirements of Condition I.A of this permit.

i) For analyses performed by contract laboratories:

a. The detection level reported by the laboratory for each sample; and

b. The laboratory analytical report including documentation of the QA/QC and analytical procedures.

The results of monitoring requirements shall be reported (in the units specified) on the DMR form WR-43 or other forms approved by the Secretary.

When "non-detects" are recorded, the method detection limit shall be reported and used in calculating any time-period averaging for reporting on DMRs.

7. Additional Monitoring

If the Permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the DMR form WR-43. Such increased frequency shall also be indicated.

J. DRY WEATHER FLOWS

Dry weather flows of untreated municipal wastewater from any sanitary or combined sewers are not authorized by this permit and are specifically prohibited by state and federal laws and regulations. If for any reason there is a discharge to waters of the State of dry weather flows of untreated municipal wastewater from any sanitary or combined sewer, the operator of the facility or the operator's delegate shall comply with the notice requirements outlined in Condition II.A.2 of this permit.

K. OPERATION, MANAGEMENT, AND EMERGENCY RESPONSE PLANS

1. The Permittee shall implement the Operation, Management, and Emergency Response Plan for the treatment facility, sewage pumping stations, and sewer line stream crossings as approved by the Secretary on June 30, 2008.

2. By no later than **July 31, 2018** the Permittee shall prepare and submit to the Secretary for review and approval, an Operation, Management, and Emergency Response Plan for the sewage collection system. The Permittee shall implement the plan upon submittal. This plan shall comply with the provisions of 10 V.S.A. § 1278, which require:

a. Identification of those elements of the facility, including collection systems that are determined to be prone to failure based on installation, age, design, or other relevant factors.

b. Identification of those elements of the facility identified under subdivision (a) of this subsection which, if one or more failed, would result in a significant release of untreated or partially treated sewage to surface waters of the State.

c. The elements identified in subdivision (b) of this subsection shall be inspected in accordance with a schedule approved by the Secretary.

d. An emergency contingency plan to reduce the volume of a detected spill and to mitigate the effect of such a spill on public health and the environment.

The Permittee shall revise these plans upon the Secretary's request or on its own motion to reflect equipment or operational changes.

L. ENGINEERING EVALUATION AND REPORT

By **June 30, 2022** the Permittee shall conduct an in-depth engineering inspection/evaluation of the WWTF and shall submit a written report of the results to the Secretary. This evaluation shall assess all parts of the WWTF that will not be replaced or refurbished to comply with the TP and TAN requirements. The engineering inspection and report shall be conducted and prepared in accordance with the following conditions:

A professional engineer with experience in the design and operation of municipal wastewater treatment facilities shall be hired to perform an in-depth inspection of the WWTF, pump stations, collection system, and manholes. At the treatment facility, all components which are critical to the treatment process or which could adversely affect effluent quality in the event of their failure shall be inspected. Such components shall include: grit removal systems, comminutors, tank and partition integrity, biological systems, aeration systems, piping, clarifier drives and chlorination and dechlorination systems, flow metering systems, all critical and necessary valves, sludge handling equipment (digesters and appurtenances), etc. In the pump stations, all components critical to the proper conveyance of sewage, the prevention of sewage bypass, and the supporting appurtenances shall be inspected. This includes pumps, alarms, check valves, piping, motor controls, ventilators, dehumidifiers, and sumps pumps, if so equipped, and the station structure.

The inspection is to be comprised of visual observation of equipment operability and condition as well as a review of maintenance records to determine recurring equipment problems and to estimate future life. Calibration checks shall be performed on all flow meters.

The resulting written inspection report shall document the components inspected, their condition, and include recommendations for currently needed repairs or replacements and/or the need for on-site spare parts. The projected date of replacement or major rehabilitation of each component and the anticipated cost shall be estimated. The Permittee shall determine how the future anticipated costs will be met and advise the Secretary in a letter transmitted with the written inspection report. The Secretary recommends an annual set-aside to a sinking fund so that funds are immediately available for the necessary rehabilitations or replacements.

Should the Secretary determine that certain critical components are in need of repair or replacement due to the results of the inspection report, this permit may be reopened and amended, pursuant to Condition II.B.4 of this permit, to include an implementation schedule for repair or replacement of those components.

M. EMERGENCY ACTION - ELECTRIC POWER FAILURE

The Permittee shall indicate in writing to the Secretary **within 90 days after the issuance date of this permit** that in the event the primary source of electric power to the WWTF (including pump stations) fails, the Permittee shall either provide an alternative source of power for the operation of its WWTF, or demonstrate that the treatment facility has the capacity to store the wastewater volume that would be generated over the duration of the longest power failure that would have affected the facility in the last five years, excluding catastrophic events.

The alternative power supply, whether from a generating unit located at the WWTF or purchased from an independent source of electricity, must be separate from the existing power source used to operate the WWTF. If a separate unit located at the WWTF is to be used, the Permittee shall certify in writing to the Secretary when the unit is completed and prepared to generate power.

The determination of treatment system storage capacity shall be submitted to the Secretary upon completion.

N. SEWER ORDINANCE

The Permittee shall have in effect a sewer use ordinance acceptable to the Secretary which, at a minimum, shall

1. Prohibit the introduction by any person into the Permittee’s sewerage system or WWTF of any pollutant which:

- **a)** Is a toxic pollutant in toxic amounts as defined in standards issued from time to time under Section 307(a) of the Clean Water Act;
- **b)** Creates a fire or explosion hazard in the Permittee’s treatment works;
- **c)** Causes corrosive structural damage to the Permittee’s treatment works, including all wastes with a pH lower than 5.0;
- **d)** Contains solid or viscous substances in amounts which would cause obstruction to the flow in sewers or other interference with proper operation of the Permittee’s treatment works; or
- **e)** In the case of a major contributing industry, as defined in this permit, contains an incompatible pollutant, as defined in this permit, in an amount or concentration in excess of that allowed under standards or guidelines issued from time to time pursuant to Sections 304, 306, and/or 307 of the Clean Water Act.

2. Require 45 days prior notification to the Permittee by any person or persons of a:

a) Proposed substantial change in volume or character of pollutants over that being discharged into the Permittee's treatment works at the time of issuance of this permit;

b) Proposed new discharge into the Permittee's treatment works of pollutants from any source which would be a new source as defined in Section 306 of the Clean Water Act if such source were discharging pollutants; or

c) Proposed new discharge into the Permittee's treatment works of pollutants from any source which would be subject to Section 301 of the Clean Water Act if it were discharging such pollutants.

3. Require any industry discharging into the Permittee's treatment works to perform such monitoring of its discharge as the Permittee may reasonably require, including the installation, use, and maintenance of monitoring equipment and monitoring methods, keeping records of the results of such monitoring, and reporting the results of such monitoring to the Permittee. Such records shall be made available by the Permittee to the Secretary upon request.

4. Authorize the Permittee's authorized representatives to enter into, upon, or through the premises of any industry discharging into the Permittee's treatment works to have access to and copy any records, to inspect any monitoring equipment or method required under subsection 3 above, and to sample any discharge into the Permittee's treatment works.

II. GENERAL CONDITIONS

A. MANAGEMENT REQUIREMENTS

1. Facility Modification / Change in Discharge

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant more frequently than, or at a level in excess of, that identified and authorized by this permit shall constitute a violation of the terms and conditions of this permit. Such a violation may result in the imposition of civil and/or criminal penalties pursuant to 10 V.S.A. Chapters 47, 201, and/or 211. Any anticipated facility alterations or expansions or process modifications which will result in new, different, or increased discharges of any pollutants must be reported by submission of a new permit application or, if such changes will not violate the effluent limitations specified in this permit, by notice to the Secretary of such changes. Following such notice, the permit may be modified, pursuant to Condition II.B.4 of this permit, to specify and limit any pollutants not previously limited.

In addition, the Permittee, within 30 days of the of the date on which the Permittee is notified shall provide notice to the Secretary of the following:

a) Any new introduction of pollutants into the treatment works from a source which would be a new source as defined in Section 306 of the Clean Water Act if such source were discharging pollutants;

b) Except for such categories and classes of point sources or discharges specified by the Secretary, any new introduction of pollutants into the treatment works from a source which would be subject to Section 301 of the Clean Water Act if such source were discharging pollutants; and

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

The notice shall include:

i. The quality and quantity of the discharge to be introduced into the system, and

ii. The anticipated impact of such change in the quality or quantity of the effluent to be discharged from the WWTF.

2. Noncompliance Notification

a) The Permittee shall give advance notice to the Secretary of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

b) In the event the Permittee is unable to comply with any of the conditions of this permit due, among other reasons, to:

i. Breakdown or maintenance of waste treatment equipment (biological and physical-chemical systems including all pipes, transfer pumps, compressors, collection ponds or tanks for the segregation of treated or untreated wastes, ion exchange columns, or carbon absorption units);

ii. Accidents caused by human error or negligence;

iii. Any unanticipated bypass or upset which exceeds any effluent limitation in the permit;

iv. Violation of a maximum day discharge limitation for any of the pollutants listed by the Secretary in this permit; or

v. Other causes such as acts of nature,

the Permittee shall provide notice as specified in subdivisions (c) and (d) of this subsection.

c) Pursuant to 10 V.S.A. § 1295, notice for “untreated discharges,” as defined.

i. Public notice. For "untreated discharges" an operator of a WWTF or the operator's delegate shall as soon as possible, but no longer than one hour from discovery of an untreated discharge from the WWTF, post on a publicly accessible electronic network, mobile application, or other electronic media designated by the Secretary an alert informing the public of the untreated discharge and its location, except that if the operator or his or her delegate does not have telephone or Internet service at the location where he or she is working to control or stop the untreated discharge, the operator or his or her delegate may delay posting the alert until the time that the untreated discharge is controlled or stopped, provided that the alert shall be posted no later than four hours from discovery of the untreated discharge.

ii. Secretary notification. For "untreated discharges" an operator of a WWTF shall within 12 hours from discovery of an untreated discharge from the WWTF notify the Secretary and the local health officer of the municipality where the facility is located of the untreated discharge. The operator shall notify the Secretary through use of the Department of Environmental Conservation's online event reporting system. If, for any reason, the online event reporting system is not operable, the operator shall notify the Secretary via telephone or e-mail. The notification shall include:

(1) The specific location of each untreated discharge, including the body of water affected. For combined sewer overflows, the specific location of each untreated discharge means each outfall that has discharges during the wet weather storm event.

(2) Except for discharges from a WWTF to a separate storm sewer system, the date and approximate time the untreated discharge began.

(3) The date and approximate time the untreated discharge ended. If the untreated discharge is still ongoing at the time of reporting, the entity reporting the untreated discharge shall amend the report with the date and approximate time the untreated discharge ended within three business days of the untreated discharge ending.

(4) Except for discharges from a WWTF to a separate storm sewer system, the approximate total volume of sewage and, if applicable, stormwater that was released. If the approximate total volume is unknown at the time of reporting, the entity reporting the untreated discharge shall amend the report with the approximate total volume within three business days.

(5) The cause of the untreated discharge and a brief description of the noncompliance, including the type of event and the type of sewer structure involved.

(6) The person reporting the untreated discharge.

d) For any non-compliance not covered under Condition II.A.2.c. of this permit, an operator of a WWTF or the operator's delegate shall notify the Secretary within 24 hours of becoming aware of such condition and shall provide the Secretary with the following information, in writing, within five days:

i. Cause of non-compliance;

ii. A description of the non-complying discharge including its impact upon the receiving water;

iii. Anticipated time the condition of non-compliance is expected to continue or, if such condition has been corrected, the duration of the period of non-compliance;

iv. Steps taken by the Permittee to reduce and eliminate the non-complying discharge; and

v. Steps to be taken by the Permittee to prevent recurrence of the condition of non-compliance.

3. Operation and Maintenance

All waste collection, control, treatment, and disposal facilities shall be operated in a manner consistent with the following:

a) The Permittee shall, at all times, maintain in good working order and operate as efficiently as possible all treatment and control facilities and systems (and related appurtenances) installed or used by the Permittee to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and 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.

b) The Permittee shall provide an adequate operating staff which is duly qualified to carry out the operation, maintenance, and testing functions required to ensure compliance with the conditions of this permit; and

c) The operation and maintenance of this facility shall be performed only by qualified personnel who are licensed as required by the Secretary and the Director of the Vermont Office of Professional Regulation.

4. Quality Control

The Permittee shall calibrate and perform maintenance procedures on all monitoring and analytical instrumentation at regular intervals to ensure accuracy of measurements, or shall ensure that both activities will be conducted.

The Permittee shall keep records of these activities and shall provide such records upon request of the Secretary.

The Permittee shall demonstrate the accuracy of the effluent flow measurement device **weekly** and report the results on the monthly report forms. The acceptable limit of error is ± 10%.

For purposes of demonstrating compliance with the requirements of Condition II.A.3.a of this permit regarding adequate laboratory controls and appropriate quality assurance procedures, the Permittee shall conduct an annual laboratory proficiency test (via an accredited laboratory) for the analysis of all pollutant parameters performed within their facility laboratory and reported as required by this permit. This requirement can be completed as part of an EPA DMR-QA study. Results shall be submitted to the Secretary by **December 31, annually**.

5. Bypass

The bypass of facilities (including pump stations) is prohibited, except where authorized under the terms and conditions of an Emergency Pollution Permit issued pursuant to 10 V.S.A. § 1268. It shall not be a defense for the Permittee in an enforcement action that it would have been necessary to halt or reduce the activity in order to maintain compliance with the conditions of this permit.

6. Duty to Mitigate

The Permittee shall take all reasonable steps to minimize or prevent any adverse impact to waters of the State, the environment, or human health resulting from non-compliance with any condition specified in this permit, including accelerated or additional monitoring as necessary to determine the nature and impact of the non-complying discharge.

7. Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed, all calibration and maintenance of instrumentation records and all original 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 shall be retained for a minimum of three years, and shall be submitted to the Secretary upon request. This period shall be extended during the course of unresolved litigation regarding the discharge of pollutants or when requested by the Secretary.

8. Solids Management

Collected screenings, sludges, and other solids removed in the course of treatment and control of wastewaters shall be stored, treated, and disposed of in accordance with 10 V.S.A. Chapter 159 and with the terms and conditions of any certification, interim or final, transitional operation authorization, or order issued pursuant to 10 V.S.A. Chapter 159 that is in effect on the issuance date of this permit or is issued during the term of this permit.

9. Emergency Pollution Permits

Maintenance activities, or emergencies resulting from equipment failure or malfunction, including power outages, which result in an effluent which exceeds the effluent limitations specified herein, shall be considered a violation of the conditions of this permit, unless the Permittee's discharge is covered under an emergency pollution permit under the provisions of 10 V.S.A. § 1268. The Permittee shall notify the Secretary of the emergency situation by the next working day, unless notice is required sooner under Section II.A.2.

10 V.S.A. § Section 1268 reads as follows:

> When a discharge permit holder finds that pollution abatement facilities require repairs, replacement or other corrective action in order for them to continue to meet standards specified in the permit, he may apply in the manner specified by the secretary for an emergency pollution permit for a term sufficient to effect repairs, replacements or other corrective action. The permit may be issued without prior public notice if the nature of the emergency will not provide sufficient time to give notice; provided that the secretary shall give public notice as soon as possible but in any event no later than five days after the issuance date of the emergency pollution permit. No emergency pollution permit shall be issued unless the applicant certifies and the secretary finds that:
>
> (1) there is no present, reasonable alternative means of disposing of the waste other than by discharging it into the waters of the state during the limited period of time of the emergency;
>
> (2) the denial of an emergency pollution permit would work an extreme hardship upon the applicant;
>
> (3) the granting of an emergency pollution permit will result in some public benefit;
>
> (4) the discharge will not be unreasonably harmful to the quality of the receiving waters;
>
> (5) the cause or reason for the emergency is not due to willful or intended acts or omissions of the applicant.

Application shall be made to the Secretary at the following address: Agency of Natural Resources, Department of Environmental Conservation, One National Life Drive, Main Building, 2nd Floor, Montpelier VT 05620-3522.

B. RESPONSIBILITIES

1. Right of Entry

The Permittee shall allow the Secretary or authorized representative, upon the presentation of proper credentials:

a) To 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;

b) To have access to and copy, at reasonable times, any records required to be kept under the terms and conditions of this permit;

c) To inspect, at reasonable times, any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

d) To sample or monitor, at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act, any substances or parameters at any location.

2. Transfer of Ownership or Control

This permit is not transferable without prior written approval of the Secretary. All application and operating fees must be paid in full prior to transfer of this permit. In the event of any change in control or ownership of facilities from which the authorized discharges emanate, the Permittee shall provide a copy of this permit to the succeeding owner or controller and shall send written notification of the change in ownership or control to the Secretary **at least 30 days in advance of the proposed transfer date**. The notice to the Secretary shall include a written agreement between the existing and new Permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them. The Permittee shall also inform the prospective owner or operator of their responsibility to make an application for transfer of this permit.

This request for transfer application must include as a minimum:

a) A properly completed application form provided by the Secretary and the applicable processing fee.

b) A written statement from the prospective owner or operator certifying:

i. The conditions of the operation that contribute to, or affect, the discharge will not be materially different under the new ownership;

ii. The prospective owner or operator has read and is familiar with the terms of the permit and agrees to comply with all terms and conditions of the permit; and

iii. The prospective owner or operator has adequate funding to operate and maintain the treatment system and remain in compliance with the terms and conditions of the permit.

c) The date of the sale or transfer.

The Secretary may require additional information dependent upon the current status of the facility operation, maintenance, and permit compliance.

3. Confidentiality

Pursuant to 10 V.S.A. § 1259(b):

Any records or information obtained under this permit program that constitutes trade secrets under 1 V.S.A. § 317(c)(9) shall be kept confidential, except that such records or information may be disclosed to authorized representatives of the State and the United States when relevant to any proceedings under this chapter.

Claims for confidentiality for the following information will be denied:

a) The name and address of any permit applicant or Permittee.

b) Permit applications, permits, and effluent data.

c) Information required by application forms, including information submitted on the forms themselves and any attachments used to supply information required by the forms.

4. Permit Modification, Suspension, and Revocation

After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including the following:

a) Violation of any terms or conditions of this permit;

b) Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts;

c) Reallocation of WLA under the LC TMDL;

d) Development of an integrated WWTF and stormwater runoff NPDES permit; or

e) A change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge.

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 shall not stay any permit condition.

The Permittee shall provide to the Secretary, within a reasonable time, any information which the Secretary may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee shall also furnish to the Secretary upon request, copies of records required to be kept by this permit.

5. Toxic Effluent Standards

If a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under section 307(a) of the Clean Water Act for a toxic pollutant which is present in the Permittee's discharge and such standard or prohibition is more stringent than any limitation upon such pollutant in this permit, then this permit shall be modified or revoked and reissued, pursuant to Condition II.B.4 of this permit, in accordance with the toxic effluent standard or prohibition and the Permittee so notified.

6. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of legal action or relieve the Permittee from any responsibilities, liabilities, or penalties to which the Permittee is or may be subject under 10 V.S.A. § 1281.

7. Other Materials

Other materials ordinarily produced or used in the operation of this facility, which have been specifically identified in the application, may be discharged at the maximum frequency and maximum level identified in the application, provided:

a) They are not:

i. Designated as toxic or hazardous under provisions of Sections 307 and 311, respectively, of the Clean Water Act, or

ii. Known to be hazardous or toxic by the Permittee,

except that such materials indicated in (i) and (ii) above may be discharged in certain limited amounts with the written approval of, and under special conditions established by, the Secretary or his/her designated representative, if the substances will not pose any imminent hazard to the public health or safety;

b) The discharge of such materials will not violate the Vermont Water Quality Standards; and

c) The Permittee is not notified by the Secretary to eliminate or reduce the quantity of such materials entering the water.

8. Navigable Waters

This permit does not authorize or approve the construction of any onshore or offshore physical structures or facilities or the undertaking of any work in any navigable waters.

9. Civil and Criminal Liability

The Permittee shall comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application. Except as provided in "Bypass" (Condition II.A.5) and "Emergency Pollution Permits" (Condition II.A.9), nothing in this permit shall be construed to relieve the Permittee from civil or criminal penalties for noncompliance. Civil and criminal penalties for non-compliance are provided for in 10 V.S.A. Chapters 47, 201, and 211.

10. State Laws

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 established pursuant to any applicable state law or regulation under authority preserved by Section 510 of the Clean Water Act.

11. Property Rights

Issuance of 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 any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations.

12. Other Information

If the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Secretary, it shall promptly submit such facts or information.

13. 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.

14. Authority

This permit is issued under authority of 10 V.S.A. §§ 1258 and 1259 of the Vermont Water Pollution Control Act, the Vermont Water Pollution Control Permit Regulation, and Section 402 of the Clean Water Act, as amended.

15. Definitions

For purposes of this permit, the following definitions shall apply.

Agency – means the Vermont Agency of Natural Resources.

Annual Average - means the highest allowable average of daily discharges calculated as the sum of all daily discharges (mg/L, lbs or gallons) measured during a calendar year divided by the number of daily discharges measured during that year.

Average - means the arithmetic means of values taken at the frequency required for each parameter over the specified period.

Bypass – means the intentional diversion of waste streams from any portion of the treatment facility.

The Clean Water Act - means the federal Clean Water Act, as amended (33 U.S.C. § 1251, *et seq*.).

Composite Sample - means a sample consisting of a minimum of one grab sample per hour collected during a 24-hour period (or lesser period as specified in the section on Monitoring and Reporting) and combined proportionally to flow over that same time period.

Daily Discharge - means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling.

For pollutants with limitations expressed in pounds the daily discharge is calculated as the total pounds of pollutants discharged over the day.

For pollutants with limitations expressed in mg/L the daily discharge is calculated as the average measurement of the pollutant over the day.

Discharge – means the placing, depositing, or emission of any wastes, directly or indirectly, into an injection well or into the waters of the State.

Grab Sample – means an individual sample collected in a period of less than 15 minutes.

Incompatible Substance – means any waste being discharged into the treatment works which interferes with, passes through without treatment, or is otherwise incompatible with said works or would have a substantial adverse effect on the works or on water quality. This includes all pollutants required to be regulated under the Clean Water Act.

Instantaneous Maximum - means a value not to be exceeded in any grab sample.

Major Contributing Industry – means one that: (1) has a flow of 50,000 gallons or more per average work day; (2) has a flow greater than five percent of the flow carried by the municipal system receiving the waste; (3) has in its wastes a toxic pollutant in toxic amounts as defined in standards issued under Section 307(a) of the Clean Water Act; or (4) has a significant impact, either singly or in combination with other contributing industries, on a treatment works or on the quality of effluent from that treatment works.

Maximum Day (maximum daily discharge limitation) – means the highest allowable "daily discharge" (mg/L, lbs or gallons).

Mean - is the arithmetic mean.

Monthly Average (average monthly discharge limitation) – means the highest allowable average of daily discharges (mg/L, lbs or gallons) over a calendar month, calculated as the sum of all daily discharges (mg/L, lbs or gallons) measured during a calendar month divided by the number of daily discharges measured during that month.

NPDES – means the National Pollutant Discharge Elimination System.

Secretary – means the Secretary of the Agency of Natural Resources or the Secretary's duly authorized representative.

Septage – means the liquid and solid material pumped from a septic tank, cesspool, or similar domestic sewage treatment system, or a holding tank when the system is cleaned or maintained.

Untreated Discharge – means (1) combined sewer overflows from a WWTF; (2) overflows from sanitary sewers and combined sewer systems that are part of a WWTF during dry weather flows, which result in a discharge to waters of the State; (3) upsets or bypasses around or within a WWTF during dry or wet weather conditions that are due to factors unrelated to a wet weather storm event and that result in a discharge of sewage that has not been fully treated to waters of the State; and (4) discharges from a WWTF to separate storm sewer systems.

Waste – means effluent, sewage or any substance or material, liquid, gaseous, solid, or radioactive, including heated liquids, whether or not harmful or deleterious to waters, provided however, the term "sewage" as used in this permit shall not include the rinse or process water from a cheese manufacturing process.

Waste Management Zone – means a specific reach of Class B waters designated by a permit to accept the discharge of properly treated wastes that prior to treatment contained organisms pathogenic to human beings. Throughout the receiving waters, water quality criteria must be achieved but increased health risks exist in a waste management zone due to the authorized discharge.

Waters includes all rivers, streams, creeks, brooks, reservoirs, ponds, lakes, springs, and all bodies of surface waters, artificial or natural, which are contained within, flow through, or border upon the State or any portion of it.

Weekly average - (average weekly discharge limitation) – means the highest allowable average of daily discharges (mg/L, lbs or gallons) over a calendar week, calculated as the sum of all daily discharges (mg/L, lbs or gallons) measured during a calendar week divided by the number of daily discharges measured during that week.

Whole Effluent Toxicity (WET) – means the aggregate toxic effect of an effluent measured directly by a toxicity test.

WWTF or wastewater treatment facility shall have the same meaning as “pollution abatement facilities,” as defined under 10 V.S.A. § 1251, which means municipal sewage treatment plants, pumping stations, interceptor and outfall sewers, and attendant facilities as prescribed by the Department to abate pollution of the waters of the State.

APPENDIX E

20 YEAR FLOW PROJECTION

HINESBURG WWTF
FUTURE WW FLOW PROJECTIONS
Nov-18

Proposed Project/Establishment	Quantity	Units	Design Flow		Projected Flow	Total Based on EPR Design Flows [6] (gpd)	Estimated Total Based on Actual Flows [7] (gpd)
Haystack Crossing - Black Rock Construction							
Single Family	66	units	210	gpd/unit	13,860		9,841
Muli-Family	60	units	210	gpd/unit	12,600		8,946
Mixed-Use	93	units	210	gpd/unit	19,530		13,866
Congregate Units	56	units	210	gpd/unit	11,760		8,350
Commercial - Dedicated	23,010	sf	0.06	gpd/sf	1,381		1,381
Commercial - Potential	10,200	sf	0.06	gpd/sf	612		612
Commercial/Light Industrial	17,756	sf	0.06	gpd/sf	1,065		1,065
				Subtotal	60,808	60,808	44,060
Wind Energy Associates - Blomstrann [1]							
Light Industrial/Office (31,200 s.f.)	154	employees	12	gpd/sf	1,848		1,848
Mixed Use/Office (92,950) s.f.)	233	employees	12	gpd/sf	2,796		2,796
Senior Housing	36	units	150	gpd/unit	5,400		3,834
Single Family	16	units	210	gpd/unit	3,360		2,386
Duplex/Townhomes	46	units	210	gpd/unit	9,660		6,859
				Subtotal	23,064	23,064	17,722
Hinesburg Center Phase 2 - Grabowski [2]							
Single Family	13	units	210	gpd/unit	2,730		1,938
Multi-Family	50	units	210	gpd/unit	10,500		7,455
Mixed-Use	6	units	210	gpd/unit	1,260		895
Commercial Space	13,400	sf	0.06	gpd/sf	804		804
				Subtotal	15,294	15,294	11,092
Quinn Property							
Single Family	40	units	210	gpd/unit	8,400		5,964
Multi-Family	85	units	210	gpd/unit	17,850		12,674
				Subtotal	26,250	26,250	18,638
Residential (other) [3]							
Dwelling Units	60	units	210	gpd/unit	12,600	12,600	8,946
Commercial (other) [4]							
Employees	200	Employees	12	gpd/unit	2,400	2,400	2,400
Industrial (other) [5]							
Misc.					10,000	10,000	10,000
Total						150,416	112,858

Notes:
1. Wind Energy Associates - Projected flows were updated based on detailed breakdown provided for Master Plan.
2. Hinesburg Center Phase 1 - Sewer allocation was issued by the Town for Phase I on 8/16/2018 for 5,004 gpd but is included here.
3. Residential category - an average of 3 new units per year are projected.
4. Commercial category - an average of 10 new employees per year are projected.
5. Industrial category - an estimate of 10,000 gpd is projected for future expansion of existing customers or new customers.
6. The total is based on using the State EPR design flows where details are available on the specific project or establishment.
7. The estimated total is based on the projected flows after connection. No changes are made in the estimated flows for the non residential establishments, but the residential flows are reduced from 210 to 150 gpd to better reflect actual flow contributions.

Aldrich + Elliott
WATER RESOURCE ENGINEERS

APPENDIX F

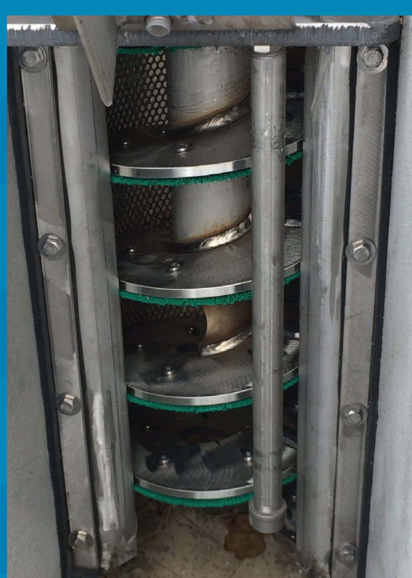
HEADWORKS

Raptor® Micro Strainer

Single Operational Unit
Screens, Compacts and
Dewaters in One Process

LAKESIDE
EQUIPMENT CORPORATION
Water Purification Since 1928

Cleaner Water for a Brighter Future®



Raptor® Inclined Micro Strainer Removes Solids Efficiently

The Lakeside *Raptor*® Micro Strainer is an efficient, proven screening technology for removal of inorganic solids that can be harmful to downstream equipment in municipal and industrial wastewater applications. Ideal for small treatment facilities, the *Raptor*® Micro Strainer utilizes a semicircular screenings basket to capture debris, such as plastics, hygienic articles and fibers. The *Raptor*® Micro Strainer features, including the screw conveyor, are all stainless steel construction (304 or 316) to handle the most severe conditions.

At 35° to 45° angle of inclination, the *Raptor*® Micro Strainer provides high removal efficiency using a perforated plate or wedge wire basket with small openings ranging from 0.04 to 0.25 inches (1 to 6 mm). A central screw conveyor with a cleaning brush removes the captured solids from the screenings basket and transports the debris for disposal. As the solids are being conveyed, they are macerated to break down large fecal matter, and then washed using a two-stage screenings wash system to return organic material back to the wastewater stream. The washed screenings are compacted and dewatered prior to being discharged, thereby reducing the volume and weight to a dry solids content of 40 percent, ultimately reducing disposal cost.

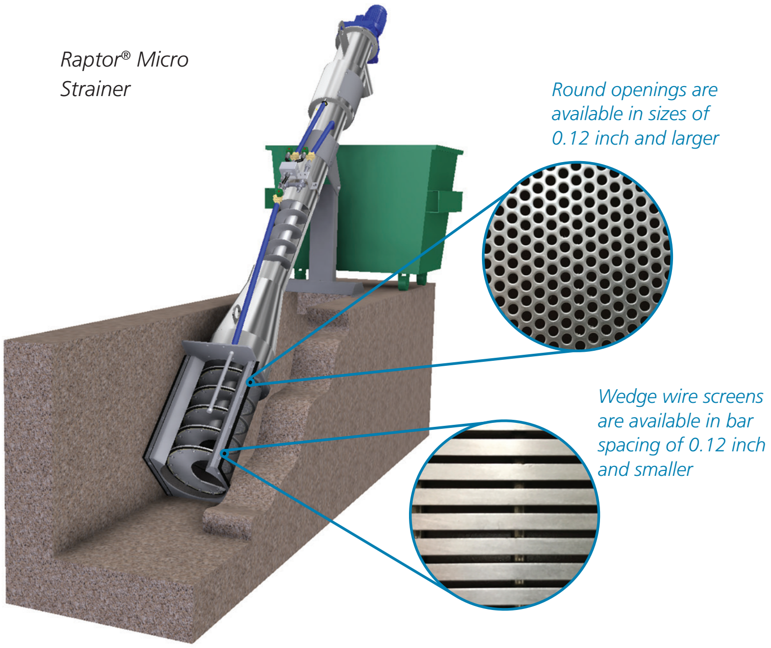
Raptor® *Micro Strainer with Bagger*

Raptor® *Micro Strainer with Weather Protection*

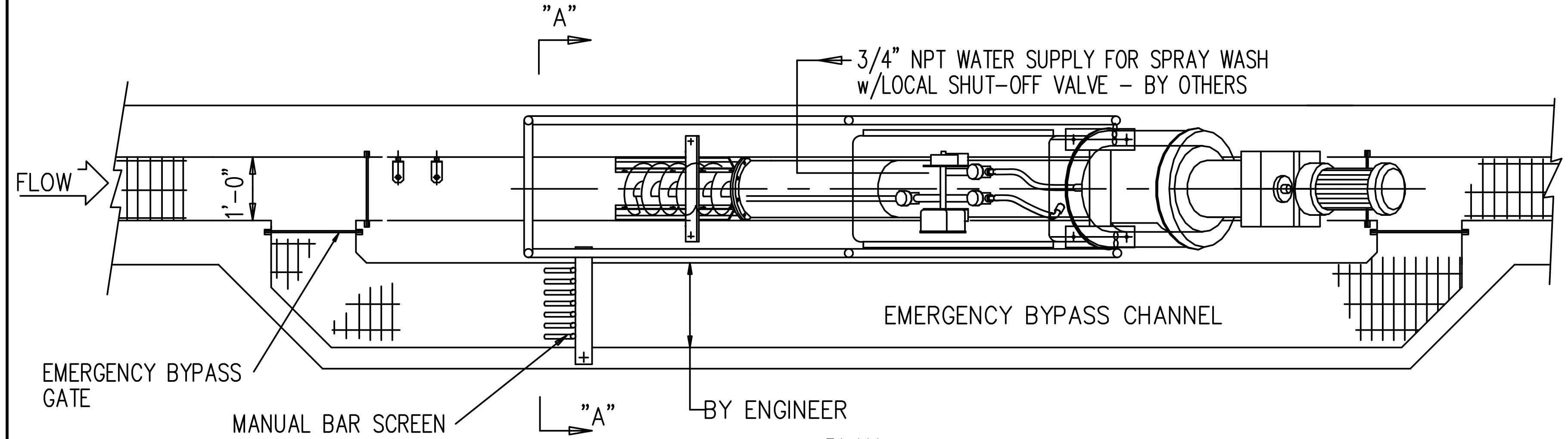
Superior design and construction

- All stainless steel construction resists corrosion
- Combines 4 processes in one unit (screens, washes, compacts and dewaters)
- Dual spray wash system provides cleaner discharge screenings
- Integrated compaction zone reduces volume and weight for reduced disposal cost
- Enclosed transport tube and optional bagger attachment reduce odors
- Hinged support to pivot screen out of channel for maintenance
- Removable bearing bars promote longer brush life without disassembling the screen
- Tank-mounted screens and explosion-proof designs are available
- Optional weather protection system protects to 13° F below zero (minus 25° C)

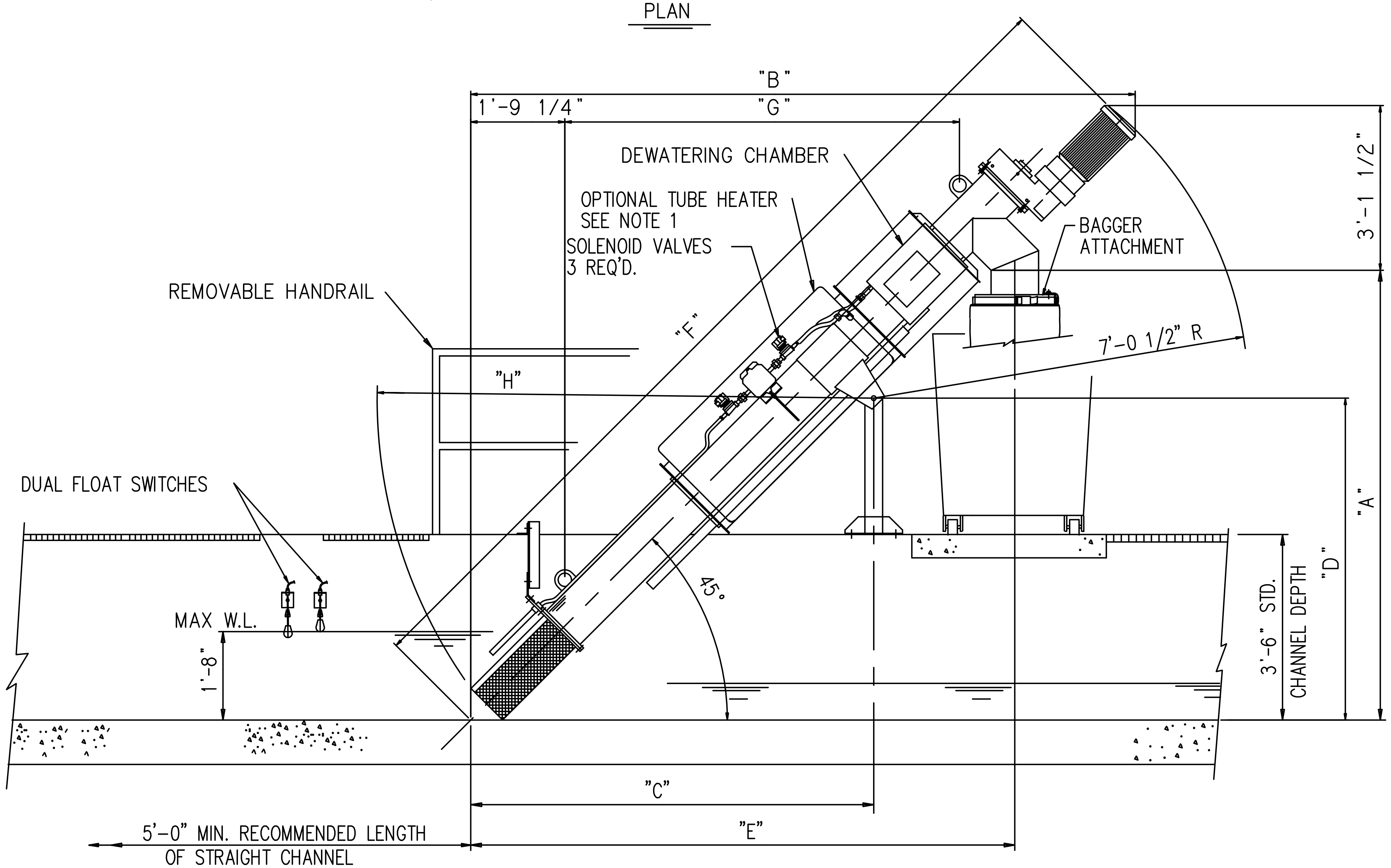
Raptor® *Micro Strainer*

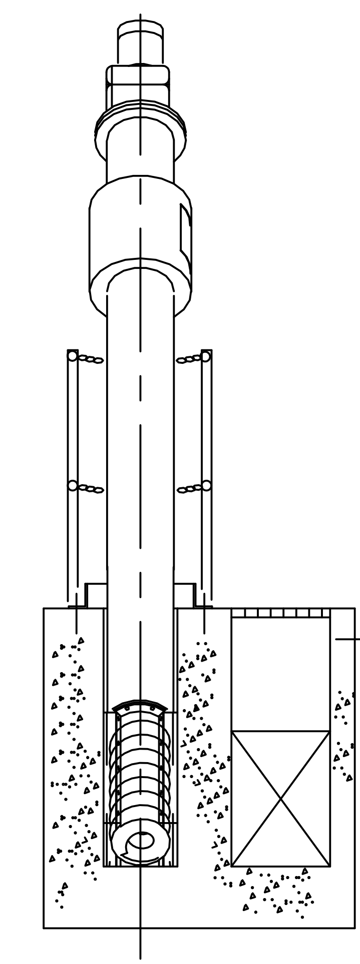


12MS	PART No	A	B	C	D	E	F	G	H
STD	-101	8'-5 1/2"	12'-4 1/4"	7'-7 1/4"	5'-11 1/2"	10'-2 3/4"	16'-7 1/2"	7'-2 1/2"	9'-3 5/8"

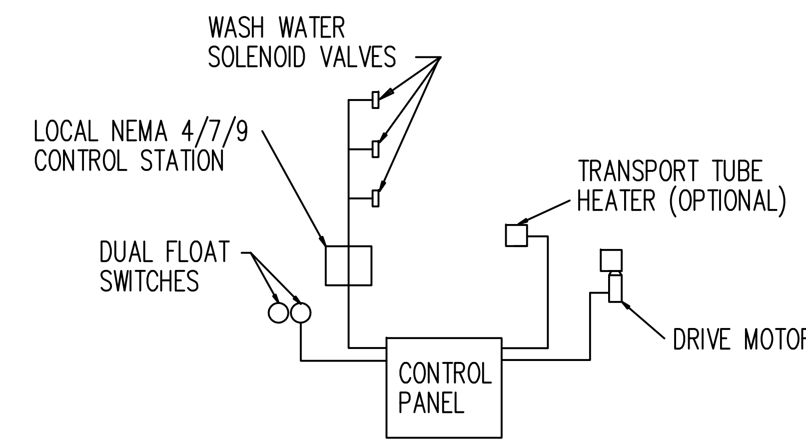


PLAN





SECTION "A-A"



CONTROL INTERCONNECTION DIAGRAM

ALL CONDUIT AND WIRE CONNECTIONS BETWEEN CONTROL PANEL AND SCREEN COMPONENTS BY OTHERS.

NOTES:

1) WHEN HEAT SYSTEM IS TO BE SUPPLIED, CHANNEL WIDTH TO BE 24" IF CHANNEL DEPTH IS GREATER THAN 3'-6".
2) CONTACT LAKESIDE FOR ANY ADDITIONAL REQUIREMENTS OR QUESTIONS.
3) KEEP TOP OF CENTER CHANNEL WALL AS LOW AS POSSIBLE TO ALLOW EASE OF CONSTRUCTION AND MAINTENANCE.
4) WATER SUPPLY LINES AND ELECTRICAL CONNECTIONS TO BE FLEXIBLE or QUICK DISCONNECT TYPE TO ALLOW UNIT TO PIVOT OUT OF CHANNEL.
5) BE SURE UPSTREAM PIPING IS NOT SURCHARGED AT MAX. W.L.
6) FOR PROPER APPLICATION OF THIS PRODUCT REFER TO RMI-95, LAKESIDE SCREEN GENERAL DESIGN NOTES.

REVISIONS	DATE	DR.	CHKD.
K w/FLOAT SWITCH-REMOVED COARSE BAR RACK	9-27-07	GS/WK	
J REVISED TO CURRENT STANDARD	12-18-06	G.F.	

LAKESIDE EQUIPMENT CORPORATION

DR. R.D. DATE 3-1-95
CHKD. SNYDER 4-18-95 FILE NO. 250

RAPTOR® 12" MICRO STRAINER

DWG. NO. D-51152-S REV. K

APPENDIX G

LEMNA

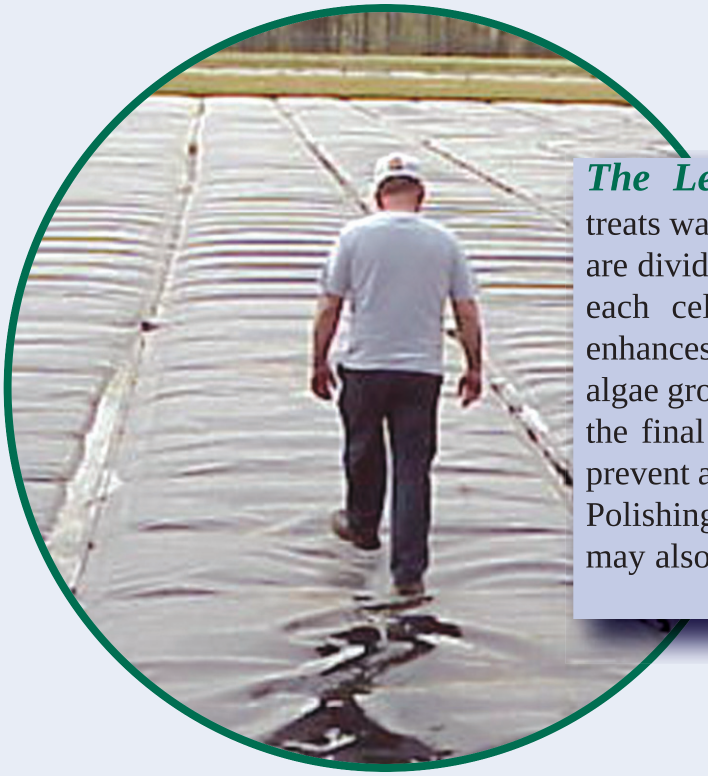
LemTec™ Process

LEMNA TECHNOLOGIES, INC.

Municipal and Industrial Treatment

INNOVATIVE WASTEWATER SOLUTIONS

The Leader In Lagoon Process Technology



The LemTec™ Biological Treatment Process (LBTP) treats wastewater as it flows through a series of aerated lagoons that are divided by baffles to reduce short-circuiting. In colder climates, each cell is covered by a LemTec™ Modular Cover, which enhances system kinetics, retains heat, controls odors, and prevents algae growth. In warmer climates, it may be necessary to cover only the final settling cell in order to promote digestion of sludge and prevent algae growth. Additional technologies, including the Lemna Polishing Reactor and the Lemna Phosphorus Removal System, may also be used for enhanced nutrient removal.

Customer satisfaction is our highest priority . . .

"The installation went very well, and the performance of the system has been excellent. We have been within our discharge limits since the installation, and have been more than satisfied with the performance of this system. I would most certainly recommend the Lemna system to other municipalities which use oxidation ponds and find themselves having problems with discharge limits." ***Operator - R.D., Louisiana***

"Lemna is definitely a leader rather than a follower. In addition, the LemTec™ Biological Treatment Process has over the last two years proven to be an excellent choice. The installation process is simple yet effective in its high degree performance and low maintenance cost." ***Client - B.L., New Hampshire***

"It has been a pleasure to work with Lemna Technologies. The service and support is fast and friendly." ***Client - P.V., Wisconsin***

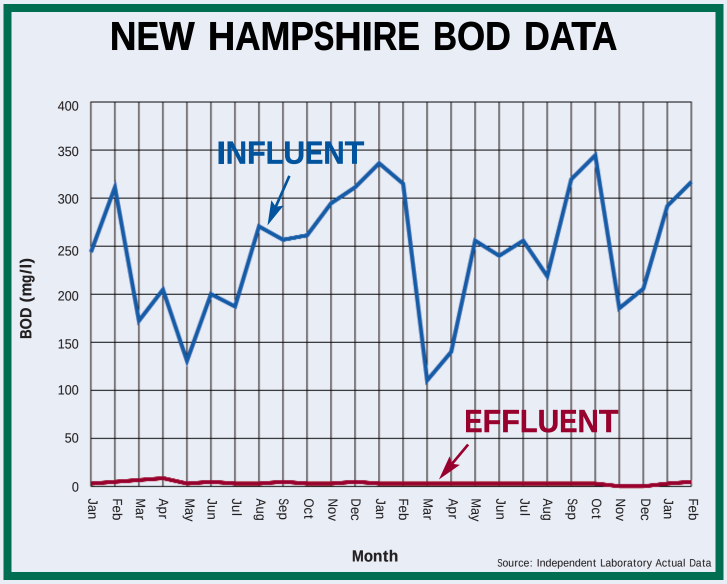
LemTec™ Process Family

LemTec™ Biological Treatment Process is an effective, reliable and affordable solution for existing aerated municipal and industrial wastewater lagoon facilities. The system incorporates the LemTec™ Modular Cover to create a reduced footprint and an operation that is virtually odor-free. The LemTec™ system is the highest performing pond-based aerated lagoon process in the world. Utilizing a series of aerobic treatment cells followed by an anaerobic settling zone and polishing reactor, the LemTec™ Process is capable of achieving year-round effluent limits as low as 10 mg/l BOD, 15 mg/l TSS and 2 mg/l NH_3-N for typical municipal or pre-treated industrial wastewater. Other nutrients such as Phosphorus can also be addressed within the process.

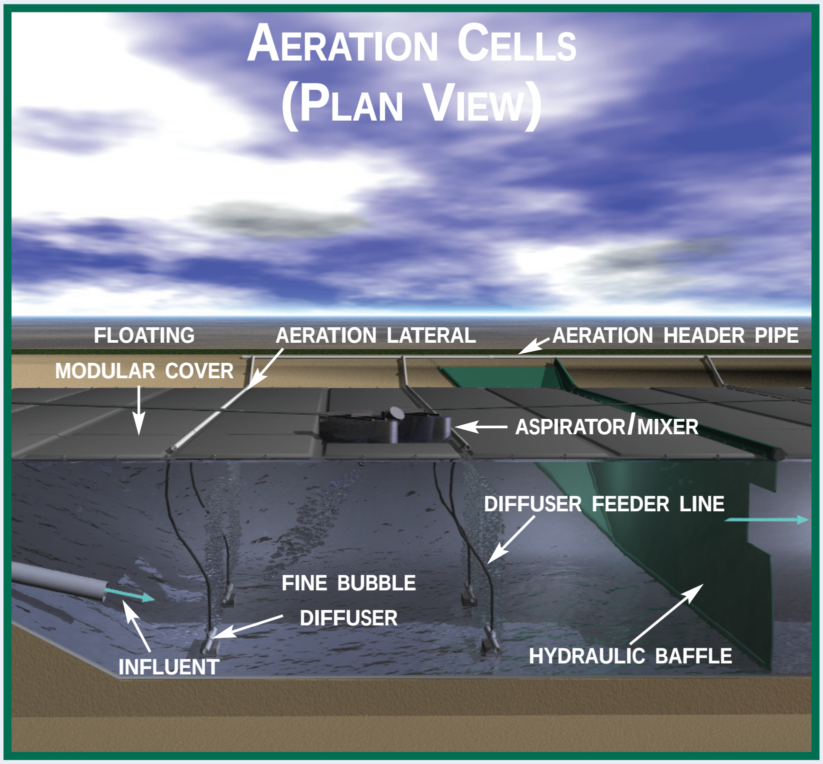
Existing Lagoons
or
New Construction

LemTec™ Facultative Treatment Process is an effective, reliable and affordable solution for existing facultative municipal and industrial wastewater lagoon facilities. At a fraction of the cost of other traditional systems, the LemTec™ Facultative Treatment Process is unmatched in its ability to meet stringent effluent limits that other traditional pond-based systems can't reach. Utilizing a series of facultative treatment cells followed by a covered settling zone and Lemna Polishing Reactor, the LemTec™ Process is capable of achieving year-round effluent limits as low as 10 mg/l BOD, 15 mg/l TSS and 2 mg/l NH_3-N.

