Village of Watkins Glen

303 North Franklin Street
Watkins Glen, NY 14891

PRELIMINARY ENGINEERING REPORT

for the

VILLAGE OF WATKINS GLEN
COMPREHENSIVE WATER SYSTEM STUDY

December 2019

MRB Group Project No. 2330.19001

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TABLE OF CONTENTS

LIST OF APPENDICES

I. EXECUTIVE SUMMARY

In September 2018, representatives of the New York State Department of Health met with the Village of Watkins Glen to conduct a sanitary survey of the public water system. This survey was performed in response to previous surveys and events related to the boil water order issued in August 2018.

In response to the recommended improvements outlined by the DOH, the following engineering study provides a comprehensive analysis of the existing Village of Watkins Glen water system. These improvements include water supply, treatment, storage, and distribution system to address water age, infrastructure condition, and water quality. A hydraulic model was used to evaluate system performance and identify problem areas in the network.

After a full economic analysis considering the capital costs, the recommended improvements were separated into individual subprojects. The following table lists each subproject with an associated cost.

Project	Description	Est. Cost
A	Raw Water Intake & Pump Station	$4,555,000
B	Water Treatment Plant	$4,548,000
C	Steuben Street Tank	$277,000
D	Steuben Street Pump Station	$236,000
E	Distribution Network	$5,972,000
	Total	**$15,600,000**

The Village, and users from the Towns of Dix and Reading comprise about 1,782 EDUs. According to the 2017 ACS survey, the Village MHI is $45,938. Based on the outstanding DOH violations and existing state of equipment, storage, and distribution, it is likely the Village would qualify for 0% Hardship financing through grant opportunities with EFC. Based on discussions with the Village leaders and financial advisors, the subprojects will be prioritized and addressed based on community need and associated financing as to limit a drastic increase in user cost. It is evident that the Village significantly benefit from a low interest loan and/or some grant funds to help offset these costs.

It is recommended that this Preliminary Engineering Report be used to pursue funding assistance from multiple agencies, including the Environmental Facilities Corporation (EFC) through the Drinking Water State Revolving Fund (DWSRF) and Water Infrastructure Improvement Act (WIIA), USDA Rural Development (RD), and the New York State Office for Community Renewal Community Development Block Grant (CDBG) program.

II. BACKGROUND

The Village of Watkins Glen ("Village") water district encompasses approximately 2.2 square miles and is situated in the central portion of Schuyler County at the south end of Seneca Lake. The Village is considering improvements to its water supply, treatment, and storage, and distribution system to address the age, condition, and water quality issues identified by the New York State Department of Health (DOH) public water system sanitary survey on November 30, 2018. The Preliminary Engineering Report (PER) includes documenting the existing Village water district system, identifying needed improvements, evaluating alternatives, preparing capital cost estimates, and presenting funding scenarios and estimated annual user costs. The PER planning effort will support future Village funding requests.

The Village will likely seek funding from multiple agencies, including the Environmental Facilities Corporation (EFC) through the Drinking Water State Revolving Fund (DWSRF) and Water Infrastructure Improvement Act (WIIA), USDA Rural Development (RD), and the New York State Office for Community Renewal Community Development Block Grant (CDBG) program. These programs require a PER prepared in accordance with program requirements, as part of the funding application process.

III. WATER SYSTEM

A Village water system analysis required assembly of data from the subsequent sections, as well as the preparation of an updated system map. The Village Water District map includes major system components, including pipelines, hydrants, pumps, and storage tanks, and serves as a foundation for system analyses and recommendations. A system network map and key components is included in Appendix A.

A. EXISTING SERVICE AREA

Seneca Lake serves as the source water supply for the Village of Watkins Glen Water District. The Village is responsible for the WTP and water infrastructure in the Village. The Village is also responsible to provide treated potable water to out-of-district users in the Towns of Reading and Dix. The out-of-district water infrastructure is owned by the respective towns, but the Village has separate water supply agreements with both Towns. The agreements require the Village to provide all user billing services and normal system operation and maintenance. The Village is reimbursed by both municipalities for incurred costs associated with all improvements and repairs to Town water infrastructure. This PER only focuses on capital improvements to the Village owned and maintained water system.

According to the Village 2018 Annual Drinking Water Quality Report, the water distribution system serves a Village district population of 2,149 through 942 metered service connections. The average daily use for the Village was 431,841 GPD and total annual consumption was 157,621,979 gallons. The Town of Reading district #1/#3 and #2 serves a total population of 86 through 38 metered connections. The average daily use was 4,230 GPD and total annual use was 1,544,100 gallons. The Town of Dix serves a population of 201 through 82 metered connections. The average daily use was 467,854 GPD and total annual use was 169,222,487 gallons. The water system is comprised of two major pressure zones, controlled by the Steuben Street and Padua storage tanks. A copy of the 2018 annual drinking water quality report is included in Appendix B.

B. SYSTEM COMPONENTS

The following sections outline the flow of water through the system, starting at the Seneca Lake intake, through treatment, into storage, and out to distribution.

1. Intake and Raw Water Pump Station

   Watkins Glen Public Water System is supplied by surface water from Seneca Lake. The water enters a pump well at an on shore pumping station. The intake is a 12 inch ductile iron main installed in the early 1900s. This intake line extends approximately 300 feet from shore at a lake depth of 35 feet. The water is seasonally treated with gaseous chlorine for zebra mussel control at the intake structure. From the pumping station, the water is pumped to the filtration plant by two vertical turbine low-lift pumps equipped with variable frequency drives. The pumps are set to alternate and pump approximately 840 gallons per minute, with a maximum discharge rate of 1,300 gallons per minute. The last significant pump station capital project was completed in 1993.

2. Water Treatment Plant

   The Watkins Glen water treatment plant (WTP) is a direct filtration plant with four filter beds built in 1993. The plant typically produces water for approximately 60 to 120 minutes at a time, 3 to 12 times a day. The typical daily production in 2018 ranged from about 300,000 to 800,000 gallons. The variation in volume of water produced is dependent on water usage at large events held at nearby Watkins Glen International (WGI) racetrack and other local industry seasonal demands. The plant can produce a maximum of approximately 1.87 MGD, however, the plant is rated for 1.3 MGD based on capacity with one filter out of service for backwashing. Alum is injected into the raw water pipeline prior to a static mixer. Next, water enters the flocculation chamber, then spills over a weird into one of four filters. The filter media consists of 18 inches of anthracite over a 12 inches of sand. Gaseous chlorine is added for disinfection and blended phosphate is added for corrosion control as treated water leaves the plant to the Steuben Street Tank for storage.

3. Distribution System

   The Village distribution system consists of two pressure zones. The lower zone serves most of the Village proper and is supplied from the Steuben Street Tank. The pressure in this zone ranges from 80 to 90 psi. The upper pressure zone is supplied from the pump station adjacent to the Steuben Street Tank. The pump station provides water to the Towns of Reading and Dix, and to Watkins Glen International (WGI) racetrack. The pressure in this zone ranges from 40 to 150 psi, but the majority of areas are below 100 psi.

4. Water Storage

   The Village owns and maintains two storage tanks: the Steuben Street Tank located at the

WTP site, which provides water to the low pressure zone, and the Padua site tank, which provides water to the high pressure zone and out of district customers.

a. Steuben Street Tank

The Steuben Street Tank is a 500,000 gallon welded steel tank constructed in 1989 with a separate inlet and outlet which provides contact time for the system. The water leaves the tank to feed two pressure zones. The tank provides storage and pressure to the lower zone, while the adjacent pump station pumps water from the Steuben Street Tank to the upper zone and Padua Tank for storage. The pump station contains two alternating pumps with a discharging capacity of approximately 150 gallons per minute.

b. Padua Tank

The original Padua Tank was a 250,000 gallon steel tank built in 1934. In 2019, a replacement 325,000 gallon tank with an aluminum domed top was constructed and the 1934 tank was demolished. The new tank location is about 600 feet north of the 1934 tank, adjacent to an existing Village right of way for ease of accessibility. The tank has a single inlet/outlet pipeline controlled by a pressure transducer manhole. The Padua Tank feeds the upper pressure zone, as well as the restroom and laboratory sink in the WTP.

IV. ASSESSMENT OF EXISTING CONDITIONS

The following sections outline violations issued by the New York State DOH, water quality deficiencies, as well as problem areas related to system hydraulics. These sections serve as focus areas for recommendations and subsequent modifications and improvements. A copy of the DOH inspection report in included in Appendix C.

A. CURRENT VIOLATIONS

In late September 2018, representatives of the New York State Department of Health met with the Village of Watkins Glen WTP chief operator and former public works director to perform a sanitary survey of the water distribution system.

The following violations were issued with regard to Title 10 of the New York State Code of Rules and Regulations:

1. Subpart 5-1, Public Drinking Water System Subpart 5-1.71 (b) for failure to exercise due care and diligence in the operation of a water treatment plant or distribution system.
2. Subpart 5-1.52 in that the location currently used to collect entry point samples does not meet the definition of entry point.
3. Subpart 5-1.72 (c) for failure to record and/or retain turbidity and chlorine readings during the time the plant is in operation.

B. HYDRANT TEST AND FIRE STORAGE ANALYSIS

Hydrant testing is an important part of comprehensive water distribution network analysis. It provides data for system pressures and flow rates, can assess the condition and operability of the network, and can address water quality issues. According to the AWWA, it is recommended to perform a hydrant test every 10 years.

According to the 2012 Recommended Standards for Water Works (Ten States), the minimum storage capacity for systems not providing fire protection shall be equal to the average daily consumption. Based on the storage calculations, the available storage without fire flow is approximately 0.81 MG, which exceeds the average daily demand of 0.5 MG.

According to the American Water Works Association (AWWA), between 500 and 1,500 gpm of fire flow are required for one and two-family residential dwellings for 2 hours. For

commercial and institutional buildings, the required fire flow is a minimum 3,500 gpm for 3 hours.

Hydrant flow tests were conducted at nine (9) locations in the Village on September 26, 2019. Based on the results of the test, the available fire flow at 20 psi for each location was calculated, to be used in subsequent hydraulic model calibration efforts.

