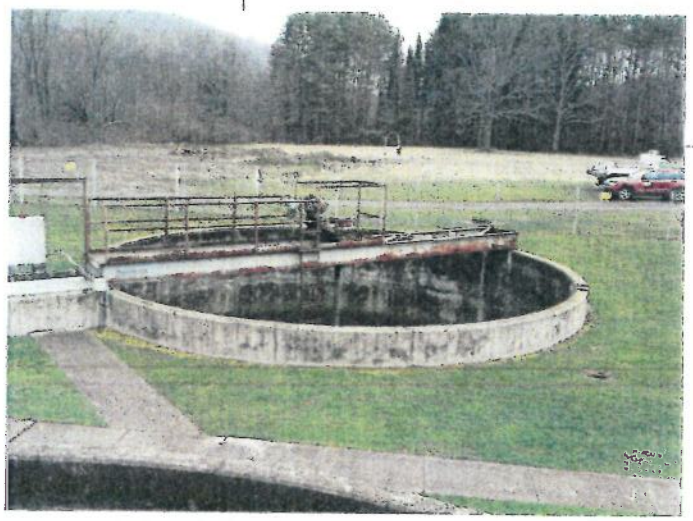
HRG
Herbert, Rowland & Grubic, Inc.
Engineering & Related Services

BOROUGH OF SHINGLEHOUSE

WASTEWATER TREATMENT PLANT EVALUATION STUDY

October 2016



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Wastewater Treatment Plant Evaluation Study

Borough of Shinglehouse
Potter County, Pennsylvania

1.0 – Executive Summary

This report and succeeding appendices represent the findings and recommendations of the Borough of Shinglehouse's Wastewater Treatment Plant (WWTP). Herbert, Rowland & Grubic, Inc. (HRG) has prepared this report, titled Wastewater Treatment Plant Evaluation Study (Study) based on existing record drawings, site visits, personal communications with Borough Staff, equipment manufacturers, and other documents provided by the Borough.

The main objectives of the Study included the following:

1. Provide a structural evaluation of the existing treatment process tanks and buildings to identify any necessary repairs or replacement.
2. Provide a headworks analysis that would consider repair or replacement of the existing building wet well, raw wastewater pumps, and existing communitor and manual bar screen.
3. Provide an evaluation of the existing treatment process to literature values and design parameters as outlined in the following documents:
    a. Pennsylvania Department of Environmental Protection (PaDEP) Domestic Wastewater Facilities Manual (Document No. 362-0300-001 10/97).
    b. Environmental Protection Agency (EPA) Process Design Manual for Sludge Treatment and Disposal (EPA 625/1-79/011).
4. Provide an evaluation of two (2) biological nutrient removal (BNR) alternatives for long term upgrades and improvements to the existing WWTP including the Modified Ludzack-Ettinger (MLE) and the Sequential Batch Reactor (SBR) processes. Furthermore, these BNR Alternatives were evaluated using trending effluent nutrient limits of 6.0 mg/L for total nitrogen (TN) and of 0.8 mg/L for total phosphorus (TP).
5. Provide a disinfection analysis that would consider repair or replacement of the existing chlorine disinfection system and maintain revised chlorine residual as required by the NPDES Permit.

In regards of Item No. 4, a 20-year total present worth analysis was performed to compare the evaluated BNR Alternatives against the existing treatment process. Present worth costs were developed with an annual rate of inflation of 3.0% and an annual interest rate of 4.0% in year 2017 US dollars. The estimated opinions of probable construction cost for the respective alternatives were developed for comparison purposes and based upon available data at the time of the finalization of this report. Each opinion of probable construction cost includes estimates for mobilization, bonding, demolition (as applicable), 30% contingency, and 15% for engineering fees.

2.0 – Conclusions and Recommendations

As described below, the existing WWTP, constructed in 1966, has reached the end of its useful life and is in need of replacement of a majority of its components. The existing process does not have the ability to meet total nitrogen (TN) or total phosphorous (TP) limits. While, the Borough currently does not currently need to meet TN or TP limits, the trend has been for regulators to add these limits to NPDES Permits throughout Pennsylvania where there is or is projected to have downstream impairment as a result of nutrient loadings. The fact that the Borough is now reporting the TN and TP discharged to the Honeoye Creek suggests that TN or TP limits may be forthcoming.

From the alternatives that were evaluated, the highest estimated 20-year present worth cost included replacement of the existing WWTP, largely in-kind, with the addition of de-nitrification filters that would provide for meeting anticipated TN limits.

It is our recommendation that the Borough proceed with implementation of Alternative 2a which has the lowest estimated 20-year present worth cost that provides for the ability to meet anticipated TN and TP limits. This alternative includes installation of a vertical fine screen and rehabilitation of the influent pump station and control building; new grit removal system; new oxidation basin that would replace the existing primary clarifier and trickling filters; rehabilitation of the final clarifier; and rehabilitation of the disinfection system. Our recommendation assumes that the Public Works Director has the opportunity to review similar installations and identifies that this process would be preferred over the SBR that has been evaluated as Alternative 3(a & b).

The recommended alternative can be completed in multiple phases in order to comply with funding grant requirements and schedules. The first phase (County CDBG Grant) may include rehabilitation of the chlorine contact tank and miscellaneous headworks improvements. The second phase (State Competitive CDBG Grant) can include installation of the vertical fine screen and rehabilitation of the final clarifier. The final phase would include installation of the oxidation basin and grit system, supervisor controls, and demolition of the existing equipment. We are recommending that the Borough proceed with preparation of a PENNVEST Funding Application for Phase 3.

It is important to note that Phases 1, 2, and 3, as proposed would require Water Quality Management Part II Permitting through the Pennsylvania Department of Environmental Protection (PaDEP) and that Phase 3 is likely to require Act 537 Planning. We recommend that the Borough schedule a meeting with PaDEP to review the planning and permitting requirements.

3.0 – Acknowledgements

Herbert, Rowland & Grubic, Inc. (HRG) would like to thank Mr. Mark Meacham, Director of Public Works, and Mrs. Debra Resig, Secretary and Treasurer for their assistance in the preparation of this evaluation and report. This evaluation report was prepared by Agustin E. Conesa, P.E., BCEE, and R. Edward Spayd, P.E. and reviewed by Joshua T. Fox, P.E. prior to issuance.

4.0 – Introduction

The Borough of Shinglehouse is in the process of designing improvements to the existing wastewater treatment plant (WWTP) that provides sanitary sewer service to the residents and businesses in the Borough of Shinglehouse as well as both the Oswayo Valley Elementary School and Jr. & Sr. High School.

The WWTP is a permitted 160,000 gallon per day (gpd) facility utilizing primary clarification, fixed film

bioreactors, and final clarification to achieve secondary treatment. Effluent is disinfected using sodium hypochlorite before being discharged to the Honeoye Creek. Sludge is stored on-site until it can be dewatered using manually cleaned drying beds and disposed of via landfilling. The WWTP was constructed in 1966 and is mostly original equipment. Small repairs and modifications have been made over the past 50 years to keep the facility in operation and in compliance with the NPDES Permit; however, all major equipment at the WWTP is now currently in need of replacement.

In addition to the need to replace existing equipment, the most recent NPDES Permit includes new requirements for total chlorine residual (TCR) effluent limits and monitoring requirements for copper, lead, total nitrogen (TN), and total phosphorous (TP). The current treatment technology and configuration utilized at the WWTP is not capable of nutrient reduction for TN and TP.

5.0 – Existing WWTP Evaluation

Several flow rates have been used in this Study. For purposes of clarification, these flows are defined as follows:

Annual Average Daily Flow (ADF) – This is the total flow received during a one year period averaged on a daily basis, and is generally referenced as the "nominal" design flow of the facility.

Maximum Monthly Average Flow (MMAF) – This is the highest monthly flow in a calendar year reported on an average daily basis, and is the "Design" flow for the facility.

Peak Hourly Flow Dry Weather (PHF_D) – This is the maximum flow rate sustained during an hour period at the facility over a 24-hour period during dry weather conditions.

5.1 - Structural Evaluation

A visual inspection of the existing concrete tanks and buildings was completed during the initial site visit. All of the buildings and concrete tanks are original to the facility and were constructed in 1966.
The visual assessments were limited by the amount of liquid in each of the tanks respectively. All of the tanks appeared to be in fair to poor condition. Scour lines were visible on both trickling filters and the chlorine contact tank. The scouring at the water level in the chlorine contact tank will require significant rebuilding of the concrete prior to coating. Similar rebuilding of the concrete would be necessary at the scour lines for the trickling filters. Other tanks including the clarifiers and aerobic digester show minor cracking and spalling.


Chlorine Contact Tank

Structural bridges for both clarifiers and the aerobic digester should be immediately considered for replacement if these processes are decided to be retained by the Borough.

Based on our limited visual inspection, all tanks and buildings could be repaired and put back into service.

5.2 – Headworks Evaluation

The existing headworks was evaluated against the PaDEP's design recommended guidelines, current

system performance, and on-going operation and maintenance requirements. Table 5.2.1 provides the physical parameters of the system while Table 5.2.2 provides a list of system performance and maintenance items that were observed/discusses during the system evaluation.

Table 5.2.1 – Headworks System Physical Parameters

Parameter	Value	Units
Comminutor	1	NA
By-Pass Screen	1	NA
Grit Removal	0	NA
Number of Influent Pumps	3	NA
Design Flow Rate (each)	500	gpm

Table 5.2.2 – Summary of Headworks System Evaluation

Item	Observations
Comminutor	1. The performance of the existing comminutor was noted to be in poor condition. This was primarily contributed from the age of the equipment and the physical wear of the grinding unit. As a result of the poor performance of the unit, the downstream components (pumps, rake arms, etc.) are continuously subjected to wear from introduction of excess grit and debris into the wastewater.
By-pass Bar Screen	1. This unit provided adequate screening when in use. However due to its location, cleaning of this screen is very difficult,
Influent Pumps	1. One of the three pump was temporality out of service. It appears that this pump will be required to be replaced due to the inability to service the pump.
Bubbler System	1. The current bubbler system was reported to be in constant need of service. A new pump controller system shall be installed to ensure proper cycling of the pumps can be maintained.
Building Condition	1. The majority of the process equipment exhibited sever signs of corrosion, and wear. The majority of this equipment has exceeded its life expectance and is no longer serviceable. 2. While the concrete structures appeared to show no signs of structural deficiencies, a significant amount of the concrete surface will require spot-repairs to address spalling and corrosion issues.

Currently, the existing Headworks System meets the PaDEP's design recommended guidelines. However, based on the current condition of the existing headworks system, the magnitude of the required operation and maintenance issues, and the escalating cost to service this equipment, the Borough should consider moving forward with the replacement of all major system components (screening, pumps, controls) and/or the construction of a new headworks building. Upgrades to a majority of the headworks components will be required to provide adequate protection for any new process equipment included as part of planned WWTP upgrade.

5.3 – Primary Clarifier Evaluation

The Primary Clarifier was evaluated against the PaDEP's design recommended guidelines. Table 5.3.1 provides the physical of the unit while Table 5.3.2 provides the results of the design

considerations' evaluation.

Table 5.3.1 – Primary Clarifier's Physical Parameters

Parameter	Value	Units
Number of Units	1	NA
Diameter	35	ft
Surface Area	962	ft^2
Volume	6,735	ft^3
Volume	50,383	gal

Table 5.3.2 – Primary Clarifier's Design Considerations Evaluation

Parameter	Actual Value	PaDEP Value [3]	Units
Side Water Depth	7.0	7.0	ft^2
Surface Overflow Rates (@ MMAF [1])	166	1,000	gpd/ft^2
Surface Overflow Rate (@ PHF_D [2])	260	2,500	gpd/ft^2
Weir Loading (MMAF)	1,455	15,000	gpd/ft

Notes: [1] MMAF = Maximum Monthly Average = 0.160 MGD; [2] PHF_D = Peak Hourly Flow Dry Weather = 0.25 MGD; [3] DEP's Domestic Wastewater Facilities, Publication No. 362-0300-001, 10/97, Section 62.

According to Table 5.3.2 results, the Primary Clarifier meets the PaDEP's design recommended guidelines. Based on this, the existing Primary Clarifier should provide adequate treatment. This is demonstrated in Table 5.3.3 when comparing theoretical removal performance versus empirical data as a function of detention time and constituents concentrations for ADF conditions showing comparable values among them.

Table 5.3.3 – Primary Clarifier's Removal Performance Comparison

Parameter	Empirical	Theoretical	Units
Average Daily Flow (ADF)	0.074 [1]		MGD
Hydraulic Retention Time (HRT)	16.4		hr
BOD Removal	67 [2]	47 [3]	%
TSS Removal	64 [2]	69 [3]	%

Notes: [1] Effluent Values from 1/14 thru 4/16 per DMR's; Average from MicroBac Lab Data of 7/7/16, 7/13/16; [3] M&E 4th ed., Equation 5-45, p. 405, using BOD = 200 – 300 mg/L, TSS = 200 – 300 mg/L at T = 20°C.

5.4 – TRICKLING FILTERS EVALUATION

The Trickling Filters were evaluated against the PaDEP's design recommended guidelines. Table 5.4.1 provides the physical of the unit while Table 5.4.2 provides the results of the design considerations' evaluation.

Table 5.4.1 – Trickling Filter's Physical Parameters

Parameter	Value	Units
Number of Units	2	NA
Depth	5	ft
Diameter	35	ft
Surface Area	962	ft^2
Volume	4,685	ft^3

Volume	70,104	gal

Table 5.4.2 – Trickling Filter's Design Considerations Evaluation

Parameter	Actual Value	Literature Value	Units
Surface Overflow Rates per TF (@ MMAF)	0.12 [1]	0.8 - 0.12	gpd/ft^2
BOD_5 [2] Loading per TF (@ MMAF)	12.0 [4]	5 - 15	lb/day/1,000 ft^3
NH_3-N [3] Loading per TF(@ MMAF)	0.73 [4]	0.04 - 0.2	lb/day/1,000 ft^3

Notes: [1] Using a Series Process Configuration; [2] Biological Oxygen Demand; [3] Ammonia-Nitrogen; [4] Average Value

According to Table 5.4.2 results, the Trickling Filters are within the recommended design range values as found in the literature for surface overflow rates as well as BOD loading. Yet, they appear to be ammonia-nitrogen overloaded with an average value of 0.41 lb/day/1,000 ft^3 for MMAF conditions. Still, the ammonia-nitrogen loading is overloaded even for present flow conditions with an estimated value of 0.34 lb/day/1,000 ft^3 demonstrating a lack of nitrification when compared to typical effluent limits of 2.0 mg/L for other WWTP's within Pennsylvania.

Table 5.4.3 – Trickling Filter's Removal Performance Comparison

Parameter	Trickling Filter No.1	Trickling Filter No.2	Units
Effluent BOD	42 [1]	18 [1]	mg/L
Effluent NH_3-N	18 [1]	4 [1]	mg/L

Notes: [1] Average values from MicroBac Lab Data of 6/30/16, 7/7/16, 7/13/16.

Nitrification is the biological oxidation of ammonia or ammonium to nitrite followed by the oxidation of the nitrite to nitrate. The Nitroso-bacteria, known as nitrite formers, convert ammonia under aerobic conditions to nitrites and derive energy from the oxidation.

$$2NH_4^+ + 3O_2 \rightarrow 2NO_2^- + 4H^+ + 2H_2O \quad (1)$$

Then the nitrites are oxidized by the Nitrobacter-bacteria, also known as the nitrate formers, into the nitrates nitrogen form.

$$2NO_2^- + O_2 \rightarrow 2NO_3^- \quad (2)$$

5.5 – Secondary Clarifier Evaluation

Similar to the Primary Clarifier, the secondary clarifier was evaluated against the PaDEP's design recommended guidelines. Table 5.5.1 provides the physical of the unit while Table 5.5.2 provides the results of the design considerations' evaluation.

Table 5.5.1 – Secondary Clarifier's Physical Parameters

Parameter	Value	Units
Number of Units	1	NA
Diameter	35	ft
Surface Area	962	ft^2
Volume	6,735	ft^3
Volume	50,383	gal

Table 5.5.2 – Secondary Clarifier's Design Considerations Evaluation

Parameter	Actual Value	PaDEP Value [3]	Units
Side Water Depth	7.0	7.0	ft^2
Surface Overflow Rates (@ MMAF [1])	166	800	gpd/ft^2
Surface Overflow Rate (@ PHF_D [2])	260	1,200	gpd/ft^2
Weir Loading (MMAF)	1,455	15,000	gpd/ft

Notes: [1] MMAF = 0.160 MGD; [2] PHF_D = 0.25 MGD; [3] DEP's Domestic Wastewater Facilities, Publication No. 362-0300-001, 10/97, Section 62.

According to Table 5.5.2 results, the Secondary Clarifier meets the PaDEP's design recommended guidelines. Based on this, the existing secondary clarifier should provide adequate treatment.

5.6 - Chlorine Contact Tank / Disinfection System Evaluation

The Borough currently achieves adequate disinfection through the use of a liquid chlorine feed system and chlorine contact tank (CCT). This chlorine contact tank and disinfection system was evaluated against the PaDEP's design recommended guidelines. The basic components of the disinfection system include:

1. Chemical feed pumps are used to deliver a solution of 12.5% sodium hypochlorite from a day tank. Operators typically mix a day tank with a ratio of 1 gall 12.5% sodium hypochlorite to 34 gallons water.
2. The chlorine solutions flow by gravity from the dosing manhole, where it is added to the trickling filter effluent, to the effluent high flow pump station.
3. The effluent pump station operates off of a series of floats. The disinfected effluent water is pumped from the effluent high flow pump station and through the chlorine contact tank.

The effluent high flow pump station was installed after the original CCT was constructed and was intended to provide continuous flow during periods when the receiving stream was flooded and the high water condition at the outfall required a higher flow rate to exceed the additional pressure head. A summary of the disinfection system is included in. Table 5.6.1.

Table 5.6.1 – Disinfection System Summary

Parameter	Value	Units
Number CCT Units	1	NA
CCT Side Water Depth (avg)	5	ft
CCT Length	44	ft
CCT Width	2	ft
CCT Volume (each)	440	ft^3
CCT Volume (each)	3,291	gal
Inlet Pipe Volume	244	gal
Outfall Pipe Volume	2,244	gal
Chlorine Pump Station Volume	2,098	gal
Volume (total)	8,317	gal
Number of Chlorinators	1	NA
Number of Effluent Pumps	2	NA
Pump Rate	700	gpm
Disinfection Chemical	Sodium Hypochlorite	NA
Solution Strength	12.5%	NA

A summary of results for the disinfection system evaluation is included in Table 5.6.2. It is important to note that the current control strategy for the high flow effluent pump station is to operate the pumps on a continuous basis, regardless of the water level in the receiving stream. A further discussion on this topic will be included in Section 6.4.

Table 5.6.2 – Summary of Disinfection System Evaluation

Parameter	Actual Value	PaDEP Value [1]	Units
Minimum Contact Period (PHF)	22	> 15	minutes
Minimum Contact Period (MMF)	32	> 30	minutes

[1] **DEP's Domestic Wastewater Facilities, Publication No. 362-0300-001, 10/97, Section 75**

According to Table 5.6.2 results, the disinfection system meets the PaDEP's design recommended guidelines. Based on this, the existing disinfection system should provide adequate disinfection treatment.

5.7 – Aerobic Digestion/Sludge Storage Evaluation

The aerobic digesters were evaluated against the PaDEP's design recommended guidelines. Table 5.7.1 provides the physical of the unit while Table 5.7.2 provides the results of the design considerations' evaluation.

Table 5.7.1 – Aerobic Digesters' Physical Parameters

Parameter	Value	Units
Number of Units	2	NA
Depth	17	ft
Length	15	ft
Width	15	ft
Surface Area	225	ft^2
Volume (each)	3,825	ft^3
Volume (each)	28,615	gal
Volume (total)	57,230	gal
Number of Mixers	2	NA
Mixers Capacity (each)	7.5	hp
Number of Blowers	2	NA
Blowers Capacity (each)	80 / 8.0	SCFM / psig

Table 5.7.2 – Aerobic Digesters' Design Considerations Evaluation

Parameter	Actual Value	PaDEP Value [4]	Units
VSS[1] Loading per Digester (@ MMAF)	32	25 - 100	lb/day/1,000 ft^3
Combined SRT [2] (@ MMAF)	26.5 [3]	≥ 15 [5]	days
Mixing per Digester	262	40	hp/MG

Notes: [1] Volatile Suspended Solids; [2] Solids Retention Time; [3] Without Supernatant Process; [4] DEP's Domestic Wastewater Facilities, Publication No. 362-0300-001, 10/97, Section 75; [5] Minimum at 59°F (higher SRT's are required for lower temperatures).

According to Table 5.7.2 results, the existing aerobic digesters are within the recommended design range values as found in PaDEP's Domestic Wastewater Facilities. Yet, it is important to mention that the estimated SRT value is well below the required 40 days, at 68°F, to achieve Class B Biosolids per the US Environmental Pollution Control (EPA) 40 CFR Part 503.

Table 5.7.3 – Aerobic Digesters' Perfomance Evaluation

Parameter	Actual Value	EPA Value [2]	Units
Combined AOR [1] (@ MMAF)	153	192	lb/day
Combined VSS Reduction (@ MMAF)	38.8	40 - 50	%

Notes: [1] Actual Oxygen Requirements; [2] From Process Design Manual for Sludge Treatment and Disposal (EPA 625/1-79/011) and using 2.3 lbO_2/lb VSS.

Per Table 5.7.3, the existing aerobic digesters shows lower than recommended AOR values thus reflecting marginal values for the VSS Reduction (VSR) performance. This translates into a deficiency of about 25 SCFM per digester that is required to meet the EPA design criteria when compared to the existing blowers.

6.0 – Evaluation of WWTP Upgrade Alternatives

Three (3) wastewater treatment alternatives were evaluated in this Study. These alternatives, although conceptual, shall provide for sustainable upgrades and treatment for future trending effluent discharge limits. The alternatives considered include the following:

1. Alternative 1 - Existing WWTP Upgrade
2. Alternative 2 – Modified-Ludzack Ettinger (MLE)
3. Alternative 3 – Sequential Batch Reactor (SBR)

Table 6.0.1 provides the basis of design criteria used for the evaluation of the respective wastewater treatment alternatives

Table 6.0.1 – Wastewater Alternatives Basis of Design

Parameter	Influent	Effluent	Units
Influent Flow Rate (MMAF)	0.16		MGD
BOD_5 Concentration	220	10	mg/L
TSS Concentration	220	10	mg/L
TKN [1] Concentration	40		mg/L
NH_3-N Concentration	NA [3]	1.0	mg/L
TN Concentration [2]	NA [3]	6.0	mg/L
TP Concentration	8.0	0.8	mg/L
Wastewater Temp Min/Max	10/20		°C
Primary Clarifier BOD/TSS Removal	45/67 @ 20°C		%
Secondary Clarifier TSS Removal	67 @ 20°C		%

Notes: [1] Total Kjeldahl Nitrogen; [2] Used TN ≤ 28 mg/L, BOD/TSS = 10 mg/L, and Nitrates = 23 mg/L for influent Denitrification Filter System influent condition; [3] Not Available.

6.1 – Existing WWTP Upgrade (Alternative 1)

The following process unit equipment were considered as part of this alternative to warrant a reliable and sustainable treatment process that would meet the design criteria stated in Table 6.0.1:

1. Headworks. Upgrades to include:
    a. Provision of a Raw Wastewater Influent Screen
    b. Replacement of existing raw sewage pumps
    c. Replacement of existing level control instrumentation
2. Grit Removal System:
    a. None considered due to existing site and hydraulic limitations
3. Primary Clarifier. Upgrades to include:
    a. Replacement of existing scraper mechanism and drive in kind
    b. Replacement of existing primary sludge pump
4. Trickling Filters. Upgrades to include:
    a. Replacement of the existing filters' media
    b. Replacement of the existing cover and addition of a cover
    c. Replacement of the recirculation pumps
5. Secondary Clarifier. Upgrades to include:
    a. Replacement of the existing scraper mechanism and drive in kind
    b. Replacement of the existing secondary sludge pump
6. New Denitrification Filter System BNR System
7. Inclusion of existing Chlorine Disinfection System (no upgrades to the existing system)
8. Effluent Pump Station. Upgrades to include:
    a. Replacement of existing effluent pumps
    b. Replacement of existing level control instrumentation
9. Inclusion of existing Aerobic Digesters
10. Use of existing chemical feed system located at the Control Building

The following sections provide a more detailed description of the for the respective unit processes' upgrades.

6.1.1 – Headworks

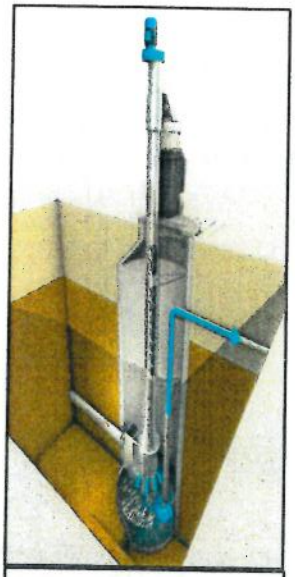
Table 6.1.1 provides the Headworks' process equipment in consideration:

Table 6.1.1 – Headworks Equipment

Equipment	Number	Type	Capacity
Grinder	1	Single Shafted Barrel	1/3 hp
Raw Influent Pumps	2	Shafted Dry Pit Centrifugal	10 hp, 500 gpm @ 35 TDH
Level Instrumentation	1	Bubbler	NA [1]

Notes: [1] Not Applicable

This study evaluated the replacement of the existing grinder with a mechanical bar screen. Due to the process configuration and layout of the Headworks, it was concluded that the most cost effective alternative would be to install a vertical fine screen at the existing Headworks (refer to Appendix 1).



ROTAMAT® RoK4
Vertical Screen

The vertical screen considered was the ROTAMAT® RoK4 as manufactured by Huber Technology. With a maximum vertical lift of approximately 30 feet, the RoK 4 consists of a vertical screen basket and a shafted auger in a vertical tube. Wastewater flows through an inflow connection and a chamber into the screen basket. The top of this chamber is open and serves as an emergency bypass, e.g. in case of power failure. The inflow drops into the screen basket thus generating turbulence for the removal of fecal matter from solids (washing action). The drop also prevents back-flooding and solids deposits in the incoming sewer. The screen is provided with 1/4" (6 mm) perforations with other sizes available upon request. When the water level in the screen basket rises above the invert level of the inflow connection, the auger revolves for a short time period. Within the screen basket the flights of the auger are equipped with a wear-resistant brush for effective cleaning of the screen.

As the screenings are gradually elevated by the auger, they are dewatered by gravity drainage. A screenings compaction zone is provided near the upper end of the auger. Water is pressed out of the screenings through perforations in the vertical tube. Filtrate drains through a hose back into the inlet chamber. The compacted screenings are discharged through a chute into a container or endless bagger for odor control.

Figure 6.1.1 Huber Technologies' ROTAMAT® RoK4

In addition to the vertical fine screen, it is proposed to replace the existing raw influent pumps with non-shafted dry pit submersible pumps with a submersible transducer and back-up float level switches for level control instrumentation. Table 6.1-2 provides a brief description of the proposed as part of the Headworks' improvements.

Table 6.1.2 – Headworks Improvements Equipment

Equipment	Number	Type	Capacity
Influent Screen	1	Vertical Basket, ¼-inch	1.04 MGD, 2.0 hp
Raw Influent Pumps	2	Dry Pit Submersible	10 hp, 500 gpm @ 35 TDH
Level Instrumentation	1	Pressure Transducer	NA [1]
Level Instrumentation	2	Non-Mercury Float Switch	NA [1]

Notes: [1] Not Applicable

6.1.2 – Primary Clarifier

Due to the age and conditions of the existing Primary Clarifier's scraper/rake mechanisms, it is recommended to replace it in kind. The budgetary quote for the rake mechanism was obtained from Monroe Environmental. Table 6.1-2 provides in detail what encompasses this budgetary proposal. In addition, it was also recommended to replace in kind the existing primary sludge pump also shown in Table 6.1-2.

Table 6.1.2 – Primary Clarifier's Retrofit Equipment

Equipment	Number	Description
Rake Mechanism	1	Coated Carbon Steel Construction · DBS Precision Fabricated Drive (Bridge Mount) · Access Bridge Walkway & Handrails (Full Diameter) · Inlet Well · Inlet Pipe · Drive Shaft · Skimmer Arm & Scum Box · Two (2) Rake Arms · FRP Weirs & Scum Baffle
Primary Sludge Pump	1	Chicago Centrifugal, 5 hp, 80 gpm @ 32 TDH

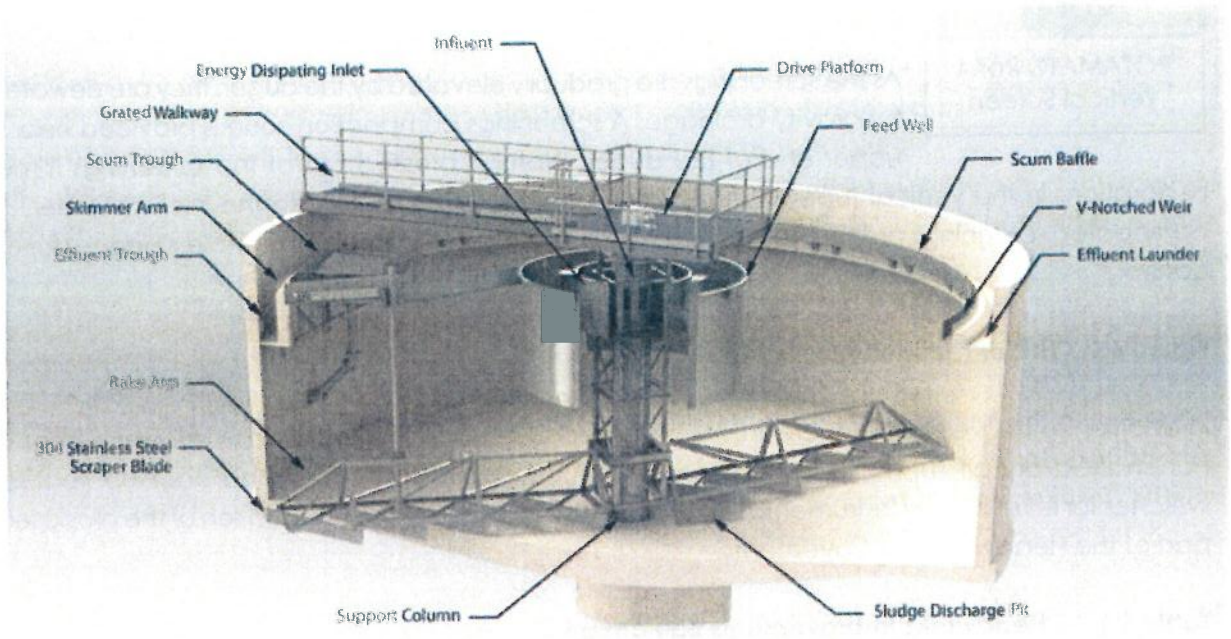
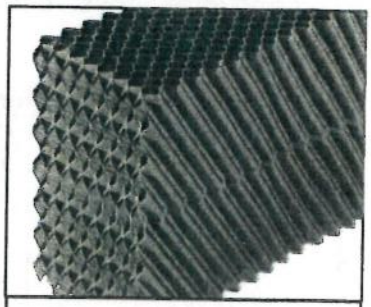


Figure 6.1.2 Monroe Environmental's Illustration of a Typical Primary Clarifier's Retrofit

6.1.3 – Trickling Filters

From on Table 5.3-4 data, it was concluded that the existing Trickling Filters provide little or no nitrification. In attached growth systems, most of the BOD has to be removed before nitrifying aerobic autotrophic bacteria is well established. With a higher biomass yield, the carbonaceous heterotrophic bacteria can dominate over nitrifying by covering more fixed film surface area. Based on this, it is highly recommended to replace both of the Trickling Filters' media with greater specific surface area that will allow for higher organic loadings thus letting the nitrification process to occur. The recommended media budgetary quote was based on the CF-1900 as manufactured by Brentwood Industries.


Brentwood's CF-1900

Brentwood's cross flow media is made of sheets formed with alternating corrugations, which are solvent-welded to each other to form modules for easy stacking. The CF-1900 is specifically designed for shallow-depth BOD roughing and polishing, nitrification and denitrification. The liquid flowing downward is redistributed at each cross point creating 720 mixing points per foot of depth. The modules are fabricated from rigid PVC sheets, which are UV-protected and resistant to rot, fungi, bacteria, acids, and alkalis commonly present in municipal wastewater. Table 6.1.3 provides a comparison of the existing Trickling Filters' media and the proposed in this Study.

Table 6.1.3 provides a loading comparison between the existing and the proposed media for the Trickling Filters' media retrofit.