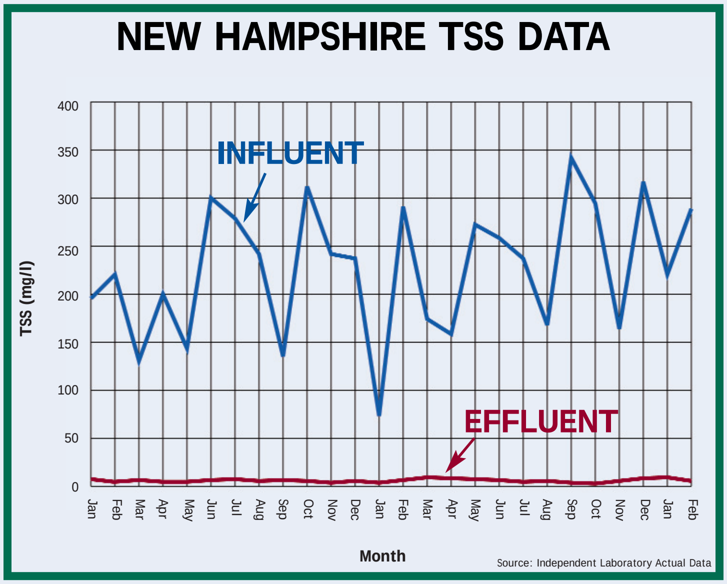
BOD Removal



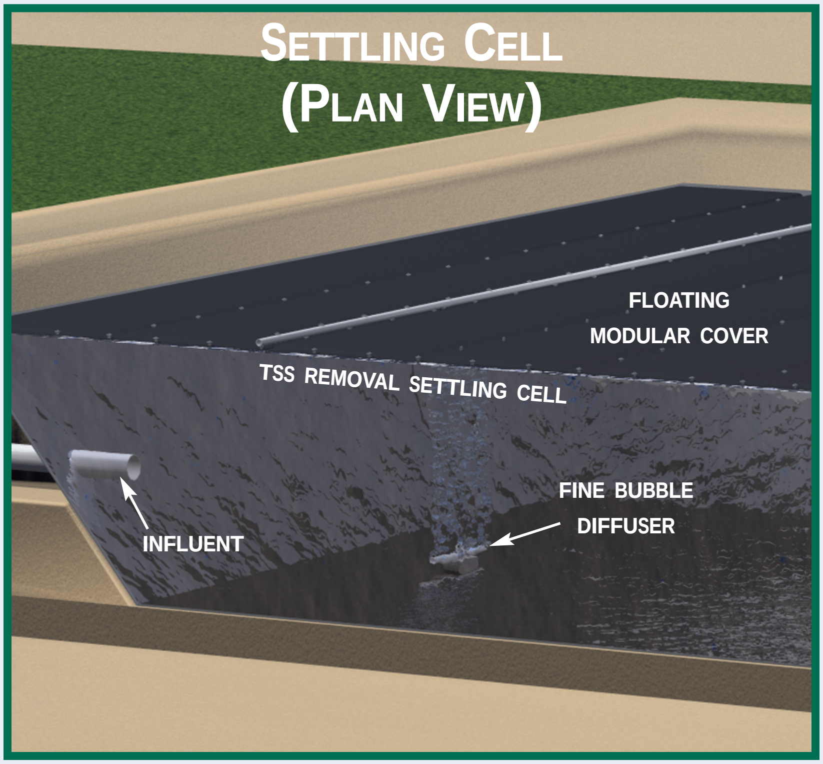
Achieving BOD levels below 10 mg/l reliably and consistently throughout the year. BOD removal to below 30 mg/l is accomplished in the complete mix and partial mix cells of the treatment process with final polishing to below 10 mg/l in the Lemna Polishing Reactor, if required. Lemna's design minimizes temperature fluctuations and the adverse treatment effects of peak flow events on BOD removal. Our low horsepower design is efficient in both aeration and mixing and requires a smaller footprint that is typically 12 days or less in detention time.



TSS Removal



Lemna's settling cell - a clarifier without the moving parts. The settling pond, covered with the LemTec™ Modular Cover, creates an effective zone for clarification of biosolids. The cover prevents algae growth by eliminating sunlight and improves clarification in two ways: 1) it prevents wind action on the water surface, thereby establishing a quiescent zone for solids to settle; and 2) the insulation minimizes seasonal and diurnal temperature fluctuation thereby reducing stirring by thermal currents. In addition, the anaerobic environment in the settling pond digests the biosolids significantly over time with no sludge disposal required for at least 5 to 7 years.

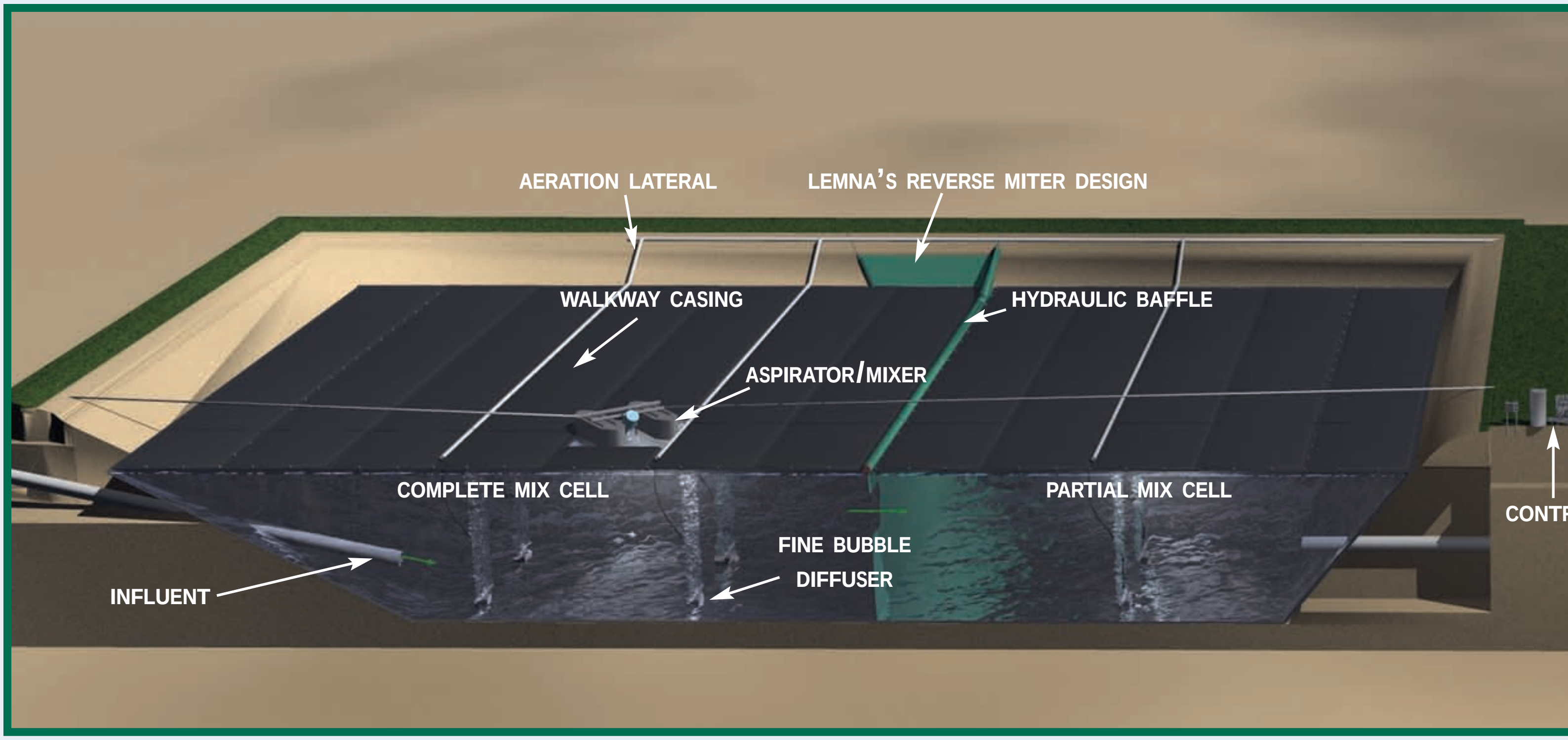


The LemTec™ Biologic

"We have done numerous projects over the last five years using Lemna Technologies Inc., and I highly recommend this company. They are very proficient, have excellent take-offs, detailed instructions, the product is easy to install and their supervisors are knowledgeable and skilled. We look forward to the next opportunity to work with them." **Contractor - T.S., Louisiana**

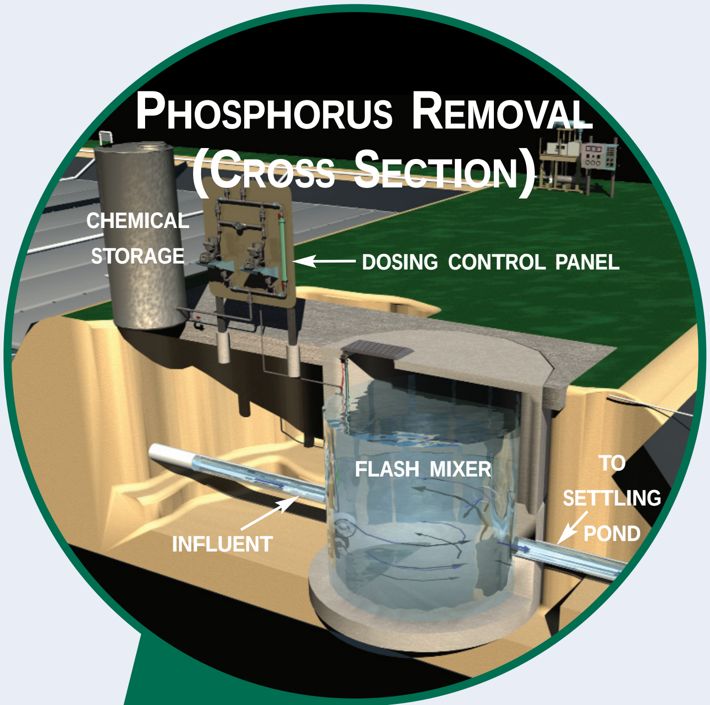
"Since installation, we have noticed excellent odor control, algae control, and our effluent test levels are remarkable. To encourage the choice of Lemna Technologies products, we welcome anyone interested to tour our facilities and/or review our weekly test results." **Client - J.R., Iowa**

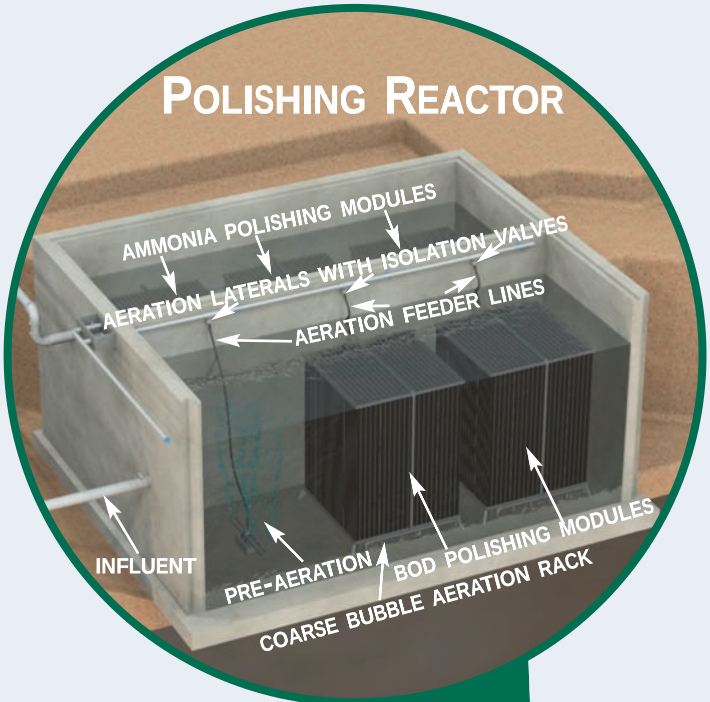
Lemna's cover and staff have provided performance as promised. Anytime we've had questions related to technical support, Lemna has been prompt in their response. I can safely state that maintenance on our cover has been virtually non-existent, and I highly recommend Lemna for anyone considering them for a cover or liner." **Client - R.L., Minnesota**

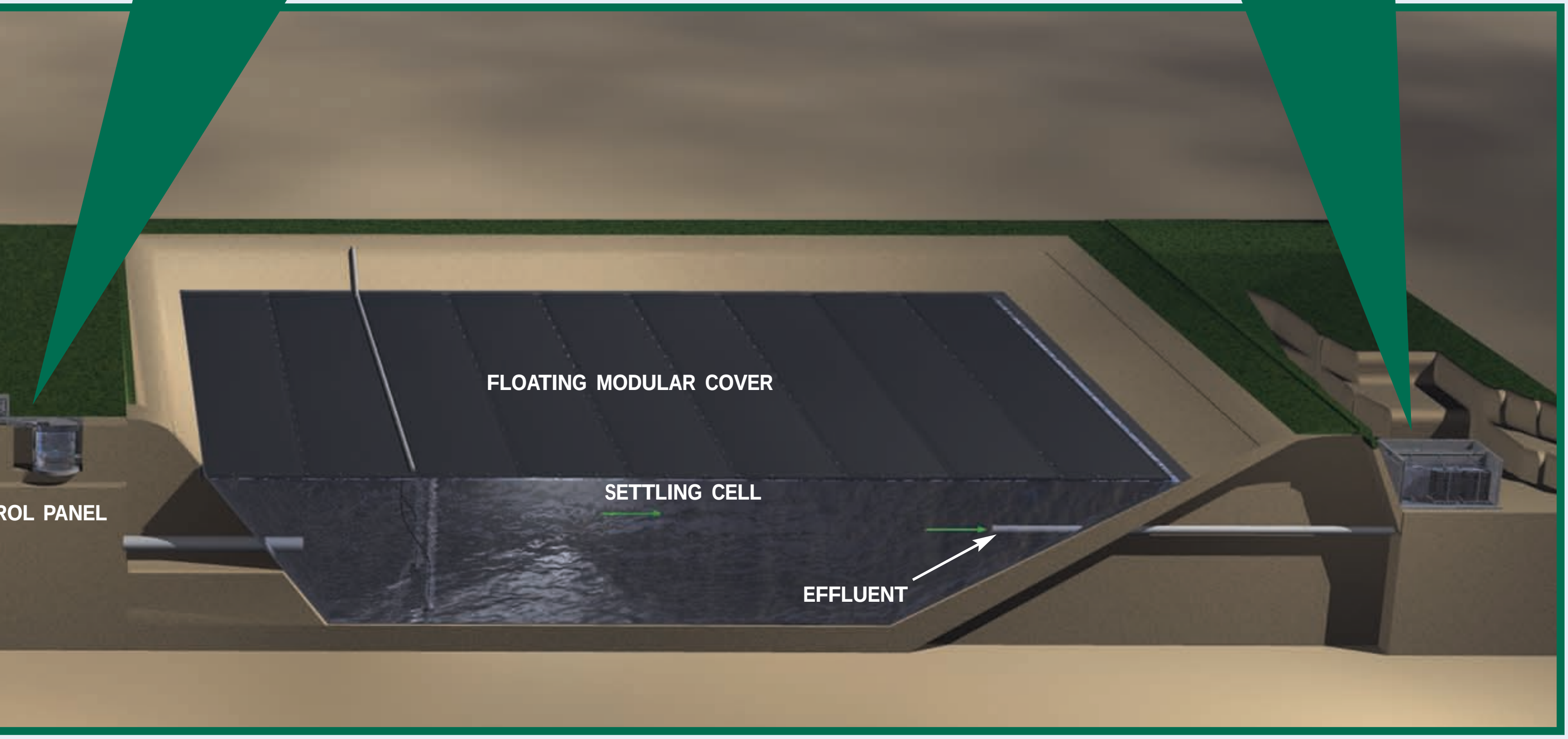


Custom-designed to me

CAL TREATMENT PROCESS

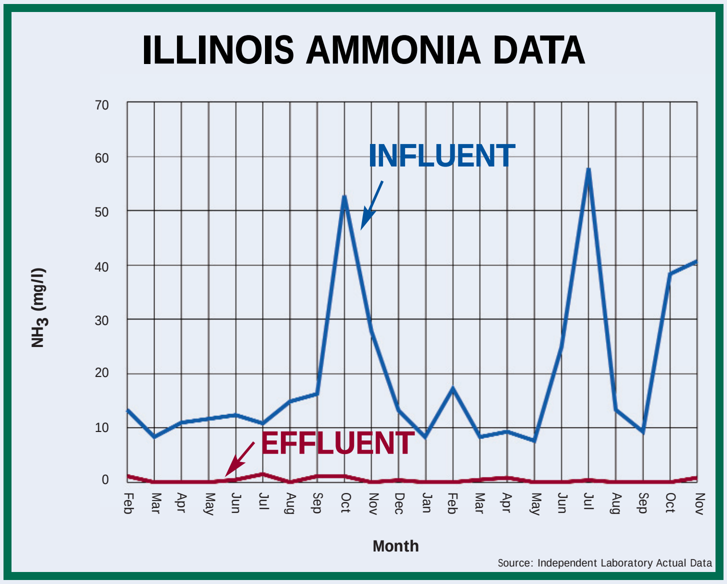




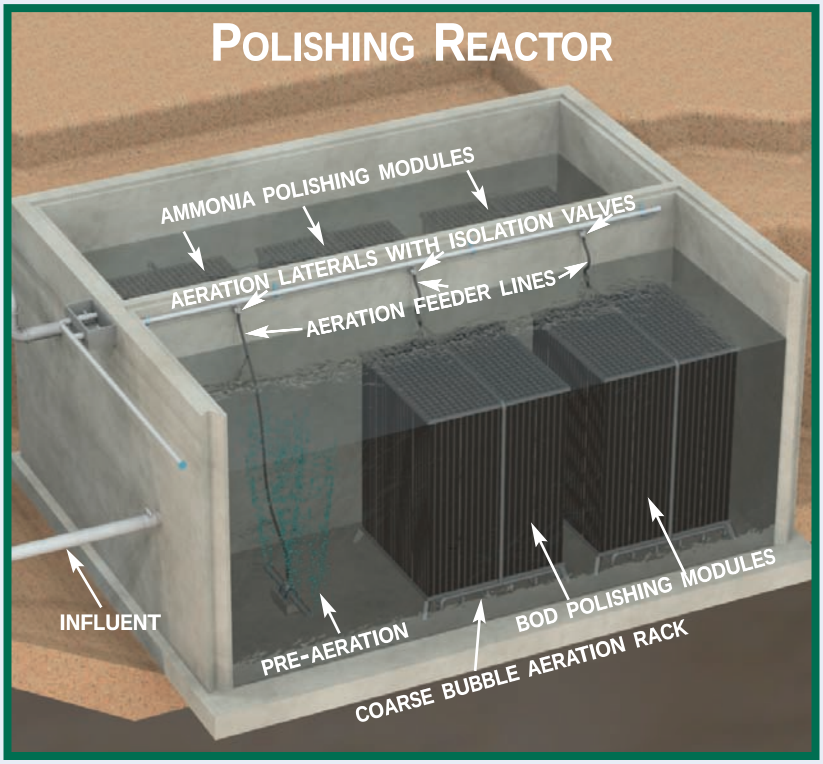


ET YOUR SPECIFIC NEEDS!

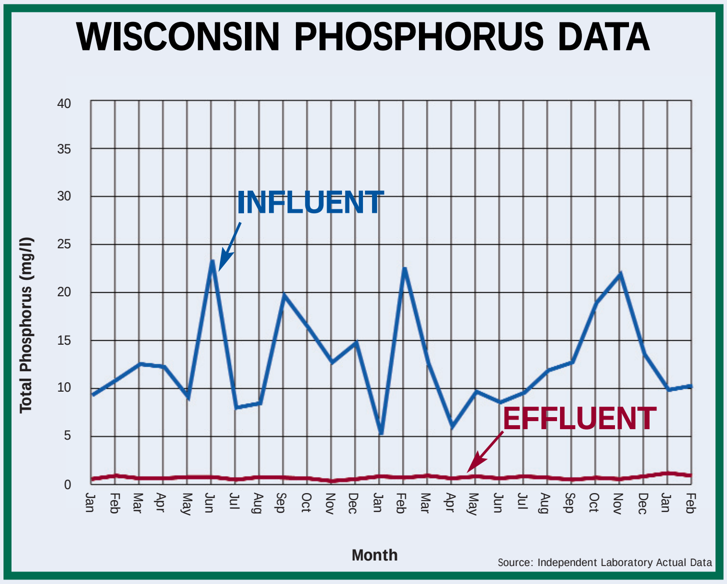
Ammonia Removal



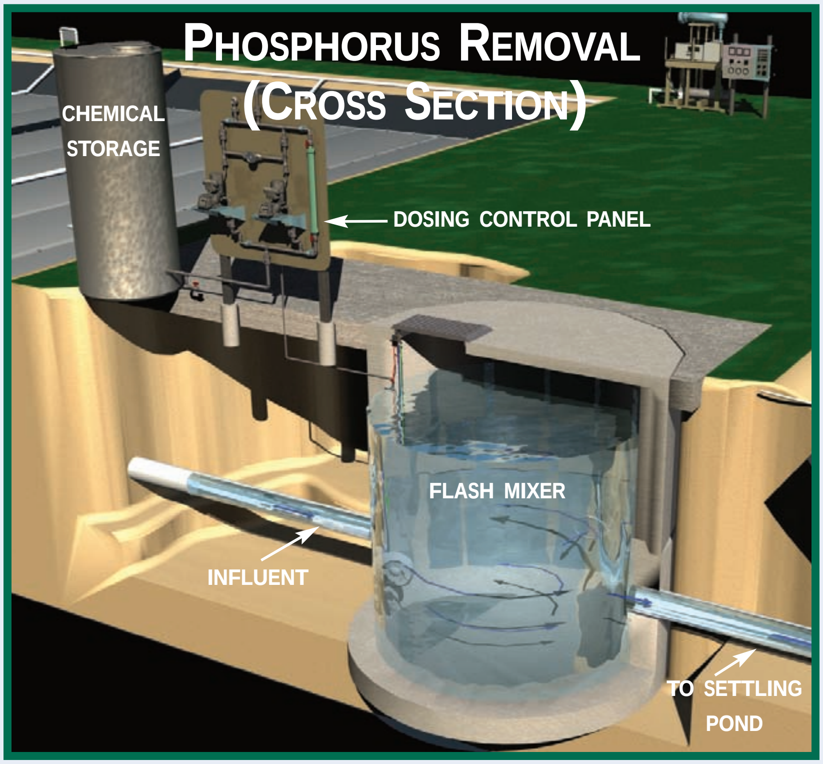
The Lemna Polishing Reactor (LPR) reduces Ammonia Nitrogen (NH_3-N) and BOD. The majority of both BOD and Ammonia removal in the Lemna design occurs in the complete mix cell. However, the LPR is included in the LBTP design to meet low BOD_5 (<10 mg/l) and NH_3 (<1 mg/l) limits if required. The LPR utilizes fixed media to promote an environment for submerged attached-growth bacteria. The LPR is composed of stainless steel hardware and frames that compress UV resistant PVC media, making the reactor sturdy and one of the best filters in the industry.



Phosphorus Removal



We use a chemical dosing system, low horsepower pumps and mixers that make operation easy. Phosphorus is precipitated chemically by the addition of coagulants, including alum or ferric chloride. Precipitation causes contaminants that are either dissolved or suspended to settle out of solution as solid floc particles that are removed along with waste biological sludge. Our system is low cost and reliable.

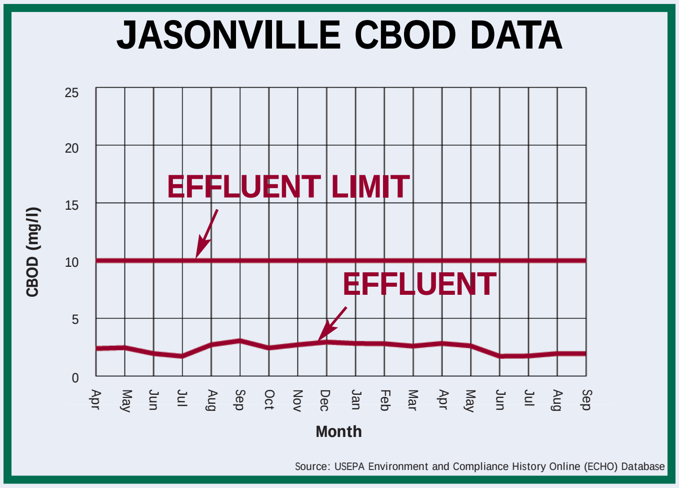


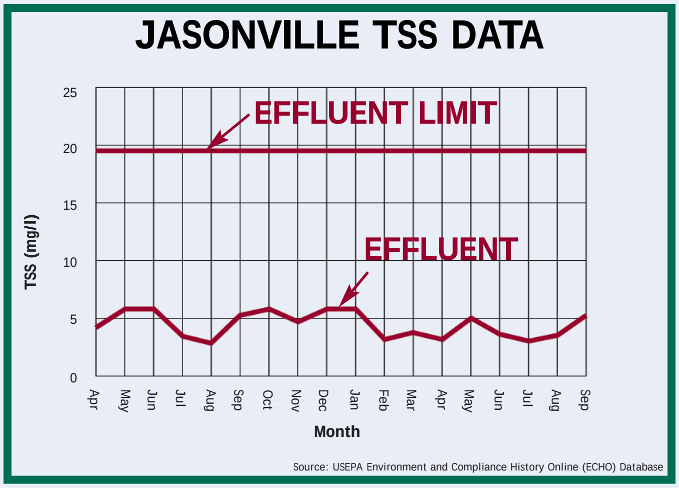
Case History

Aerated lagoon upgrades

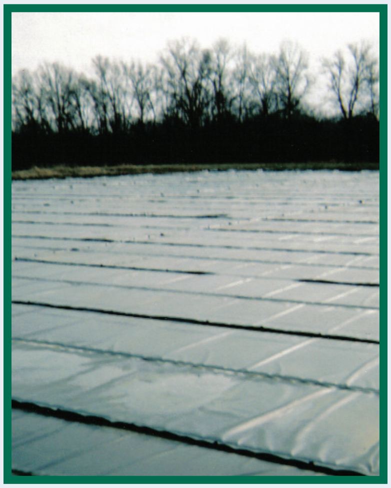
Case Study: Jasonville, Indiana

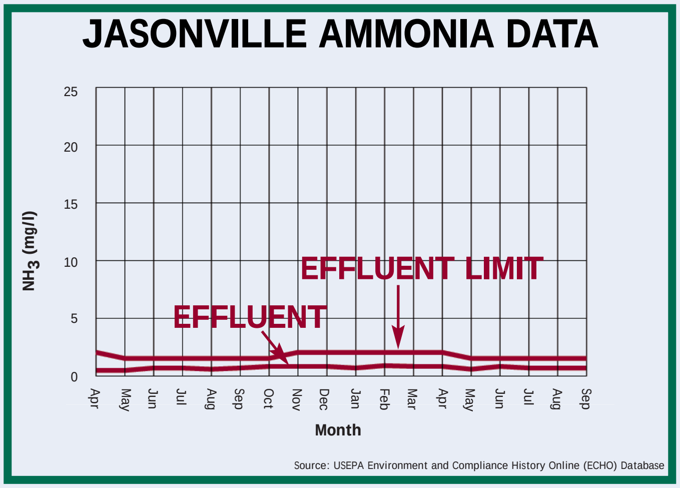
Project Background: The wastewater treatment plant, located in Jasonville, Indiana, was an existing lagoon system that no longer performed to the new environmental regulations for Ammonia. The Ammonia removal process, which is difficult in any wastewater treatment system, is especially complex in cold weather climates like Jasonville.





This system was designed to incorporate the existing lagoons and aeration equipment to create the most cost effective system. There were two existing large wastewater treatment ponds. The entire first pond was incorporated into this design and half of the second pond was used by constructing a berm in that pond. The aeration pond has a detention time of 15.8 days. The aeration cell is partially mixed. New diffused aeration was added to supplement the existing aeration. The third cell is a settling cell with a detention time of 7.4 days. The settling pond is followed by a Lemna Polishing Reactor (LPR) consisting of sixteen media modules for effluent polishing.





Site Performance: The Jasonville facility provides reliable removal of CBOD, TSS and Ammonia over a wide range of operating conditions including high flows, cold operating temperatures and variable loads.

FEATURES AND BENEFITS

Easy to Operate

- Minimal operator requirements
- No complicated sludge handling
- No solids return/recycle
- Start-up and operator training provided

Flexible Designs

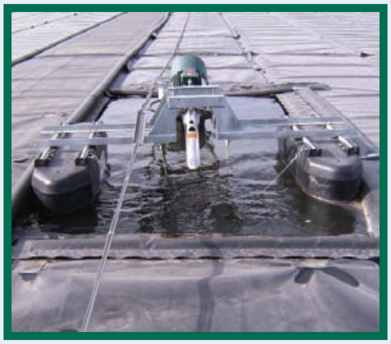
- New or existing lagoons
- Reliable at high or low flows
- Easy to expand for future flows
- Designs for any climate

Affordable

- Small footprint and land required
- Minimal HP required
- Low operator costs
- Simple construction

Proven Technology

- 25 years of experience
- The leader in lagoon nitrification
- Dedicated to the environment

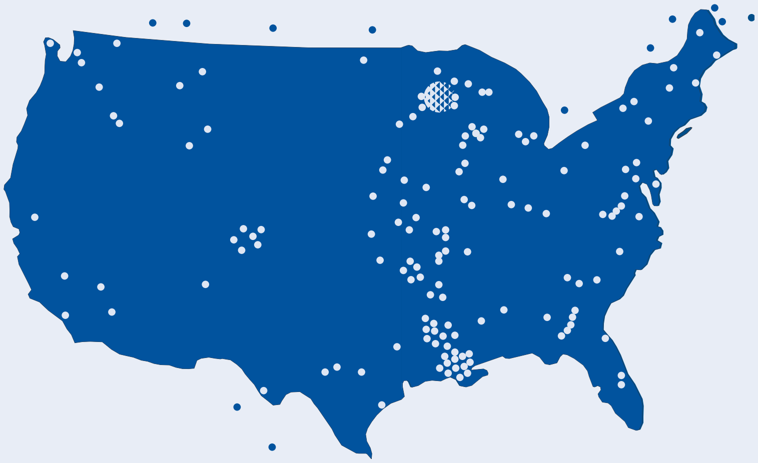


"The city purchased a turn-key wastewater treatment facility over 20 years ago. I would recommend Lemna to any community or industry in need of water treatment." ***Client - J.M., North Dakota***

Wastewater Treatment Experts

Lemna has been the world leader for more than 25 years in high-performance lagoon-based wastewater treatment technologies. We have 100's of treatment facilities with installations on four continents.

Headquartered in Minneapolis, Minnesota, Lemna designs and installs systems for all municipal and industrial applications. Lemna provides a full range of wastewater design and engineering services, backed by exceptional results and customer service.



"LEMNA PROVIDES A SIMPLE SOLUTION FOR WASTEWATER TREATMENT PROBLEMS"

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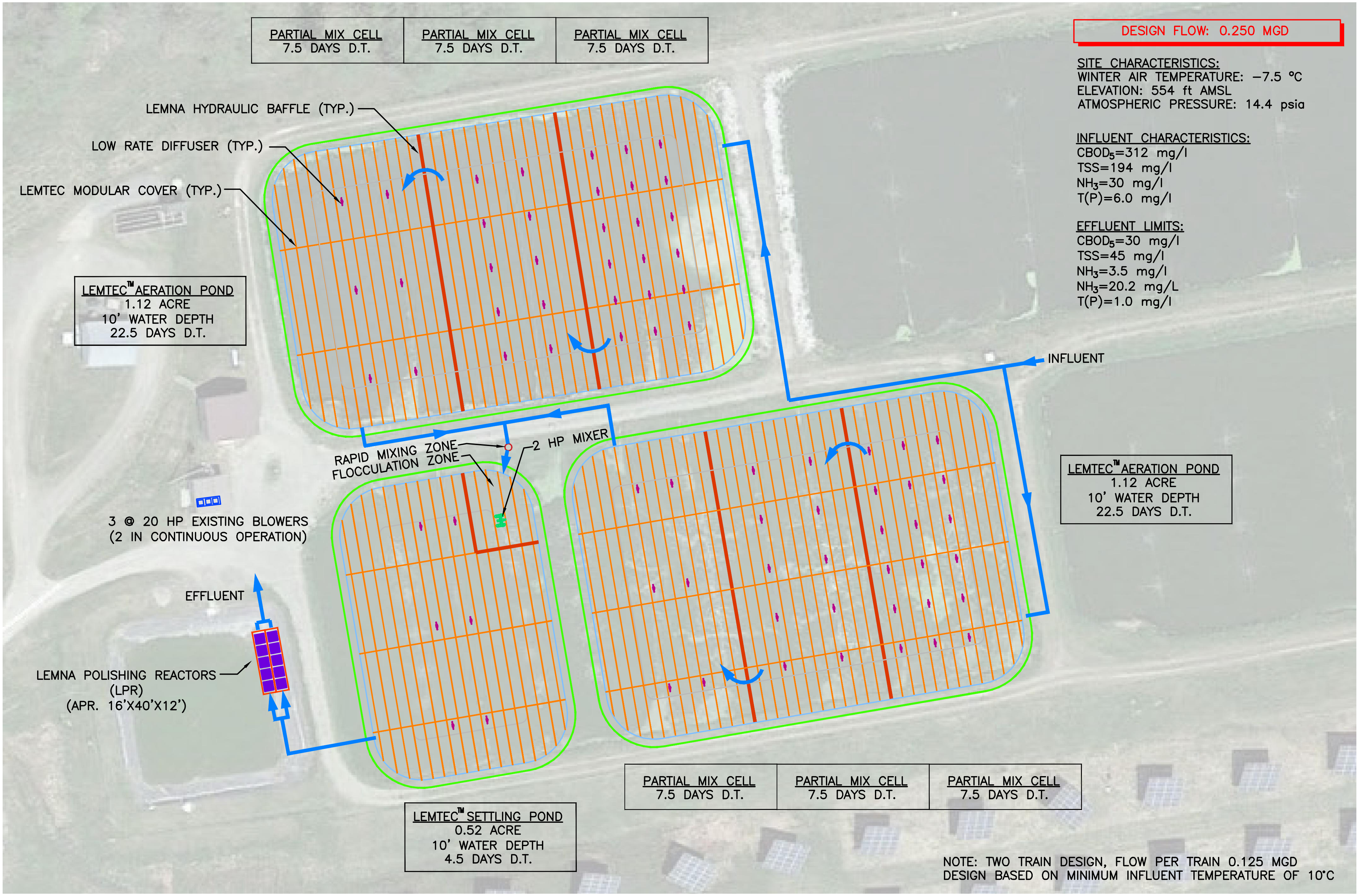

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APPROVED BY: TB
SCALE: NOT TO SCALE
DATE: APRIL 2019
SHEET NO: 1 OF 1

LEMTEC™ BIOLOGICAL TREATMENT PROCESS
HINESBURG, VT

L·E·T
LEMNA ENVIRONMENTAL TECHNOLOGIES, INC.
4215 WHITE BEAR PARKWAY, SUITE 200 • VADNAIS HEIGHTS, MN 55110
PHONE: 612-253-2000 FAX: 612-253-2003 WWW.LEMNATECHNOLOGIES.COM

APPENDIX H

BALLASTED FLOCCULATION

HINESBURG, VT

COMAG™ CONCEPTUAL PROPOSAL

ALDRICH & ELLIOT

November 2018

Evoqua Sales Contact:
Matthew Vareika
Matthew.Vareika@evoqua.com

CONTENTS

Evoqua Water Technologies is pleased to present a preliminary CoMag system proposal. The CoMag Treatment System is an innovative and proven technology for the removal of solids, heavy metals and other particulate or precipitated contaminants. The CoMag process is based on conventional coagulation and flocculation but uses an innovative ballast material which differentiates the process from other technologies. The ballast material is magnetite (Fe_3O_4), which is a fully inert, high specific gravity (5.2), finely ground, non-abrasive, iron ore. Additionally, the magnetite ballast used in the CoMag system is NSF/ANSI 61 certified for use in drinking water applications.

The treatment goals for this facility, in applying the CoMag system, are to:

- Achieve an effluent phosphorus concentration of 0.15 mg/l;
- handle highly variable flows and solids loads

1 DESIGN SUMMARY

Table 1 summarizes the design basis for the proposed CoMag system.

Table 1: Design basis.

Parameter	Units	Design
Design Average Daily Flow	MGD	0.325
Design Peak Day Flow	MGD	0.78
Design Peak Hourly Flow	MGD	1.04
Design Average Daily Influent Total Suspended Solids	mg/L	50
Design Average Daily Influent Total Phosphorus	mg/L	2

Table 2 summarizes the effluent performance used as the basis for the proposed CoMag system.

Table 2: Effluent performance.

Parameter	Units	Design
Average Monthly Effluent Total Suspended Solids	mg/L	10
Average Monthly Effluent Total Phosphorus	mg/L	0.15

Table 3 summarizes the preliminary process configuration for the proposed CoMag system. This configuration may be adjusted to best fit, but the Hydraulic residence times should be maintained.

Table 3: Preliminary process configuration.

Parameter	Design
Number of Static Mixers	1 (8")
Number of Treatment Trains	1
Coagulation Reaction Tank (T-1) volume	1400 gal
Ballast Reaction Tank (T-3) volume	700 gal
Polymer Reaction Tank (T-4) volume	700 gal
Clarifier Type	Conventional Circular
Clarifier Dimensions	10′ × 10′ SWD

2 COMAG OPERATING COSTS

The estimated operation and maintenance requirements listed below are based on past experience at other CoMag installations. The quantities listed herein are estimates and do not represent a warranty or guarantee. The actual requirements might differ due to differences in the influent wastewater characteristics and the manner by which the system is operated.

2.1 Electrical Loads and Chemical Use

As guidance and reference, Table 4 lists the main consumables associated with the CoMag system recommended for this project

Table 4: Estimated CoMag consumables.

Item	Guidance
Daily magnetite usage	~ 15 lb per MGD treated
Power usage of CoMag equipment	~ 160 kWh/d
Polymer – as dry active	0.5 – 1.0 mg/L
Coagulant	To be discussed
Caustic	To be discussed

3 FUTURE DESIGN EVALUATION NEEDS

The following design features will need to be evaluated and discussed in more detail as the CoMag design progresses:

- Chemical feed systems; chemical preference
- Coagulant addition and dispersion method
- Location of magnetic drums in relation to reaction tanks
- Building and equipment layout consideration
- Upstream unit operation
- Sludge Handling

4 SCOPE OF SUPPLY

Table 5 below is a summary of Evoqua's scope of supply for the proposed CoMag system included in this budgetary proposal.

Table 5: Evoqua scope of supply.

Item	Quantity	Description
CoMag Components		
Mixer – inline static	1	8" FRP
Mixer – coagulation tank	1/tank	Pier mounted, vertical shaft 1.5 HP
Mixer – ballast tank	1/tank	Pier mounted, vertical shaft 1.5 HP
Mixer – polymer tank	1/tank	Pier mounted, vertical shaft 1.5 HP
Clarifier internals	1/clarifier	
Pump – return sludge / waste sludge	2	Centrifugal, 50 gpm, 2 HP
Magnetic recovery drum separator	1	1.5 HP
Sludge shear mixer	1/drum	1 HP
Flow meters	3	Influent feed, Waste sludge, and re-cycle sludge
Level sensors/switches	3	Reaction tank high level, mag drum proximity and high level
Probes	2	pH, Turbidity
Control System Hardware		
Control panel	1	Control panel, HMI, PLC, I/O

Item	Quantity	Description
Services		
Engineering support		Site visits/design kickoff; basis of design engineer support
Installation oversight, start-up, commissioning, performance testing and training		Up to 21 days

Appendices

Appendix A – Frequently Asked Questions

1. General questions about magnetite, the fundamental element used in CoMag to increase settling rates and reliability.

Q. What is magnetite?

A. Magnetite is oxidized iron ore (Fe_3O_4). It is completely inert; it cannot rust; it doesn't degrade with time or usage; it has no effect on biological floc; and it is not magnetic itself; i.e., it doesn't stick to metal.

Q. How does magnetite improve the performance of clarifiers and biological treatment systems?

A. Magnetite is a very dense material with a specific gravity of 5.2. By comparison the specific gravity of water is 1.0; a chemical hydroxide floc is fractionally over 1.0. By infusing magnetite into a chemical floc, the specific gravity is significantly increased; thereby increasing the settling rate of the floc and gaining consistent control of the sludge blanket in the clarifier and greater stability for the whole system.

Q. Is magnetite readily available?

A. Yes, magnetite is mined and processed at multiple sites around the world. In the USA, Evoqua has identified multiple vendors that will provide magnetite to our specifications.

Q. What is the cost of magnetite?

A. Magnetite is inexpensive, ranging from $0.20 to $0.50 per pound delivered, depending on the location of the distributor and the facility. Moreover, since the recovery rates of magnetite in CoMag systems are so high, daily consumption is very low; so much so that in assessing the operating cost of a CoMag system, the ongoing cost of magnetite is of no consequence.

Q. Is the magnetite abrasive? Does magnetite cause excessive wear to pumps?

A. Unlike micro-sand, a ballast used by our competitors, Evoqua specified magnetite is so fine that it has the consistency of talcum powder. Hence, it is not abrasive and doesn't cause abnormal wear and tear on a treatment systems pumps, mixers, valves and other components. At the seminal CoMag plant in Concord, MA there has been no discernable wear on the plants sludge pumps or mixers after 5.0 years of operation.

Q. Does magnetite degrade at high temperatures (or low temperatures) or with changes in pH?

A. Magnetite does not undergo any physical or chemical change in the temperature and pH ranges associated with almost all municipal and industrial wastewater treatment.

Q. Does magnetite affect pH or the chemical characteristics of the effluent?

A. No, magnetite is completely inert; has no effect on pH or the chemical characteristics of a system's effluent.

Q. Does magnetite affect the oxygen content of wastewater?

A. Since magnetite (Fe_3O_4) is oxidized, it does not consume dissolved oxygen in the wastewater.

Q. How much magnetite is recovered on the magnetic drum and where does the remainder go?

A. Evoqua has modified the design of conventional magnetic drums to optimize the capture and reuse of magnetite. In CoMag systems, the drums recover in excess of 99.8% of the magnetite in the sludge. Any magnetite not captured by the drum is carried away in the sludge where we have found no effect on downstream sludge management systems or processing.

Q. What is the impact of magnetite on the effluent; TSS, turbidity, etc.

A. Less than a half a percent of the magnetite used in CoMag escapes the system; hence, the direct effect on the effluent quality of either system is negligible. It is however, the use of magnetite in Evoqua's CoMag systems that enables both systems to achieve such high levels of contaminant removal. For example, the effluent turbidity from the Concord CoMag system can be easily reduced to levels less than that of bottled drinking water.

Q. How does magnetite in the effluent effect the performance of a downstream UV disinfection system?

A. Since very little of the magnetite escapes the system, the direct effect is not discernable. In fact, CoMag as a tertiary polishing system is a UV enabler. The fact that CoMag can perform well with alum coagulants and achieve very high levels of transmissivity, makes it possible to employ less UV treatment (and power)to achieve required levels of pathogen removal. Concord uses only 50% of one of its three banks of UV to meet its permit levels.

2. QUESTIONS OFTEN ASKED ABOUT THE COMAG PROCESS AND PERFORMANCE:

Q. How does CoMag handle high flows and surges?

A. CoMag uses automated controls to rapidly respond to flow variations. CoMag is also particularly effective in maintaining high removal levels during surges in solids loading. Unlike other ballasted sedimentation systems, the CoMag process recycles a significant fraction of settled solids from its clarifier back to its reaction tanks. The high mass and density of solids in the reaction *tanks is many times greater than that of any surge in influent loading. The system is fully capable of managing surges in load with little degradation of performance. The result is superior solids removal, especially compared to those processes that don't incorporate an internal solids recycle.*

Q. Can CoMag equipment be serviced over the 20-year design period?

A. All the components of the CoMag process are readily available in the marketplace. The system employs standard pumps, mixers, piping, valves, clarifier systems, and instruments. The magnetic components have been used in the mining industry since the early 1970s. Spare parts are readily available from multiple sources.

Q. What is the cost to install CoMag including the cost of structures, equipment, connecting piping, peripheral support systems, associated power and instrumentation, etc?

A. The installation costs are low for a CoMag system because of its simplicity, small footprint, and readily available parts. In addition and unlike alternative solutions, CoMag may not need expensive post treatment filters to achieve the required treatment levels of current and expected future permits.

Q. What are the costs of chemicals, additives, power, equipment, and labor associated with the CoMag process.

A. Generally, the operational costs of CoMag are quite low.

Chemical consumption with CoMag is likely to be less than other competitive systems due to the ability of CoMag to achieve required treatment levels with less coagulant and flocculent.

The process provides for a nearly complete recovery and reuse of the magnetic ballast hence the cost is low.

Energy consumption is very low, using gravity to flow through the system with minimal required head. The ballast recovery drum employs permanent magnets and hence consumes no energy other than that required to turn the drum.

The system is fully automated; the need for operator attention is minimal.

Q. Are there major parts that will require replacement?

A. There are no major parts that will require replacement other than the perhaps the pumps and sludge shear mixer, which are expected to have a useful life of 10 years or more. Their replacement is a simple process as they are easily accessible and readily available. None of the parts are hazardous or would require special disposal.

Q. Does CoMag enable the use of alternative chemicals with the same performance?

A. *Yes. CoMag will produce nearly the same contaminant removal levels with alum, ferric chloride, or poly-aluminum chloride (PAC), and other conventional coagulants. The size of the CoMag system is the same for any coagulant, unlike other competitive systems. This gives the flexibility to meet limits with a coagulant chemical that best suits a plant's needs.*

Q. Are CoMag and its operation easily understood and operated?

A. *Yes, CoMag is very operator friendly. The system readily responds to changing influent flows and loads, easily handling excess solids from the secondary clarifiers. It has few parts needing replacement and CoMag requires no sand filters, which can clog and must be backwashed.*

Q. Can the process operate 24 hours with only being manned 8 hours a day?

A. *Yes. The CoMag system has fully automated PLC controls.*

Q. Are the process and its operation safe for operations and/or maintenance personnel?

A. *Yes. CoMag equipment complies with industry standards for safety. It uses chemicals that can be safely handled without additional or specialized training.*

Q. Does the process have operational flexibility such as taking some units out of service on a seasonal basis to save on operational costs?

A. *Yes. CoMag can be designed to provide a high level of redundancy when required and the ability to modify operations to meet effluent requirements*

The CoMag system is designed to treat peak flows and meet the treatment requirements.

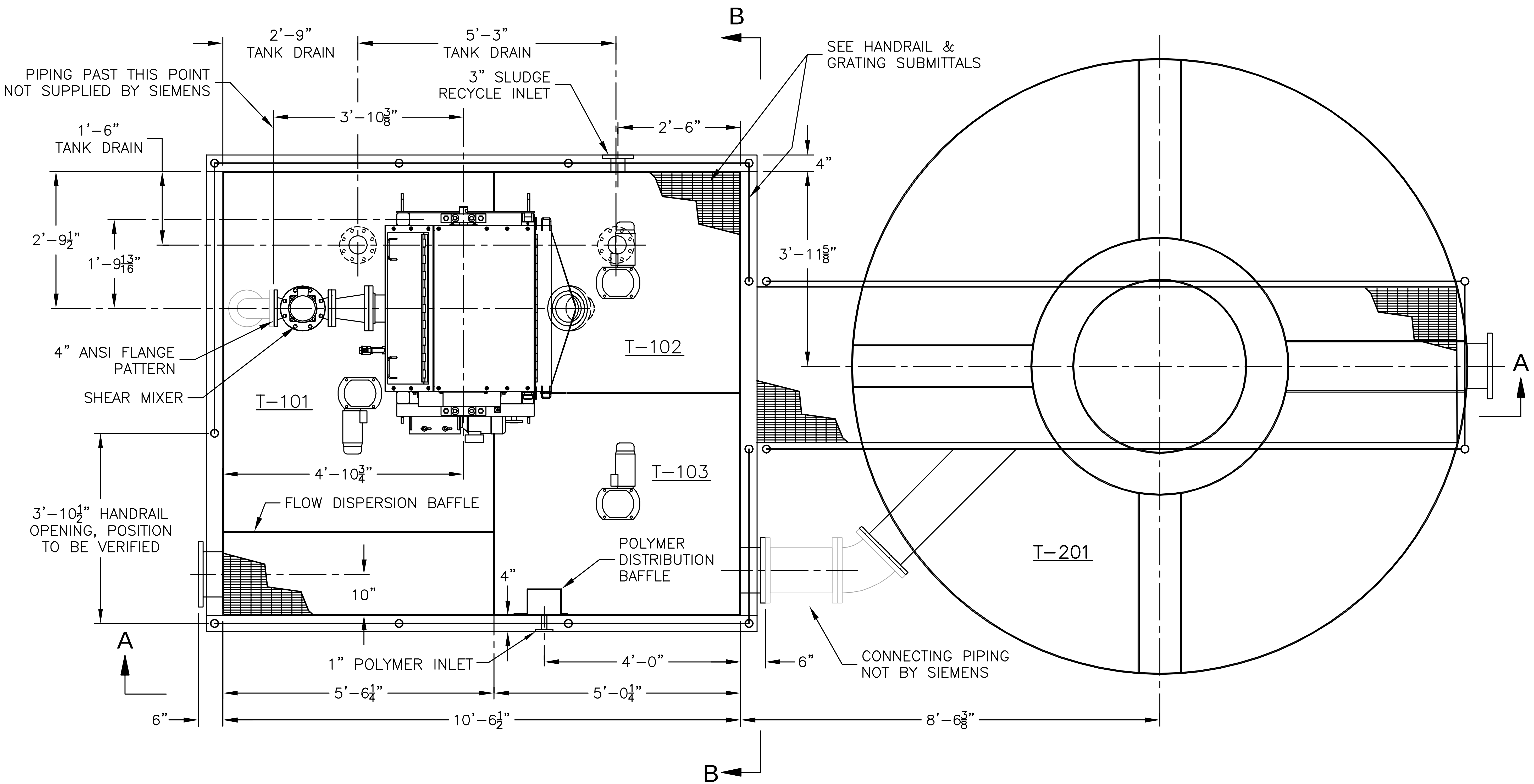
Inherent in the operation of CoMag is the ability to manage dosage levels to meet effluent contaminant requirements.

Q. Could the process have a negative effect on downstream unit operations, if needed for higher effluent quality in the future?