Both the Steuben Street Tank and Padua Tank were evaluated to determine if the total available storage would meet average daily design demand of 1 MGD plus the maximum fire flow of 3,500 gpm for 3 hours. This equates to 0.63 MG required for fire storage, and a total required storage of 1.63 MG. Tank calculations were based on the following storage requirements: operating, equalizing, standby, fire suppression, and dead, where fire suppression storage is the summation of the equalizing storage and standby storage. Based on the analysis, the total available storage plus fire flow was 1.71 MG, which exceeds the required storage of 1.63 MG. Therefore, no additional storage is needed. A full analysis of storage tank and fire flow calculations, as well as a map of the hydrant test locations and results are included in Appendix D.

C. System Deficiencies

The following sections discuss the general existing conditions of the water system and the associated deficiencies outlined by the DOH. The intent of this report is to address each deficiency and provide an analysis of alternatives.

1. Zebra Mussels

Zebra mussels were first detected in Seneca Lake during the summer of 1992. Zebra mussel infestations have a significant effect on the environment and economy. Young zebra mussels are microscopic and easily pass through the intake screens. The mussels prefer slightly alkaline water with temperatures between 68 and 77 degrees Fahrenheit, but can survive more extreme ranges. Although zebra mussels reproduce throughout the year, the peak period occurs in the late spring and early summer. The largest populations occur in late summer and early fall when the water temperatures rise above 65 degrees Fahrenheit.

Unfortunately, zebra mussels attach to anything, including other mussels, producing thick mussel colonies. With an affinity for water currents, zebra mussels extensively colonize water pipelines and canals, such as those in drinking water treatment plants. Once inside

an intake, the mussels are protected from predation and the weather, resulting in large densities. Mussel growth on this scale can severely reduce water flow, result in loss of intake head, obstruct valves, clog condensers and heat exchangers, result in noxious tastes and smells in treated water, produce nuisance methane gas, and increase electro-corrosion of steel and ductile iron pipelines. The Village is currently combating high zebra mussel colonies by dispersing chlorine into the Lake at the intake box. Unfortunately, annual inspections show that this solution is only somewhat effective, and the system experiences many of the negative impacts listed above.

2. Chlorine Contact Time

The EPA reaffirms its commitment to the current Safe Water Drinking Act, which includes regulations related to disinfection and pathogenic organism control for drinking water supplies. The Surface Water Treatment Rule requires treatment for *Giardia lamblia* (*Giardia*) and viruses of all surface water and groundwater under the direct influence of surface water. Public water systems are required to comply with a new operating parameter referred to as a CT value, which is the concentration of free chlorine multiplied by the physical contact time in the storage tank. The CT value is used as an indicator of the effectiveness of the disinfection process. This parameter depends on pH and temperature to remove or inactivate *Giardia* and viruses that could pass through water treatment unit processes. According to Title 10 of New York Code of Rules and Regulations (10NYCRR), Subpart 5-1, Section 5-1.30 of the State Sanitary Code, total treatment of the system must achieve at least 99.9% (3-log) removal or inactivation of *Giardia* cysts and 99.99% (4-log) removal or inactivation of viruses. Direct filtration would account for a 2 credit log removal of *Giardia* and a 1 credit log removal of viruses. Therefore, 1-log removal of *Giardia* and 2-log removal of viruses are required through chlorine contact. The current treated water sampling point is directly downstream of the treatment plant, and therefore, only the volume of the Steuben Street tank is considered for chlorine contact time.

Based on the 2018 SCADA data for the filling and draining of the Steuben Street Tank, the maximum flow rate out of the tank was approximately 589 gpm. This flow rate was then compared to the design flow of 1.3 MGD and the peak design flow at 1.9 MGD. In order to determine the most conservative contact time for log inactivation, it was assumed that as the temperature decreases, the pH increases, and the chlorine residual is at a maximum value. The maximum pH was 8.5, the minimum temperature was 4 deg-C, and the maximum chlorine residual was 1.7 mg/L. Since no mixing or baffling exists in the Steuben

Street tank, an unbaffled value of 0.1 was used in calculations.

Based on the analysis, the Steuben Street tank far exceeds the 4-log inactivation requirement for viruses for all three flow rates, but only slightly exceeds the 3-log inactivation requirement for *Giardia* under existing flow conditions. The log inactivation for viruses with credit was approximately 71 at existing flow, 46.7 at design flow, and 32.2 at peak design flow. All three flow rates far surpass the 4-log required. The log inactivation for *Giardia* with credit was approximately 3.5 at existing flow, 3.0 at design flow, and 2.7 at peak design flow. Therefore, only existing flow rates meet the required 3-log inactivation and additional CT time is required.

In addition, the DOH requested monthly analysis *Giardia* to ensure 3-log inactivation is provided at all times during the year. Based on these results, only the months of August, September, and October fall below required limits without credit, but all months meet requirements with credit.

3. Water Quality

A drinking water system's water quality may be acceptable when the water leaves the WTP, but a variety of physical, chemical, and biological transformations can occur once the water enters and travels through the distribution system. The principal factors that affect water degradation during distribution are the system's structure, its operation, and a number of water quality factors like turbidity and age.

a. Turbidity

Turbidity is caused by particles suspended or dissolved in water that scatter light, making the water appear cloudy or murky. Particulate matter can include clay and silt sediment, fine organic and inorganic matter, soluble colored organic compounds, algae, and other microscopic organisms. Turbidity is tested in drinking water distribution systems to measure the filtration process effectiveness. Turbidity is measured in Nephelometric Turbidity Units (NTUs), where a greater scattering of light indicates low water clarity, and a lower scattering of light indicates high water clarity. The EPA maximum turbidity reading is 0.3 NTU, and New York State regulations require the turbidity always be below 1 NTU.

According to the Village 2018 Annual Drinking Water Quality Report, all three service areas (Village, Town of Dix and Town of Reading) were in violation for turbidity. The average level measured was 0.077 NTU, but the maximum recorded was 19.414 NTU. The regulatory level is considered Action Level (AL), where the concentration of containment, if exceeded, triggers treatment or other requirements which the water system must follow. The high levels of turbidity are a caused by soil runoff. According to the 2018 DOH inspection report, a review of the most recent water quality monitoring report results indicates there were two turbidity violations in August 2018, where more than 5% of the composite filter effluent turbidity readings were above the performance standard of 0.3 NTU in a single month. These violations were issued in a separate correspondence and public notification was completed on August 16, 2018 and November 2, 2018.

b. Water Age

Water age is a function primarily of water demand, system operation, and system design. As water demand increases, the amount of water that remains stagnant in the system decreases. The Water Industry Database indicated an average distribution system retention time of 1.3 days and a maximum retention time of 3.0 days based on a survey of over 800 utilities in the United States, but depending on the size of . There are a number of chemical, biological, and physical problems that can be caused or worsened by increased detention time in a distribution system. The following water quality problems have a direct potential public health impact:

- Disinfection By-Product (DBP) formation and biodegeneration
- Corrosion control effectiveness
- Nitrification
- Microbial regrowth, recovery, and shielding

The Village district and its purchased water systems in the Towns of Reading and Dix must work together to address disinfection by-products. The Environmental Protection Agency has set Maximum Containment Levels (MCLs) for total trihalomethanes (TTHMs) and haloacetic acids (HAAs) of 80 and 60 micrograms per liter, respectively, based on annual averages of quarterly sample results taken from the distribution system. Although the Village has not exceeded these standards, there are exceedances in both Towns that

purchase water from the Village. It is recommended that the Village consider all options for the reduction of these contaminants within its system.

c. Pipe Size

The existing water distribution network contains pipes of 4, 6, 8, 10, 12 inch diameters. A significant portion of the system is comprised of unlined ductile iron, and small 4" diameter water mains. According the AWWA Manual M31, one of the most significant distribution system impacts from fire flow requirements includes providing adequate storage capacity and meeting requirements for minimum pipe sizes. Ten States specifies a minimum pipe diameter of 6" at all locations providing fire protection, but it is suggested to install a minimum of 8" diameter for the Village. For 4" pipes, the approximate delivery volume is 3,466 gallons per mile. For 8" pipes, the approximately delivery volume is 13,786 gallons per mile. Therefore, for every mile of 4" pipe that is replaced with 8" pipe, the effective volume of the distribution system increases by about 10,320 gallons.

d. Structural Factors

Cast or ductile iron pipes provide suitable environments for microorganism growth. Oxidant-resistant microorganisms settle on the pipe surfaces and become entrapped in the low flow areas, line obstructions, or dead-ends and produce biofilms. In addition, iron pipes are susceptible to corrosion.

As of November 2018, the Village was in the process of replacing approximately 1,900 linear feet of 8" diameter old pipe along NY State Route 14 between Bath and Division Street. The existing Village distribution currently includes approximately 17,000 LF of 4" diameter unlined ductile iron pipe. It is recommended the Village continues to implement a program to replace old and deteriorating ductile iron mains.

4. Water Loss

Old and poorly constructed pipelines, inadequate corrosion protection, poorly maintained valves, and mechanical damage are some of the factors contributing to leakage. One important effect of water leakage, besides the loss of water resources, is reduced pressure in the system. Raising pressures to make up for these losses increases energy consumption as well as making leaking worse. In general, a 10 to 20% allowance for unaccounted water

is normal. A loss of more than 20% requires priority attention and corrective actions. There are different types of leaks, including service line leaks, valve leaks, and most commonly, main line leaks. The material, composition, age, and joining methods of the distribution system components can influence leak occurrence.

Unaccounted water is the difference between water produced at the treatment facility and metered use by customers. In 2018, the total annual use drawn from Seneca Lake and treated at the WTP was approximately 188.5 MG, whereas the total amount consumed was about 182.2. MG. The following equation was used to determine water loss in the distribution system.

$$Unaccounted\ water\ loss\ (\%) = \frac{Production - Consumption}{Production} \times 100\%$$

Therefore, the total unaccounted loss for the system is about 3.3%, which falls within the normal range. In order to prevent future leaks, it is recommended to initiate leak detection efforts in the near future that focus on distribution policies that encourage conservation, public education programs, pressure reduction, requests for voluntary cutbacks or bans on certain water uses, and water recycling. There are various methods for detecting water leaks, most of which involve using sonic leak-detection equipment. This equipment identifies the sound of water escaping a pipe, and the devices include pinpoint listening devices that make contact with valves and hydrants, and geophones to listen directly on the ground. In addition, correlator devices can listen at two point simultaneously to pinpoint the exact location of a leak.