Table 6.1.3 Trickling Filters' Media Retrofit Loading Comparison

Parameter	Trickling Filter No.1	Trickling Filter No.2	Units
Existing			
Type of Media	River Rock (Large)	Plastic Random Packing	NA
Approximate Surface Area	18	30	ft^2/ft^3
BOD_5 Loading per TF (@ MMAF)	13.28	10.74	lb/day/1,000 ft^3
NH_3-N Loading per TF(@ MMAF)	0.75	0.70	lb/day/1,000 ft^3
Recycle Ratio	60	40	%
Proposed			
Type of Media	Structured Sheet Media	Structured Sheet Media	NA
Approximate Surface Area	48	48	ft^2/ft^3
BOD_5 Loading per TF (@ MMAF)	11.0	11.0	lb/day/1,000 ft^3
NH_3-N Loading per TF(@ MMAF)	0.26	0.26	lb/day/1,000 ft^3
Recycle Ratio	50	50	%

Notes: [1] MMAF = Maximum Monthly Average = 0.160 MGD; [2] PHF_D = Peak Hourly Flow Dry Weather = 0.25 MGD; [3] DEP's Domestic Wastewater Facilities, Publication No. 362-0300-001, 10/97, Section 62.

Per Table 6.1.3, by using a higher surface area media, the ammonia-nitrogen loadings per unit volume (lb/day/1,000 ft^3) can be greatly reduced thus inducing the nitrification process to occur. Per communications with Brentwood Industries' engineers, effluent ammonia values of 2.0 mg/L or less can be expected with the media retrofit. Yet, it is important to note that nitrification is inhibited at 10°C or less. This means that in addition to the media retrofit, the Trickling Filters will have to be covered and actively ventilated to provide air as this is an aerobic reaction.

The recommended budgetary quote for the covers was based on Ultraflote LLC. This company specializes in all aluminum geodesic domes. Table 6.1.4 provides a general scope of work for the Trickling Filters' cover retrofit.

Table 6.1.4 – Trickling Filters' Cover Retrofit Equipment

Equipment	Number	Description
Cover	2	Ventilation System: . Comprised of Louver and a Fan . Fan capacity of 600 SCFM at p = 1.0 – 1.5 in W.C. [1] Nominal 8.0 feet high vertical side wall system with: . 7.0 feet high by 3.0 feet wide entrance 10.0 feet diameter center hatch for equipment removal

Notes: [1] Water Column

6.1.4 – Secondary Clarifier

Similar to the Primary Clarifier, it is also recommended to replace the Secondary Clarifier's rake mechanism in kind. The budgetary quote for the rake mechanism was also obtained from Monroe Environmental. Table 6.1-4 provides in detail what encompasses this budgetary proposal. In addition, it was also recommended to replace in kind the existing primary sludge pump also shown in Table 6.1-4.

Table 6.1-4 – Secondary Clarifier's Retrofit Equipment

Equipment	Number	Description
Rake Mechanism	1	Coated Carbon Steel Construction · DBS Precision Fabricated Drive (Bridge Mount) · Access Bridge Walkway & Handrails (Full Diameter) · Inlet Well · Inlet Pipe · Drive Shaft · Skimmer Arm & Scum Box · Two (2) Rake Arms · FRP Weirs & Scum Baffle
Secondary Sludge Pump	1	Chicago Centrifugal, 5 hp, 80 gpm @ 32 TDH

6.1.5 – New Denitrification Filter System

In order to meet the effluent TN of 6.0 mg/L per the basis of design criteria established in Table 6.0.1, denitrification process has to occur. Based on this, a denitrification filter system is proposed as part of the existing WWTP upgrades. In denitrification, nitrates are reduced to nitrites, and then the reduction of nitrites to nitrogen gas occurs. Reduction of nitrites is carried all the way to ammonia by a few bacteria organisms, but most of them carry the reduction to the end product of nitrogen gas, which escapes into the atmosphere. The bacteria utilize the nitrites and nitrates as the oxygen source in their life processes. This process is carried out under anoxic or near anaerobic conditions.

$$2NO_3^- \rightarrow 2NO_2^- \rightarrow N_2 \quad (3)$$

The recommended budgetary quote for the denitrification system was based on the elimi-NITE® as manufactured by Leopold-Xylem Water Solutions Inc. The elimi-NITE® is an attached growth, microbiological process. Heterotrophs microorganisms responsible for the denitrification process. Usually an exogenous carbon source such as methanol, acetic acid, and others is added upstream of the filter. This carbon source acts as an electron donor that is required for the denitrification reaction to occur. The filter media is composed of a coarse, hard, predominately siliceous material. This media can filter out solids and serve as a support system for the denitrifying microorganisms.

As denitrification occurs, nitrogen gas accumulates in the filter media, which increases the headloss over the headloss due to the accumulation of solids. The nitrogen gas bubbles are periodically released from the media by taking the filter off line and applying backwash water for a few minutes. This process is called the nitrogen release cycle or filter bumping. The frequency of the nitrogen release cycle is a function of both nitrate removal and a minimum acceptable time between cycles, typically less than one hour.

Usually a filter needs to be bumped once every four to eight hours, again depending on the nitrogen loading rate. The bumps are usually set on a time basis. After a bump the headloss in the filter is reduced or recovered. However, when the liquid level in the filter reaches a designated high level, signifying that the bumps are not effective in reducing headloss, a full backwash is performed on the filter. Table 6.1.5a provides a general summary of the Leopold's elimini-NITE® system as part of the Alternative 1- Existing WWTP.

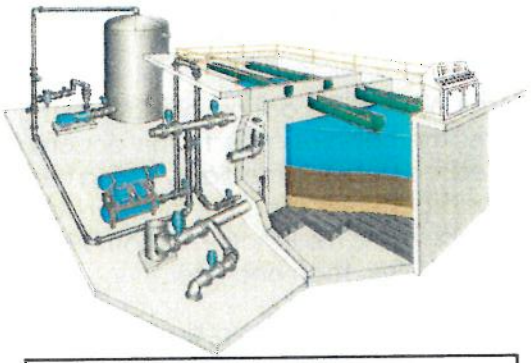
Table 6.1.5a Alternative 1 – Existing WWTP; Leopold's elimi-NITE® Summary

Parameter	Value
Number of Filters	2
Active Filtration Volume	1,152 ft^3
Total Filtration Area	192 ft^2
Area per Filter	96 ft^2
Length per Filter	12 ft
Width per Filter	8.0 ft
Media Depth	72 inch
Media Volume	576 ft^3
Loading Rate w/o Backwash (@ MMAF)	0.58 gpm/ft^2
Loading Rate w/Backwash (@ MMAF)	1.16 gpm/ft^2
Backwash Concurrent Water Rate	6.0 gpm/ft^2
Backwash Concurrent Air Rate	5.0 scfm/ft^2
Driving Head	7.0 ft

Figure 6.1.5 provides an illustration of a typical elimi-NITE® Denitrification System. The proposed system for the Borough's WWTP will be mainly comprised of two (2) filters with a surface area of 96 ft^2 each and a media depth will be of 72 inches using silica sand. The combined filter's surface area is of 12 feet wide by 16 feet long. This area does not take into account space appropriations for the mudwell tank, and mudwell pumps nor the filter's gallery which encompasses the following equipment:

1. Air Scour Blowers (2)
2. Backwash Pumps (2)
3. Electrical Room
4. Carbon Source Feed System

It is proposed to locate the denitrification filter systems' west of the existing chlorine contact tanks (refer to Appendix 1). More detailed information on the scope of supply can be found in Appendix 2.



Leopold's elimi-NITE® Denitrification System

6.1.6 – Effluent Pump Station

It is proposed to replace the existing effluent pumps in kind with new level control instrumentation (i.e. submersible transducer and back-up float level switches). Table 6.1.6 provides the process equipment to for the Effluent Pump Station's retrofit.

Table 6.1.6 – Effluent Pump Station's Retrofit Equipment

Equipment	Number	Type	Capacity
Effluent Pumps	2	Submersible Centrifugal	5 hp, 700 gpm @ 15 TDH
Level Instrumentation	1	Level Transducer	NA [1]
Level Instrumentation	2	Non-Mercury Float Switches	NA [1]

Notes: [1] Not Applicable

6.2 – Modified Ludzack-Ettinger (MLE; Alternative 2)

The following process unit equipment were considered as part of this alternative to warrant a reliable and sustainable treatment that would meet the design criteria stated in Table 6.0.1:

1. Inclusion of existing Headworks (Option A). Similar to Alternative 1, the following upgrades will be included:
    a. Provision of a Raw Wastewater Influent Screen
    b. Replacement of existing raw sewage pumps
    c. Replacement of existing level control instrumentation

2. New Headworks Building (Option B) to include the following equipment:
    a. One (1) Raw Wastewater Influent Screen
    b. Two (2) Submersible raw sewage pumps
    c. Level control instrumentation
    d. Wet Well
    e. Electrical Room
3. New Grit Removal System
4. Elimination of the existing Primary Clarifier
5. Elimination of the existing Trickling Filters
6. Inclusion of the Secondary Clarifier. Similar to Alternative 1, the following upgrades will be included:
    a. Replacement of the existing rake mechanism in kind
    b. Replacement of the existing secondary sludge pump
7. New Oxidation Ditch BNR (MLE) System
8. Inclusion of existing Chlorine Disinfection System (with no upgrades)
9. Inclusion of existing Effluent Pump Station. Similar to Alternative 1, the following upgrades will be included:
    a. Replacement of existing effluent pumps
    b. Replacement of existing level control instrumentation
10. Inclusion of existing Aerobic Digesters
11. Use of existing chemical feed system yet relocated to Grit Building

Duperon® FPSS Fine Screen

Headworks (Option B)

It is proposed this equipment in a new Headworks building to be located in the vicinity of MH #A (please refer to Appendix 1). The new headworks will be comprised of two operating floors; with the wet well, submersible pumps, and bar screen equipment located on the lower operating floor, and the washer/compactor equipment, and the electrical room located in the upper operating room. The building will have an approximate area of 600 ft^2. The proposed headworks raw influent screen was based on the Flex Rake® - Front Clean Front-Return (FPFS) fine screen as manufactured by Duperon®. Table 6.2.1 provides a general summary of the scope of work while Figure 6.2.1 provides a general illustration.

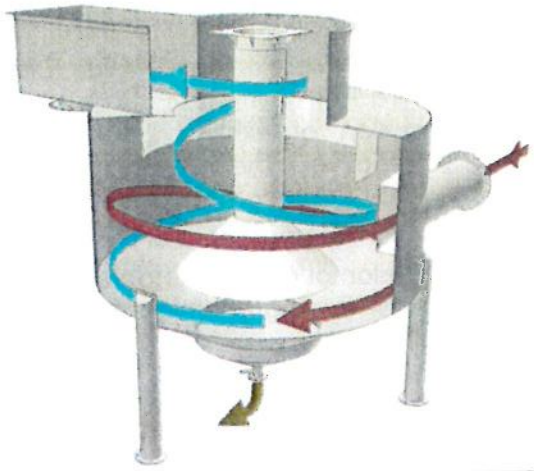
Table 6.2.1 – Headworks (Option B) Equipment

Equipment	Number	Type	Capacity
Raw Wastewater Pumps			
Raw Influent Pumps	2	Dry Pit Submersible	10 hp, 500 gpm TDH[1]
Level Instrumentation	1	Pressure Transducer	NA [1]
Level Instrumentation	2	Non-Mercury Float Switch	NA [1]
Raw Wastewater Screen			
Influent Screen	1	Bar Screen, ¼-inch, 1.66 channel width	1.04 MGD, 2.0 hp
Washer Compactor	1	Shafted Auger	0.75 hp
Conveyor	1	Shafted Auger	1.0 hp
Main Control Panel	1	PLC/Relay Based – NEMA4X	NA [2]

Notes: [1] To be determined; [2] Not Applicable

Grit Removal System

As the treatment processes of a wastewater plant have become more sophisticated, the performance of the headworks has also been emphasized. The function of a grit removal system is to remove undesirable grit and sand from the wastewater stream to protect and reduce wear on the downstream process equipment. Without the inclusion of a primary clarifier in neither of the Alternatives 2, and 3, grit will eventually accumulate in the BNR process tanks presenting with an operational cost and maintenance challenge cost over time. One proponent of this technology if the Grit King® as manufactured by Hydro International ®. The Grit King® is an all-hydraulic/non-mechanical vortex separator designed to remove grit, sediment and sand from wastewater, raw water and other liquids using vortex motion and boundary layer effects to aid gravitational settlement. The unit can be installed into the flow line, downstream of the screens, of any system where limited head is available. The unit requires no external power source, has no internal moving parts, is self-cleaning, has a compact modular construction and is virtually maintenance free. This unpowered grit management system can remove 95% of 106 µm particles or larger, preventing the expensive impacts grit abrasion and deposition.



Grit King® by Hydro International® Configuration

The accumulated grit in the grit concentrator is transported to a Grit Classifier. The Grit Classifier separates and dewaters the concentrated grit underflow from the grit concentrator, or Grit King®, producing relatively dry, dewatered solids with low organic content suitable for landfill disposal. Using a settling area and a screw conveyor, the dewatered grit is transported up an inclined trough for disposal into a dumpster. The organics, which remain in suspension, are discharged over a weir and delivered back to the Headworks for treatment.

Table 6.2.2 provides a summary and scope of supply for the proposed Grit King® for both Alternative 2 and 3 and Figure 6.2.3 provides a typical illustration of the grit concentrator.

Hydro International® Grit Classifier's Configuration

The proposed location of the Grit King® would be adjacent to the respective BNR tanks. A grit building also located nearby the Grit King®'s grit concentrator will house the grit classifier equipment and the control enclosure. Please refer to Appendix 1 for a preliminary location of the grit removal system for both Alternatives 2, 3 as well as Appendix 2 for more information of the system.

Table 6.2.2 Alternative 2, 3 – Grit King® Removal System; Summary/Scope of Supply

Parameter	**Value**
Grit King® Grit Concentrator	
Number of Tanks	1
Tank Diameter	5.0 ft
Configuration	Free Standing with Structural Support
Removal Capacity	95% removal of all grit (specific gravity 2.65) ≥ 75 microns @ average flow
Tank Construction	304 SS
Grit Classifier	
Number of Units	1
Maximum Grit Load	0.16 cy/hr @ 1 rpm
Screw Diameter	9.0 inch
Screw Drive	1.0 hp, TENV, 480V/3 phase/60 Hz
Maximum Flow Rate	100 gpm
Construction	304 SS Body
Controls	
Control Panel	1
Construction	NEMA 4X
Control Logic	Programmable Relay

MLE Description

The MLE process consists of the modification of a conventional activated sludge process where an anoxic zone is created or added upstream of the aerobic zone. The process uses an internal recycle that carries nitrates created in the nitrification process in the aerobic zone along with the mix liquor to be mixed in the influent to the anoxic zone. The amount of nitrates potentially removed in the anoxic zone depends on the recycle flow and availability of influent BOD. Figure 6.2.4 provides a typical process configuration.

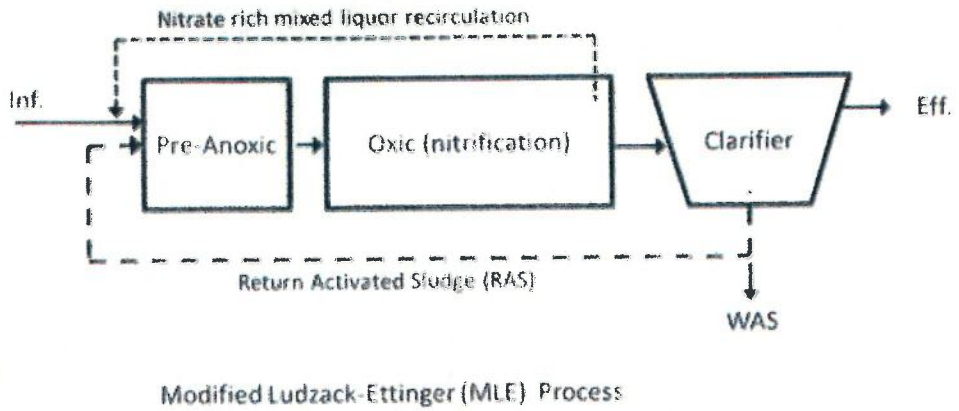


Figure 6.2.4 Modified Ludzack-Ettinger (MLE) Typical Process Configuration

Among manufacturing companies that represent an MLE process, we recommend the Bio-Denipho™ Oxidation Ditch System as manufactured by Kruger Inc. (owned by Veolia Water Solutions and Technologies). The BioDenipho™ system consists of two stage anaerobic selector followed by a dual oxidation ditch train. The system is designed to meet the effluent TN requirement of 6.0 mg/L as stated in Table 6.0.1 without the addition of supplemental carbon, internal recycle streams, and/or post anoxic zones. An anaerobic selector for biological phosphorous removal is also included in the design to provide for TP removal thus to eliminate or minimize operational cost incurred in the chemical TP removal process. The aeration rotors are sized to meet the AOR requirements should one rotor fail and a ditch need be removed from service. Additionally, should one ditch be removed from service, the process volume of a single ditch is sufficient to meet treatment objectives at minimum design temperature and up to 75% of design load. Tables 6.2.3 and 6.2.4 provide a summary and scope of supply for the proposed Alternative 2 – MLE system while Figure 6.2.5 provides a process flow diagram.

Table 6.2.3 Alternative 2 – MLE; Kruger's BIO-DENIPHO Reactor Summary

Parameter	Value
Bio-Phosphorus Tank	
Number of Trains/Number of Trains per Tank	1 / 2
Length/Width per Tank	9.0 ft / 9.0 ft
Side Water Depth	8.5 ft
Total Anoxic Volume	0.010 MG
HRT	1.5 hr
Bio-Denipho Tanks	
Number of Oxidation Ditches	2
Internal Length per Ditch	64 ft
Internal Width per Ditch	28 ft
Average Side Water Depth	7.5 ft
Total System Volume	0.186 MG
Design Anoxic / Aerobic Operating Time	30% / 70%
System HRT	27 hrs
System SBR	16 days
MLSS at 10°C	3,000 mg/L
System F/M Ratio (days-1)	0.09 $days^{-1}$
Design Sludge Yield	0.9 lbs MLSS/lb BOD_5
Waste Activated Sludge	260 lb WAS/day
Total Tankage Surface Area	4,118 ft^2

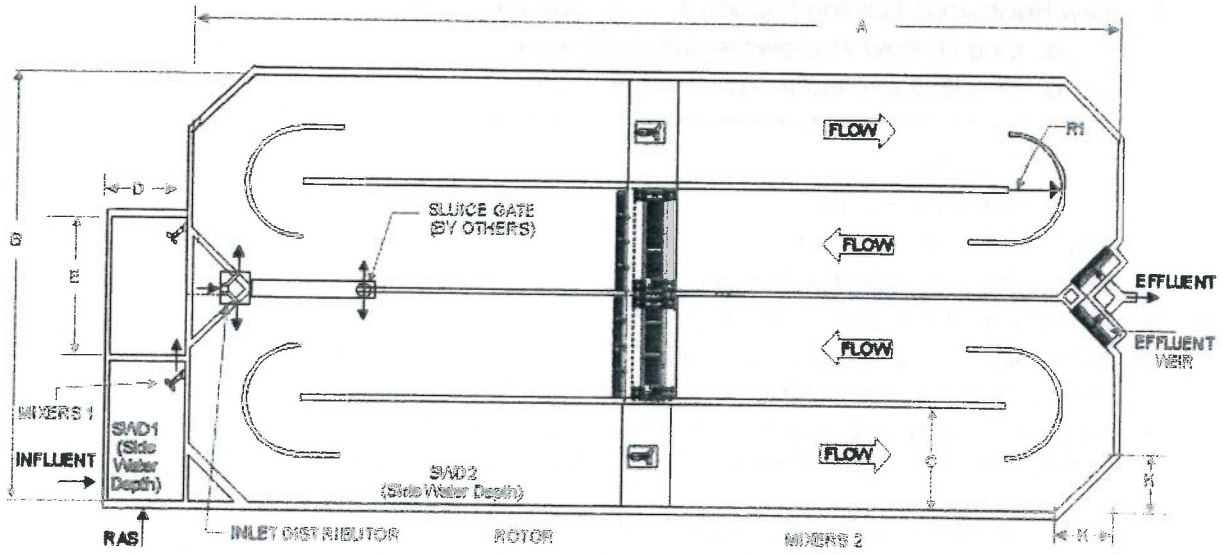


Figure 6.2.5 Kruger's BIO-DENIPHO™ Process Flow Diagram for Singlehouse Borough WWTP

Table 6.2.4 Alternative 2 – MLE; Kruger's BIO-DENIPHO Scope of Supply

Equipment	Number	Description	Capacity
Influent Flow Distributors	1	Type 200 Actuated Influent Distributor	1/12 hp
Anaerobic Selector Mixers	1	TR 21. Submersible Mixer, 304 SS Rails w/ Hoist	0.7 hp
Oxidation Ditch Mixers	2	TR 60 Submersible Mixer, 304 SS Rails w/ Hoist	2.7 hp
Brush Rotors	2	3.0 meter MIDI Rotor, 304SS Center Tube with HDG Rotor Blades	15 hp
Effluent Flow Control Weirs	2	2.5 meter automated HDG Weir	0.5 hp
Submersible Pressure Transducer	2	Ditch Liquid Level Measurement	NA
Dissolved Oxygen Probe	2	Hach LDO w/ SC200 Transmitter	NA
PLC Control Cabinet	1	NEMA 12; ControlLogix PLC; Panelview	NA

6.3 – Sequential Batch Reactor (SBR; Alternative 3)

The following process unit equipment were considered as part of this alternative to warrant a reliable and sustainable treatment that would meet the design criteria stated in Table 6.0.1:

1. Inclusion of existing Headworks (Option A). Similar to Alternative 1, the following upgrades will be included:
    a. Provision of a Raw Wastewater Influent Screen
    b. Replacement of existing raw sewage pumps
    c. Replacement of existing level control instrumentation
2. New Headworks Building (Option B) to include the following equipment:
    a. One (1) Raw Wastewater Influent Screen
    b. Two (2) Submersible raw sewage pumps
    c. Level control instrumentation
    d. Wet Well
    e. Electrical Room
3. New Grit Removal System
4. Elimination of the existing Primary Clarifier
5. Elimination of the existing Trickling Filters
6. Elimination of the Secondary Clarifier.
7. New Sequential Batch Reactor (SBR) BNR System
8. Inclusion of existing Chlorine Disinfection System (with no upgrades)
9. Inclusion of existing Effluent Pump Station. Similar to Alternative 1, the following upgrades will be included:
    a. Replacement of existing effluent pumps
    b. Replacement of existing level control instrumentation
10. Inclusion of existing Aerobic Digesters
12. Use of existing chemical feed system yet relocated to Grit Building

SBR Description

The sequencing batch reactor (SBR) process is a sequential suspended growth (activated sludge) process in which all major steps occur in the same tank in sequential order (please refer to Figure 6.3.1). There are two process configurations for SBRs: the intermittent flow (IF), depicted in Figure 6.3.1, and the continuous flow (CF) system, which does not follow any of the steps shown in Figure 6.3.1. SBRs can be designed and operated to enhance removal of nitrogen, phosphorus, and ammonia, in addition to removing TSS and BOD. The intermittent flow SBR accepts influent only at specified intervals and, in general, follows the five-step sequence. There are usually two IF units in parallel. Because this system is closed to influent flow during the treatment cycle, two units may be operated in parallel, with one unit open for intake while the other runs through the remainder of the cycles. In the continuous inflow SBR, influent flows continuously during all phases of the treatment cycle. To reduce short-circuiting, a partition is normally added to the tank to separate the turbulent aeration zone from the quiescent area.

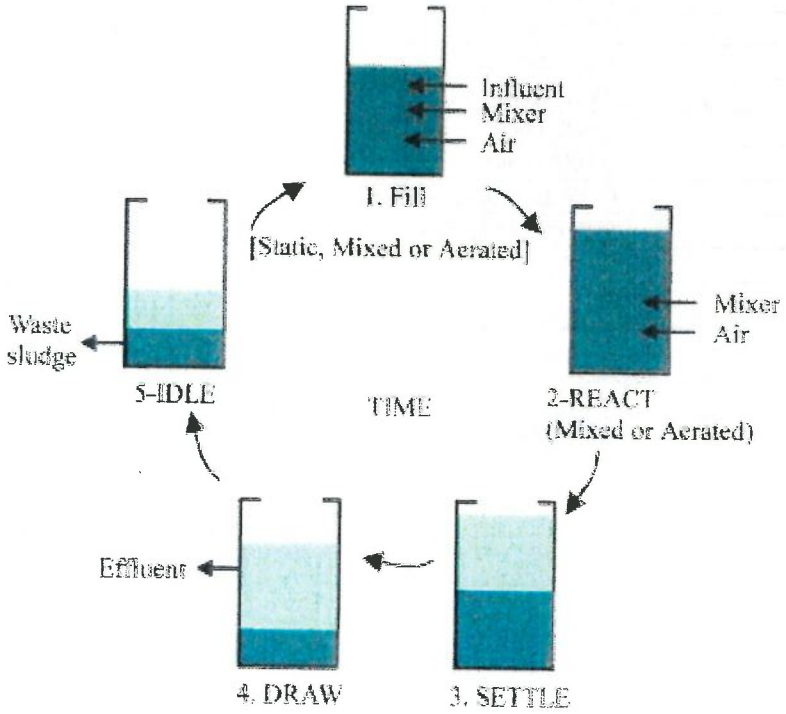


Figure 6.3.1 Sequential Batch Reactor (SBR) Typical Process Configuration

The major components of this system are a batch tank(s), aerators, mixers, decanter devices, process control system (including timers), pumps, piping, and appurtenances. Aeration may be provided by diffused air or mechanical devices. SBRs are often sized to provide mixing as well and are operated by the process control timers. Mechanical aerators have the added value of potential operation as mixers or aerators. The decanter is a critical element in the process. Several decanter

configurations are available, including fixed and floating units. At least one commercial package employs a thermal processing step for the excess sludge produced and wasted during the "idle" step. The key to the SBR process is the control system, which consists of a combination of level sensors, timers, and microprocessors. Programmable logic controllers can be configured to suit the owner's needs. This provides a precise and versatile means of control.

The type of SBR system considered for Alternative 3 is of the intermittent flow as manufactured by Aqua-Aerobics Systems, Inc. Tables 6.3.1 and 6.3.2 provide a summary and scope of supply for the proposed Alternative 3 – SBR system.

Table 6.3.1 Alternative 3 – SBR; Aqua-Aerobics Reactor Summary

Parameter	Value
SBR Tanks	
Number of Tanks	2
Length/Width per Tank	27 ft / 27 ft
Side Water Depth	20.6 ft
Total Volume	0.112 MG
System HRT	1.1 days
System SBR	21.3 days
MLSS at 10°C	4,500 mg/L
System F/M Ratio (days-1)	0.057 $days^{-1}$
Design Sludge Yield	0.78 lbs MLSS/lb BOD_5
Waste Activated Sludge	229 lb WAS/day
Equalization Tank	
Number of Tanks	2
Length/Width per Tank	27 ft / 15 ft
Side Water Depth	11.1 ft
Total System Volume	33,700 gal
Total Tankage Surface Area	2,001 ft^2

Table 6.3.2 Alternative 3 – SBR; Aqua-Aerobics Scope of Supply

Equipment	Number	Description	Capacity
SBR Tanks			
Influent Flow Valves	2	6-inch Electrically Actuated Plug Valves	115 V
Mixers	2	Endura Series Model FSS DDM Mixer	3.0 hp
Decanters	2	6x4 with fiberglass float, 304 SS Weir	2.7 hp
Transfer Pumps	2	Submersible, with Lifting Mechanism	2.4 hp
Diffusers	4	Fine Bubble, Tube Type, Retrievable	NA
Blowers	3	Sutorbilt 4H PD Blower Package	10 hp
Air Valves	2	3-inch Electrically Actuated Butterfly Valves	115 V
Dissolved Oxygen Probes	2	Hach LDO with SC200 Controller	115 V
Level Controllers	2	Pressure Transducers	115V
Level Controllers	4	Float Switches (as Back-Up)	115V
Equalization Tanks			
Transfer Pumps	3	Submersible, with Lifting Mechanism	2.4 hp
Diffusers	1	Coarse Bubble, PVC, Floor Mounted	NA
Blowers	1	Sutorbilt 3H PD Blower Package	5 hp
Level Controllers	1	Pressure Transducers	115V
Level Controllers	2	Float Switches (as Back-Up)	115V
System Control	1	NEMA 12 Control Panel, Compactlogix	

6.4 – Disinfection System Improvements

Based on the evaluation of the existing disinfection system, this system is capable of providing adequate disinfection treatment for the proposed Max Month (MMF) and Peak Hourly (PHF) Flows.

However, various recommendations were made in order to improve the efficiency of the disinfection system and extend the use of the existing CCT. A summary of these recommendations is included in Table 6.4.1 and further discussed in the paragraphs below.

Table 6.4.1 – Summary of Disinfection System Recommendations

No.	Recommendation
1	Modify High Flow Effluent Pump Control Strategy
2	Repairs to CCT
3	Chlorine Feed Pump Control
4	Future Provision for De-chlorinating
5	Future Provision for Additional Chemical Storage
6	Future Consideration for Ultraviolet Disinfection

1. Modify High Flow Effluent Pump Control Strategy

The current control strategy for the high flow effluent pump station is to operate the pumps on a continuous basis, regardless of the water level in the receiving stream. The operators shall consider revising the pump control strategy and operate the pumps manually, based the water level of the receiving stream and/or, a high water level in the CCT. This revision will increase the contact time in the CCT by reducing the flow rate though the tanks. This scenario would be typical for most flow conditions experienced at the plant. Additionally, most effluent pumps are operated after the CCT, and thus are only used when pump flow is required to ensure the system does not back-up due to rising water levels at the outfall structure.

2. Repairs to CCT

A visual inspection of the CCT concrete walls indicated areas that may require some minor non-structural concrete repairs due to spalling and deterioration on the concrete surface. It is likely that these non-structural repairs can be made as spot grout repairs.

3. Chlorine Feed Pump Control

Improved optimization of the chlorine disinfection system can be achieved by adding a simple chemical feed loop strategy. This control strategy can be achieved by flow pacing the pumps off of the plant flow meter or, by targeting the pump flow rate based on maintaining a chlorine residual set-point. Equipment that would be required to achieve this level of process control would include an on-line chlorine analyzer, an analogue signal from a flow meter, a pump controller, and/ or chemical feed pumps capable of receiving an analogue signal.

4. Future Provision for dechlorinating

Currently, the WWTP is in compliance with effluent Total Chlorine Residual (TRC) limits and requires no further need to de-chlorinate. However, should future WWTP upgrades include the conversion to a new activated sludge system, the current chlorine demand on the wastewater may change requiring the need to add more chlorine for adequate disinfection. Based on the amount of additional chlorine that may be added, the ability to de-chlorinate may be required in order to achieve compliance with the effluent TRC limit.

5. Future Provision for Additional Chemical Storage

As stated in the paragraph above, future upgrades to the biological process may require the need to add more chlorine for adequate disinfection. The operators currently add chlorine at a rate of 1 gallon per day. Future estimates indicate a dosage rate of up to 10 gallons a day may be required. Therefore, the need evaluate the provision for additional chemical storage may be required in the future.

6. Future Consideration for Ultraviolet disinfection

Future consideration for using an alternate disinfection process (such as ultraviolet disinfection) may be required if future upgrades to the WWTP include processes that require the use of additional utility water. Typically, this utility water demand is supplied by plant effluent water, or a potable water supply. In the event plant effluent water is used, the UV disinfection process may limit the inclusion of algae or other particulates that are often associated with chlorine contact tanks and require the use of downstream filters to eliminate clogging of valves, nozzles, etc.

7.0 – PRESENT WORTH ANALYSIS

A 20-year present worth analysis was completed for each of the WWTP Alternatives including Headworks Option B for Alternatives 2, and 3. The estimated opinion of probable construction costs are shown in Table 7.0.1, including a thirty (30) percent contingency and a fifteen (15) percent for engineering and administrative costs associated with the preliminary design. It does not include an allowance for the contractor's overhead and profit. The operation and maintenance costs are shown in Table 7.0.2. Details of the estimated opinion of probable construction cost can be found in Appendix 3. Appendix 4 provides details on the annual operation and maintenance costs (Appendix 2 provides the budgetary proposal information from the respective manufacturers).