A. *Implementation of CoMag will eliminate the need for downstream filters, thus eliminating the associated capital and O&M costs.*

Q. Does the ballast rust or stick to steel pipe?

A. *No, the ballast is a type of iron ore that is oxidized and does not rust. It is attracted to magnets, but it does not attach itself to steel pipe.*



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CHECKER FEDIE	DATE
ENGINEER BMW	DATE 11/1/13
MANAGER RC	DATE 11/15/13
MADE FROM:	
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TITLE: GENERAL ARRANGEMENT – PLAN VIEW
REACTION TANKS & SOLIDS SEPARATION TANK
CoMag EFFLUENT POLISHING SYSTEM

CUST.: KINGSBURY COMPANIES LLC
LOC.: VILLAGE OF WATERBURY, VT
ENG.: STANTEC

SIEMENS Industry
Waukesha, WI
262-547-0141

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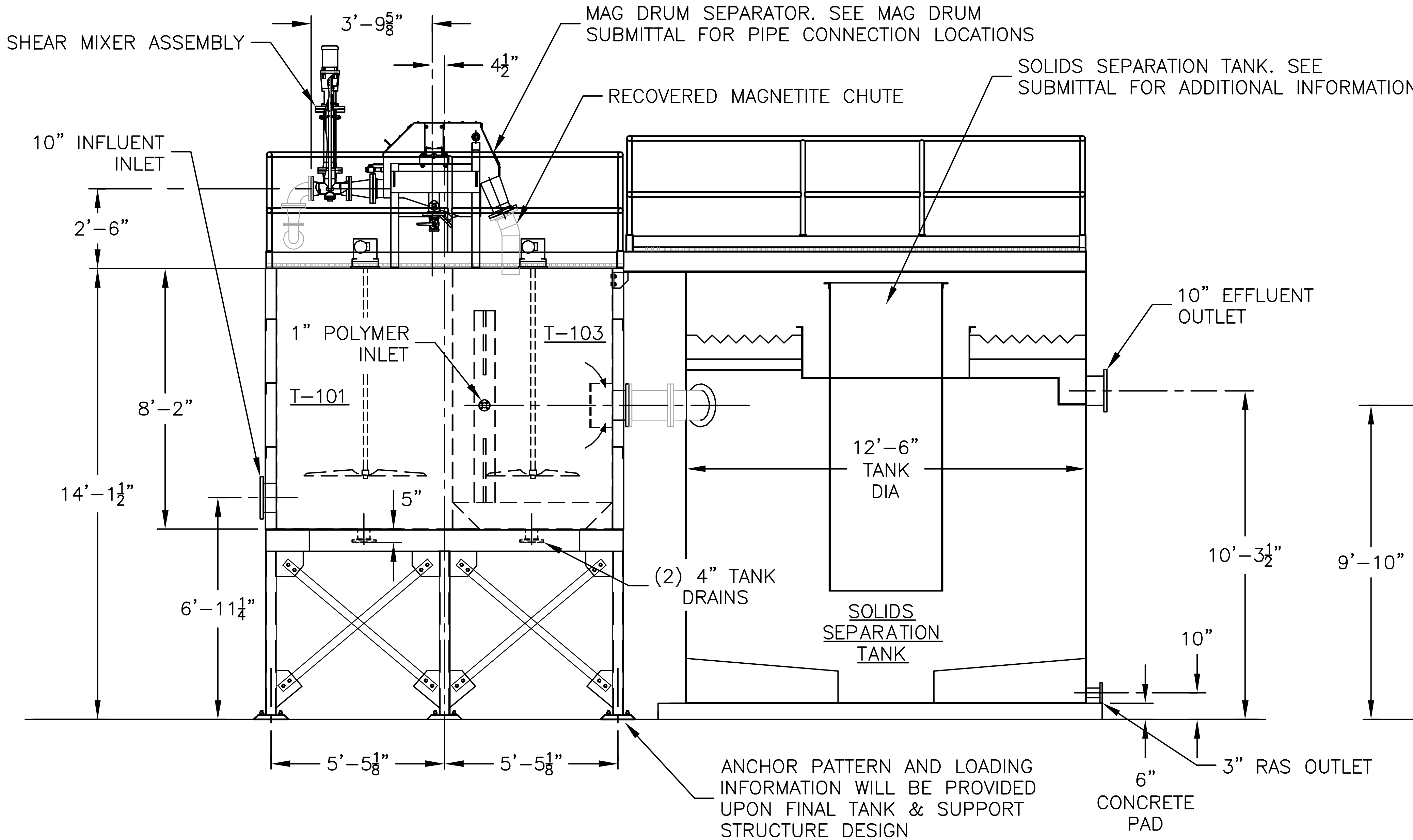

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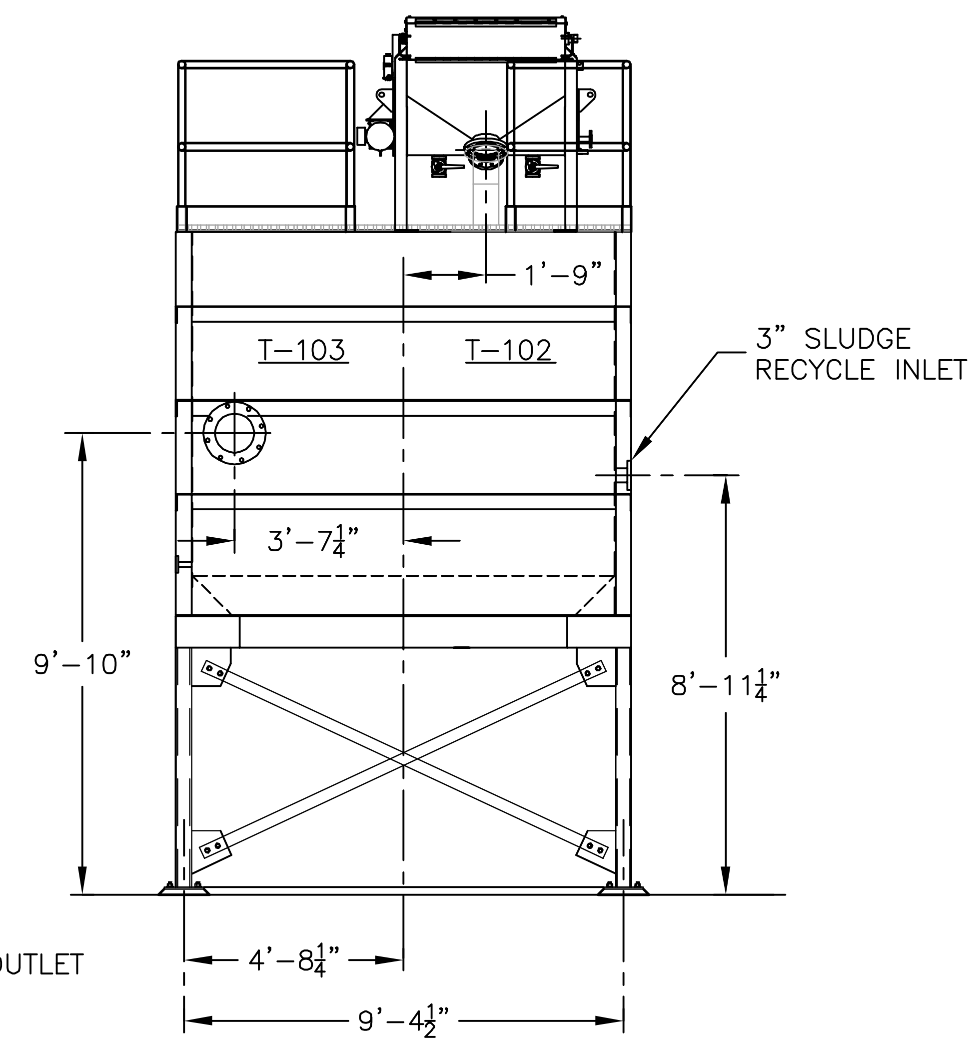

SECTION B-B/104

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

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DESIGNER	RJF	DATE 11/7/13
CHECKER	FEDIE	DATE
ENGINEER	BMW	DATE 11/1/13
MANAGER	RC	DATE 11/15/13
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REACTION TANKS & SOLIDS SEPARATION TANK
CoMag EFFLUENT POLISHING SYSTEM

CUST.: KINGSBURY COMPANIES LLC
LOC.: VILLAGE OF WATERBURY, VT
ENG.: STANTEC

SIEMENS Industry
Waukesha, WI
262-547-0141

PROJECT	CODE	DRAWING	SHEET	REV
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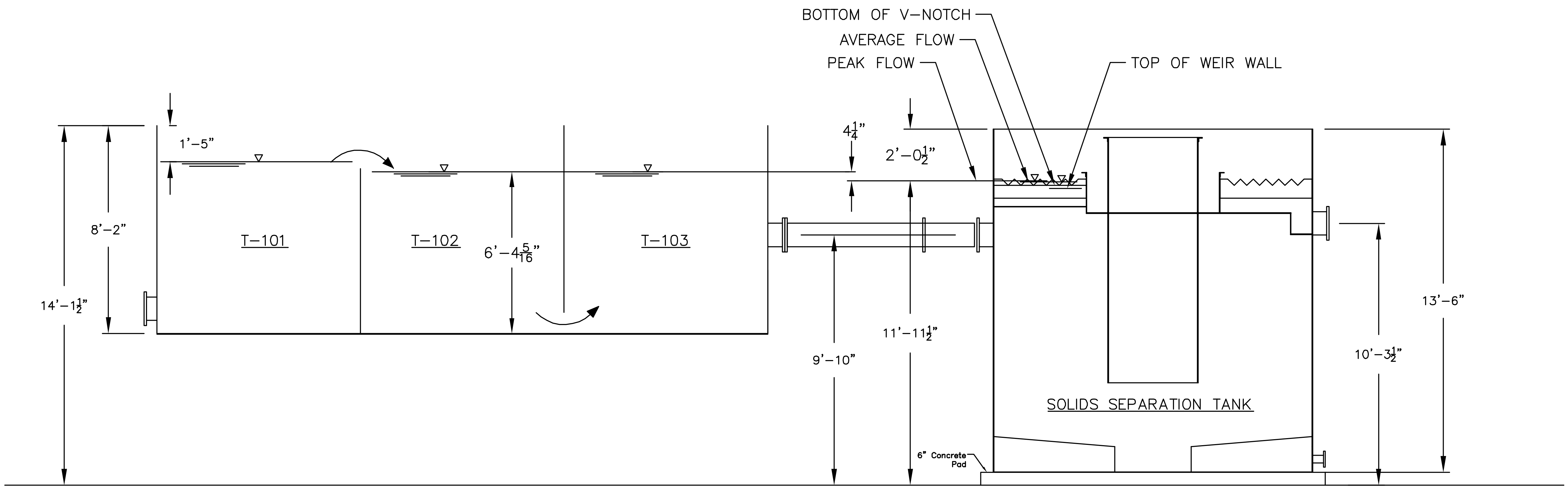

PRELIMINARY
NOT TO BE USED FOR
CONSTRUCTION
PURPOSES

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
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CHECKER	FEDIE	DATE
ENGINEER	BMW	DATE 11/1/13
MANAGER	RC	DATE 11/15/13
MADE FROM:		
SCALE:	1/4" = 1'	

TITLE: GENERAL ARRANGEMENT – HYDRAULIC PROFILE
REACTION TANKS & SOLIDS SEPARATION TANK
CoMag EFFLUENT POLISHING SYSTEM

CUST.: KINGSBURY COMPANIES LLC
LOC.: VILLAGE OF WATERBURY, VT
ENG.: STANTEC

SIEMENS Industry
Waukesha, WI
262-547-0141

PROJECT	CODE	DRAWING	SHEET	REV
2033/000318	8002B	45094-106	1 OF 1	A

APPENDIX I

SBR AND CLOTH MEDIA FILTRATION

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

AquaSBR®

Sequencing Batch Reactor

AquaSBR®
Typical Applications

Biological Nutrient Removal

- 1.65 MGD Avg. Daily Flow
- Replaced flow-through activated sludge system for enhanced biological nutrient removal (EBNR) to meet Chesapeake Bay Initiative.

Nitrification

- 0.3 MGD Avg. Daily Flow
- Utilizes the ballast decanter option with process control via the IntelliPro system.

Industrial Pretreatment

- .075 MGD Avg. Daily Flow
- Treating high strength dairy waste since 1991.

Phosphorus Removal

- 2.7 MGD Avg. Daily Flow
- Dissolved oxygen control optimizes power consumption
- Process control achieves 98% removal of typical municipal wastewater's total influent phosphorus

Reuse

- 2.0 MGD Avg. Daily Flow
- 3-basin system followed by (2) AquaDisk® cloth media filters supplies reuse water to the nearby U.S. Army base for irrigation and cooling water

Retrofit

- 12 MGD Avg. Daily Flow
- 3-basin retrofit uses existing lagoons to meet today's nitrogen requirements

AquaSBR®

Sequencing Batch Reactor

For over 30 years, Aqua-Aerobic Systems has led the industry in sequencing batch reactor technology with performance proven and cost effective treatment systems capable of effectively removing nutrients and reducing phosphorus with the flexibility of process control that adapts to changing demands.

The AquaSBR® sequencing batch reactor provides true batch technology with all phases of treatment accomplished in a single reactor. All components are easily accessible and the advanced decant system ensures optimum quality effluent withdrawal. Treatment can be optimized with the IntelliPro® process monitoring and control system to further reduce operation and maintenance,energy costs and improve performance.

System Features and Advantages

- Independent aeration and mixing with the Aqua MixAir® system provides process advantages and lower energy consumption
- A true-batch system utilizes Mix-Fill, React-Fill, React, Settle and Decant phases within a single reactor
- The Mix-Fill phase is essential for effective phosphorus removal
- All components of the AquaSBR system are retrievable and easily accessible
- No secondary clarifiers and return activated sludge (RAS) lines
- Capable of enhanced biological nutrient removal:
  - Total nitrogen < 3 mg/l
  - Total phosphorus < 0.3 mg/l
- Hydraulic fluctuations are easily managed through the flexibility of a time managed process operating strategy
- Low cost of ownership

Aqua MixAir® System

The AquaSBR sequencing batch reactor utilizes the Aqua MixAir® system by providing separate mixing with the AquaDDM® direct-drive mixer and an aeration source such as the Aqua-Jet® surface aerator or Aqua-Aerobic diffused aeration. This system has the capability to cyclically operate the aeration and mixing to promote anoxic/aerobic and anaerobic environments with low energy consumption. In addition, the Aqua MixAir system can achieve and recover alkalinity through denitrification, prevent nitrogen gas disruption in the settle phase, promote biological phosphorus removal, and control certain forms of filamentous bacteria.

Advanced Decanter

The Aqua-Aerobic floating decanter follows the liquid level, maximizing the distance between the effluent withdrawal and sludge blanket. It is an integral component to the AquaSBR system and provides reliable, dual barrier subsurface withdrawal with low entrance velocities to ensure surface materials will not be drawn into the treated effluent. The electric actuated or ballast decanter option is easily accessible from the side of the basin and requires minimal maintenance.

AquaSBR®
Phases of Operation

The AquaSBR sequencing batch reactor system features time-managed operation and control of aerobic, anoxic and anaerobic processes within each reactor including equalization and clarification. The AquaSBR system utilizes five basic phases of operation to meet advanced wastewater treatment objectives. The duration of any particular phase may be based upon specific waste characteristics and/or effluent objectives.

1 Mix-Fill

- Influent flow enters the reactor
- Mixing is initiated with the AquaDDM mixer to achieve complete mix of the reactor contents in the absence of aeration
- Anoxic conditions are created which facilitate removal of any residual nitrites/nitrates (NO_X) via the process of denitrification
- In systems requiring phosphorus removal, the Mix-Fill phase is extended to create anaerobic conditions where phosphorus accumulating organisms (PAO) release phosphorus then ready for subsequent luxury uptake during aeration times
- Anoxic conditions assist in the control of some types of filamentous organisms

3 React

- Influent flow is terminated creating true batch conditions
- Mixing and aeration continue in the absence of influent flow
- Biological/chemical oxygen demand (BOD/COD) and ammonia nitrogen (NH_3) reduction continue under aerated conditions
- Oxygen can be delivered on a "as needed" basis via dissolved oxygen probes while maintaining completely mixed conditions
- Provides final treatment prior to settling to meet targeted effluent objectives

4 Settle

- Influent flow does not enter the reactor
- Mixing and aeration are terminated
- Ideal solids/liquid separation is achieved due to perfectly quiescent conditions
- Adjustable time values allow settling time to match prevailing process conditions

2 React-Fill

- Influent flow continues under mixed and aerated conditions
- Intermittent aeration may promote aerobic or anoxic conditions
- Biological/chemical oxygen demand (BOD/COD) and ammonia nitrogen (NH_3) are reduced under aerated conditions
- Luxury uptake of phosphorus is produced under aerated conditions
- NO_x is reduced under anoxic conditions
- Separation of aeration and mixing allows the aeration source to be turned down during low flow conditions to conserve energy while the system's flexibility allows nitrification/denitrification to be easily managed

5 Decant/Sludge Waste

- Influent flow does not enter the reactor
- Mixing and aeration remain off
- Decantable volume is removed by subsurface withdrawal
- Floating decanter follows the liquid level, maximizing distance between the withdrawal point and the sludge blanket
- Small amount of sludge is wasted near the end of each cycle

IntelliPro®
Process Monitoring and Control System

The IntelliPro system is a personal computer (PC) based program that interfaces with the AquaSBR system's programmable logic controller (PLC) via a network connection to assist operators in optimizing the treatment process of the plant and further reducing operating costs.

System Advantages

- Real-time, online monitoring and control
- "Active Control Mode" which automatically receives, interprets and proactively adjusts in-basin instruments and process variables including biological nutrient removal, chemical addition and energy
- Reduces the operator's sampling time
- Real-time and historical graphical trending of process parameters
- BioAlert™ process notification provides corrective action to eliminate operational interruptions and upsets
- Assists in the optimization of enhanced nutrient removal
- Online operation and maintenance support
- Remote troubleshooting provides on-demand troubleshooting assistance

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Cloth Media Filtration

Featuring OptiFiber® Pile Cloth Media

Aqua-Aerobic® Cloth Media Filtration

Featuring OptiFiber® Pile Cloth Media

In the early 1990s Aqua-Aerobic Systems revolutionized tertiary treatment by introducing Cloth Media Filtration utilizing a disk configuration. Since then, over 70 different media have been researched and tested with a select few that are currently being applied to five mechanical configurations in a variety of applications including: water reuse, low level phosphorus, stormwater and primary treatment.

Effective Depth Filtration

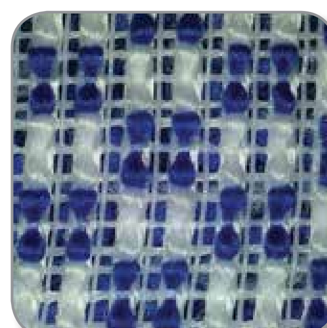
The original OptiFiber® pile cloth media is specifically engineered for water and wastewater applications and designed to maximize solids removal over a wide range of particle sizes. Deep, thick, pile fibers capture particles for the most effective depth filtration. OptiFiber media is exclusive to the entire line of cloth media filter configurations including:

- AquaDisk®
- Aqua MegaDisk®
- AquaDiamond®
- Aqua MiniDisk®
- AquaDrum®

OptiFiber PA2-13®

OptiFiber PES-13®

OptiFiber PES-14®



Unique Backing Design

OptiFiber® Media Advantages

- Woven, precision fibers provide strength and durability
- Discrete pile fibers effectively release solids during backwash
- Open backing minimizes potential for biofouling
- Low backwash volume results in water savings and energy reduction
- Variety of application-specific cloth including 5 µm nominal pore size media

OptiFiber® Cloth Filtration Media

Awarded BlueTech® Research Innovation Badge

Shown is pile cloth media in its natural state (left) and its conditioned state (right).

Engineered Cloth Media

OptiFiber PES-14®

MICROFIBER CLOTH FILTRATION MEDIA

The latest in cloth media advancements is the OptiFiber PES-14 microfiber media. This media is specifically engineered to remove suspended solids, turbidity and fine particles up to 50% better than other filters or microscreens.

An AquaDisk® filter with Microfiber cloth treats cooling tower blow-down.

OptiFiber PES-14® Media Advantages

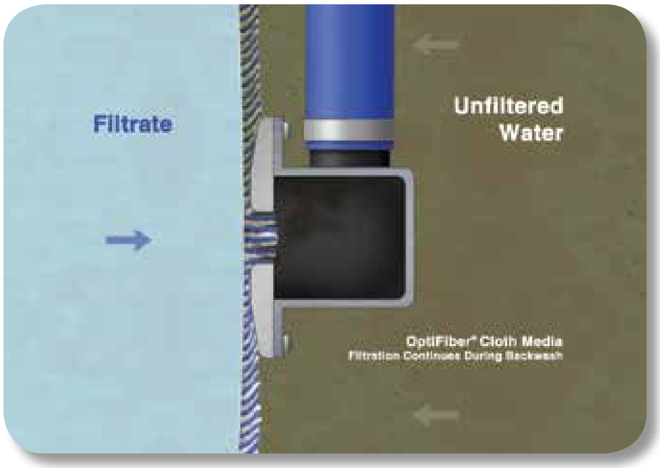
- Ideal for fine polishing applications
- Proven to reduce phosphorus to 0.1 mg/l or less
- More surface area for particle interception
- 5 micron nominal pore size removes small particles to enhance disinfection
- Maintains high filtrate quality even during backwash

An AquaDiamond® filter with Microfiber cloth polishes phosphorus to < 0.1 mg/l.

Backwash System

EFFECTIVE CLEANING WITH LESS WATER AND ENERGY

Maximum cleaning of the OptiFiber® cloth media is accomplished with a unique backwash system. The backwash shoe makes direct contact with the cloth media and solids are vacuumed from the surface. During backwash, fibers fluidize to provide an efficient release of stored solids deep within the fiber depth.



Backwash shoe makes direct contact with the media.

Backwash System Advantages

- Filtration continues during backwash
- Initiated at a pre-determined liquid level or time
- Low backwash rates
- Less water volume required
- Low energy consumption

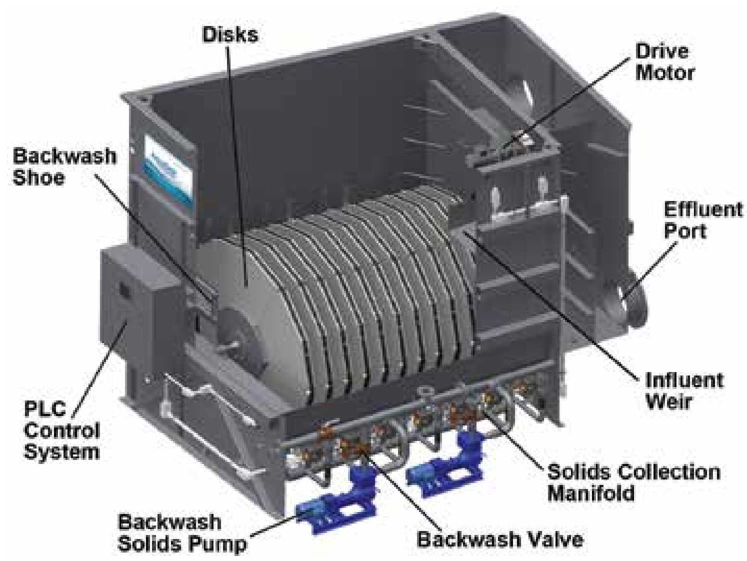
Configurations

AquaDisk®
CLOTH MEDIA FILTER

The cloth media "Disk" configuration was the first to enter the marketplace as an alternative to conventional granular media filtration technologies. This original configuration comprises the majority of Aqua-Aerobic cloth media filters installed today. A history of exceptional operating experience in a variety of municipal and industrial applications continues to make the AquaDisk® the tertiary filter of choice.

Features and Benefits

- Vertically oriented cloth media disks reduce required footprint
- Each disk has six lightweight, removable segments for ease of maintenance
- Low hydraulic profile
- Higher solids and hydraulic loading rates
- Low backwash rate
- Available in painted steel, stainless steel or concrete tanks
- Fully automatic PLC control system with color touchscreen HMI
- Low cost of ownership



Modes of Operation

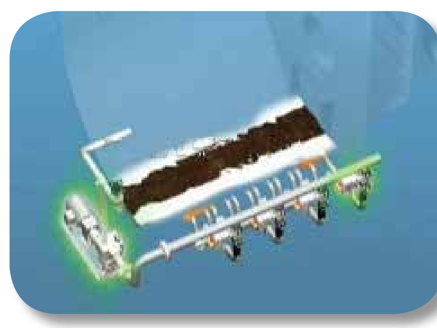
All Aqua-Aerobic cloth media filter configurations operate on the same (3) modes of operation: **FILTRATION**, **BACKWASH** and **SOLIDS WASTING**. For graphical representation, the AquaDisk is used to describe each mode below.

Filtration Mode

- Inlet wastewater enters filter
- Cloth media is completely submerged
- Disks are stationary
- Solids deposit on outside of cloth media forming a mat as filtrate flows through the media
- Tank liquid level rises
- Flow enters the filter by gravity and filtrate is collected inside the disks and discharged
- Heavier solids settle to the tank bottom

Backwash Mode

- Solids are backwashed at a predetermined liquid level or time
- Backwash shoes contact the media directly and solids are removed by vacuum pressure using the backwash pump
- Two disks are backwashed at a time (unless a single disk is utilized)
- Disks rotate slowly
- Filtration is not interrupted
- Backwash water is directed to headworks



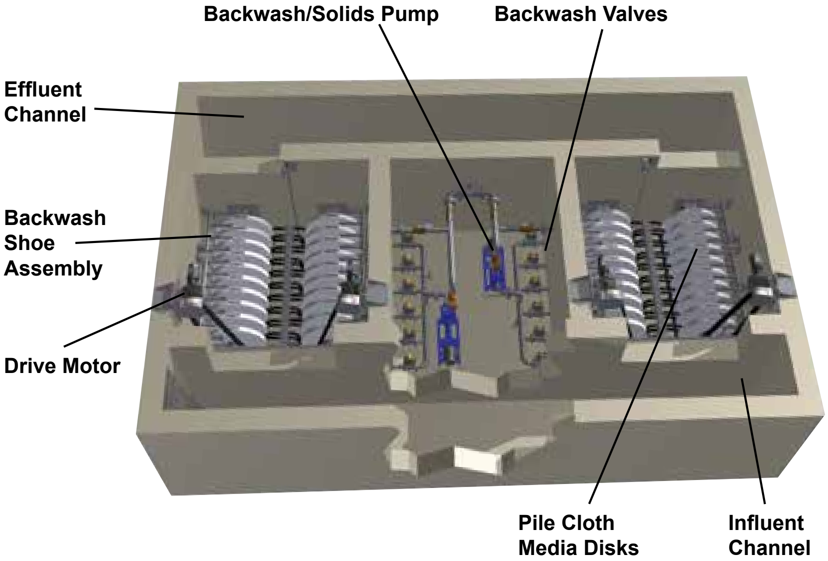
Solids Wasting Mode

- Heavier solids on the tank bottom are removed on an intermittent basis
- Solids are pumped back to the headworks, digester or other solids collection area of the treatment plant

Aqua MiniDisk®

CLOTH MEDIA FILTER

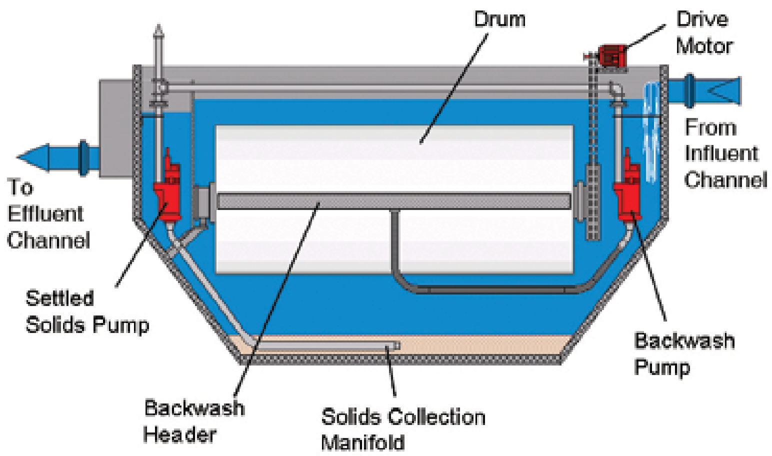
The Aqua MiniDisk and AquaDrum filters feature all the same benefits and (3) modes of operation as the original AquaDisk. Both configurations are designed to provide economical treatment of smaller flows and easily retrofit into existing traveling bridge sand filters. The AquaDrum is particularly ideal where driving head is limited.



The modular design of the Aqua MiniDisk filter retrofits neatly into existing 9 ft. (2.74 m) wide concrete traveling bridge filter basins, providing more than two times the hydraulic capacity of the original sand filters.

AquaDrum®

CLOTH MEDIA FILTER



Internal view of an AquaDrum® cloth media filter

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Sequencing Batch Reactor and Cloth Media Filter Preliminary Design Package

Hinesburg, VT

October 17, 2018

Original

Project Contact:
Jakob Nowicki, Application Engineer
Phone: 815-639-4487 | Fax: 815-654-8258
Email: jnowicki@aqua-aerobic.com

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Process Design Report

HINESBURG, VT

Design# 153825
Option: Preliminary Design (Scenario 2 SBR)

AquaSBR®

Sequencing Batch Reactor

October 17, 2018
Designed By: Jakob Nowicki

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

Design Notes

Pre-SBR

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

- Neutralization is recommended/required ahead of the SBR if the pH is expected to fall outside of 6.5-8.5 for significant durations.

- Coarse solids removal/reduction is recommended prior to the SBR.

SBR

- The maximum flow, as shown on the design, has been assumed as a hydraulic maximum and does not represent an additional organic load.

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

Aeration

- The aeration system has been designed to provide 1.25 lbs. O2/lb. BOD5 applied and 4.6 lbs. O2/lb. TKN applied at the design average loading conditions.

Process/Site

- An elevation and temperatures have been assumed as displayed on the design.

- An influent TKN (organic nitrogen plus NH3-N) and TP has been assumed, as displayed on the design.

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

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

Anticipated

- Biological phosphorus removal, with chemical addition and filtration is required to meet the effluent objectives.

Post-SBR

- Effluent flow equalization follows the AquaSBR process.

Diffused Aeration

- The discharge pressure that is listed on the design is the blower's discharge pressure. (engineer to verify)

Equipment

- The basin dimensions reported on the design have been assumed based upon the required volumes and assumed basin geometry. Actual basin geometry may be circular, square, rectangular or sloped with construction materials including concrete, steel or earthen.

- Rectangular or sloped basin construction with length to width ratios greater than 1.5:1 may require alterations in the equipment recommendation.

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

- Influent is assumed to enter the reactor above the waterline, located appropriately to avoid proximity to the decanter, splashing or direct discharge in the immediate vicinity of other equipment.

- If the influent is to be located submerged below the waterline, adequate hydraulic capacity shall be made in the headworks to prevent backflow from one reactor to the other during transition of influent.

- A minimum freeboard of 2.0 ft is recommended for diffused aeration.

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

- Aqua-Aerobic Systems, Inc. is familiar with various “Buy American” Acts (i.e. AIS, ARRA, Federal FAR 52.225, EXIM Bank, USAid, PA Steel Products Act, etc.). As the project develops Aqua-Aerobic Systems can work with you to ensure full compliance of our goods with various Buy American provisions if they are applicable/required for the project. When applicable, please provide us with the specifics of the project’s “Buy American” provisions.

AquaSBR - Sequencing Batch Reactor - Design Summary

DESIGN INFLUENT CONDITIONS

Avg. Design Flow	= 0.325 MGD	= 1230 m3/day
Max Design Flow	= 0.78 MGD	= 2953 m3/day
Peak Hyd. Flow	= 1.04 MGD	= 3937 m3/day (with advancing cycles)

DESIGN PARAMETERS

			Effluent			
	Influent	**mg/l**	**Required**	**<= mg/l**	**Anticipated**	**<= mg/l**
Bio/Chem Oxygen Demand:	BOD5	312	BOD5	30	BOD5	30
Total Suspended Solids:	TSS	194	TSS	45	TSS	45
Total Kjeldahl Nitrogen:	TKN	30	--	--	--	--
Ammonia Nitrogen:	--	--	NH3-N	2.70	NH3-N	2.70
Phosphorus:	Total P	8	Total P	0.60	Total P	0.60

SITE CONDITIONS

	Maximum		**Minimum**		**Design**		**Elevation (MSL)**
Ambient Air Temperatures:	80 F	26.7 C	25 F	-3.9 C	80 F	26.7 C	554 ft
Influent Waste Temperatures:	68 F	20.0 C	46 F	7.5 C	68 F	20.0 C	168.9 m

SBR BASIN DESIGN VALUES

			Water Depth			Basin Vol./Basin		
No./Basin Geometry:	= 2 Rectangular Basin(s)		**Min**	= 13.6 ft	= (4.1 m)	**Min**	= 0.142 MG	= (537.2 m³)
Freeboard:	= 2.0 ft	= (0.6 m)	**Avg**	= 16.7 ft	= (5.1 m)	**Avg**	= 0.174 MG	= (660.3 m³)
Length of Basin:	= 40.0 ft	= (12.2 m)	**Max**	= 21.0 ft	= (6.4 m)	**Max**	= 0.220 MG	= (832.5 m³)
Width of Basin:	= 35.0 ft	= (10.7 m)						

Number of Cycles:	= 5 per Day/Basin	
Cycle Duration:	= 4.8 Hours/Cycle	
Food/Mass (F/M) ratio:	= 0.079 lbs. BOD5/lb. MLSS-Day	
MLSS Concentration:	= 4500 mg/l @ Min. Water Depth	
Hydraulic Retention Time:	= 1.073 Days @ Avg. Water Depth	
Solids Retention Time:	= 18.6 Days	
Est. Net Sludge Yield:	= 0.532 lbs. WAS/lb. BOD5	
Est. Dry Solids Produced:	= 450.0 lbs. WAS/Day	= (204.1 kg/Day)
Est. Solids Flow Rate:	= 40 GPM (5393 GAL/Day)	= (20.4 m³/Day)
Decant Flow Rate @ MDF:	= 1444.0 GPM (as avg. from high to low water level)	= (91.1 l/sec)
LWL to CenterLine Discharge:	= 1.0 ft	= (0.3 m)
Lbs. O2/lb. BOD5	= 1.25	
Lbs. O2/lb. TKN	= 4.60	
Actual Oxygen Required:	= 1431 lbs./Day	= (649.2 kg/Day)
Air Flowrate/Basin:	= 563 SCFM	= (16.0 Sm³/min)
Max. Discharge Pressure:	= 9.7 PSIG	= (67 KPA)
Avg. Power Required:	= 429.2 KW-Hrs/Day	

POST-SBR EQUALIZATION DESIGN PARAMETERS

Avg. Daily Flow (ADF):	= 0.325 MGD	= (1,230 m³/day)
Max. Daily Flow (MDF):	= 0.78 MGD	= (2,953 m³/day)
Decant Flow Rate from (Qd):	= 1,444 gpm	= (5.5 m³M)
Decant Duration (Td):	= 54 min	
Number Decants/Day:	= 10	
Time Between Start of Decants:	= 144 min	

POST-SBR EQUALIZATION VOLUME DETERMINATION

The volume required for equalization/storage shall be provided between the high and the low water levels of the basin(s). This Storage Volume (Vs) has been determined by the following:

Vs = [(Qd -(MDF x 694.4)] x Td = 48,726 gal = (6,514.2 ft³) = (184.5 m³)

The volumes determined in this summary reflect the minimum volumes necessary to achieve the desired results based upon the input provided to Aqua. If other hydraulic conditions exist that are not mentioned in this design summary or associated design notes, additional volume may be warranted.

Based upon liquid level inputs from each SBR reactor prior to decant, the rate of discharge from the Post-SBR Equalization basin shall be pre-determined to establish the proper number of pumps to be operated (or the correct valve position in the case of gravity flow). Level indication in the Post-SBR Equalization basin(s) shall override equipment operation.

POST-SBR EQUALIZATION BASIN DESIGN VALUES

No./Basin Geometry:	= 1 Rectangular Basin(s)				
Length of Basin:	= 40.0 ft	= (12.2 m)			
Width of Basin:	= 15.0 ft	= (4.6 m)			
Min. Water Depth:	= 1.5 ft	= (0.5 m)	**Min. Basin Vol. Basin:**	= 6,732.0 gal	= (25.5 m³)
Max. Water Depth:	= 12.4 ft	= (3.8 m)	**Max. Basin Vol. Basin:**	= 55,458.0 gal	= (209.9 m³)

POST-SBR EQUALIZATION EQUIPMENT CRITERIA

Mixing Energy with Diffusers:	= 15 SCFM/1000 ft³	
SCFM Required to Mix:	= 111 SCFM/basin	= (189 Nm³/hr/basin)
Max. Discharge Pressure:	= 5.9 PSIG	= (40.86 KPA)
Max. Flow Rate Required Basin:	= 542 gpm	= (2.051 m³/min)
Avg. Power Required:	= 69.6 kW-hr/day	

AquaSBR

Influent Valves

2 Influent Valve(s) will be provided as follows:

- 8 inch diameter Milliken 601 electrically operated eccentric plug valve(s) with 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated ductile iron plug, assembled and tested with an Auma, 115 VAC, 60 hertz, single phase open/close service electric actuator. Valve actuator includes compartment heater.

Mixers

2 AquaDDM Direct Drive Mixer(s) will be provided as follows:

- 5 HP Aqua-Aerobic Systems Endura Series Model FSS DDM Mixer(s).

Mixer Mooring

2 Mixer pivotal mooring assembly(ies) consisting of:

- 304 stainless steel pivotal mooring arm(s).
- #12 AWG-four conductor electrical service cable(s).
- Electrical cable strain relief grip(s), 2 eye, wire mesh.

2 Mixer De-Watering Support(s) will be provided as follows:

- Galvanized steel dewatering support post(s).
- Galvanized steel support angle(s).
- Stainless steel anchors.

Decanters

2 Decanter assembly(ies) consisting of:

- 8x7 Aqua-Aerobics decanter(s) with fiberglass float, 304 stainless steel weir, galvanized restrained mooring frame, and painted steel power section with #14-10 conductor power cable.
- Decant pipe(s).
- 4" schedule 40 galvanized steel mooring post.
- Galvanized steel dewatering support post(s).
- 10 inch electrically operated butterfly valve(s) with actuator.

Transfer Pumps/Valves

2 Submersible pump assembly(ies) consisting of the following items:

- 2.4 HP Submersible Pump(s) with painted cast iron pump housing, discharge elbow, and multi-conductor electrical cable.
- Manual plug valve(s).
- 3 inch diameter swing check valve.
- Galvanized steel slide rail assembly(ies).

Retrievable Coarse Bubble Diffusers

4 Retrievable Coarse Bubble 10 Tube Diffuser Assembly(ies) consisting of:

- 316 L stainless steel wide band coarse bubble diffusers with Schedule 80 3/4" NPT male pipe thread connection with integral hex head nut.
- Galvanized manifold assembly.
- Galvanized vertical support beam.
- Galvanized upper vertical beam and pulley assembly with manual winch.
- Galvanized top support bracket.
- 3" EPDM flexible air line with ny-glass quick disconnect end fittings.
- Galvanized threaded flange.
- 3" manual isolation butterfly valve with cast iron body, EPDM seat, aluminum bronze disk and one-piece steel shaft.

- Ny-glass quick disconnect cam lock adapter.
- 304 stainless steel adhesive anchors.

Positive Displacement Blowers

3 Positive Displacement Blower Package(s), with each package consisting of:

- Sutorbilt 5M Positive Displacement Blower Package with common base, V-belt drive, enclosed drive guard, pressure gauge, pressure relief valve, and vibration pads.
- Stainless steel anchors.
- 25 HP motor with slide base.
- Inlet filter and inlet silencer.
- Discharge silencer, check valve, manual butterfly isolation valve, and flexible discharge connector.

Air Valves

2 Air Control Valve(s) will be provided as follows:

- 6 inch electrically operated butterfly valve(s) with actuator.

Level Sensor Assemblies

2 Pressure Transducer Assembly(ies) each consisting of:

- Submersible pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting pipe weldment(s).

2 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

AquaSBR: Post-Equalization

Transfer Pumps/Valves

2 Submersible Pump Assembly(ies) consisting of the following items:

- 5 HP Submersible Pump(s) with painted cast iron pump housing, discharge elbow, and multi-conductor electrical cable.
- Manual plug valve(s).
- 6 inch diameter swing check valve.
- Galvanized steel slide rail assembly(ies).

Fixed Coarse Bubble Diffusers

1 Aqua-Aerobic's Fixed Coarse Bubble Diffuser System(s) consisting of the following components:

- PVC diffuser(s).
- Schedule 40 galvanized steel riser pipe(s).
- Schedule 40 PVC manifold piping.
- Stainless steel anchors.

Positive Displacement Blowers

1 Positive Displacement Blower Package(s), each consisting of:

- Sutorbilt 3L Positive Displacement Blower Package with common base, V-belt drive, enclosed drive guard, pressure gauge, pressure relief valve, and vibration pads.
- Stainless steel anchors.
- 7.5 HP motor with slide base.
- Inlet filter and inlet silencer.
- Discharge silencer, check valve, manual butterfly isolation valve, and flexible discharge connector.

Level Sensor Assemblies

1 Pressure Transducer Assembly(ies) each consisting of:

- Submersible pressure transducer(s).
- Mounting bracket weldment(s).
- Transducer mounting pipe weldment(s).

1 Level Sensor Assembly(ies) will be provided as follows:

- Float switch(es).
- Float switch mounting bracket(s).
- Stainless steel anchors.

Controls

Controls wo/Starters

1 Controls Package(s) will be provided as follows:

- NEMA 12 panel enclosure suitable for indoor installation and constructed of painted steel.
- Fuse(s) and fuse block(s).
- Compactlogix Processor.
- Operator interface(s).
- Remote Access Ethernet Modem.

AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Process Design Report

HINESBURG, VT

Design# 153827
Option: Preliminary Design (Scenario 2 Filter)

Aqua MiniDisk®
Cloth Media Filter

October 17, 2018
Designed By: Jakob Nowicki

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

Design Notes

Process/Site

- To achieve an effluent monthly average total phosphorus limit, the biological process, chemical feed systems, and Cloth Media Filters need to be designed to facilitate optimum performance.

- A minimum of twelve (12) daily composite samples per month (both influent and effluent) shall be obtained for total phosphorus analysis.

- Influent to the biological system is a typical municipal wastewater application with a TP range of 6–8 mg/l. Influent TP shall be either in a particle associated form or in a reactive soluble phosphate form or in a soluble form that can be converted to reactive phosphorus in the biological system. Soluble hydrolyzable and organic phosphates are not removable by chemical precipitation with metal salts. A water quality analysis is required to determine the phosphorus speciation with respect to soluble and insoluble reactive, acid hydrolyzable and total phosphorus at the system influent, point(s) of chemical addition, and final effluent.

- Chemical feed lines (i.e. metal salts) shall be furnished to each reactor, aerobic digester and dewatering supernatant streams as necessary. Metal salts shall be added to each reactor during the React phase of the cycle.

- Chemical addition (i.e. metal salts, polymer) shall be furnished prior to the filter. Adequate rapid mixing must be provided as part of the chemical feed system. The chemical dosage should be flow-paced and controlled to avoid overdosing. Jar testing with various metal salts and polymers is recommended to determine the most effective metal salt and polymer as well as the optimum dosages of each, and to estimate the degree of phosphorus removal that can be achieved. In addition, a pilot study may be required to verify the actual performance capability.

- A flocculation tank with a minimum of 5-minute HRT at the maximum daily flow shall be furnished after chemical addition and prior to the filter.

- pH monitoring and control in a range of 6.8-7.2 of the upstream biological reactor is required when adding metal salts.

- The cloth media filter will only remove TP that is associated with the TSS removed by the filter. Solids include both biological and chemical solids. Since only insoluble, particle-associated phosphorous is capable of being removed by filtration with tertiary filtration technology, phosphorous speciation shall be provided by the owner to substantiate the concentrations of soluble and insoluble phosphorous in the filter influent. If the proportions of soluble (unfilterable) and insoluble phosphorous are such that removal to achieve the desired effluent limit is not practical, the owner will provide for proper conditioning of the wastewater, upstream of the filter system, to allow for the required removal.

Filtration

- The cloth media filter recommendation and anticipated effluent quality are based upon influent water quality conditions as shown under "Design Parameters" of this Process Design Report

- The anticipated filtered effluent quality is based on the filter influent conditions as shown under "Design Parameters" of this Process Design Report. In addition, the filter influent should be free of algae and other solids that are not filterable through a nominal 5 micron pore size media. Provisions to treat algae and condition the solids to be filterable are the responsibility of others.

- For this application, pile filter cloth is recommended.

- The cloth media filter has been designed to handle the maximum design flow while maintaining one unit out of service.

- The cloth media filter design assumes the equalization basin is equipped with a pump system with one standby pump to control flow.

Equipment

- Equipment selection is based upon Aqua Aerobic Systems' standard materials of construction and electrical components.

- Aqua-Aerobic Systems, Inc. is familiar with various “Buy American” Acts (i.e. AIS, ARRA, Federal FAR 52.225, EXIM Bank, USAid, PA Steel Products Act, etc.). As the project develops Aqua-Aerobic Systems can work with you to ensure full compliance of our goods with various Buy American provisions if they are applicable/required for the project. When applicable, please provide us with the specifics of the project’s “Buy American” provisions.

AquaDISK Tertiary Filtration - Design Summary

DESIGN INFLUENT CONDITIONS

Pre-Filter Treatment:	AquaSBR		
Avg. Design Flow	= 0.325 MGD	= 225.69 gpm	= 1230 m^3/day
Max Design Flow	= 0.78 MGD	= 541.7 gpm	= 2953 m^3/day

DESIGN PARAMETERS	Influent	mg/l	Effluent Required	<= mg/l	Effluent Anticipated	<= mg/l
Avg. Total Suspended Solids:	TSSa	15	TSSa	45	TSSa	5
Max. Total Suspended Solids:	TSSm	25	--	--	--	--
Phosphorus:	Total P	0.60	Total P	0.15	Total P	0.15

AquaDISK FILTER RECOMMENDATION

Qty Of Filter Units Recommended	= 2
Number Of Disks Per Unit	= 8
Total Number Of Disks Recommended	= 16
Total Filter Area Provided	= 172.8 ft^2 = (16.05 m^2)
Filter Model Recommended	= AquaDisk Package: Model ADFSP-11-8E-PC
Filter Media Cloth Type	= OptiFiber PES-14

AquaDISK FILTER CALCULATIONS

Filter Type:

Vertically Mounted Cloth Media Disks featuring automatically operated vacuum backwash . Tank shall include a rounded bottom and solids removal system.

Average Flow Conditions:

Average Hydraulic Loading
= Avg. Design Flow (gpm) / Recommended Filter Area (ft^2)
= 225.7 / 172.8 ft^2
= 1.31 gpm/ft^2 (3.19 m/hr) at Avg. Flow

Maximum Flow Conditions:

Maximum Hydraulic Loading
= Max. Design Flow (gpm) / Recommended Filter Area (ft^2)
= 541.7 / 172.8 ft^2
= 3.13 gpm/ft^2 (7.66 m/hr) at Max. Flow

Solids Loading:

Solids Loading Rate
= (lbs TSS/day at max flow and max TSS loading) / Recommended Filter Area (ft^2)
= 162.6 lbs/day / 172.8 ft^2
= 0.94 lbs. TSS /day/ft^2 (4.59 kg. TSS/day/m^2)

The above recommendation is based upon the provision to maintain a satisfactory hydraulic surface loading with (1) unit out of service. The resultant hydraulic loading rate at the Maximum Design Flow is: 6.3 gpm / ft^2 = (15.3 m/hr)

Cloth Media Filters

AquaDisk Tanks/Basins

2 AquaDisk Model # ADFSP-11x8E-PC Package Filter Painted Steel Tank(s) consisting of:

- 8 Disk painted steel tank(s).
- 2" ball valve(s).

AquaDisk Centertube Assemblies

2 Cloth set(s) will have the following feature:

- Cloth will be OptiFiber PES-14.

2 Centertube(s) consisting of:

- 304 stainless steel centertube weldment(s).
- Centertube driven sprocket(s).
- Dual wheel assembly(ies).
- Rider wheel bracket assembly(ies).
- Centertube bearing kit(s).
- Effluent centertube lip seal.
- Pile cloth media and non-corrosive support frame assemblies.
- 304 Stainless steel frame top plate(s),
- Media sealing gaskets.
- Disk segment 304 stainless steel support rods.

AquaDisk Drive Assemblies

2 Drive System(s) consisting of:

- Gearbox with motor.
- Drive sprocket(s).
- Drive chain(s) with pins.
- Stationary drive bracket weldment(s).
- Adjustable drive bracket weldment(s).
- Chain guard weldment(s).
- Warning label(s).

AquaDisk Backwash/Sludge Assemblies

2 Backwash System(s) consisting of:

- Backwash shoe assemblies.
- Backwash shoe support weldment(s).
- 1 1/2" flexible hose.
- Stainless steel backwash shoe springs.
- Hose clamps.

2 Backwash/Solids Waste Pump(s) consisting of:

- Backwash/waste pump(s).
- 0 to 15 psi pressure gauge(s).
- 0 to 30 inches mercury vacuum gauge(s).
- Throttling gate valve(s).
- 2" bronze 3 way ball valve(s).

AquaDisk Instrumentation

2 Pressure Transmitter(s) consisting of:

- Level transmitter(s).

2 Float Switch(es) consisting of:

- Float switch(es).

2 Vacuum Transmitter(s) consisting of:

- Vacuum transmitter(s).

AquaDisk Valves

2 Solids Waste Valve(s) consisting of:

- 2" full port, three piece, stainless steel body ball valve(s), grooved end connections with single phase electric actuator(s). Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork), Nibco, or equal.
- 2" flexible hose.
- Victaulic coupler(s).

2 Set(s) of Backwash Valves consisting of:

- 2" full port, three piece, stainless steel body ball valve(s), grooved end connections with single phase electric actuator(s). Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork), Nibco, or equal.
- 2" flexible hose.
- Victaulic coupler(s).

AquaDisk Controls w/Starters

2 Control Panel(s) consisting of:

- NEMA 4X fiberglass enclosure(s).
- Circuit breaker with handle.
- Transformer(s).
- Fuses and fuse blocks.
- Line filter(s).
- GFI convenience outlet(s).
- Control relay(s).
- Selector switch(es).
- Indicating pilot light(s).
- MicroLogix 1400 PLC(s).
- Ethernet switch(es).
- Operator interface(s).
- Power supply(ies).
- Motor starter(s).
- Terminal blocks.
- UL label(s).

2 Conduit Installation(s) consisting of:

- PVC conduit and fittings.

AquaDISK: Operation & Maintenance Requirements

Design# 153827

Project:	**HINESBURG, VT**
Qty / Model#:	**2 / ADFSP-11X8E-PC**
Description:	**AquaDisk Package: Model ADFSP-11-8E-PC**

Avg Flow (Gal):	325,000
Influent TSS (mg/l):	15
Qty Of Disks Per Unit:	8
Area Provided/Disk:	10.8

I. LUBRICATION REQUIREMENTS

	# of Units		Minutes/Unit		Times/Year		Hours/Year
1) Backwash / Solids Waste Pump - Routine Lubrication:	4	x	5	x	12	/ 60 =	4.00
2) Backwash / Solids Waste Pump - Drain and Refill:	4	x	30	x	1	/ 60 =	2.00
3) Drive Gear Box:	2	x	30	x	0.25	/ 60 =	0.25
4) Drive Motor:	2	x	5	x	0.25	/ 60 =	0.04

TOTAL LUBRICATION REQUIREMENTS: 6.29

II. PARTS REPLACEMENT

	Replace Interval (Years)	# of Units		Minutes/Unit		Hours Per Replacement	Material Cost Per Unit	Total Material Cost
1) Main "V-Ring" Seal:	10	2	x	240	=	8.0	$382	$764
2) Filter Media Cloths (2/Disk):	7	32	x	15	=	8.0	$219	$7,008

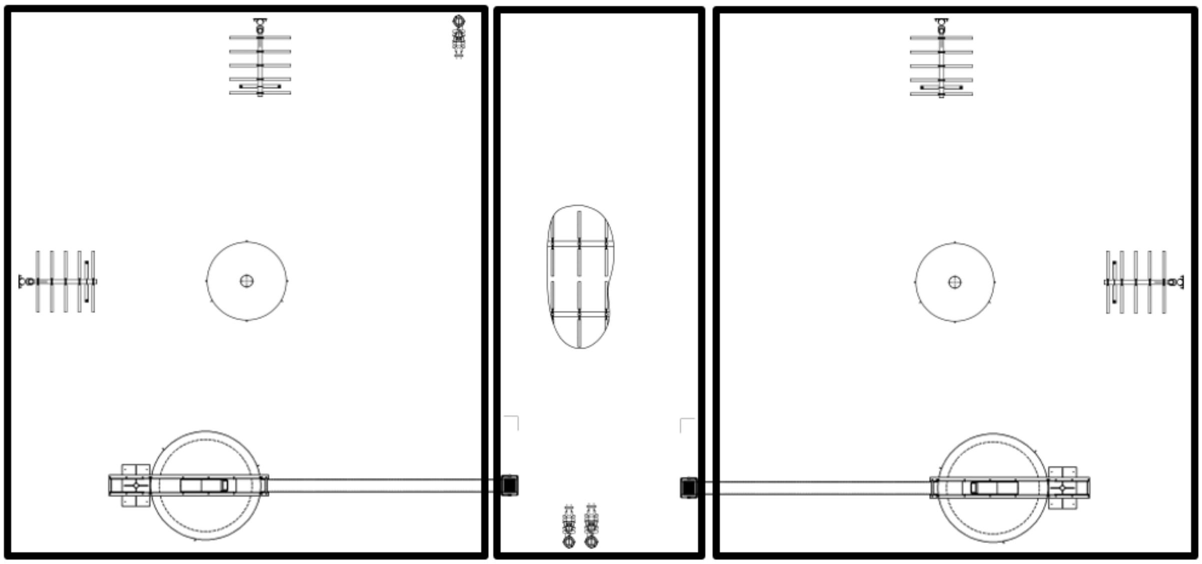
III. POWER CONSUMPTION

1) Backwash / Solids Waste Pump (kW Hours/Year):	2,259.0
2) Disk Drive Motor (kW Hours/Year):	328.3
3) Power Control Panel (kW Hours/Year):	2,800.0
Total Annual Power Usage (kW Hours/Year):	5,387.3

Hinesburg WWTF, VT Preliminary Sketches

Design #153825 – Scenario 2

October 17, 2018



SBR Basins (40’ x 35’ x 23’ TOW)

- Two (2) 10-Tube Retrievable Coarse Bubble Diffusers
- One (1) AquaDDM® Mixer with Pivotal Mooring
- One (1) Sludge Transfer Pump
- One (1) Decanter

Post-Equalization Basin (40’ x 15’ x 23’ TOW)

- One (1) grid of Fixed PVC Coarse Bubble Diffusers for Mixing
- Two (1+1) Transfer Pumps

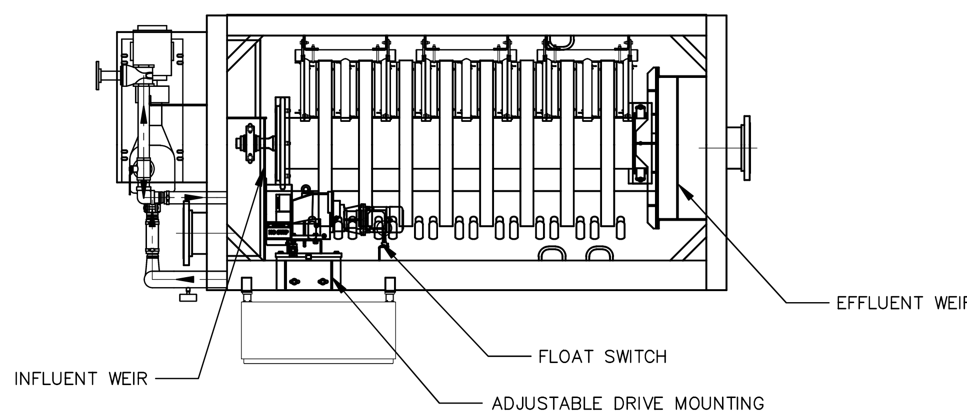
NOT FOR CONSTRUCTION

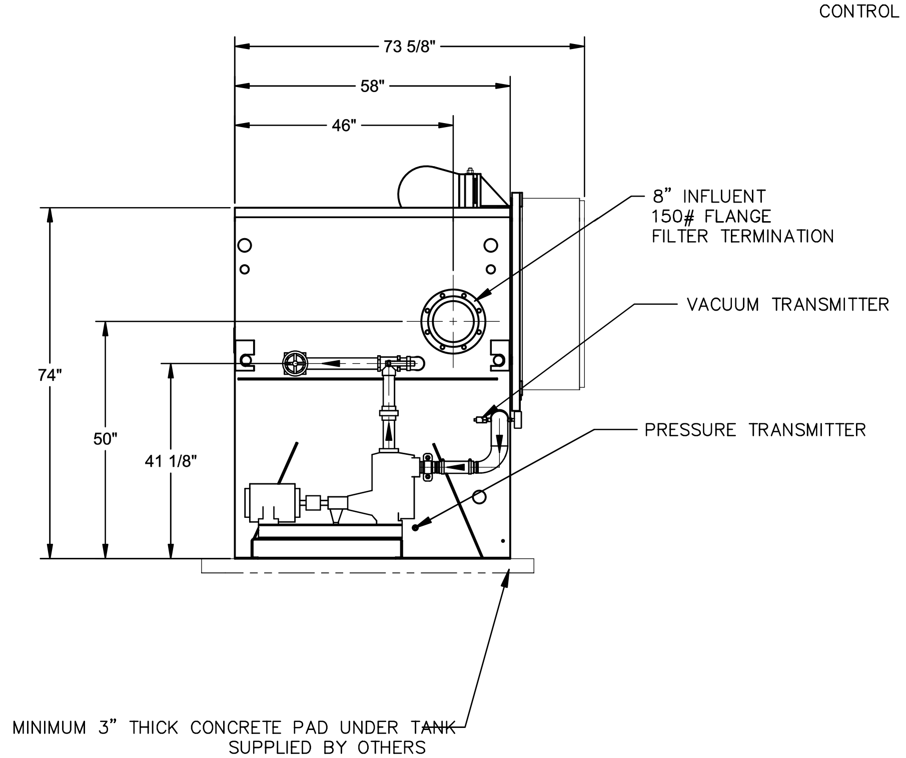
1. IF FREEZING IS A CONCERN AQUA-AEROBIC SYSTEMS RECOMMENDS THE FILTERS BE PLACED IN A HEATED BUILDING. IF A BUILDING IS NOT PROVIDED, ANY NECESSARY PROTECTION, INCLUDING BUT NOT LIMITED TO, HEAT TRACING AND INSULATION OF PUMPS AND PIPING, AS WELL AS PROTECTION AGAINST INTERNAL TANK FREEZING, SHALL BE PROVIDED BY THE INSTALLING CONTRACTOR.