V. HYDRAULIC MODEL

The updated system map was translated to a working hydraulic water distribution model to simulate existing conditions, identify problem areas in the network, and explore future improvements through "what if" scenarios. A visual screen capture of the model network is included in Appendix E. Please note the pipes are color-coordinated by diameter for easy reference with purple representing 4", blue representing 6", green representing 8", yellow representing 10", and red representing 12".

A. SOFTWARE

A hydraulic water distribution model was created in MIKE URBAN+, part of a software suite developed by DHI Water & Environment, Inc. The components are based on the worldwide standard EPANET engine, allowing for steady state, extended period, and water quality, and transient flow simulations. In addition, MIKE URBAN+ includes full GIS integration. Some of the most useful features include computing water demands for each node in the network, calculating water age in network, and determining available flow and residual pressure for a comprehensive fire flow analysis.

B. SYSTEM DEMANDS

Based on the 2018 water use data for the Village and Towns of Reading and Dix, the average demand was approximately 467,854 gpd, or approximately 325 gpm. The total annual usage was estimated at 170 million gallons. Residential use accounted for about 58%, commercial use accounted for 34%, institutional use accounted for 10%, and industrial use accounted for less than 1% of the total use. In order to simulate realistic demand conditions for the existing model, a demand curve was applied to all junction nodes in the network. However, it was important to assign higher demands to the top water users.

C. OPERATIONS & STORAGE

The hydraulic model includes six (6) storage tanks and four (4) pumps to represent actual system operations. The first tank, representing the intake from Seneca Lake, is modeled as a reservoir with a fixed hydraulic grade line of 443 feet. A lakeside pump station draws water from the lake and up to the WTP. The second tank, representing the WTP, is modeled as a variable tank with a maximum weir crest of 663 feet. The Steuben Street Tank has a storage capacity of 0.5 MG, and is modeled as a reservoir with a fixed hydraulic grade line of 653 feet. Although the water level in the tank fluctuates, for the simplicity of overall operations

in the system, a reservoir was used instead.

There are two separate distribution mains from the existing Steuben Street Tank: the first provides low-pressure gravity flow to the majority of the Village system; and the second provides high-pressure pump flow to the northern part of the system and the Padua Tank. A pump station immediately downstream of the Steuben Street Tank services the high-pressure flow zone demands to the higher elevation areas and to fill the Padua tank.

The Padua Tank has a storage capacity of 0.325 MG, and is modeled as a variable tank with a base elevation of 800 feet and overflow elevation of 833 feet. In real-world operation there is one line in and out of the Padua tank, with a transducer manhole controlling the flow. Modeling flow from the Padua Tank to the distribution system was based on available demand data.

Flow from the distribution system supplies Watkins Glen State Park via a pump station. A variable storage tank inside to the park provides water to the adjacent gorge and the Six Nations Campground. Once flow distribution reaches the southern part of the system, the Franklin Street booster pump station sends flow to the Town of Dix via the South Tank at a higher elevation than the Village. The South Tank has a storage capacity of 0.18 MG, and is modeled as a variable tank with a base elevation of 972 feet and an overflow elevation of 992 feet.

D. System Performance

The following sections describe the results of a series of hydraulic model simulations based on tests performed and proposed system alternatives.

1. Working Pressure

According to Ten States Standards, the normal distribution system working pressure should be approximately 60 to 80 psi, but not less than 35 psi. Using this as a guideline, the model was calibrated based on the lowest operating level of the Steuben Street Tank which provides a minimum system pressure of 20 psi and a minimum system working pressure of 35 psi. On an average day, the peak demand occurs at 12 PM. At peak demand the point furthest from the tank has a pressure of approximately 59 psi. This pressure was used to determine ground elevations associated with the following recommended pressure zones:

- 20 psi: minimum system pressure during all flow events
- 35 psi: minimum system working pressure
- 40 psi: minimum pressure where a water service enters a house
- 65 psi: recommended normal working pressure
- 80 psi: recommended maximum working pressure
- 100 psi: maximum pressure allowed before individual PRVs are required

2. Fire Flow

Calibration of the hydraulic model based on the hydrant flow tests determined the majority of old ductile iron pipes in the Village perform as smaller diameter pipes. Although new ductile iron pipe has a Hazen-Williams C-factor of 140, each hydrant location was adjusted to determine the approximate roughness coefficient that corresponded to the calculated available flow. The following table shows the results.

Location	Diameter (in)	C-factor	Calc. FF (gpm)	Existing 4" Model FF (gpm)	Proposed 8" Model FF (gpm)
Howard St. & Bath St.	4	65	580	582	833
N. Madison St. & Partition St.	8	82	3,467	3,465	4,203
8th St. & Porter St.	8	88	3,975	3,982	4,883
10th St. & Magee St.	8	130	3,330	3,339	2,765
Wal-Mart (SW corner)	8	140	2,438	2,416	2,014
14th St. & S. Franklin St.	12	78	3,554	3,573	4,872
6th St. & N. Franklin St.	12	140	3,975	3,928	5,858

Therefore, an average roughness C-factor of 100 was assigned to the pipelines to represent age, tuberculation, excess sediment buildup, or one or more partially closed valves in the system.

Using the MU+ Fire Flow Analysis module, the maximum available flow rate was calculated for the selected hydrants given a minimum residual pressure of 20 psi. Using a C-factor of 100, the average fire flow available for the network was approximately 2,755 gpm, which falls between the upper residential range at 1,500 gpm and commercial range of 3,500 gpm. The hydrant locations represent a mix of residential and commercial properties. If the C-factor is increased to 140 across the system to represent brand new ductile iron pipe, the average fire flow available increased to 3,552 gpm. Therefore, it is evident the old pipeline has a significant impact on pipe flow.

In addition, the Fire Flow Analysis tool was used to evaluate the available fire flow for the entire distribution network. Using the existing network with 4" pipes, the average available fire flow was 3,109 gpm. However, when the 4" pipes were replaced with C-factor 140, new 8" pipes, the available fire flow increased to 3,726 gpm. A bar chart was created to compare the number of junctions within each flow range for both the 4" pipe and 8" pipe. Based on the results, there was an increase in the number of junction with more than 3,500 gpm of available fire flow, and fewer with less than 500 gpm available fire flow when the 4" pipes were replaced with 8" pipes. This bar chart is included in Appendix E. Therefore, increasing pipe diameter and replacing old pipe improves overall fire flow in the system.

3. Water Age

A point constituent tracer simulation was run for 7 days to simulate water age in the distribution system. To reflect existing operations, only the Padua Tank contains complete mixing operations; the Steuben Tank was simulated as first in, first out plug flow. The tracer represents DBPs formed in the Steuben Street Tank, and is set to the recommended concentration of 0.08 mg/L. Based on the results, the turnover in the Steuben Street Tank was approximately 64 hours, or 2.7 days. However, the average water age of the system was 97.7 hours, or 4.1 days. Improved mixing and flushing operations could improve turnover time and water age in the system.

In order to visually identify areas of the network with the highest water age, a color map was created with water age displayed in hours. As reflected by the results, the majority of the network has a water age around 4 days. However, the pipes with the highest water age reside at the edges of the system or dead-ends. Therefore, these are the areas that require the most attention for water quality issues, such as high levels of DBPs. The plot for water age is included in Appendix E.

VI. IMPROVEMENT ALTERNATIVES

Based on the analysis of existing conditions, the 2018 NYSDOH Sanitary Survey, and hydraulic model results, the following sections detail proposed system improvements, recommendations, and future capital projects.

A. DEPARTMENT OF HEALTH IMPROVEMENTS

In response to these violations, the DOH issued number recommendations and requirements. It is important to note that a number of the deficiencies outlined have already been addressed by the Village with the ongoing SCADA upgrade.

A chlorine gas leak alarm and a door alarm were installed at the raw intake pump station. The Village is in the process of developing Stand Operating Procedures (SOPs) for the WTP. In addition, at the treatment plant the Village identified an entry point sampling location, is currently taking plant operation and turbidity readings, installed chemical feed pump control valves, is in the process of installing door alarms connected to the SCADA system, and are taking pre-disinfection and raw water turbidity readings. At the Steuben Street Tank an entry point sampling location was identified. With regard to the distribution system, the Village acknowledges the requirement of annual cross-connection control testing and are actively addressing it. In addition, the Village periodically replaces system meters and will replace the backwash meter in the plant.

B. ZEBRA MUSSEL CONTROL

The DOH issued a requirement that the Village explore alternative forms of treatment at the raw water intake. The location of the chlorine gas adjacent to apartment buildings is a safety and health hazard. Using a different chemical for zebra mussel control may also improve disinfection by-product levels in the distribution system. Based on this issue, several alternatives were considered:

1. Intake Pipeline Depth

Based on a study conducted in 2007, the majority of zebra mussels residing in Seneca Lake were between 10 to 100 feet of the water surface. However, there were also large populations at depths between 150 to 250 feet. Very few mussels were seen below a depth of 300 feet. Currently, the normal surface level elevation of Seneca Lake is approximately 444 feet, with fluctuations between 442 feet and 449 feet depending on the year and season.

The intake box is located 60 feet below the water surface, at an elevation of 384 feet. Unfortunately, this depth falls precisely in the densest zebra mussel colony location.

The USGS climate data for Seneca Lake during September 2018 showed a temperature range between 60 and 68 degrees Fahrenheit at a depth of 48 feet, and a range between 45 and 65 degrees Fahrenheit at a depth of 97 feet. Therefore, the intake box at 60 feet falls within the highest growth temperature range.