Table 7.0.1 Alternatives' Estimated Opinion of Probable Construction Costs

Alternative 1a (w Denitrification)	Alternative 2 (Option A)	Alternative 2 (Option B)	Alternative 3 (Option A)	Alternative 3 (Option B)
$3,788,000	$2,795,000	$3,438,000	$3,115,000	$3,763,000

Table 7.0.2 Alternatives' Annual Operation and Maintenance Costs [1]

Description	Alternative 1a (w Denitrification)	Alternative 2 (Options A, B)	Alternative 3 (Options A,B)
Power [2]	$55,080	$71,270	$58,900
Chemicals [3]	$44,400	$11,320	$17,450
Labor [4]	$3,120	$4,680	$4,680
Maintenance [5]	$6,839	$6,118	$4,976
Total O&M	$109,440	$93,390	$86,010
20-Year O&M PW [6]	**$1,750,000**	**$1,550,000**	**$1,420,000**

Notes: [1]Disposal cost of dewatered sludge was not considered as part of the PW analysis; [2] Electric costs were based on $0.14 per kW-hr per Shinglehouse Borough Staff; [3] Based following chemical cost: MicroC $2.0/$lb_{wet}$, DelPAC $0.2/$lb_{wet}$, Sodium Hypochlorite (12.5% Solution) $3.0/gal; [4]Operator labor costs were estimated to be $30.00 per hour including benefits; [5] Assumed as a percentage of their total equipment cost using a fixed value of 0.5%; [6] Present worth costs were developed with an annual rate of inflation of 3% and an annual interest rate of 4% in Year 2017 US Dollars.

Table 7.0.3a Alternatives' Total Present Worth Comparison

Description	Alternative 1a (w Denitrification)	Alternative 2 (Option A)	Alternative 2 (Option B)	Alternative 3 (Option A)	Alternative 3 (Option B)
Capital Cost	$3,788,000	$2,795,000	$3,438,000	$3,115,000	$3,763,000
20-Year O&M	$1,750,000	$1,550,000	$1,550,000	$1,420,000	$1,420,000
Total PW	**$5,538,000**	**$4,345,000**	**$4,988,000**	**$4,535,000**	**$5,183,000**

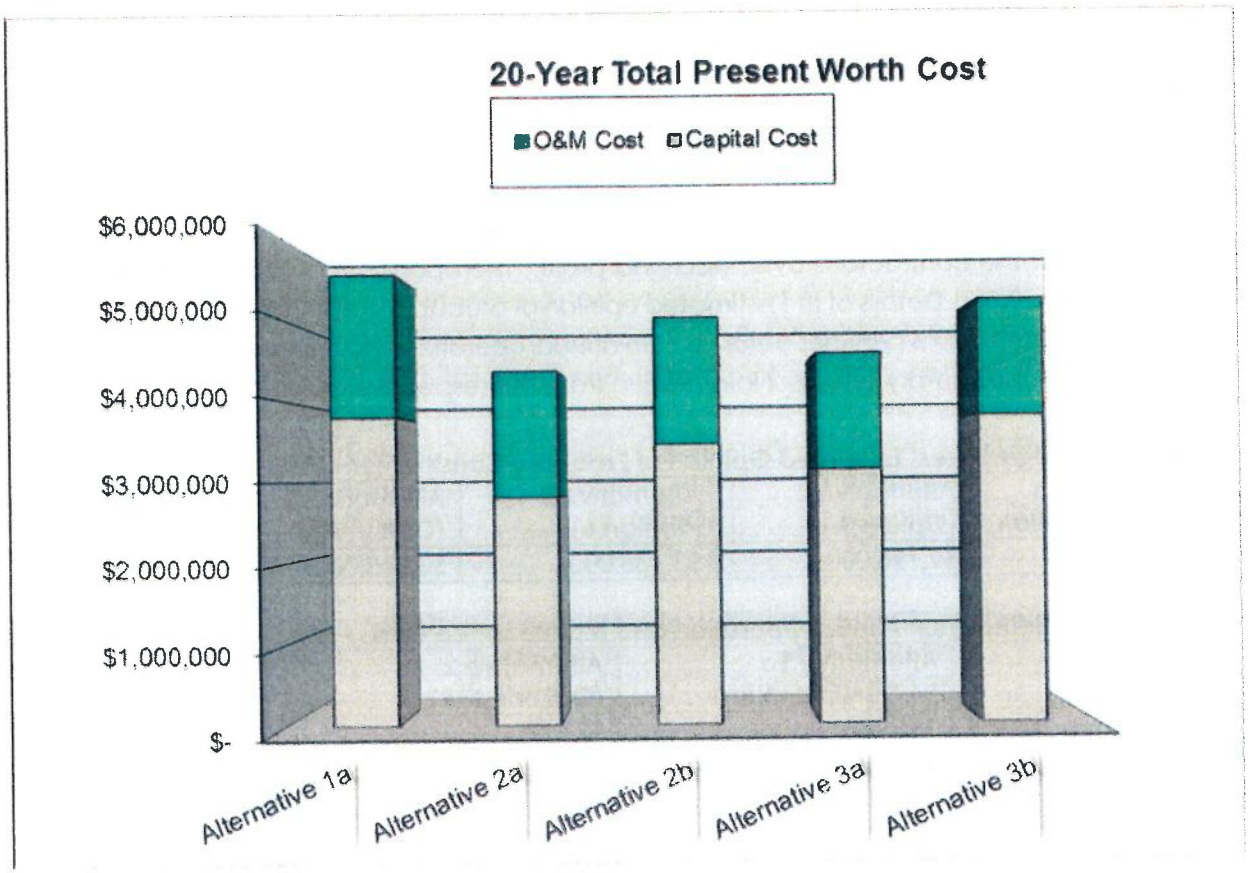


Figure 7.0.1 Shinglehouse Borough WWTP Alternatives Present Worth Comparison

From Table 7.0.1 we learned that Alternative 2, Option A, provides with the lowest capital cost and with the second lowest operation and maintenance cost ranking it No.1 with the lowest present worth. Yet, with an estimated tankage total tankage of 4,118 ft^2, this alternative requires the largest footprint among all of the alternatives. Furthermore, this alternative integrates the secondary clarifier as part of its process configuration potentially presenting a hydraulic challenge during the design and construction phases of the project.

Alternative 3, Option B, provides with the second lowest capital cost and with the lowest operation and maintenance cost ranking it No.2. Opposite to Alternative 2, the proposed SBR is almost an independent treatment plant from the existing one by just integrating its chlorine disinfection system along with the aerobic digestion system.

Alternative 1a, presents with both highest capital cost and highest operation and maintenance cost. This alternative will require a denitrification filter system if a biological nutrient removal (BNR) were to be considered in the future. As an option, if a BNR system was not to be considered or delayed for a distant future, the denitrification system could be eliminated making it the most feasible alternative, named Alternative 1b, as presented in Table 7.03b.

Table 7.0.3b Alternatives' Total Present Worth Comparison

Description	Alternative 1a (w/Denitrification)	Alternative 1b (w/o Denitrification)	Alternative 2 (Option A)	Alternative 3 (Option A)
Capital Cost	$3,788,000	$1,480,000	$2,795,000	$3,115,000
20-Year O&M	$1,750,000	$1,230,000	$1,550,000	$1,420,000
Total P&W	**$5,538,000**	**$2,710,000**	**$4,345,000**	**$4,535,000**

8.0 – FINANCIAL CONSIDERATION

USDA

The Borough meets the income requirements to be funded under USDA's poverty category, meaning the Borough qualifies for a current interest rate of 1.375% for 40 years and grant up to 75%. In order to receive 75% grant DEP must agree that there is a public health hazard. USDA also requires that the debt service percentage of the user rate to equal 1% or less of their annual income in place of 1.5%. Under this scenario, the user rate is roughly $366/year (not including inflation for O&M costs).

If DEP cannot make this certification or if the Borough has issues with the 1.5% rule, then the Borough would likely receive 45% grant. Under this scenario, the user rate is roughly $402/year.

Option A1 - USDA Financing with 75% grant	
Total Project Cost:	$2,795,000
Less CDBG Grant:	$ (979,000)
Amount to be financed by USDA	**$1,816,000**
Total Number of EDUs	522
Annual Collection Operation & Maintenance Costs:	$ 175,392
Yearly Operation & Maintenance Costs:	$ 175,392
subtotal Operation & Maintenance Costs per EDU: [1]	$ 336
USDA Funding: 40 Year Loan @ 1.375%:	
Amount Financed:	$ 1,816,000
Max USDA Grant Award of 75%	$ 1,362,000
Amount Financed by Loan:	$ 454,000
Interest Rate	1.375%
Term (years)	40.00
Assumed Grant to get down to Affordability Limit	$ 1,362,000
Yearly Debt Service per EDU:	$ 30
Total Annual Cost Per EDU	
Annual O&M Cost	$ 336
Annual USDA Debt Service	$ 30
Total Annual User Fee/EDU	$ 366
Total Interest Over Term of Loan	$170,500
(1) Assumes 5% deficiency rate on monthly user fees	
Total Annual Debt Service Per USDA 1.5% Rule	$338
Total Annual Debt Service Per EDU Based Upon Above Financing	$359

Option A2 - USDA Financing with 45% grant	
Total Project Cost:	$2,795,000
Less CDBG Grant:	$ (979,000)
Amount to be financed by USDA	**$1,816,000**
Total Number of EDUs	522
Annual Collection Operation & Maintenance Costs:	175392
Yearly Operation & Maintenance Costs:	175392
subtotal Operation & Maintenance Costs per EDU: [1]	336
USDA Funding: 40 Year Loan @ 1.375%:	
Amount Financed:	$ 1,816,000
Max USDA Grant Award of 75%	$ 817,200
Amount Financed by Loan:	$ 998,800
Interest Rate	1.375%
Term (years)	40.00
Assumed Grant to get down to Affordability Limit	$ 817,200
Yearly Debt Service per EDU:	$ 66
Total Annual Cost Per EDU	
Annual O&M Cost	$ 336
Annual USDA Debt Service	$ 66
Total Annual User Fee/EDU	$ 402
Total Interest Over Term of Loan	$375,099

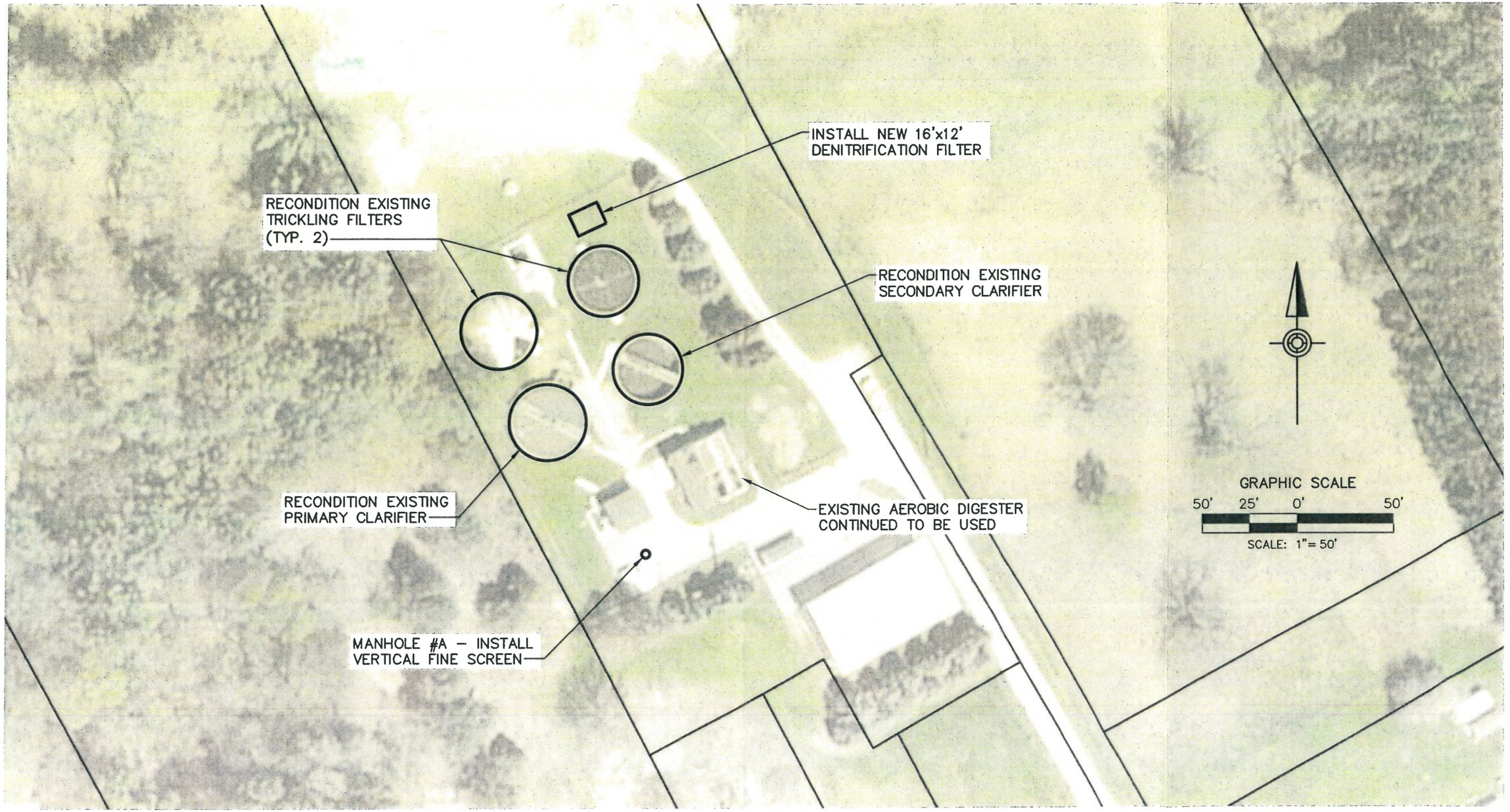
PENNVEST

The Household Median Income from the PA Data Center for Shinglehouse Borough is approximately $33,750. The current annual "Affordable Rate" for the Borough is calculated at $371.25 annually, or approximately $30.94 per month; however recent information suggests that the "Affordable Rate' is going to increase to $400 - $450 or $33.33 – $37.50 per month.

If 60% grant funding and a 30-year loan at 1% interest can be achieved from PENNVEST, than the annual user rate of $393 per EDU or $32.75 per month.

Option B1 - PENNVEST Financing	
Total Project Cost:	$ 2,795,000
Less CDBG Grant:	$ (979,000)
Amount to be financed by PENNVEST	**$ 1,816,000**
Total Number of EDUs	522
Annual Collection Operation & Maintenance Costs:	$ 175,392
subtotal Operation & Maintenance Costs:	$ 175,392
subtotal Operation & Maintenance Costs per EDU: [(1)]	$ 336
PENNVEST Annual Affordability Rate for Municipality	$ 400
Less Annual O&M Cost	$ 336
Remaining Annual Debt Service Factored into PENNVEST Offer	$ 64
PENNVEST Funding:	
Total PENNVEST Funding Need:	$ 1,816,000
Total PENNVEST Grant Award	$ 1,080,520
Amount Financed by Loan:	$ 735,480
Interest Rate	1.000%
Term (years)	30.00
Assumed Grant to get down to Affordability Limit	$ 1,080,520
Yearly Debt Service per EDU:	$ 57
Total Annual Cost Per User	
Annual O&M Cost	$ 336
Annual PENNVEST Debt Service	$ 57
Total Annual User Fee	$ 393
Total Interest Over Term of Loan	$164,471

(1) Assumes 5% delinquency rate on monthly user fees



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HRG
Herbert, Rowland & Grubic, Inc.
Engineering & Related Services
AN EMPLOYEE-OWNED COMPANY

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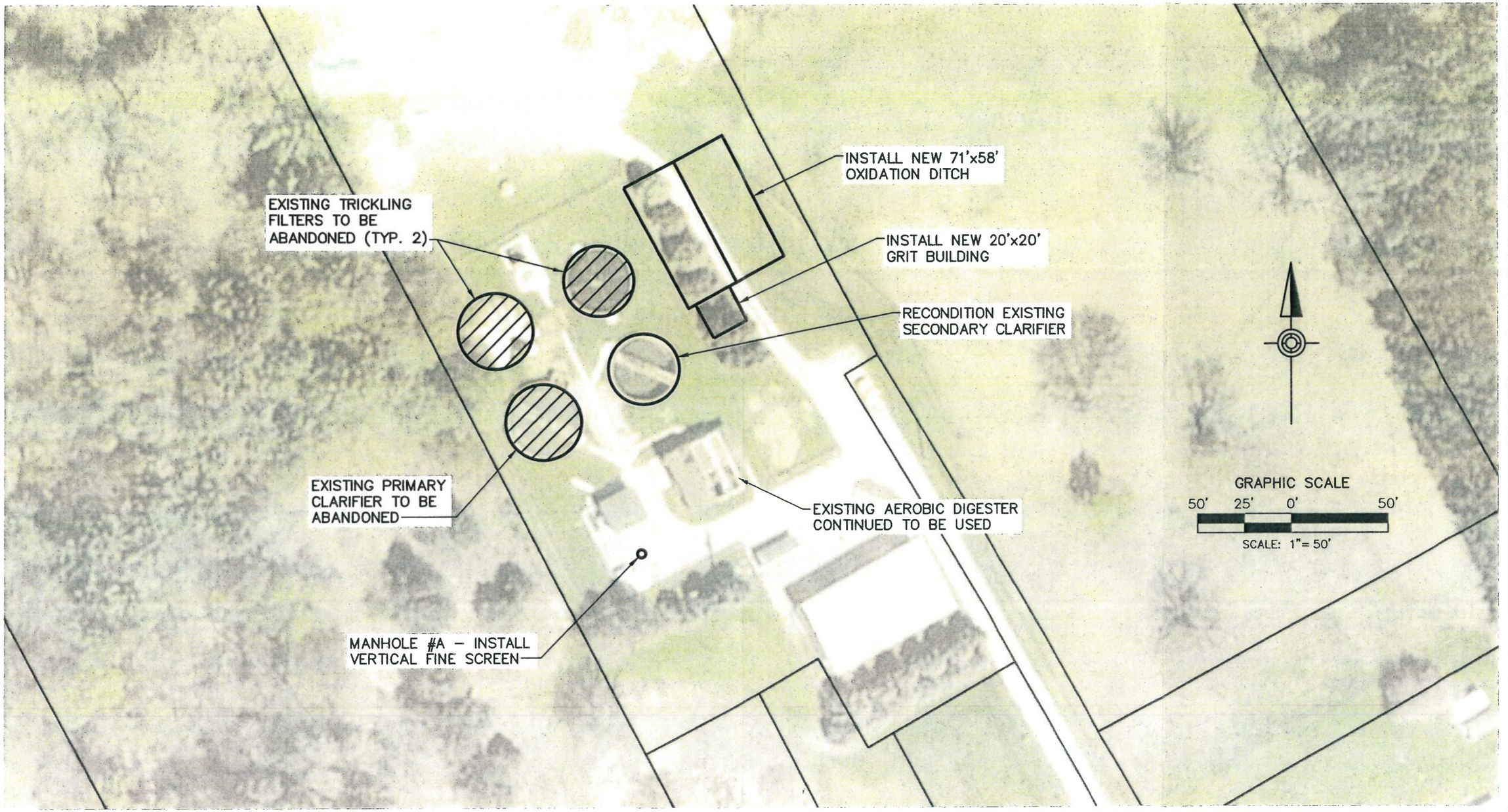
www.hrg-inc.com

SHINGLEHOUSE BOROUGH
P.O. BOX 156
SHINGLEHOUSE, PA 16748

ALTERNATIVE 1
EXISTING WWTP
FOR
SHINGLEHOUSE BOROUGH

PROJ. MGR. – JTF	
DESIGN– RES	
CADD– RSF	
CHECKED–	
SCALE– 1" = 50'	
DATE– OCT. 2016	

DRAWING NO. 1
SHEET NO. 1 OF 1
PROJECT 004004.0426



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SHINGLEHOUSE BOROUGH
P.O. BOX 156
SHINGLEHOUSE, PA 16748

ALTERNATIVE 2 - OPTION A
MLE (OXIDATION DITCH)
FOR
SHINGLEHOUSE BOROUGH

PROJ. MGR. – JTF	
DESIGN– RES	
CADD– RSF	
CHECKED–	
SCALE– 1" = 50'	
DATE– OCT. 2016	

DRAWING NO. 1
SHEET NO. 1 OF 1
PROJECT 004004.0426

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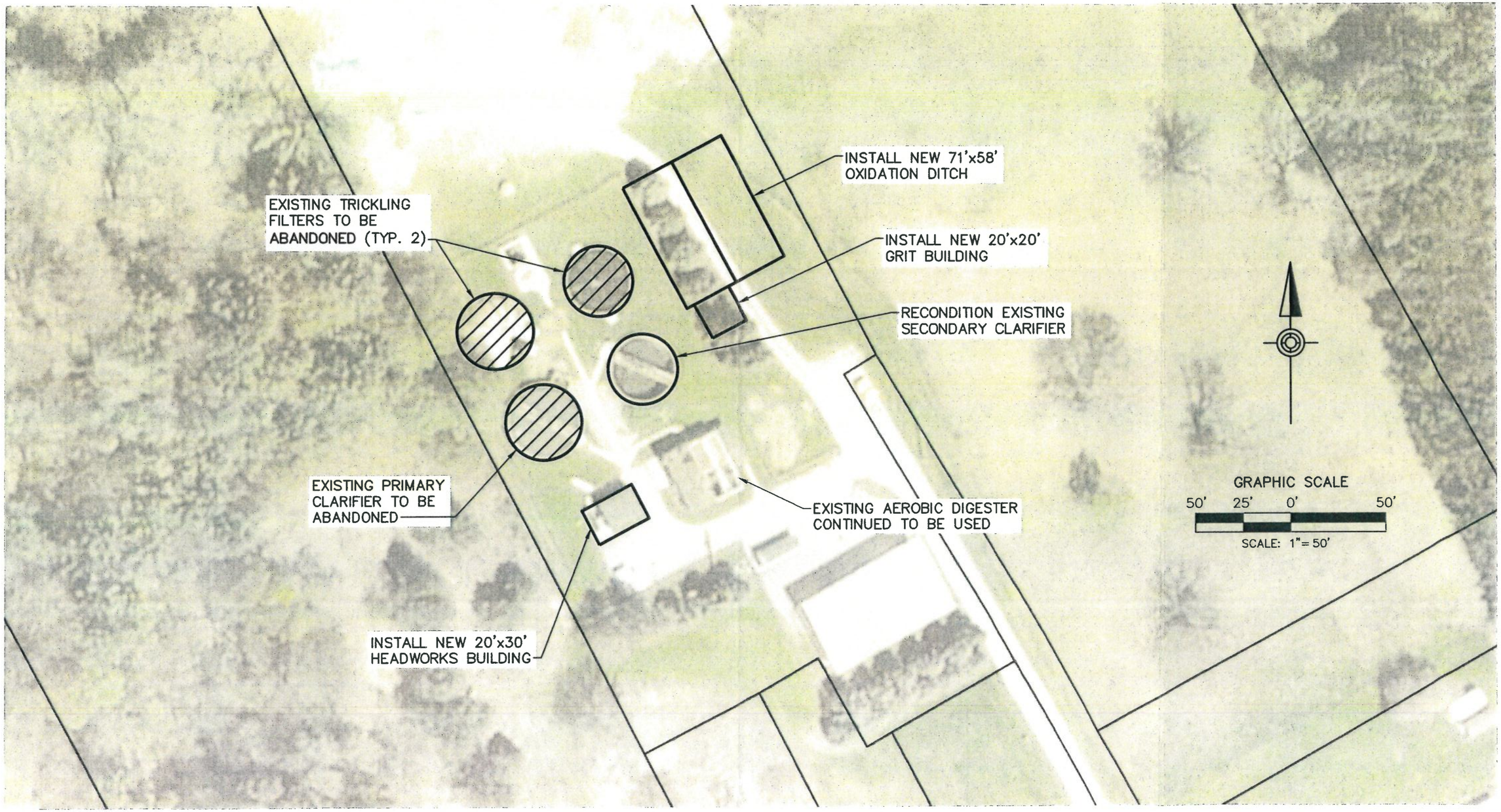

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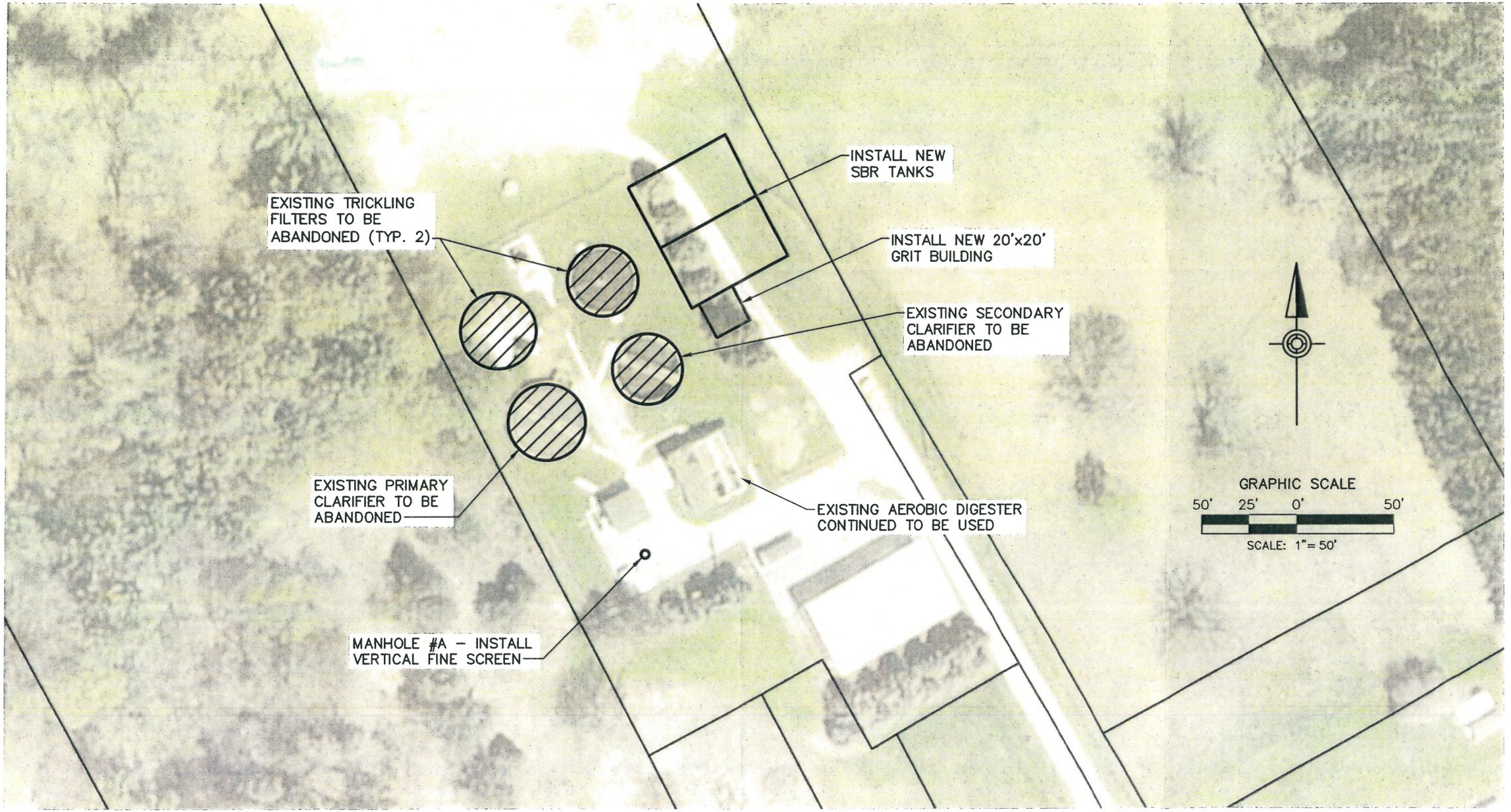
SHINGLEHOUSE BOROUGH
P.O. BOX 156
SHINGLEHOUSE, PA 16748

ALTERNATIVE 2 - OPTION B
MLE (OXIDATION DITCH)
FOR
SHINGLEHOUSE BOROUGH

PROJ. MGR. – JTF	
DESIGN– RES	
CADD– RSF	
CHECKED–	
SCALE– 1" = 50'	
DATE– OCT. 2016	

DRAWING NO. 1
SHEET NO. 1 OF 1
PROJECT 004004.0426



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SHINGLEHOUSE BOROUGH
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SHINGLEHOUSE, PA 16748

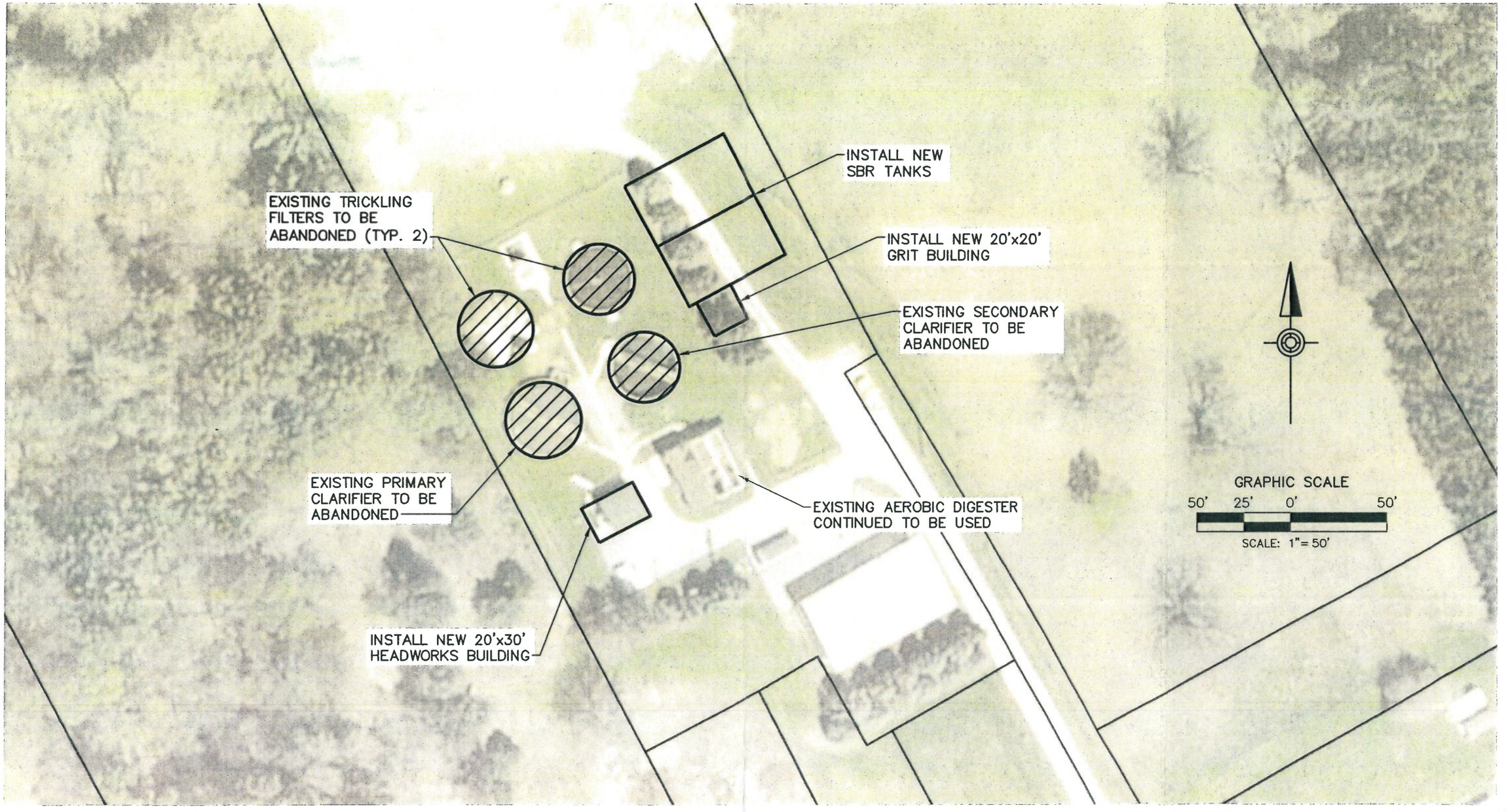
ALTERNATIVE 3 - OPTION A
SBR
FOR
SHINGLEHOUSE BOROUGH

PROJ. MGR. – JTF	
DESIGN– RES	
CADD– RSF	
CHECKED–	
SCALE– 1" = 50'	
DATE– OCT. 2016	

DRAWING NO. 1

SHEET NO. 1 OF 1

PROJECT 004004.0426



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ALTERNATIVE 3 - OPTION B
SBR
FOR
SHINGLEHOUSE BOROUGH

PROJ. MGR. – JTF	
DESIGN– RES	
CADD– RSF	
CHECKED–	
SCALE– 1" = 50'	
DATE– OCT. 2016	

DRAWING NO. 1

SHEET NO. 1 OF 1

PROJECT 004004.0426

PROCESS DESIGN REPORT

AQUA-AEROBIC SYSTEMS, INC.