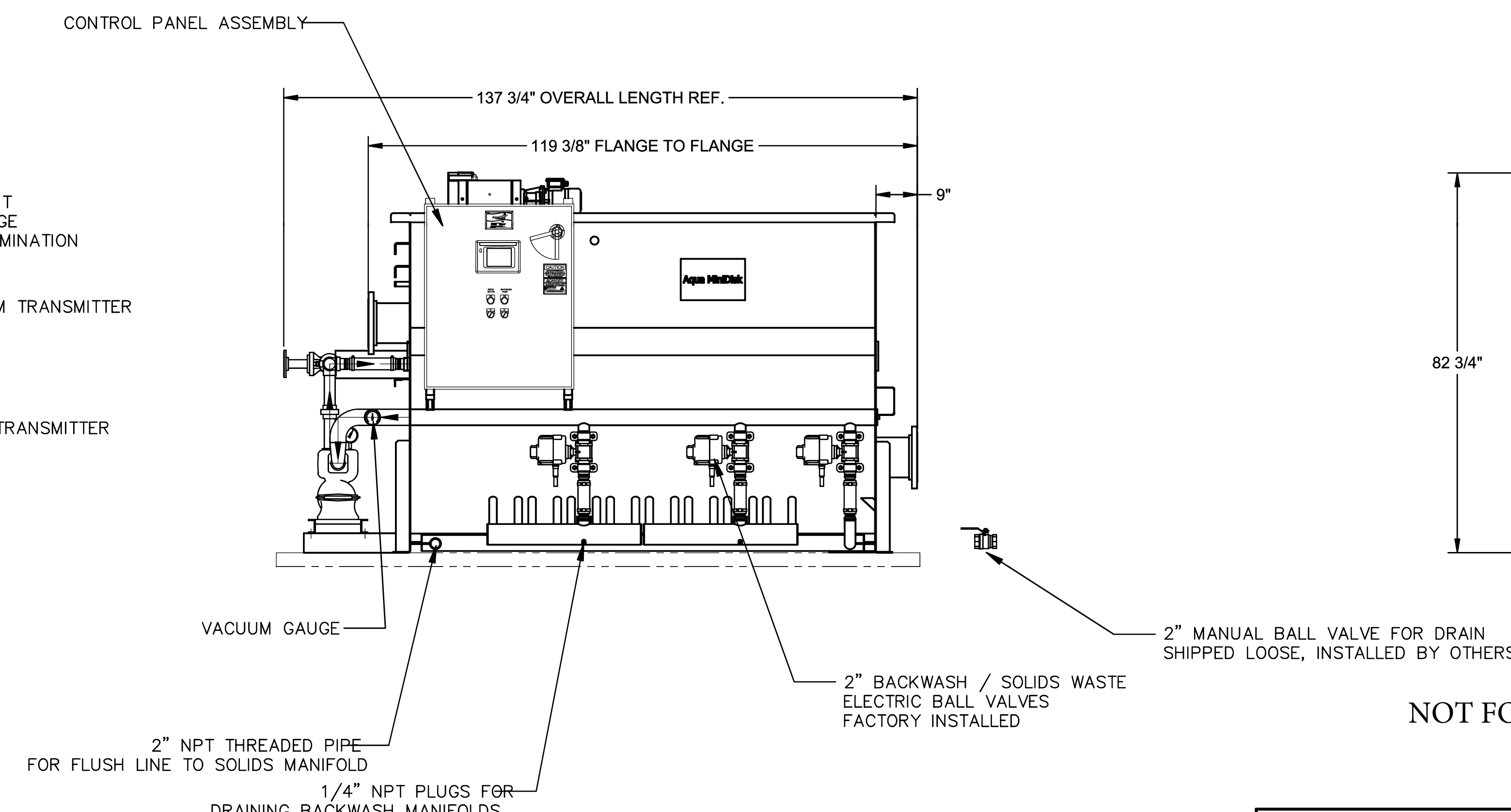
2. THE FILTER CONTROL PANEL IS SHOWN IN THE STANDARD LOCATION. IF THE FILTER IS LOCATED OUTSIDE, THE CONTROL PANEL SHOULD FACE NORTH, TO LIMIT EXPOSING THE H.M.I. TO DIRECT SUNLIGHT.

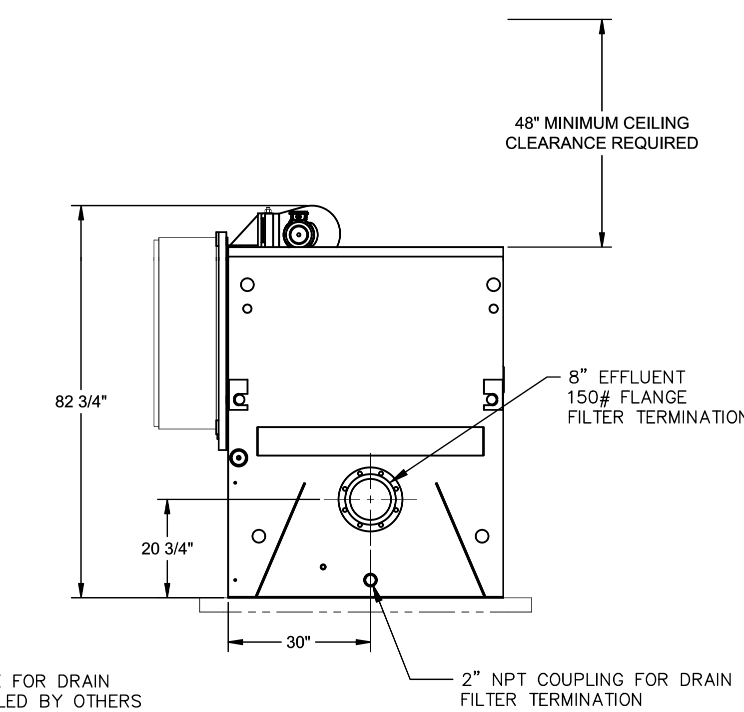
3. THE GRAPHIC ELEMENTS OF THIS COMPUTER GENERATED DRAWING ARE DRAWN FULL SIZE. THE DIMENSIONS ARE ASSOCIATIVE. IF THE SIZE OF THE GRAPHIC ELEMENTS IS CHANGED THE DIMENSIONS WILL NOT BE CORRECT.

4. AN INFLUENT VALVE IS REQUIRED FOR ISOLATION / MAINTENANCE OF THE FILTER UNIT. THE INFLUENT VALVE SHALL BE PROVIDED BY OTHERS AND INSTALLED BY OTHERS.









NOT FOR CONSTRUCTION

DRY WT (LBS)	OPER. WT. (LBS)
4,500	13,000

JOB NAME:
JOB LOCATION:

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

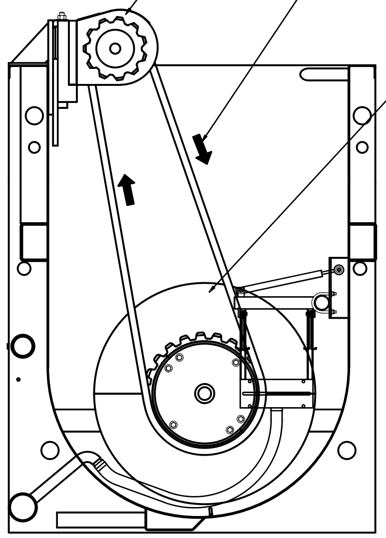
AQUA-AEROBIC SYSTEMS, INC.

DO NOT SCALE DRAWING

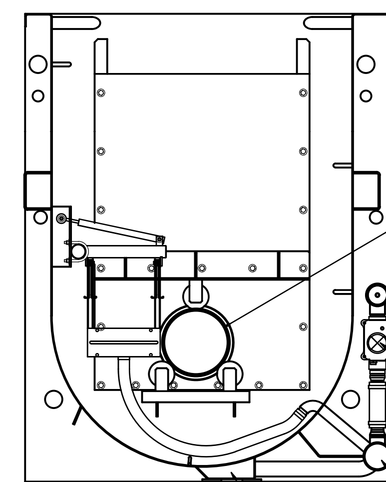
UNLESS OTHERWISE SPECIFIED
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: SLT DATE: 2012-03-29
CHECKED BY: DATE:
WEIGHT: SHEET: 1 OF 4

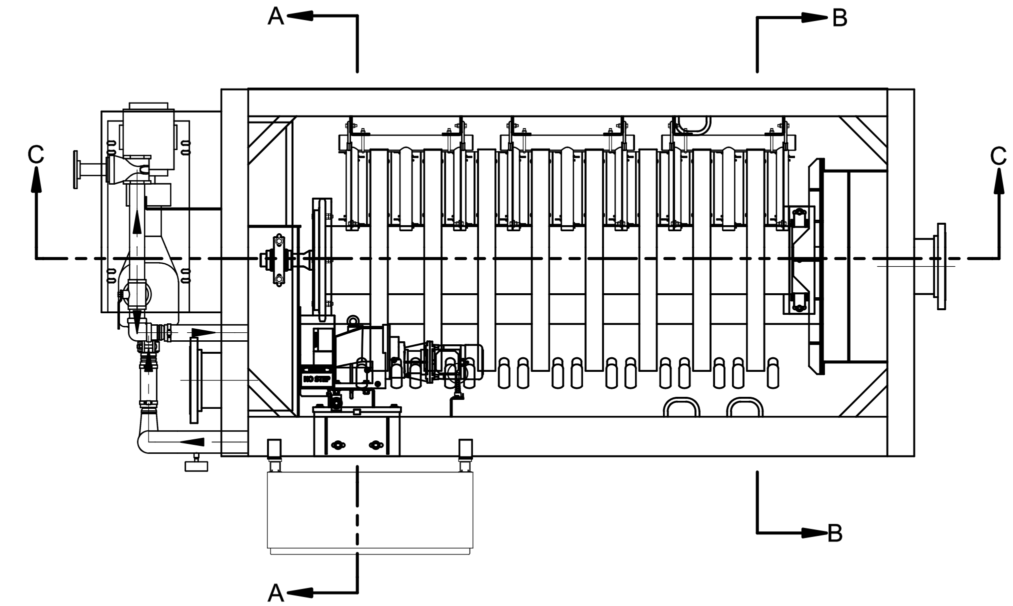
DRAWING NAME: AQUADISK FILTER MODEL ADFSP-11 X 8E-PC-RH
DRAWING NUMBER: 2801995
SCALE:
SIZE: D

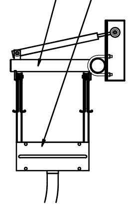


SECTION A-A

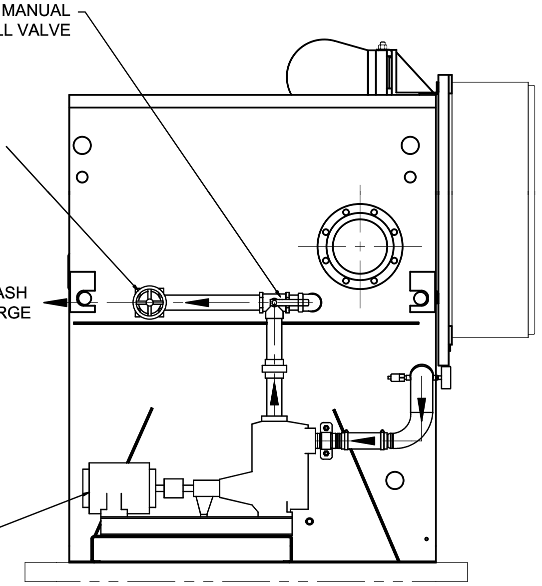


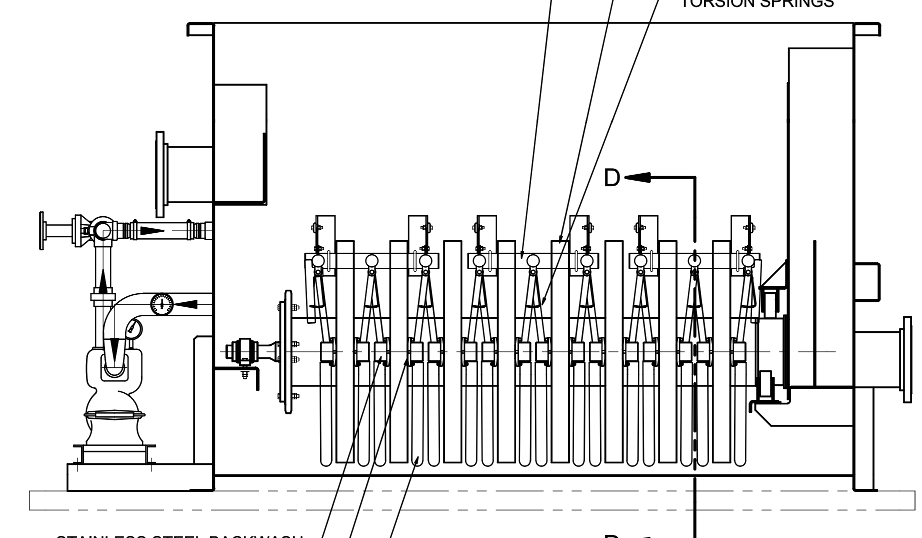
SECTION B-B





SECTION D-D





SECTION C-C

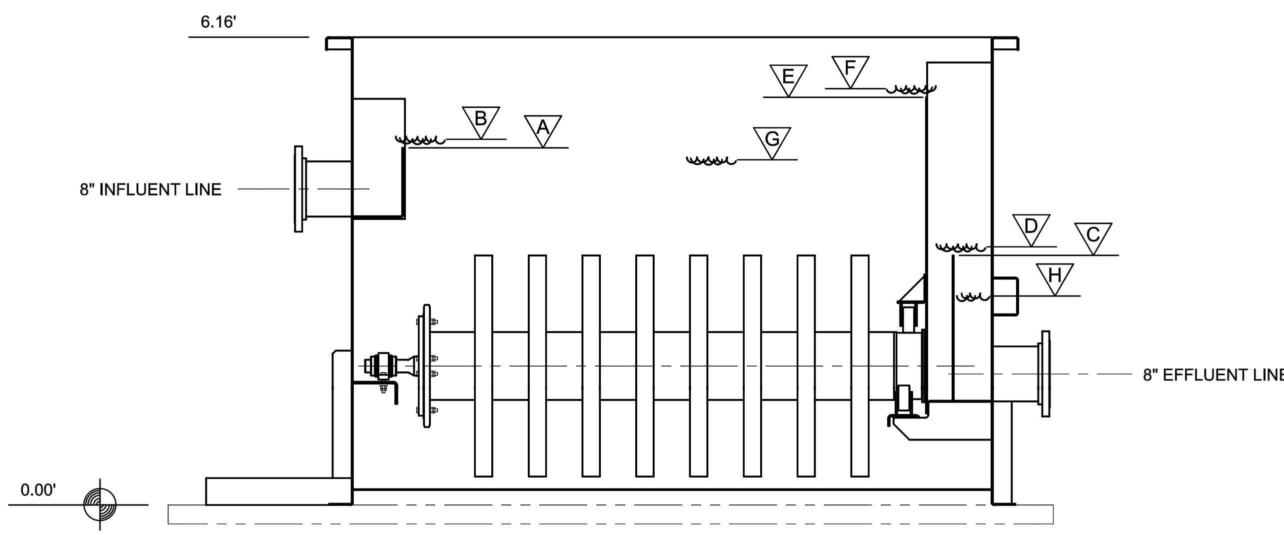
NOT FOR CONSTRUCTION

1 THE BACKWASH / WASTE PUMP CAPABILITIES ARE AS FOLLOWS:

- HORSEPOWER: 2 HP
- FLOW: 130 GPM
- TOTAL DYNAMIC HEAD: 23.2 FT
- ALLOWABLE DISCHARGE HEAD, AFTER FILTER LOSSES: 12 FT

FOR INSTALLATIONS THAT REQUIRE MORE DISCHARGE HEAD, ALTERNATIVE PUMPS ARE AVAILABLE. PLEASE CONSULT ENGINEERING TO VERIFY THE SUITABILITY OF THE DISCHARGE PIPING OR FOR SPECIAL PUMP REQUIREMENTS.

JOB NAME:	AQUA-AEROBIC SYSTEMS, INC.
JOB LOCATION:	DO NOT SCALE DRAWING — UNLESS OTHERWISE SPECIFIED: FRACTIONAL DIMENSIONS +/- 1/16; ALL TWO PLACE DECIMALS +/- 0.010; ALL THREE PLACE DECIMALS +/- 0.005; ALL ANGLES +/- 1/2°; ANSI
REV / ERN / ECO / DATE / BY / REVISION DESCRIPTION	MATERIAL:
	SIMILAR TO:
	TYPE:
	DRAWN BY: SLT — DATE: 2012-03-29
	CHECKED BY: — DATE:
	WEIGHT: — SHEET: 2 OF 4
DRAWING NAME: AQUADISK FILTER MODEL ADFSP-11 X 8E-PC-RH	DRAWING NUMBER: 2801995 — SCALE: — SIZE: D



ELEVATION

A	4.71'	INFLUENT WEIR ELEVATION
B	4.89'	NAPPE OVER INFLUENT WEIR AVERAGE FLOW
	4.99'	NAPPE OVER INFLUENT WEIR MAXIMUM FLOW
C	3.29'	EFFLUENT WEIR ELEVATION
D	3.47'	NAPPE OVER EFFLUENT WEIR AVERAGE FLOW
	3.57'	NAPPE OVER EFFLUENT WEIR MAXIMUM FLOW
E	5.35'	OVERFLOW WEIR ELEVATION
F	5.53'	NAPPE OVER OVERFLOW WEIR AVERAGE FLOW
	5.64'	NAPPE OVER OVERFLOW WEIR MAXIMUM FLOW
G	4.67'	BACKWASH INITIATE LEVEL
H	2.79'	MAXIMUM AVAILABLE LIQUID LEVEL FOR EFFLUENT CONVEYANCE

HYDRAULIC PROFILE
BASED UPON AVERAGE FLOW RATE OF 3.25 GPM PER SQUARE FOOT (.4 MGD)
BASED UPON MAXIMUM FLOW RATE OF 6.5 GPM PER SQUARE FOOT (.81 MGD)

WEIR LENGTHS
INFLUENT = 2.50'
EFFLUENT = 2.50'
OVERFLOW = 2.50'

NOT FOR CONSTRUCTION

JOB NAME:
JOB LOCATION:

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

AQUA-AEROBIC SYSTEMS, INC.

DO NOT SCALE DRAWING

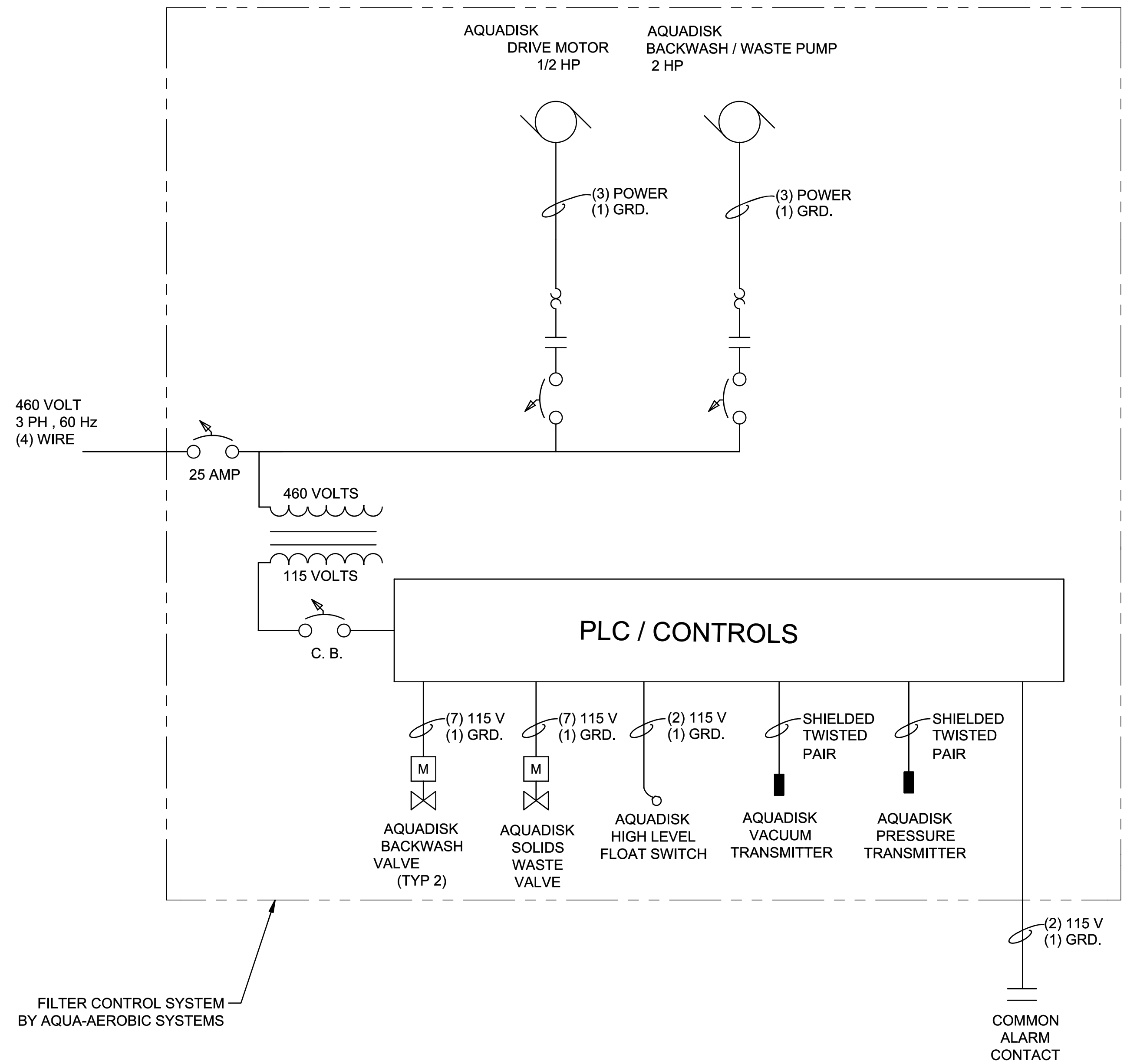
UNLESS OTHERWISE SPECIFIED
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

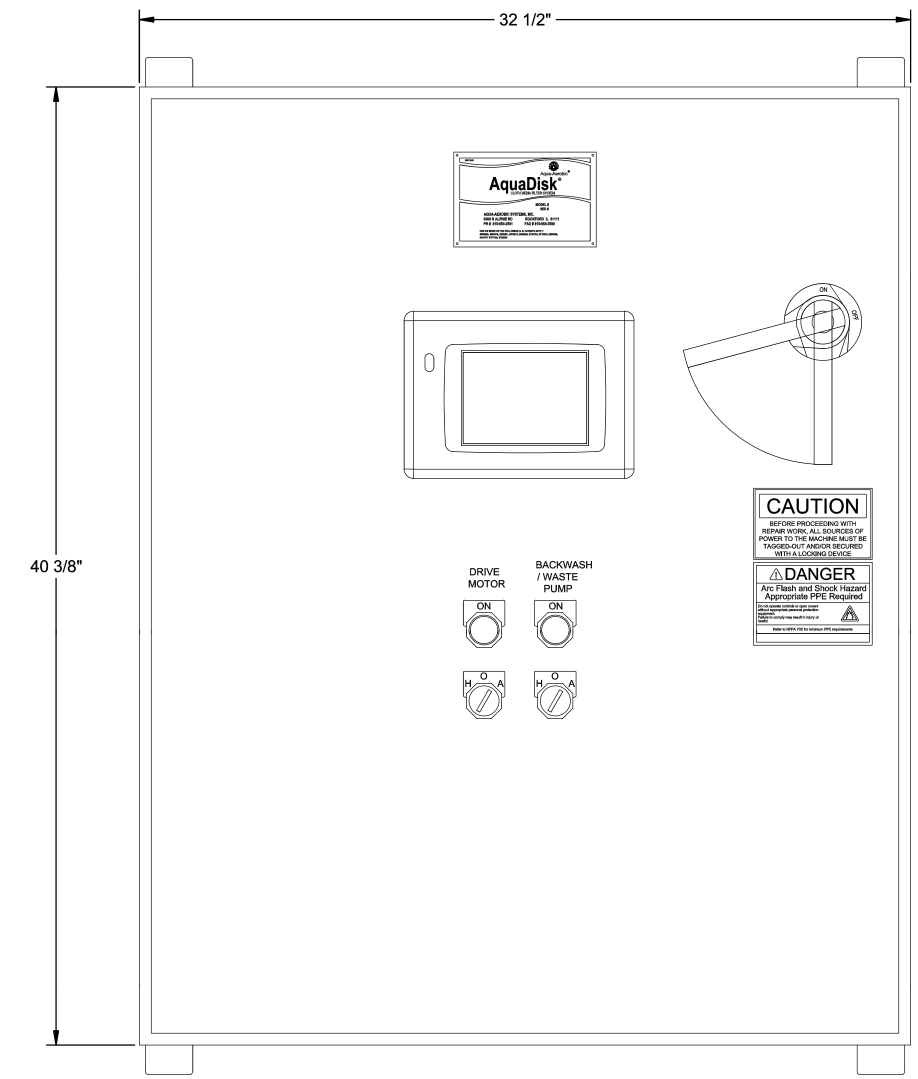
MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: SLT DATE: 2012-03-29
CHECKED BY: DATE:
WEIGHT: SHEET: 3 OF 4
DRAWING NAME: AQUADISK FILTER MODEL ADFSP-11 X 8E-PC-RH
DRAWING NUMBER: 2801995 SCALE: SIZE: D

SYMBOL KEY

	MOTOR		CIRCUIT BREAKER		ELECTRICAL DISCONNECT	VFD	VARIABLE FREQUENCY DRIVE		TRANSDUCER		STARTER CONTACTOR
M	MOTOR OPERATED VALVE		TRANSFORMER		MOTOR OVERLOAD	P	PNEUMATIC OPERATED VALVE		FUSE		FLOAT SWITCH

NOTE: SOME SYMBOLS MAY NOT BE APPLICABLE





1. CONTROL PANEL
ENCLOSURE NEMA 4X WALL MOUNTED TYPE FIBERGLASS
FACTORY ASSEMBLED AND SHIPPED LOOSE. INSTALLED BY OTHERS.
MUST BE LOCATED WITHIN 50 FEET OF THE PRESSURE TRANSMITTER.
FACING NORTH TO LIMIT THE H.M.I. EXPOSURE TO DIRECT SUNLIGHT.
FLOOR MOUNTING IS AVAILABLE WITH STEEL OR STAINLESS STEEL ENCLOSURES.

2. STANDARD CONTROL PANEL SIZE
40" HEIGHT X 32" WIDE X 12" DEEP

NOT FOR CONSTRUCTION

JOB NAME:
JOB LOCATION:

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

AQUA-AEROBIC SYSTEMS, INC.

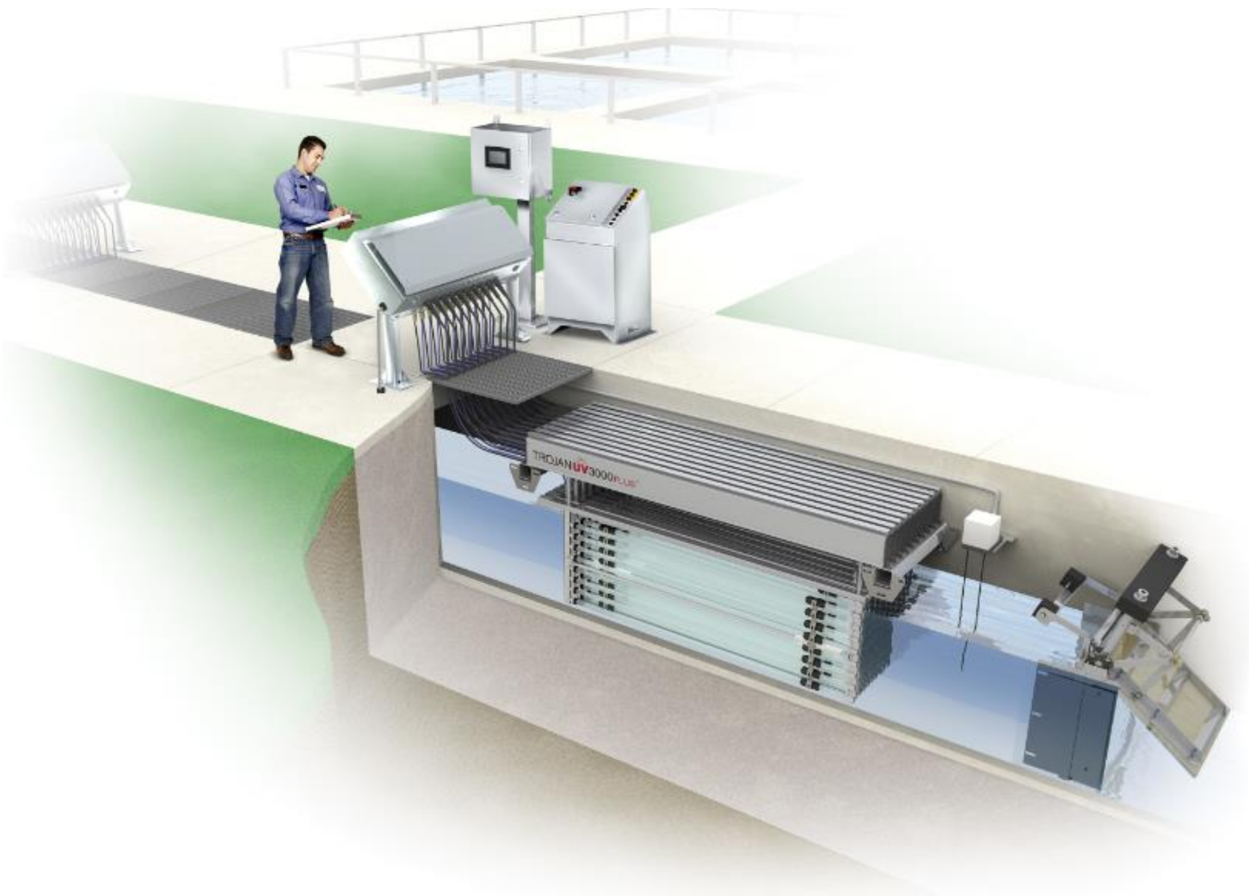
DO NOT SCALE DRAWING — UNLESS OTHERWISE SPECIFIED — ANSI

MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: SLT — DATE: 2012-03-29
CHECKED BY: — DATE:
WEIGHT: — SHEET: 4 OF 4
DRAWING NAME: AQUADISK FILTER MODEL ADFSP-11 X 8E-PC-RH
DRAWING NUMBER: 2801995 — SCALE: — SIZE: D

APPENDIX J

UV DISINFECTION

PROPOSAL FOR THE CITY OF HINESBURG, Vermont
QUOTE: 218800
12/11/2018



The TrojanUV3000Plus™ is operating in **over 2000** municipal wastewater plants around the world.
Disinfecting **over 17 billion** gallons a day, the TrojanUV3000Plus™ has become
the reference standard in the industry.

December 12, 2018

In response to your request, we are pleased to provide the following TrojanUV3000Plus™ proposal for the HINESBURG – Scenario 2 project.

The TrojanUV3000Plus™ has been shown in over 2000 installations to provide dependable performance, simplified maintenance, and superior electrical efficiency. As explained in this proposal, the system incorporates innovative features to reduce O&M costs, including variable output electronic ballasts to provide dimming capability and Trojan's revolutionary ActiClean-WW™ system – the industry's only online chemical and mechanical quartz sleeve cleaning system. All Trojan installations are supported by a global network of certified Service Representatives providing local service and support.

Please do not hesitate to call us if you have any questions regarding this proposal. Thank you for the opportunity to quote the TrojanUV3000Plus™ and we look forward to working with you on this project.

With best regards,

Mike Shortt
Trojan Technologies
3020 Gore Road
London, Ontario N5V 4T7
Canada
(519) 457 – 3400 ext. 2235
mshortt@trojanuv.com

Local Representative:

Paul H. Sussman
The MAHER Corporation
192 Pleasant Street
Rockland, MA 02370
psussman@themahercorp.com

,

TROJANUV3000PLUS™

DESIGN CRITERIA

HINESBURG

Peak Design Flow:	**1.05 MGD**
UV Transmittance:	**65 %** (minimum)
Total Suspended Solids:	**5 mg/l** (Maximum, grab sample)
Disinfection Limit:	**77 E.coli per 100 ml,** based on a 1 day maximum
Design Dose:	**35 mJ/cm^2 (**bioassay validated)
Validation Factors:	**0.98** end of lamp life factor (Low-Pressure Amalgam Lamps) **0.95** fouling factor (ActiClean-WW™ Chemical / Mechanical Cleaning System)

DESIGN SUMMARY

QUOTE: 218800

Based on the above design criteria, the TrojanUV3000Plus™ proposed consists of:

CHANNEL (Please reference Trojan layout drawings for details.)	
Number of Channels:	**1**
Approximate Channel Length Required:	**30 ft**
Channel Width Based on Number of UV Modules:	**0.7 ft**
Channel Depth Recommended for UV Module Access:	**3.8 ft**
UV MODULES	
Total Number of Banks:	**2**
Number of Modules per Bank:	**2**
Number of Lamps per Module:	**4**
Total Number of UV Lamps:	**16**
Maximum Power Draw:	**4 kW**
UV PANELS	
Power Distribution Center Quantity:	**2**
System Control Center Quantity:	**1**
MISCELLANEOUS EQUIPMENT	
Level Controller Quantity:	**1**
Type of Level Controller:	**Fixed Weir (Weir)**
Automatic Chemical / Mechanical Cleaning:	**Trojan ActiClean-WW™**
Standard Spare Parts / Safety Equipment:	**Included**
Other Equipment:	
ELECTRICAL REQUIREMENTS	

APPENDIX K

A/O SYSTEM

VEOLIA

Activated Sludge Technologies

WATER TECHNOLOGIES

Activated Sludge Technologies

With over 100 installations in the United States, Kruger offers wastewater treatment facilities extensive biological experience and proven operating strategies. Kruger offers a multitude of processes, including our signature Phased Isolation Technologies and A/O®, A²/O, and An/O systems, providing flexibility in meeting the diverse requirements of plants. Kruger's activated sludge technologies efficiently achieve today's stringent effluent requirements.

Double Ditch

Perfect Fit for Smaller Communities

- All processes, including settling, occur within two reactors; secondary settling tanks are not required
- Reduced plant maintenance
- Continuous flow; no batching, no decanters, no post equalization required
- Achieves exceptional effluent quality of BOD and TSS <10 mg/L, complete nitrification, and total nitrogen removal to less than 8 mg/L
- Ease of future expansion and upgrade for increased nitrogen removal or flow by adding secondary clarifiers to convert to BIO-DENITRO

1.2 MGD D-Ditch - Lawrenceville, VA

Phased Isolation Technologies

Dynamic System for Meeting Plant Challenges

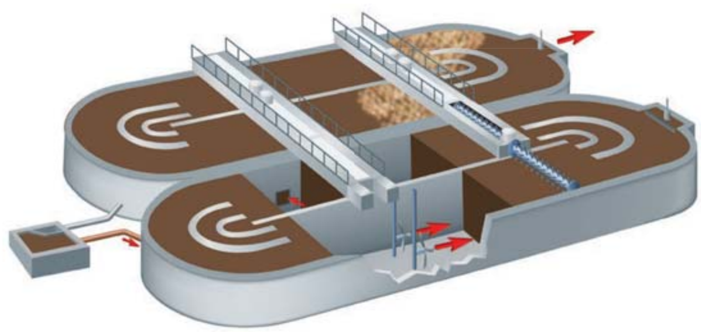
Kruger's phased isolation technologies provide operational flexibility by alternating phase lengths, accurately matching the level of treatment needed for changing wastewater treatment strengths. Systems are optimized for biological nutrient removal (BNR) and flow increases or future tighter effluent requirements. Kruger's phased processes are equipped with PLC based control and preprogrammed operational modes, simplifying daily operation.

BIO-DENITRO™

Adaptable Process for Varying Conditions

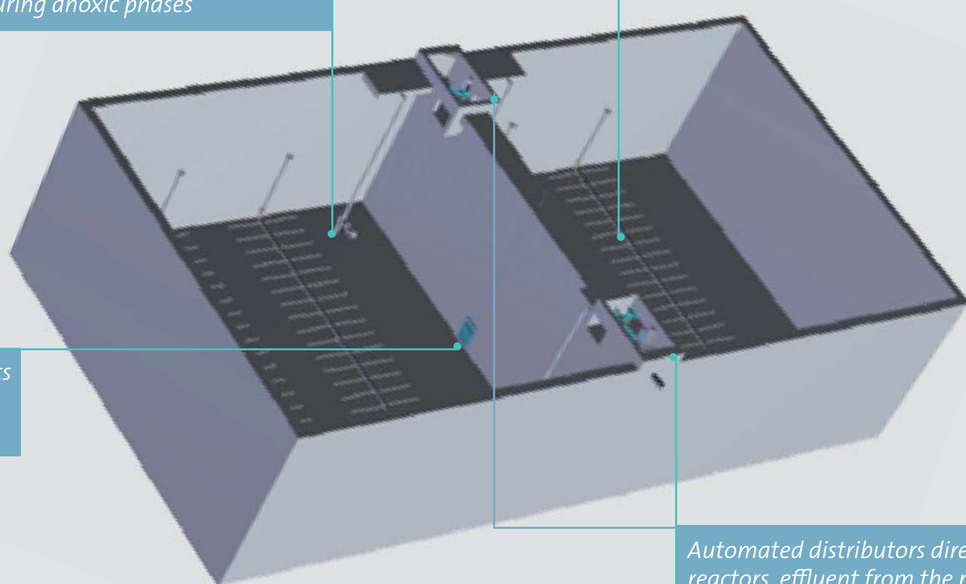
- Energy efficient; separation of mixing and aeration with dissolved oxygen (DO) control
- Reduced operation and maintenance costs by achieving high level total nitrogen removal without internal recycle pumping or chemical dosing
- Advanced storm flow control made to ensure maximum treatment with no solids washout during wet weather events
- Advanced control modes with all phasing and aeration based on real-time ammonia and nitrate monitoring

BIO-DENITRO with Oxidation Ditches



Phased Isolation imparts tremendous process flexibility. The operational strategy provides the ability to effectively vary the process volumes (e.g. aerobic or anoxic), unlike conventional processes where these volumes are fixed. By adjusting the specific phase lengths of the process, the volume allocated for specific treatment can be adjusted, thereby enabling the treatment process to accommodate a wide range in influent flow and characteristics.

Proven Phased Operation in a Simpler Package

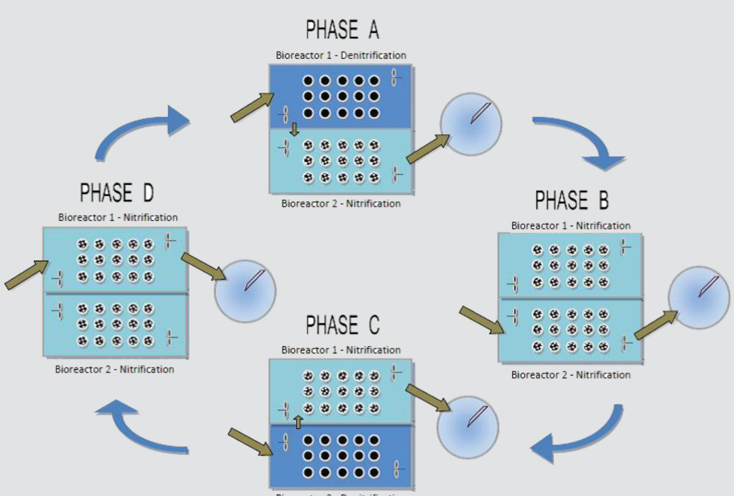


Benefits vs Oxidation Ditch

- *Simplified Concrete Construction*
- *25-50% Reduced Footprint and Installed Cost*
- *Replaces Rotors with Diffusers and Blowers*
- *Eliminates Automated Effluent Weirs*
- *25-50% More Energy Efficient*

3.0 MGD BIO-DENITRO - Sanford, FL

BIO-DENITRO Phases Diagram



BIO-DENIPHO™

Enhanced Biological Phosphorus Removal

- Biological phosphorus removal achieving TP<1 mg/L, resulting in highly efficient BNR system
- Expansion of BIO-DENITRO with addition of Block and Hong 3-Stage Anaerobic Selector
- Optimized anaerobic zones to maximize PAO growth and activity

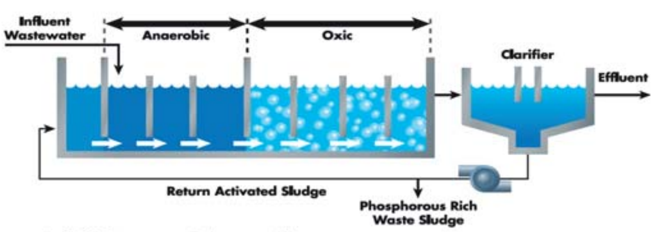
Additional Activated Sludge Solutions

Veolia's additional biological treatment solutions are superior alternatives to other multi-stage BNR systems. We apply the A/O® and A^2/O processes in both oxidation ditch and rectangular tank layouts. These processes can be applied to existing activated sludge and oxidation ditch plants resulting in significantly improved performance.

6.3 MGD An/O - Derry Township, PA

A/O® (Anaerobic/Oxic)

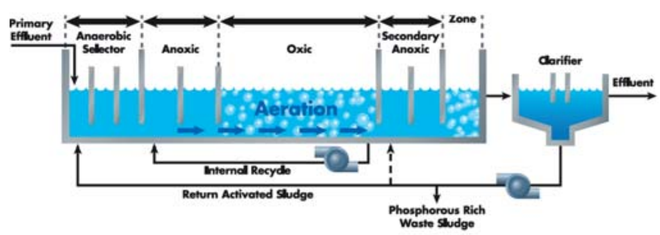
Kruger's A/O process utilizes the Block and Hong Anaerobic Selector followed by a single or multiple reactors for nitrification. The anaerobic selector performs two important functions for effective treatment – biological phosphorus removal and filament control.



A/O® Process Schematic

A^2/O (Anaerobic/Anoxic/Oxic)

Another attractive feature of the A/O process is that upon expansion, nitrogen removal can be added by including anoxic tanks and operating as an A^2/O process. Kruger's A^2/O process incorporates an anoxic zone between the anaerobic selector and oxic zones for nitrate reduction. For more stringent TN limits, a secondary anoxic zone can be added for additional denitrification.



A^2/O Process Schematic

Motor-operated Effluent Weir

Typical Effluent Quality (mg/L)

Kruger Process	NH_3-N	TN	TP
D-Ditch	≤1	≤8	≤2
BIO-DENITRO	≤1	≤3	≤2
BIO-DENIPHO	≤1	≤3	≤1
A/O®	≤1	N/A	≤1
A^2/O	≤1	≤3	≤1

Advanced BNR Technologies

For New or Existing Plants

Kruger's advanced BNR technologies are incorporated in many of our activated sludge processes. In addition, each process is easily implemented into existing plants for treatment upgrades. Kruger solutions are therefore ideal for helping plants address new nitrogen and phosphorus limits.

Block and Hong Anaerobic Selector

Kruger's Block and Hong Anaerobic Selector ensures optimum biological phosporus removal with little to no chemical addition. In many cases, use of the Block and Hong Anaerobic Selector eliminates the expense and quantity of excess sludge generated by chemical precipitation. In addition, filamentous growth is inhibited, providing consistent performance during difficult treatment conditions.

12.0 MGD BIO-DENIPHO with Anaerobic Selectors and Secondary Anoxic Zones, North Cary WRF, NC

Secondary Anoxic Zone

Kruger's advanced Secondary Anoxic Zone design enhances denitrification with our RAS Bleed Off addition. Kruger's RAS Bleed Off process increases nitrate removal rates by more than 30% and reduces effluent TN up to 2 mg/L. This results in plants benefiting from cost savings of a reduced secondary anoxic zone and chemical usage.

Process Control Features

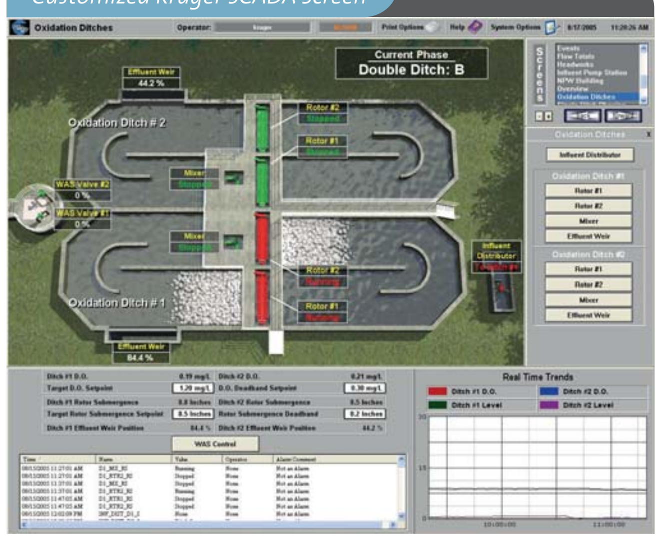
Enhancing Daily Operations

- Customizable PLC-based control
- Plant-wide SCADA system
- Open architecture software
- Point-and-click navigation and control
- 24-hour alarm monitoring and notification

STAC (Superior Tuning and Control)

- Dynamically control aerobic and anoxic phase lengths in response to incoming nitrogen loading
- Improve total nitrogen (TN) removal by 2-4 mg/L
- Energy savings by an estimated 10% from optimization of ditch aeration equipment operation
- Automated chemical dosing for phosphorus removal via online phosphate monitoring
- Ideal for new or existing phased isolation plants

Customized Kruger SCADA Screen



Proposal
Hinesburg, VT

A/O Process

Proj. No. 5700145802

Submitted to: Jennie Auster, PE

Submitted by: Robby Bailey
Applications Engineer

Date: 10/22/2018

This document is confidential and may contain proprietary information.
It is not to be disclosed to a third party without the written consent of Veolia Water Technologies.

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Water Technologies

Introduction

Kruger is pleased to present this preliminary proposal for our A/O (Anaerobic/Oxic) process for BOD, ammonium and phosphorus removal for the WWTF in Hinesburg, VT.

Kruger proposes to construct an A/O process system including anaerobic selector reactor and oxic reactor. The system is designed to meet the ten State standards with common Bio-P selector followed by two trains of oxic tanks each able to treat 50% of the average design load.

Please note that in order to improve the biological phosphorous removal efficiency by trimming off residual NOx-N and DO ahead of anaerobic fermentation, we recommend equally splitting the anaerobic selector into three (3) zones in series with RAS returning into the first zone and influent being introduced into the second zone.

The A/O system will obtain an effluent TP in the range of 0.5 to 2 mg/l depending on the influent BOD:TP ratio and the characteristics of the influent BOD. In order to achieve a final effluent TP of < 0.2 or <0.15 mg/l, ACTIFLO tertiary treatment will need to follow the A/O system.

We appreciate the opportunity to provide this proposal to you. If you have any questions or need further information, please contact our local Representative, Dennis Geran of FR Mahony, or our Regional Sales Manager, Ken Krupa, at (919)-345-0685 (ken.krupa@veolia.com).

cc: CT, KK, LGW, PP, project file (Kruger)
FR Mahony

Revision	Date	Process Eng.	Comments
1	10/20/2018	PP	Initial, budgetary proposal.

We Know Water

Kruger is a water and wastewater solutions provider specializing in advanced and differentiating technologies. Kruger provides complete processes and systems ranging from biological nutrient removal to mobile surface water treatment. The ACTIFLO® Microsand Ballasted Clarifier, BioCon® Dryer, BIOSTYR® Biological Aerated Filter (BAF) and NEOSEP™ MBR are just a few of the innovative technologies offered by Kruger. Kruger is a subsidiary of Veolia Water, a world leader in engineering and technological solutions in water treatment for industrial companies and municipal authorities.

Veolia Water Technologies, the fully-owned subsidiary of **Veolia**, is the world leader in water and wastewater treatment with over 155 years of experience. As an experienced design-build company and a specialized provider of technological solutions in water treatment, Veolia combines proven expertise with unsurpassed innovation to offer technological excellence to our industrial customers. Based on this expertise, we believe that we have developed the best solution for your application. Below is a brief description of the proposed project.

Energy Focus

Kruger, along with Veolia is dedicated to delivering sustainable and innovative technologies and solutions.

We offer our customers integrated solutions which include resource-efficient technology to improve operations, reduce costs, achieve sustainability goals, decrease dependency on limited resources, and comply with current and anticipated regulations.