As a first alternative, it was investigated whether extending the raw intake pipeline to a deeper and colder location would minimize zebra mussel intake through altering the preferred ecosystem. After reviewing the bathymetry of Seneca Lake, the maximum depth occurs at 620 feet below the surface elevation near the northern boundary of Schuyler County. At the southern end near the Village of Watkins Glen, the maximum depth occurs at 230 feet below the surface elevation, at about 3,000 feet from shore. The existing intake pipeline runs approximately 300 feet from shore. Therefore, it is infeasible to run a pipeline an additional 2,700 feet. A detailed map displaying Seneca Lake depth is included in Appendix F.

2. Intake Screen

The Village employs pre-chlorination to combat the high zebra mussel population in Seneca Lake. However, a problem with pre-chlorination is that chlorine is applied to water where it contain the highest concentration of natural organic matter, which reacts with chlorine to form harmful disinfection by-products. Ideally, chlorination should be delayed until as much natural organic material is removed from the water as possible through the processes at the WTP. Although eliminating pre-chlorination completely at the raw intake is not plausible, it is recommended to conduct a pilot study to ensure the chlorine used at this point is properly dosed. Installation of a copper-based intake screen in conjunction with a lower chlorine dose could significantly reduce DBPs.

Under current operations, the raw water intake pipeline has a capped end through which chlorine is dispersed into the lake to inhibit zebra mussel attachment and growth. An alternative is the Passive Intake Screen Z-Alloy developed by Johnson Screens®, part of the Aqseptence Group. The high capacity passive intake screens provide uninterrupted water withdrawal from lakes and are custom designed to provide maximum efficiency, while minimizing installation, operation, and maintenance costs. The product is

environmentally friendly, with an intake approach that meets the EPA's 316b regulations for fish protection. There is no waste stream, easy cleaning, and no moving parts. The 304 stainless steel option is applicable for fresh water and the Z-Alloy has shown to specifically repel zebra mussels. The dual-flow modifier creates a nearly uniform low flow velocity through the entire screen surface. This significantly reduces impingement and entrainment of debris, while protecting aquatic organisms. A pilot study would determine the need for the use of chlorine or similar chemicals in conjunction with the proposed intake screen. Product information, design specs, and an associated quotes for Johnson Screens® is included in Appendix G.

There is current concern of cavitation occurring at the raw water intake pump station with only one intake line. Approach velocity and flow patterns are two of the most important characteristics required for efficient sump pumps. An approach velocity between 0.5 fps and 1.5 fps, evenly distributed flows to the pump suction, and no turbulence is required. The effect of vortex formation on pump operations is associated with free surface vortices causing aerated flow, air ingestion, rumbling noises, and submerged or free surface vortices imposing load fluctuations on impeller blades. As a result, the pump experiences vibrations, rough running, cavitation, and damage and erosion to the impeller. Headloss calculations were performed at the intake crib, as well at the pump station to ensure the existing pumps supply sufficient suction.

Based on the calculations, there is adequate submergence for the two (2) pumps, and the approach velocity is about 1.28 fps at average operation at 1.3 MGD. However, if both pumps operate at their maximum output and the WTP produces a maximum of about 1.9 MGD, the approach velocity is 1.87 fps, which exceeds the maximum recommended value. The plant can only safely produce a maximum about 1.5 MGD to maintain evenly distributed flow. The proposed Johnson Screen has a dual-flow modifier with a maximum flow of 1,300 gpm, which equates to about 1.9 MGD. The average slot velocity is about 0.4 fps, and the maximum slot velocity is about 0.47 fps. Therefore, even flow is maintained even at maximum WTP capacity. Headloss and submergence calculations for the intake and raw water pump station are included in Appendix H.

3. Chemical Treatment Alternatives

Alternatives to chlorine were investigated to control zebra mussel growth and limit potential risks to the water distribution system. Although there are numerous chemical and

physical solutions available, the following paragraphs discuss two of the best alternatives based on previous applications and successful case studies in the Great Lakes and Finger Lake Regions.

Although there are chemical alternatives to chlorine such are bromine and copper, the best alternative, although costly, is the biological pesticide Zequanox®. This molluscicide controls the invasive species during all life stages, from larva to adult. Once ingested, it deteriorates the digestive lining of the mussels, resulting in mortalities over a period of several days to weeks. The advantage is this product delivers efficacy comparable to chemical solutions, but does not endanger employees, damage equipment, or result in harmful impacts to the environment or other aquatic organisms when used properly. It is ideal for open water systems because it is highly selective with no significant effect on water quality of non-target organisms. In addition, Zequanox® can be applied using standard mixing and injection equipment. Unlike mechanical solutions, there is no need for costly capital investments or complicated installation and maintenance. The treatments are non-corrosive, non-volatile, and do not require detoxification or deactivation before water discharge. Each treatment is customizable, designed to fit the needs for an individual water system based on the degree of infestation and desired level of control. The treatments can be completed between 2 and 8 hours. Finally, the EPA approves Zequanox® and classifies it as a reduced-risk aquatic pesticide and there are minimal regulatory restrictions in comparison to chemical alternatives. A product brochure for Zequanox® is included in Appendix I.

C. Pump Station Upgrades

The equipment and layout of both the raw water intake pump station and the Steuben Street pump station are dated and nearing the end of their useful lives. In addition, the Village discussed a concern that the pumps at the raw intake station are improperly sized, and consequently inefficient. In 2011, there was a proposed 2-phase raw water station improvement project, but the plans were never implemented. It is recommended to revisit these proposed plans and make upgrades or adjustments as needed. Both pump stations upgrades are included in the cost estimate.

D. Water Treatment Plant Upgrades

Although the WTP operates well, there were a few recommendations outlined by the DOH inspection, many of which are already being addressed by the Village. The following

sections describe outlying required upgrades to the chlorine room, current filter and processes, and recommendations for combating and monitoring high turbidity levels reported in treatment plant effluent. An existing and updated hydraulic profile are included in Appendix J.

1. Chlorine Room Ventilation

   As addressed during the DOH inspection, there is improper ventilation for the chlorine room. In the event of a gas leak, the fan discharges adjacent to the access door to the treatment plant, which poses a serious health and safety concern for plant operators. According to Ten States, the ventilating fan requires a capacity to complete one air change per minute when the room is occupied. The fan should take suction near the floor and be installed at as great a distance as is practical from the door and air inlet, with the point of discharge located so as not to contaminate air inlets to any rooms or structures. It is also recommended the new vents discharge to the outside atmosphere above grade and remote from air intakes.

2. Turbidity Reduction

   The relationship between turbidity breakthrough and limiting headloss is also strongly affected by the efficiency of chemical pre-treatment. Currently, alum is added as a coagulant as the raw water influent enters the flocculation chamber. The operators at the plant noted that when large meteorological events occur, the sediment in Seneca Lake churns up, and the turbidity of the influent water significantly increases. It is possible to add more during these events, but this is not a practical long term solution. Additional coagulant and polymer use could be considered in addition to another form of pre-treatment.

   Currently the WTP does not include any clarifiers. Although the clarification process is commonly used for treating raw surface water, it is not considered an economical alternative due to capital and operation costs, as well as the time required to bring the process online. In addition, clarifiers need to be on line for several days before providing effective pre-treatment, and since the high turbidity is tied to irregular meteorological events, this is not a reliable alternative. Finally, multiple clarifiers would be required to treat the 2.5 MGD peak design flow. The size of the units, the required land area for construction, and the cost of materials and construction is prohibitive for a process that is needed only after significant meteorological events.

Adding pre-filtration in the form of pressure filters or bag filters was considered the most effective alternative. Pressure roughing filters can be brought on line quickly as raw water turbidity increases, and allows for the use of coagulants to further reduce turbidity levels if necessary. It is recommended to install a pressure filter system which included three trains, with each train consisting of a contact clarifier followed by an anthracite filter to capture some of the larger solids before flow reaches the finishing filters. Therefore, adding vertical pressure roughing filters to the raw water influent end of the WTP would maintain low turbidity effluent regardless of meteorological events, and subsequently decrease the solids load on the finishing filters downstream. Filter details and updated WTP site plans are included in Appendix K.

According to Ten States, for systems with three or more filters, online turbidimeters should be installed on the effluent line from each filter. Turbidimeters on individual filters should have an alarm that sounds when the effluent levels exceeds 0.3 NTU. Therefore, monitoring these events using a SCADA system at both the intake and entrance to the treatment plant would assist in managing pre-treatment doses prior to filtration.

3. Filtration Processes

The WTP houses four (4) 10 feet x 10 feet filtration cells, with three (3) active and one (1) for backwash in typical operations. The filter media is 30 inches thick, with the top layer comprised of 18 inches of 1.0 – 1.2 mm anthracite, and the remaining 12 inches comprised of 0.45 – 0.55 mm sand. The larger grain size of the anthracite layer permits greater depth penetration of solids and larger solids storage volume in the filter. The sand layer is used as a protective barrier against breakthrough. Although a dual-media filter is preferred over mono-sand filters, the WTP effluent still contains high turbidity and disinfection byproducts.

Two factors are important for media selection: the time required for turbidity to break through the filter bed and the time required for the filter to reach limiting headloss. With properly selected media, these times should be about the same. Based on an average flow rate of 1.3 MGD produced by the plant with (3) filters in use and (1) reserved for backwash, the approximate filtration rate per filter is about 3.62 gpm/ft2.

Granulated Activated Carbon (GAC) is effective in reducing taste and odor control (TOC),

as well as adsorbing natural organic compounds and synthetic organic chemicals. GAC is made from organic materials with high carbon contents such as wood, lignite, and coal. It typically has a diameter ranging between 1.2 – 1.6 mm. GAC has a high uniformity constant to promote stratification after backwashing, and minimize desorption and premature breakthrough. Existing rapid sand filters can easily be retrofitted to replace anthracite with GAC, and pilot studies have shown GAC filters outperforms anthracite filters with superior reduction of organics, lower chlorine demand, and lower TTHM formation, while maintaining similar run times and filtered water turbidities. By retrofitting the existing underdrains to include air scouring, the media bed can be expanded by 30%. This will accommodate 12 inches or sand and 32 inches of GAC. At design flow of 1.3 MGD, this provides approximately 7.5 minutes of Empty Bed Contact Time (EBCT). At peak design flow of 1.9 MGD, this provides approximately 6.1 minutes of EBCT. If at a future date, the plant requires additional TOC, free standing GAC vessels can be added to the filtration process. However, at this point, retrofitting the existing filters is the most cost-effective solution. The product information and drawings for the proposed GAC retrofitted filters are included in Appendix L.