A Metawater Company

SHINGLEHOUSE BOROUGH PA

Design#: 145226

Option: Preliminary SBR & PostEq Design

Designed By: Sophia Bainbridge on Thursday, August 25, 2016

Pre-SBR

- 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.

- 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.

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

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

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

- To achieve the effluent monthly average total phosphorus limit, the biological process and chemical feed systems 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 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.

- pH monitoring of the biological reactor is required when adding metal salts.

Anticipated

- The effluent total nitrogen limit of 6 mg/l is assumed to be comprised of 2 mg/l organic nitrogen, 3 mg/l NOx-N, and 1 mg/l NH3-N.

- The ability to meet the anticipated effluent organic nitrogen concentration is contingent upon the system's ability to hydrolyze the influent organic nitrogen to NH3-N. A certain fraction of the organic nitrogen may be refractory and, therefore, will not be biologically converted.

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.

- 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.

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

AquaSBR - Sequencing Batch Reactor - Design Summary

DESIGN INFLUENT CONDITIONS

Avg. Design Flow = 0.16 MGD = 606 m3/day

Max Design Flow = 0.35 MGD = 1325 m3/day

DESIGN PARAMETERS

	Influent	mg/l	Effluent Required	<= mg/l	Anticipated	<= mg/l
Bio/Chem Oxygen Demand:	BOD5	220	BOD5	10	BOD5	10
Total Suspended Solids:	TSS	200	TSS	10	TSS	10
Total Kjeldahl Nitrogen:	TKN	40	TKN	3	TKN	3
Ammonia Nitrogen:	--	--	NH3-N	1	NH3-N	1
Oxidized Nitrogen:	--	--	NOx-N	3	NOx-N	3
Total Nitrogen:	--	--	TN	6	TN	6
Total Inorganic Nitrogen:	--	--	TIN	4	TIN	4
Phosphorus:	Total P	8	Total P	0.80	Total P	0.80

SITE CONDITIONS

	Maximum		Minimum		Design		Elevation (MSL)
Ambient Air Temperatures:	85 F	29.4 C	30 F	-1.1 C	85 F	29.4 C	1,490 ft
Influent Waste Temperatures:	68 F	20.0 C	50 F	10.0 C	68 F	20.0 C	454.2 m

SBR BASIN DESIGN VALUES

No./Basin Geometry: = 2 Square Basin(s)

Freeboard: = 2.0 ft = (0.6 m)

Length of Basin: = 27.0 ft = (8.2 m)

Width of Basin: = 27.0 ft = (8.2 m)

Water Depth			Basin Vol./Basin		
Min	= 12.6 ft	= (3.8 m)	**Min**	= 0.069 MG	= (260.1 m³)
Avg	= 16.3 ft	= (5.0 m)	**Avg**	= 0.089 MG	= (335.8 m³)
Max	= 20.6 ft	= (6.3 m)	**Max**	= 0.112 MG	= (425.7 m³)

Number of Cycles: = 4 per Day/Basin (advances cycles beyond MDF)

Cycle Duration: = 6.0 Hours/Cycle

Food/Mass (F/M) ratio: = 0.057 lbs. BOD5/lb. MLSS-Day

MLSS Concentration: = 4500 mg/l @ Min. Water Depth

Hydraulic Retention Time: = 1.109 Days @ Avg. Water Depth

Solids Retention Time: = 21.3 Days

Est. Net Sludge Yield: = 0.780 lbs. WAS/lb. BOD5

Est. Dry Solids Produced: = 229.0 lbs. WAS/Day = (103.9 kg/Day)

Est. Solids Flow Rate: = 100 GPM (2746 GAL/Day) = (10.4 m³/Day)

Decant Flow Rate @ MDF: = 729.0 GPM (as avg. from high to low water level) = (46.0 l/sec)

LWL to CenterLine Discharge: = 1.1 ft = (0.3 m)

Lbs. O2/lb. BOD5 = 1.25

Lbs. O2/lb. TKN = 4.60

Actual Oxygen Required: = 612 lbs./Day = (277.8 kg/Day)

Air Flowrate/Basin: = 219 SCFM = (6.2 Sm3/min)

Max. Discharge Pressure: = 10.5 PSIG = (72 KPA)

Avg. Power Required: = 186.7 KW-Hrs/Day

POST-SBR EQUALIZATION DESIGN PARAMETERS

Avg. Daily Flow (ADF):	= 0.16 MGD	= (606 m^3/day)
Max. Daily Flow (MDF):	= 0.35 MGD	= (1,325 m^3/day)
Decant Flow Rate from (Qd):	= 729 gpm	= (2.8 m^3M)
Decant Duration (Td):	= 60 min	
Number Decants/Day:	= 8	
Time Between Start of Decants:	= 180 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 = 29,157 gal = (3,898.0 ft^3) = (110.4 m^3)

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:	= 27.0 ft	= (8.2 m)			
Width of Basin:	= 15.0 ft	= (4.6 m)			
Min. Water Depth:	= 1.5 ft	= (0.5 m)	**Min. Basin Vol. Basin:**	= 4,544.0 gal	= (17.2 m^3)
Max. Water Depth:	= 11.1 ft	= (3.4 m)	**Max. Basin Vol. Basin:**	= 33,700.7 gal	= (127.6 m^3)

POST-SBR EQUALIZATION EQUIPMENT CRITERIA

Mixing Energy with Diffusers:	= 15 SCFM/1000 ft^3	
SCFM Required to Mix:	= 68 SCFM/basin	= (115 Nm^3/hr/basin)
Max. Discharge Pressure:	= 5.4 PSIG	= (37.16 KPA)
Max. Flow Rate Required Basin:	= 243 gpm	= (0.920 m^3/min)
Avg. Power Required:	= 39.3 kW-hr/day	

AquaSBR

Influent Valves

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

- 6 inch electrically operated plug valve(s).

Mixers

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

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

Mixer Mooring

2 Mixer restrained mooring assembly(ies) consisting of:

- Galvanized steel restrained mooring frame(s).
- #12 AWG-four conductor electrical service cable(s).
- Vinyl electrical cable float(s).
- Electrical cable strain relief grip(s), 2 eye, wire mesh.
- 4" Schedule 40 galvanized restrained mooring post(s) with base plate.

Decanters

2 Decanter assembly(ies) consisting of:

- 6x4 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 wired into a NEMA 4X stainless steel junction box with terminal strips for the single phase, 60 hertz actuator and limit switches.
- 8 inch diameter decant hose assembly.
- 4" schedule 40 galvanized steel mooring post.
- 8 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.
- 304 stainless steel upper guide bar bracket(s).
- 304 stainless steel slide rail assembly(ies).

Retrievable Fine Bubble Diffusers

4 Retrievable Fine Bubble Diffuser Assembly(ies) consisting of:

- 10 diffuser tubes consisting of two flexible EPDM porous membrane sheaths mounted on a rigid support pipe with 304 stainless steel band clamps.
- 304 stainless steel manifold weldment.
- 304 stainless steel leveling angles.
- 304 stainless steel leveling studs.
- Galvanized vertical support beam.
- Galvanized vertical air column assembly.
- Galvanized upper vertical beam and pulley assembly.
- Galvanized top support bracket.
- 3" EPDM flexible air line with 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.

- Brace angles.

1 Diffuser Electric Winch(es) will be provided as follows:

- Portable electric winch.

Positive Displacement Blowers

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

- Sutorbilt 4H Positive Displacement Blower Package with common base, V-belt drive, enclosed drive guard, pressure gauge, pressure relief valve, and vibration pads.
- 304 stainless steel anchors.
- 10 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:

- 3 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).
- 304 stainless steel anchors.

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

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

Instrumentation

2 Dissolved Oxygen Assembly(ies) consisting of:

- Hach LDO dissolved oxygen probe with replaceable sensor cap and electric cable. Probe includes stainless steel stationary bracket and retrievable pole probe mounting assembly. One (1) probe per basin.
- Hach SC200 controller and display module(s).

AquaSBR: Post-Equalization

Transfer Pumps/Valves

3 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.
- 304 stainless steel upper guide bar bracket(s).
- Manual plug valve(s).
- 3 inch diameter swing check valve.
- Set(s), 2 inch diameter 304 stainless steel slide rails.

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.
- 304 stainless steel anchors.

Positive Displacement Blowers

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

- Sutorbilt 3H Positive Displacement Blower Package with common base, V-belt drive, enclosed drive guard, pressure gauge, pressure relief valve, and vibration pads.
- 304 stainless steel anchors.
- 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).
- 304 stainless steel anchors.

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

- Float switch(es).
- Float switch mounting bracket(s).
- 304 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).
- Allen Bradley Compactlogix programmable controller.
- Operator interface(s).
- Remote Access Ethernet Modem.
- Pump seal leak relay(s).

AQUA-AEROBIC SYSTEMS, INC.

Project E-Mail

Correspondence ID#: AAE-119095

Attention: David Lounsbury
Company: Envirep/TLC Environmental, Inc.
E-Mail: tlcenvironmental@aol.com
From: Sophia Bainbridge
Project: SHINGLEHOUSE BOROUGH PA

Date: August 22, 2016
Phone#: 717/299-3596

Reference:

Dave,

Please review the attached preliminary design (Design # 145226) for the Shinglehouse Borough project in PA. The design consists of two (2) concrete 27 ft x 27 ft AquaSBR®, Sequencing Batch Reactor, systems with one commonwalled 27 ft x 15 ft post-equalization basin. The design is able to process an average design flow of 160,000 gpd and a peak flow of 350,000 gpd. As requested, RFB diffusers are included in the SBR.

Preliminary budget pricing for the recommended equipment (the SBR and post-eq) in this design, including freight to the job site and our standard start-up supervision services, is $438,096.

Breakout pricing for the post-equalization basin in this design is $45,180.

Please let me know if you have any questions or need additional information.

Best regards,

Sophia Bainbridge
Application Engineer
sbainbridge@aqua-aerobic.com

CC: Aqua-Aerobic Systems, Inc.
Tamera Knapp / TKnapp@aqua-aerobic.com

Aqua-Aerobic Systems, Inc.
Bernie Eiswert / BEiswert@aqua-aerobic.com

Aqua-Aerobic Systems, Inc.
Joann Riedl / JRiedl@aqua-aerobic.com

BRENTWOOD

8/18/2016

WATER TECHNOLOGY GROUP

Technical Data Summary[1]

PROJECT: WG02343_Shinglehouse Borough 1 of 2 TFs in parallel
ENGINEERING FIRM:
ENGINEERS NAME:
REPRESENTATIVE FIRM:
REPRESENTATIVE: ph:
fax:
PROJECT DESCRIPTION: A new circular-trickling-filter tower design is proposed using CF-1900 media for CBOD & NH3-N removal. Tower depth is 5(ft) and tower plan view is 35 (ft) dia. The influent flow rate to this filter is 0.08 mgd, CBOD load would average 16.85 lbs/10^3 ft3-day, and the wetting rate 0.25 gal/ft2-min, design temperature was 20 deg. C., Clarified effluent result.

Wastewater Influent & Effluent Data:	PRIMARY-TREATED DOMESTIC WW	Primary Effluent	Required Effluent	Clar. Eff. (est.)
Wastewater Type:		Domestic Wastewater		
Flow, mgd (l/sec.):	0.08 (3.51)			
CBOD5 (mg/l):	220	121	10.0	18.5
NH3-N (mg/l):	40.0	40.0	1.00	3.0
TSS (mg/l):	220	73	10	30.0

Filter System Configuration:

Treatment Objective	CBOD & NH3-N removal
No. of Trains	1
No.of Filters	1

System Configuration

1 Filter	Tower Diameter	Depth (ft)	Media Type	A_s	Volume
Tower Dimensions, ft (m):	35 (10.7)	5 (1.5)	CF-1900	48 ft2/ft3 (157) m2/m3	4794 ft3 (136 m3)
			Total Volume of Tower(s):		4794 (ft3)

Process Information:

Purpose of Biological Filter:	CBOD,R & NH3-N,R
Design Temp., deg. F (deg. C):	68 (20)
Recycle Ratio (R):	3.31
Hydraulic Load, (Qt, gpm/ft2 (l/m2-sec)):	0.25 (0.17)
Org. Load, lbs/10^3ft3-day (kg/m3-day):	16.85 (0.27)
NH3-N Load, lbs/day (kg/day):	27 (12)
NH3-N Load, lbs/10^3ft3-day (gms/m3-day):	5.57 (89.41)
NH3-N, R Cap. at Conditions, lbs/day (kg/day):	38 (17)
NH3-N T-F Eff, lbs/day (kgs/day):	2 (1)
Vent Rate Each Filter, ft3/min (m3/min) =	593 (17)

Process Load Data:

Raw WW Load/system, lbs/day (kg/day):	147 (67)
CBOD Load/Trickling Filter, lbs/day (kg/day):	81 (37)
CBOD Removed in T-F, lbs/day (kgs/day):	68 (31)
CBOD, T-F effluent, lbs/day (kg/day):	12 (6)

(1) These calculations are completed as a courtesy. Brentwood Industries does not provide nor accept any responsibility for performance or process warranties as part of this offering, whether expressed or implied. We recommend that a professional engineer provide detailed structural and process designs.

Hydro International

Proposal Package

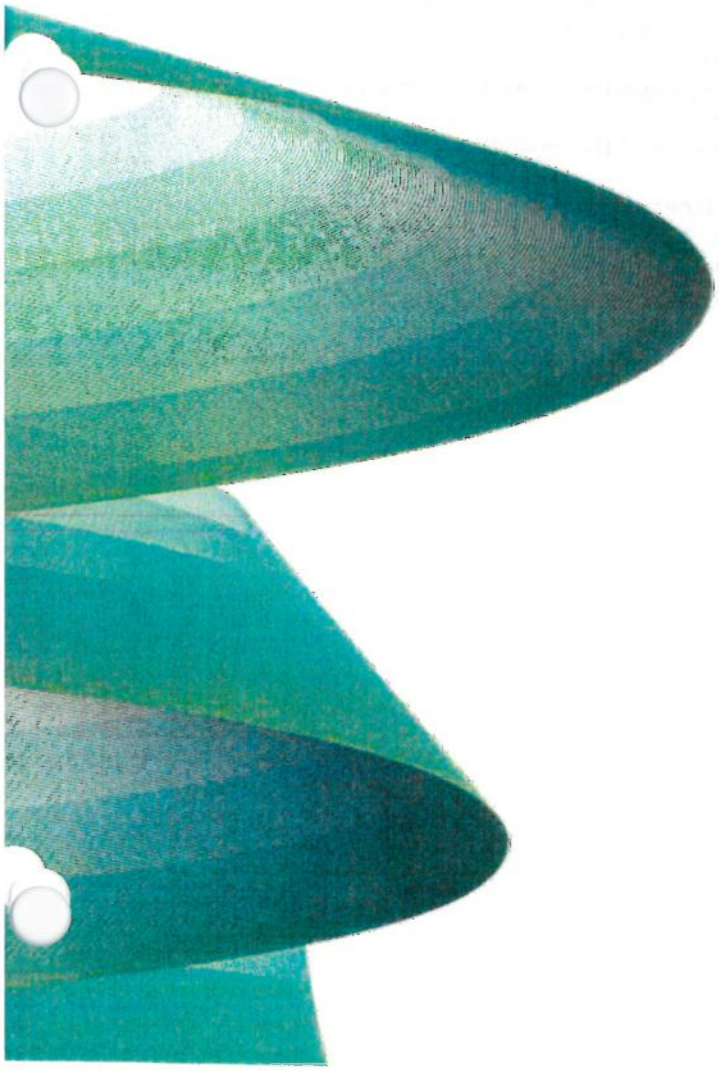
Grit Removal System

Shinglehouse Borough, PA WWTP

Engineer: Herbert, Rowland & Grubic, Inc.

Representative: Sherwood Logan & Associates, Inc.

Manufacturer: Hydro International
2925 NW Aloclek Suite 140 · Hillsboro, OR 97124
(503) 615-8130 ph · (503) 615-2906 fax · www.hydro-int.com



Water & Wastewater Solutions
Grit Removal at its Finest...®

Hydro International

September 1, 2016

Mr. Agustin E. Conesa, PE, BCEE
Herbert, Rowland & Grubic, Inc.
369 East Park Drive
Harrisburg, PA 17111

RE: Headworks Grit Control & Dewatering System
Shinglehouse Borough, PA WWTP
File #16_11_0120A

Dear Mr. Conesa:

Thank you for your interest in Hydro International. We are pleased to present our proposal for a Grit King® Grit Removal, Classification, Washing, and Dewatering System. Hydro International is dedicated to providing innovative, high performance grit removal equipment through superior engineering, high-quality products and unmatched customer service. Our extensive experience includes thousands of installations throughout the world.

Grit is continually introduced into collection systems, but is not uniformly carried to treatment facilities. As flows increase, the grit load entering the plant elevates. Once in the treatment plant, where velocities are slower than in the collection system, grit will deposit in processes, disrupting systems, decreasing equipment longevity, and increasing maintenance costs. The Grit King® Grit Removal System offers many benefits over conventional grit removal systems including:

- Removing fine grit protects equipment and processes from abrasive wear and sedimentation
- All-hydraulic design with no moving parts, minimizing operating and maintenance costs
- Small footprint system capable of high efficiency solids capture and removal
- Robust design allowing long component life with minimal wear
- Complete grit system with no weak link through capture to washing/classification to dewatering
- Minimal headloss at peak flows fits most existing flow profiles
- Structured flow ensures maximum retention time and full utilization of tank volume

We sincerely appreciate your interest in our equipment and look forward to working with you on this project. As you progress with the design, we can quickly generate CAD drawings, budget updates, and specifications as well as review equipment layouts and specifications for your particular application. Reference lists are available through your local representative. If you have any questions or concerns, do not hesitate to contact us.

Regards,
Hydro International

Kelly Rini
Applications Engineer

Hydro International – Water & Wastewater
2925 NW Aloclek Suite 140, Hillsboro, OR 97124
Tel: (503) 615-8130 Fax: (503) 615-2906 Web: www.hydro-int.com

Performance Objective

Hydro International is pleased to propose the following Grit King® grit removal, washing, and dewatering system to be installed in an existing plant which has flows of 0.16 mgd average and 0.35 mgd peak. Each component of the grit removal system is designed to remove 95% of all grit 106 micron or better at the component flows listed below.

Proposed Equipment Summary

Grit King® Grit Concentrator

The Grit King® is an all-hydraulic/non-mechanical vortex separator designed to remove grit, sediment and sand from wastewater, raw water and other liquids using vortex motion and boundary layer effects to aid gravitational settlement. The unit can be installed into the flow line, downstream of the screens, of any system where limited head is available. The unit requires no external power source, has no internal moving parts, is self-cleaning, has a compact modular construction and is virtually maintenance free.

Quantity:	1
Size:	5' diameter
Configuration:	Free Standing with Support Structure
Performance:	95% removal of all grit (specific gravity 2.65) ≥ 106 microns @ peak flow
Performance:	95% removal of all grit (specific gravity 2.65) ≥ 75 microns @ average flow
Peak Flow/Unit:	0.35 mgd with 3" headloss
Average Flow/Unit:	0.16 mgd with 1" headloss
Depth of flow in Effluent channel @ Peak/Average:	4"/3"
Influent Connection:	6" flanged pipe
Effluent Connection:	12" channel
Underflow Connection:	3"
Underflow Flow Control:	3" Hydro-Brake® SXV type Vortex Valve
Underflow Flow Rate:	75 gpm
NPW Connection:	1" NPT
NPW Requirement/Unit (for 2-4 min. every hour):	Intermittent 50 gpm @ 50 psig
Grit King Material of Construction:	304 SS
Support Structure Material of Construction:	304 SS
Weight Dry/Wet (approximate):	3,100/7,200 lbs

Grit Classifier

The Grit Clasifier uses a scew auger to simultaneously wash and dewater grit. The unit incorporates a large clarifier area and a slow turning spiral to reatin fine grit particles. The Grit Classifier dewaters and retains settleable high-density solids from municipal grit slurries or industrial abrasive slurries. The unit is capable of producing dry grit with low organic content suitable for landfill disposal.

Quantity:	1

Maximum Grit Load:	0.16 cy/hr @ 1 rpm
Screw Diameter:	9"
Maximum Flow Rate:	100 gpm
Motor:	1.0 hp, TENV, 480V/3 phase/60 Hz
Overflow Connection:	6" flanged pipe
Drain Connection:	2" NPT pipe
Material of Construction:	304 SS body
	Carbon Steel Spiral
Weight Dry/Wet (approximate):	1,350/2,600 lbs

Control Panel

The panel shall contain all timers, VFDs, switches, and indicator lights to operate one (1) Grit King® unit and one (1) classifier unit in either fully automated or manual mode.

Quantity:	1
Enclosure Material:	304 SS
Enclosure Type:	NEMA 4X
Power Supply:	480V/15 amp/3-phase
Control Logic:	Programmable Relay
Grit Classifier Control:	VFD

System Hydraulics

System hydraulics is the responsibility of the design engineer. Hydro International can provide information on Grit King® hydraulics and pumping and piping FAQ's to assist the engineer in determining system hydraulics and pump requirements, upon request.

Design Recommendations

- 1/2" or finer screening prior to the grit removal system
- Velocity through bar screen openings/slots/apertures should not exceed 4 ft/s at peak flow as recommended by industry design manuals.
- Estimated grit load a peak flow 0.01 yd^3/hr
- All piping connected to Hydro equipment must be supported by other means than the Hydro equipment.
- 2 – 3 ft/s channel velocities at peak flow as recommended by industry design manuals
- 4 – 7 ft/s grit slurry pipe velocities as recommended by industry design manuals
- Incorporate a drain line, piped to a floor drain, in the grit dumpster to allow for further dewatering prior to disposal
- A minimum 18" of access clearance around all equipment and minimum 3' of access clearance above equipment
- Operators find that it is useful to locate a spray hose adjacent to the equipment so that they can spray all equipment down during an inspection
- Incorporate a minimal access platform to facilitate inspection access to the top of the equipment

Start-up

One (1) factory trained representative, two (2) trips, for start-up and instruction services as required totaling four (4) days.

Quote Validity: 30 days

Exclusions

Any item(s) not specifically described above are excluded and are not to be supplied by Hydro International including but not limited to the following:

- Field assembly, erection and installation
- Anchor Bolts
- Interconnecting piping and valving not expressly stated above
- Pipe connections and fittings not expressly stated above
- All pipe supports, hangers and braces
- Controls, switches, control panels and instrumentation of any kind not expressly stated above
- Wiring and conduit
- Grit pump(s)
- Field or touch-up paint, painting, blasting and touch-up of surface finish
- Spare parts not specifically stated above
- Unloading, hauling and storage charge
- Lubricating oil and greases
- Grit study, field performance testing, laboratory testing and sample collection and analysis
- All concrete and grouting work
- Insulation and heat tracing of any kind
- Performance and/or Supply Bond(s)
- Grit dumpsters
- Translation Services

Options

Quotes will be provided upon request for the following optional features:

- Stainless steel valve bodies
- Additional field days for startup or training
- Explosion proof upgrade
- PLC Based Control Panel
- Alternative Grit King® discharge configuration
- Grit King® Floatables trap
- Influent/Effluent boxes for Grit King®
- Upgrade 304 to 316 Stainless Steel
- Seismic Certification
- Grit Pump(s)
- Extended Warranty
- Field performance testing, laboratory testing and sample collection and analysis
- Service & maintenance contract

Warranty

Hydro International's Standard Warranty shall apply per the Terms and Conditions of Sale.

Delivery

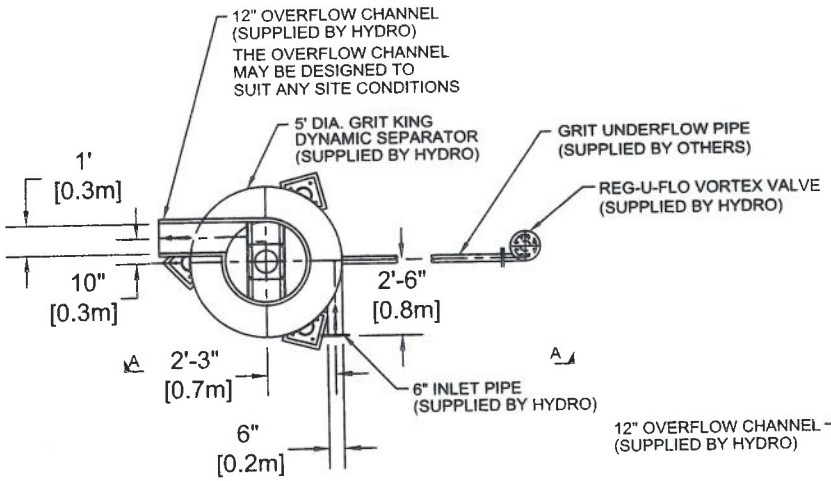
Please allow 4 to 6 weeks after receipt of purchase order for approval drawings. Shipment is typically a maximum of 16 weeks after receipt of "Approved" or "Approved As Noted, Resubmittal Not Required" submittal package. Price includes truck freight to jobsite, but does not include any state or local taxes if required.

Terms & Conditions

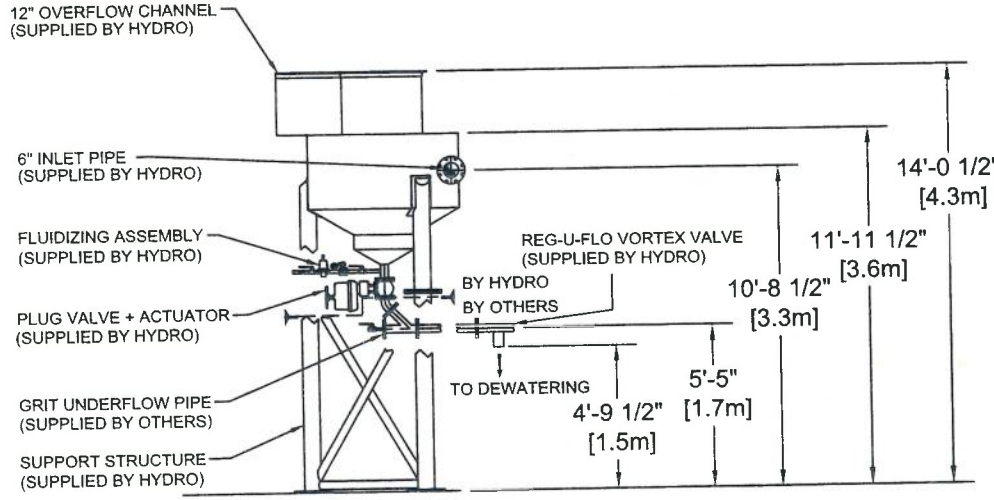
This proposal is made pursuant to Hydro International's standard Terms & Conditions of Sale, attached hereto and made a part hereof.

Contacts

Local Representative:
Mr. Paul Bellezza
Sherwood Logan & Associates
370 Middletown Blvd., Suite 500
Langhorne, PA 19047
Phone: (610) 304-7517
Fax: (215) 702-1401
Email: bellezza.p@sherwoodlogan.com

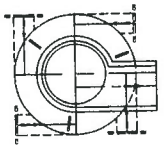


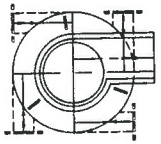
PLAN VIEW



ELEVATION A-A

ALTERNATE CONFIGURATIONS





PROJECTION

NOTES:

1. PLANT FLOW BYPASS IS RECOMMENDED TO ALLOW THE GRIT KING TO BE TAKEN OUT OF SERVICE IF MAINTENANCE IS REQUIRED.
2. THE INLET PIPE AND OVERFLOW CHANNEL MAY BE ROTATED 360 DEGREES ABOUT THE UNITS CENTRAL AXIS BUT INLET AND OUTLET ORIENTATION MUST REMAIN THE SAME.
3. CLOCKWISE & COUNTERCLOCKWISE CONFIGURATIONS ARE AVAILABLE.
4. THE INLET PIPE DIAMETER VARIES BASED ON THE DESIGN FLOW RATE AND HEADLOSS REQUIREMENTS.
5. ALTERNATE INLET & EFFLUENT CONFIGURATIONS ARE AVAILABLE.
6. FLUIDIZING WATER REQUIREMENTS
   50 gpm [2.3 l/s] @ 50 psi [345 Kpa]
7. THE OVERALL ELEVATIONS CAN VARY BASED ON THE SITE CONDITIONS

REV	BY	DATE	DESCRIPTION
-	AP	12/31/2011	FIRST RELEASE

REVISION HISTORY

Date	Scale
12/31/2011	1/4"=1'0"

Drawn By	Checked By	Approved By
AP	-	LS

Title

GRIT KING SEPARATOR

5' DIAMETER
FREE STANDING

PROPOSAL DRAWING

Hydro International wastewater

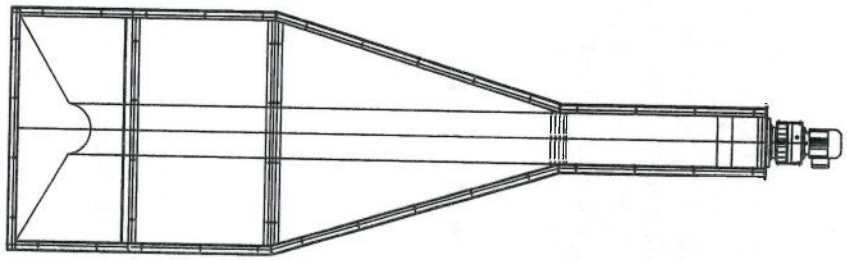
2925 NW Aloclek Drive
Suite 140
Hillsboro, OR 97124
Tel: (503) 615-8130
Fax: (503) 615-2906
email: sales@eutek.com

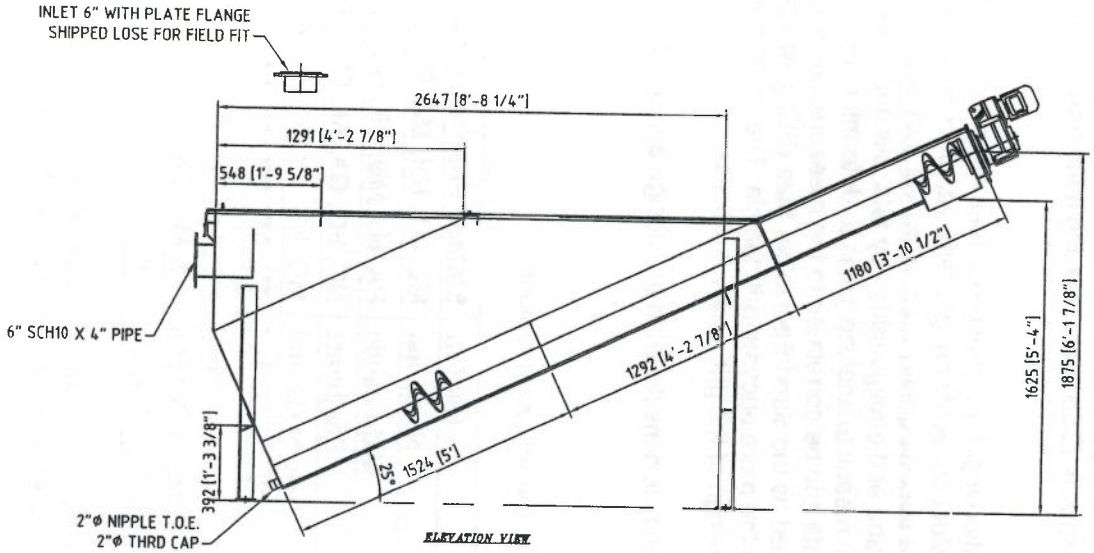
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES. TOLERENCES ARE:

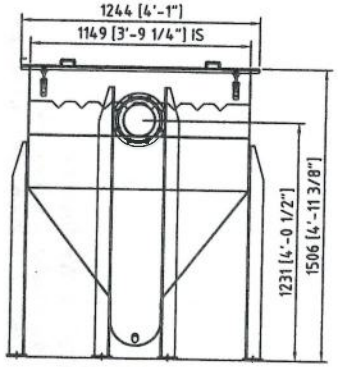
FRACTIONS ± 1/16
DECIMALS ± .06
ANGLES ± 1°

Approximate Weight:	3100 LBS
Finish:	-
Treatment:	-
Sheet Size:	B
Sheet:	1 OF 1
Next Assembly:	-
Ref. No.	PROPOSAL
Drawing No.	5' GK FSU 6"
Rev	-





ELEVATION VIEW



END ELEVATION VIEW

PROJECTION

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT GENERAL ARRANGEMENT & DETAIL DRAWINGS.