Veolia's investments in R&D outpace that of our competition. Our focus is on delivering

- neutral or positive energy solutions
- migration towards green chemicals or zero chemical consumption
- water-footprint-efficient technologies with high recovery rates

Our carbon footprint reduction program drives innovation, accelerates adoption and development of clean technologies, and offers our customers sustainable solutions.

Kruger is benchmarking its technologies and solutions by working with our customers and performing total carbon cost analysis over the lifetime of the installation.

By committing to the innovative development of clean and sustainable technologies and solutions worldwide, Kruger and Veolia will continue to maximize the financial benefits for every customer.

We Know Smart Water Management

Veolia is the only company in the world that can combine decades of water treatment expertise, process knowledge and our wide range of domestic and global references into a comprehensive digital solutions platform that provides numerous opportunities to enhance the management of water.

When AQUAVISTA™ is paired with process and equipment instrumentation, your facility will have access to the most advanced suite of cloud-based monitoring, control and technical support mechanisms in the industry. AQUAVISTA™ provides the opportunity to improve your plant's overall performance with enhancements in operational efficiencies and critical asset management. AQUAVISTA™ runs on today's most secure cloud based services and is fully accessible with any common smart devices (phone, pad, tablet).

Four (4) tiers of service are available:

- Portal: A remote monitoring and reporting tool with overview of all plant data and access to important facility documentation.
- Insight: Portal + Data driven performance optimization advice regarding the general status and operational conditions of your plant.
- Assist: Added level of access to Veolia's process experts for process, maintenance, and training support.
- Plant: Operator adjustable levels of automatic control of your treatment facility.

All levels of service provide a simple link to Veolia's customer service group to facilitate easy access to spare parts and other service needs.

Process Description

A/O Process

The proposed A/O (Anaerobic/Oxic) process consists of a three-stage anaerobic selector followed by an oxic fine bubble zone or by an oxidation ditch equipped with brush aerators (rotors). The anaerobic selector is supplied with top entry mixers to maintain the biological solids in suspension. The A/O process provides a sound solution for nutrient removal without utilizing chemicals that result in an increase in sludge generation.

Biological phosphorus removal is achieved by creating an anaerobic zone upstream of an aerobic treatment process. The recycling of activated sludge from the secondary clarifiers through an anaerobic zone prior to the aerobic treatment process selects a group of organisms capable of up taking excessive levels of phosphorus. The excess phosphorus present in the biomass is then removed from the system via the waste activated sludge.

In addition to phosphorus removal, the anaerobic selector prevents the excessive growth of filamentous bacteria responsible for a common problem at treatment facilities, referred to as sludge bulking. By passing the RAS through the anaerobic selector, the growth of filamentous bacteria, which are obligate aerobes, is inhibited. This results in the formation of a dense rapidly settling floc which increases the RAS concentration, thereby decreasing the volume of RAS that must be pumped to the head of the activated sludge process.

To ensure economical and efficient treatment, the aeration equipment can be controlled by automatic dissolved oxygen control. Dissolved oxygen probe(s) continuously monitor and report residual dissolved oxygen levels within the aeration tanks to a PLC-based control panel that controls the aeration equipment to meet, but not exceed, the current oxygen demand.

Design Summary

The design assumes that the raw influent wastewater is biodegradable, no toxic compounds are present, sufficient alkalinity is available to avoid pH depressions, and that the COD/BOD ratio is between 1.7 and 2.3. The amount of water that enters the oxidation ditches during a given phase is small, resulting in an increase resistance to shock loading and process upset.

Influent Design Basis

Parameter	Option 1	Option 2
Influent Flow, Average Design (MGD)	0.25	0.325
Influent Flow, Peak Day (MGD)	0.6	0.78
Influent Flow, Peak Hour (MGD)	0.8	1.04
BOD_5, Design, lbs/day(mg/L)	611 (293)	795 (293)
TSS, Design lbs/day (mg/L)	404 (193)	525 (193)
TKN (mg/L)	40	
NH_4-N (mg/L)	30	
TP (mg/L)	8	
Elevation[a] (ft AMSL)	550	
Min/Max Temperature (˚C)	7.5/18	

a - Assumed value.

Effluent Objectives*

Parameter	Option 1	Option 2
$CBOD_5$ (mg/L)	< 30	< 30
TSS (mg/L)	< 45	< 45
NH_4-N (mg/L) Summer Winter	 < 3.5 <20.2	 < 2.7 <15.5

*Effluent TP objectives will be achieved by an ACTIFLO system following the A/O system.

Design Summary

Parameter	Units	Option 1	Option 2
Number of Trains	-	2	2
Number of Anaerobic Reactors	-	3	3
Number of Oxic Reactors per train	-	1	1
Anaerobic Selector			
Dimensions (Each)	ft	9 L x 10 W x 11 SWD	11 L x 10 W x 11 SWD
Volume (Each)	ft^3	990	1,210
Total Volume (All Reactors)	ft^3	2,970	3,630
Number of Mixers Per Reactor	-	1	1
Total Number of Mixers	-	3	3
Oxic Reactor			
Dimensions (Each)	ft	37 L x 35 W x 16 SWD	48 L x 35 W x 16 SWD
Volume (Each)	ft^3	20,700	26,900
Total Volume (All Reactors)	ft^3	41,400	53,800
Aeration System Type	-	Fine Bubble	Fine Bubble
Residual DO, Max. Month	mg/L	2	2
MLSS, Max. Month	mg/L	~ 3,500	~ 3,500
RAS, Max. Month	%	50-100	50-100
Recommended Freeboard	ft	2-3	2-3
SRT	days	20	20
HRT	hrs	30	30
Design Sludge Yield	lbs MLSS/lb BOD_5	0.75	0.75
System F/M Ratio	$days^{-1}$	0.09	0.09
Sludge Production, Max. Month	lb/day	~ 460	~ 600

A/O System Aeration Summary

Parameter	Option 1	Option 2
AOR BOD Basis (lbs O_2/lb BOD_5 applied)	1.5	
AOR TKN Basis (lbs O_2/lb TKN nitrified)	4.6	
AOR Denite Basis (lbs O_2/lb NO_3-N denitrified)	-2.86	
Total System *Average* AOR (lbs O_2/day)	1,170	1,520
Total System *Design* AOR (lbs O_2/day)	1,290	1,670
Design Alpha / Beta	0.58 / 0.95	
Design Residual DO during Aerobic Phase	2.0	
Total System Design SOR (lbs O_2/day)	2,830	3,700
Total System Design SOR (lbs O_2/hr)	118	155
Airflow Requirement at Design Load (SCFM)	420	540
Number of Blowers	2 + 1	
Nameplate Power per Blower (HP)	15	20

Scope of Supply

Kruger is pleased to present our scope of supply which includes process engineering design, equipment procurement, and field services required for the proposed treatment system, as related to the equipment specified. The work will be performed to Kruger's high standards under the direction of a Project Manager. All matters related to the design, installation, or performance of the system shall be communicated through the Kruger representative giving the Engineer and Owner ready access to Kruger's extensive capabilities.

Process and Design Engineering

Kruger provides comprehensive process engineering and design support for our A/O system, including but not limited to:

- Detail process design assistance including BIOWIN modeling of the system for confirmation of design capabilities.
- Provision of drawings and specifications for use by the consulting engineer in developing the detailed plant design.
- Provision of calculations and other data and attendance at meetings as necessary during state approval processes.
- Shop drawing submittal for Engineer's review and approval. Includes detailed equipment information for all equipment supplied by Kruger.
- Equipment installation instructions for all equipment supplied by Kruger, as well as detailed Operations and Maintenance Manuals.

System Equipment – Limited to In-Basin Equipment Only- Option 1

Mechanical Equipment Items	Qty	Description	Est. HP
Top Entry Mixers	3	One (1) for each Anaerobic zone. Top Entering Type Mixer: TEFC 460/3/60 premium efficient – severe duty - AC induction motor. 304 SS shaft and hydrofoil impeller	1.0
Positive Displacement Blowers	2 + 1	Two (2) duty plus one (1) standby. Each blower will be rated for 220 SCFM at 7.9 psig discharge pressure. Tri-lobe blower with acoustic enclosure. Kaeser, Aerzen, or equal.	15
Modulating Airflow Control Valves	2	One (1) actuated BFV for each basin	N/A
Fine bubble aeration system	2	One (1) fine bubble aeration system per reactor. 304L SS drop pipe with PVC header, lateral piping, and SS hardware (excluding anchor bolts). Fine bubble 9" disc diffusers. EDI, SSI, or equal.	N/A

Instrumentation and Controls Equipment Items*	Qty	Description
Process Air Flow Meter	2	FCI Thermal Mass Flowmeter, one for each oxic reactor
Dissolved Oxygen Probe	2	Hach LDO w/ SC200 Transmitter
PLC Control Cabinet	1	NEMA 12; ControlLogix PLC; Panelview HMI; 120V Feed

System Equipment – Limited to In-Basin Equipment Only- Option 2

Mechanical Equipment Items	Qty	Description	Est. HP
Top Entry Mixers	3	One (1) for each Anaerobic zone. Top Entering Type Mixer: TEFC 460/3/60 premium efficient – severe duty - AC induction motor. 304 SS shaft and hydrofoil impeller	1.0
Positive Displacement Blowers	2 + 1	Two (2) duty plus one (1) standby. Each blower will be rated for 280 SCFM at 7.9 psig discharge pressure. Tri-lobe blower with acoustic enclosure. Kaeser, Aerzen, or equal.	20
Modulating Airflow Control Valves	2	One (1) actuated BFV for each basin	N/A
Fine bubble aeration system	2	One (1) fine bubble aeration system per reactor. 304L SS drop pipe with PVC header, lateral piping, and SS hardware (excluding anchor bolts). Fine bubble 9" disc diffusers. EDI, SSI, or equal.	N/A

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PLC Control Cabinet	1	NEMA 12; ControlLogix PLC; Panelview HMI; 120V Feed

Field Services

Kruger provides very comprehensive support of our systems throughout the installation and start-up period. Our experienced staff of field service personnel will inspect the installation of each component and assist in mechanical start-up, and will typically include direct manufacturer assistance for key pieces of equipment (e.g. blowers). Our dedicated team of instrumentation and controls engineers will provide calibration and start-up of all instrumentation and onsite verification of proper functioning of our PLC programming and operator interface systems. Process Engineers will assist in verification of program functions, start-up of the process, any process performance testing and optimization of the process. Kruger personnel will also provide onsite instruction of the operations staff in the proper operation of the Kruger supplied equipment and systems.

APPENDIX L

SECONDARY CLARIFIERS

Hinesburg WWTF

Vermont

Engineer
Aldrich + Elliot PC

Furnished by
Matt Williams
mwilliams@westech-inc.com

Represented by
Mike Sullivan
David F. Sullivan & Assoc., Inc.
Seabrook, New Hampshire
(508) 878-1016
mikesullivan@davidfsullivan.com

WESTECH

WesTech Opportunity Number: 1660002
Thursday, December 13, 2018

ISO 9001 SYSTEM CERTIFICATION SGS

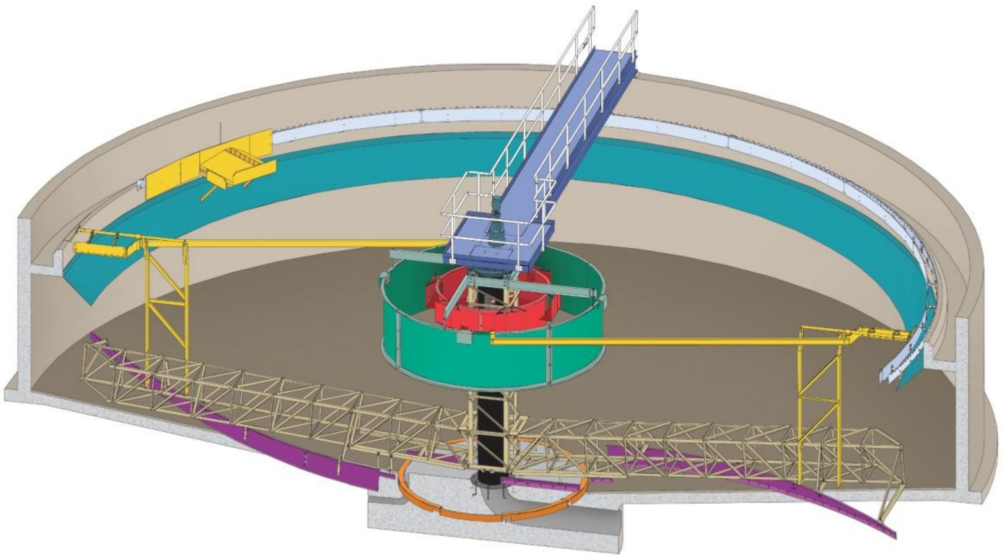
Item A – Two (2) Clarifier Mechanisms, Model Number COPC1G

General Scope of Supply		
Item	Unit	Value/Description
Number of Mechanisms	Each	2
Application	-	Activated Sludge Secondary
Tank Diameter	ft	35
Tank Side Wall Depth	ft	14
Tank Side Water Depth	ft	12
Tank Bottom Slope	-	1 :12
Average Flow Rate	MGD	.325
Peak Flow Rate	MGD	1.04
Influent MLSS Concentration	mg/L	3000 **

** Assumed

Equipment Description

The WesTech Clarifier Optimization Package, or COP™ Clarifier, introduced in 1989, is a significant improvement to conventional clarifier designs. Most often used to treat secondary wastewater, the COP is suitable for virtually any sedimentation application. It combines multiple proven components in an optimized combination that produces the highest quality effluent possible while providing a long lasting, low maintenance design. WesTech's knowledgeable process engineers can assist in appropriate application and sizing, while our extensive installation list and ISO 9001 certified quality system ensure you of a consistently high quality product.



The WesTech COPC clarifier mechanism includes spiral rake blades and a Dual-Gate EDI.

Detailed Scope of Supply

Item	Unit	Qty	Size/Description	Material
Walkway Bridge	each	1	Beam Type	Steel
Walkway Handrail	-	-	2 Rail Component	Aluminum
Walkway Flooring	-	-	1-1/4" Grating	Aluminum
Platform Handrail	-	-	2 Rail Component	Aluminum
Platform Flooring	-	-	1/4" Checker Plate	Aluminum
Center Column Diameter	in	1	18	Steel
Dual-Gate EDI Diameter	ft	1	6	Steel
Dual-Gate EDI Total Height	ft	-	2.5	
Feedwell Diameter	ft	1	10	Steel
Feedwell Total Height	ft	-	5	
Feedwell Supports	-	-	Supported from the Cage	Steel
Full Radius Rake Arms	-	2	Box truss w/ spiral scrapers	Steel
Sludge Withdrawal Ring	-	1	20% of tank dia. w/ multiple ports	Steel
Squeegees	-	-	Bolted to scraper blades	304 SS
Scum Skimmer	each	2	Std. hinged skimmer assembly	Aluminum
Scum Box/Trough	each	1	Standard scum box	Steel
Anchor Bolts & Fasteners	-	-	-	304 SS

Walkway Bridge

The walkway bridge allows access to the center platform and drive unit for equipment maintenance. It includes non-slip flooring and handrails along both sides and around the center platform, with sufficient clearance around the drive for easy maintenance.

Center Column

The mechanism is supported by a central column that normally serves as the influent pipe. It is designed to carry all appropriate structural loads and sized to reduce inlet velocities and minimize floc shearing in the feed. Large ports in the upper end direct the incoming flow into the clarifier basin.

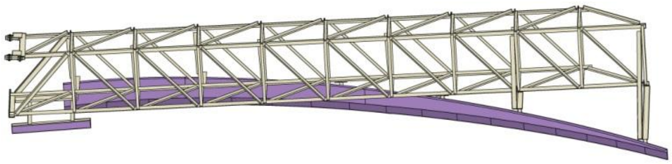
Energy Dissipating Inlet (EDI)

The WesTech dual-gate EDI converts the high energy feed from the center column into a lower velocity flow that is evenly distributed into the feedwell. Opposing gates cause the incoming flow to impinge upon itself as it exits the EDI, thus reducing energy and gently mixing the flow to promote flocculation.

Flocculating Feedwell

The feedwell prevents influent flow from short-circuiting directly across the surface of the basin to the effluent, directing the flow deeper into the settling zone. In combination with the EDI, it also creates a contained volume in which incoming flow is gently mixed to promote flocculation.

Spiral Rake Blades



Spiral rake blades are a significant improvement over conventional segmented rakes. They significantly increase raking capacity, providing rapid solids removal and lower sludge blankets, and eliminate septicity and denitrification. Spiral blades can be mounted on two or four rake arms for additional capacity. They are a highly effective but low maintenance alternative to expensive suction systems, and have no underwater seals and no pipes or orifices to plug.

Scum Removal

Floating material is skimmed from the surface of the clarifier and carried up a ramp into the scum box at the clarifier periphery by a standard WesTech hinged skimmer mechanism. An optional flushing valve can be supplied to automatically flush the scum box with each pass of the skimmer.

Sludge Withdrawal Ring

The sludge withdrawal ring is an improvement over the traditional single-point sludge sump. Multiple large withdrawal ports on the ring reduce sludge inventory and blanket depth while maintaining high solids concentration. The sludge withdrawal ring assists in rapid solids removal in conjunction with the spiral rake blades.

Density Current Baffle (Optional)

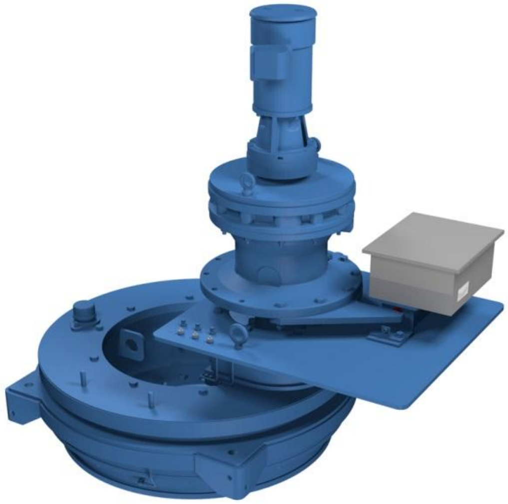
This wall-mounted baffle is designed to prevent the density current common to activated sludge clarifiers from carrying solids up the basin wall to the weirs. It requires no maintenance and is particularly effective at reducing solids carryover during high flows.

Drive Unit		
Description	Unit	Value/Description
Drive Type	-	Cage w/ Precision Bearing
Housing Material	-	Steel
Continuous Rated Torque	ft·lbs	6000
Momentary Peak Torque	ft·lbs	12000
Rake Tip Speed	ft/min	8.5
Motor Size	HP	0.5
Motor Speed/Voltage/Frequency/Phase	RPM / V / Hz / Phase	1800 / 460 / 60 / 3
Torque Control Settings	Alarm: ft·lbs Motor Cutout: ft·lbs	100%: 6000 120%: 7200
Main Gear and Pinion Lubrication	-	Oil
Main Bearing and Reducer Lubrication	-	Grease

WesTech drive units are delivered to the job site as a single, completely assembled and shop-tested unit, ready to be installed on the clarifier center column. The result of a thorough design and meticulous component selection is a strong, reliable, high-quality drive that will provide a long service life with minimum maintenance.

Direct Coupling

Direct coupling of motor, reducer, and pinion shaft eliminates chain or belt drive transmissions, thus increasing efficiency and operator safety. This arrangement also allows for direct and accurate torque monitoring with WesTech's Load Cell torque control.



Electric Motor

The electric motor, direct coupled to a speed reducer, rotates the internal gear by means of a pinion fastened to the output shaft of the speed reducer. The drive control pointer indicates the torque loading in percentages. The electric motor is totally enclosed, suitable for outdoor service, but other commercially available motors to suit environment or service, such as explosion proof, can be furnished. When required, a variable speed drive can be added to vary the output speed of the drive. This allows optimization of the process, which can result in long term savings.

Input Speed Reducer

The speed reducer, driven by the motor, is a completely sealed oil or grease lubricated unit. It is of the cycloidal type, which combines extremely high ratios with high efficiency and low wear in a compact unit. Torque transmitting elements roll rather than grinding or sliding, thus achieving efficiencies of 90 percent. Virtually no wear failures have occurred in properly sized Westech drives. Even after 30 years of operation, many WesTech reducers are still in use.

Torkmatic™ Drive Control

The Torkmatic drive control indicates and senses the output torque of the drive main gear. At excessively high torques, an alarm will sound or the motor will stop, thus protecting the drive unit and mechanism. The Load Cell torque control is extremely accurate at reading torque and is protected by a NEMA 4X outdoor enclosure. The drive control comes with a 4-20 mA signal output for customer ease and monitoring of the process from a remote location.

Precision Bearing Advantages

Precision Manufacturing Tolerances

The bearings utilized are acceptable for high load, high speed applications and are manufactured by recognized bearing companies. The use of these precision bearings is widespread among larger and more heavily loaded clarifier and thickener mechanisms common to the metallurgical industries.

Exceptional long life and load capacities
Instead of applying the bearing load in four points on the bearing balls as with old-style strip lined bearings, the precision bearing utilizes a full band contact race with hardness equal to that of the strip liners. Calculated bearing life is at least five times that for strip liners of the same ball size and diameter. The need for splitting gears and housings is eliminated because of the superior service life.

Overturning Load Capacity
Strip lined bearings have no inherent overturning load capacity and must rely on the mechanism weight alone to hold the bearing race together. This capacity of the precision bearing makes possible tank settling, misalignment, and lack of precision leveling of the drive during installation and operation a far less determining factor in premature bearing failure.

Main Bearing Protection
WesTech gear housings protect from dirt and contamination using designed neoprene seals and gaskets, whereas strip lined bearings can only use a loose felt seal. WesTech precision gears also allow the bearing to run in a separate sealed grease cavity, which achieves additional protection from contamination.

Surface Preparation and Coating

Coating Area	Surface Preparation	Coating
Submerged	None	None
Non-Submerged	None	None
Drive Unit	SSPC-SP6	One (1) coat Tnemec N140F-1255 Epoxy, 3-9 mils DFT, and one(1) coat Tnemec 1074U-B5712 Polyurethane, 2-5 mils DFT

On-site Services

Item	Quantity
Total Number of Trips	1
Total Number of Days	1

For inspection, observation of torque testing, startup, and instruction of plant personnel. Additional on-site services may be purchased at standard WesTech daily rates plus travel and living expenses.

Clarifications and Comments
The information provided above is for budgetary purposes only.

Items Not Included in WesTech's Base Scope of Supply
- Electrical Controls and Wiring
- Coatings
- Piping, Valves, or Fittings
- Lubricants
- Unloading or Storage
- Erection or Assembly
- Weir, Scum Baffle, & Supports
- Concrete

APPENDIX M

GEOTECHNICAL REPORT

Proposed Hinesburg Waste Water Treatment Facility Upgrades
Preliminary Geotechnical Summary (02/10/2019)

A. General:

1. In January 2019, Knight Consulting Engineers, Inc. engaged Mike's Boring & Coring to perform 4 soil borings (B-1 thru B-4) at the existing Hinesburg Waste Water Treatment Facility off Lagoon Road. The soil borings ranged in depth from 42 to 78 feet. All soil borings were performed using hollow stem augers and Standard Penetration Test (SPT) split-spoon sampling procedures.

2. **Subsurface Soils:** The soil borings indicate that the subsurface soil conditions are generally comprised of:

   Lagoon Berms (B-2 thru B-4): 2' to 3' of gravel followed by 9' of very stiff brown/gray silt & clay (Moist).

   Native Surface Soil: 6.5' to 8.5' of stiff-to-very stiff brown/gray silt & clay (Moist-to-Damp).

   Ground Water Level: The January soil borings indicated a range in elevation of approximately 316.5' to 318.5'.

   Soft-to-Medium Stiff Gray Clay: 5' of soft-to-medium stiff gray clay (Wet).

   Very Soft Gray Clay: 35' (B-2) to 65' (B-4) of very soft, highly-plastic, gray clay (Wet).

   Glacial Outwash: Approximately 12' in thickness at Soil Boring B-2 (Wet).

   Refusal: Approximately 70' deep at Soil Boring B-2.

3. Atterberg Limit testing was performed on the deeper very soft gray clays. Below is a summary of Atterberg Limit results:

Soil Boring	Depth	Approx. Elevation	LL	PL	PI	In-situ Moisture	Type
B-1	40'-42'	293'-295'	62	28	34	66.8%	CH
B-2	35'-37'	299'-301'	68	30	38	69.5%	CH
B-2	50'-52'	284'-286'	56	26	30	52.4%	CH
B-3	30'-32'	304'-306'	58	26	32	60.4%	CH
B-4	20'-22'	305'-307'	71	30	41	79.3%	CH

4. Based upon Atterberg Limit testing, none of the tested soft-to-medium stiff clay samples met the requirements for liquefiable fine-grained soils (Wang 1979):

- Fraction finer than 0.005 mm≤15% (≤15% Clay)
- Liquid Limit, LL ≤ 35%
- Natural water content, $W_N \geq 0.9$ LL
- Liquidity Index, LI≤ 0.75

Soil Boring	**Depth**	**<15% <0.005 mm**	**LL<35**	**W_N/LL(>0.9)**	**LI**	**LI<0.75**	**Liquefiable**
B-1	40'-42'	Likely No	No	1.08 (Yes)	1.14	No	No
B-2	35'-37'	Likely No	No	1.02 (Yes)	1.04	No	No
B-2	50'-52'	Likely No	No	0.94 (Yes)	0.88	No	No
B-3	30'-32'	Likely No	No	1.04 (Yes)	1.08	No	No
B-4	20'-22'	Likely No	No	1.12 (Yes)	1.20	No	No

5. Consolidation testing was performed on the deeper very soft gray clays in soil borings B-3 & B-4. Based upon these results, the existing clays appear to be still in the early stages of consolidation resulting from the construction of the original lagoons in the 1960's. This is supported by the calculated OCR of 0.64 at soil boring B-3 and an estimated 150 to 600-year duration for pore water dissipation, depending upon 1-way or 2-way vertical dissipation for a clay thickness of 53 feet. An OCR<1 means that the soil is under-consolidated (not finished) whereas an OCR>1 means that the soil is over-consolidated (off-loaded). Approximately 3' to 3.5' of long-term consolidation settlements are expected to result from the 1960's lagoon construction. Below is a summary of pocket penetrometer and consolidation testing results:

Boring	**Depth**	**Po (psf)**	**Pc (psf)**	**Su(psf)**	**OCR**	**Cc**	**Cr**
B-1 (Berm)	25’-27’	-	-	365	-	-	-
B-3 (Berm)	40’-42’	2877*	1834	242	0.64*	1.295	.0771
B-4	30’-32’	1875	2045	423	1.09	1.021	.0852

*The Pre-1960 loading at B-3 was calculated to be approximately 1793 PSF (OCR=1.02).

B. **2015 IBC Seismic (As-is):**

Site Class “E” (Average Su_{100} = 360 psf)
Ss=0.316 (Fa=2.289)
S1=0.082 (Fv=3.500)
Sds=0.482
Sd1=0.191

Site Class “E” results in Seismic Design Category “D” for Risk Category 4.

Because the site is not located directly over an active fault, the risk of surface rupture during a seismic event is relatively low. Based upon the Atterberg Limit results, there is little risk of liquefaction due to a design seismic event.

C. **Proposed WWTF Upgrade Alternatives & Impacts:**

Alternative #1: The existing lagoon #1 would remain similar in function as it is today. The existing Sludge Holding Area would be filled-in (up to elevation 335') for construction of a new control building, sludge storage tanks and new structure for the comag system. Bottom of slab would be approximately at the bottom of the existing lagoons. This alternative is expected to result in long-term consolidation settlements of 3.6' to 4.5'. This settlement is expected to occur over a 150 to 600 year consolidation period. Assuming a design life of 50 years, we would expect approximately 18" to 42" of total consolidation settlement. This is an excessive amount of settlement for most structures. A small rigid building on top of the fill may not feel any ill effects but you will not be able to maintain any critical elevations.

Alternative #2: The Southern portion of Lagoon #1 would be filled up to the top of the existing berm (elevation 336') to support the proposed new buildings. The resulting fill would be approximately 100 feet wide and slope down at a 2.5:1 slope on the north side of the new structures. The new headworks structure, built at existing berm grade. The new SBR tank would be about 23' high and extend at least 10' below the bottom of the existing lagoons. Bottom of the other new structures would be about the bottom of the existing lagoons. This alternative is expected to result in long-term consolidation settlements of 3.9' to 4.9' over a 150 to 600 year consolidation period. Total differential consolidation settlements are expected to be approximately 12" (ultimate). Assuming a design life of 50 years, we would expect approximately 3.5" to 8.5" of differential consolidation settlement. This is an excessive amount of differential settlement for most structures. A small rigid building on top of the fill may not feel any ill effects but you will not be able to maintain any critical elevations. Soft soil conditions exist below approximately elevation 319'.

Alternative #3: This alternative would be similar to Alternative #2. The bottom of aeration tanks would be below the bottom of the lagoons and other structures at about bottom of the existing lagoons. This alternative is expected to result in long-term consolidation settlements similar to those of Alternative #2.

D. **Subgrade Improvement Options:**

Traditionally on sites with large consolidation settlements, the subgrade would be mitigated by pre-loading the compressible soils or supporting the structures on piles. For thick clay deposits, preloading is typically combined with vertical wick drains in order to accelerate the consolidation process. Consequently, the 2 options recommended for this site are:

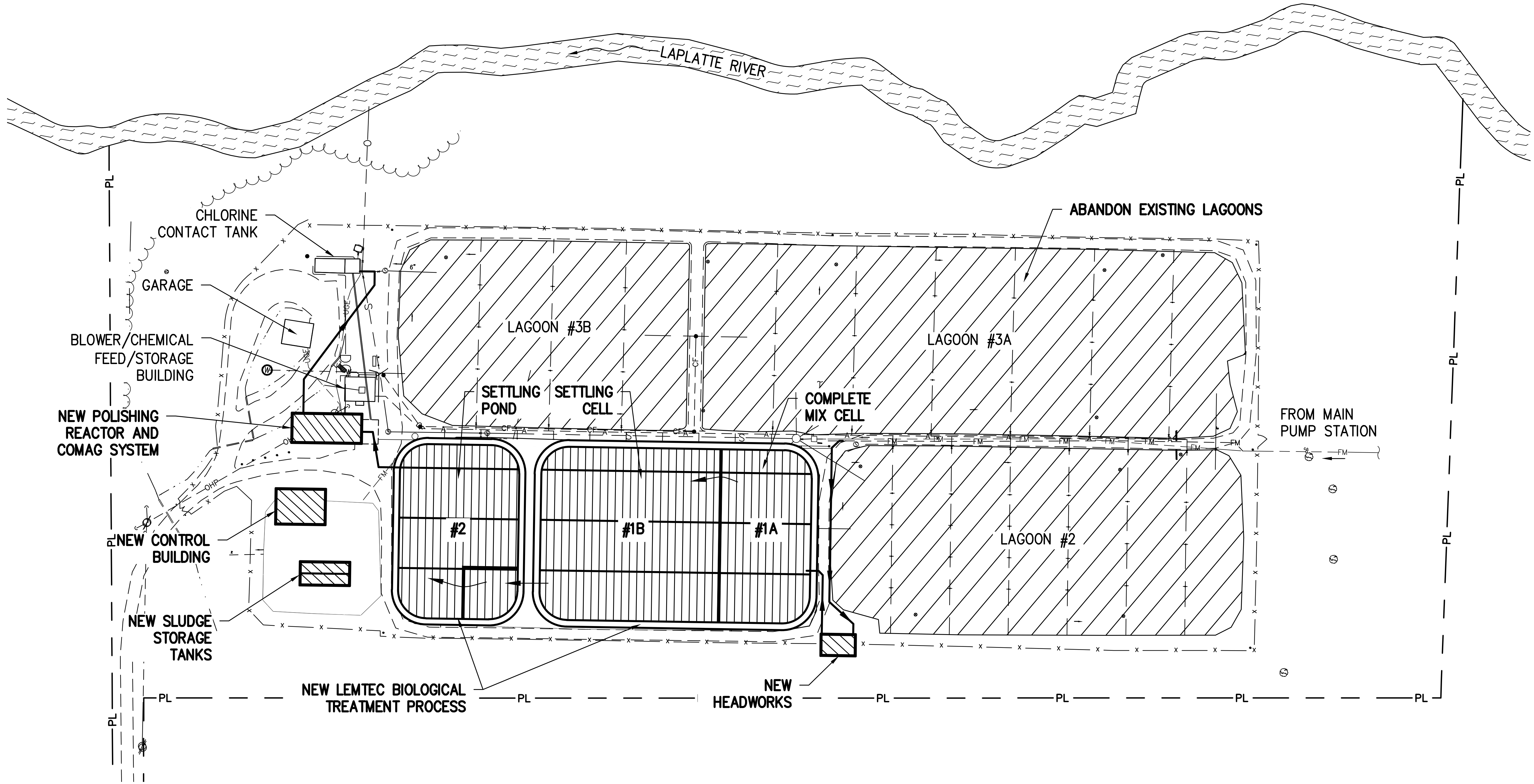
Subgrade Option #1 (Preloading and Vertical Wick Drains): This option would include placing the design quantity of fill plus an additional amount equal to or greater than the calculated amount of settlement. The vertical wick drain spacing would be design to balance cost with the resulting duration of the preload period.

Subgrade Option #2 (Piles): This option would include placing the design quantity of fill and supporting the new structures on end-bearing piles. Because the ground around the structures is expected to settle, the piles will likely need to be designed for down-drag forces which will likely increase the required capacity or number of piles. Also, this slow (150 to 600-year) long-term settlement will likely result in the need for periodic filling around the buildings. Anticipated settlements during a 50-year design life would amount to approximately 20" to 46".

Submitted by,

____

Eric Goddard, P.E.
Senior Vice President



N

PLAN
SCALE: 1"=100'

GRAPHIC SCALE

0 100 150 200

(IN FEET)

Aldrich + Elliott
WATER RESOURCE ENGINEERS

6 Market Place, Suite 2
Essex Jct., VT 05452

P: 802.879.7733
AEengineers.com

ALTERNATIVE NO.1 LAGOON UPGRADE WITH BALLASTED FLOC	DESIGNED		PROJECT NO. 18049
	DRAWN JEB		
	CHECKED (PM) WAE		
WWTF UPGRADE/EXPANSION STUDY PRELIMINARY ENGINEERING REPORT	CHECKED (PE) WAE		FIGURE NO. 7
TOWN OF HINESBURG	SCALE AS NOTED		
HINESBURG VERMONT	DATE MARCH 2019		

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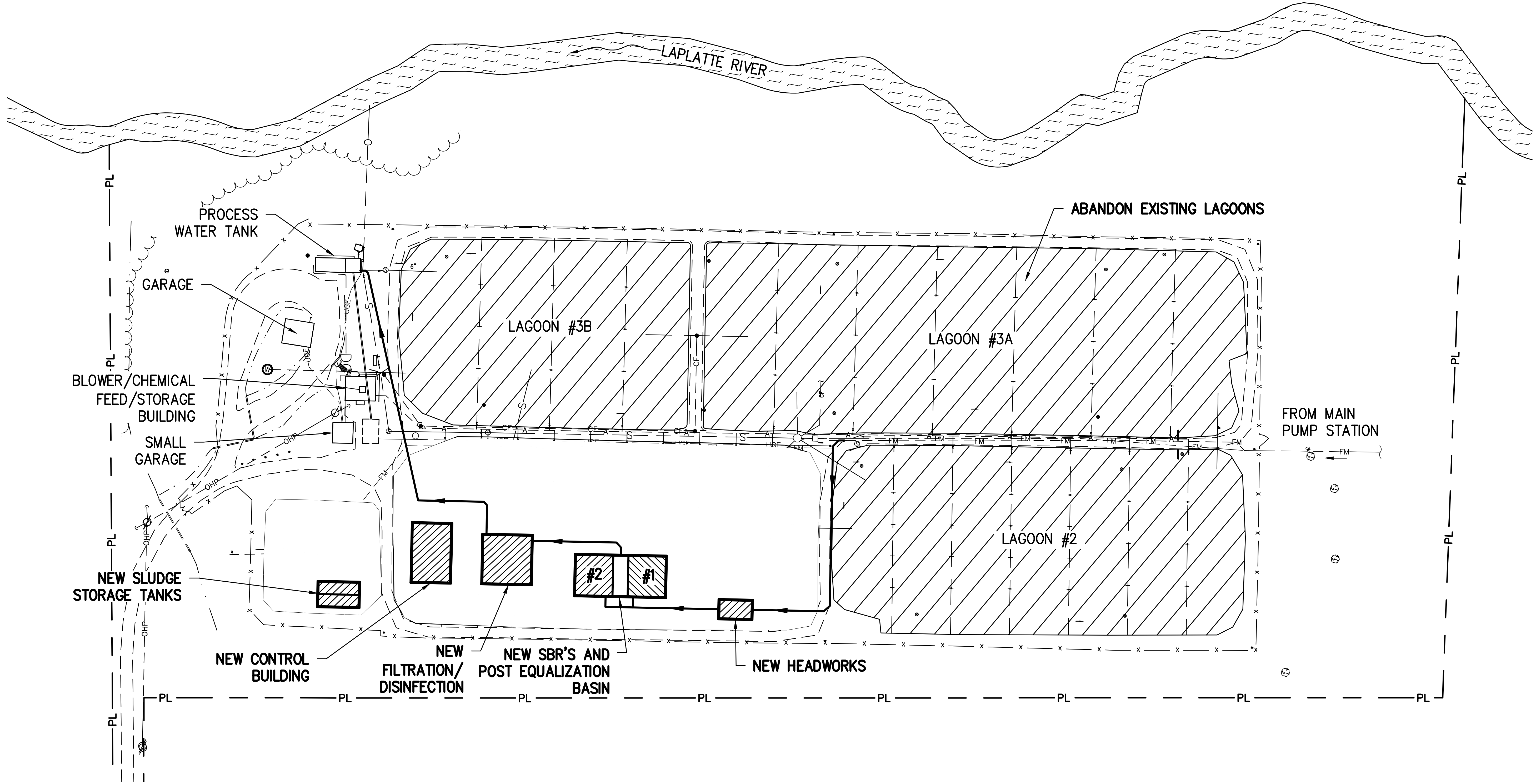


PLAN
SCALE: 1"=100'

GRAPHIC SCALE

0 100 150 200

(IN FEET)

AE
Aldrich + Elliott
WATER RESOURCE ENGINEERS
6 Market Place, Suite 2
Essex Jct., VT 05452
P: 802.879.7733
AEengineers.com

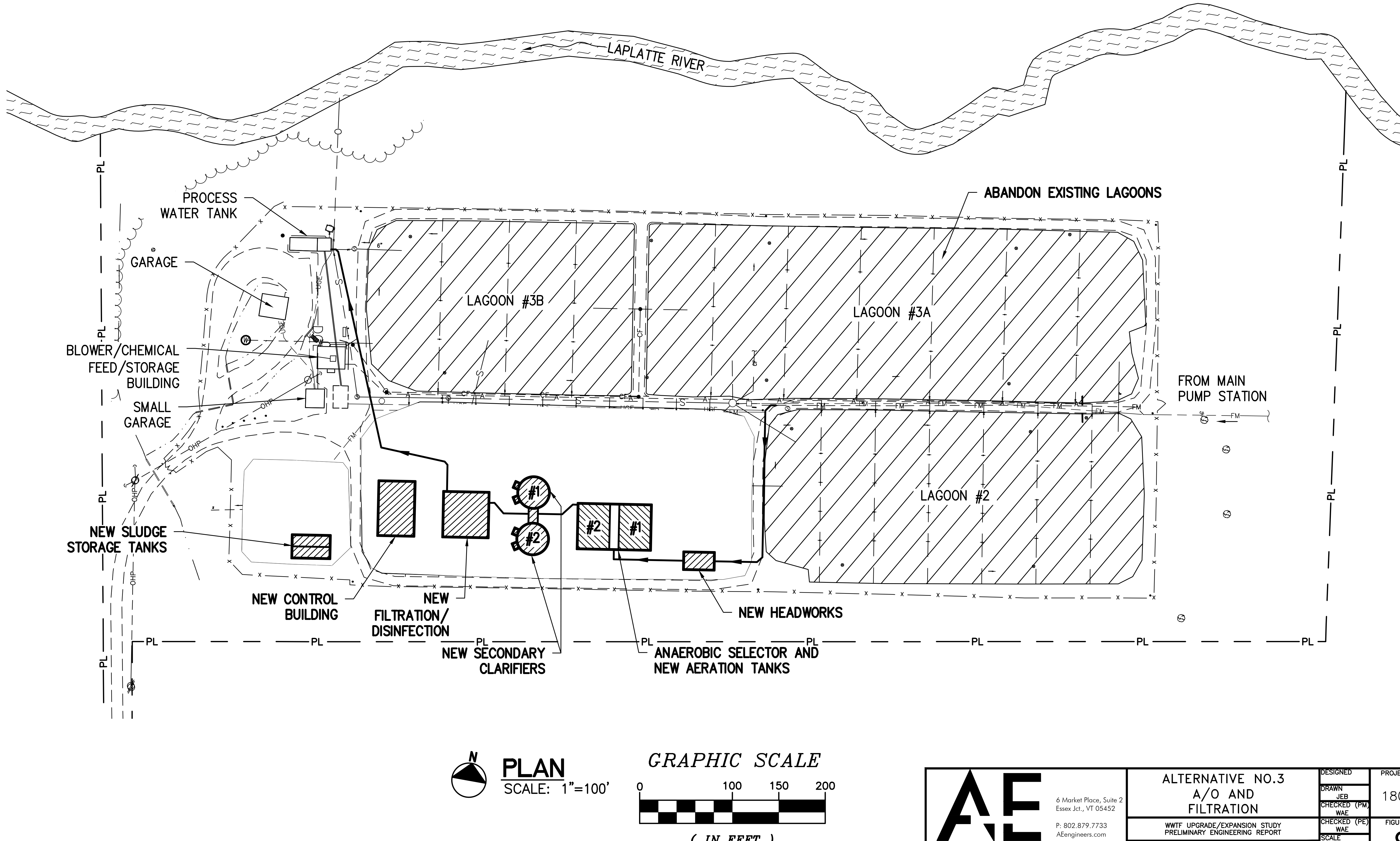
ALTERNATIVE NO.2
SEQUENTIAL BATCH REACTOR WITH FILTRATION

WWTF UPGRADE/EXPANSION STUDY
PRELIMINARY ENGINEERING REPORT

TOWN OF HINESBURG

HINESBURG VERMONT

DESIGNED	
DRAWN	JEB
CHECKED (PM)	WAE
CHECKED (PE)	WAE
SCALE	AS NOTED
DATE	MARCH 2019
PROJECT NO.	18049
FIGURE NO.	8



Aldrich + Elliott
WATER RESOURCE ENGINEERS

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AEengineers.com

ALTERNATIVE NO.3
A/O AND
FILTRATION

WWTF UPGRADE/EXPANSION STUDY
PRELIMINARY ENGINEERING REPORT

TOWN OF HINESBURG

HINESBURG VERMONT

DESIGNED	
DRAWN	JEB
CHECKED (PM)	WAE
CHECKED (PE)	WAE
SCALE	AS NOTED
DATE	MARCH 2019

PROJECT NO. 18049

FIGURE NO. 9

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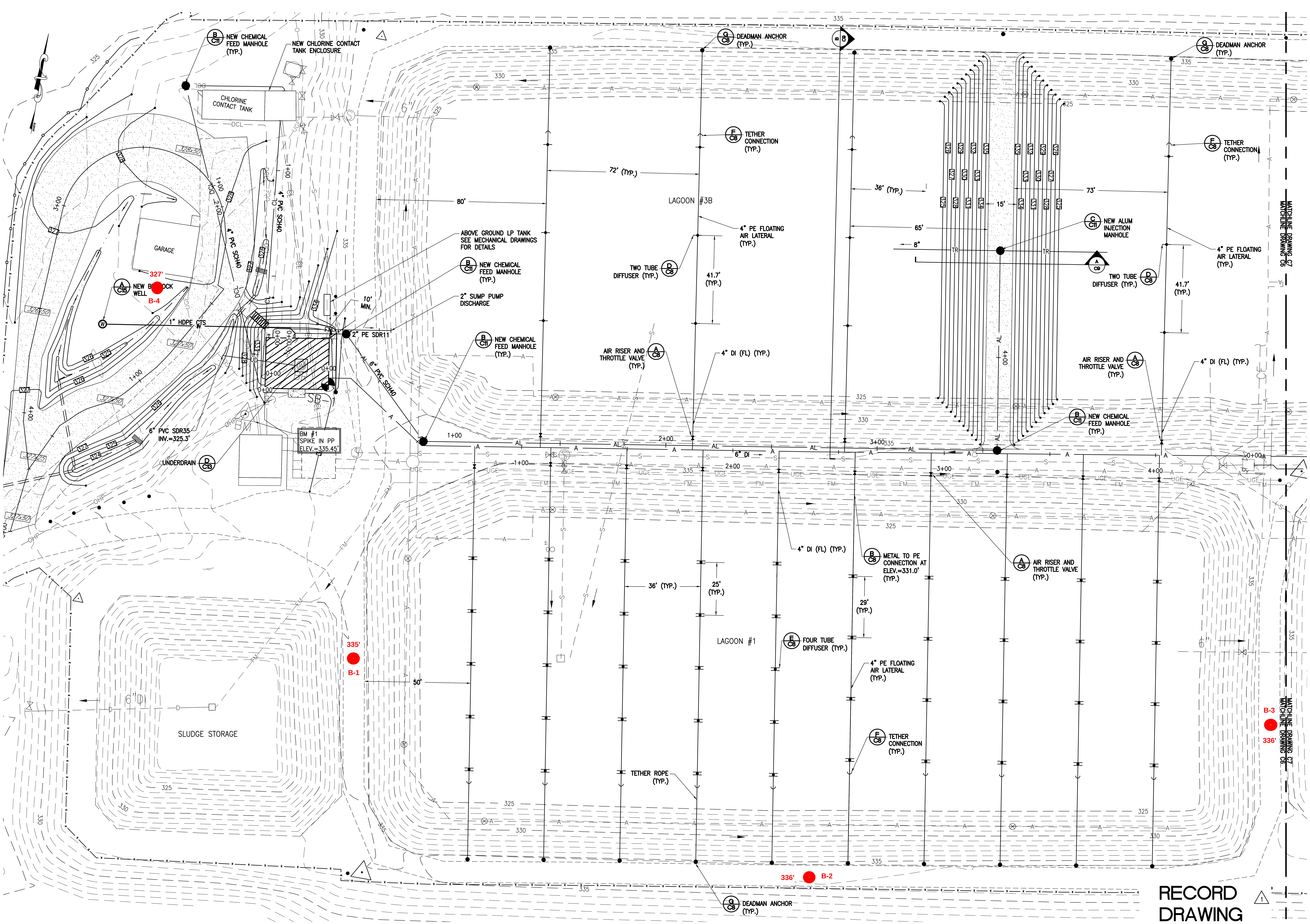

Soil Boring Plan
Hinesburg WWTF

PLAN
SCALE: 1"=20'

RECORD DRAWING

THE RECORD DRAWING INFORMATION FOR THIS PROJECT IS AS PROVIDED BY THE CONTRACTOR AND IS COMPILED FOR RECORD PURPOSES. THERE IS NO GUARANTEE OF ACCURACY.

FA&A
FORCIER ALDRICH & ASSOCIATES
CIVIL & ENVIRONMENTAL ENGINEERS
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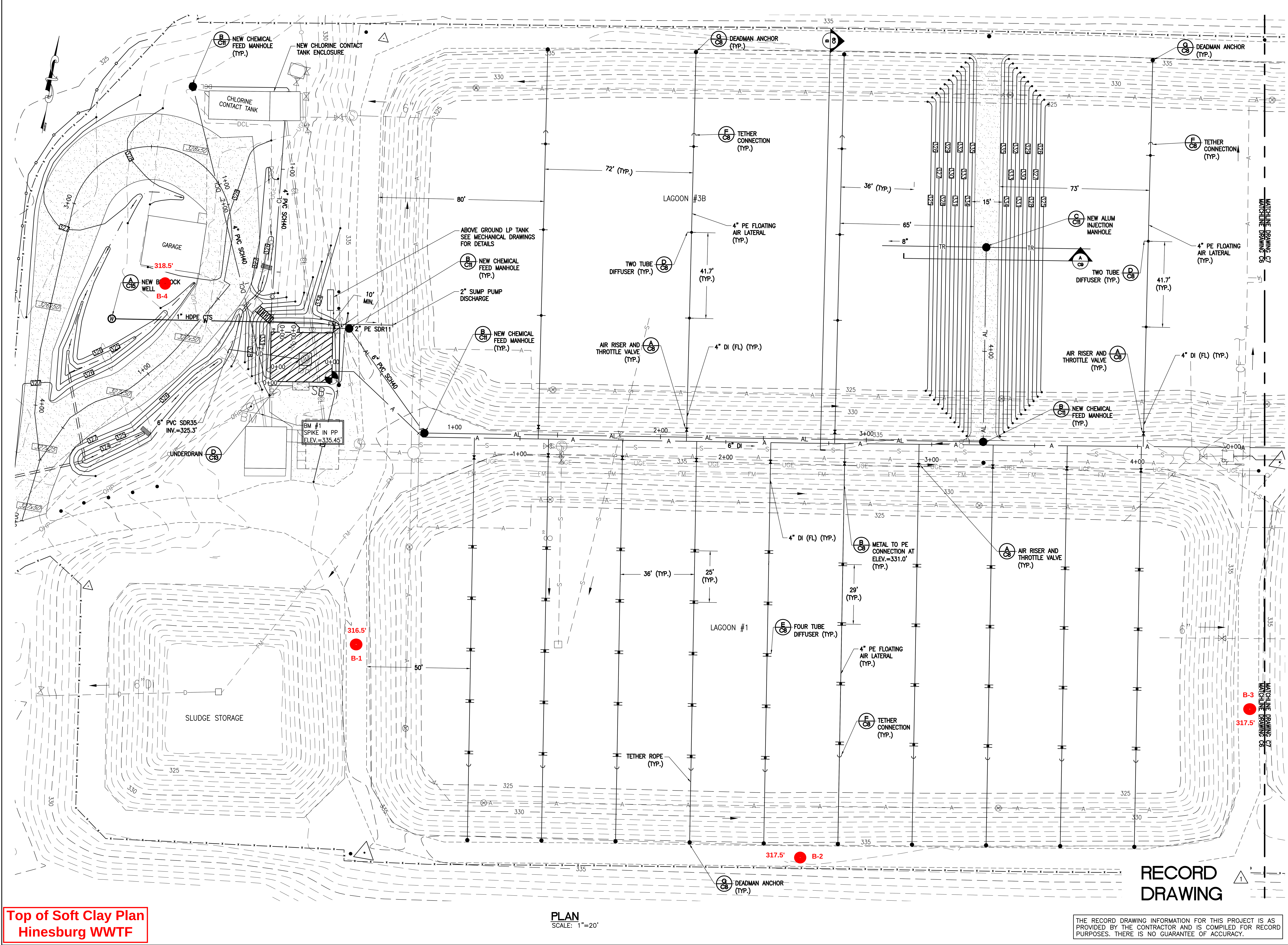
TOWN OF HINESBURG
HINESBURG, VERMONT

WASTEWATER TREATMENT FACILITY UPGRADE
CONTRACT No. 1

NO.	DATE	REVISION DESCRIPTION	CHECKED
1		RECORD DRAWINGS	BFA

WASTEWATER TREATMENT FACILITY YARD PIIPING PLAN

DESIGNED KJC	PROJECT NO. 08077
DRAWN JEN	DRAWING NO.
CHECKED WAE	C6
DATE JUNE, 2009	SHEET 8



THE RECORD DRAWING INFORMATION FOR THIS PROJECT IS AS PROVIDED BY THE CONTRACTOR AND IS COMPILED FOR RECORD PURPOSES. THERE IS NO GUARANTEE OF ACCURACY.