E. STEUBEN STREET TANK

The Steuben Street Tank is a critical part of the water distribution system. It houses treated water directly from the clear well and stores it for the entire lower pressure zone of the network.

1. Chlorine Contact CT

According to the DOH report, after evaluating monthly operation reports, it is not clear that adequate concentration time to meet the 3-log removal and/or inactivation requirement for *Giardia* cysts is provided at all times during the year at the Steuben Street tank and pump stations. Based on the previous analysis, the months of July, August, and September were in violation. However, when the 2-log credit for direct filtration is applied, all 12 months exceed the 3-log inactivation requirement. Since the contact time is very close to the limit, it is recommended to improve baffling factor of the Steuben Street Tank by adding inlet and outlet baffles.

In addition, as the existing tank does not provide sufficient contact time to meet the 3-log inactivation of *Giardia*, an additional 0.5 MG tank is recommended. This will also create redundancy for the existing 0.5 MG tank, and prevent disruption in operations when one

tank needs maintenance or repair. With an additional 0.5 MG of storage, the log inactivation time is approximately 63.5 for viruses and 3.3 for *Giardia*. A summary of all CT calculations is included in Appendix M.

2. Tank Rehabilitation

In 2019, the Steuben Street Tank was inspected in response to a violation to AWWA Standard G-200 that internal inspections on storage tanks be conducted every 5 years. Based on the structural conditions from the inspection, the seal between the base and tank bottom needs attention and the exterior sidewall welds, plate surfaces and roof exterior plates are corroded. There was less than 1 inch of sediment in the tank. The general recommendations include reinspecting the tank in 5 years, recoating the tank exterior, and resealing the junction of the exterior tank bottom and concrete base. In addition, it is recommended that lead paint tests be conducted. A copy of the inspection report is included in Appendix N.

F. WATER QUALITY

According to the 2018 Annual Drinking Water Quality Report issued by the Village, the total trihalomethanes (TTHMs) were in violation in the Town of Reading. From the four samples taken over the course of the year, the average level detected was 72.6 µg/L with a range of 45 to 100 µg/L. In the Town of Dix, four samples were taken as well. The average level detected was 98.8µg/L with a range of 80.2 to 110µg/L. The Maximum Containment Level (MCL) issued by the EPA is 80µg/L. An MCL is the highest level of containment that is allowed in drinking water. It is likely the high levels of TTHMs are a by-product of drinking water chlorination. Consuming drinking water with high levels of TTHMs over many years may experience liver physiological problems related to the liver, kidneys, or central nervous system, in addition to an increased risk of cancer.

Although the majority of water quality issues were reported in the Town of Dix and Town of Reading, it is important to consider alternatives to prevent formation of disinfection by-products (DBPs). There are many alternative strategies to minimize DBPs, such as eliminating pre-chlorination, moving the chlorination point, practicing enhanced coagulation, optimizing chlorine dosing through disinfection benchmarking, and switching to chloramines for secondary disinfection.

The newly constructed Padua Tank includes a mixing system, but not a THM removal

system with aeration. As this point the Village is not in violation of high THMs, so the mixing is sufficient. If the levels increase in the future, it is suggested to add THM removal systems to both the Padua Tank and the South Tank.

G. Distribution System Upgrades

Much of the water distribution network was installed in the early 1900s and consists of old ductile iron or ductile iron piping. Based on the model results, DOH inspection, and direct correspondence with the Village, the following sections discuss recommended improvements to address the boil water notice and improve overall system efficiency.

1. Water Age

From an operational perspective, tanks, valves, pipe diameter, and pumping rates have a direct impact on water age and quality. Finished water storage facilities may exhibit poor mixing conditions because tank turnover is limited by minimum available fire flow requirements. Tank mixing can also be optimized by cycling the tanks periodically or installing mechanical devices, such as diffusers and nozzles to achieve higher velocities. Valve settings and pumping rates determine water velocities and flow direction. Velocity, in turn, impacts hydraulic pathway and retention time. Therefore, it is recommended to assess system pressures and valve position on a regular basis, such that the operators can adjust as needed to induce flow in the system in a direction that can minimize water age. In addition, the Village should work with the Towns of Reading and Dix to develop and implement a robust flushing program.

2. Pipe Size and Dead-Ends

Based on the results of the hydrant flow test and hydraulic model calibration efforts, it is evident the existing pipeline it causing excess resistance to flow. Much of the system is operating as a smaller diameter pipeline due to age and tuberculation. In addition, Ten States specifies a minimum pipe diameter of 6 inches for all locations providing fire protection. Therefore, it is recommended to replace the 4-inch pipes with larger diameter 8-inch pipes to increase flow and volume in the system.

There are several locations in the network with dead-ends lines. In conjunction with replacing old 4-inch diameter pipes, it is recommended to connect any associated dead-end lines into the rest of network, in order to provide increased reliability of service and reduce head loss. Any remaining dead-end mains should be equipped with a means to provide

adequate flushing.

3. Valve Exercising Program

Valves are an essential part of a water distribution system that regulate, stop, and start the flow of water. Some of the benefits of fully operational valves include being able to isolate a water main break, which in turns reduces water loss, makes repairs easier, and reduces property damage. If valves aren't used over an extended period of time, they can seize up from corrosion and become inoperable. Currently, the Village has no master record of existing valve and hydrant locations, but they are aware of numerous non-operational valves that need testing and replacement. Therefore, it is recommended to create a valve exercising and maintenance program to prolong the useful life and operation of the water system. The location of the valves and hydrants can be recorded using GPS-based equipment and software for record keeping and future use. This database should also include documentation of maintenance records and digital photos.

H. Additional System Improvements

The Village is currently undergoing SCADA upgrades throughout the distribution system. These upgrades are scheduled for completion by December 31, 2019.

VII. COST ESTIMATE

The following economic analysis includes review of water use and associated costs per dwelling and type of user, a cost estimate of overall system improvements, and a Village prioritized list of improvements.

A. EDU ANALYSIS

An Equivalent Dwelling Unit (EDU) is defined as a one single-family residential household. It is the unit of measure by which the user is charged for water services provided by the municipal water district. It is calculated and imposed upon each improved property served as determined in accordance with district approved ordinances. Non-residential facilities EDU's are calculated based on their demand.

The Village serves a population of 2,149 through 943 metered connections. In addition, the Town of Reading serves a population of 86 through 38 metered connections and the Town of Dix serves a population of 201 through 82 metered connections. The total annual use for the three service areas is approximately 170,766,487 gallons, with an average daily use of 467,854 gpd. Based on the calculations for water use in the community, the average residential consumption rate was 262 gpd, with a total of 1,782 EDUs. Using the average residential value, the breakdown of EDUs for all residential, commercial, institutional, and industrial users are as follows.

Property Use	No. of EDUs
Residential	989
Commercial	603
Institutional	183
Industrial	8
Total	**1,782**

A copy of the 2019 water budget and full analysis of EDU calculations for the Village and Towns is included in Appendix O.

B. Capital Cost Estimates

The 2019 water budget was estimated at $752,130, with about $150,000 spent on O&M. The Village will need to accommodate an increase in O&M costs for the proposed system improvements. The new annual O&M costs are estimated at $750,000.

Based on the comprehensive water system study analyses, the recommended improvements can be consolidated into the five (5) subprojects:

Subproject	Description	Est. Cost
A	Raw Water Intake & Pump Station	$4,555,000
B	Water Treatment Plant	$4,548,000
C	Steuben Street Tank	$277,000
D	Steuben Street Pump Station	$236,000
E	Distribution Network	$5,972,000
	Total	**$15,600,000**

Based on discussions with the Village, associated cost per EDU were calculated for four (4) tiers of subproject combinations:

Option No.	Subprojects	Est. Cost
1	A + B + C + D + E	$15,600,000
2	A + B + C + D	$9,620,000
3	A + C + D	$5,070,000
4	B + C + D	$5,065,000

Depending on the option chosen, the anticipated new debt service payment ranges from approximately $957,708 for Option 1 to $311,000 for Option 4 based on a market rate loan at 4.5% over a 30 year period. After discussions with the Village, these estimates include a planned budget for $50,000 in capital reserve. With 1,782 EDUs, the average user cost would range between $986 per EDU and about $82 per month for Option 1, to $591 per EDU and

about $50 per month for Option 4.

If the EFC awards hardship financing, the average annual debt service payment would decrease to approximately $520,000 for Option 1 and $169,000 for Option 4. With 1,782 EDUs, the average user cost would range between $741 per EDU and about $62 per month for Option 1, to $544 per EDU and about $46 per month for Option 4.

Further details of the overall cost estimate and the possible finance and EDU cost alternatives are provided in Appendix P.

VIII. CONCLUSION

Based on the full comprehensive water system study, there are a number of recommended improvements that can be accomplished in several phases. It is recommended that further discussions take place and that the Village start to pursue funding for the project including both loans and potential grants.

After conducting a full economic analysis, the following improvements are to be addressed in order of criticality of existing conditions, outstanding DOH violations, and future development of the Village.

1. Install new intake screen to control zebra mussel population
2. Construct new raw water pump station to meet peak design demand
3. Install vertical pressure filters at WTP to decrease turbidity
4. Upgrade existing finishing filters and underdrains at WTP
5. Construct additional 0.5 MG storage tank to increase CT time
6. Install baffles in Steuben Street Tank to increase CT time
7. Upgrade Steuben Street pump station to improve system efficiency
8. Replace 4-inch water mains and valves to reduce corrosion and improve water quality
9. Complete SCADA system upgrades including GPS-based monitoring program

As discussed in the previous section, these recommended improvements were consolidated into five (5) subprojects. After discussions with the Village, the subprojects serve as a basis for financial planning, with careful consideration to the overall fiscal status of the Village and associated user costs. It is understood that the Village leaders and financial advisors will prioritize the subprojects as they see fit.