2. ALL COMPONENTS SHALL BE MANUFACTURED IN ACCORDANCE WITH THE PRODUCTION SPECIFICATION HRD-FM09/15.

REV	BY	DATE	DESCRIPTION

REVISION HISTORY

Date	Scale
09/10/10	NTS

Drawn By	Checked By	Approved By
LS		

Title

SCREW CLASSIFIER

GENERAL ARRANGEMENT

Hydro International wastewater

2925 NW Aloclek Drive
Suite 140
Hillsboro, OR 97124
Tel: (503) 615-8130
Fax: (503) 615-2906
email: sales@eutek.com

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES. TOLERENCES ARE:

FRACTIONS ± 1/16
DECIMALS ± .06
ANGLES ± 1°

Approximate Weight:	1320 lbs
Finish:	CLEAN & SMOOTH
Treatment:	
Next Assembly:	
Ref. No.	
Sheet Size:	B
Sheet:	1 OF 1
Drawing No.	SA260
Rev	

Hydro International

North American Grit Gradations

Hydro International is pleased to announce the availability of national and regional grit gradation data. This data, which has been compiled from over 120 tests across North America, contains average physical size data as well as settling velocity (SES) data, making it the most comprehensive information available on grit and its behavior.

Virtually all conventional grit removal processes rely on gravity sedimentation to achieve the separation of grit from wastewater. Most conventional grit removal processes are designed based on the assumption that grit is spherical and has a specific gravity 2.65. However, not all grit maintains a specific gravity of 2.65 and other factors such as shape and encapsulation by fats, oils and grease significantly impact its settling velocity. Therefore, the best means to analyze grit is to determine the settling velocity for given particle size ranges. Settling velocity data can be correlated to the measured settling velocity of a clean sand sphere. The settling velocity is expressed as the Sand Equivalent Size (SES), which is the sand particle size having the same settling velocity as the more buoyant grit particle. The correlated particle size, or Sand Equivalent Size can then be used for design of the grit removal process.

When settling velocity is considered in the design actual removal efficiency of grit particles can be estimated more realistically.

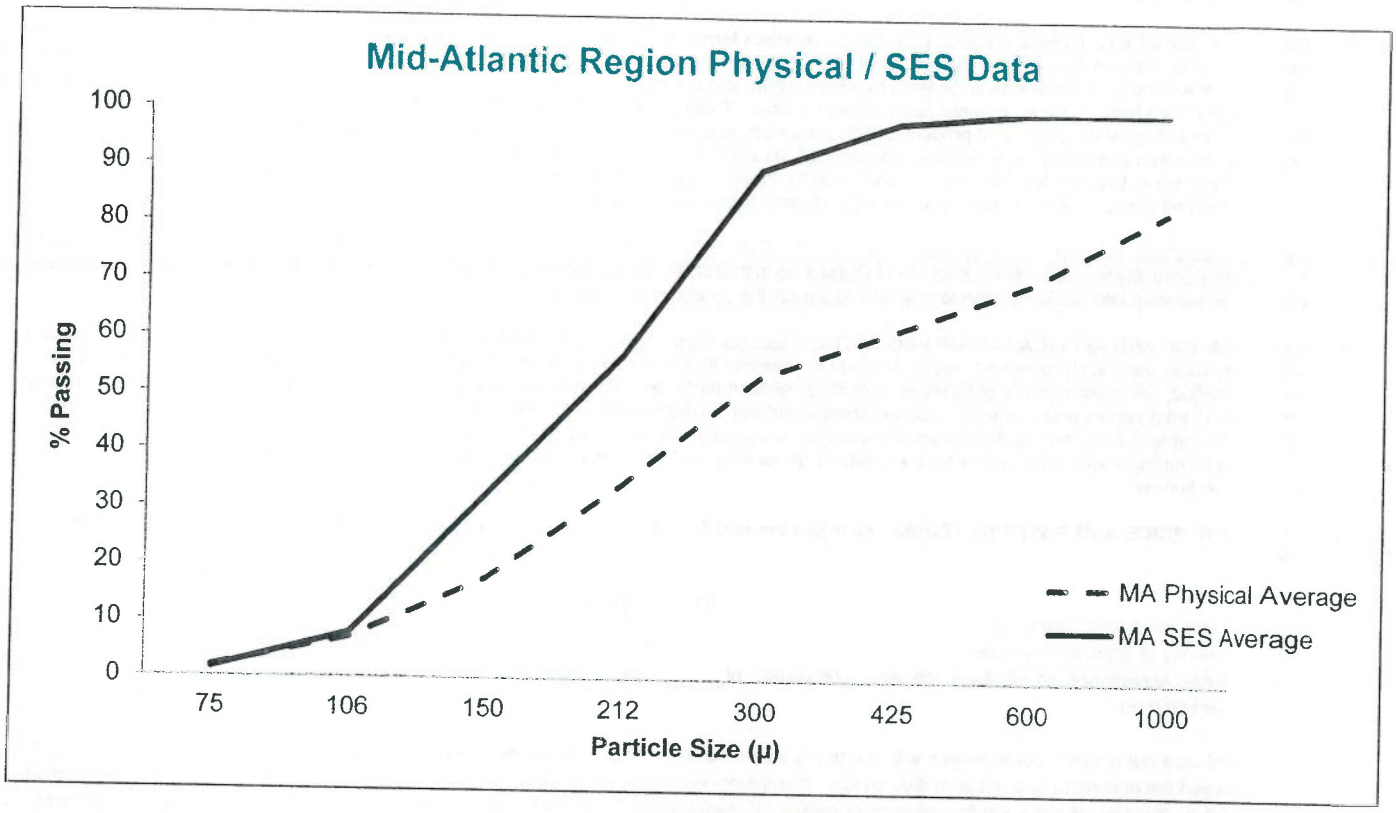
Data is available for the following regions:

Region	States / Provinces Included
Northeast	ME, VT, NH, MA, RI, NY, CT
Mid-Atlantic	PA, NJ, MD, DE, DC, VA, WV
Southeast	NC, SC, GA, AL, FL, MS
North Central	MO, KS, KY, IN, OH, IL, MI, WI, IA, MN, ND, SD, NE
South Central	TN, AR, OK, TX, LA
West	WA, OR, CA, AK, HI, AZ, NV, NM, CO, ID, MT, UT, WY
Western Canada	AB, MB, SK
Ontario Canada	ON

State data is available for individual states where more than 5 data points are available; those states currently include: Georgia, Texas, Florida, California, and Virginia.

Hydro International – Water & Wastewater
2925 NW Aloclek Suite 140, Hillsboro, OR 97124
Tel: (503) 615-8130 Fax: (503) 615-2906 Web: www.hydro-int.com

Mid-Atlantic Regional Gradation



Micron	% Passing								
	75	106	150	212	300	425	600	1000	
MA Physical Average	1.7	7.0	17.7	34.3	53.3	61.8	70.2	82.7	*Physical*
MA SES Average	1.4	7.8	32.5	57.0	89.7	98.0	100	100	*SES*

The above table shows the % of grit passing through various sieve sizes based on physical size (unshaded) and Sand Equivalent Size (SES) (shaded). SES provides the settling velocity distribution of the grit particles.

Standard Terms and Conditions of Sale

1. **DEFINITIONS.** "Hydro" is Hydro International with an address of 2925 NW Aloclek Drive #140 in Hillsboro, Oregon. "Buyer" is the party purchasing the goods from Hydro.

2. **ENTIRE AGREEMENT.** Hydro's agreement is based on these terms and conditions of sale. This document, together with any additional writings signed by Hydro, represents a final, complete, and exclusive statement of the agreement between the parties and may not be modified, supplemented, explained, or waived by parol evidence, Buyer's purchase order, any course of dealing, Buyer's payment or acceptance, or in any other way except in writing signed by Hydro through its authorized representative. These terms and conditions are intended to cover all activity of Hydro and Buyer hereunder, including sales and use of products, parts, and work, and all related matters (references to products include parts and references to work include construction and installation). Hydro's obligations hereunder are expressly conditioned on Buyer's assent to these terms and conditions. Hydro objects to any terms that are different from, or additional to, these terms and conditions. Any applicable detail drawings and specifications are hereby incorporated and made a part of these Terms and Conditions of Sale insofar as they apply to the material supplied hereunder.

3. **SPECIFICATIONS.** Products are supplied in accordance with information received by Hydro, or its duly authorized agent, from Buyer. Hydro shall have no responsibility for products created or sold based upon inaccurate and/or incomplete information supplied to it. Buyer shall ensure that Hydro receives all relevant information in time to enable it to supply the appropriate products.

4. **INSTALLATION AND APPLICATION OF PRODUCTS.** Products supplied hereunder shall be installed and used only in the particular application for which they were specifically designed. Buyer should not presume that any products supplied by Hydro may be utilized for any applications other than those specified; nor shall Hydro's obligations, including, without limitation, any warranty obligations, survive Buyer's transfer of products supplied hereunder to third parties unless the products are transferred with Hydro's consent. In addition, Buyer shall not use any product supplied hereunder at any location other than at the location for which Hydro has previously received notice from Buyer. Any breach of any of the foregoing restrictions may amount to an infringement of the patent for the products in question and will in any event void all express or implied warranties relating to the products supplied hereunder.

5. **PURCHASE PRICE AND PAYMENT TERMS.** All prices are in U.S. dollars and all payments shall be made in U.S. dollars. Payment terms are as follows:

	Incremental Payment	Cumulative Payment
Upon Approval of Shop Drawings	10%	10%
Upon Delivery of Equipment to Site	80%	90%
Upon Final Acceptance or 45 days following completion of equipment start up	10%	100%

If payments are not made in conformance with the terms stated herein, any unpaid balance shall be subject to interest at a rate 1½% per month, but not to exceed the maximum amount permitted by law. If shipment is delayed by Buyer, the previously agreed date of readiness for shipment shall be deemed to be the date of shipment for payment purposes. If manufacture is delayed by Buyer, a payment shall be made based on purchase price and percentage of completion, with the balance payable in accordance with the terms as stated. If at any time in Hydro's judgment Buyer may be or may become unable or unwilling to meet the terms specified, Hydro may require satisfactory assurance or full or partial payment as a condition to commencing, or continuing manufacture, or in advance of shipment.

Until payment in full has been received by Hydro, this Standard Terms and Conditions of Sale shall constitute a security agreement and Buyer hereby grants Hydro a purchase money security interest in and to the products produced by Hydro hereunder, and any products or proceeds thereof. In particular:

(i) Hydro will retain an express purchase money security interest in and to the products and all proceeds thereof.

(ii) Until full payment for the products is received by Hydro, Hydro reserves the right to retake possession of the products at any time and for this purpose Buyer authorizes Hydro or its duly authorized agent to enter upon land or premises where it believes the product may be.

(iii) Proceeds of any disposal of the products shall be held in trust for Hydro pursuant to the terms of the Maine Uniform Commercial Code.

(iv) Buyer grants Hydro a power of attorney for the purpose of filing a UCC-1 financing statement in the name of Buyer to evidence Hydro's security interest in the products.

6. **BACKCHARGES.** In the event that Buyer is required to make repairs, corrections or modifications to the goods supplied by Hydro, it shall only do so upon written approval from Hydro. Backcharges shall be limited to the costs directly associated in making the repairs, corrections or modifications to the goods supplied by Hydro. The costs of such backcharges shall be subject to approval by Hydro and shall be limited to: (1) directly related labor and material costs, (2) directly related equipment and tool rental at prevailing rates in the project location and (3) Buyer's overhead & supervision costs to make repairs, corrections or modifications to the goods supplied by Hydro. Buyer shall submit complete documentation to Hydro's satisfaction including but not limited to labor time sheets, material lists, and rental fees detailing the nature of the back charges. Backcharges shall be in the form

of an adjustment to the contract price or reduction in retained payments and not a direct payment. No incidental or consequential backcharges shall be allowed.

7. **DELIVERY.** The goods are sold F.O.B. manufacturing site, freight prepaid to Buyer at job site. Except as outlined in Paragraph 8 below, the risk of loss passes to Buyer after Hydro delivers the goods to the carrier. Hydro reserves the right to select the method of shipment and carrier. Delivery dates are approximate only and are not a guarantee of delivery on a particular day. Hydro is not liable for failure or delays in deliveries of any cause whatsoever beyond the control of Hydro.

8. **TITLE & INSURANCE:** Title to the product(s) and risk of loss or damage shall pass to Buyer upon delivery to a carrier as outlined in Paragraph 7 above, or, in the event Buyer delays shipment, by the previously agreed date of readiness for shipment, except that a security interest in the product(s) or any replacement shall remain in Hydro's name, regardless of the mode of attachment to realty or other property, until the full price has been paid in cash. Buyer agrees to protect Hydro's interest by adequately insuring the product(s) against loss or damage from any external cause with Hydro named as insured or co-insured.

9. **ERECTION:** Unless otherwise stated in writing, the goods provided hereunder shall be assembled and erected by and at the expense of Buyer.

10. **CANCELLATION & BREACH:** Orders placed cannot be canceled, nor shipments of goods made up, or in process, be deferred beyond the original shipment dates specified, except with Hydro's written consent and upon terms which shall indemnify Hydro against all loss. In the event of cancellation or the substantial breach of Buyer's obligations, as by failing to make any of the payments when due, the parties agree that Hydro will suffer a serious and substantial damage that will be difficult, if not impossible, to measure, both as of the time of entering into this purchase agreement and as of the time of such cancellation or breach. Therefore, the parties agree that, upon such cancellation or breach, Buyer shall pay to Hydro the sums set forth herein below, which sums the parties do hereby agree shall constitute agreed and liquidated damages in such event:

    - If cancellation or breach shall occur after the acceptance of the purchase order but prior to mailing of submittal documents by Hydro to Buyer, liquidated damages shall be 10% of the selling price.
    - If cancellation or breach shall occur within thirty (30) days from the mailing of submittal documents by Hydro to Buyer, the liquidated damages shall be 20% of the selling price.
    - If the cancellation or breach occurs after thirty (30) days from the mailing of submittal documents by Hydro to Buyer, but prior to notification that the order is ready for shipment, the liquidated damages shall be the total of 30% of the selling price plus the expenses incurred, cost of material, and reasonable value of the work expended to fill the order involved herein by Hydro's engineers and other employees, agents and representatives after the mailing of general arrangement drawings by Hydro to Buyer, said sums to be determined at the sole reasonable discretion of Hydro; provided, however, that the total liquidated damages under this provision shall not exceed the total selling price.
    - If cancellation or breach shall occur after Hydro has notified Buyer that the order is ready for shipment, then the liquidated damages shall be the total selling price, less costs associated with startup or field testing.

11. **MATERIALS OF CONSTRUCTION, PAINTS AND COATINGS:** Buyer is responsible for determining the suitability of, and for giving final approval of, the materials of construction, paints, coatings, etc. to be used by Hydro.

12. **WARRANTY:** Any product that proves defective in material, workmanship or design within twelve (12) months after delivery (or entry into storage) will be, at the discretion of HYDRO, modified, repaired or replaced, or Buyer's payment for the products will be refunded. This shall be Buyer's sole remedy. HYDRO EXPRESSLY EXCLUDES AND DISCLAIMS ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHER WARRANTIES, EXPRESS OR IMPLIED.

    This warranty does not cover any defects or costs caused by: (1) normal wear and tear of equipment from designed operation. (2) modification, alteration, repair or service of the goods by anyone other than Hydro; (3) physical abuse to, or misuse of, the goods, or operation thereof in a manner contrary to Hydro's instructions; (4) any use of the goods other than that for which they were intended; (5) chemicals or components which were not disclosed to Hydro; (6) storage contrary to Hydro's instructions; or (7) failure to maintain the goods in accordance with Hydro's instructions.

    This warranty does not apply to component parts of the goods that were not both originally designed and manufactured by Hydro, including, but not limited to, valves and controls. These component parts do not carry any warranties by Hydro, and only carry the warranties, if any, of their manufacturers.

    In order for Buyer to make a claim under this warranty, Buyer must promptly, and within the warranty period, notify Hydro in writing of any defect(s) in the goods covered by this warranty. If any defect(s) in the goods covered by this warranty are visible at the time of delivery, Buyer must notify Hydro of the defect(s) in writing within five working days. To make any claim under this warranty, Buyer must also fully comply with written authorization and return instructions from Hydro.

13. **FIELD SERVICE:** Startup/Field Service will only be scheduled upon written request. Buyer shall notify Hydro of schedule requirements at least ten (10) working days in advance, or additional charges may be added to cover late-scheduled travel costs. Additional costs will be limited to those arising out of late-scheduled costs. Should Buyer have outstanding balances due Hydro, no startup / field service will be scheduled until such payments are received by Hydro. Hydro will send documents to Buyer defining the service or startup requirements. Buyer assumes all responsibility for the readiness of the system when it requests startup service. Should Hydro's Field Service Engineer arrive at the jobsite and determine that the system cannot be started up within a reasonable time, Hydro shall have the option to bring the Field Service Engineer home and bill Buyer for time, travel and living expenses. Additional field service is available from Hydro at the prevailing per-diem rate at the time of the request for service plus all travel and living expenses, portal-to-portal. A purchase order or change order will be required prior to scheduling this additional service.

14. **LIMITATION OF HYDRO'S LIABILITY.** Hydro assumes no liability or responsibility for the misuse of its products by Buyer, Buyer's employees, agents or assigns, or other use inconsistent with the use appropriate to the performance specification requirements submitted to Hydro, and Buyer agrees to indemnify and hold harmless Hydro for any loss, costs, expense or liability that it may incur or be put to as a result of misuse or inconsistent use of the products. In addition, Hydro shall have no liability to Buyer for any consequential or incidental damages incurred by Buyer in connection with the contract documents or the products purchased by Buyer. Hydro shall not be liable for any loss which results from delay in delivery caused by any

reason beyond its control, including, but not limited to, acts of God, casualty, civil disturbance, labor disputes, strikes, transportation or inability to obtain materials or services, any interruption of its facilities, or act of any governmental authority. The time for delivery shall be extended during the continuance of such conditions. The total liability of Hydro to Buyer in the form of liquidated damages for any loss, indemnity, damage or delay of any kind will not under any circumstances exceed 25% of the Contract Sum.

15. **INTELLECTUAL PROPERTY.** Hydro shall retain sole ownership of all of its intellectual property used or produced in connection with the Project, including but not limited to all drawings, specifications, software, written materials, manuals, marks, business methods, and all other property that is capable of protection by a patent, copyright or trademark (whether or not such protection has actually been sought). Buyer shall not use such intellectual property except for the purpose of confirming the quality of design and/or manufacturing of the products and services set forth in the Proposal. Buyer shall not photocopy, duplicate or in any way copy such intellectual property except for the Buyer's internal purposes only (but not for rendering services or selling products to third persons). Buyer shall not sell, license, assign or transfer the intellectual property protected by this paragraph to anyone. Buyer shall ensure that Owner is in possession of valid licenses for all third-party software (not provided by Hydro) used for the Project, and shall indemnify and hold harmless Hydro against all claims by licensors of such software. Hydro makes no warranty regarding the effect of such third-party software on the performance of the software to be developed by Hydro for the Project and Hydro shall be released from any warranties given to Buyer to the extent that such software causes or contributes to problems. Following acceptance and final payment to Hydro, Hydro will grant to the Owner a non-transferable, non-exclusive license to use the software for the Owner's internal purposes only in the form of the license agreement attached as Exhibit A.

16. **TAXES.** Prices stated herein do not include any tax, excise, duty or levy now or hereafter enacted or imposed, by any governmental authority on the manufacture, sale, delivery and/or use of any item delivered. An additional charge will be made therefore and paid by Buyer unless Hydro is furnished with a proper exemption certificate relieving Hydro of paying or collecting the tax, excise, duty or levy in question.

17. **INTERPRETATION OF CONTRACT.** This contract shall be construed according to the laws of the State of Maine.

18. **CHOICE OF FORUM.** Buyer and Hydro hereby consent and agree that the United States District Court for the District of Maine or the District Court or Superior Court located in the City of Portland, County of Cumberland, Maine will have exclusive jurisdiction over any legal action or proceeding arising out of or relating to the contract documents, and each party consents to the personal jurisdiction of such Courts for the purpose of any such action or proceeding. Buyer and Hydro further hereby consent and agree that the exclusive venue for any legal action or proceeding arising out of or relating to the contract documents will be in the County of Cumberland, Maine. Each party hereby waives all rights it has or which may hereafter arise to contest such exclusive jurisdiction and venue.

19. **ATTORNEYS' FEES.** If any judicial or non-judicial proceeding is initiated for the purpose of enforcing a provision of this contract, the prevailing party shall be awarded reasonable attorneys' fees in addition to all other costs associated with the proceeding, whether or not the proceeding advances to judgment.

20. **SEVERABILITY.** If any provisions of this contract are held invalid by a court of competent jurisdiction, the remainder of this contract shall not be rendered invalid, and such invalid provisions shall be modified, in keeping with the letter and spirit of this contract, to the extent permitted by applicable law so as to be rendered valid.

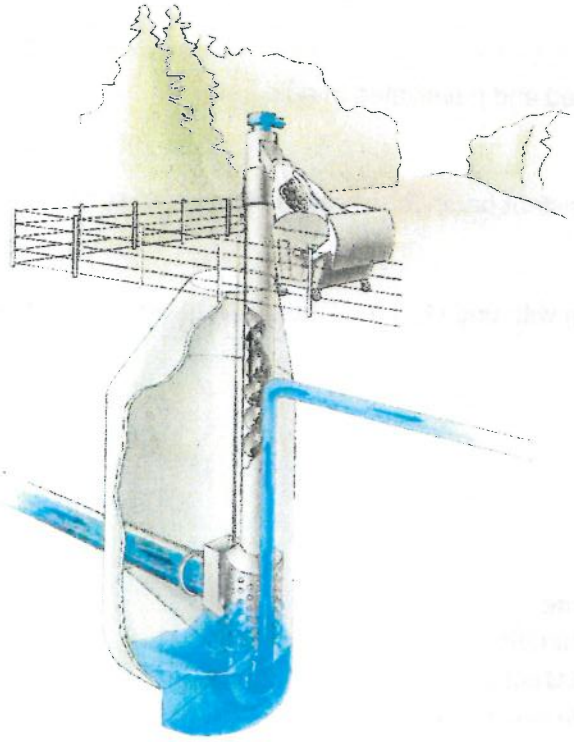
21. **ANTI-BRIBERY.** Hydro International will not engage in any form of bribery or corruption. The offering, giving or receiving of bribes is contrary to Hydr International's values and can play no part in the way in which it carries out its business. Hydro requires you to support our approach and implemer provisions consistent with our policy through your own organization and your supply chain. Please find a copy of our Anti-Bribery and Corruption Policy on our website at http://plc.hydro-intl.com/content/view/296/247/

BUDGET PROPOSAL

Project Name: Shinglehouse Borough, PA

Equipment Type: RoK4 300/6

Date: September 7, 2016



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HUBER TECHNOLOGY
WASTE WATER Solutions

Huber Technology, Inc.
9735 NorthCross Center Court
Suite A
Huntersville, NC 28078

Phone: (704) 949-1010
Fax: (704) 949-1020

HUBER TECHNOLOGY
WASTE WATER Solutions

DESCRIPTION

ROTAMAT® RoK4 Fine Screen for Confined Spaces
Model: One (1) x RoK4 300/6

Design Clarifications:
Maximum Flow: 1.04 MGD Wastewater
Plant Specific Flow: 0.35 MGD Wastewater
Top of Well to Invert: 10.85 ft (estimated)
Total Length: 22.31 ft (6800 mm)

Including:
- 316L Stainless Steel construction; pickled and passivated in acid bath
- Vertical screen basket
- Basket perforation: 1/4 in. (6 mm)
- Flights of screw equipped with wear resistant brush for effective cleaning of screen
- Shafted auger in vertical tube
- Integrated screening press
- Automatic Press Zone Washing System with one (1) 1 in., Brass, C1D1 Solenoid Valve
- Class 1 / Division 1 Motor, 2 hp
- Closed Discharge Chute
- Bagging Unit
- 8 in. ANSI Flange Inlet Connection

RoK4 Main Control Panel
Including:
- NEMA 4X, 304 Stainless Steel Enclosure
- Main disconnect, non-fused with door handle
- FVR, IEC starter w/CB branch circuit [screen]
- PLC, Allen-Bradley MicroLogix 1400 w/required IO
- OIU, Allen-Bradley PanelView 300 Micro
- UL label
- Pressure sensor, 0-2 PSI with cable

Manufacturer's Services
Including:
- One (1) trip, two (2) days on site for start-up, installation, training, etc.
- Additional services are available on a per diem rate upon request
- Freight to site included

Price: $125,000

HUBER Technology, Inc.
Huber Technology, Inc. 9735 NorthCross Center Court STE A Huntersville, NC 28078
Phone (704) 949-1010 Fax (704) 949-1020 huber@htusa.net www.huber-technology.com
A member of the HUBER Group

Optional: Lift In / Lift Out Device and Structure: +$10,000 ADDER
Optional: Cold Weather Package Protection (to -20F): +$14,000 ADDER

Notes:

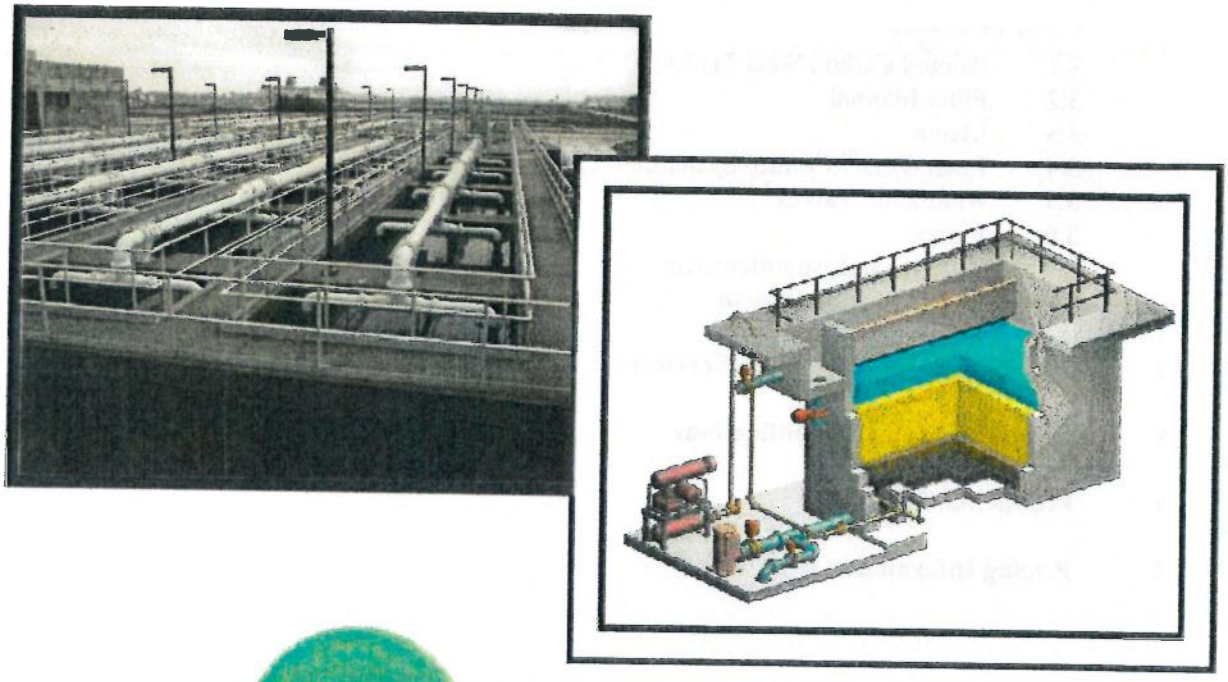
1. Budget Proposal is quoted in US$ unless otherwise stated.
2. Detailed Equipment Specification, Drawing, and Formalized Proposal are available upon request.
3. Huber recommends the lift in lift out device to facilitate removing the screen for any required maintenance
4. Machines made from 316L stainless steel or Duplex are available for a price adder for extremely harsh operating environments.
5. Proposal estimate is based upon Huber Technology's Standard Design, Terms, and Conditions. Any deviation from these standards may result in a price adder.
6. If there are site-specific hydraulic constraints that must be applied, please consult Huber Technology's representative to ensure compatibility with the proposed system.
7. Huber's Cold Weather package list above includes heated motor windings, cold weather gearbox, heat tracing and insulation of the screens rising pipe and discharge chute. This can be had in C1D1 configuration
8. All of Huber's standard machines and systems are manufactured from 316L stainless steel. Huber makes no representation or warranties concerning the service life of the equipment against such abrasion or corrosion. The concentration of chloride and hydrogen sulfide (H2S) in the equipment operating environment shall be kept below the following values:
   a. Chloride < 400 mg/l
   b. Hydrogen sulfide (H2S) < 6 ppm

LEOPOLD
a xylem brand

Proposal Number: I16482

September 1, 2016

Shinglehouse Borough, PA
WWTP



elimi•NITE®

Denitrification System

Proposal Prepared for
Shinglehouse Borough, PA

Xylem Water Solutions USA, Inc — 227 South Division Street — Zelienople, PA 16063
Phone (724) 452-6300 — Fax (724) 453-2122

Table of Contents

1. elimi-NITE Denitrification System General Process Description

The elimi-NITE Denitrification System is an attached growth, microbiological process. This gravity, downflow, packed-bed denitrification system is physically identical to a deep-bed downflow sand filter. Denitrifying microorganisms attach to the filter media, which provides the support system for their growth. A carbon source such as methanol, acetic acid, molasses, etc. is added upstream of the packed-bed filter and a nitrified influent is filtered through the media. The packed-bed filter system is well suited for denitrification because it provides the necessary hydraulic detention time for the biological reaction to take place. The filter media is composed of a coarse, hard, predominately siliceous material. This media can filter out solids and serve as a support system for the denitrifying microorganisms. The downflow packed-bed system eliminates the requirement for downstream filtration or clarification required of other denitrification systems.

As denitrification occurs, nitrogen gas accumulates in the filter media, which increases the headloss over the headloss due to the accumulation of solids. The nitrogen gas bubbles are periodically released from the media by taking the filter off line and applying backwash water for a few minutes. This process is called the nitrogen release cycle or filter bumping. The frequency of the nitrogen release cycle is a function of both nitrate removal and a minimum acceptable time between cycles, typically less than one hour. Usually a filter needs to be bumped once every four to eight hours, again depending on the nitrogen loading rate. The bumps are usually set on a time basis. After a bump the headloss in the filter is reduced or recovered. However, when the liquid level in the filter reaches a designated high level, signifying that the bumps are not effective in reducing headloss, a full backwash is performed on the filter.

The elimi-NITE Denitrification System is comprised of the following basic principles:

- A packed deep-bed layer of sand for biomass attachment and retention of suspended solids
- A Leopold Universal® Type S® Filter System for distribution of air and water for superior backwashing of the elimi-NITE filter module.
- A complete chemical feed system of the carbon source for denitrification (future)
- Automated backwash sequence and controls optimized for each applications requirement utilizing Leopold FilterWorx™ Control System.

The full backwash consists of the following sequence:

- Influent and effluent valves are closed
- Waste valve is opened
- Blower is started
- Air isolation valve is opened, vent valve is closed and air only wash for approximately one minute
- Backwash pump is started
- Backwash isolation valve is opened and air/water backwash for approximately 15 minutes
- Air isolation valve is closed, vent valve is open and the blower is stopped

- Water only backwash continues for approximately 5 minutes to purge air from the filter
- Backwash isolation valve is closed and the backwash pump is stopped
- Waste valve is closed
- Influent and effluent valves are opened

Gases such as nitrogen or dissolved oxygen will build-up high levels in the filter and cause air binding. In this case the filters are water-only "bumped." The bump consists of isolating the filters from the influent flow, closing the effluent valve, starting the backwash pump, opening the backwash valve, opening the waste valve (optional if the water depth stays below the effluent launder) and backwashing the filter for approximately 2-5 minutes. This reversal of flow allows the built-up gases to escape the filter. The filter is then put back on-line. The bumps can be programmed to occur either on time or on level and are site specific.

2. Design Criteria

The elimi-NITE Denitrification System described here-in is a wastewater treatment system designed for the removal of nitrate-nitrogen.

The elimi-NITE Denitrification System that shall be furnished and installed is described in Section 3 - Scope of Supply.

The system has been designed based on the Leopold's standard specifications using the following criteria:

Plant Flow	MGD
Average Flow	0.16
Peak Flow	0.35

Note: Please define the following parameters to help optimize the denitrification process.

The elimi-NITE Denitrification System is based on treating the influent the filters with the following characteristics:

Influent Parameter	mg/L	Given	Assumed
Total Suspended Solids (TSS)	10	X	-----
Nitrates	23	X	-----
BOD	10	X	-----
Total Nitrogen	<28	X	-----
Total phosphorus (PO_4-P)	----	-----	-----
Minimum Water Temperature (°C)	10	X	-----

The elimi-NITE Denitrification System is designed to achieve the following monthly average effluent quality:

Effluent Parameters	mg/L	Given	Assumed
Total Suspended Solids (TSS)	<10.0	X	-----
Nitrates	----	-----	-----
Total Nitrogen	6.0	X	-----
Total Phosphorus (TP)	0.8	X	-----

The external carbon source for the elimi-NITE Denitrification System that will be provided by others is methanol.