Top of Soft Clay Plan
Hinesburg WWTF

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TOWN OF HINESBURG
HINESBURG, VERMONT

WASTEWATER TREATMENT FACILITY UPGRADE
CONTRACT No. 1

NO.	DATE	REVISION DESCRIPTION	CHECKED
1		RECORD DRAWINGS	BFA

WASTEWATER TREATMENT FACILITY
YARD PIIPING PLAN

DESIGNED KJC	PROJECT NO. 08077
DRAWN JEN	DRAWING NO.
CHECKED WAE	C6
DATE JUNE, 2009	SHEET 8

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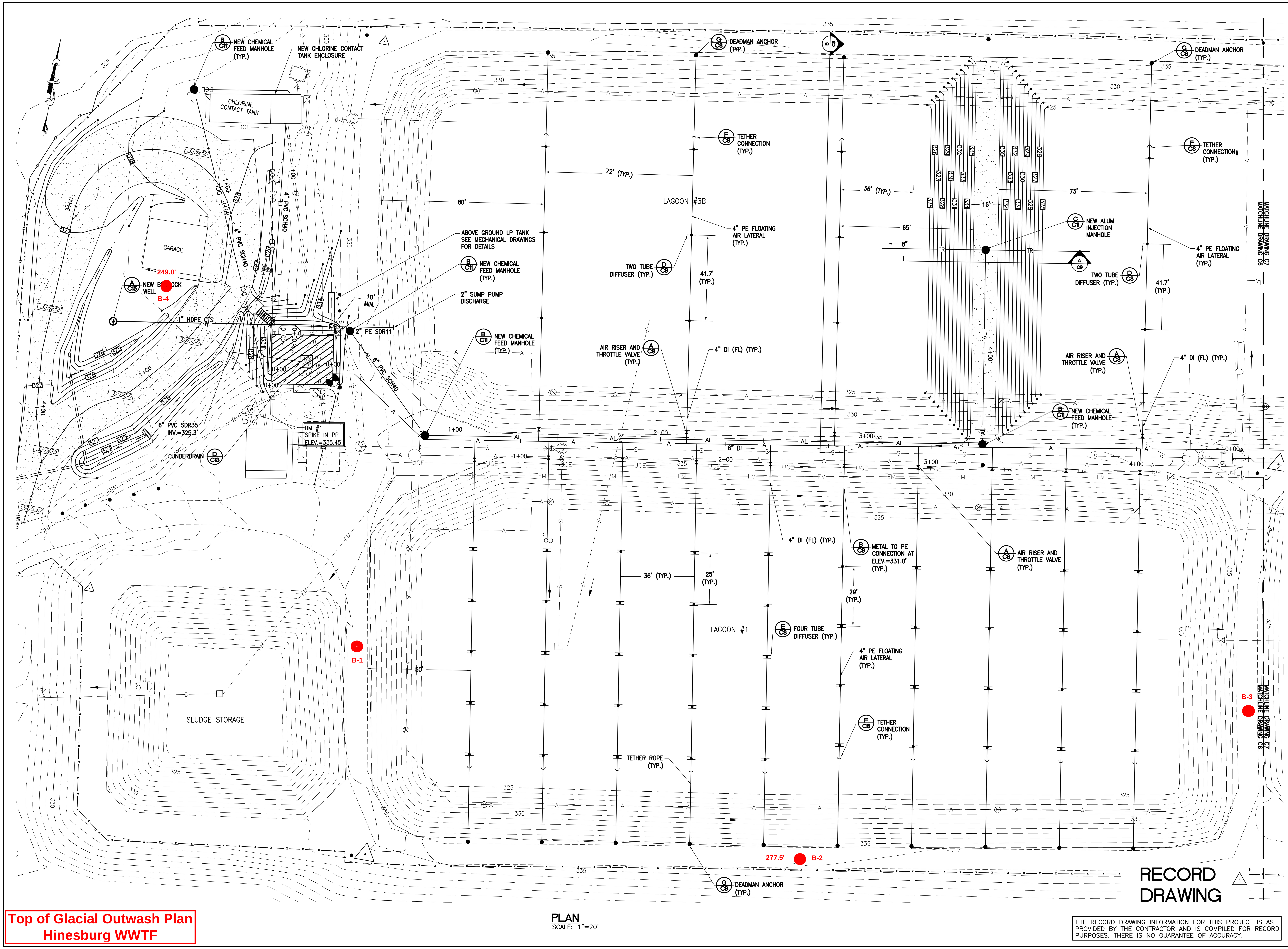

RECORD DRAWING

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Top of Glacial Outwash Plan
Hinesburg WWTF

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TOWN OF HINESBURG
HINESBURG, VERMONT

WASTEWATER TREATMENT FACILITY UPGRADE CONTRACT No. 1

NO.	DATE	REVISION DESCRIPTION	CHECKED
1		RECORD DRAWINGS	BFA

WASTEWATER TREATMENT FACILITY YARD PIIPING PLAN

DESIGNED KJC	PROJECT NO. 08077
DRAWN JEN	DRAWING NO. C6
CHECKED WAE	
DATE JUNE, 2009	SHEET 8

MIKE'S BORING & CORING LLC.
PO Box 75 ° East Barre, Vermont 05649 ° 802 476-5073

TO: Eric Goddard Knight Consulting Engineers, Inc. 51 Knight Lane Williston, VT 05495	PROJECT NAME: WWTF LOCATION: Hinesburg, VT MBC JOB #: 19005	SHEET: 1 DATE: 1-14-19 HOLE #: B- 1 LINE & STA. OFFSET:

Ground Water Observations 18.5' est. at 0 hours	Augers-Size I.D. 3.25" Split Spoon 2" Hammer Wt. 140# Hammer Fall 30"	Surface Elevation: 335'+/- Date Started: 1-14-19 Date Completed: 1-14-19 Boring Foreman: Mike McGinley Inspector: Eric Goddard Soils Engineer: Eric Goddard

LOCATION OF BORING: As staked

Sample Depths From/To (Feet)	Type of Sample	Blows per 6" on Sampler	Moisture Density or Consist.	Strata Change Elev.	Soil Identification	Sample		
						No.	Pen. Inches	Rec. Inches
5'-7'	Dry	5/8/11/11	Moist	2.5'	Very stiff gray silty clay, some f gravel (PP=3.61 TSF)	1	24	14
10'-12'	Dry	7/4/4/11	Moist		Very stiff brown/gray silty clay, some f gravel (PP=2.45 TSF)	2	24	18
15'-17'	Dry	5/9/10/11	Moist	18.5'	Very stiff gray silt, trace clay (PP=3.36 TSF)	3	24	18
20'-22'	Dry	1/1/1/2	Wet		Soft-to-medium stiff gray clay (PP=0.71 TSF)	4	24	23
25'-27'	UT				Pushed tube 10 seconds at 50 PSI Soft gray clay (PP=0.37 TSF)	5	24	24
30'-32'	Dry	WORHx4	Wet		Very soft gray clay (PP=0.16 TSF)	6	24	24
35'-37'	Dry	WORHx4	Wert		Very soft gray clay (PP<0.16 TSF)	7	24	24
40'-42'	Dry	WORHx4	Wet		Very soft gray clay (CH, LL=62, PL=28, PI=34, w=66.8%, PP<0.16 TSF)	8	24	24

Ground Surface to 40' Used 3.25" augers: Then SS to 42'

Earth Boring	42'
Rock Coring	
Samples:	8
HOLE NUMBER	B-1

MIKE'S BORING & CORING LLC.
PO Box 75 ° East Barre, Vermont 05649 ° 802 476-5073

TO: Eric Goddard Knight Consulting Engineers, Inc. 51 Knight Lane Williston, VT 05495	PROJECT NAME: WWTF LOCATION: Hinesburg, VT MBC JOB #: 19005	SHEET: 2 DATE: 1-14-19 HOLE #: B- 2 LINE & STA. OFFSET:

Ground Water Observations 18.5' est. at 0 hours	Augers-Size I.D. 3.25" Split Spoon 2" Hammer Wt. 140# Hammer Fall 30"	Surface Elevation: 336'+/- Date Started: 1-14-19 Date Completed: 1-14-19 Boring Foreman: Mike McGinley Inspector: Eric Goddard Soils Engineer: Eric Goddard

LOCATION OF BORING: As staked

Sample Depths From/To (Feet)	Type of Sample	Blows per 6" on Sampler	Moisture Density or Consist.	Strata Change Elev.	Soil Identification	Sample No.	Pen. Inches	Rec. Inches
5'-7'	Dry	5/4/5/7	Moist	2.5'	Very stiff gray/brown silt, some clay (PP=2.45 TSF)	1	24	14
10'-12'	Dry	3/5/6/9	Moist		Very stiff brown/gray silt (PP=2.77 TSF)	2	24	18
15'-17'	Dry	5/6/7/7	Wet	18.5'	Stiff gray silty clay (PP=1.66 TSF)	3	24	4
20'-22'	Dry	2/1/1/1	Wet		Soft gray clay (PP=0.32 TSF)	4	24	24
25'-27'	Dry	1/0/0/1	Wet		Very soft gray clay (PP=0.16 TSF)	5	24	24
30'-32'	Dry	WORHx4	Wet		Very soft gray clay (PP<0.16 TSF)	6	24	24
35'-37'	Dry	WORHx4	Wert		Very soft gray clay (CH, LL=68, PL=30, PI=38, w=69.5%, PP=0.12 TSF)	7	24	24
40'-42'	Dry	WORHx4	Wet		Very soft gray clay (PP=0.18 TSF)	8	24	24
45'-47'	Dry	WORHx4	Wet		Very soft gray clay (PP=0.16 TSF)	9	24	24
50'-52'	Dry	WORHx4	Wet		Very soft-to-soft gray clay (CH, LL=56, PL=26, PI=30, w=52.4%, PP=0.23 TSF)	10	24	24
55'-57'	Dry	WORHx3/2	Wet	58.5'	Very soft gray clay (PP=0.16 TSF)	11	24	24
60'-62'	UT				Pushed tube 18 seconds at 75 PSI (No recovery - probable glacial outwash)	12	18	0
63'-65'		26/30			Pushed point (Probable glacial outwash)			
65'-70'		42/52/52/48/ 100			Refusal in probable glacial till at 70'.			

Ground Surface to 65' Used 3.25" augers: Then SS to 62' pushed point to 70'

Earth Boring	70'
Rock Coring	
Samples:	12
HOLE NUMBER	B-2

MIKE'S BORING & CORING LLC.
PO Box 75 ° East Barre, Vermont 05649 ° 802 476-5073

TO: Eric Goddard Knight Consulting Engineers, Inc. 51 Knight Lane Williston, VT 05495	PROJECT NAME: WWTF LOCATION: Hinesburg, VT MBC JOB #: 19005	SHEET: 3 DATE: 1-14-19 HOLE #: B-3 LINE & STA. OFFSET:

Ground Water Observations 18.5' est. at 0 hours	Augers-Size I.D. 3.25" Split Spoon 2" Hammer Wt. 140# Hammer Fall 30"	Surface Elevation: 336'+/- Date Started: 1-14-19 Date Completed: 1-14-19 Boring Foreman: Mike McGinley Inspector: Eric Goddard Soils Engineer: Eric Goddard

LOCATION OF BORING: As staked

Sample Depths From/To (Feet)	Type of Sample	Blows per 6" on Sampler	Moisture Density or Consist.	Strata Change Elev.	Soil Identification	Sample		
						No. Rec. Inches	Pen. Inches	
5'-7'	Dry	2/1/1/1	Moist	2.5'	Soft brown silt, trace clay	1	24	2
10'-12'	Dry	7/7/8/8	Moist		Very stiff brown/gray silt, some clay (PP=2.82 TSF)	2	24	22
15'-17'	Dry	10/5/9/11	Moist	18.5'	Very stiff brown/gray silty clay & fine sand (PP=2.40 TSF)	3	24	23
20'-22'	Dry	2/1/1/2	Wet		Soft-to-medium stiff olive brown silty clay (PP=0.51 TSF)	4	24	24
25'-27'	Dry	1/0/1/0	Wet		Very soft-to-soft gray clay (PP=0.23 TSF)	5	24	24
30'-32'	Dry	WORHx4	Wet		Very soft gray clay (CH, LL=58, PL=26, PI=32, w=60.4%, PP<0.16 TSF)	6	24	24
35'-37'	Dry	WORHx4	Wet		Very soft gray clay (PP=0.16 TSF)	7	24	24
40'-42'	UT		Wet		Pushed tube 8 seconds at 50 PSI - Very soft-to-soft gray clay (CH, Cc=1.020, Cr=0.0852, w=66.0%, e_o=1.8570, Pc=0.917 TSF, Po=0.896-1.438 TSF, OCR=0.64 to 1.02, PP=0.24 TSF)	8	24	24

Ground Surface to 40' Used 3.25" augers: Then SS to 37'

Earth Boring	42'
Rock Coring	
Samples:	8
HOLE NUMBER	B-3

MIKE'S BORING & CORING LLC.
PO Box 75 ° East Barre, Vermont 05649 ° 802 476-5073

TO: Eric Goddard Knight Consulting Engineers, Inc. 51 Knight Lane Williston, VT 05495	PROJECT NAME: WWTF LOCATION: Hinesburg, VT MBC JOB #: 19005	SHEET: 4 DATE: 1-15-19 HOLE #: B-4 LINE & STA. OFFSET:

Ground Water Observations 8.5' est. at 0 hours	Augers-Size I.D. 3.25" Split Spoon 2" Hammer Wt. 140# Hammer Fall 30"	Surface Elevation: 327'+/- Date Started: 1-15-19 Date Completed: 1-15-19 Boring Foreman: Mike McGinley Inspector: Eric Goddard Soils Engineer: Eric Goddard

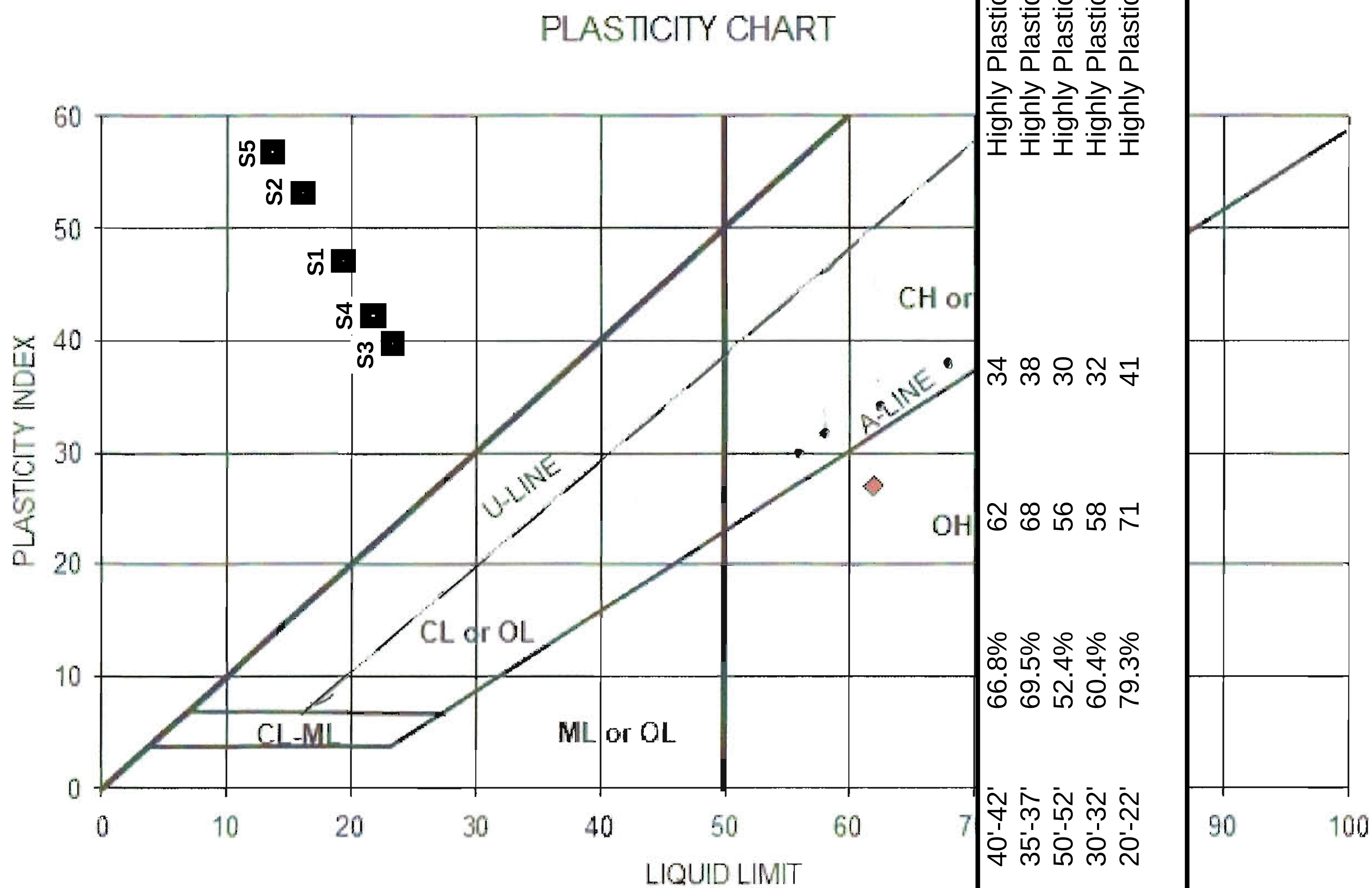
LOCATION OF BORING: As staked

Sample Depths From/To (Feet)	Type of Sample	Blows per 6" on Sampler	Moisture Density or Consist.	Strata Change Elev.	Soil Identification	Sample No.	Pen. Inches	Rec. Inches
0'-2'	Dry	4/4/5/2			No recovery - Loose silty fine sand	1	24	0
5'-7'	Dry	8/7/7/7	Damp	8.5'	Medium dense gray silty fine sand, some medium sand layers	2	24	18
10'-12'	Dry	2/1/1/2	Wet		Very soft gray clay (PP=0.18 TSF)	3	24	24
15'-17'	Dry	WORHx3/1	Wet		Very soft gray clay (PP=0.16 TSF)	4	24	24
20'-22'	Dry	WORHx4	Wet		Very soft gray clay (CH, LL=71, PL=30, PI=41, w=79.3%, PP=0.14 TSF)	5	24	24
25'-27'	Dry	WORHx4	Wet		Very soft gray clay (PP=0.15 TSF)	6	24	24
30'-32'	UT		Wet		Pushed tube 9 seconds at 50 PSI - Soft gray clay (CH, Cc=1.295, Cr=0.0771, w=66.7%, e_o=1.8146, Pc=1.023 TSF, Po=0.938 TSF, OCR=1.09, PP=0.42 TSF)	7	24	24
35'-37'	Dry	WORHx4	Wet		Very soft gray clay (PP=0.16 TSF)	8	24	24
				78'	Pushed point into stiffer material at 78'			

Ground Surface to 35' Used 3.25" augers: Then SS to 37'

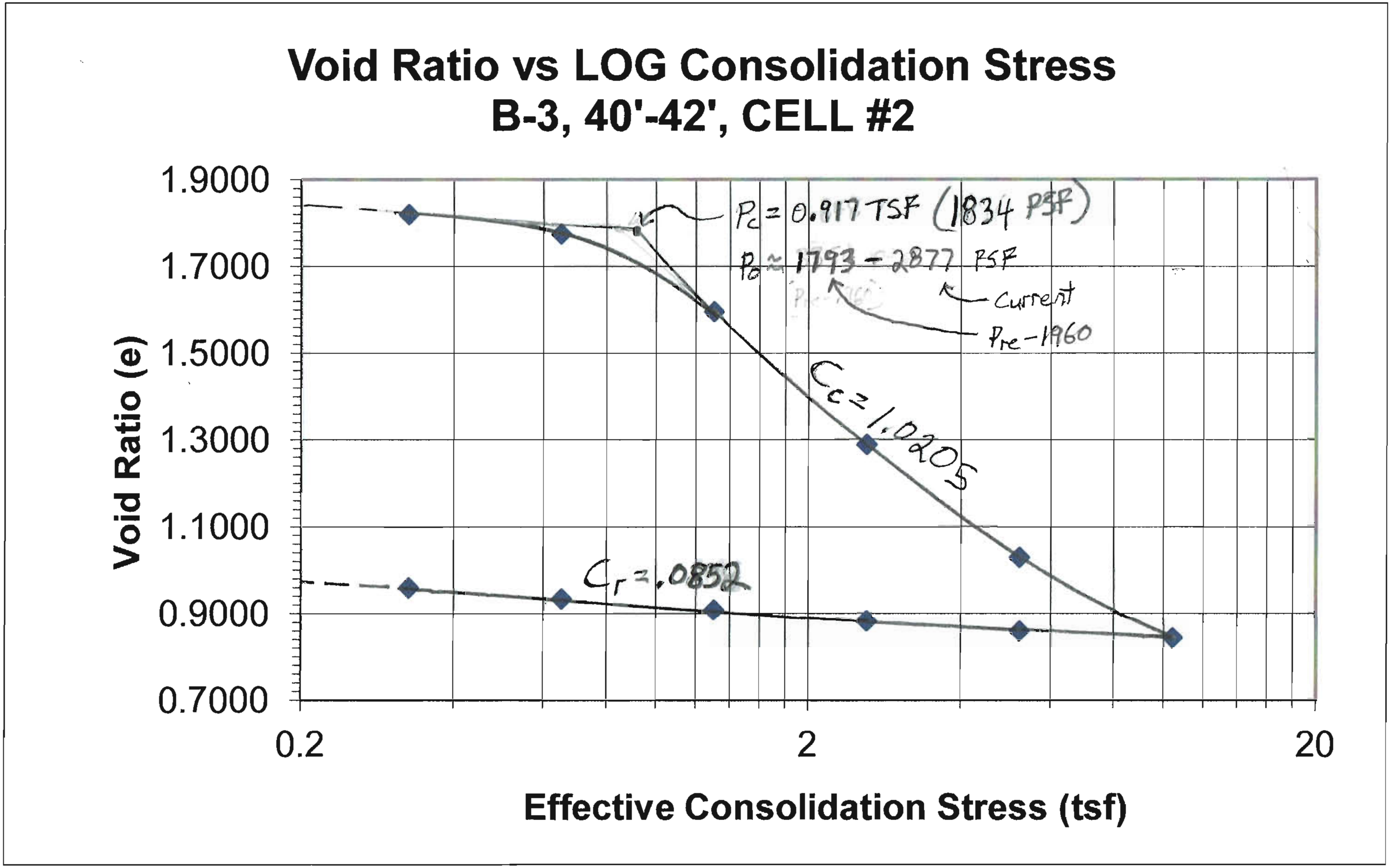
Earth Boring	78'
Rock Coring	
Samples:	8
HOLE NUMBER	B-4

PLASTICITY CHART



S1	B-1	40'-42'	66.8%	62	34	Highly Plastic Gray C
S2	B-2	35'-37'	69.5%	68	38	Highly Plastic Gray C
S3	B-2	50'-52'	52.4%	56	30	Highly Plastic Gray C
S4	B-3	30'-32'	60.4%	58	32	Highly Plastic Gray C
S5	B-4	20'-22'	79.3%	71	41	Highly Plastic Gray C

SYMBOL	EXPLORATION NUMBER	SAMPLE DEPTH	MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	...RIPTION
◆	B-11	10'	31.[illegible]	62	27	...stic silt (MH)


Void Ratio vs LOG Consolidation Stress
B-3, 40'-42', CELL #2
1.9000
1.7000
1.5000
1.3000
1.1000
0.9000
0.7000
Void Ratio (e)
0.2
2
20
Effective Consolidation Stress (tsf)
Pc = 0.917 TSF (1834 PSF)
Po ≈ 1793 - 2877 PSF
Current
Pre-1960
Cc = 1.0205
Cr = .0852

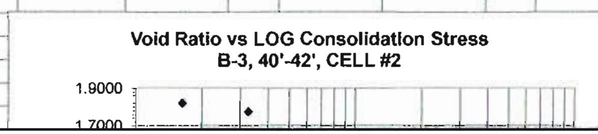
Knight Consulting Engineers | **CONSOLIDATION REDUCTION WORKSHEET**

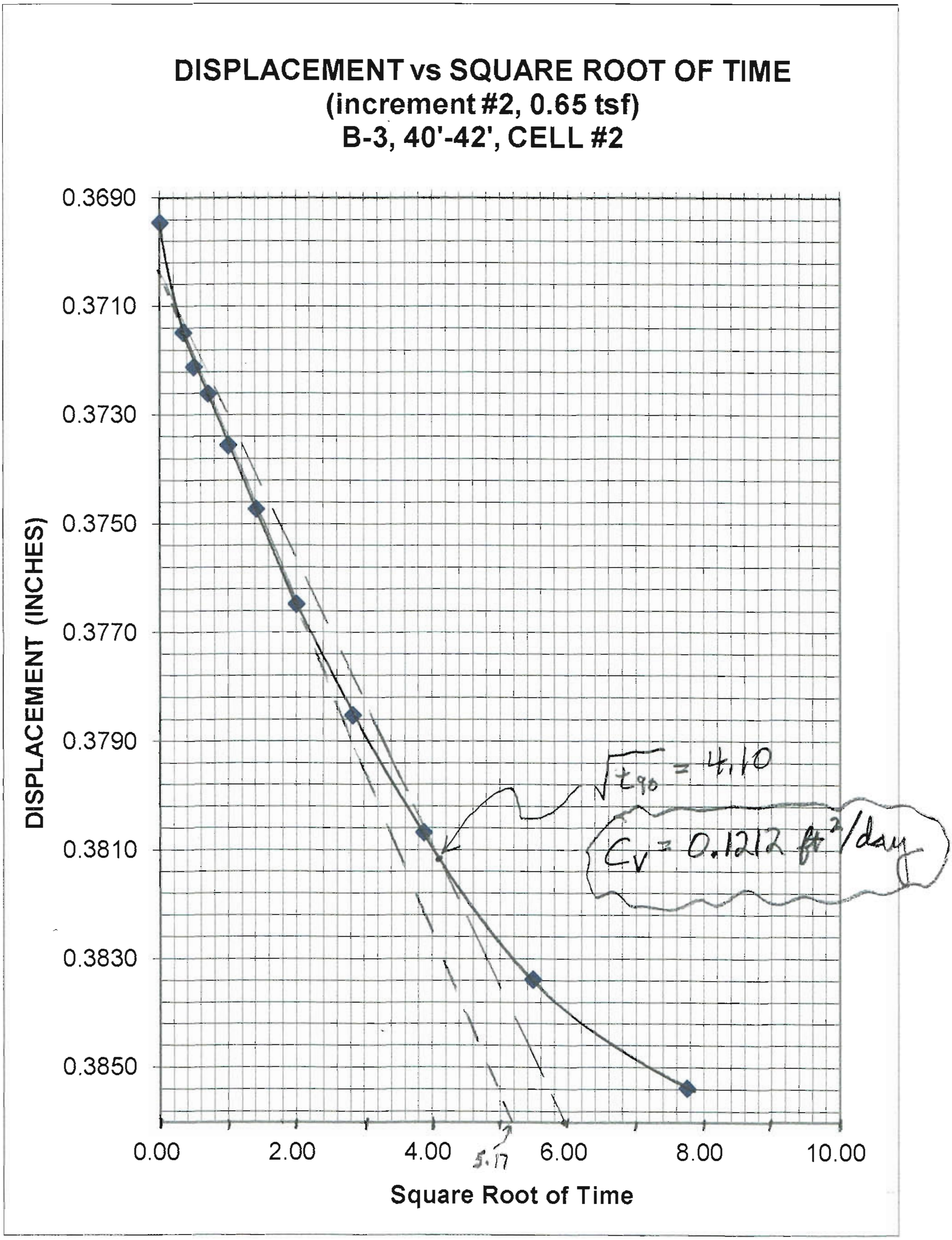
PROJECT: Hinesburg WWTF

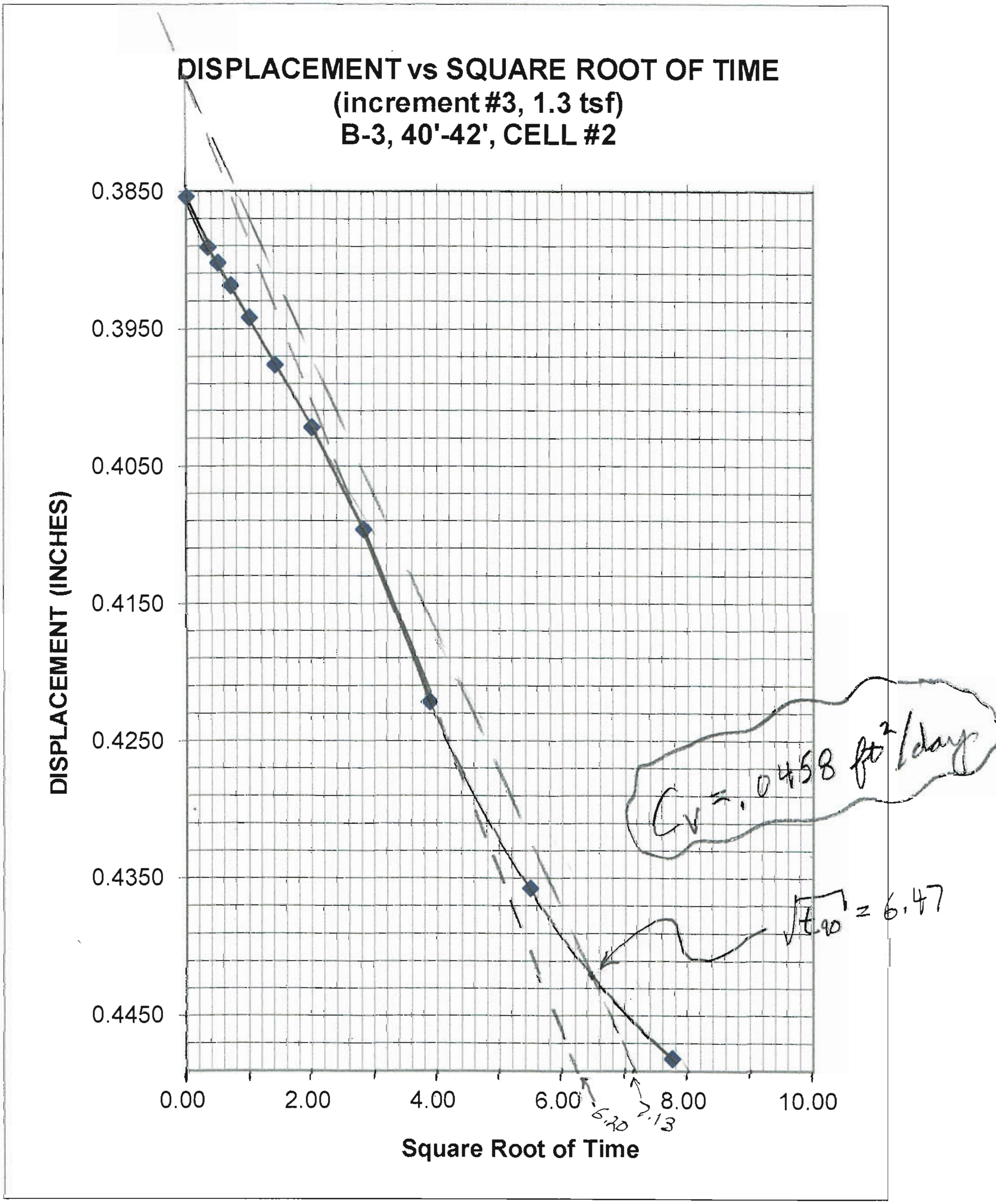
WATER CONTENT FROM TRIMMINGS			**VOID RATIO CALCULATION**		
TARE	21.00	grams	WT OF RING	523.9	grams
TARE + WET SOIL	74.99	grams	WT OF RING AND WET SOIL	651	grams
TARE + DRY SOIL	53.52	grams	WT OF DRY SOIL	76.56	grams
MOISTURE CONTENT	66.02%		DENSITY OF DRY SOIL	59.41	pcf
			INITIAL VOID RATIO	1.8570	

CELL #2 SAMPLE: B-3, 40'-42'

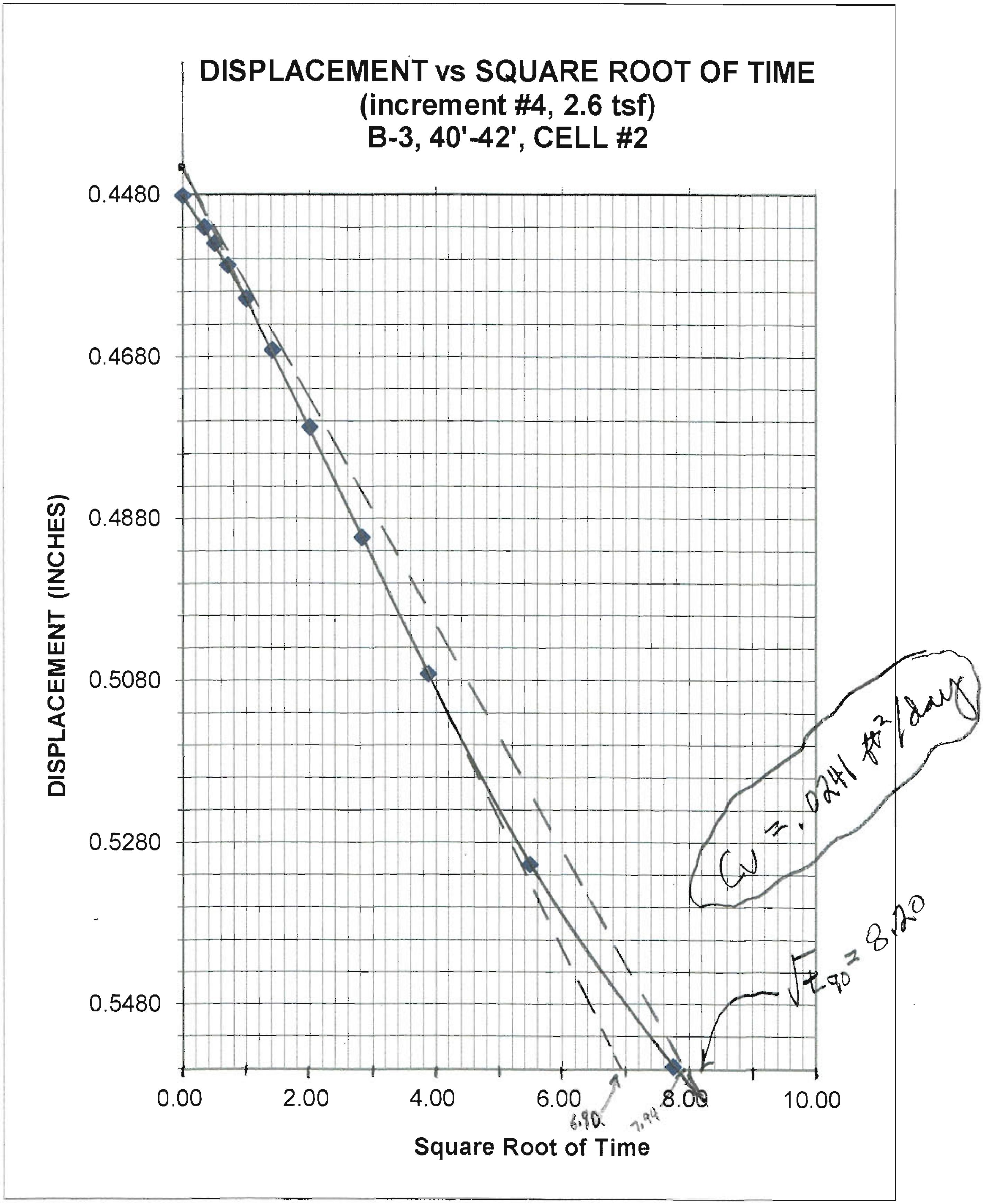
Date: 01-25-19				AVG DISPL	0.3762		0.4060		0.4817		0.5867		0.6720		
			INCRMNT1	INCRMNT2	ADJ.	INCRMNT3	ADJ.	INCRMNT4	ADJ.	INCRMNT5	ADJ.	INCRMNT6	ADJ.		
TIME	SQRT TIME		DISPL	READING	DISPL	READING	DISPL	READING	DISPL	READING	DISPL	READING	DISPL		
0.00	0.00		0.3566	0.3752	0.3695	0.3925	0.3854	0.4569	0.4481	0.5663	0.5556	0.6592	0.6466		
0.12	0.34			0.3780	0.3715	0.3972	0.3891	0.4619	0.4520	0.5715	0.5596	0.6647	0.6508		
0.25	0.50			0.3787	0.3721	0.3984	0.3902	0.4640	0.4540	0.5735	0.5615	0.6667	0.6527		
0.50	0.71			0.3793	0.3726	0.4001	0.3919	0.4668	0.4567	0.5764	0.5643	0.6692	0.6551		
1.00	1.00			0.3803	0.3736	0.4025	0.3942	0.4710	0.4608	0.5805	0.5683	0.6730	0.6588		
2.00	1.41			0.3815	0.3747	0.4060	0.3976	0.4774	0.4672	0.5865	0.5743	0.6783	0.6640		
4.00	2.00			0.3833	0.3765	0.4107	0.4022	0.4871	0.4767	0.5954	0.5831	0.6860	0.6717		
8.00	2.83			0.3854	0.3785	0.4182	0.4096	0.5008	0.4903	0.6088	0.5964	0.6968	0.6824		
15.00	3.87			0.3876	0.3807	0.4308	0.4221	0.5177	0.5072	0.6245	0.6120	0.7083	0.6938		
30.00	5.48			0.3904	0.3834	0.4445	0.4357	0.5413	0.5307	0.6443	0.6317	0.7196	0.7050		
60.00	7.75		0.3752	0.3925	0.3854	0.4569	0.4481	0.5663	0.5556	0.6592	0.6466	0.7260	0.7114		
		e=	1.8203		1.7748		1.5957		1.2885		1.0284		0.8433	0.8593	0.8823
		tsf=	0.325		0.65		1.3		2.6		5.2		10.4	5.2	2.6
												unload cycle			
											5.2 tsf	0.7197	0.7058	e=	0.8593
											2.6 tsf	0.7106	0.6978	e=	0.8823
											1.3 tsf	0.7006	0.6887	e=	0.9082
											0.65 tsf	0.6907	0.6797	e=	0.9339
											0.325 tsf	0.6810	0.6709	e=	0.9592



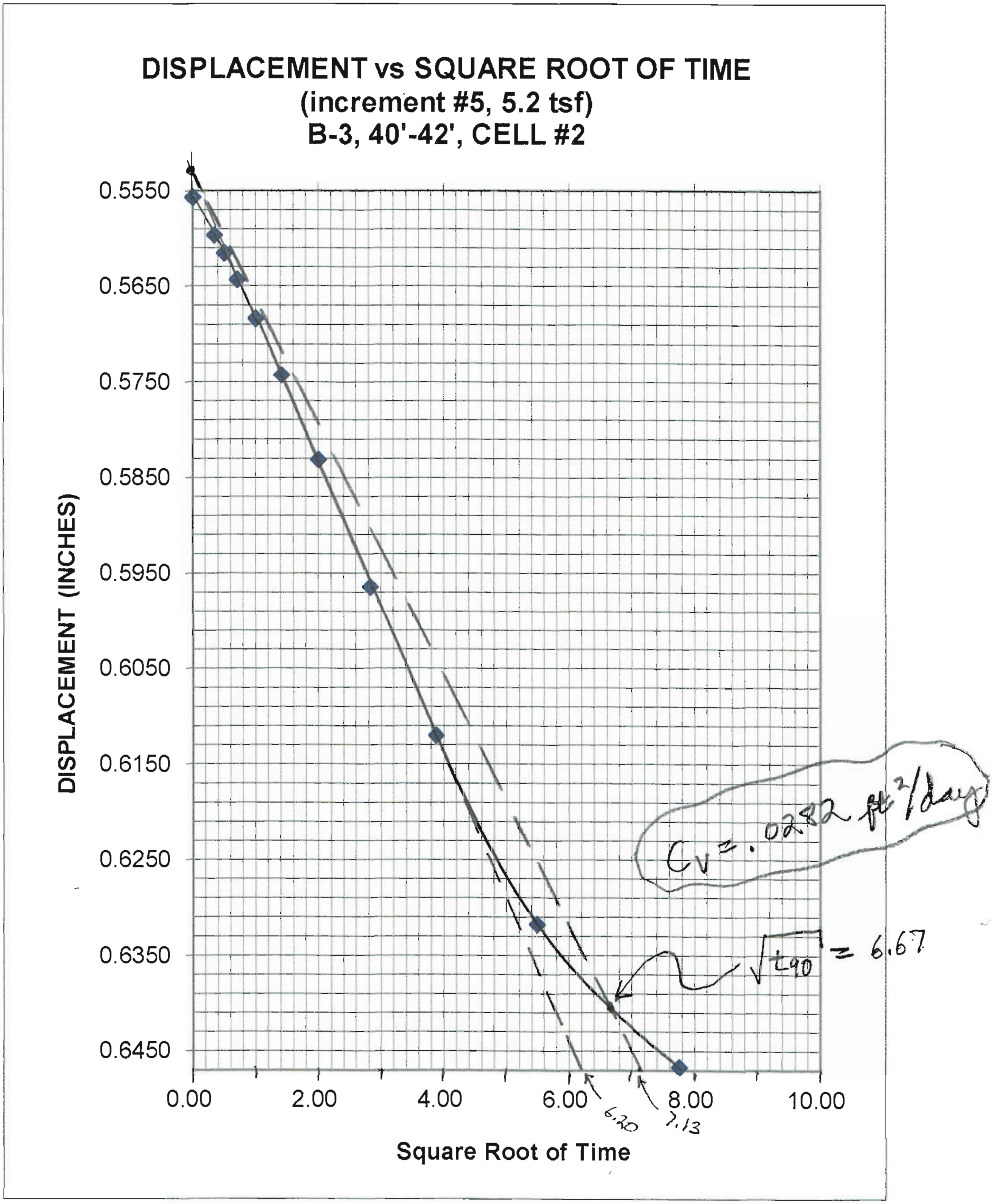

DISPLACEMENT vs SQUARE ROOT OF TIME
(increment #2, 0.65 tsf)
B-3, 40'-42', CELL #2
DISPLACEMENT (INCHES)
0.3690
0.3710
0.3730
0.3750
0.3770
0.3790
0.3810
0.3830
0.3850
0.00
2.00
4.00
6.00
8.00
10.00
Square Root of Time
5.17
√t90 = 4.10
Cv = 0.1212 ft²/day

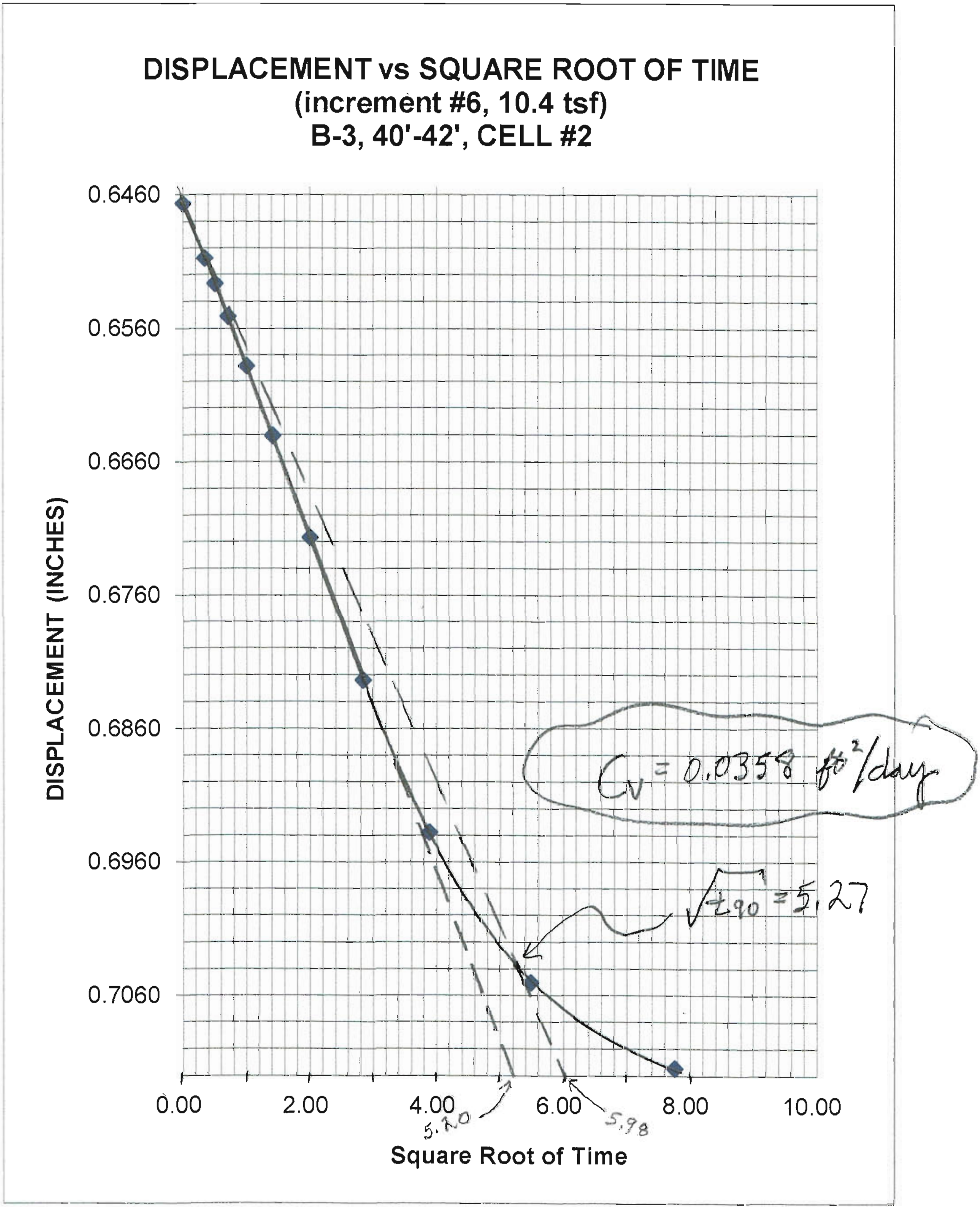


DISPLACEMENT vs SQUARE ROOT OF TIME
(increment #3, 1.3 tsf)
B-3, 40'-42', CELL #2
DISPLACEMENT (INCHES)
0.3850
0.3950
0.4050
0.4150
0.4250
0.4350
0.4450
0.00
2.00
4.00
6.00
8.00
10.00
Square Root of Time
Cv = .0458 ft²/day
√t90 = 6.47
6.20
7.13

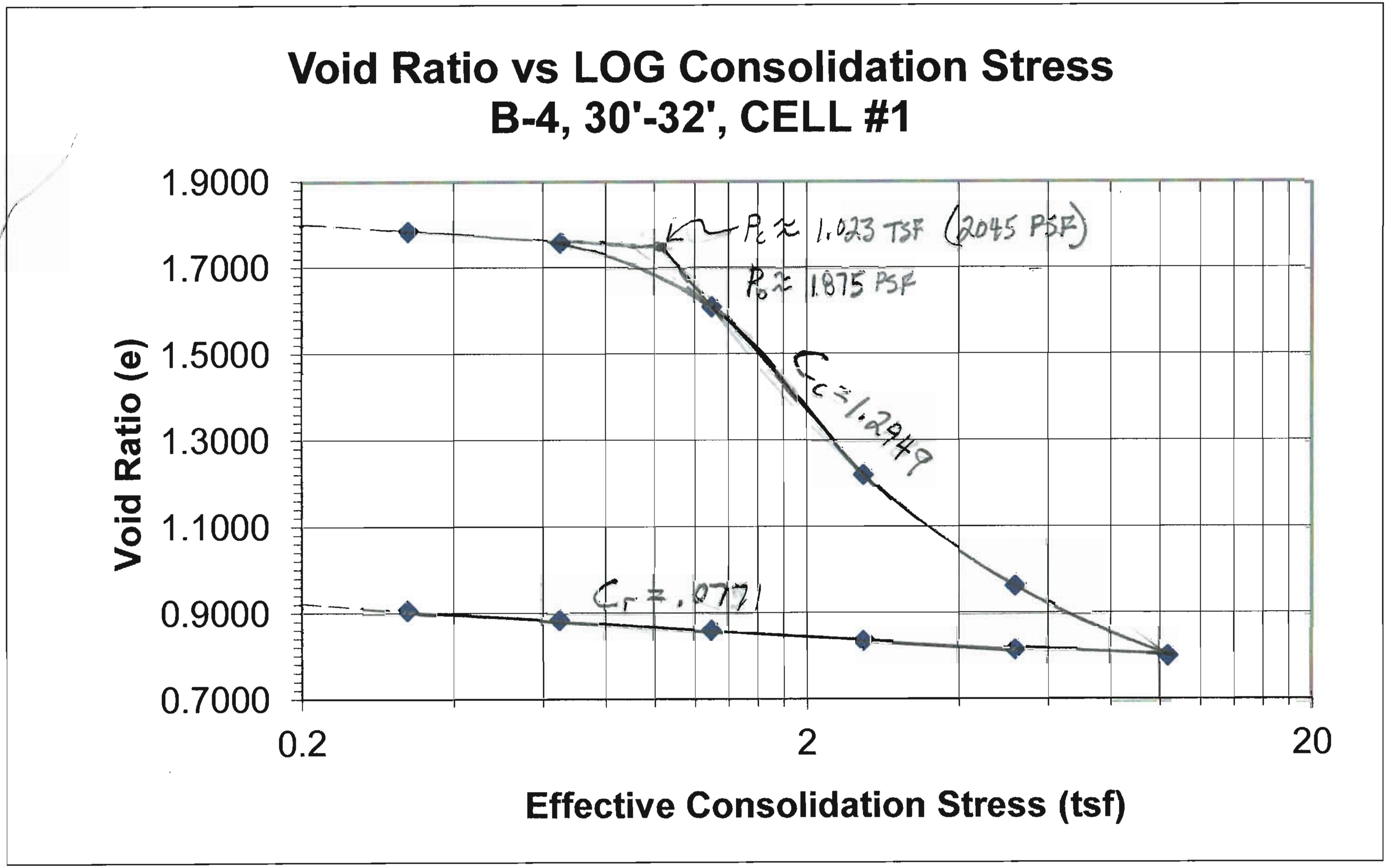


DISPLACEMENT vs SQUARE ROOT OF TIME
(increment #4, 2.6 tsf)
B-3, 40'-42', CELL #2
DISPLACEMENT (INCHES)
0.4480
0.4680
0.4880
0.5080
0.5280
0.5480
0.00
2.00
4.00
6.00
8.00
10.00
Square Root of Time
6.90
7.94
√t90 = 8.20
Cv = .0241 ft²/day


DISPLACEMENT vs SQUARE ROOT OF TIME
(increment #5, 5.2 tsf)
B-3, 40'-42', CELL #2
DISPLACEMENT (INCHES)
0.5550
0.5650
0.5750
0.5850
0.5950
0.6050
0.6150
0.6250
0.6350
0.6450
0.00
2.00
4.00
6.00
8.00
10.00
Square Root of Time
6.20
7.13
√t90 = 6.67
Cv = .0282 ft²/day



DISPLACEMENT vs SQUARE ROOT OF TIME
(increment #6, 10.4 tsf)
B-3, 40'-42', CELL #2
DISPLACEMENT (INCHES)
0.6460
0.6560
0.6660
0.6760
0.6860
0.6960
0.7060
Square Root of Time
0.00
2.00
4.00
6.00
8.00
10.00
Cv = 0.0358 ft²/day
√t90 = 5.27
5.20
5.98



Void Ratio vs LOG Consolidation Stress
B-4, 30'-32', CELL #1
Void Ratio (e)
1.9000
1.7000
1.5000
1.3000
1.1000
0.9000
0.7000
0.2
2
20
Effective Consolidation Stress (tsf)
Pc ≈ 1.023 TSF (2045 PSF)
Po ≈ 1875 PSF
Cc ≈ 1.2949
Cr ≈ .0771

Knight Consulting Engineers	CONSOLIDATION REDUCTION WORKSHEET

PROJECT: Hinesburg WWTF

WATER CONTENT FROM TRIMMINGS			VOID RATIO CALCULATION		
TARE	21.99	grams	WT OF RING	513.1	grams
TARE + WET SOIL	74.75	grams	WT OF RING AND WET SOIL	642.6	grams
TARE + DRY SOIL	53.65	grams	WT OF DRY SOIL	77.71	grams
MOISTURE CONTENT	66.65%		DENSITY OF DRY SOIL	60.30	pcf
			INITIAL VOID RATIO	1.8146	