There are a number of funding sources available within New York State. These sources include loan financed and potential grant from multiple agencies, including the Environmental Facilities Corporation (EFC) through the Drinking Water State Revolving Fund (DWSRF) and Water Infrastructure Improvement Act (WIIA), USDA Rural Development (RD), and the New York State Office for Community Renewal Community Development Block Grant (CDBG) program.

APPENDIX A

SITE LOCATION MAP

DRAWING ALTERATION
THE FOLLOWING IS AN EXCERPT FROM THE NEW YORK EDUCATION LAW ARTICLE 145 SECTION 7209 AND APPLIES TO THIS DRAWING.
"IT IS A VIOLATION OF THIS LAW FOR ANY PERSON UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER OR LAND SURVEYOR TO ALTER AN ITEM IN ANY WAY. IF AN ITEM BEARING THE SEAL OF AN ENGINEER OR LAND SURVEYOR IS ALTERED, THE ALTERING ENGINEER OR LAND SURVEYOR SHALL AFFIX TO THE ITEM HIS SEAL AND THE NOTATION "ALTERED BY" FOLLOWED BY HIS SIGNATURE AND THE DATE OF SUCH ALTERATION AND A SPECIFIC DESCRIPTION OF THE ALTERATION".

No.	REVISIONS AND DESCRIPTIONS	BY	DATE

Project Title:
WATER SYSTEM STUDY
VILLAGE OF WATKINS GLEN
SCHUYLER COUNTY, NEW YORK

Drawing Title:
POINTS OF INTEREST

Drawn By: BT
Checked By: JLB
Scale: 1" = 2000'
Date: 08/06/2019

MRB group
Engineering, Architecture & Surveying, D.P.C.
The Culver Road Armory, 145 Culver Road, Suite 160, Rochester, New York 14620
Phone: 585-381-9250
www.mrbgroup.com

Sheet No.
____ of ____

Project No.
2330.19001

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APPENDIX B

2018 ANNUAL DRINKING WATER QUALITY REPORT

Annual Drinking Water Quality Report for 2018

Village of Watkins Glen
303 North Franklin St.
Watkins Glen, NY 14891
(Public Water Supply Watkins Glen ID#NY4801188, Town of Reading #1,#3 ID#NY4801186 & #2 ID#NY4830034 and Town of Dix ID#NY4830037)

INTRODUCTION

To comply with State regulations, **The Village of Watkins Glen**, **Town of Reading and the Town of Dix** will be annually issuing a report describing the quality of your drinking water. The purpose of this report is to raise your understanding of drinking water and awareness of the need to protect our drinking water sources. In 2018 we experienced a boil water notice for the village in April for a water main break, a violation for the village and all districts a boil water notice was issued in August for exceeding turbidity limits due to severe flooding. This report provides an overview of last year's water quality. Included are details about where your water comes from, what it contains, and how it compares to State standards.

If you have any questions about this report or concerning your drinking water, please contact **Mr. Martin Pierce, Water Department Supervisor at (607) 535-6914 or 535- 2736 during regular business hours.** We want you to be informed about your drinking water. If you want to learn more, please attend any of our regularly scheduled Watkins Glen Village board meetings. The meetings are held normally the first and third Tuesday of each month at 6:00 PM at the Municipal Building at 303 N. Franklin Street. The Town of Dix board meetings are held on the Forth Monday of each month at 7:00 PM at 304 7th Street. The Town of Reading meetings are held on the second Wednesday of each month at 7:30 PM at 3914 Route 28.

WHERE DOES OUR WATER COME FROM?

In general, the sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and can pick up substances resulting from the presence of animals or from human activities. Contaminants that may be present in source water include: microbial contaminants; inorganic contaminants; pesticides and herbicides; organic chemical contaminants; and radioactive contaminants. In order to ensure that tap water is safe to drink, the State Health Department and the EPA prescribe regulations which limit the amount of certain contaminants in water provided by public water systems. The State Health Department's and the EPA's regulations establish limits for contaminants in bottled water which must provide the same protection for public health.

The revised Source Water Assessment report was not available at the time of printing. This will be included in the Annual water report when the New York Department of Health completes it.

Our water source is surface water drawn from Seneca Lake, which is truly an excellent and clean source. During 2018
Our system did not experience any restriction of our water source. The water is collected at the lake and pumped to the filtration plant located on Steuben Street. It is then put through the filtering process that includes treatment with Alum and Soda Ash and disinfection with Chlorine. The water is then put through flocculation then filtration that include four reinforced concrete filter cells each with a filter area of 100 square feet designed for an approved filtration rate of 3 gallons per minute per square foot. Each filter cell contains thirty inches of dual media comprised of eighteen inches of anthracite and twelve inches of sand on a General Filter Co. multi-crete under drain system that includes media restraining nozzles.

The Village of Watkins Glen system serves a population of 2149 through 943 metered service connections. The average daily usage for the year 2018 was 452,546 gallons a day and total usage for the year was 165,179,000 gallons.

The Town of Reading district #1 - #3 and #2 serves a population of 86 through 38 metered service connections. The average daily usage for the year 2018 was 4,230 gallons a day and the total usage for the year was 1,544,100 gallons. The Town of Dix serves a population of 201 through 82 metered service connections in their water system. The average daily usage for the year 2018 was 42,517 a day and the total usage for the year was 15,519,000 gallons. The total gallons drawn from Seneca Lake for all districts was 188,471,800. These districts used 182,242,100. This leaves 6,229,700 gallons unaccounted for (3.3%). This water was lost through leaks, fire calls and sewer and hydrant flushing. Our largest single day withdrawal was 957,900 on January 19. The average cost for 1000 gallons of water is $6.01.

ARE THERE CONTAMINANTS IN OUR DRINKING WATER?

As the State regulations require, we routinely test your drinking water for numerous contaminants. These contaminants include: total coliform, turbidity, inorganic compounds, nitrate, nitrite, lead and copper, volatile organic compounds, total trihalomethanes, total haloacetic acids, radiological contaminants and synthetic organic compounds. The table presented below depicts which compounds were detected in your drinking water. The State allows us to test for some contaminants less than once per year because the concentrations of these contaminants do not change frequently. Some of our data, though representative, are more than one year old.

It should be noted that all drinking water, including bottled drinking water, may be reasonably expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling **the EPA's Safe Drinking Water Hotline (800-426-4791) or the New York State Department of Health-Hornell Office, at (607) 324-8371.**

Table of Detected Contaminants							
Contaminant	**Violation Yes/ No**	**Date of Sample**	**Level Detected (Avg/Max) (Range)**	**Unit Measure-ment**	**MCLG**	**Regulatory Limit (MCL, TT or AL)**	**Likely Source of Contamination**
Turbidity *1	Yes	Daily	Avg .077 Avg.Range .025 – 19.414	NTU	NA	AL= .3 NTU	Soil run-off
Chlorine Watkins Glen distribution system	No	5 / week	Avg 1.08 Range .28 – 2.09	Mg/l	MRDLG = 4.00	MRDL= 4.00	Added for disinfection
Chlorine Watkins Glen (entry point) Chlorine = Cl2	No	Daily	Avg: 1.18 Range:.36 – 2.16	Mg/l	MRDLG = 4.00	MRDL = 4.00	Added for Disinfection
CL2 Reading 1-3	No	Weekly	Avg: .59 Range .12 – 1.22	Mg/l	MRDLG = 4.00	MRDL = 4.00	Added for Disinfection
CL2 Reading	No	Weekly	Avg: .72 Range: .28 – 1.17	Mg/l	MRDLG = 4.00	MRDL = 4.00	Added for Disinfection
CL2 Town of Dix Distribution system	No	Daily	Avg: .78 Range: .05 – 2.3	Mg/l	MRDLG = 4.00	MRDL = 4.00	Added for Disinfection
Barium	No	4/10/18	27.2	Ug/l	2000	MCL=2000	Discharge of drilling wastes; Discharge from metal refineries; Erosion of natural deposits.
Village of Watkins Glen, Town of Reading & Dix Copper *2	No	8/16	Highest Avg.=73.7 Range 19-160	Ug/l	1300	AL=1300	Corrosion of household plumbing systems; Erosion of natural deposits; leaching from wood preservatives.
Village of Watkins Glen, Town of Reading & Dix Lead ***3**	No	8\16	Highest AVG. 1.44 Range 0-2.6	Ug/l	0	AL=15	Corrosion of household plumbing systems; Erosion of natural deposits.
Village of Watkins GlenTTHM [Total trihalomethanes] *6	No	2/18 5/18 8/18 11/18	Highest Avg.=47.6 Range 30.7 – 58.8	Ug/l	0	MCL=80	By-product of drinking water chlorination
Town of Dix TTHM [Total trihalomethanes] *6	Yes *9	2/18 5/18 8/18 11/18	Highest Avg.=98.8 Range 80.2 - 110	Ug/l	0	MCL=80	By-product of drinking water chlorination
Town of Reading #1 TTHM [Total trihalomethanes] *6	Yes	2/18 5/18 8/18 11/18	Avg. 72.6 Range 45 - 110	Ug/l	0	MCL=80	By-product of drinking water chlorination
Town of Reading #2 THM[Total trihalomethanes *6]	No	2/18 5/18 8/18 11/18	Avg. 55.1 Range 28.9 – 72.5	Ug/l	0	MCL=80	By-product of drinking water chlorination

Town of Reading #1 HAA [Total haloacetic acids]	No	2/18 5/18 8/18 11/18	Avg. 20.5 Range 17 - 22	Ug/l	0	MCL=60	By-product of drinking water chlorination
Town of Reading #2 HAA [Total haloacetic acids]	No	2/18 5/18 8/18 11/18	Avg. 20.2 Range 11 – 25	Ug/l	0	MCL=60	By-product of drinking water chlorination
Nitrate Sodium Chloride	No No No	4/18 4/18 5/18	.478 73.3 125	Mg/l Mg/l Mg/l	10 250	MCL= 10 MCL = 250	Runoff from fertilizer use; leaching from septic tanks, sewage; Erosion of natural deposits.
Village of Watkins Glen HAAs [Total Haloacetic Acids]	No	2/18 5/18 8/18 11/18	Highest Avg.= 18.8 Range 14 - 23	Ug/l	0	MCL=60	By-Product of drinking water chlorination.
Town of Dix HAAs [Total Haloacetic Acids]	No	2/18 5/18 8/18 11/18	Highest Avg.=20.9 Range 19.2 - 22	Ug/l	0	MCL=60	By-Product of drinking water chlorination.
The Town of Dix has been in violation since August 2014 for Trihalomethanes. We are working on lowering the levels by flushing and keeping the water tanks at lower levels.							