If Phosphorous removal is required, the phosphorous must be in an insoluble form. This may require the use of coagulants upstream of the Filtration System.

Elimi-NITE Denitrification System Design Criteria

Total number of filters	Two (2)
Active Filtration volume	1,152 ft^3
Total filtration area	192 ft^2
Individual filter sizing	
Area	96 ft^2
Length	12'-0"
Width	8'-0"
Media Depth	72"
Media volume	576 ft^3

Media Type

Coarse Silica Sand	1/8" x No. 12 – 72"

Loading Rates	**Filter Loading Rate**	**with one in backwash**
At 0.16 MGD (Design Average)	0.58 gpm/ft^2	1.16 gpm/ft^2
At 0.35 MGD (Peak Flow)	1.26 gpm/ft^2	2.53 gpm/ft^2

Backwash Rates	
Design concurrent water rate	6 gpm/ft^2
Design concurrent air rate	5 scfm/ft^2
Design high water rate	6 gpm/ft^2
Designed Driving Head	7'-0"
Air Scour Blowers	
Total Number	Two (2)
Number in standby	One (1)
Flow Capacity per blower	480 scfm
Backwash Pumps	
Total Number	Two (2)
Number in standby	One (1)
Flow Capacity per pump	576 gpm
Mudwell Pumps	
Total Number	Two (2)
Number in standby	One (1)
Flow Capacity per pump	115 gpm

3. Scope of Supply

Xylem Water Solutions USA, Inc. will supply only the items specifically detailed within this proposal.

3.1 Painted Carbon Steel Tanks

Two (2) Under this section we propose to furnish two (2) painted carbon steel tanks with inside dimensions of 12'-0" x 8'-0". Each tank will be constructed from painted carbon steel (ASTM A-36) with the following included:

1. One (1) carbon steel wash trough, 12" wide by 13" deep.
2. Influent weir box.
3. Backwash collection box.
4. Collection flume.
5. Flanged connections for influent, backwash, overflow, effluent, and air.

3.2 Filter Internals

Two (2) **Complete elimi-NITE filters**, 192 square feet effective filtration area total, 12'-0" by 8'-0" each inside filter dimensions utilizing a wall flume arrangement including:

192 square feet **Leopold Universal® Type S® Underdrain** of the Dual/Parallel Lateral type, manufactured from corrosion resistant, high-density polyethylene supplied with necessary "O"-rings. Each filter cell shall have a type 304 stainless steel orifice plate. The orifice plate is required to be sealed against the wall and floor and also between the orifice plate and the underdrain block. The sealant is not to be supplied by Leopold. Leopold recommends the use of Sikaflex® 1a or equivalent sealant.

192 square feet **I.M.S® 1000 MEDIA RETAINER** shall be supplied. The scope includes molded thermoplastic I.M.S® 1000 media retainer factory installed onto the proposed Leopold Universal® Type S® block prior to shipment.

Two (2) sets **Air Header Assemblies** shall be manufactured from schedule 5, type 304 stainless steel pipe. The air header pipe shall measure 6" in diameter and will run the width of the filter cell. The air header shall commence with a flange approximately 6" outside the filter cell. Mating flange and hardware is to be supplied by others. The air header pipe will have drop pipes to provide air to each of the individual filter laterals.

3.3 Media

1,152 cubic feet **Coarse Silica Sand** – 72" Depth
Effective Size: 1/8" x No. 12

56 Tons

3.4 FilterWorx™ Control System

One (1) **Leopold model AFC-5000 Dual Filter Control Panel.** The panel shall be housed in a NEMA 4X rated, 304 stainless steel enclosure. The panel shall include provisions for the automatic, semi-automatic, and manual control of the filtration and backwashing operations of two (2) filters. Logic functions shall be performed by an Allen Bradley Compact Logix Series PLC. Manual operation shall be independent of the PLC. Operator interface shall be via an Allen Bradley Panelview Plus 1000 touchscreen and Square D type ZB4 selector switches, pushbuttons and pilot lights.

Two (2) **Siemens Hydroranger 200 Ultrasonic filter level transmitters**

One (1) **Siemens Hydroranger 200 Clearwell Level Transmitter**

One (1) **Siemens Hydroranger 200 Mudwell Level Transmitter**

Two (2) **Hach Nitratax Sensors and SC200 Controllers (One Influent& One Effluent)**

One (1) **Siemens 5100W 6" magnetic flow meter for filter influent**

One (1) Lot **Spare Equipment** consisting of:
One (1) PLC DI module
One (1) PLC DO module
One (1) PLC AI module
One (1) PLC AO module
Two (2) of each type of relay, selector switch, pushbutton, and pilot light used.

3.5 Automatic Valves

Under this section we propose to furnish the following 150 lb. Class flanged butterfly valves conforming to AWWA C-504. The valves shall be flanged with EDPM seats, 316 stainless steel shafts and cast iron bodies per ASTM A126. Shaft seals should be self-compensating split V-type or O-ring packing made of BUNA-N per AWWA C-504 Class B. The valves shall be supplied with the listed electric operators. Actuators shall be Rotork IQT / IQTM as specified.

Quantity	Function	Size	Service
Two (2)	Influent	6-inch	open/close
Two (2)	Effluent	6-inch	open/close
Two (2)	BW Inlet	8-inch	open/close
Two (2)	BW Waste	8-inch	open/close
Two (2)	Air Inlet	6-inch	open/close
One (1)	Air Vent	3-inch	open/close

3.6 Pumps

Two (2) **Submersible Backwash Pumps**. The pumps shall be rated for 576 gpm at an estimated 30 feet of head. Accessories shall include a 50' cable, leakage sensor, discharge connection and hardware, guide bar brackets and stainless steel lift chains. The pump motor shall be 7.5 hp, 60 Hz , 460v, 3 phase and have a cast iron housing, volute and impeller. Also included shall be a manual isolation butterfly valve and an air cushioned swing check valve. **The stainless steel guide bars shall be supplied by the contractor.**

Two (2) **Submersible Mudwell Pumps**. The pumps shall be rated for 115 gpm at an estimated 30 feet of head. Accessories shall include a 50' cable, leakage sensor, discharge connection and hardware, guide bar brackets and stainless steel lift chains. The pump motor shall be 3 hp, 60 Hz , 460v, 3 phase and have a cast iron housing, volute and impeller. Also included shall be a manual isolation butterfly valve and an air cushioned swing check valve. **The stainless steel guide bars shall be supplied by the contractor.**

3.7 Blowers and Appurtenances

Two (2) **Positive Displacement Blower Packages** The blower packages shall be capable of supplying air to the filters during backwash at a rate of 480 scfm. Included with the blower package are TEFC motor, silencer, filter, pressure relief valve, flexible connections, pressure gauges, temperature gauges, discharge check valve and discharge butterfly valve. The blower shall have a 50 hp, 460 volts, 3 phase, 60 hertz, TEFC motor. An acoustical enclosure will be included.

3.8 Chemical Feed System

Two (2) **Positive Displacement Diaphragm Pumps**, hydraulically actuated, capable of supplying the influent with the required Micro® C, etc. to denitrify. The pumps will come with an explosion proof DC motor. Accessories shall include a backpressure valve, pulsation dampener, and pressure relief valve for each discharge line.

One (1) **Carbon Steel Methanol Storage Tank,** designed to meet API 650 Appendix J. The tank shall come equipped with a fill adapter, vents, mechanical gauge, ladder, signage, level indicator, and leak detector. The exterior of the tank shall be shipped factory primed. Finish coats shall be provided and applied by the on-site contractor.

One (1) **Methanol Control Panel,** to be housed in a NEMA 4X rated, 304 stainless steel, wall-mounted enclosure. The panel shall include provisions for control of the methanol feed pumps. The panel shall also include a digital indicator for methanol tank level. Logic functions shall be performed by an Allen Bradley Micro Logix series system. Interface with the Filter Control Panels shall be via a 4 – 20 mA signal.

4. Installation and Instruction Services

The services of a qualified Leopold technical representative to instruct the Contractor's personnel about the proper installation technique of the mechanical **filter equipment** will be provided for a period of six (6) days (8 hr/day) on site plus four (4) days travel time to and from the job-site in two (2) trips.

The services of a qualified Leopold technical representative for **filter control system startup and operator training** will be provided for a period of nine (9) days (8 hr/day) on site plus six (6) days travel time to and from the job-site in three (3) trips.

Additional services may be obtained at the current prevailing rate plus living and travel expenses.

Should our service representative be scheduled and arrive on site at the time requested by the contractor/purchaser and the equipment is not ready, our standard per diem rate, plus travel and living expenses will apply.

5. Clarifications and Qualifications

MEDIA:

Submittals:

Materials meet and/or exceed American Water Works Association Standard B100 (latest revision) for Filtering Material. Typical samples and/or test reports detailing the physical and chemical characteristics of the filtering material will be provided for review and approval as required by the specification. If independent testing is required per specification, test reports of the actual material produced will be submitted for approval prior to release for shipment.

Packaging and Placement of Materials:

Material will be packaged in semi-bulk containers, "Super Bags," with lifting sleeves and bottom discharge spout, containing approximately 2,000 to 4,000 pounds per sack.

Quantities:

Quantities indicated above are Xylem Water Solutions USA, Inc best calculations of the quantity requirements. Loss of gravel due to storage or handling is not covered by this proposal.

FILTER MEDIA WARRANTY (if applicable): SELLER warrants that its filter media products will meet the standards established by the latest edition of AWWA (American Water Works Association) B100. SELLER shall be responsible for verifying that the filter media meets or exceeds the AWWA B100 Standard at the point of sale. Testing shall be by an independent laboratory, which regularly

performs testing of filter media. BUYER shall notify Xylem Water Solutions USA, Inc. immediately upon discovery of any defective product. The SELLER shall have the right to inspect said product and BUYER shall, if requested, return the defective product to the SELLER with transportation prepaid. NO LIABILITY IS ASSUMED BY THE SELLER UNDER ANY CIRCUMSTANCES FOR LABOR, MATERIAL OR OTHER COSTS ASSOCIATED WITH THE REMOVAL OR REPLACEMENT OF MEDIA UNLESS PREVIOUSLY APPROVED IN WRITING BY AN AUTHORIZED EMPLOYEE OF THE SELLER.

ITEMS NOT INCLUDED

The following items, while not comprehensive, are not included in the elimi-NITE Denitrification System:

- Receiving, unloading, storing, and proper installation of supplied equipment and materials.
- Concrete for filter, building/architectural work and engineering thereof.
- Grout between and under the underdrain laterals in filters.
- Platforms, ladders, or walkways.
- Lubricants for mechanical equipment.
- Interconnecting piping, piping supports, and wall sleeves/pipes including flanges, bolts, nuts, and gaskets.
- Instrument air pipe, isolation valves, tubing, and engineering thereof.
- Electrical starters, circuit breakers, motor control center, conduit, and interconnecting wiring and engineering thereof, and 480 VAC, 3 phase, 60 HZ power.
- Water supply/disposal for flushing of filter internals, media installation or backwash testing.
- Lab services for performance guarantee testing.

6. Production Schedule

Submittal of PID's and mechanical drawings for approval 6 to 8 weeks after receipt of purchase order.

Submittal of EIC drawings for approval 6 to 8 weeks after receipt of purchase order.

Delivery of fabricated items and filter media 14 to 16 weeks after drawing approval.

7. Pricing Information

BASIS of PRICING:

Any items and/or accessories not specifically called out in this quotation must be construed as being furnished by others.

This quotation is considered firm for 90 days. Orders received more than 90 days after the date of this quotation is reviewed by Xylem Water Solutions USA, Inc before acceptance and is subject to changes in prices or delivery depending on conditions existing at the time of entry. Quoted prices are firm for delivery within 12 months from the delivery date stipulated in the plans & specifications or mutually agreed upon by Xylem Water Solutions USA, Inc. and Purchase Order issuer at time of order placement.

We do not include any applicable taxes.

Orders resulting from this quotation should be addresses to Xylem Water Solutions USA, Inc. 227 S. Division St., Zelienople, PA, 16063, USA.

We propose to furnish the material described in this document for **a total budget selling price of $_____**, FCA factory with full freight allowed to the job site.

For final pricing and further information pertaining to the equipment contained in this proposal, please contact our area representative, who is:

Sherwood-Logan & Associates, Inc.
370 Middletown Blvd.
Suite 500
Langhorne, PA 19047
Phone: (610) 304-7517
Fax: (215) 702-1401

Attention: Paul Bellezza

Payment terms:
10% net 30 days upon initial submittal of mechanical, electrical and I/C drawings for approval
80% net 30 days from the date of the respective shipments of the products
5% installation of the Leopold equipment, NTE 150 days after shipment
5% start-up/training on the Leopold equipment, NTE 180 days after shipment

Respectfully submitted,

Xylem Water Solutions USA, Inc

Wayne Steen
Sr. Sales Engineer

Attachment: Terms of Quotation

T&C'S FOR PROPOSAL

1. Agreement, Integration and Conflict of Terms. These terms and conditions, together with any special conditions expressly incorporated thereto in the quotation or sales form, are to govern any sale between the Seller and Buyer. The Seller shall mean the applicable affiliate of Xylem Inc. that is party to the Agreement ("Seller"). The Buyer shall mean the entity that is party to the Agreement with Seller. This writing is an offer or counteroffer by Seller to sell the goods and/or services set forth on the quotation or sales form subject to these terms and conditions and is expressly made conditional on Buyer's assent to these terms and conditions. Acceptance by Buyer is expressly limited to these terms and conditions. Any additional or different terms and conditions contained in Buyer's purchase order or other communication shall not be effective or binding upon Seller unless specifically agreed to in writing by Seller; Seller hereby objects to any such conditions, and the failure of Seller to object to specific provisions contained in any purchase order or other communication from Buyer shall not be construed as a waiver of these terms and conditions nor an acceptance of any such provisions. Neither Seller's commencement of performance nor delivery shall be deemed or construed as acceptance of Buyer's additional or different terms and conditions. Buyer agrees that these terms and conditions, together with any accompanying quotation and any special conditions or limited process guarantees or documents referred to or included within the quotation and expressly made a part of this agreement, (e.g., drawings, illustrations, specifications, or diagrams), is the complete and final agreement between Buyer and the Seller ("Agreement"). This Agreement supersedes all prior negotiations, representations, or agreements, either written or oral, between the parties and, further, can only be altered, modified or amended with the express written consent of Seller.

2. Quotation, Withdrawal, Expiration. Quotes are valid for thirty (30) calendar days from the date of issuance unless otherwise provided therein. Seller reserves the right to cancel or withdraw the quotation at any time with or without notice or cause prior to acceptance by Buyer. There is no Agreement if any conditions specified within the quotation ***or*** sales form are not completed by Buyer to Seller's satisfaction within thirty (30) calendar days of Seller's acknowledgement in writing of an order. Seller nevertheless reserves its right to accept any contractual documents received from Buyer after this 30-day period.

3. Prices. Prices apply to the specific quantities stated on the quotation or sales form. Unless otherwise agreed to in writing by Seller, all prices are FCA; Origin (as defined in accordance with the latest version of Incoterms), and do not include transportation costs or charges relating to transportation unless otherwise specified. Prices include standard packing according to Seller's specifications for delivery. All costs and taxes for special packing requested by Buyer, including packing for exports, shall be paid by Buyer as an additional charge. Prices are subject to change without notice.

4. Taxes. The price for the goods does not include any applicable sales, use, excise, GST, VAT, or similar tax, duties or levies. Buyer shall have the responsibility for the payment of such taxes if applicable.

5. Payment Terms. Seller reserves the right to require payment in advance or C.O.D. and otherwise modify credit terms should Buyer's credit standing not meet Seller's acceptance. Unless different payment terms are expressly set forth in the quotation or sales form or order acknowledgment or Sales Policy Manual, goods will be invoiced upon shipment. Payment shall be made in U.S. Dollars. Payment in full is due within thirty (30) days from the invoice date. In the event payment is not made when due, Buyer agrees to pay Seller a service or finance charge of the lesser of (i) one and one-half percent (1.5%) per month (18% per annum), or (ii) the highest rate permitted by applicable law, on the unpaid balance of the invoice from and after the invoice due date. Buyer is responsible for all costs and expenses associated with any checks returned due to insufficient funds. All credit sales are subject to prior approval of Seller's credit department. Export shipments will require payment prior to shipment or an appropriate Letter of Credit. If, during the performance of the contract with Buyer, the financial responsibility or condition of Buyer is such that Seller in good faith deems itself insecure, or if Buyer becomes insolvent, or if a material change in the ownership of Buyer occurs, or if Buyer fails to make any payments in accordance with the terms of its contract with Seller, then, in any such event, Seller is not obligated to continue performance under the contract and may stop goods in transit and defer or decline to make delivery of goods, except upon receipt of satisfactory security or cash payments in advance, or Seller may terminate the order upon written notice to Buyer without further obligation to Buyer whatsoever. If Buyer fails to make payments or fails to furnish security satisfactory to Seller, then Seller shall also have the right to enforce payment to the full contract price of the work completed and in process. Upon default by Buyer in payment when due, Buyer shall immediately pay to Seller the entire unpaid amounts for any and all shipments made to Buyer irrespective of the terms of said shipment and whether said shipments are made pursuant to this Agreement or any other contract of sale between Seller and Buyer, and Seller may withhold all subsequent shipments until the full amount is settled. Acceptance by Seller of less than full payment shall not be a waiver of any of its rights hereunder. Buyer shall not assign or transfer this Agreement or any interest in it, or monies payable under it, without the written consent of Seller and any assignment made without such consent shall be null and void.

6. Delivery, Risk of Loss. Delivery dates are estimates, and time is not of the essence. All shipments will be made FCA; Origin, unless otherwise specified. Seller shall not be responsible to Buyer for any loss, whether direct, indirect, incidental or consequential in nature, including without limitation loss of profits, arising out of or relating to any failure of the goods to be delivered by the specified delivery date. In the absence of specific instructions, Seller will select the carrier. Upon delivery to the common carrier, title and the risk of loss for the material shall pass to Buyer. Buyer shall reimburse Seller for the additional cost of its performance resulting from inaccurate or lack of delivery instructions, or by any act or omission on Buyer's part. Any such additional cost may include, but is not limited to, storage, insurance, protection, re-inspection and delivery expenses. Buyer further agrees that any payment due on delivery shall be made on delivery into storage as though goods had been delivered in accordance with the order.

Buyer grants to Seller a continuing security interest in and a lien upon the products and the proceeds thereof (including insurance proceeds), as security for the payment of all such amounts and the performance by Buyer of all of its obligations to Seller pursuant to the order and all such other sales, and Buyer shall have no right to sell, encumber or dispose of the products. Buyer

shall execute any and all financing statements and other documents and instruments and do and perform any and all other acts and things which Seller may consider necessary, desirable or appropriate to establish, perfect or protect Seller's title, security interest and lien. In addition, Buyer authorizes Seller and its agents and employees to execute any and all such documents and instruments and do and perform any and all such acts and things, at Buyer's expense, in Buyer's name and on its behalf. Such documents and instruments may also be filed without the signature of Buyer to the extent permitted by law.

7. Warranty. For goods sold by Seller to Buyer that are used by Buyer for personal, family or household purposes, Seller warrants the goods to Buyer on the terms of Seller's limited warranty available on Seller's website. For goods sold by Seller to Buyer for any other purpose, Seller warrants that the goods sold to Buyer hereunder (with the exception of membranes, seals, gaskets, elastomer materials, coatings and other "wear parts" or consumables all of which are not warranted except as otherwise provided in the quotation or sales form) will be (i) be built in accordance with the specifications referred to in the quotation or sales form, if such specifications are expressly made a part of this Agreement, and (ii) free from defects in material and workmanship for a period of one (1) year from the date of installation or eighteen (18) months from the date of shipment (which date of shipment shall not be greater than thirty (30) days after receipt of notice that the goods are ready to ship), whichever shall occur first, unless an alternate period of time is provided by law or is specified in the product documentation from Xylem (the "Warranty").

Except as otherwise provided by law, Seller shall, at its option and at no cost to Buyer, either repair or replace any product which fails to conform with the Warranty; provided, however, that under either option, Seller shall not be obligated to remove the defective product or install the replaced or repaired product and Buyer shall be responsible for all other costs, including, but not limited to, service costs, shipping fees and expenses. Seller shall have complete discretion as to the method or means of repair or replacement. Buyer's failure to comply with Seller's repair or replacement directions shall constitute a waiver of its rights and render all warranties void. Any parts repaired or replaced under the Warranty are warranted only for the balance of the warranty period on the parts that were repaired or replaced. The Warranty is conditioned on Buyer giving written notice to Seller of any defects in material or workmanship of warranted goods within ten (10) days of the date when any defects are first manifest. Seller shall have no warranty obligations to Buyer with respect to any product or parts of a product that: (a) have been repaired by third parties other than Seller or without Seller's written approval; (b) have been subject to misuse, misapplication, neglect, alteration, accident, or physical damage; (c) have been used in a manner contrary to Seller's instructions for installation, operation and maintenance; (d) have been damaged from ordinary wear and tear, corrosion, or chemical attack; (e) have been damaged due to abnormal conditions, vibration, failure to properly prime, or operation without flow; (f) have been damaged due to a defective power supply or improper electrical protection; or (g) have been damaged resulting from the use of accessory equipment not sold by Seller or not approved by Seller in connection with products supplied by Seller hereunder. In any case of products not manufactured by Seller, there is no warranty from Seller; however, Seller will extend to Buyer any warranty received from Seller's supplier of such products.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ANY AND ALL OTHER EXPRESS OR IMPLIED WARRANTIES, GUARANTEES, CONDITIONS OR TERMS OF WHATEVER NATURE RELATING TO THE GOODS PROVIDED HEREUNDER, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES

OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY EXPRESSLY DISCLAIMED AND EXCLUDED. EXCEPT AS OTHERWISE PROVIDED BY LAW, BUYER'S EXCLUSIVE REMEDY AND SELLER'S AGGREGATE LIABILITY FOR BREACH OF ANY OF THE FOREGOING WARRANTIES ARE LIMITED TO REPAIRING OR REPLACING THE PRODUCT AND SHALL IN ALL CASES BE LIMITED TO THE AMOUNT PAID BY THE BUYER HEREUNDER. IN NO EVENT IS SELLER LIABLE FOR ANY OTHER FORM OF DAMAGES, WHETHER DIRECT, INDIRECT, LIQUIDATED, INCIDENTAL, CONSEQUENTIAL, PUNITIVE, EXEMPLARY OR SPECIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF PROFIT, LOSS OF ANTICIPATED SAVINGS OR REVENUE, LOSS OF INCOME, LOSS OF BUSINESS, LOSS OF PRODUCTION, LOSS OF OPPORTUNITY OR LOSS OF REPUTATION.

8. Inspection. Buyer shall have the right to inspect the goods upon their receipt. When delivery is to Buyer's site or to a project site ("Site"), Buyer shall notify Seller in writing of any nonconformity of the goods with this Agreement within three (3) days from receipt by Buyer. For all other deliveries, Buyer shall notify Seller in writing of any nonconformity with this Agreement within fourteen (14) days from receipt by Buyer. Failure to give such applicable notice shall constitute a waiver of Buyer's right to inspect and/or reject the goods for nonconformity and shall be equivalent to an irrevocable acceptance of the goods by Buyer. Claims for loss of or damage to goods in transit must be made to the carrier, and not to Seller.

9. Seller's Limitation of Liability. EXCEPT AS OTHERWISE PROVIDED BY LAW, IN NO EVENT SHALL SELLER'S LIABILITY UNDER THIS AGREEMENT EXCEED THE AMOUNT PAID BY BUYER UNDER THIS AGREEMENT. SELLER SHALL HAVE NO LIABILITY FOR LOSS OF PROFIT, LOSS OF ANTICIPATED SAVINGS OR REVENUE, LOSS OF INCOME, LOSS OF BUSINESS, LOSS OF PRODUCTION, LOSS OF OPPORTUNITY, LOSS OF REPUTATION, INDIRECT, CONSEQUENTIAL, INCIDENTAL, PUNITIVE OR EXEMPLARY DAMAGES.

10. Force Majeure. Seller may cancel or suspend this Agreement and Seller shall have no liability for any failure to deliver or perform, or for any delay in delivering or performing any obligations, due to acts or omissions of Buyer and/or its contractors, or due to circumstances beyond Seller's reasonable control, including but not limited to acts of God, fire, flood or other natural disasters, war and civil disturbance, riot, acts of governments, terrorism, disease, currency restrictions, labor shortages or disputes, unavailability of materials, fuel, power, energy or transportation facilities, failures of suppliers or subcontractors to effect deliveries, in which case the time for performance shall be extended in an amount equal to the excused period, provided that Seller shall have, as soon as reasonably practicable after it has actual knowledge of the beginning of any excusable delay, notified Buyer of such delay, of the reason therefor and of the probable duration and consequence thereof. Seller shall use its best efforts to eliminate the cause of the delay, interruption or cessation and to resume performance of its obligations hereunder with the least possible delay.

11. Cancellation. Except as otherwise provided in this Agreement, no order may be cancelled on special or made-to-order goods or unless otherwise requested in writing by either party and accepted in writing by the other. In the event of a cancellation by Buyer, Buyer shall, within thirty (30) days of such cancellation, pay Seller a cancellation fee, which shall include all costs and expenses incurred by Seller prior to the receipt of the request for cancellation including, but not

limited to, all commitments to its suppliers, subcontractors and others, all fully burdened labor and overhead expended by Seller, plus a reasonable profit charge." Return of goods shall be in accordance with Seller's most current Return Materials Authorization and subject to a minimum fifteen percent (15%) restocking fee.

Notwithstanding anything to the contrary herein, in the event of the commencement by or against Buyer of any voluntary or involuntary proceedings in bankruptcy or insolvency, or in the event Buyer shall be adjusted bankrupt, make a general assignment for the benefit of its creditors, or if a receiver shall be appointed on account of Buyer's insolvency, or if Buyer fails to make payment when due under this Agreement, or in the event Buyer does not correct or, if immediate correction is not possible, commence and diligently continue action to correct any default of Buyer to comply with any of the provisions or requirements of this Agreement within ten (10) calendar days after being notified in writing of such default by Seller, Seller may, by written notice to Buyer, without prejudice to any other rights or remedies which Seller may have, terminate its further performance of this Agreement. In the event of such termination, Seller shall be entitled to receive payment as if Buyer has cancelled the Agreement as per the preceding paragraph. Seller may nevertheless elect to complete its performance of this Agreement by any means it chooses. Buyer agrees to be responsible for any additional costs incurred by Seller in so doing. Upon termination of this Agreement, the rights, obligations and liabilities of the parties which shall have arisen or been incurred under this Agreement prior to its termination shall survive such termination.

12. Drawings. All drawings are the property of Seller. Seller does not supply detailed or shop working drawings of the goods; however, Seller will supply necessary installation drawings. The drawings and bulletin illustrations submitted with Seller's quotation show general type, arrangement and approximate dimensions of the goods to be furnished for Buyer's information only and Seller makes no representation or warranty regarding their accuracy. Unless expressly stated to the contrary within the quotation or sales form, all drawings, illustrations, specifications or diagrams form no part of this Agreement. Seller reserves the right to alter such details in design or arrangement of its goods which, in its judgment, constitute an improvement in construction, application or operation. All engineering information necessary for installation of the goods shall be forwarded by Seller to Buyer to upon Buyer's acceptance of this Agreement. After Buyer's acceptance of this Agreement, any changes in the type of goods, the arrangement of the goods, or application of the goods requested by Buyer will be made at Buyer's expense. Instructions necessary for installation, operating and maintenance will be supplied when the goods are shipped.

13. Proprietary Information, Injunction. Seller's designs, illustrations, drawings, specifications, technical data, catalogues, "know-how", economic or other business or manufacturing information (collectively "Proprietary Information") disclosed to Buyer shall be deemed proprietary and confidential to Seller. Buyer agrees not to disclose, use, or reproduce any Proprietary Information without first having obtained Seller's express written consent. Buyer's agreement to refrain from disclosing, using or reproducing Proprietary Information shall survive completion of the work under this Agreement. Buyer acknowledges that its improper disclosure of Proprietary Information to any third party will result in Seller's suffering irreparable harm. Seller may seek injunctive or equitable relief to prevent Buyer's unauthorized disclosure.

14. Installation and Start-up. Unless otherwise agreed to in writing by Seller, installation shall be the sole responsibility of Buyer. Where start-up service is required with respect to the goods

purchased hereunder, it must be performed by Seller's authorized personnel or agents; otherwise, the Warranty is void. In the event Buyer has engaged Seller to provide an engineer for start-up supervision, such engineer will function in a supervisory capacity only and Seller shall have no responsibility for the quality of workmanship of the installation. In any event, Buyer understands and agrees that it shall furnish, at Buyer's expense, all necessary foundations, supplies, labor and facilities that might be required to install and operate the goods.

15. Specifications. Changes in specifications requested by Buyer are subject to approval in writing by Seller. In the event such changes are approved, the price for the goods and the delivery schedule shall be changed to reflect such changes.

16. Buyer Warranty. Buyer warrants the accuracy of any and all information relating to the details of its operating conditions, including temperatures, pressures, and where applicable, the nature of all hazardous materials. Seller can justifiably rely upon the accuracy of Buyer's information in its performance. Should Buyer's information prove inaccurate, Buyer agrees to reimburse Seller for any losses, liabilities, damages and expenses that Seller may have incurred as a result of any inaccurate information provided by Buyer to Seller.

17. Minimum Order. Seller reserves the right to refuse to process any order that does not meet quantity requirements that Seller may establish for any given product or group of products.

18. Quality Levels. Prices are based on quality levels commensurate with normal processing. If a different quality level is required, Buyer must specify its requirements, as approved in writing by Seller, and pay any additional costs that may be applicable.

19. Product Recalls. In cases where Buyer purchases for resale, Buyer shall take all reasonable steps (including, without limitation, those measures prescribed by the seller): (a) to ensure that all customers of the Buyer and authorised repairers who own or use affected products are advised of every applicable recall campaign of which the Buyer is notified by the Seller; (b) to ensure that modifications notified to Buyer by Seller by means of service campaigns, recall campaigns, service programmes or otherwise are made with respect to any products sold or serviced by Buyer to its customers or authorized repairers. The reimbursement of Buyer for parts and labor used in making those modifications shall be as set forth in the campaign or program instructions. Without the prior consent of the Seller, the Buyer shall not disclose to any third party the information contained in service campaign, recall campaign or service programme literature. Should Buyer fail to perform any of the actions required under this section, Seller shall have the right to obtain names and address of the Buyer's customers and shall be entitled to get into direct contact which such customers.

19. GOVERNING LAW. THE TERMS OF THIS AGREEMENT AND ALL RIGHTS AND OBLIGATIONS HEREUNDER SHALL BE GOVERNED BY THE LAWS OF THE STATE OF SELLER'S OFFICE TO WHICH THIS ORDER HAS BEEN SUBMITTED (WITHOUT REFERENCE TO PRINCIPLES OF CONFLICTS OF LAWS). THE RIGHTS AND OBLIGATIONS OF THE PARTIES HEREUNDER SHALL NOT BE GOVERNED BY THE 1980 U.N. CONVENTION ON CONTRACTS FOR THE INTERNATIONAL SALE OF GOODS.

20. Titles. The section titles are for reference only, and shall not limit or restrict the interpretation or construction of this Agreement.

21. Waiver. Seller's failure to insist, in any one or more instances, upon Buyer's performance of this Agreement, or to exercise any rights conferred, shall not constitute a waiver or relinquishment of any such right or right to insist upon Buyer's performance in any other regard.

22. Severability. The partial or complete invalidity of any one or more provisions of this Agreement shall not affect the validity or continuing force and effect of any other.

AGREEMENT TO PURCHASE: BUYER agrees to purchase the equipment and services herein in accordance with the terms and conditions set forth above.

_____
(BUYER)

BY:_____

_____

_____

_____, 20 _____

ACCEPTANCE:SELLERhereby accepts BUYER'S offer to purchase.