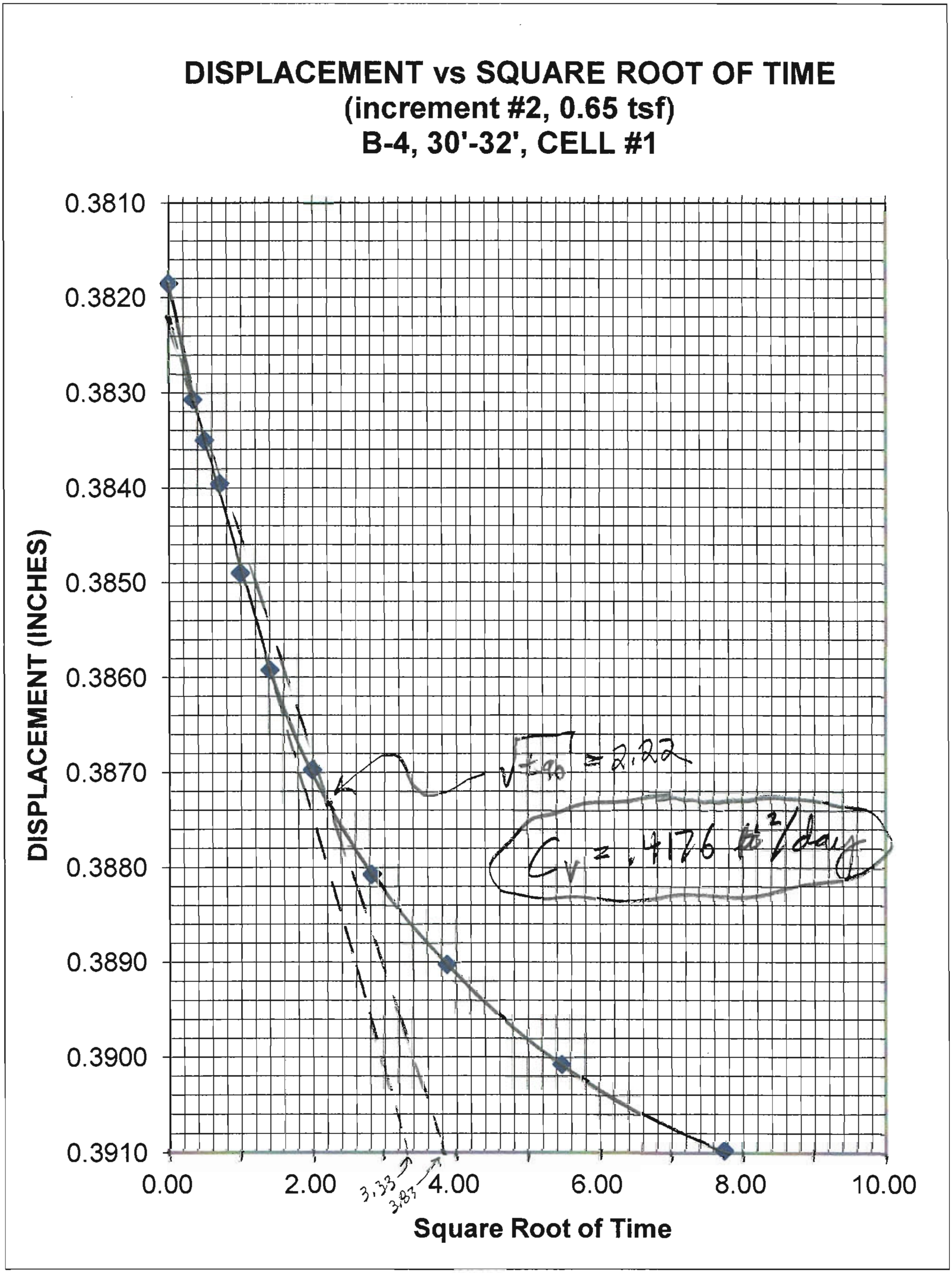
CELL #1 SAMPLE: B-4, 30'-32'

Date: 01-25-19

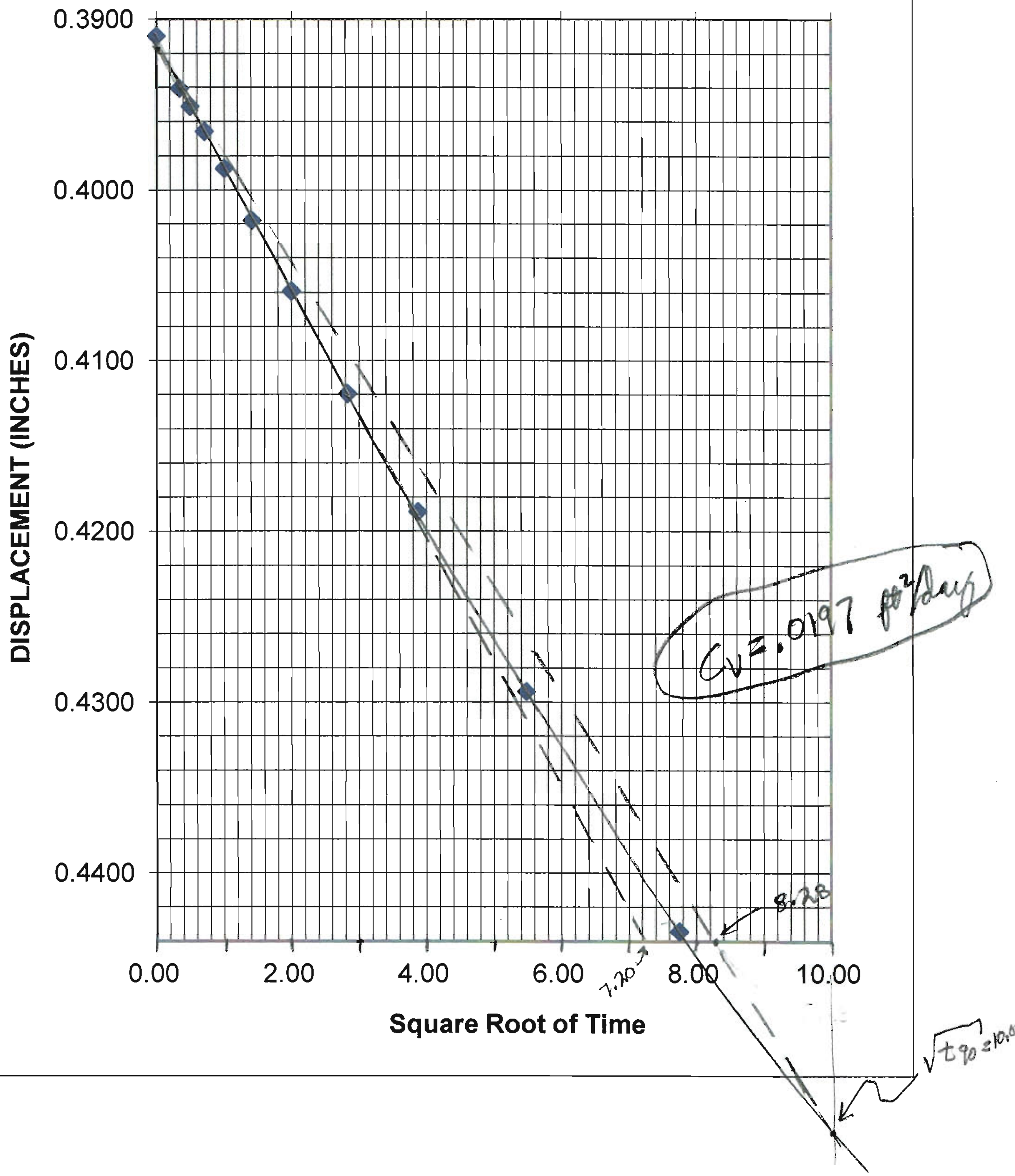
				AVG DISPL:	0.3862		0.4079		0.4843		0.6127		0.6956		
			INCRMNT1	INCRMNT2	ADJ.	INCRMNT3	ADJ.	INCRMNT4	ADJ.	INCRMNT5	ADJ.	INCRMNT6	ADJ.		
TIME	SQRT TIME		DISPL	READING	DISPL	READING	DISPL	READING	DISPL	READING	DISPL	READING	DISPL		
0.00	0.00		0.3716	0.3876	0.3819	0.3981	0.3910	0.4523	0.4434	0.5926	0.5819	0.6856	0.6730		
0.12	0.34			0.3896	0.3831	0.4022	0.3941	0.4568	0.4469	0.5973	0.5854	0.6900	0.6761		
0.25	0.50			0.3901	0.3835	0.4033	0.3951	0.4594	0.4494	0.5995	0.5875	0.6918	0.6778		
0.50	0.71			0.3906	0.3840	0.4048	0.3966	0.4628	0.4527	0.6025	0.5904	0.6942	0.6801		
1.00	1.00			0.3916	0.3849	0.4071	0.3987	0.4680	0.4578	0.6065	0.5943	0.6977	0.6835		
2.00	1.41			0.3927	0.3859	0.4102	0.4018	0.4754	0.4652	0.6122	0.6000	0.7030	0.6887		
4.00	2.00			0.3938	0.3870	0.4144	0.4059	0.4872	0.4769	0.6210	0.6087	0.7099	0.6956		
8.00	2.83			0.3950	0.3881	0.4205	0.4120	0.5040	0.4935	0.6340	0.6216	0.7198	0.7054		
15.00	3.87			0.3960	0.3890	0.4275	0.4189	0.5252	0.5147	0.6505	0.6380	0.7302	0.7157		
30.00	5.48			0.3971	0.3901	0.4381	0.4294	0.5560	0.5454	0.6711	0.6585	0.7398	0.7252		
60.00	7.75		0.3876	0.3981	0.3910	0.4523	0.4434	0.5926	0.5819	0.6856	0.6730	0.7455	0.7309		
		e=	1.7856		1.7599		1.6123		1.2225		0.9661		0.8033	0.8176	0.8384
		tsf=	0.325		0.65		1.3		2.6		5.2		10.4	5.2	2.6

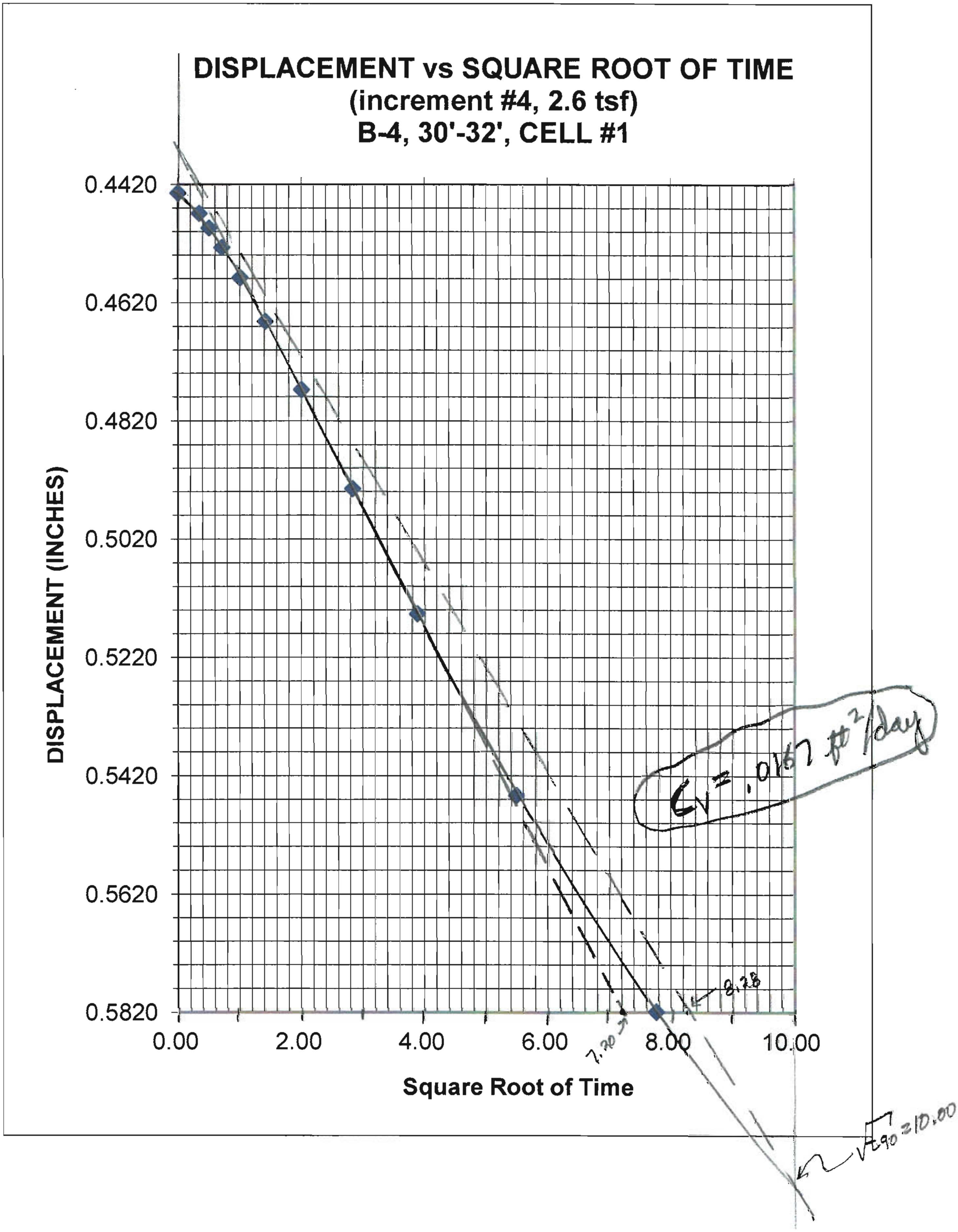
unload cycle

5.2	tsf	0.7397	0.7258	e=	0.8176
2.6	tsf	0.7313	0.7184	e=	0.8384
1.3	tsf	0.7218	0.7099	e=	0.8623
0.65	tsf	0.7125	0.7015	e=	0.8859
0.325	tsf	0.7038	0.6937	e=	0.9080

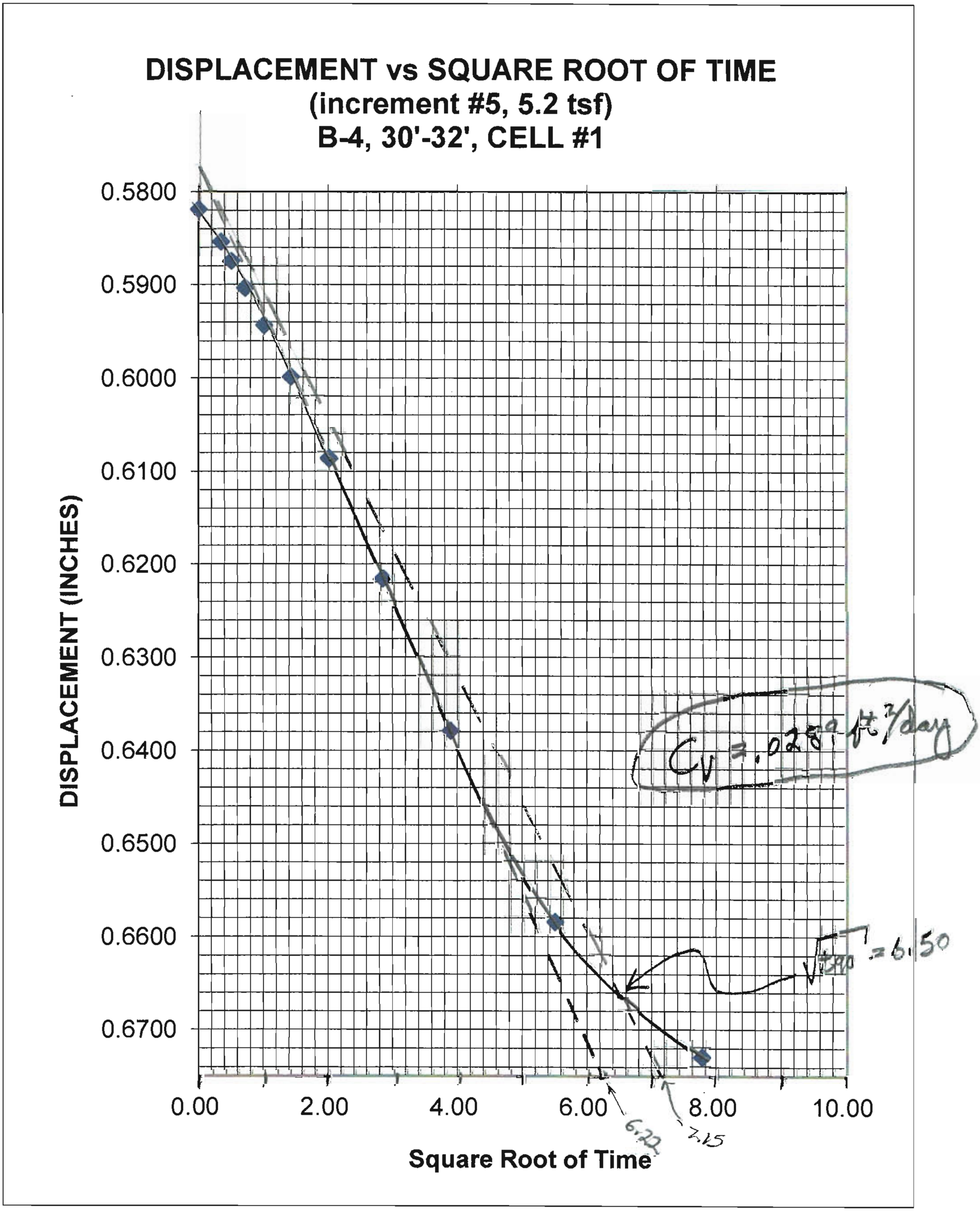

DISPLACEMENT vs SQUARE ROOT OF TIME
(increment #2, 0.65 tsf)
B-4, 30'-32', CELL #1
DISPLACEMENT (INCHES)
0.3810
0.3820
0.3830
0.3840
0.3850
0.3860
0.3870
0.3880
0.3890
0.3900
0.3910
0.00
2.00
4.00
6.00
8.00
10.00
Square Root of Time
√t90 = 2.22
Cv = .476 ft²/day
3.33
3.83

DISPLACEMENT vs SQUARE ROOT OF TIME
(increment #3, 1.3 tsf)
B-4, 30'-32', CELL #1



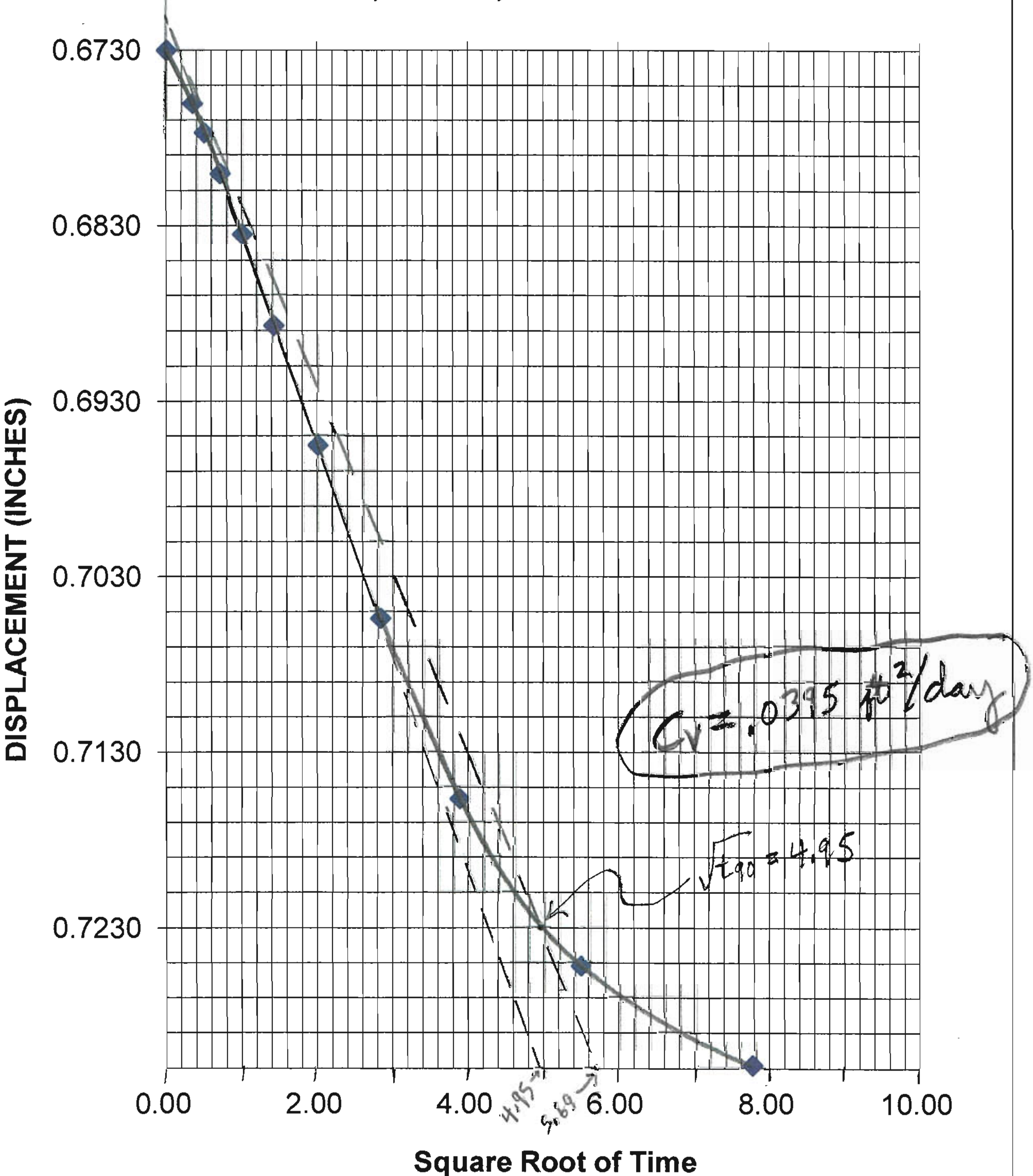


DISPLACEMENT vs SQUARE ROOT OF TIME
(increment #4, 2.6 tsf)
B-4, 30'-32', CELL #1
DISPLACEMENT (INCHES)
0.4420
0.4620
0.4820
0.5020
0.5220
0.5420
0.5620
0.5820
0.00
2.00
4.00
6.00
8.00
10.00
Square Root of Time



DISPLACEMENT vs SQUARE ROOT OF TIME
(increment #5, 5.2 tsf)
B-4, 30'-32', CELL #1
DISPLACEMENT (INCHES)
0.5800
0.5900
0.6000
0.6100
0.6200
0.6300
0.6400
0.6500
0.6600
0.6700
0.00
2.00
4.00
6.00
8.00
10.00
Square Root of Time
Cv = .0289 ft²/day
√t90 = 6.50
6.22
7.15

DISPLACEMENT vs SQUARE ROOT OF TIME
(increment #6, 10.4 tsf)
B-4, 30'-32', CELL #1



APPENDIX N

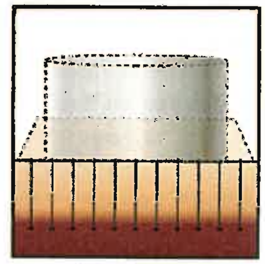
WICK DRAINS

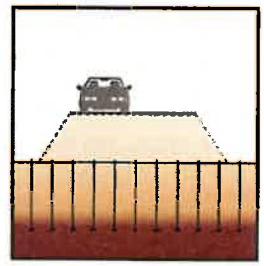
WICK DRAINS

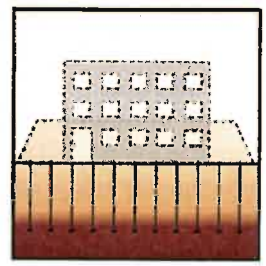
Wick drains accelerate the consolidation of compressible soils, in turn accelerating your project schedule.

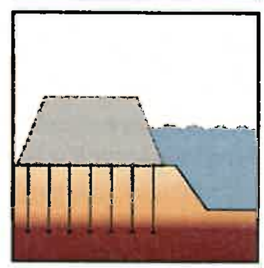
Above: Horizontal strip drains being placed after installation of wicks for a new maintenance facility on the Mississippi River floodplain in Memphis, TN.

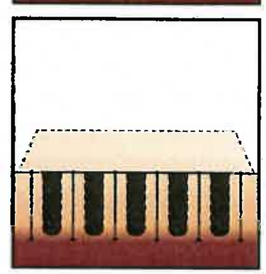
Right: Two of three rigs used to install 1,700,000 linear feet of wick drain to a maximum depth of 75 feet, and 55,000 feet of strip drain for a new housing development in Yorba Linda, CA.







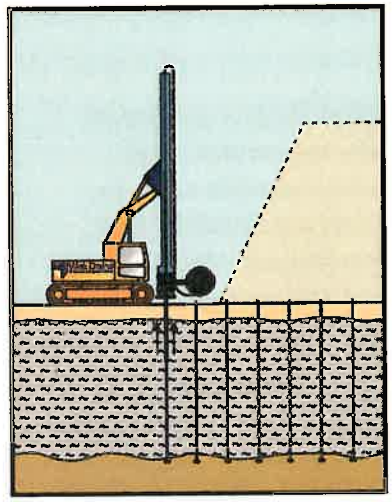




Wick drains are prefabricated vertical drains installed to accelerate the consolidation of compressible soils. The drain consists of a geotextile filter-wrapped plastic strip with extruded channels that allow water to drain from soft soil as it consolidates under an applied surcharge load. The geotextile filter prevents soil particles from entering the channels and clogging the drain. The time required for the consolidation to occur depends on the permeability of the soft strata, the existence of sand layers in the strata, the weight of the surcharge, and the spacing of the wicks.

HB Wick Drains
A Division of Hayward Baker

Wick Drain Technology...



The prefabricated wick drain was invented in the mid-1930s by Walter Kjellman at the Swedish Geotechnical Institute. The first drain consisted of two cardboard sheets glued together, with internal channels. The modern wick drain consisting of geotextile filter-wrapped plastic with extruded channels was developed in 1971, also at the Swedish Geotechnical Institute. The plastic wick drain allowed for faster installation and increased flow rate volume over the early cardboard style. HB Wick Drains uses the Mebra™ brand of wick drains, the most effective and efficient design in the industry.

Applications

- Rapid consolidation of soft soils in conjunction with a preload fill (or applied negative pressure)
- Accelerated construction schedule for staged loading or staged construction on soft soils

Wick drains can be applied to any site that requires consolidation, including sites for:

- Roadway embankments
- Bridge approaches and overpasses
- Dams and levees
- Railway embankments
- Airports and seaports
- Storage tanks
- Commercial and residential buildings
- Mining wastes and tailings

Installation

Before installation can begin, the working surface must be prepared to ensure a stable working platform. Since wick drain sites are typically soft, a sand or gravel blanket may be needed to provide support for the equipment. The sand and gravel will also act as a drainage blanket to direct water away from the treatment area.

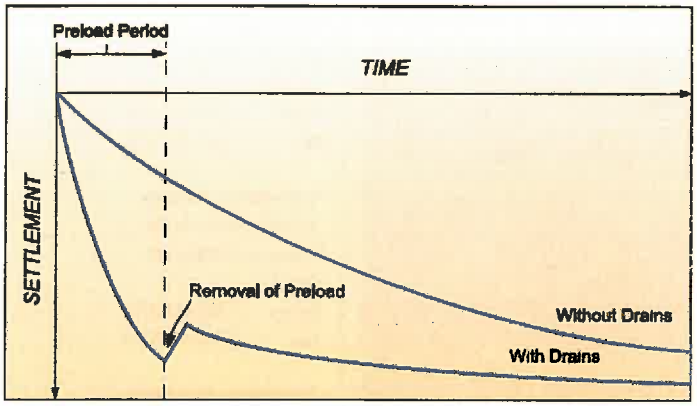
A specialized mast consisting of drain material and a mandrel is mounted on either a track-mounted excavator or crane, depending on the installation depth. Drains can be installed up to 140 feet deep from a track-mounted excavator. Drains deeper than 140 feet often require the mast to be mounted on a crane for stability.

The wick drain is threaded through the mandrel, which protects it from damage as it is installed through the soil. The installation force is typically provided by vibratory hammers, static force methods, or a combination of these methods depending on the soil conditions. Water may be utilized to lubricate the mandrel during installation to reduce the friction on the mandrel. An anchor attached to the bottom of the drain keeps it in place during withdrawal of the mandrel. The drain is then cut several inches above ground, and a new anchor is fastened to the wick at the bottom of the mandrel in preparation for the next installation point.

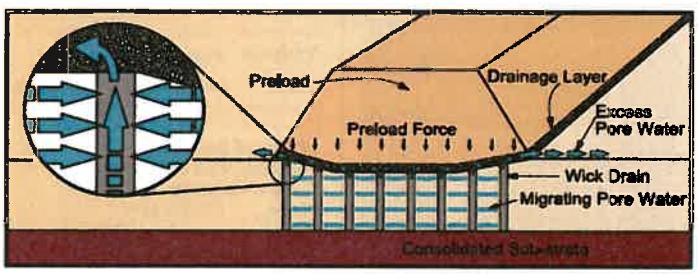
Layout usually consists of triangular or square grid patterns. Typical spacing ranges from 2.5 to 8 feet on center.

A total of 2,300,000 linear feet of wick drain was installed offshore (top photo) through as much as 40 feet of water, to depths up to 120 feet, and 8,800,000 linear feet of wick drain was installed on land (bottom photo), to depths of 98 feet, for the Port of Los Angeles Channel Deepening.

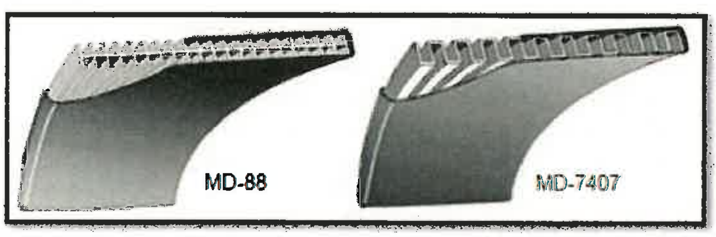
As a division of Hayward Baker, North America's leader in geotechnical construction, HB Wick Drains has direct contact with experts in other ground improvement methods that might be a suitable complement for your site.



Settlement/Time Curve



Pore Water Drainage Flow Path



Mebra™ wick drains, designed and fabricated by HB Wick Drains, are composed of a central core surrounded by a filter sleeve.

Design Considerations

Wick drains are typically used in soft saturated fine-grained soils, such as silts, clays, organic silts, organic clays, peat, sludges, mine tailings, and dredge fills.

The geotechnical investigation should include continuous sampling to identify any sand drainage layers that may contribute to faster consolidation. Appropriate consolidation tests should be performed on the soft material strata to estimate the magnitude and rate of the settlement.

Soft soils, when loaded by surcharge, will undergo:

- Initial elastic compression
- Consolidation
- Secondary compression

Geotechnical Considerations

Wick drains are effective in the following soil conditions:

- Moderate to highly compressible
- Low permeability
- Saturated soils
- Maximum past consolidation stress less than load induced stress

Some site and soil conditions that require evaluation prior to determining the economic and technical feasibility of wick drain systems include:

- Working surface stability
- Overhead and below grade obstructions
- Stiff to very stiff layers (may be addressed with pre-drilling)
- Softness of anchoring layer
- Site accessibility

Environmental Considerations

Water removed by wick drains will need to be collected and treated if the in situ soils are contaminated. For contaminated sites, the drain design length should not fully penetrate into an underlying aquifer.

Quality Assurance/Quality Control

Pore pressures may be monitored along with settlement and loading. Ground movement can be monitored by settlement plates, gauges, and inclinometers. Extensometers can be installed to evaluate settlement versus depth.

Advantages of HB Wick Drains

- *Fast mobilization and installation*
- *Reduced construction time*
- *Minimal post-construction settlement*
- *Increased strength gain rate due to consolidation of soft soils*
- *Several types of rigs with different capabilities that can be matched to the soil conditions to provide the best installation*

A total of 180,000 linear feet of wick drain was installed to 50 feet in sub-zero temperatures to accelerate drainage of soft compressible clay for the construction of an oil drilling platform in Prudhoe Bay, Alaska.

Why Should You Choose HB Wick Drains?

As a division of North America's leader in geotechnical construction, HB Wick Drains has the resources to build your project. Our network of offices and full-service equipment yards means fast mobilization and reduced start-up costs.

From job start-up to installation of the last drain, our attention to quality control helps to ensure that project specifications are achieved. We customize and design our equipment and tooling, helping to ensure that performance and reliability are the best in the industry.

HB Wick Drains has the experience and innovation to assist engineers, contractors, and owners with identifying, developing, and implementing the best wick drain solution.

HB Wick Drains
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Email wickdrains@HaywardBaker.com

Hayward Baker Inc.
A member of the Keller Worldwide Group of Companies
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WI-MAR-10001-JW Rev 08/13

HB Wick Drains
A Division of Hayward Baker

THINK SAFE

APPENDIX O

PROPOSED PROJECT
PRELIMINARY DESIGN CRITERIA

TOWN OF HINESBURG
WASTEWATER TREATMENT FACILITY UPGRADE/EXPANSION

PRELIMINARY DESIGN CRITERIA
June 2019

1.0 Influent Hydraulic/Organic Loadings

Influent Parameters	Current[(1)]	Original Design[(2)]	Design Year 2043
Flow			
Average Daily	0.161 mgd	0.308 mgd	0.325 mgd
Peak Daily	0.465 mgd	0.600 mgd	0.780 mgd
Peak Hourly	----	0.800 mgd	1.040 mgd
Biochemical Oxygen Demand (BOD_5)	326 mg/l 422 lbs/day	157 mg/l 331 lbs/day	325 mg/l 885 lbs/day
Total Suspended Solids (TSS)	204 mg/l 254 lbs/day	151 mg/l 319 lbs/day	205 mg/l 550 lbs/day
Total Phosphorus	5.7 mg/l	6.0 mg/l	6.0 mg/l
Total Ammonia Nitrogen	---	---	25 mg/l

Notes:

1. The current conditions are based on the information in the WR-43 monthly operations reports from January 2016 to December 2018.
2. Design criteria is based on the January 2008 upgrade but the current Discharge Permit limits the flow to 250,000 gpd.

2.0 Effluent Characteristics

June 1 through September 30

Effluent Parameters	Current[1] Permit	Design Year[2] 2043
Flow	0.250 mgd	0.325 mgd
Ultimate Oxygen Demand		
Maximum Day	400 lbs/day	400 lbs/day
Biochemical Oxygen Demand		
Monthly Average	30 mg/l 63 lbs/day	23.2 mg/l 63 lbs/day
Weekly Average	45 mg/l 94 lbs/day	34.6 mg/l 94 lbs/day
Total Suspended Solids		
Monthly Average	45 mg/l 94 lbs/day	34.6 mg/l 94 lbs/day
Weekly Average	45 mg/l 94 lbs/day	34.6 mg/l 94 lbs/day
Total Phosphorus		
Monthly Average	0.8 mg/l 152 lbs/year	0.8 mg/l 152 lbs/year
Total Ammonia Nitrogen		
Monthly Average	3.5 mg/l 7.3 lbs/day	2.7 mg/l 7.3 lbs/day
Maximum Day	34.6 lbs/day	34.6 lbs/day
Settleable Solids	1.0 ml/l	1.0 ml/l
Total Residual Chlorine[3]	0.02 mg/l	----
E. Coli	77 col/100 ml	77 col/100 ml
pH	Between 6.5 and 8.5 S.U.	

Notes:
1. Based on the current Discharge Permit effluent limitations effective after the upgrade.
2. The future effluent limitations as proposed in the amended Discharge Permit.
3. No total residual chlorine is shown because of the conversion to UV disinfection.

October 1 through May 31

Effluent Parameters	Current[1] Permit	Design Year[2] 2043
Flow	0.250 mgd	0.325 mgd
Ultimate Oxygen Demand		
Maximum Day	----	----
Biochemical Oxygen Demand		
Monthly Average	30 mg/l 63 lbs/day	23.2 mg/l 63 lbs/day
Weekly Average	45 mg/l 94 lbs/day	34.6 mg/l 94 lbs/day
Total Suspended Solids		
Monthly Average	45 mg/l 94 lbs/day	34.6 mg/l 94 lbs/day
Weekly Average	45 mg/l 94 lbs/day	34.6 mg/l 94 lbs/day
Total Phosphorus		
Monthly Average	0.8 mg/l 152 lbs/year	0.8 mg/l 152 lbs/year
Total Ammonia Nitrogen		
Monthly Average	20.2 mg/l 42.1 lbs/day	15.5 mg/l 42.1 lbs/day
Maximum Day	175 lbs/day	175 lbs/day
Settleable Solids	1.0 ml/l	1.0 ml/l
Total Residual Chlorine[3]	0.02 mg/l	----
E. Coli	77 col/100 ml	77 col/100 ml
pH	Between 6.5 and 8.5 S.U.	

Notes:

1. Based on the current Discharge Permit effluent limitations effective after the upgrade.
2. The future effluent limitations as proposed in the amended Discharge Permit.
3. No total residual chlorine is shown because of the conversion to UV disinfection.

3.0 Type of Treatment Process

Sequential Batch Reactor (SBR) System with Filtration

4.0 Headworks

Item Description	Proposed	Design Standard
Fine Screening		Required
Number of Units	1	
Type	Fine screen with screw conveyor	
Hydraulic Capacity	1.040 mgd	> 1.040 mgd
Diameter	12 inches	
Screen Openings	¼ inch	
Bypass Channel	Provided with fine bar rack	Required

5.0 Biological/Sequential Batch Reactor

Item Description	Proposed	Design Standard
Tanks (Basins)		
Number	2	2 minimum
Dimensions, Each		
Width	40 feet	
Length	35 feet	
Water Depths		
Top Water Level (TWL)	21.0 feet	
Bottom Water Level (BWL)	13.6 feet	
Volume, Each Tank	220,000 gallons	
Cycles		
Normal	4.8 hours	
Aeration/Mixing System		
Aeration Type	Diffused Air/ Fine Bubble	
Mixing Equipment		
Number	2	2 minimum
Type	Floating	
Aeration Blowers		
Number Capacity, Total Motor Horsepower	3 (1 standby) 563 scfm 25 hp	

Decanters		
Number	2	
Type	Floating	
Decant Rates		
Normal	1,444 gpm	
Pre Equalization Tank		
Dimensions		
Width	30.0 feet	
Length	20.0 feet	
Top Water Level	21.0 feet	
Volume	94,000 gallons	
Post Equalization Tank		
Dimensions		
Width	30.0 feet	
Length	20.0 feet	
Volume	55,500 gallons	
Pumps		
Number Type Capacity, Total	3 (1 standby) Submersible 540 gpm	
Anticipated Removals BOD5 TSS	 95% 95%	

6.0 Chemical Precipitation

Item Description	Proposed	Design Standard
Type of Chemical	Liquid alum	
Feed Pumps Number Type	 2 (1 spare) Peristaltic	 2 minimum
Dosage Rates	25 to 150 mg/l	
Storage Tanks (existing) Number Volume	 1 4,500 gallons	

7.0 RAS/WAS Pumps

Item Description	Proposed	Design Standard
Sludge Waste Pumps		
Number	2	1 minimum each tank
Type	Submersible	
Capacity	110 gpm	
Motor Horsepower	5 hp	

8.0 Filtration

Item Description	Proposed	Design Standard
Number of Units	2 (1 standby)	2 minimum
Type	Cloth media	
Filter Cloth	5 micron	
Number of Disks per Unit	8	
Filter Area per Unit	86.4 sq. ft.	
Maximum Design Flow	542 gpm	
Maximum Solids Loading Rate	< 1.0 lbs/day per sq. ft.	
Effluent Limits Total Suspended Solids Total Phosphorus	 < 5 mg/l < 0.15 mg/l	 < 5 mg/l < 0.15 mg/l

9.0 Disinfection

Item Description	Proposed	Design Standard
Disinfection System		
Type	Ultraviolet open channel	
Configuration	Horizontal	
Number of Banks	2	2 minimum
Type of Lamps	Low pressure – high Intensity	
Number of Lamps	32	
Peak Design Flow	1.040 mgd	> 1.040 mgd
UV Transmission	60%	60% minimum
Design Dose	35,000 μWs/cm^2	
Channel		
Number	1	
Length	30 feet	
Width	9 inches	
Water Depth (Average)	34 inches	
Level Control Weir		
Type	Rectangular fixed weir	
Length	14 feet	

10.0 Sludge Storage/Disposal

Item Description	Proposed	Design Standard
Tank		
Number of Cells	2	1 minimum
Type of Tank	Cast-in-place Concrete	
Type of Cover	Concrete	
Total Volume	90,000 gallons	
Maximum Liquid Level	12 feet	
Aeration/Mixing System		
Type	Diffused Air/ Fine Bubble	30 scfm/ 1,000 c.f.
Aeration Blowers (existing)		
Number	2 (1 standby)	1 minimum
Type	Positive displacement	
Capacity	420 scfm @ 6.5 psig	
Motor Horsepower	20 hp	
Drive Type	Variable speed	

11.0 Effluent Flow Metering

Item Description	Proposed	Design Standard
Primary Device		
Type	90 degree V-notch weir	
Flow Range	0 to 1.1 mgd	>1.1 mgd
Secondary Device	Ultrasonic open channel	

12.0 Main Pump Station

Item Description	Proposed	Design Standard
Number of Units	2 (1 standby)	1 minimum
Type	Dry pit vertical Centrifugal	
Capacity, Each Minimum Maximum	 450 gpm @ 50' 725 gpm @ 80'	
Motor Horsepower	25 hp	
Drive Type	Variable speed	
Level Control System	Level transducer with float back-up	

13.0 In-Plant Pump Station

Item Description	Proposed	Design Standard
Type	Above ground pump station/wet well	
Pumps		
Number	2 (1 standby)	2 minimum
Type	Self priming centrifugal	
Capacity, Each pump	150 gpm	
Total Head	25'	
Motor Horsepower	7.5 hp	
Wet Well		
Volume	1,500 gallons	

14.0 Standby Power

Item Description	Proposed	Design Standard
Type	Diesel	
Size	150 KW	
Treatment Components Served	SBR's, UV, PLC	Required

APPENDIX P

OVERALL PROJECT SCHEDULE

Hinesburg WWTF Upgrade/Expansion (July 2019)

As of July 10, 2019

	TASK	Start	Finish
1	**Hinesburg WWTF Upgrade/Expansion**	12/01/19	12/29/23
2	**Bond Vote**	12/01/19	03/03/20
3	Public Education/Outreach	12/01/19	02/28/20
4	Public Information Meeting No. 1	02/09/20	02/09/20
5	Public Information Meeting No. 2	02/28/20	02/28/20
6	Bond Vote	03/03/20	03/03/20
7	**Final Design - Phase I**	10/01/19	07/01/20
8	Begin Final Design	10/01/19	10/01/19
9	30% Review Meeting	12/15/19	12/15/19
10	60% Review Meeting	02/15/20	02/15/20
11	90% Submittal	04/01/20	04/01/20
12	Permits	03/15/20	06/15/20
13	Issue Final Documents	07/01/20	07/01/20
14	**Construction - Phase I**	07/15/20	02/01/22
15	Advertise for Bids	07/15/20	07/15/20
16	Open Bids	08/15/20	08/15/20
17	Construction	09/15/20	12/31/20
18	Monitor Wick Drains	01/01/21	02/01/22
19	**Final Design - Phase II**	11/01/20	11/01/21
20	Begin Final Design	11/01/20	11/01/20
21	30% Review Meeting	03/01/21	03/01/21
22	60% Review Meeting	06/01/21	06/01/21
23	90% Submittal	09/01/21	09/01/21
24	Permits	08/01/21	11/01/21
25	Issue Final Documents	11/01/21	11/01/21
26	**Construction - Phase II**	12/01/21	12/31/23
27	Advertise for Bids	12/01/21	12/01/21
28	Open Bids	01/15/22	01/15/22
29	Construction	05/01/22	12/29/23
30	Substantial Completion	12/31/23	12/31/23

APPENDIX Q

ACT 250 DETERMINATION

June 13, 2019

Rachel Lomonaco, District 4 Coordinator
District #4 Environmental Commission
111 West Street
Essex Junction, VT 05452

Re: Town of Hinesburg
Wastewater Treatment Facility/Upgrade Expansion
Request for Act 250 Determination
A+E Project No. 18049

Dear Rachel,

Thank-you for meeting to discuss the Hinesburg WWTF upgrade project. As we discussed, we are submitting some additional information to request an Act 250 determination. The Town received a new NPDES Discharge Permit effective March 1, 2018, which imposes lower ammonia and total phosphorus limits. This permit requires that facility modifications be implemented to comply with these new limits by December 31, 2022.

In addition to the facility modifications, the Town also requires an increase in the permitted treatment capacity from 250,000 to 325,000 gpd. This additional flow from new development is planned within the existing sewer service area.

The Town has been in the preliminary engineering phase to evaluate treatment alternatives and develop a proposed project that can comply with these new discharge permit limits. During this study, geotechnical investigation was performed on-site and found a layer of soft clays at depths of 35' to 65'. Additional assessment was completed and indicated that excessive settlement could occur making it difficult to maintain critical elevations for new structures and interconnection piping. Alternatives were evaluated for subgrade improvements and installing wick drains in advance of the WWTF upgrade project to accelerate the settlement was determined to be the most feasible approach. Technical information on the wick drains is attached.

To coordinate this subgrade improvement work, the project has been split into 2 phases as follows:

- Phase I – Wick Drains
- Phase II – WWTF Upgrade/Expansion

Phase I for the wick drains will include the following work as shown on the attached Figure 10. For this phase of work, the disturbed area is estimated at about 3 acres.

- Taking Lagoon #1 and the Sludge Storage Lagoon off-line
- Removing the existing berm between Lagoon #1 and the Sludge Storage Tank
- Excavating the existing material down to approximate elevation 317.5'
- Installing the wick drains within the work areas
- Filling the area above the wick drains to approach elevation 336' plus 5' of additional material to surcharge the fill areas

After the wick drains are installed and functional, monitoring of the fill area will be performed for about 10 to 12 months to document the consolidation and settlement. A detailed project schedule is attached which shows the timeline for this project, and is based on a positive bond vote in March 2020.

Once the settlement occurs, construction of the overall wastewater treatment facility upgrade and expansion will be started and is anticipated to take about 18 months. This work is shown on the attached Figure 11 and will include; Main pump station upgrades, headworks, biological treatment and secondary clarification, filtration, ultraviolet disinfection, sludge storage, and Control Building, and abandonment of the existing lagoons. Total disturbance for both phases is less than 9 acres which includes taking the existing lagoons out of service.

For the Act 250 permitting, the plan would be to submit for an Act 250 Master Plan Permit for Phase I. Upon approval, this initial application would allow the subgrade improvements under Phase I to be completed in advance of the overall project. Once the Phase II engineering is far enough along for State and local permit applications, then the application would be submitted to amend the Master Act 250 Permit for Phase 2.

On behalf of the Town of Hinesburg, we are requesting a determination for an Act 250 permit based on this phasing plan.

Please let us know if you have any additional questions.

Sincerely,

Aldrich + Elliott PC

Wayne Elliott, PE
President

Attachments

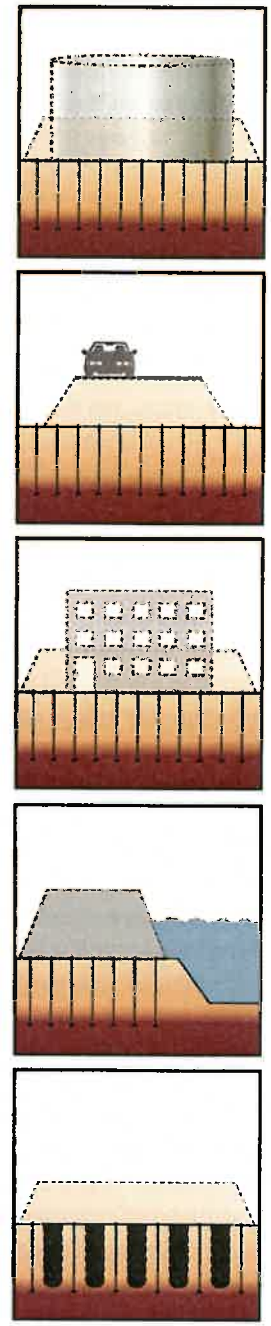
Cc: Renae Marshall, Hinesburg
Lynnette Claudon, State FED

WICK DRAINS

Wick drains accelerate the consolidation of compressible soils, in turn accelerating your project schedule.

Above: Horizontal strip drains being placed after installation of wicks for a new maintenance facility on the Mississippi River floodplain in Memphis, TN.

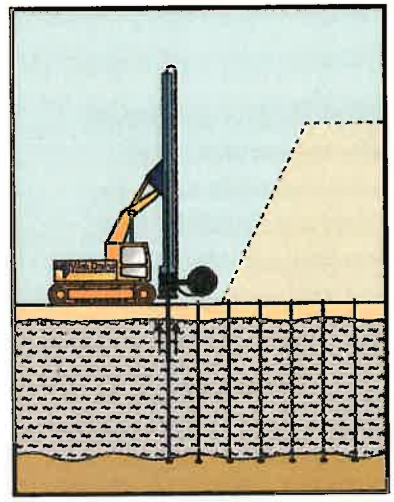
Right: Two of three rigs used to install 1,700,000 linear feet of wick drain to a maximum depth of 75 feet, and 55,000 feet of strip drain for a new housing development in Yorba Linda, CA.



Wick drains are prefabricated vertical drains installed to accelerate the consolidation of compressible soils. The drain consists of a geotextile filter-wrapped plastic strip with extruded channels that allow water to drain from soft soil as it consolidates under an applied surcharge load. The geotextile filter prevents soil particles from entering the channels and clogging the drain. The time required for the consolidation to occur depends on the permeability of the soft strata, the existence of sand layers in the strata, the weight of the surcharge, and the spacing of the wicks.

HB Wick Drains
A Division of Hayward Baker

Wick Drain Technology...



The prefabricated wick drain was invented in the mid-1930s by Walter Kjellman at the Swedish Geotechnical Institute. The first drain consisted of two cardboard sheets glued together, with internal channels. The modern wick drain consisting of geotextile filter-wrapped plastic with extruded channels was developed in 1971, also at the Swedish Geotechnical Institute. The plastic wick drain allowed for faster installation and increased flow rate volume over the early cardboard style. HB Wick Drains uses the Mebra™ brand of wick drains, the most effective and efficient design in the industry.

Applications

- Rapid consolidation of soft soils in conjunction with a preload fill (or applied negative pressure)
- Accelerated construction schedule for staged loading or staged construction on soft soils

Wick drains can be applied to any site that requires consolidation, including sites for:

- Roadway embankments
- Bridge approaches and overpasses
- Dams and levees
- Railway embankments
- Airports and seaports
- Storage tanks
- Commercial and residential buildings
- Mining wastes and tailings

Installation

Before installation can begin, the working surface must be prepared to ensure a stable working platform. Since wick drain sites are typically soft, a sand or gravel blanket may be needed to provide support for the equipment. The sand and gravel will also act as a drainage blanket to direct water away from the treatment area.

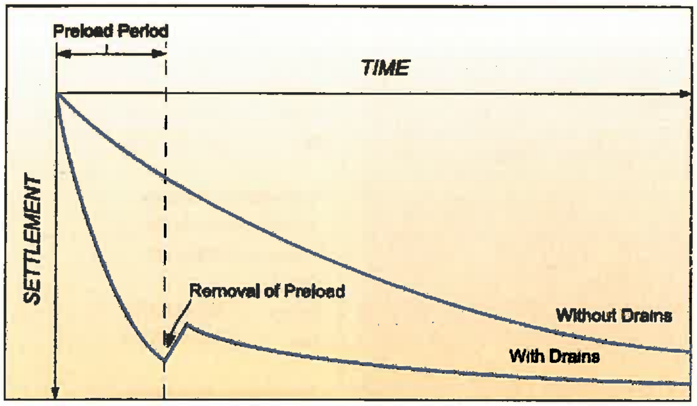
A specialized mast consisting of drain material and a mandrel is mounted on either a track-mounted excavator or crane, depending on the installation depth. Drains can be installed up to 140 feet deep from a track-mounted excavator. Drains deeper than 140 feet often require the mast to be mounted on a crane for stability.