***Notes:**

1. Turbidity is a measure of the cloudiness of the water. We test it because it is a good indicator of the effectiveness of our filtration system. Our highest single turbidity measurement for the year occurred on 8/16/18, (19.414 NTU) State regulations require that turbidity must always be below 1 NTU. The regulations require that 95% of the turbidity samples collected have measurements below 0.3 NTU.
2. The copper level presented represents the 90th percentile of the 10 sites tested. A percentile is a value on a scale of 100 that indicates the percent of a distribution that is equal to or below it. The 90th percentile is equal to or greater than 90% of the copper values detected at your water system. In this case, ten samples were collected at the Village of Watkins Glen Town of Reading & Dix water systems and the 90th percentile value was 73.7 ug/l. The action level for copper was not exceeded at any of the sites tested.
3. The Lead level presented represents the 90th percentile of the 10 sites tested. A percentile is a value on a scale of 100 that indicates the percent of a distribution that is equal to or below it. The 90th percentile is equal to or greater than 90% of the lead values detected at the Village of Watkins Glen Town of Reading & Dix water systems. In this case, ten samples were collected at your water system and the 90th percentile value was 1.44 ug/l. The action level for lead was not exceeded at any of the sites tested.
5. Total Haloacetic Acids (HAA's – mono-,di-, and trichloroacetic acid, and mono- and di-bromoacetic acid)
6. Total Trihalomethanes (TTHM's - chloroform, bromodichloromethane, , dibromochloromethane, and bromoform)
7. The State considers 50 pCi/L to be level of concern for beta particles. If beta particles are detected above 50pCi/l, the water supplier must determine the actual radioactive constituents present in the present in the water to calculate the dose exposure level in mrem/year, and must report both the detected level and MCL as mrem/year.
8. Arsenic: NYS and EPA have promulgated a drinking water arsenic standard of 10 parts per billion. While your drinking water meets the standard for arsenic, it does contain low levels of arsenic. The standard balances the current understanding of arsenic, which is a mineral known to cause cancer in humans at high concentrations and is linked to other health effects such as skin damage and circulatory problems.
9. Some people who drink water containing trihalomethanes in excess of the MCL over many years may experience problems with their liver, kidneys, or central nervous systems, and may have an increased risk of getting cancer.

Definitions:

Action level (AL): The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible.

Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

Maximum Residual Disinfectant Level (MRDL): The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.

Maximum Residual Disinfectant Level Goal (MRDLG): The level of drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contamination.

Milligrams per liter (mg/l): Corresponds to one part of liquid in one million parts of liquid (parts per million - ppm).

Micrograms per liter (ug/l): Corresponds to one part of liquid in one billion parts of liquid (parts per billion - ppb).

Nanograms per liter (ng/l): Corresponds to one part of liquid to one trillion parts of liquid (parts per trillion - ppt).

Nephelometric Turbidity Unit (NTU): A measure of the clarity of water. Turbidity in excess of 1 NTU is just noticeable to the average person.

Non-Detects(ND): Laboratory analysis indicates that the constituent is not present.

Treatment Technique (TT): A required process in tended to reduce the level of a contaminant in drinking water.
Piococuries per liter(pCi/L): Picocuries per liter is a measure of the radioactivity in water.

WHAT DOES THIS INFORMATION MEAN?

As you can see by the table, our system uncovered some problems this year. In august, the monthly performance standard and maximum contaminate level (MCL) for turbidity were exceeded. This occurred between August 16 and August 24. Turbidity has no health effects. However, turbidity can interfere with disinfection and provide a medium for microbial growth. Turbidity may indicate the presence of disease-causing organisms. These organisms include bacteria, viruses, and parasites that can cause symptoms such as nausea, cramps, diarrhea, and associated headaches. We are working to prevent further violations by adding valving and automation to the treatment plant. In addition the maximum contaminate level for trihalomethanes was exceeded in Reading Water District #1-3 (August 2018) and in the Town of Dix(Feb, May, Aug, and Nov. 2018). The Town of Dix has been in violation since August 2014 for total trihalomethanes. We are working on lowering the levels by flushing and keeping water tanks at lower levels. An aeration treatment system designed to reduce total trihalomethanes is being installed in the Town of Dix in 2019. Some people who drink water containing trihalomethanes in excess of the MCL over many years may experience problems with their liver, kidneys, or central nervous system, and may have an increased risk of getting cancer.

IS OUR WATER SYSTEM MEETING OTHER RULES THAT GOVERN OPERATIONS?

In 2018, the water facility received an administrative order from the Department of Health on September 21, mandating improvements to the water treatment plant and its' operation. Some items addressed in this administrative order include additional alarming, valving, data acquisition, equipment, and changes to sampling locations for improved monitoring. The Town of Dix also received an administrative order from the DOH to make improvements to its system on January 30. Some items addressed in this order are emergency power supplies to all pump stations, replacements of outdated pumping equipment and back-up pumping. The Town of Dix and village have contracted an engineering firm to work towards addressing the concerns identified in this order.

GENERAL INFORMATION ON LEAD:

If present, elevated levels of lead can cause serious health problems, especially for pregnant women, infants, and young children. It is possible that lead levels at your home may be higher than at other homes in the community as a result of materials used in your home's plumbing. The Village of Watkins Glen is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline (1-800-426-4791) or at *http:??www.epa.gov/safewater/lead*

DO I NEED TO TAKE SPECIAL PRECAUTIONS?

Although our drinking water met or exceeded state and federal regulations, some people may be more vulnerable to disease causing microorganisms or pathogens in drinking water than the general population. Immune-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice from their health care provider about their drinking water. EPA/CDC guidelines on appropriate means to lessen the risk of infection by Cryptosporidium, Giardia and other microbial pathogens are available from the Safe Drinking Water Hotline (800-426-4791).

WHY SAVE WATER AND HOW TO AVOID WASTING IT?

Although our system has an adequate amount of water to meet present and future demands, there are a number of reasons why it is important to conserve water:

- Saving water saves energy and some of the costs associated with both of these necessities of life;
- Saving water reduces the cost of energy required to pump water and the need to construct costly new wells, pumping systems and water towers; and
- Saving water lessens the strain on the water system during a dry spell or drought, helping to avoid severe water use restrictions so that essential fire fighting needs are met.

You can play a role in conserving water by becoming conscious of the amount of water your household is using, and by looking for ways to use less whenever you can. It is not hard to conserve water. Conservation tips include:

- Automatic dishwashers use 15 gallons for every cycle, regardless of how many dishes are loaded. So get a run for your money and load it to capacity.
- Turn off the tap when brushing your teeth or shaving.
- Check every faucet in your home for leaks. Just a slow drip can waste 15 to 20 gallons a day. Fix it up and you can save almost 6,000 gallons per year.
- Check your toilets for leaks by putting a few drops of food coloring in the tank, watch for a few minutes to see if the color shows up in the bowl. It is not uncommon to lose up to 100 gallons a day from one of these otherwise invisible toilet leaks. Fix it and you save more than 30,000 gallons a year.
- Use your water meter to detect hidden leaks. Simply turn off all taps and water using appliances, then check the meter after 15 minutes, if it moved, you have a leak.

CLOSING:

Thank you for allowing us to continue to provide your family with quality drinking water this year. We ask that all our customers help us protect our water sources, which are the heart of our community and our way of life. Please call our office if you have questions.

APPENDIX C

2018 NYSDOH INSPECTION REPORT

NEW YORK STATE OF OPPORTUNITY. Department of Health

ANDREW M. CUOMO
Governor

HOWARD A. ZUCKER, M.D., J.D.
Commissioner

SALLY DRESLIN, M.S., R.N.
Executive Deputy Commissioner

November 30, 2018

Village of Watkins Glen
303 North Franklin Street
Watkins Glen, NY 14891

PUBLIC WATER SYSTEM
Watkins Glen Village
Sanitary Survey - 2018

Attn: Mayor Steve Schimizzi

Dear Village Board:

On September 21 & 28, 2018, representatives of the New York State Department of Health (Hyland Hartsough, April Kellerhouse, Gary Garofalo and Michael Bailey) met with Martin Pierce, Watkins Glen Water Treatment Plant chief operator and Lee Kent, former Public Works Director to perform a sanitary survey of the Watkins Glen Village Public Water System. Internal review of previous sanitary surveys and events related to the Watkins Glen Village Boil Water Order in mid-August led to the joint inspection by Regional and District Office staff.

RECENT IMPROVEMENTS

We commend the Village Board, Mr. Kent, Mr. Pierce, and other involved personnel for undertaking the following activities and improvements:

1. Hunt Engineers, Architects, and Land Surveyors has been commissioned to prepare a study for obtaining funding to replace the main Programable Logic Controller (PLC) that runs the water treatment plant.

2. In response to issues during the storm event in August that identified problems with alarms, the Village has upgraded turbidity alarms to notify operators of high turbidity events. Two turbidimeters were upgraded to insure readings are properly recorded. Please note there are additional comments on the requirements for Supervisory Control and Data Acquisition (SCADA) in the discussion of the Water Treatment Plant.

3. The Village is in the process of replacing approximately 1,900 linear feet of 8-inch diameter old deteriorated water main along New York State Route 14, between Bath and Division Street.