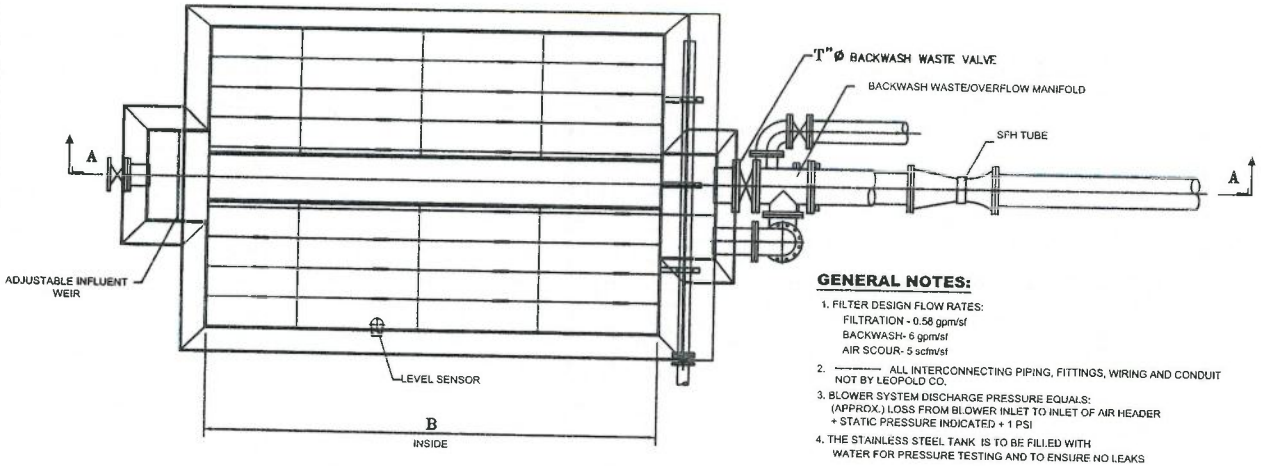
Xylem Water Solutions USA, Inc.

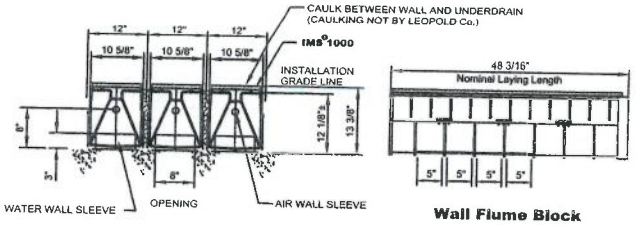
BY:_____

_____

_____

_____, 20 _____



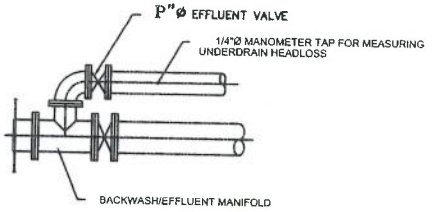


SECTION B-B

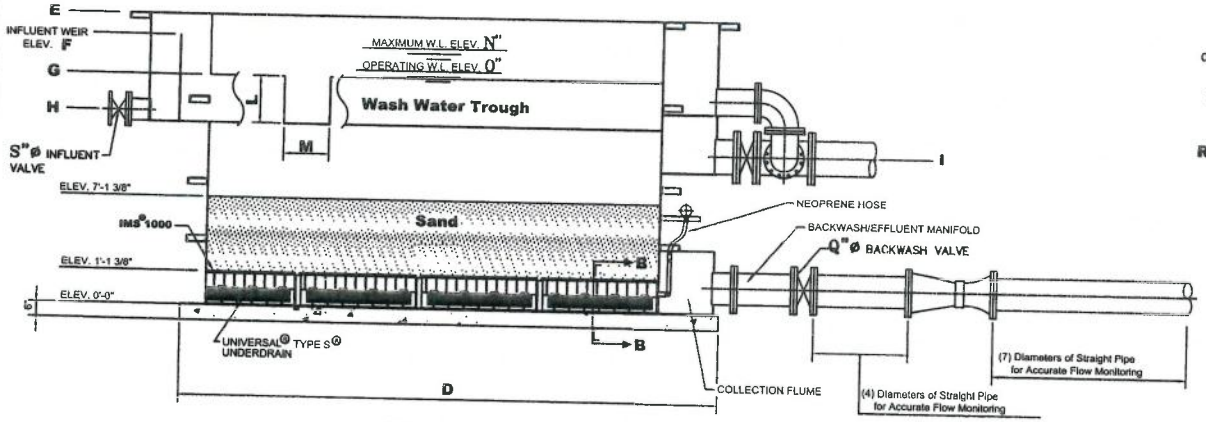
Wall Flume Block

GENERAL NOTES:

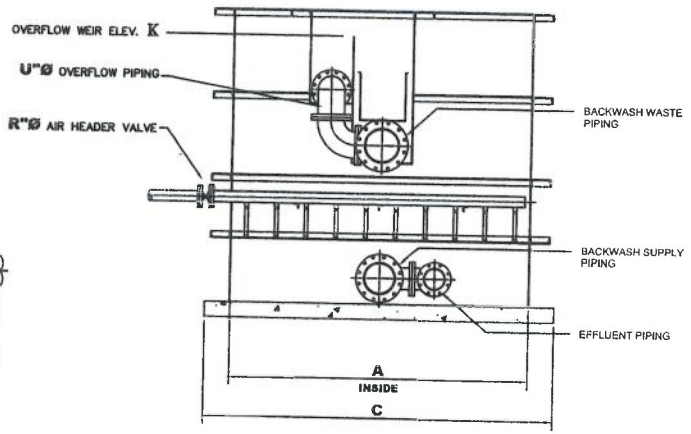
1. FILTER DESIGN FLOW RATES:
   FILTRATION - 0.58 gpm/sf
   BACKWASH- 6 gpm/sf
   AIR SCOUR- 5 scfm/sf
2. ———— ALL INTERCONNECTING PIPING, FITTINGS, WIRING AND CONDUIT NOT BY LEOPOLD CO.
3. BLOWER SYSTEM DISCHARGE PRESSURE EQUALS: (APPROX.) LOSS FROM BLOWER INLET TO INLET OF AIR HEADER + STATIC PRESSURE INDICATED + 1 PSI
4. THE STAINLESS STEEL TANK IS TO BE FILLED WITH WATER FOR PRESSURE TESTING AND TO ENSURE NO LEAKS



BACKWASH/EFFLUENT PIPING



SECTION A-A



PRELIMINARY

DESIGN FLOW (MGD)	DIMENSIONS & DATA — PROCESS TANK															PIPING					
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
0.243	8'-0"	12'-0"	10'-0"	14'-0"	15'-4 3/8"	14'-3 3/8"	11'-8 3/8"	10'-10 3/8"	9'-2 3/8"		14'-3 3/8"	13"	12"	14'-2 3/8"	13'-8 3/8"	6"	8"	6"	6"	8"	6"

REVISION
1
2
3

Universal® Type S® Pre-Engineered Filter System

Shinglehouse Borough, PA I16482

DRAWN BY	CHECKED BY	DATE	SCALE	DWG NO
CDF		9/1/16	NONE	I16482.90.1

Kappe Associates Inc

Since 1946

403 Chestnut St
Suite 1
Emmaus PA 18049

Office 215 361-5700
Fax 215 361-5701
ewalters@kappe-inc.com

May 13, 2016

To: Josh Fox

Project: Shinglehouse Pa

Engineer: HRG

Regarding: Monroe **Environmental** budget proposal to rehab existing primary and final clarifiers

Mr. Fox:

Per your request, Monroe **Environmental** is pleased to provide the following budgetary proposal for two (2) 35' Diameter Monroe Primary Circular Clarifier Mechanisms and two (2) 17' Diameter Final Circular Clarifier **Mechanisms** for the Shingle House, PA WWTP.

Circular Clarifier System Components:

- Coated Carbon Steel Construction (Submerged & Non-Submerged)
- DBS Precision Fabricated Drive (Bridge Mount)
- Access Bridge, Walkway & Handrails (Full Diameter)
- Inlet Well
- Inlet Pipe
- Drive Shaft
- Skimmer Arm & Scum Box
- Two (2) Rake Arms
- FRP Weirs & Scum Baffle

Budgetary Price – 35' Diameter Circular Clarifier: $ 105,000.00/each

Budgetary Price – 17' Diameter Circular Clarifier: $ 65,000.00/each

Delivery: Normal delivery is sixteen to eighteen (16 - 18) weeks after receipt of approved submittal drawings. Approval drawings to be sent three to five (3 - 5) weeks after receipt of acceptable purchase order. To be confirmed at time of purchase order.

Note: Installation, concrete work, pumps, exterior piping, freight and start-up services are not included.

Please contact our office as necessary. Thank you.

Respectfully:

Evan Walters

Duperon ADAPTIVE TECHNOLOGY™
Let's Build a System that Works for You™

Date: April 29, 2016

Project: Shinglehouse WWTP, PA

Proposal Number: 8735

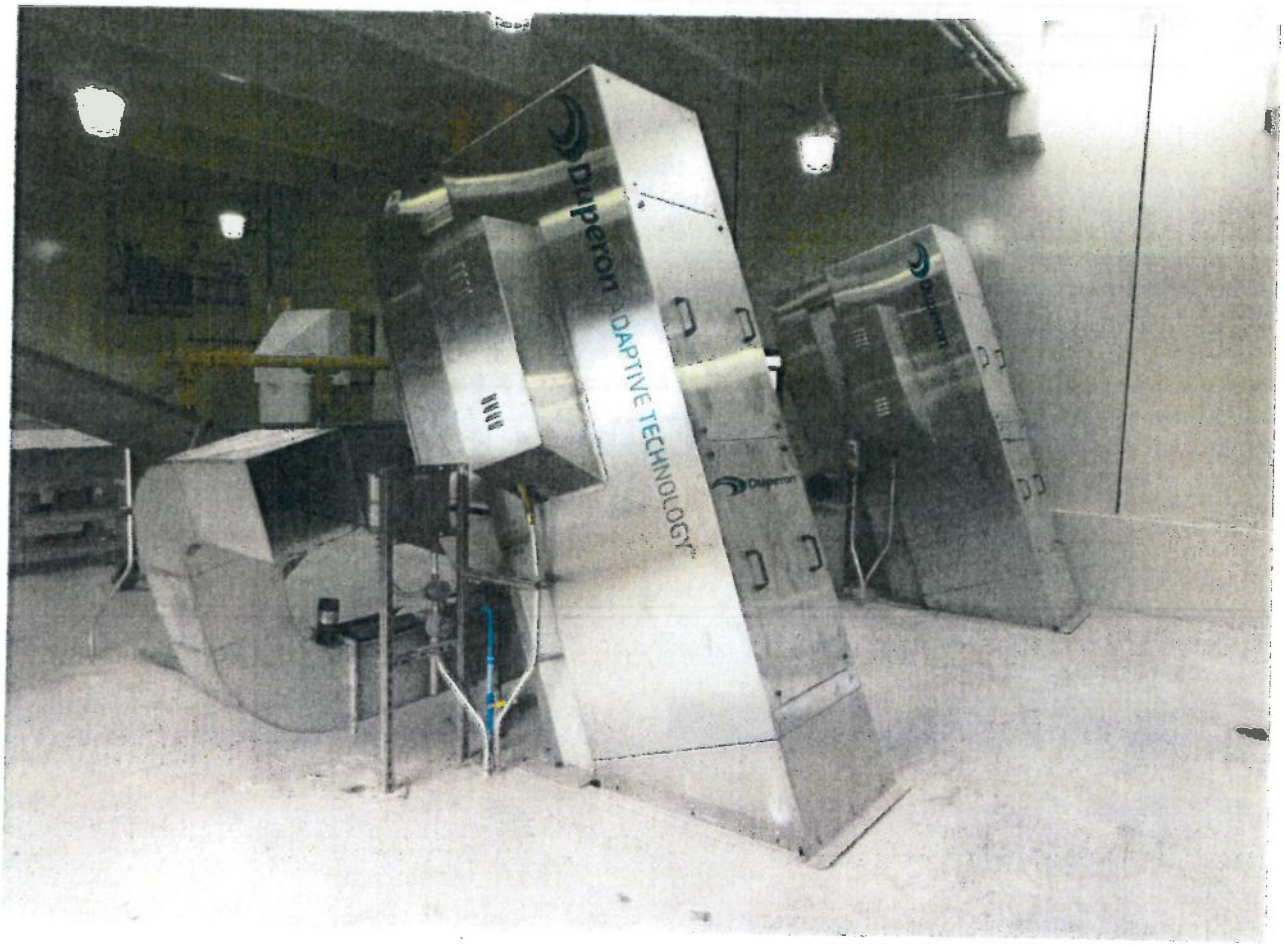
PRELIMINARY BUDGET EQUIPMENT SCOPE

To: Shinglehouse WWTP, PA

From: **Your Duperon® Team**
Scott Bartlett
Sales Project Manager
(989) 754-8800
sbartlett@duperon.com

Lorene Bruns
Regional Sales Manager
(989) 754-8800
lbruns@duperon.com

Rep: Evan Walters
Sales Rep
Kappe Associates, Inc
(215) 361-5700



Duperon ADAPTIVE TECHNOLOGY™
Let's Build a System that Works for You™

Date: April 29, 2016

Project: Shinglehouse WWTP, PA **Proposal Number:** 8735

PRELIMINARY BUDGET EQUIPMENT SCOPE

Thank you for considering **Duperon®** system solutions for your project. We appreciate the opportunity to provide you with a **Preliminary Budget Equipment Scope**. Please do not hesitate to contact your **Duperon® Team** with any questions as we work with you through the design process and ensure a successful project.

Equipment Scope

SCREENS:

QTY	UNIT	DESCRIPTION		
1	EA	**Duperon® FlexRake® - Front Clean Front-Return**		
		Model:	FPFS - Full Penetration, Fine Screen	
Notes: A downstream weir is recommended based on the flow and low water level, Heat pad and Thermostat pricing included. Power to be supplied by others.		Enclosure (& Material):	Fully Enclosed (304)	
		Nom Width x Length:	1.5 x 10	Feet
		Clear Opening Size:	0.25	Inches
		Angle of Installation:	15	Deg. from Vertical
		Material Construction:	304	SSTL

Screenings Processing

QTY	UNIT	DESCRIPTION
0	EA	**See Optional Equipment**

CONTROLS

QTY	UNIT		
1	EA	**Main Control Panel:**	**1 - FPFS**
		Power:	480V/3ph/60hz
Notes:		Panel Rating:	NEMA 4X
		PLC/Relay Based:	Relay
		Screen Instrumentation:	Dual Mechanical Float
		Local Pushbutton Station(s):	Three Button (E-Stop/Run/Jog Rev)

TECH/FREIGHT

QTY	UNIT	DESCRIPTION		
1	LOT	**On-Site Technical Assistance**		
		Number of Trips:	1	Trip(s)
		Days On-Site per Trip:	2	8-hour man-day(s)
1	LOT	**Freight**		
		FOB Factory, Full Freight Allowed		

Clarifications:

- This is not a fully designed project; preliminary pricing may be affected by scope change/project development
- Operational, structural, wind, or seismic calculations are not included
- Scope is based on models and assumptions widely utilized in the industry
- Scope does not convey an offer to sell; installation and taxes are not included
- **For reference only:** Standard Delivery Schedule: Submittals 4-6 week from PO - Delivery 8-12 weeks from approval

PRELIMINARY BUDGET PRICING: **$125,000.00**

Duperon ADAPTIVE TECHNOLOGY™
Let's Build a System that Works for You™

Date: April 29, 2016

Project: Shinglehouse WWTP, PA

Proposal Number: 8735

OPTIONAL EQUIPMENT AND ACCESSORIES

Thank you for considering **Duperon®** system solutions for your project. We appreciate the opportunity to provide you with a **Preliminary Budget Equipment Scope**. Please do not hesitate to contact your **Duperon® Team** with any questions as we work with you through the design process and ensure a successful project.

Optional Equipment

Washer Compactor

QTY	UNIT	DESCRIPTION	
1	EA		**Duperon® Washer Compactor**
		Model:	WC2.A1.5
Notes:		Appx Footprint:	2 ft wide x 7 ft long
		Motor HP:	0.75 HP
		Chute Allowance:	10 ft long w/ 1 bend (customizable)
		Material Construction:	304 SSTL
		ADD PRICE (EA):	**$55,000.00**

Conveyor

QTY	UNIT	DESCRIPTION	
1	EA	**Conveyor**	**Shaftless Screw Conveyor**
		Appx Footprint:	2 ft wide x 10 ft long
Notes:		Motor HP:	1 HP
		Material Construction:	304 SSTL
		ADD PRICE (EA):	**$18,000.00**

Optional Accessories

Bar Screen Deadplate Heat Pad
12" x 12" heat pad (power by others)
Thermostat

ADD PRICE (EA): $1,800

Washer Compactor Chute Extension
10 ft extension beyond the 10 ft supplied
Includes 1 support leg for extension
(Additional support legs $600 ea)

ADD PRICE (EA): $2,100

Washer Compactor Elephant Drop Sleeve
Solid canvas flexible tube
10 ft overall length
Attaches directly to discharge chute

ADD PRICE (EA): $1,575

Washer Compactor Heat Trace & Blanket Kit
Required in applications where freezing temperature are possible
Teflon heat blanket (weather-proof) construction
Thermostat (NEXA 4X) with remote probe for temperature reading
Components are CLASS I DIVISION I rated

ADD PRICE (EA): $5,000

Washer Compactor Bagging System
Longofill cassette holder - SSTL & ABS plastic
Longopac PE continuous bagger cassette, 230 ft (80 m)

ADD PRICE (EA): $3,400

Washer Compactor Caster Frame System
304SSTL frame structure
4 highly durable casters

ADD PRICE (EA): $3,855

Washer Compactor Open Channel Support Frame
304SSTL frame structure
Custom built to span open channels

ADD PRICE (EA): $1,770

Budget Pricing
High Head Pump.

Let Evan Know what I find out.

Shinglehouse Borough Wastewater Equipment Data

Raw Sewage pump #1
Wemco Torque-Flow Pump
Pump size 4x4x11M 500 GPM
US Electric Motor
HP 10 3 ph 60 hz 1165 rpm
208 volts F.L. Amps 28 S.F. 1.15
Serial # 9491914 Model EV
List $ 8,500.00

Raw Sewage pump #2
Chicago Vortex pump
500 gpm @ 35' TDH
World Wide electric motor
HP 10 3 ph 6 hz 1180 rpm
230 volts amps 28.4/14.2 S.F. 1.15
VTX-0-44111 So# 9805101
List $ 8,200.00

Sludge pumps (2)
Chicago pump
Marathon electric motor
HP 5 3 ph 60 hz 1155 rpm
208 volts Fla 17 S.F. 1.0 44091
80 GPM @ 32' TDH
$ 3,600.00 9804985
~~Muffin grinder~~
~~HP 3 S.F. 1.15 230 volts~~
~~60 hz~~

Recirculating Pumps (2)
Flygt submersible
235 gpm
2.2 hp 3 ph 3-60 hz 1.6 k.w.
208 volts 7.6 amps 1730 rpm
List $ 5,500.00

~~Clarifiers (2)~~
~~Dorr-Oliver~~
~~HP ½ 3 ph 208 volts~~
~~2.88 amps 60 hz~~

Pump station (2)
Paco submersible pumps
HP 5 700 gpm @ 14.27' TDH
3 ph 60 hz 870 rpm
230 volts F.L. amps 18 S.F. 1.15
58-QDF-61215 / ~~612~~ 612-15
List $ 7,700.00
Sludge pump for drying beds
Scavenger pump
H.P. 3 3 ph 230 volt 60 hz
8.4/4.2 amps S.F.1.15
List $ [redacted]
$3,800.00 3 h.p.

~~Blowers (2)~~
~~M-D Pneumatics~~
~~Competitor Plus~~
~~Rotary Positive Displacement~~
~~H.P. 7.5 208 volts amps 21.4-20.4-19.2~~

225 GPM @ 15' TDH
VCS-LMC4
9804986-A
SC4412
9804463

BRENTWOOD

Trickling Filter Proposal No.: **WG02343**

TO:	Geiger Pump & Equipment Company	**DATE:**	August 19, 2016
ATTN:	Sara R. Urbanczyk	**FROM:**	Larry Li
RE:	Shinglehouse PA	**PAGES:**	1 (Including Cover)

Please forward this information to the customer as appropriate.

As requested, it is our pleasure to offer our **Budget Estimate** based on the parameters below:

No. of Filters:	2	Filter Media Depth, ft:	5.0
Filter Diameter, ft:	35.0	Media Volume, ft^3:	10,234

Product		Description	Material	Area	Notes
AccuPac®	**CF1900**	Cross Flow Media	SPVC	48 ft2/ft3	
			TOTAL ESTIMATE FOR ABOVE SCOPE:	**$**	**67,700.00**
			Estimated Freight to Jobsite (Included Above)		

Notes:

-Above estimate is for the supply of our standard products as per our standard specifications.
-Above estimate includes packaging the modules on pallets to minimize shipping damage.
-The media modules will be of approximate size: 2 ft. high, 2 ft. wide, 4 or 6 ft. long
-The finished modules shall be suitable for normal wastewater temperatures between 50°F and 75°F.
-Estimate includes wastage, supervision, testing and excludes offloading and installation.
-Please note that actual price may vary at bid time due to changes in PVC raw material costs.

Options:

-Additional technical installation supervision can be purchased for $950 per day plus actual expenses.
-Additional compression tests at independent testing lab, if desired can be added for $1,200.00

Brentwood Industries is proud of our high quality products, our comprehensive engineering support and our unique success in never having had any trickling filter media failures. We have succeeded by maintaining stringent internal standards in the construction and application of our media.

We hope the above information is helpful. Please contact us if you have any questions.

Sincerely,

Larry Li
Product Line Manager
Brentwood Industries, Inc.

Brentwood Industries, Inc.
500 Spring Ridge Drive, Reading, PA 19610, USA
brentwoodindustries.com

Phone: 610.374.5109

Fax: 610.685.0127

Submitted to: Herbert, Rowland, and Grubic, Inc.

Submitted by: Ashley Garbett
Applications Engineer

Date: 9/8/2016

Kruger Inc.
4001 Weston Parkway
Cary, NC 27513
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www.krugerusa.com

Water Technologies

Introduction

I Kruger Inc is pleased to present this budgetary proposal for our BIO-DENIPHO Oxidation Ditch System. The BIO-DENIPHO system proposed herein includes a guarantee of the process performance, and a 2 yr warranty on all components can be provided at the stated price. This proposal describes the various treatment objectives, process configurations recommended to meet those objectives, and a detailed listing of the equipment proposed for the process. Spare parts are not included in this proposal.

The system proposed for the Shinglehouse WWTP is fully optimized to provide maximum efficiency and process flexibility with sufficient aeration to ensure demands are met at full load, at all times of the day, and with a rotor out of service. In comparing the BIO-DENIPHO system to competitors' systems, it is imperative that all other systems under consideration provide *at minimum* the daily design AOR stated herein, and be capable of maintaining the same residual DO concentration. If the level of safety and assurance of oxygen supply represented in this proposal is not required, Kruger can potentially reduce the number of rotors included. In addition, to ensure the targeted effluent Total Nitrogen limit is reached under winter time conditions, an absolute minimum total volume (aerobic+anoxic) should be provided by all systems under consideration and should not be less than the volume stated herein.

Thank you for your consideration of the BIO-DENIPHO system. Detailed operational descriptions, process calculations, recommended spare parts lists, concrete estimates, power consumption estimates and other supporting information can be provided upon request.

The BioDenipho system consists of two stage anaerobic selector followed by a dual oxidation ditch train. The system is designed to meet the effluent TN requirement of 6 mg/L without the addition of supplemental carbon, internal recycle streams, or post anoxic zones. An anaerobic selector for biological phosphorous removal is also included in the design. The rotors are sized to meet the AOR requirements should one rotor fail and a ditch need be removed from service. Additionally, should one ditch be removed from service, the process volume of a single ditch is sufficient to meet treatment objectives at minimum design temperature and up to 75% of design load. Two ditches in operation have a design MLSS of 3,000 mg/L.

We Know Water

I. Kruger Inc. (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 Solutions & Technologies, the fully-owned subsidiary of **Veolia Water**, 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 Water Solutions & Technologies (VWS) 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 VWS will continue to maximize the financial benefits for every customer.

Process Description

BIO-DENIPHO® Phased Isolation Ditch

The proposed ditch system will operate in the BIO-DENIPHO mode of Phased Isolation Ditch (PID) technology. A distinguishing feature of this process is the alternating flow pattern and process conditions (aerobic and anoxic) occurring within the oxidation ditches. This operating strategy allows nitrogen and carbonaceous BOD removal to occur within the active process volume, eliminating the need for internal recycle pumping.

A PID operation strategy imparts tremendous process flexibility. The time-based 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 to a specific treatment objective can be adjusted, thereby enabling the treatment process to accommodate a wide range in influent flow and character. This type of process provides an operating strategy to allow the facility to accommodate the actual loading, as opposed to treating flows with a treatment strategy designed for 20 year projected loadings. For example, during start-up conditions a greater fraction of the process volume could be allocated to anoxic conditions, thereby minimizing the facility's energy consumption.

View of a rotor from inside the ditch.

A submersible mixer in the ditch.

The PID operation is executed by a PLC-based control system that coordinates the operation of the mechanical process equipment and controls the phase lengths within each ditch. The PLC control system can allow both manual and automatic control of the treatment process. The PLC-based control panel also includes pre-programmed operational modes, such as the storm water mode to address I/I concerns. For example, automatic or manual activation of the storm water

mode incorporates a sedimentation phase into the BIO-DENIPHO process to prevent solids washout during severe rain events. This innovation may potentially reduce the required size of the secondary clarifiers or eliminate the requirement for redundant clarifiers.

To ensure economical and efficient treatment, the control system also controls the aeration equipment by automatic dissolved oxygen (D.O.) control. D.O. probes continuously monitor and report residual D.O. levels within the oxidation ditches to a PLC-based control panel that controls the aeration equipment to meet, but not exceed, the current oxygen demand. This control eliminates costly and wasteful over-aeration that can compromise process stability and operational budgets.

Listed below are several advantages that BIO-DENIPHO process offers compared to other biological nutrient removal processes.

- No internal recycle pumping or separate anoxic reactors, resulting in simpler process control.
- Does not require a supplemental carbon source for denitrification in oxidation ditches;
- Automated and simple control system with preprogrammed operational modes ensures energy efficient treatment;
- Separation of mixing and aeration combined with automatic dissolved oxygen control ensures energy efficiency and stable operation;
- Automatic dissolved oxygen control enhances denitrification capability and saves energy;
- Process flexibility afforded by the capability to vary the effective process volumes allocated for aerobic treatment and anoxic, thereby providing a process that can adapt to either load or seasonal variations;
- Design incorporates improved anaerobic selector reactor configuration which enhances phosphorus uptake and removal;
- Anaerobic selector technology prevents the excessive growth of filamentous bacteria responsible for sludge bulking, thereby producing a superior settling floc.

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, that the COD/BOD ratio is between 1.7 and 2.3, and that none of the equipment provided would be used in a classified area (e.g. Class 1, Division 1 or Class 1, Division 2).

Influent Design Basis

Parameter	Value
Influent Flow, Average Design (MGD)	0.16
Influent Flow, Peak Day (MGD)	0.38
BOD_5 (mg/L)	220
TSS (mg/L)	220
TKN (mg/L)	40
TP (mg/L)	8
Elevation[a] (ft AMSL)	1,500
Min/Max Temperature (˚C)	10/20

a - Assumed value.

Effluent Objectives

Parameter	Value
$CBOD_5$ (mg/L)	< 10
TSS (mg/L)	< 10
TN (mg/L)	< 6
TP (mg/L)	<0.8[A]

A. Provisions for coagulant addition (iron or aluminum) are required to ensure consistent compliance with effluent limits (by others).

Bio-P Selector Reactor

Parameter	Value
Number of Trains / Number of Tanks per Train	1 / 2
(Length/Width) per Tank (ft)	9 x 9
Side Water Depth (ft)	8.5
Total Anoxic Volume (MG)	0.010
HRT (hrs)	1.5

BIO-DENIPHO Design Summary

Parameter	Value
Number of Oxidation Ditches	2
Internal Length per Ditch (ft)	64
Internal Width per Ditch (ft)	28
Average Side Water Depth (ft)	7.5
Total System Volume (MG)	0.186
Design Anoxic / Aerobic Operating Time (%)	30/ 70
System HRT (hrs)	27
System SRT (days)	16
MLSS at 10˚C (mg/L)	3000
System F/M Ratio ($days^{-1}$)	0.09
Design Sludge Yield (lbs MLSS/lb BOD_5 applied)	0.9
Waste Activated Sludge (lb WAS/day)	260

BIO-DENIPHO Aeration Summary

Parameter	Value
AOR BOD Basis (lbs O_2/lb BOD_5 applied)	1.2
AOR TKN Basis (lbs O_2/lb TKN nitrified)	4.57
AOR Denite Basis (lbs O_2/lb NO_3-N denitrified)	-2.86
Total System *Average* AOR[1] (lbs O_2/day)	438
Design Rotor Alpha / Beta	0.85 / 0.95
Design Residual DO during Aerobic Phase	2.0

Design SOR (lbs O_2/day)	763
Total System Design SOR (lbs O_2/hr)	32
Number of MIDI Rotors per Ditch	1
Nameplate Power per MIDI Rotor (HP)	15
SOTR Capability, (lbs O_2/hr)	
Installed	96
N-1 Rotors[2]	48

1: The wastewater load is typically received according to a diurnal flow pattern resulting in organic and nitrogen loads that exceed the average load during limited periods of the day. Kruger recommends a safety factor be in place in determining the design AOR that accounts for the diurnal characteristics of the influent wastewater.

2: Kruger recommends an installed aeration capacity that meets the design oxygen requirement with the single largest mechanical aerator out of service.

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 BIO-DENIPHO 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.

BIO-DENIPHO System Equipment

Mechanical Equipment Items	Qty	Description	Est. HP
Influent Flow Distributors	1	Type 200 Actuated Influent Distributor	1/12
Anaerobic Selector Mixers	2	TR 21. Submersible Mixer, 304 SS Rails w/ Hoist	0.7
Oxidation Ditch Mixers	2	TR 60 Submersible Mixer, 304 SS Rails w/ Hoist	2.7
Brush Rotors	2	3.0 meter MIDI Rotor, 304SS Center Tube with HDG Rotor Blades	15
Rotor Accessories	2	Splash Plate, Painted Steel Flow Directional Baffle, Aluminum Access Grating, Sound Attenuating Motor Cover, total of one (1) manual oil pump	N/A
Effluent Flow Control Weirs	2	2.5 meter automated HDG Weir	1/2

Instrumentation and Controls Equipment Items*	Qty	Description
Submersible Pressure Transducer	2	Ditch Liquid Level Measurement
Dissolved Oxygen Probe	2	Hach LDO w/ SC200 Transmitter
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. 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. Together, Kruger's estimate of on-site field service for this project includes:

- Four (4) Total Trips to the Project Site
- Twenty (20) Total Man-Days of Service (Travel Time Inclusive)

Scope of Supply BY INSTALLER/PURCHASER

The following items are NOT included in the scope of supply for the system and should be provided for by the Installing Contractor/Purchaser of the system *unless explicitly stated as included in the above scope of supply*. These items include, but are not necessarily limited to, the following items:

- Concrete foundations, pads, tanks, structural components, walkways, handrail, grating and covers,
- Equipment installation, piping to and from the system, interconnecting piping, manual isolation valves or gates, anchor bolts, epoxy/adhesive for anchors,
- Raw influent wastewater pumping, influent screening and grit removal facilities,
- Solids handling/disposal system, WAS pumps, digester equipment,
- Effluent holding tanks/equipment, disinfection equipment, outfalls,
- Chemical addition systems, containment, odor control equipment, laboratory systems or equipment,
- Overhead gantries or cranes,
- Motor control center, motor starters, adjustable frequency drives, main disconnects, breakers, generators, or power supply,

- Field wiring, interconnecting wiring, conduit, wiring terminations at equipment, local equipment disconnects, local equipment control panels, and wiring terminations at control panels,
- All electrical and mechanical hardware with the exception of the equipment that is identified above,
- All work associated with buildings or other structures used for housing any part of the system provided, including HVAC and electrical work.

Schedule

- Drawings and Specifications for use in preparation of Engineer's Bidding Documents can be provided following completion of Kruger P&S Questionnaire and follow-up design discussions to confirm materials, equipment preferences, overall scope of supply, controls requirements, etc. Drawings and specifications typically require 1-2 weeks following questionnaire completion and confirmation of scope.
- Shop drawings will be submitted within 6-8 weeks of receipt of an executed contract by all parties.
- All equipment will be delivered within 18-20 weeks after receipt of written approval of the shop drawings.
- Installation manuals will be furnished upon delivery of equipment.
- Operation and Maintenance Manuals will be submitted within 90 days after receipt of approved shop drawings.

Pricing

The price for the Kruger BIO-DENIPHO system, as defined herein, including process and design engineering, field services, and equipment supply is: **$420,000**

Pricing is FOB shipping point, with freight allowed to the job site. This pricing does not include any sales or use taxes. In addition, pricing is valid for ninety (90) days from the date of issue and is subject to negotiation of a mutually acceptable contract.

Please note that the above pricing is expressly contingent upon the items in this proposal and are subject to I. Kruger Inc. Standard Terms of Sale detailed herein.

Kruger Standard Terms of Payment

The terms of payment are as follows:

- 10% on receipt of fully executed contract
- 15% on submittal of shop drawings
- 75% on the delivery of equipment to the site

Payment shall not be contingent upon receipt of funds by the Contractor from the Owner. There shall be no retention in payments due to I. Kruger Inc. All other terms per our Standard Terms of Sale are attached.