The wick drain is threaded through the mandrel, which protects it from damage as it is installed through the soil. The installation force is typically provided by vibratory hammers, static force methods, or a combination of these methods depending on the soil conditions. Water may be utilized to lubricate the mandrel during installation to reduce the friction on the mandrel. An anchor attached to the bottom of the drain keeps it in place during withdrawal of the mandrel. The drain is then cut several inches above ground, and a new anchor is fastened to the wick at the bottom of the mandrel in preparation for the next installation point.

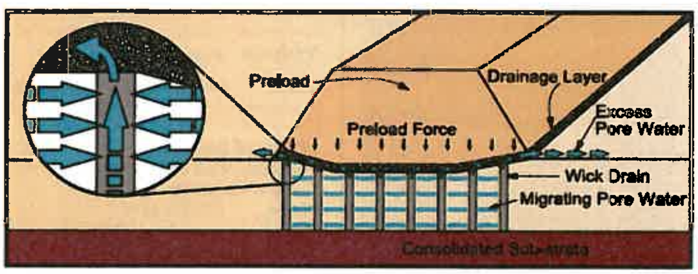
Layout usually consists of triangular or square grid patterns. Typical spacing ranges from 2.5 to 8 feet on center.

A total of 2,300,000 linear feet of wick drain was installed offshore (top photo) through as much as 40 feet of water, to depths up to 120 feet, and 8,800,000 linear feet of wick drain was installed on land (bottom photo), to depths of 98 feet, for the Port of Los Angeles Channel Deepening.

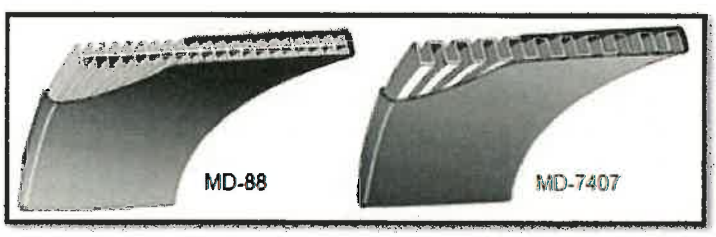
As a division of Hayward Baker, North America's leader in geotechnical construction, HB Wick Drains has direct contact with experts in other ground improvement methods that might be a suitable complement for your site.



Settlement/Time Curve



Pore Water Drainage Flow Path



Mebra™ wick drains, designed and fabricated by HB Wick Drains, are composed of a central core surrounded by a filter sleeve.

Design Considerations

Wick drains are typically used in soft saturated fine-grained soils, such as silts, clays, organic silts, organic clays, peat, sludges, mine tailings, and dredge fills.

The geotechnical investigation should include continuous sampling to identify any sand drainage layers that may contribute to faster consolidation. Appropriate consolidation tests should be performed on the soft material strata to estimate the magnitude and rate of the settlement.

Soft soils, when loaded by surcharge, will undergo:

- Initial elastic compression
- Consolidation
- Secondary compression

Geotechnical Considerations

Wick drains are effective in the following soil conditions:

- Moderate to highly compressible
- Low permeability
- Saturated soils
- Maximum past consolidation stress less than load induced stress

Some site and soil conditions that require evaluation prior to determining the economic and technical feasibility of wick drain systems include:

- Working surface stability
- Overhead and below grade obstructions
- Stiff to very stiff layers (may be addressed with pre-drilling)
- Softness of anchoring layer
- Site accessibility

Environmental Considerations

Water removed by wick drains will need to be collected and treated if the in situ soils are contaminated. For contaminated sites, the drain design length should not fully penetrate into an underlying aquifer.

Quality Assurance/Quality Control

Pore pressures may be monitored along with settlement and loading. Ground movement can be monitored by settlement plates, gauges, and inclinometers. Extensometers can be installed to evaluate settlement versus depth.

Advantages of HB Wick Drains

- *Fast mobilization and installation*
- *Reduced construction time*
- *Minimal post-construction settlement*
- *Increased strength gain rate due to consolidation of soft soils*
- *Several types of rigs with different capabilities that can be matched to the soil conditions to provide the best installation*

A total of 180,000 linear feet of wick drain was installed to 50 feet in sub-zero temperatures to accelerate drainage of soft compressible clay for the construction of an oil drilling platform in Prudhoe Bay, Alaska.

Why Should You Choose HB Wick Drains?

As a division of North America's leader in geotechnical construction, HB Wick Drains has the resources to build your project. Our network of offices and full-service equipment yards means fast mobilization and reduced start-up costs.

From job start-up to installation of the last drain, our attention to quality control helps to ensure that project specifications are achieved. We customize and design our equipment and tooling, helping to ensure that performance and reliability are the best in the industry.

HB Wick Drains has the experience and innovation to assist engineers, contractors, and owners with identifying, developing, and implementing the best wick drain solution.

HB Wick Drains
A Division of Hayward Baker

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Suite 300
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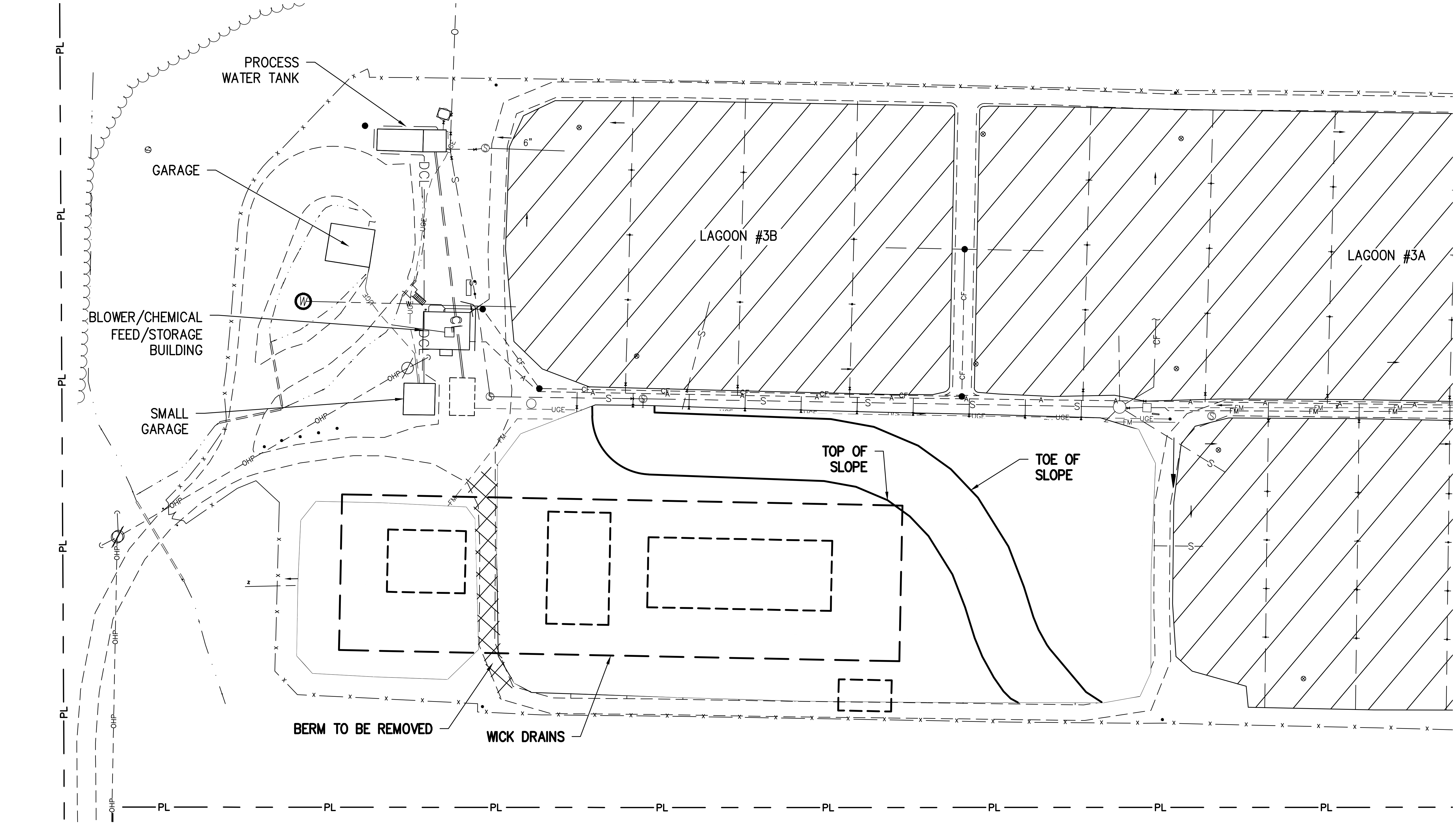
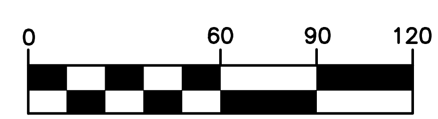
THINK SAFE



PLAN
SCALE: 1"=60'

GRAPHIC SCALE



(IN FEET)

AE
Aldrich + Elliott
WATER RESOURCE ENGINEERS

6 Market Place, Suite 2
Essex Jct., VT 05452

P: 802.879.7733
AEengineers.com

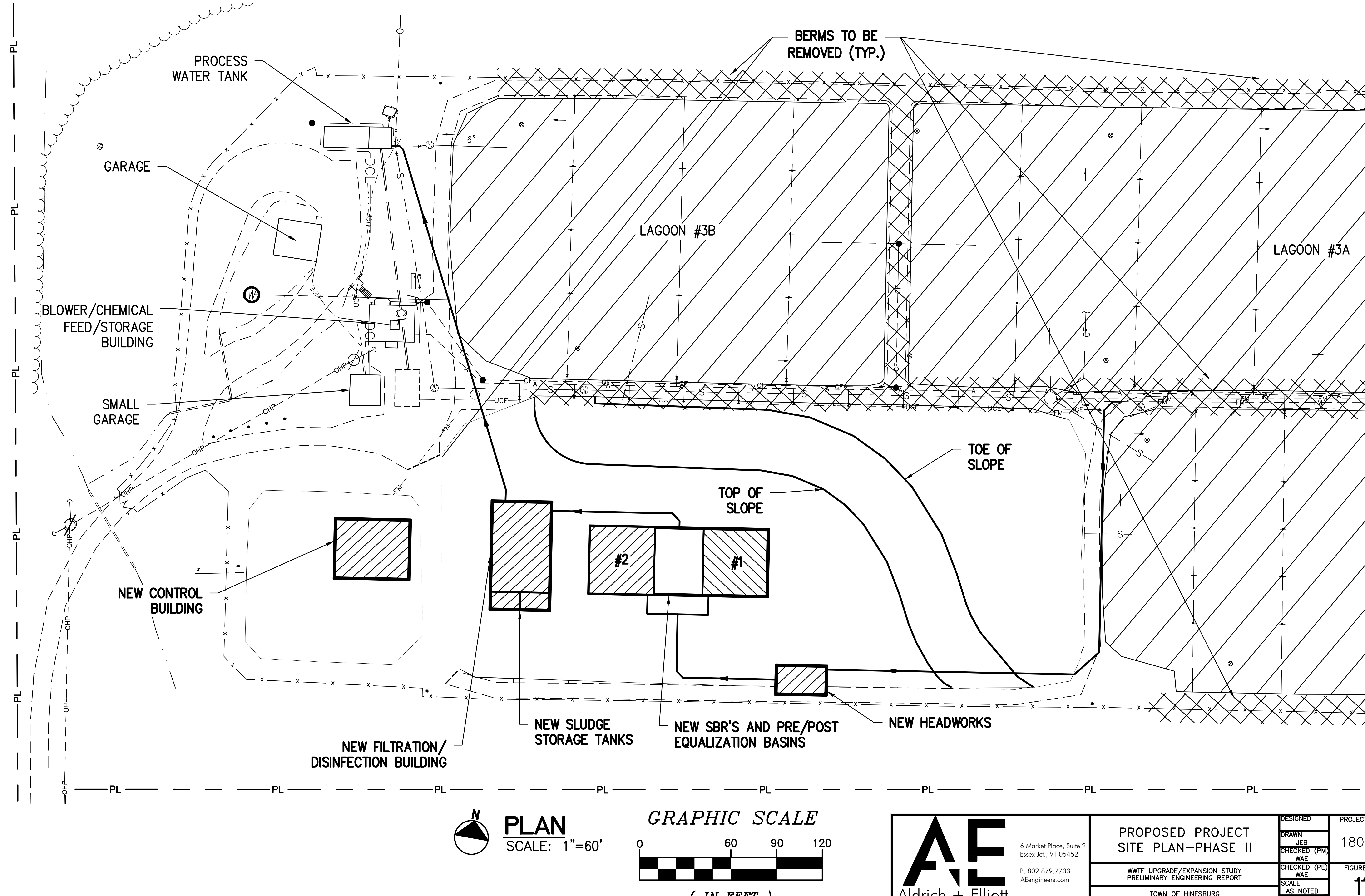
PROPOSED PROJECT
SITE PLAN–PHASE I

WWTF UPGRADE/EXPANSION STUDY
PRELIMINARY ENGINEERING REPORT

TOWN OF HINESBURG

HINESBURG VERMONT

DESIGNED	
DRAWN	JEB
CHECKED (PM)	WAE
CHECKED (PE)	WAE
SCALE	AS NOTED
DATE	JUNE, 2019
PROJECT NO.	18049
FIGURE NO.	10



Aldrich + Elliott WATER RESOURCE ENGINEERS 6 Market Place, Suite 2 Essex Jct., VT 05452 P: 802.879.7733 AEengineers.com	PROPOSED PROJECT SITE PLAN–PHASE II WWTF UPGRADE/EXPANSION STUDY PRELIMINARY ENGINEERING REPORT TOWN OF HINESBURG HINESBURG VERMONT	DESIGNED DRAWN JEB CHECKED (PM) WAE CHECKED (PE) WAE SCALE AS NOTED DATE JUNE, 2019	PROJECT NO. 18049 FIGURE NO. 11

Hinesburg WWTF Upgrade/Expansion (June 2019)

As of June 12, 2019

	TASK	Start	Finish
1	**Hinesburg WWTF Upgrade/Expansion**	12/01/19	12/29/23
2	**Bond Vote**	12/01/19	03/03/20
3	Public Education/Outreach	12/01/19	02/28/20
4	Public Information Meeting No. 1	02/09/20	02/09/20
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6	Bond Vote	03/03/20	03/03/20
7	**Final Design – Phase I**	03/15/20	09/01/20
8	Begin Final Design	03/15/20	03/15/20
9	30% Review Meeting	05/05/20	05/05/20
10	60% Review Meeting	06/16/20	06/16/20
11	90% Submittal	07/16/20	07/16/20
12	Permits	07/01/20	09/01/20
13	Issue Final Documents	09/01/20	09/01/20
14	**Construction – Phase I**	09/06/20	02/01/22
15	Advertise for Bids	09/06/20	09/06/20
16	Open Bids	10/06/20	10/06/20
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23	90% Submittal	09/01/21	09/01/21
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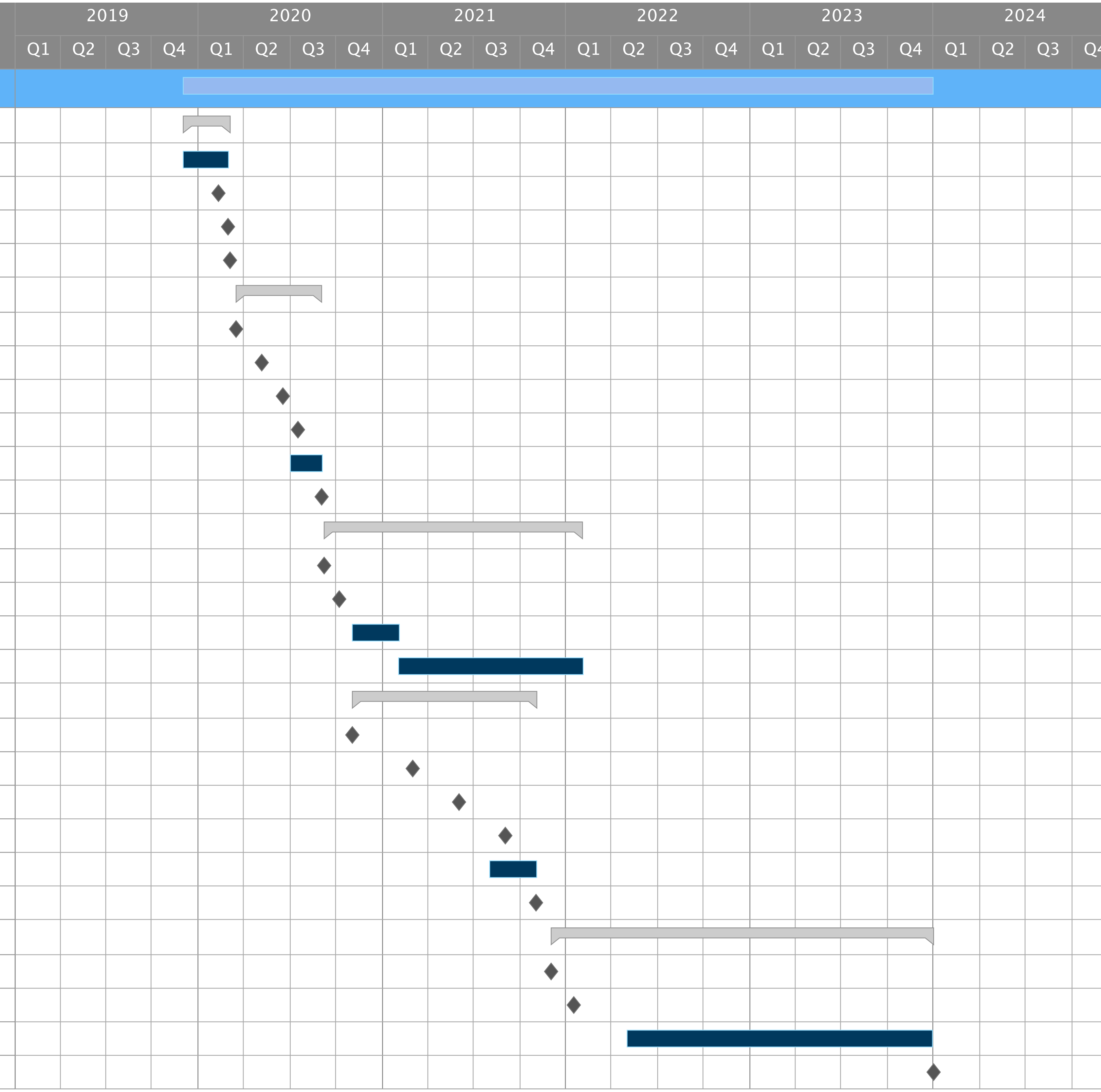
28	Open Bids	01/15/22	01/15/22
29	Construction	05/01/22	12/29/23
30	Substantial Completion	12/31/23	12/31/23



Natural Resources Board
111 West Street
Essex Jct., VT 05452

Act 250 Jurisdictional Opinion

This is a Jurisdictional Opinion based upon available information and a written request from the Landowner/Agent or Other Person. Any Notified Person or entity will be bound by this opinion unless that person or entity files a request for reconsideration with the District Coordinator (10 V.S.A. § 6007 (c) and Act 250 Rule 3 (b)) or an Appeal with the SUPERIOR COURT, Environmental Division within 30 days of the issuance of this opinion

☒ I hereby request a jurisdictional opinion from the District Coordinator or Assistant District Coordinator regarding the jurisdiction of 10 V.S.A. Chapter 151 (Act 250) over the project described below: **Wayne Elliott, Aldrich + Elliot**

PROJECT DESCRIPTION:

The proposed project includes facility upgrades to the Hinesburg Wastewater Treatment Facility ("WWTF") located at 290 Lagoon Road in Hinesburg, Vermont. The project is located in close proximity to the LaPlatt River. The project includes an increase in treatment capacity from 250,000 to 325,000gpd, which expands the capacity of the facility by more than a 10%. No change is proposed to the sewer service area, at this time.

Geotechnical evaluations indicate that excessive settlement can occur at the project site due to the presence of soft subsurface clays. The applicant proposes to split the project into two Phases, as described below. Total disturbance area of Phase I and II is approximately 9 acres.

Phase I will include (1) taking Lagoon #1 and the Sludge Storage Tank off-line and removing a berm that separates these features, (2) excavating existing material to approximately 317.5 feet amsl (3) installing wick drains, and (4) filling the area above the wick drains to approximately 336 feet amsl with 5 feet of additional material to surcharge the fill area. The wick drains are proposed to be in place for about 10-12 months in order to accelerate the settlement process.

Phase II will include the construction and expansion of the new WWTF including (1) Main pump station upgrades, (2) new headworks, biological treatment, secondary clarification, filtration, ultraviolet disinfection, sludge storage, and Control Building, and (3) abandonment of the remaining existing lagoons.

Existing Act 250 permit: No Act 250 permit found

Project Type: ☐ Commercial ☐ Residential ☒ Municipal/State ☐ Mixed
☐ Agriculture ☐ Silviculture ☐ Other

Has the landowner subdivided before? ☐ Yes ☐ No ☒ N/A

AN ACT 250 PERMIT IS REQUIRED: ☒ YES ☐ NO

BASIS FOR DECISION:

The project is a substantial change pursuant to Act 250 Rule 2(C)(7) and does not qualify for an exemption under 10 VSA Section 6081(d)(1).

SIGNATURE: /s/ Rachel Lomonaco DATE: 6/28/2019

Rachel Lomonaco, District Coordinator
Environmental Commission District #4
111 West Street, Essex Junction, VT 05452
802-879-5658
rachel.lomonaco@vermont.gov

This is a jurisdictional opinion issued pursuant to 10 V.S.A. § 6007(c) and Act 250 Rule 3(B). Reconsideration requests are governed by Act 250 Rule 3(B) and should be directed to the district coordinator at the above address. As of May 31, 2016, with the passage of Act 150, Act 250 Rule 3(C) (Reconsideration by the Board) is no longer in effect. Instead, any appeal of this decision must be filed with the Superior Court, Environmental Division (32 Cherry Street, 2nd Floor, Ste. 303, Burlington, VT 05401) within 30 days of the date the decision was issued, pursuant to 10 V.S.A. Chapter 220. The Notice of Appeal must comply with the Vermont Rules for Environmental Court Proceedings (VRECP). The appellant must file with the Notice of Appeal the entry fee required by 32 V.S.A. § 1431 which is $295.00. The appellant also must serve a copy of the Notice of Appeal on the Natural Resources Board, 10 Baldwin Street, Montpelier, VT 05633-3201, and on other parties in accordance with Rule 5(b)(4)(B) of the Vermont Rules for Environmental Court Proceedings.

APPENDIX R

ESTIMATED CONSTRUCTION COSTS

ESTIMATED BUDGET WORKSHEET

PROJECT: Hinesburg WWTF Upgrade/Expansion
ITEM: Lagoon Retrofit
DATE: May-19

CATEGORY	ITEM	QUANTITY	UNIT COST	UNIT	SUBTOTAL	USE (ENR 11200)
General Requirements						$27,000
Demolition						
					$0	
					$0	
	Subtotal				$0	$0
Sitework						
	Erosion Control	1	$10,000	Lump sum	$10,000	
	Silt Fence	1700	$4	l.f.	$6,800	
	Cut/cap pipes	8	$500	Each	$4,000	
	Remove Lagoon #1 Equip.	4	$5,000	Job	$20,000	
	Remove manhole's	4	$1,000	Each	$4,000	
	Remove Fence	2300	$4	l.f.	$9,200	
	New Fence	1300	$12	l.f.	$15,600	
	Cut/Fill slopes/grade	17000	$6	c.y.	$102,000	
	Silt/sand fill/place/grade	5000	$10	c.y.	$50,000	
	Upgrade Gravel Drives	1000	$12	l.f.	$12,000	
	2" Loam/Hydroseed & Mulch	25000	$4.00	s.y.	$100,000	
	Subtotal				$333,600	$340,000
				Subtotal		$367,000
				10% OH&P		$36,700
				Total		$403,700
				Use		$403,700

Notes:

1. ENR 11200 = May 2019
2. The general requirements are based on 8% of the total.

ESTIMATED BUDGET WORKSHEET

PROJECT: Hinesburg WWTF Upgrade/Expansion
ITEM: Alternative No. 1,2,3 - Headworks
DATE: May-19

CATEGORY	ITEM	QUANTITY	UNIT COST	UNIT	SUBTOTAL	USE (ENR 11200)
General Requirements						$58,000
Demolition						
	Remove Garage	0	$5,000	l.s	$0	
	Retrofit CCT	0	$5,000	l.s.	$0	
	Chemical Feed Room	0	$2,500	l.s.	$0	
	Subtotal				$0	$0
Sitework						
	Erosion Control	1	$4,000	Lump sum	$4,000	
	Excavation	150	$50	c.y.	$7,500	
	Structural Bedding	160	$75	c.y.	$12,000	
	Structural Backfill	150	$50	c.y.	$7,500	
	Bit. Walks	60	$60	s.y.	$3,600	
	Bit. Pavement	35	$65	s.y.	$2,275	
	Dewatering/Sheeting	1	$2,500	Lump sum	$2,500	
	Loam, Seed & Mulch	200	$5.00	s.y.	$1,000	
	Subtotal				$40,375	$45,000
Yard Piping						
	12" Gravity Sewer	35	$200	l.f.	$7,000	
	CF Piping	0	$30	l.f.	$0	
	8" Forcemain	500	$100	l.f.	$50,000	
	1" Process water	850	$30	l.f.	$25,500	
	Electrical Conduit	600	$30	l.f.	$18,000	
	Subtotal				$100,500	$105,000
Concrete						
	Base Slab	55	$850	c.y.	$46,750	
	Walls	45	$900	c.y.	$40,500	
	Channels/top slab	35	$900	c.y.	$31,500	
	Slab on grade- Electric rm	6	$800	c.y.	$4,800	
	Misc.	1	$2,500	Allowance	$2,500	
	Subtotal				$126,050	$130,000
Misc. Metals						
	Al Handrail	40	$75	l.f.	$3,000	
	Stairs	16	$500	Riser	$8,000	
	Slide gates	4	$1,500	Each	$6,000	
	Flume	1	$1,500	Each	$1,500	
	Bar Rack	1	$1,500	Each	$1,500	
	Subtotal				$20,000	$25,000
Building						
	Building	680	$175	s.f.	$119,000	$120,000
Equipment						
	Process Water System	1	$7,500	Allowance	$7,500	
	Rotary Screen	1	$125,000	Each	$125,000	
	Subtotal				$125,000	$130,000
Instrumentation						
	Gas Detection System	1	$7,500	Each	$7,500	
	Chart Recorder System	1	$2,500	Each	$2,500	
	Flow meter	1	$3,000	Each	$3,000	
					$13,000	$15,000
Process Piping						
	Interior Piping/Valves	1	$20,000	Allowance	$20,000	$20,000
Heating/Ventilation						
	Mechanical	1	$60,000	Allowance	$60,000	$60,000
Electrical						
	Electrical/Controls	1	$75,000	Allowance	$75,000	$75,000
				Subtotal		$783,000
				10% OH&P		$78,300
				Total		$861,300
				Use		$861,300

Notes:
1. ENR 11200 = May 2019
2. The general requirements are based on 8% of the total.

ESTIMATED BUDGET WORKSHEET

PROJECT: Hineburg WWTF PER
ITEM: Lemtec Treatment
DATE: May-19

CATEGORY	ITEM	QUANTITY	UNIT COST	UNIT	SUBTOTAL	USE (ENR 11200)
General Requirements						$161,000
Demolition						
	Lagoon equipment	1	$5,000	Allowance	$5,000	
	Blower/chem feed building	1	$20,000	Allowance	$20,000	
					$0	
	Subtotal				$25,000	$25,000
Sitework						
	Erosion Control	1	$7,500	Lump sum	$7,500	
	Excavation	450	$100	c.y.	$45,000	
	Berm	3000	$16	c.y.	$48,000	
	Lagoon Liner	150000	$2	s.f.	$300,000	
	Sand layer	2500	$17		$42,500	
	Structural Bedding	125	$75	c.y.	$9,375	
	Structural Backfill	150	$75	c.y.	$11,250	
	Walks	25	$45	s.y.	$1,125	
	Bit. Pavement	40	$65	s.y.	$2,600	
	Loam, Seed & Mulch	1500	$5.00	s.y.	$7,500	
	Subtotal				$474,850	$475,000
Yard Piping						
	12" Gravity Sewer	100	$200	l.f.	$20,000	
	8" Forcemain	200	$125	l.f.	$25,000	
	RAS Lines	150	$75	l.f.	$11,250	
	WAS Lines	100	$75	l.f.	$7,500	
	Drain lines	30	$75	l.f.	$2,250	
	Electrical Conduit	40	$30	l.f.	$1,200	
	Subtotal				$67,200	$75,000
Concrete						
	Base Slab	75	$750	c.y.	$56,250	
	Walls	60	$600	c.y.	$36,000	
	Suspended slab	0	$800	c.y.	$0	
	Misc./Equipment Pads	1	$5,000	Allowance	$5,000	
	Subtotal				$97,250	$100,000
Misc. Metals						
	Al Handrail	50	$75	l.f.	$3,750	
	Stairs	24	$500	Riser	$12,000	
	Al hatch	1	$2,500	Each	$2,500	
	Al Grating	40	$50	s.f.	$2,000	
	Subtotal				$20,250	$24,000
Building						
	Building	1250	$150	s.f.	$187,500	$190,000
Equipment						
	Lemna Equipment					
	Equipment:	1	$700,000	Each	$700,000	
	Installation:	1	$150,000	Each	$150,000	
	Subtotal				$850,000	$850,000
Instrumentation						
	Flow Meters					
	Equipment:	3	$5,000	Each	$15,000	
	Installation:	3	$1,500	Each	$4,500	
	Subtotal				$19,500	$22,000
Process Piping						
	Interior Piping/Valves	1	$50,000	Allowance	$50,000	$50,000
Heating/Ventilation						
		1	$75,000	Allowance	$75,000	$75,000
Electrical						
		1	$125,000	Allowance	$125,000	$125,000
				Subtotal		$2,172,000
				10% OH&P		$217,200
				Total		$2,389,200
				Use		**$2,389,200**

Notes:
1. ENR 11200 = April 2019
2. The general requirements are based on 8% of the total.

ESTIMATED BUDGET WORKSHEET

PROJECT: **Hinesburg WWTF Upgrade/Expansion**
ITEM: **Alternative No. 1 - Ballasted Floc System**
DATE: **May-19**

CATEGORY	ITEM	QUANTITY	UNIT COST	UNIT	SUBTOTAL	USE (ENR 11200)
General Requirements						$178,000
Demolition						
	Remove Garage	0	$5,000	l.s	$0	
	Retrofit CCT	0	$5,000	l.s.	$0	
	Chemical Feed Room	0	$2,500	l.s.	$0	
	Subtotal				$0	$0
Sitework						
	Erosion Control	1	$2,000	Lump sum	$2,000	
	Excavation	400	$20	c.y.	$8,000	
	Structural Bedding	280	$60	c.y.	$16,800	
	Structural Backfill	800	$30	c.y.	$24,000	
	Bit. Walks	60	$60	s.y.	$3,600	
	Bit. Pavement	35	$65	s.y.	$2,275	
	Dewatering/Sheeting	1	$2,500	Lump sum	$2,500	
	Loam, Seed & Mulch	200	$5.00	s.y.	$1,000	
	Subtotal				$60,175	$75,000
Yard Piping						
	12" Gravity Sewer	320	$100	l.f.	$32,000	
	CF Piping	200	$30	l.f.	$6,000	
	6" Sludge	40	$80	l.f.	$3,200	
	1" Process water	150	$30	l.f.	$4,500	
	Electrical Conduit	300	$30	l.f.	$9,000	
	Subtotal				$54,700	$60,000
Concrete						
	Base Slab	144	$850	c.y.	$122,400	
	Walls	158	$900	c.y.	$142,200	
	Suspended Slab	48	$900	c.y.	$43,200	
	Channels/top slab	0	$1,000	c.y.	$0	
	Slab on grade- Filter area	0	$800	c.y.	$0	
	Misc./Pads	1	$5,000	Allowance	$5,000	
	Subtotal				$312,800	$325,000
Misc. Metals						
	Grating	300	$70	s.f.	$21,000	
	Railing	150	$45	l.f.	$6,750	
	Stairs	30	$500	Each	$15,000	
	Misc.	1	$5,000	Allowance	$5,000	
		0	$1,500	Each	$0	
	Subtotal				$47,750	$75,000
Building						
	Building	2600	$150	s.f.	$390,000	$390,000
Equipment						
	CoMag System					
	Equipment:	1	$750,000	Each	$750,000	
	Installation	1	$200,000	Each	$200,000	
	Subtotal				$950,000	$950,000
Instrumentation						
	Instrumentation	1	$25,000	Allowance	$25,000	
					$0	
	Subtotal				$25,000	$25,000
Process Piping						
	Interior Piping/Valves	1	$100,000	Allowance	$100,000	$100,000
Heating/Ventilation						
	Mechanical	1	$100,000	Allowance	$100,000	$100,000
Electrical						
	Electric/Controls	1	$125,000	Allowance	$125,000	$125,000
				Subtotal		$2,403,000
				10% OH&P		$240,300
				Total		$2,643,300
				Use		$2,643,300

Notes:
1. ENR 11200 = April 2019
2. The general requirements are based on 8% of the total.

ESTIMATED BUDGET WORKSHEET
PROJECT: Hinesburg WWTF Upgrade/Expansion
ITEM: SBR's
DATE: May-19

CATEGORY	ITEM	QUANTITY	UNIT COST	UNIT	SUBTOTAL	USE (ENR 11200)
General Requirements						$139,000
Demolition						
	Remove Garage	0	$5,000	l.s	$0	
	Retrofit CCT	0	$5,000	l.s.	$0	
	Chemical Feed Room	0	$2,500	l.s.	$0	
	Subtotal				$0	$0
Sitework						
	Erosion Control	1	$4,000	Lump sum	$4,000	
	Excavation	800	$35	c.y.	$28,000	
	Structural Bedding	280	$60	c.y.	$16,800	
	Structural Backfill	900	$30	c.y.	$27,000	
	Granular Backfill					
	Bit. Walks	60	$65	s.y.	$3,900	
	Bit. Pavement	35	$75	s.y.	$2,625	
	Dewatering/Sheeting	1	$10,000	Allowance	$10,000	
	Loam, Seed & Mulch	200	$5.00	s.y.	$1,000	
	Subtotal				$93,325	$100,000
Yard Piping						
	12" Gravity Sewer	180	$100	l.f.	$18,000	
	CF Piping	500	$25	l.f.	$12,500	
	6" SS Air	200	$60	l.f.	$12,000	
	8" EFF FM	200	$80	l.f.	$16,000	
	6" Sludge FM	200	$70	l.f.	$14,000	
	1" Process water	850	$30	l.f.	$25,500	
	Electrical Conduit	600	$30	l.f.	$18,000	
	Subtotal				$116,000	$120,000
Concrete						
	Base Slab	290	$850	c.y.	$246,500	
	Walls	380	$900	c.y.	$342,000	
	Sludge piping vault	1	$20,000	Each	$20,000	
	EQ Precast Vault	1	$20,000	Each	$20,000	
	Subtotal				$628,500	$630,000
Misc. Metals						
	Al Handrail	550	$70	l.f.	$38,500	
	Al Grating	1800	$35	s.f.	$63,000	
	Slide gates		$1,500	Each	$0	
	Flume		$1,500	Each	$0	
	Bar Rack		$1,500	Each	$0	
	Subtotal				$101,500	$105,000
Building						
	Building	0	$150	s.f.	$0	$0
Equipment						
	SBR's					
	Equipment:	1	$500,000	Each	$500,000	
	Installation:	2	$75,000	Each	$150,000	
	Subtotal				$650,000	$650,000
Instrumentation						
	SBR - DO, floats	3	$10,000	Each	$30,000	
		0	$2,500	Each	$0	
		0	$3,000	Each	$0	
	Subtotal				$30,000	$30,000
Process Piping						
	Interior Piping/Valves	1	$50,000	Allowance	$50,000	$50,000
Heating/Ventilation						
		0			$0	$0
Electrical						
	Subtotal	1	$50,000	Allowance	$50,000	$50,000
				Subtotal		$1,874,000
				10% OH&P		$187,400
				Total		$2,061,400
				Use		$2,061,400

Notes:
1. ENR 11200 = April 2019
2. The general requirements are based on 8% of the total.

ESTIMATED BUDGET WORKSHEET

PROJECT: **Hinesburg WWTF Upgrade/Expansion**
ITEM: **Extended Aeration & Clarifiers**
DATE: **Jan-19**

CATEGORY	ITEM	QUANTITY	UNIT COST	UNIT	SUBTOTAL	USE (ENR 10970)
General Requirements						$190,000
Demolition						
	Sludge Removal-Town	0	$150,000	Allowance	$0	
	Remove Garage	0	$5,000	l.s	$0	
	Retrofit CCT	0	$5,000	l.s.	$0	
	Chemical Feed Room	0	$2,500	l.s.	$0	
	Subtotal				$0	$0
Sitework						
	Erosion Control	1	$5,000	Lump sum	$5,000	
	Excavation	2500	$25	c.y.	$62,500	
	Structural Bedding	500	$75	c.y.	$37,500	
	Granular backfill	1500	$30	c.y.	$45,000	
	Bit. Walks	120	$65	s.y.	$7,800	
	Bit. Pavement	100	$75	s.y.	$7,500	
	UGE/C	600	$20	l.f.	$12,000	
	Dewatering/Sheeting	1	$15,000	Allowance	$15,000	
	Loam, Seed & Mulch	400	$5.00	s.y.	$2,000	
	Subtotal				$194,300	$194,300
Yard Piping						
	12" Sewer to AO and to Clar	300	$100	l.f.	$30,000	
	6" CF	500	$25		$12,500	
	6" SS Air	350	$60	l.f.	$21,000	
	12" Sewer to Filtration bld	200	$100	l.f.	$20,000	
	1" Process water	850	$30	l.f.	$25,500	
	Electrical Conduit	600	$30	l.f.	$18,000	
	Subtotal				$127,000	$127,000
Concrete						
Aeration Tanks	Base Slab	230	$850	c.y.	$195,500	
	Walls	410	$900	c.y.	$369,000	
Clarifiers	Base Slab	155	$850	c.y.	$131,750	
	Walls	200	$900	c.y.	$180,000	
	Launder	18	$1,200	c.y.	$21,600	
	Grout Fill slab	40	$850	c.y.	$34,000	
	Grout Fill launder	8	$850	c.y.	$6,800	
	Scum Vaults	40	$950	c.y.	$38,000	
	Distribution Structure	40	$1,000	c.y.	$40,000	
	Under slab pipe encasement	12	$850	c.y.	$10,200	
	Subtotal				$1,026,850	$1,026,900
Misc. Metals						
	Al Handrail	680	$70	l.f.	$47,600	
	Al Grating	500	$40	s.f.	$20,000	
	Slide gates	4	$1,500	Each	$6,000	
	Stop gates	4	$1,500	Each	$6,000	
	Weir gates	9	$2,500	Each	$22,500	
	Alum Hatch's	2	$1,500	Each	$3,000	
	Subtotal				$105,100	$105,100
Painting/Coatings						
	Extended Aeration	1	$25,000	Job	$25,000	
	Clarifiers	1	$50,000	Job	$50,000	
	Subtotal				$75,000	$75,000
Equipment						
	Extended Aeration	1	$460,000	Job	$460,000	
	Clarifiers	1	$280,000	Job	$280,000	
	Weirs, scum baffle, supports	1	$45,000	Job	$45,000	
	Subtotal				$785,000	$785,000
Instrumentation						
		1	$7,500	Each	$7,500	
			$2,500	Each	$0	
			$3,000	Each	$0	
	Subtotal				$0	$0
Process Piping						
	Interior Piping/Valves	1	$15,000	Allowance	$15,000	$15,000
Heating/Ventilation						
					$0	$0
Electrical						
	Subtotal	1	$50,000	Allowance	$50,000	$50,000
				Subtotal		$2,568,300
				8% OH&P		$205,464
				Total		$2,773,764
				Use		$2,774,280

Notes:
1. ENR 11200 = April 2019
2. The general requirements are based on 8% of the total.

ESTIMATED BUDGET WORKSHEET

PROJECT: Hinesburg WWTF Upgrade/Expansion
ITEM: Alternative # 2&3 - Filtration
DATE: May-19

CATEGORY	ITEM	QUANTITY	UNIT COST	UNIT	SUBTOTAL	USE (ENR 11200)
General Requirements						$68,000
Demolition						
	Retrofit CCT	0	$5,000	l.s.	$0	
	Chemical Feed Room	0	$2,500	l.s.	$0	
	Subtotal				$0	$0
Sitework						
	Erosion Control	1	$2,000	Lump sum	$2,000	
	Excavation	100	$50	c.y.	$5,000	
	Structural Bedding	125	$75	c.y.	$9,375	
	Structural Backfill	120	$50	c.y.	$6,000	
	Bit. Walks	60	$60	s.y.	$3,600	
	Bit. Pavement	35	$65	s.y.	$2,275	
	Dewatering/Sheeting	1	$2,500	Lump sum	$2,500	
	Loam, Seed & Mulch	200	$5.00	s.y.	$1,000	
	Subtotal				$31,750	$35,000
Yard Piping						
	12" Gravity Sewer	0	$100	l.f.	$0	
	CF Piping	0	$30	l.f.	$0	
	8" Forcemain	125	$100	l.f.	$12,500	
	1" Process water	50	$30	l.f.	$1,500	
	Electrical Conduit	300	$30	l.f.	$9,000	
	Subtotal				$23,000	$25,000
Concrete						
	Footings	25	$850	c.y.	$21,250	
	Exterior Walls	30	$900	c.y.	$27,000	
	Interior Walls	0	$900	c.y.	$0	
	Channels/top slab	0	$1,000	c.y.	$0	
	Slab on grade- Filter area	30	$800	c.y.	$24,000	
	Misc.	1	$2,500	Allowance	$2,500	
	Subtotal				$74,750	$80,000
Misc. Metals						
	Grating	80	$75	s.f.	$6,000	
	Stairs	12	$500	Riser	$6,000	
	Flow Alignment Baffle	0	$1,500	Each	$0	
	Misc.	0	$5,000	Allowance	$0	
		0	$1,500	Each	$0	
	Subtotal				$12,000	$12,000
Building						
	Building	1200	$150	s.f.	$180,000	$180,000
Equipment						
	Filtration					
	Equipment:	2	$140,000	Each	$280,000	
	Installation:	2	$50,000	Each	$100,000	
	Subtotal				$380,000	$380,000
Instrumentation						
	Gas Detection System	0	$7,500	Each	$0	
	Chart Recorder System	0	$2,500	Each	$0	
	Misc	0	$5,000	Each	$0	
	Subtotal				$0	$0
Process Piping						
	Interior Piping/Valves	1	$40,000	Allowance	$40,000	$40,000
Heating/Ventilation						
	Mechanical	1	$50,000	Allowance	$50,000	$50,000
Electrical						
	Electrical	1	$50,000	Allowance	$50,000	$50,000
				Subtotal		$920,000
				10% OH&P		$92,000
				Total		$1,012,000
				Use		$1,012,000

Notes:

1. ENR 11200 = May 2019
2. The general requirements are based on 8% of the total.

ESTIMATED BUDGET WORKSHEET

PROJECT: Hinesburg WWTF Upgrade/Expansion
ITEM: Alternative # 2&3 - Ultraviolet Disinfection
DATE: May-19

CATEGORY	ITEM	QUANTITY	UNIT COST	UNIT	SUBTOTAL	USE (ENR 11200)
General Requirements						$38,000
Demolition						
	Remove Garage	0	$5,000	l.s	$0	
	Retrofit CCT	0	$5,000	l.s.	$0	
	Chemical Feed Room	0	$2,500	l.s.	$0	
	Subtotal				$0	$0
Sitework						
	Erosion Control	1	$1,000	Lump sum	$1,000	
	Excavation	100	$50	c.y.	$5,000	
	Structural Bedding	125	$75	c.y.	$9,375	
	Structural Backfill	120	$50	c.y.	$6,000	
	Bit. Walks	60	$60	s.y.	$3,600	
	Bit. Pavement	35	$65	s.y.	$2,275	
	Dewatering/Sheeting	1	$2,500	Lump sum	$2,500	
	Loam, Seed & Mulch	200	$5.00	s.y.	$1,000	
	Subtotal				$30,750	$35,000
Yard Piping						
	12" Gravity Sewer	150	$100	l.f.	$15,000	
	CF Piping	0	$30	l.f.	$0	
	8" Forcemain	0	$100	l.f.	$0	
	1" Process water	50	$30	l.f.	$1,500	
	Electrical Conduit	300	$30	l.f.	$9,000	
	Subtotal				$25,500	$30,000
Concrete						
	Base Slab	24	$850	c.y.	$20,400	
	Exterior Walls	22	$900	c.y.	$19,800	
	Interior Walls	17	$900	c.y.	$15,300	
	Channels/top slab	11	$1,000	c.y.	$11,000	
	Slab on grade- Filter area	0	$850	c.y.	$0	
	Misc.	1	$2,500	Allowance	$2,500	
	Subtotal				$69,000	$75,000
Misc. Metals						
	Grating	100	$75	l.f.	$7,500	
	Rectangular Weir Plate	1	$500	Riser	$500	
	Flow Alignment Baffle	1	$1,500	Each	$1,500	
	Misc.	1	$5,000	Allowance	$5,000	
		0	$1,500	Each	$0	
	Subtotal				$14,500	$15,000
Building						
	Building	480	$150	s.f.	$72,000	$75,000
Equipment						
	UV Disinfection					
	Equipment:	1	$150,000	Each	$150,000	
	Installation:	1	$25,000	Each	$25,000	
	Subtotal				$175,000	$175,000
Instrumentation						
	Chart Recorder System	0	$2,500	Each	$0	
	Misc	1	$5,000	Each	$5,000	
	Subtotal				$5,000	$5,000
Process Piping						
	Interior Piping/Valves	1	$10,000	Allowance	$10,000	$10,000
Heating/Ventilation						
	Mechanical	1	$25,000	Allowance	$25,000	$25,000
Electrical						
	Electrical/Controls	1	$30,000	Allowance	$30,000	$30,000
				Subtotal		$513,000
				10% OH&P		$51,300
				Total		$564,300
				Use		$564,300

Notes:
1. ENR 11200 = April 2019
2. The general requirements are based on 8% of the total.

ESTIMATED BUDGET WORKSHEET

PROJECT: Hinesburg WWTF Upgrade/Expansion

ITEM: Sludge Tanks - Alt. #1

DATE: May-19

CATEGORY	ITEM	QUANTITY	UNIT COST	UNIT	SUBTOTAL	USE (ENR 11200)
General Requirements						$30,000
Demolition						
	Chemical Feed Room	0	$2,500	l.s.	$0	
	Subtotal				$0	$0
Sitework						
	Erosion Control	1	$2,000	Lump sum	$2,000	
	Excavation	250	$50	c.y.	$12,500	
	Structural Bedding	100	$75	c.y.	$7,500	
	Structural Backfill	550	$50	c.y.	$27,500	
	Bit. Walks	60	$60	s.y.	$3,600	
	Bit. Pavement	35	$65	s.y.	$2,275	
	Dewatering/Sheeting	1	$2,500	Lump sum	$2,500	
	Loam, Seed & Mulch	200	$5.00	s.y.	$1,000	
	Subtotal				$58,875	$60,000
Yard Piping						
	6" DI Sludge piping	300	$65	l.f.	$19,500	
	4" SS Air piping	0	$30	l.f.	$0	
	6" SS Air piping	200	$70	l.f.	$14,000	
	1" Process water	0	$30	l.f.	$0	
	Electrical Conduit	0	$30	l.f.	$0	
	Subtotal				$33,500	$35,000
Concrete						
	Base Slab	70	$850	c.y.	$59,500	
	Walls	102	$900	c.y.	$91,800	
	Roof Slab	52	$1,000	c.y.	$52,000	
	Subtotal				$203,300	$205,000
Misc Metals						
	Roof Scuttles	4	$2,000	Each	$8,000	
	Stairs	8	$750	Riser	$6,000	
	Subtotal				$14,000	$15,000
Equipment						
	Diffusers	42	$200		$8,400	
	Subtotal				$8,400	$8,400
Instrumentation						
	Level Sensors	1	$10,000	Allowance	$10,000	
	Subtotal				$10,000	$10,000
Process Pipe/Valves						
	6" Telescoping valves	2	$2,500	Each	$5,000	
	6" Gate Valves	2	$850	Each	$1,700	
	4" SS interior piping	280	$100	Each	$28,000	
	4" Butterfly Valves	2	$500	Each	$1,000	
	6" DI interior piping	70	$120	Each	$8,400	
	6" Roof vents	2	$250	Each	$500	
	4" Pumper connection	2	$500	Each	$1,000	
	Subtotal				$45,600	$45,000
				Subtotal		$408,400
				10% OH&P		$40,840
				Total		$449,240
				Use		$449,240

Notes:

1. ENR 11200 = April 2019
2. The general requirements are based on 8% of the total.

ESTIMATED BUDGET WORKSHEET

PROJECT: Hinesburg WWTF Upgrade/Expansion
ITEM: Control Building
DATE: May-19

CATEGORY	ITEM	QUANTITY	UNIT COST	UNIT	SUBTOTAL	USE (ENR 11200)
General Requirements						$76,000
Demolition						
	Sludge Removal-Town	0	$150,000	Allowance	$0	
	Remove Garage	0	$5,000	l.s	$0	
	Retrofit CCT	0	$5,000	l.s.	$0	
	Chemical Feed Room	0	$2,500	l.s.	$0	
	Subtotal				$0	$0
Sitework						
	Erosion Control	1	$2,000	Lump sum	$2,000	
	Excavation	200	$50	c.y.	$10,000	
	Structural Bedding	300	$75	c.y.	$22,500	
	Structural Backfill	300	$50	c.y.	$15,000	
	Bit. Walks	60	$60	s.y.	$3,600	
	Bit. Pavement	100	$65	s.y.	$6,500	
	Dewatering/Sheeting	1	$2,500	Lump sum	$2,500	
	Loam, Seed & Mulch	200	$5.00	s.y.	$1,000	
	Subtotal				$63,100	$65,000
Yard Piping						
	8" Gravity Sewer	200	$100	l.f.	$20,000	
	CF Piping	0	$30	l.f.	$0	
	8" Forcemain	0	$100	l.f.	$0	
	1" Potable water	150	$30	l.f.	$4,500	
	Electrical Conduit	300	$30	l.f.	$9,000	
	Subtotal				$33,500	$35,000
Concrete						
	Footings	25	$850	c.y.	$21,250	
	Frost Walls	40	$900	c.y.	$36,000	
	Slab on grade	75	$800	c.y.	$60,000	
	Misc.	1	$5,000	Allowance	$5,000	
	Subtotal				$122,250	$125,000
Misc. Metals						
	Stairs	24	$125	l.f.	$3,000	
	Rectangular Weir Plate		$500	Riser	$0	
	Flow Alignment Baffle		$1,500	Each	$0	
	Misc.	1	$5,000	Allowance	$5,000	
	Subtotal				$8,000	$10,000
Building						
	Building	2000	$125	s.f.	$250,000	$250,000
Equipment						
					$0	
	Laboratory	1	$35,000	Allowance	$35,000	
	Subtotal				$35,000	$35,000
Instrumentation						
	Chart Recorder's	2	$2,500	Each	$5,000	
	Misc	0	$5,000	Each	$0	
	Subtotal				$5,000	$5,000
Process Piping						
	Interior Piping/Valves	1	$5,000	Allowance	$5,000	$5,000
Heating/Ventilation						
	System	1	$150,000	Allowance	$150,000	$150,000
Electrical						
	Electric	1	$75,000	Allowance	$75,000	
	SCADA	1	$200,000	Allowance	$200,000	
	Subtotal				$275,000	$275,000
				Subtotal		$1,031,000
				10% OH&P		$103,100
				Total		$1,134,100
				Use		$1,134,100

Notes:
1. ENR 11200 = April 2019
2. The general requirements are based on 8% of the total.