All payment terms are net 30 days from the date of invoice. Final payment not to exceed 120 days from delivery of equipment.

I. Kruger Inc. Standard Terms of Sale

1. Applicable Terms. These terms govern the purchase and sale of the equipment and related services, if any (collectively, "Equipment"), referred to in Seller's purchase order, quotation, proposal or acknowledgment, as the case may be ("Seller's Documentation"). Whether these terms are included in an offer or an acceptance by Seller, such offer or acceptance is conditioned on Buyer's assent to these terms. Seller rejects all additional or different terms in any of Buyer's forms or documents.

2. Payment. Buyer shall pay Seller the full purchase price as set forth in Seller's Documentation. Unless Seller's Documentation provides otherwise, freight, storage, insurance and all taxes, duties or other governmental charges relating to the Equipment shall be paid by Buyer. If Seller is required to pay any such charges, Buyer shall immediately reimburse Seller. All payments are due within 30 days after receipt of invoice. Buyer shall be charged the lower of 1 ½% interest per month or the maximum legal rate on all amounts not received by the due date and shall pay all of Seller's reasonable costs (including attorneys' fees) of collecting amounts due but unpaid. All orders are subject to credit approval.

3. Delivery. Delivery of the Equipment shall be in material compliance with the schedule in Seller's Documentation. Unless Seller's Documentation provides otherwise, Delivery terms are F.O.B. Seller's facility.

4. Ownership of Materials. All devices, designs (including drawings, plans and specifications), estimates, prices, notes, electronic data and other documents or information prepared or disclosed by Seller, and all related intellectual property rights, shall remain Seller's property. Seller grants Buyer a non-exclusive, non-transferable license to use any such material solely for Buyer's use of the Equipment. Buyer shall not disclose any such material to third parties without Seller's prior written consent.

5. Changes. Seller shall not implement any changes in the scope of work described in Seller's Documentation unless Buyer and Seller agree in writing to the details of the change and any resulting price, schedule or other contractual modifications. This includes any changes necessitated by a change in applicable law occurring after the effective date of any contract including these terms.

6. Warranty. Subject to the following sentence, Seller warrants to Buyer that the Equipment shall materially conform to the description in Seller's Documentation and shall be free from defects in material and workmanship. The foregoing warranty shall not apply to any Equipment that is specified or otherwise demanded by Buyer and is not manufactured or selected by Seller, as to which (i) Seller hereby assigns to Buyer, to the extent assignable, any warranties made to Seller and (ii) Seller shall have no other liability to Buyer under warranty, tort or any other legal theory. If Buyer gives Seller prompt written notice of breach of this warranty within 18 months from delivery or 1 year from beneficial use, whichever occurs first (the "Warranty Period"), Seller shall, at its sole option and as Buyer's sole remedy, repair or replace the subject parts or refund the purchase price therefore. If Seller determines that any claimed breach is not, in fact, covered by this warranty, Buyer shall pay Seller its then customary charges for any repair or replacement made by Seller. Seller's warranty is conditioned on Buyer's (a) operating and maintaining the Equipment in accordance with Seller's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to Seller. Seller's warranty does not cover damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by Seller). THE WARRANTIES SET FORTH IN THIS SECTION ARE SELLER'S SOLE AND EXCLUSIVE WARRANTIES AND ARE SUBJECT TO SECTION 10 BELOW. SELLER MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.

7. Indemnity. Seller shall indemnify, defend and hold Buyer harmless from any claim, cause of action or liability incurred by Buyer as a result of third party claims for personal injury, death or damage to tangible property, to the extent caused by Seller's negligence. Seller shall have the sole authority to direct the defense of and settle any indemnified claim. Seller's indemnification is conditioned on Buyer (a) promptly, within the Warranty Period, notifying Seller of any claim, and (b) providing reasonable cooperation in the defense of any claim.

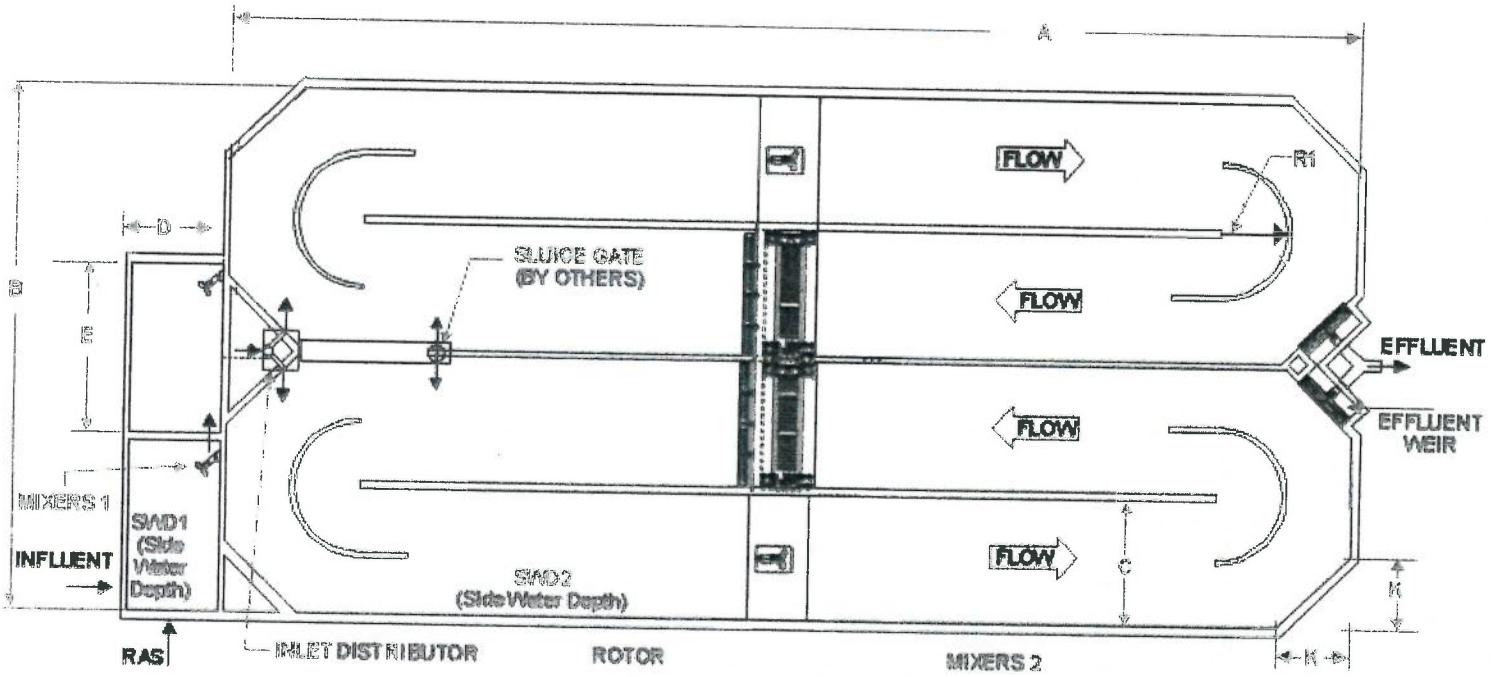
8. Force Majeure. Neither Seller nor Buyer shall have any liability for any breach (except for breach of payment obligations) caused by extreme weather or other act of God, strike or other labor shortage or disturbance, fire, accident, war or civil disturbance, delay of carriers, failure of normal sources of supply, act of government or any other cause beyond such party's reasonable control.

9. Cancellation. If Buyer cancels or suspends its order for any reason other than Seller's breach, Buyer shall promptly pay Seller for work performed prior to cancellation or suspension and any other direct costs incurred by Seller as a result of such cancellation or suspension.

10. LIMITATION OF LIABILITY. NOTWITHSTANDING ANYTHING ELSE TO THE CONTRARY, SELLER SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER INDIRECT DAMAGES, AND SELLER'S TOTAL LIABILITY ARISING AT ANY TIME FROM THE SALE OR USE OF THE EQUIPMENT SHALL NOT EXCEED THE PURCHASE PRICE PAID FOR THE EQUIPMENT. THESE LIMITATIONS APPLY WHETHER THE LIABILITY IS BASED ON CONTRACT, TORT, STRICT LIABILITY OR ANY OTHER THEORY.

11. Miscellaneous. If these terms are issued in connection with a government contract, they shall be deemed to include those federal acquisition regulations that are required by law to be included. These terms, together with any quotation, purchase order or acknowledgement issued or signed by the Seller, comprise the complete and exclusive statement of the agreement between the parties (the "Agreement") and supersede any terms contained in Buyer's documents, unless separately signed by Seller. No part of the Agreement may be changed or cancelled except by a written document signed by Seller and Buyer. No course of dealing or performance, usage of trade or failure to enforce any term shall be used to modify the Agreement. If any of these terms is unenforceable, such term shall be limited only to the extent necessary to make it enforceable, and all other terms shall remain in full force and effect. Buyer may not assign or permit any other transfer of the Agreement without Seller's prior written consent. The Agreement shall be governed by the laws of the State of North Carolina without regard to its conflict of laws provisions.

Equipment					
	Mixers 1	Mixers 2	Rotors	Effluent Weirs	Influent Distributor
Qty.	2	2	2	2	1
Model	TR 174	TR 60	Midi 3.0	2.5 meter	Type 200
HP	0.6	2.7	15		



Inside Dimensions (ft.)	
A	64
B	59
C	14
D	9
E	9
R1	5.6
R2	N/A
K	8.3
SWD1	8.5
SWD2	7.5

KRÜGER
Krüger, Inc.
4001 Weston Pkwy
Cary, NC 27513
Ph: (919) 677-8310 Fax: (919) 677-0082

Checked: JLB | Drawn: LGW

Scale: Not To Scale – For Concept Visualization Only

Date: 09/08/2016

Process Flow Diagram
DE DENIPHO

Shinglehouse, PA

Project No. 5700138611

HRG
Herbert, Rowland & Grubic, Inc.
Engineering & Related Services
AN EMPLOYEE-OWNED COMPANY

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Phone: (717) 564-1121
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OPINION OF PROBABLE CONSTRUCTION COST ESTIMATE
FOR
ALTERNATIVE 1a - EXISTING WWTP RETROFIT (WITH DENITRIFICATION FILTER SYSTEM)
BOROUGH OF SHINGLEHOUSE
SEPTEMBER 2016

ITEM NO.	DESCRIPTION	EST. QTY.	UNIT	UNIT COST	EXTENSION
	GENERAL				
1	MOBILIZATION/PROJECT MANAGEMENT (5%)	1	L.S.	$ 119,000.00	$ 119,000.00
2	BONDS & INSURANCES (2%)	1	L.S.	$ 48,000.00	$ 48,000.00
3	DEMOLITION (EXISTING FLOOR MOUNTED DIFFUSERS)	1	L.S.	$ 36,000.00	$ 36,000.00
	CIVIL				
4	EXCAVATION	78	CY	$ 10.00	$ 784.14
5	BACKFILL	49	CY	$ 30.00	$ 1,481.49
	STRUCTURAL				
6	WALL CONCRETE	0	CY	$ 1,200.00	$ -
	ARCHITECTURAL				
7	BUILDING	0	SF	$ 200.00	$ -
	EQUIPMENT				
8	PRIMARY CLARIFIER'S COMPONENTS RETROFIT	1	L.S.	$ 157,500.00	$ 157,500.00
9	SECONDARY CLARIFIER'S COMPONENT'S RETROFIT	1	L.S.	$ 157,500.00	$ 157,500.00
10	RAW SEWAGE PUMPS	2	EA	$ 10,625.00	$ 21,250.00
11	CLARIFIER'S SLUDGE TRANSFER PUMPS	2	EA	$ 10,625.00	$ 21,250.00
12	TRICKLING FILTERS RECIRCULATON PUMPS	2	EA	$ 4,500.00	$ 9,000.00
13	EFFLUENT PUMP STATION	2	EA	$ 4,750.00	$ 9,500.00
14	TRICKLING FILTER'S COVER	1	L.S.	$ 247,125.00	$ 247,125.00
15	TRICKLING FILTER MEDIA REPLACEMENT	1	L.S.	$ 84,625.00	$ 84,625.00
16	RAW SEWAGE FINE SCREEN	1	EA	$ 223,500.00	$ 223,500.00
17	DENITRIFICATION FILTER SYSTEM	1	L.S.	$ 1,440,000.00	$ 1,440,000.00
	ELECTRICAL SYSTEMS				
11	ELECTRICAL	1	L.S.	$ 129,000.00	$ 129,000.00
				SUBTOTAL	$ 2,705,515.64
				CONTINGENCY (25%)	$ 676,378.91
				ENGINEERING (15%)	$ 405,827.35
				TOTAL	$ 3,787,721.89
				SAY	$ 3,788,000.00

ASSUMPTIONS:

Trickling Filters' Cover have passive ventilation

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OPINION OF PROBABLE CONSTRUCTION COST ESTIMATE
FOR
ALTERNATIVE 1b - EXISTING WWTP RETROFIT (NO DENITRIFICATION FILTER SYSTEM)
BOROUGH OF SHINGLEHOUSE
SEPTEMBER 2016

ITEM NO.	DESCRIPTION	EST. QTY.	UNIT	UNIT COST	EXTENSION
	GENERAL				
1	MOBILIZATION/PROJECT MANAGEMENT (5%)	1	L.S.	$ 47,000.00	$ 47,000.00
2	BONDS & INSURANCES (2%)	1	L.S.	$ 19,000.00	$ 19,000.00
3	DEMOLITION (EXISTING FLOOR MOUNTED DIFFUSERS)	1	L.S.	$ 14,000.00	$ 14,000.00
	CIVIL				
4	EXCAVATION	78	CY	$ 10.00	$ 784.14
5	BACKFILL	49	CY	$ 30.00	$ 1,481.49
	STRUCTURAL				
6	WALL CONCRETE	0	CY	$ 1,200.00	$ -
	ARCHITECTURAL				
7	BUILDING	0	SF	$ 200.00	$ -
	EQUIPMENT				
8	PRIMARY CLARIFIER'S COMPONENTS RETROFIT	1	L.S.	$ 157,500.00	$ 157,500.00
9	SECONDARY CLARIFIER'S COMPONENT'S RETROFIT	1	L.S.	$ 157,500.00	$ 157,500.00
10	RAW SEWAGE PUMPS	2	EA	$ 10,625.00	$ 21,250.00
11	CLARIFIER'S SLUDGE TRANSFER PUMPS	2	EA	$ 10,625.00	$ 21,250.00
12	TRICKLING FILTERS RECIRCULATON PUMPS	2	EA	$ 4,500.00	$ 9,000.00
13	EFFLUENT PUMP STATION	2	EA	$ 4,750.00	$ 9,500.00
14	TRICKLING FILTER'S COVER	1	L.S.	$ 247,125.00	$ 247,125.00
15	TRICKLING FILTER MEDIA REPLACEMENT	1	L.S.	$ 84,625.00	$ 84,625.00
16	RAW SEWAGE FINE SCREEN	1	EA	$ 223,500.00	$ 223,500.00
17	DENITRIFICATION FILTER SYSTEM	1	L.S.	$ -	$ -
	ELECTRICAL SYSTEMS				
11	ELECTRICAL	1	L.S.	$ 43,000.00	$ 43,000.00
				SUBTOTAL	$ 1,056,515.64
				CONTINGENCY (25%)	$ 264,128.91
				ENGINEERING (15%)	$ 158,477.35
				TOTAL	$ 1,479,121.89
				SAY	$ 1,480,000.00

ASSUMPTIONS:

Trickling Filters' Cover have passive ventilation

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OPINION OF PROBABLE CONSTRUCTION COST ESTIMATE
FOR
ALTERNATIVE 2a - BIO-DENIPHO OXIDATION DITCH (KRUGER-VEOLIA, no HEADWORKS)
BOROUGH OF SHINGLEHOUSE
SEPTEMBER 2016

ITEM NO.	DESCRIPTION	EST. QTY.	UNIT	UNIT COST	EXTENSION
	GENERAL				
1	MOBILIZATION/PROJECT MANAGEMENT (5%)	1	L.S.	$ 63,000.00	$ 63,000.00
2	BONDS & INSURANCES (2%)	1	L.S.	$ 26,000.00	$ 26,000.00
3	DEMOLITION (EXISTING FLOOR MOUNTED DIFFUSERS)	1	L.S.	$ 26,000.00	$ 26,000.00
	CIVIL				
4	EXCAVATION	949	CY	$ 10.00	$ 9,493.33
5	BACKFILL	136	CY	$ 30.00	$ 4,077.04
	STRUCTURAL				
6	OXIDATION DITCH TANK	348	CY	$ 1,200.00	$ 418,133.33
7	HEADWORKS	0	CY	$ 1,200.00	$ -
	ARCHITECTURAL				
8	HEADWORKS BUILDING	0	SF	$ 200.00	$ -
9	GRIT BUILDING	420	SF	$ 200.00	$ 84,000.00
	EQUIPMENT				
10	OXIDATION DITCH EQUIPMENT	1	EA	$ 630,000.00	$ 630,000.00
11	RAW SEWAGE PUMPS	2	EA	$ 10,625.00	$ 21,250.00
12	EFFLUENT PUMP STATION	2	EA	$ 4,750.00	$ 9,500.00
13	RAW SEWAGE FINE SCREEN	1	L.S.	$ 223,500.00	$ 223,500.00
14	GRIT REMOVAL SYSTEM	1	L.S.	$ 369,000.00	$ 369,000.00
	ELECTRICAL SYSTEMS				
11	ELECTRICAL	1	L.S.	$ 112,000.00	$ 112,000.00
				SUBTOTAL	$ 1,995,953.70
				CONTINGENCY (25%)	$ 498,988.43
				ENGINEERING (15%)	$ 299,393.06
				TOTAL	$ 2,794,335.19
				SAY	$ 2,795,000.00

ASSUMPTIONS:

Be able to use and retrofit existing blowers with VFD's

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OPINION OF PROBABLE CONSTRUCTION COST ESTIMATE
FOR
ALTERNATIVE 2b - BIO-DENIPHO OXIDATION DITCH (KRUGER-VEOLIA, with HEADWORKS)
BOROUGH OF SHINGLEHOUSE
SEPTEMBER 2016

ITEM NO.	DESCRIPTION	EST. QTY.	UNIT	UNIT COST	EXTENSION
	GENERAL				
1	MOBILIZATION/PROJECT MANAGEMENT (5%)	1	L.S.	$ 70,000.00	$ 70,000.00
2	BONDS & INSURANCES (2%)	1	L.S.	$ 28,000.00	$ 28,000.00
3	DEMOLITION (EXISTING FLOOR MOUNTED DIFFUSERS)	1	L.S.	$ 28,000.00	$ 28,000.00
	CIVIL				
4	EXCAVATION	2,549	CY	$ 10.00	$ 25,493.33
5	BACKFILL	1,203	CY	$ 30.00	$ 36,077.04
	STRUCTURAL				
6	OXIDATION DITCH TANK	348	CY	$ 1,200	$ 418,133.33
7	HEADWORKS	126	CY	$ 1,200.00	$ 151,111.11
	ARCHITECTURAL				
8	HEADWORKS BUILDING	600	SF	$ 200.00	$ 120,000.00
9	GRIT BUILDING	420	SF	$ 200.00	$ 84,000.00
	EQUIPMENT				
10	OXIDATION DITCH EQUIPMENT	1	EA	$ 630,000.00	$ 630,000.00
11	RAW SEWAGE PUMPS	2	EA	$ 10,625.00	$ 21,250.00
12	EFFLUENT PUMP STATION	2	EA	$ 4,750.00	$ 9,500.00
13	RAW SEWAGE FINE SCREEN	1	L.S.	$ 362,100.00	$ 362,100.00
14	GRIT REMOVAL SYSTEM	1	L.S.	$ 369,000.00	$ 369,000.00
	ELECTRICAL SYSTEMS				
11	ELECTRICAL	1	L.S.	$ 103,000.00	$ 103,000.00
				SUBTOTAL	$ 2,455,664.81
				CONTINGENCY (25%)	$ 613,916.20
				ENGINEERING (15%)	$ 368,349.72
				TOTAL	$ 3,437,930.74
				SAY	$ 3,438,000.00

ASSUMPTIONS:

Be able to use and retrofit existing blowers with VFD's

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OPINION OF PROBABLE CONSTRUCTION COST ESTIMATE
FOR
ALTERNATIVE 3a - SEQUENTIAL BATCH REACTOR (AQUA-AEROBICS, no HEADWORKS)
BOROUGH OF SHINGLEHOUSE
SEPTEMBER 2016

ITEM NO.	DESCRIPTION	EST. QTY.	UNIT	UNIT COST	EXTENSION
	GENERAL				
1	MOBILIZATION/PROJECT MANAGEMENT (5%)	1	L.S.	$ 68,000.00	$ 68,000.00
2	BONDS & INSURANCES (2%)	1	L.S.	$ 27,000.00	$ 27,000.00
3	DEMOLITION (EXISTING FLOOR MOUNTED DIFFUSERS)	1	L.S.	$ 27,000.00	$ 27,000.00
	CIVIL				
4	EXCAVATION	1,516	CY	$ 10.00	$ 15,155.63
5	BACKFILL	579	CY	$ 30.00	$ 17,378.79
	STRUCTURAL				
6	SBR PRECAST CONCRETE TANK	1	CY	$ 479,740	$ 479,740
7	HEADWORKS	0	CY	$ 1,200.00	$ -
	ARCHITECTURAL				
8	HEADWORKS BUILDING	0	SF	$ 200.00	$ -
9	GRIT BUILDING	420	SF	$ 200.00	$ 84,000.00
	EQUIPMENT				
8	SBR SYSTEM EQUIPMENT	1	L.S.	$ 657,144.00	$ 657,144.00
9	POST EQUALIZATION BASIN EQUIPMENT	1	L.S.	$ 67,770.00	$ 67,770.00
10	RAW SEWAGE PUMPS	2	EA	$ 10,625.00	$ 21,250.00
11	EFFLUENT PUMP STATION	2	EA	$ 4,750.00	$ 9,500.00
12	RAW INFLUENT FINE SCREEN	1	EA	$ 223,500.00	$ 223,500.00
13	GRIT REMOVAL SYSTEM	1	L.S.	$ 369,000.00	$ 369,000.00
	ELECTRICAL SYSTEMS				
14	ELECTRICAL	1	L.S.	$ 158,000.00	$ 158,000.00
				SUBTOTAL	$ 2,224,438.41
				CONTINGENCY (25%)	$ 556,109.60
				ENGINEERING (15%)	$ 333,665.76
				TOTAL	$ 3,114,213.77
				SAY	$ 3,115,000.00

ASSUMPTIONS:

Tanks are half way buried

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OPINION OF PROBABLE CONSTRUCTION COST ESTIMATE
FOR
ALTERNATIVE 3b- SEQUENTIAL BATCH REACTOR (AQUA-AEROBICS, with HEADWORKS)
BOROUGH OF SHINGLEHOUSE
SEPTEMBER 2016

ITEM NO.	DESCRIPTION	EST. QTY.	UNIT	UNIT COST	EXTENSION
	GENERAL				
1	MOBILIZATION/PROJECT MANAGEMENT (5%)	1	L.S.	$ 75,000.00	$ 75,000.00
2	BONDS & INSURANCES (2%)	1	L.S.	$ 30,000.00	$ 30,000.00
3	DEMOLITION (EXISTING FLOOR MOUNTED DIFFUSERS)	1	L.S.	$ 30,000.00	$ 30,000.00
	CIVIL				
4	EXCAVATION	3,116	CY	$ 10.00	$ 31,155.63
5	BACKFILL	1,646	CY	$ 30.00	$ 49,378.79
	STRUCTURAL				
6	SBR PRECAST CONCRETE TANK	1	CY	$ 479,740	$ 479,740
7	HEADWORKS	126	CY	$ 1,200.00	$ 151,111.11
	ARCHITECTURAL				
8	HEADWORKS BUILDING	600	SF	$ 200.00	$ 120,000.00
9	GRIT BUILDING	420	SF	$ 200.00	$ 84,000.00
	EQUIPMENT				
8	SBR SYSTEM EQUIPMENT	1	L.S.	$ 657,144.00	$ 657,144.00
9	POST EQUALIZATION BASIN EQUIPMENT	1	L.S.	$ 67,770.00	$ 67,770.00
10	RAW SEWAGE PUMPS	2	EA	$ 10,625.00	$ 21,250.00
11	EFFLUENT PUMP STATION	2	EA	$ 4,750.00	$ 9,500.00
12	RAW INFLUENT FINE SCREEN	1	EA	$ 362,100.00	$ 362,100.00
13	GRIT REMOVAL SYSTEM	1	L.S.	$ 369,000.00	$ 369,000.00
	ELECTRICAL SYSTEMS				
14	ELECTRICAL	1	L.S.	$ 150,000.00	$ 150,000.00
				SUBTOTAL	$ 2,687,149.52
				CONTINGENCY (25%)	$ 671,787.38
				ENGINEERING (15%)	$ 403,072.43
				TOTAL	$ 3,762,009.33
				SAY	$ 3,763,000.00

ASSUMPTIONS:

Tanks are half way buried

HRG
Engineering & Planning Services
AN EMPLOYEE-OWNED COMPANY

Subject	Shinglehouse WWTP
Date	8/22/2016
Evaluation	WWTP Plant Study
Comp. By	AEC

OBJECTIVE:

1. Evaluate various BNR Removal Systems
2. Develop operating and maintenance costs for each alternative.

Alternative Number	Alternative 1a - Existing WWTP Retrofit			Alternative 1b			Alternative 2 -Modified Ludzack-Ettinger (MLE)			Alternatives 2a,b -Oxidation Ditch			Alternatives 3a,b -Sequential Batch Reactor (SBR) - Aqua-Aerobics		
	Item	HP	Operating Time (hrs/day)	HP	Operating Time (hrs/day)	Item	HP	Operating Time (hrs/day)	Item	HP	Operating Time (hrs/day)	Item	HP	Operating Time (hrs/day)
	Influent Screen	10.0	24.0	10.0	24.0	Influent Screen	10.0	24.0	Influent Screen	10.0	24.0	Influent Screen	10.0	24.0
	Influent Raw Sewage Pumps	10.0	24.0	10.0	24.0	Influent Raw Sewage Pumps	10.0	24.0	Influent Raw Sewage Pumps	10.0	24.0	Influent Raw Sewage Pumps	10.0	24.0
	Primary Clarifier's Drive	0.5	24.0	0.5	24.0	Equalization Basins' Transfer Pumps	1.0	24.0	Bio-Phosphorus No.1 Tank Mixer	1.0	24.0	Aeration Basin No. 1 Mixer	3.0	14.9
	Primary Clarifier's Sludge Pump	5.0	12.0	5.0	12.0	Equalization Basins' Mixing Blowers	5.0	24.0	Bio-Phosphorus No.2 Tank Mixer	1.0	24.0	Aeration Basin No. 2 Mixer	3.0	14.9
	Trickling Filter No.1 Cover Fan Drive	1.0	6.0	1.0	6.0	Anoxic Basin No. 2 Mixer	2.2	24.0	Oxidation Ditch No.1 Tank Mixer	2.7	24.0	Aeration Basin No. 1 Blower	10.0	12.4
	Trickling Filter No.1 Recirculation Pump	1.5	24.0	1.5	24.0	Anoxic Basin No. 1 Mixer	2.2	24.0	Oxidation Ditch No.2 Tank Mixer	2.7	24.0	Aeration Basin No. 2 Blower	10.0	12.4
	Trickling Filter No.2 Cover Fan Drive	1.0	6.0	1.0	6.0	Aeration Basin No. 1 Blower	7.5	24.0	Oxidation Ditch No.1 Rotor	15.0	24.0	Aeration Basin No. 1 Transfer Pump	2.4	0.1
	Trickling Filter No.2 Recirculation Pump	1.5	24.0	1.5	24.0	Aeration Basin No. 2 Blower	7.5	24.0	Oxidation Ditch No.2 Rotor	15.0	24.0	Aeration Basin No. 2 Transfer Pump	2.4	0.1
	Secondary Clarifier's Drive	0.5	24.0	0.5	24.0	Aeration Basin No. 1 IMLR Pump	5.0	24.0	Final Clarifier No.1 Drive	0.5	24.0	Post-Equalization Basin No.1 Pump	2.4	24.0
	Secondary Clarifier's Sludge Pump	5.0	12.0	5.0	12.0	Aeration Basin No. 2 IMLR Pump	5.0	24.0	Final Clarifier No.1 Sludge Pump	1.0	24.0	Post-Equalization Basin No.2 Pump	2.4	24.0
	Denitrification Filter's Influent Pumps	10.0	24.0	10.0	24.0	Final Clarifier No.1 Drive	0.5	24.0	Aerobic Digester No.1 Aerator's Drive	7.5	24.0	Post-Equalization Basins Blower	5.0	24.0
	Denitrification Filter's Backwash Pumps	5.0	1.0	5.0	1.0	Final Clarifier No.1 Sludge Pump	1.0	24.0	Aerobic Digester No.1 Blower's Motor	5.0	12.0	Aerobic Digester No.1 Aerator's Drive	7.5	24.0
	Aerobic Digester No.1 Aerator's Drive	7.5	24.0	7.5	24.0	Final Clarifier No.2 Drive	0.5	24.0	Aerobic Digester No.2 Aerator's Drive	7.5	24.0	Aerobic Digester No.1 Blower's Motor	5.0	12.0
	Aerobic Digester No.1 Blower's Motor	5.0	12.0	5.0	12.0	Final Clarifier No.2 Sludge Pump	1.0	24.0	Aerobic Digester No.2 Blower's Motor	5.0	12.0	Aerobic Digester No.2 Aerator's Drive	7.5	24.0
	Aerobic Digester No.2 Aerator's Drive	7.5	24.0	7.5	24.0	Denitrification Backwash Compressor	1.0	1.0	Drying Beds Sludge Transfer Pumps	3.0	4.0	Aerobic Digester No.2 Blower's Motor	5.0	12.0
	Aerobic Digester No.2 Blower's Motor	5.0	12.0	5.0	12.0	Aerobic Digester No.1 Aerator's Drive	7.5	24.0				Drying Beds Sludge Transfer Pumps	3.0	4.0
	Drying Beds Sludge Transfer Pumps	3.0	4.0	3.0	4.0	Aerobic Digester No.1 Blower's Motor	5.0	12.0						
	Submersible Backwash Pumps	7.5	1.0	7.5	1.0	Aerobic Digester No.2 Aerator's Drive	7.5	24.0						
	Submersible Mudwell Pumps	3.0	1.0	3.0	1.0	Aerobic Digester No.2 Blower's Motor	5.0	12.0						
	Air Scour Blowers	50.0	1.0	50.0	1.0	Drying Beds Sludge Transfer Pumps	3.0	4.0						
	Average BHP/Operating Time	139.5	14.2	139.5	14.2		87.4	20.7		86.9	21.1		88.6	15.7
	Average kW		1,078		1,078			1,413			1,395			1,153
	Annual Power Usage (kWh/yr)		393,459		393,459			515,881			509,073			420,727
Total Annual Average Electrical Cost			**$55,084**		**$55,084**			**$72,223**			**$71,270**			**$58,902**
Alternatives Chemical Consumption														
	DelPAC		**$12,268**		**$12,268**			**$12,268**			**$6,134**			**$12,268**
	MicroC		**$24,353**		**$0**			**$24,353**			**$0**			**$0**
	Chlorine		**$7,779**		**$7,779**			**$5,186**			**$5,186**			**$5,186**
Total Annual Chemical Consumption Costs			**$44,400**		**$20,050**			**$41,810**			**$11,320**			**$17,450**
Alternatives Equipment Maintenance														
	Annual Labor Cost		**$3,120**		**$3,120**			**$3,120**			**$4,680**			**$4,680**
	Annual Maintenance Costs		**$6,839**		**$2,039**			**$3,713**			**$6,118**			**$4,976**
Total Annual Equipment Maintenance Costs			**$9,960**		**$5,160**			**$6,830**			**$10,800**			**$9,660**
Summary of Annual Operating and Maintenance Costs														
	Annual Average Electrical Cost		$55,080		$55,080			$72,220			$71,270			$58,900
	Annual Average Chemical Cost		$44,400		$20,050			$41,810			$11,320			$17,450
	Annual Average Maintenance Cost		$9,960		$5,160			$6,830			$10,800			$9,660
	Total Annual Average Operating and Maintenance Costs		**$109,440**		**$80,290**			**$120,860**			**$93,390**			**$86,010**
	Assumptions													
	Parameter		**Alternative 1**		**Alternative 1**			**Alternative 2a**			**Alternative 2b**			**Alternatives 3a, 3b**
	Labor Hours		104		104			156			156			156
	Percentage Cost		0.005		0.005			0.005			0.005			0.005