INTAKE AND RAW WATER PUMP STATION

Watkins Glen Public Water System is supplied by surface water from Seneca Lake. The intake is a 12-inch cast iron main installed in the early 1900's. The intake extends approximately 300 feet from shore at a depth of approximately 35 feet. The intake has a bend up and screen and is

surrounded by a timber crib. The water is seasonally treated with gaseous chlorine for zebra mussel control at the intake structure. The water enters a raw water pump well on shore at the raw water pumping station. The water is pumped to the filtration plant by two vertical turbine low-lift pumps equipped with variable frequency drives (VFDs). The pumps are set to alternate and pump approximately 840 gallons per minute (gpm), with a maximum discharge rate of 1,300 gpm.

Violations:

Figure 1: Raw Water Chlorine Gas Room & Apartments

1. The Village is in violation of Title 10 of the New York State Code of Rules and Regulations, Subpart 5-1, Public Drinking Water Systems (hereafter Subpart 5-1) Subpart 5-1.71 (b) for failure to exercise due care and diligence in the operation of a water treatment plant or distribution system. There is no provision for an alarm to notify the operator of a chlorine gas leak at a remote (not typically staffed) location. Potential release of chlorine gas is an immediate health and safety concern. In addition to the failure to alarm the operator, no provision is made to chemically neutralize a leak as required by Subpart 5-1 Appendix A, Recommended Standards for Water Works (RSWW). Chlorine gas is a toxic substance and the recent development of apartments in the adjoining building makes this a significant risk to neighboring residents.

Requirements:

1. The Village must explore alternative forms of treatment at the intake. As noted previously the location of the chlorine gas adjacent to apartment buildings is a safety and health hazard. Should there be a release, the vent for the room will discharge gas into the driveway for the apartments, and into the pathway of anyone attempting to access the room. Using a different chemical for zebra mussel control may also improve disinfection by-product levels in the distribution system.

Recommendations:

1. The Village should evaluate security at the raw water intake building. The remote location makes it a candidate for intrusion alarms or video surveillance.

WATER TREATMENT PLANT

The Watkins Glen Water Treatment Plant is a direct filtration plant that was approved for construction in 1993. The plant typically produces water for approximately 60 to 120 minutes at a time, 3 to 12 times per day. Typical daily production during 2018 ranged from approximately 300,000 to 800,000 gallons per day (gpd). The variation in volume of water produced depends on water usage at large events being held at Watkins Glen International (WGI) and local industry demands, which are seasonal. The plant can produce a maximum of approximately 1.87 million gallons per day (mgd). However, the rating of the plant is approximately 1.3 mgd which is based on capacity with one filter out of service (typically for backwashing). Alum is injected into the raw waterline prior to a static mixer then the water enters a flocculation chamber. Sodium bicarbonate can also be injected into the incoming waterline for improved flocculation. Water then spills over a weir and is routed to one of four filters. The filter media was designed at 18 inches of anthracite over a 12-inch sand layer. Gaseous chlorine is added for disinfection and a blended phosphate is added for corrosion control as water leaves the plant to the water storage tank on the premises (Steuben Street Tank).

Violations:

1. The Village is in violation of Subpart 5-1.71 (b) for failure to exercise due care and diligence in the operation of a water treatment plant or distribution system. The water treatment facility is operated without staff on site and without the proper controls, alarms, and call out features in place to ensure any issues with water quality and/or quantity are detected and reported to an operator in a timely manner. Proper automation must include features to shut the plant down in the event of a turbidity exceedance and chlorine over/under feed. Since the August storm and system upset the Village has installed a new alarm with a call-out feature based on turbidity levels. This must be evaluated to insure it meets the requirements of the unattended operation policy. If the Village wishes to continue with unattended operation, a plan to comply with Subpart 5-1, Appendix A, Recommended Standards for Water Works, Unattended Operation Policy Statement must be submitted to the Hornell District Office for review and approval.

2. The Village is in violation of Subpart 5-1.52 in that the location currently used to collect entry point samples does not meet the definition of entry point. A true entry point location must be determined, and a sampling tap provided for all future required samples. Subpart 5-1.1 (aj) defines an entry point as, “a representative sampling location after the last point of treatment but before the first consumer connection.”

3. The Village is in violation of Subpart 5-1.72 (c) for failure to record and/or retain turbidity readings. Composite filter effluent (CFE) turbidity is shown on the graph in the computer, but no other form of the result records could be found. At the time of the storm event only 2 of the 4 individual filter turbidimeters were recording data.

In addition to the system control and data acquisition improvements to allow for unattended operation in item 1 of this section, turbidimeters must be evaluated and upgraded if necessary to provide the plant operators with the capability of maintaining the data in tabular format for the minimum required period of 10 years as specified under Subpart 5-1.72 (d)(1).

4. The Village is in violation of Subpart 5-1.72 (c) for failure to report turbidity and chlorine readings during the time the plant is in operation. The operators are reporting readings on the monthly operation report during the time they are at the plant, which does not always coincide with plant operation. Data reported on the operation report must indicate conditions when water is being produced. Each time the plant is in operation readings must be recorded and reported. If the plant is not producing finished water, readings do not need to be reported. This should also be indicated on the operation report.

Requirements:

1. While ventilation is provided for the chlorine room as required by Subpart 5-1, Appendix A, in the event of a gas leak it was noted that the fan discharges adjacent to the access door to the plant and this is a health and safety concern for operators accessing the plant.

2. None of the chemical feed pumps in the treatment plant appear to be equipped with devices to prevent the potential for siphoning and/or overfeed. The valves should be multifunction and provide pressure relief for the protection of discharge tubing, back pressure regulation for maintaining feed output, air bleeding to prevent air locking, and discharge drainage to help protect operators from chemical exposure. If the chemical feed pumps are not equipped with such valves, they must be installed.

Recommendations:

1. The treatment plant lacks any type of security features such as fences, intrusion alarms, or cameras.

2. Standard Operating Procedures (SOPs) should be developed for operation of the plant. The document should detail actions to be taken by un-certified workers who assist with operation of the plant while Mr. Pierce is not present. The procedures should also reference the required plan for unattended operation.

3. On-line analyzers, with recording and alarm capabilities are recommended for monitoring the level of pre-disinfectant and raw water turbidity at the plant.

STEUBEN STREET TANK AND PUMP STATIONS

The Steuben Street Tank is a 500,000-gallon welded steel tank built in 1989 with a separate inlet and outlet which provides contact time for the system. The water leaves the tank to feed two pressure zones. Storage and pressure in the lower zone is provided by the Steuben Street Tank. The Steuben Street Pump Station adjacent to the tank pumps water to the upper zone and Padua water storage tank. This pump station contains two pumps that alternate and are capable of discharging approximately 150 gallons per minute.

Requirements:

1. We have evaluated monthly operation reports and information provided by Hunt Engineers regarding minimum treatment requirements for a surface water source. Based on information provided during the sanitary survey and a preliminary report from Hunt Engineers dated October 17, 2018, it is not clear that adequate CT (concentration x time) to meet the 3.0-log removal and/or inactivation requirement for Giardia lamblia cysts is provided at all times during the year. CT is dependent on temperature, pH of the water, chlorine residual and flow rates through the plant and tank. Because the tank represents the volume of water where the minimum treatment requirements are met it is critical to understand the tank configuration (i.e. inlet and outlet pipes). Because there is no flow meter registering flow rates out of the tank and chlorine residual monitoring must be relocated in accordance with item 2 from the previous section, the CT calculation may be inaccurate. The Village must contract with an engineer to evaluate all conditions to determine if adequate treatment is being provided.

2. It was reported that this tank has not been internally inspected in approximately 18 years. AWWA Standard G-200 recommends internal inspections of all storage tanks be performed every 5 years. As such, and due to the questions surrounding appropriate CT for the system, this tank must be internally inspected by May 1, 2019. All reports, pictures, and videos based upon this inspection shall be submitted to the Hornell District Office.

Recommendations:

1. Based on a review of plans and discussion with Mr. Pierce, it appears that there is a ¾" pipe in this pump house that could be used as the entry point sampling location identified as the second violation under the Water Treatment Plant section.

DISTRIBUTION SYSTEM

The distribution system consists of two pressure zones. The lower pressure zone serves most of the Village proper and is fed from the Steuben Street Tank. The pressure in this zone ranges from 80 – 90 pounds per square inch (psi). The upper pressure zone is fed from the Steuben

Street Booster Station and provides water to the Towns of Reading and Dix, and to Watkins Glen International (WGI) racetrack. The pressure in this zone ranges from 40 – 150 psi, with most areas being below 100 psi.

LOWER PRESSURE ZONE

A significant portion of the distribution system is comprised of older, small diameter water mains with deficient fire flows. The Village should continue to implement its program to gradually replace undersized and deteriorating mains.

Some areas of the distribution system also have pressure/flow problems, such as Lee and Monroe Streets. In a few instances, individual homes have booster pumps installed to boost the Village water pressure. Subpart 5-1.27 requires water systems to assure a minimum working pressure of 20 psi at ground level at all points in the distribution system. While this is the minimum requirement in accordance with Subpart 5-1.27, the design standards, referenced as Subpart 5-1, Appendix A, Recommended Standards for Water Works recommends a minimum operating pressure of 35 psi.

UPPER PRESSURE ZONE

Padua Tank

The Padua Tank is a 250,000-gallon steel tank built in 1934. The tank has a single inlet/outlet that feeds the upper pressure zone. This tank also feeds back to the water treatment plant to supply the restroom facility and laboratory sink.

Figure 2: Padua Tank

Requirements:

1. This tank appears to be at the end of its useful life. The foundation appears to be crumbling and there is at least one bullet hole completely through the side wall. Mr. Pierce reports that he cannot completely fill the tank because of this hole. This tank must be rehabilitated or replaced. No information was available regarding recent inspection of the tank. AWWA Standard G-200 recommends internal inspections of all storage tanks be performed every 5 years.

2. The water main from the plant to this tank was installed in the 1930's. As this line is aging, and in an area that is not easily accessible, the Village should also consider replacing it.

Recommendations:

1. Access to this tank is difficult. The Village should insure that there is an easement through the property and gravel pit. The road to the tank itself must be maintained to allow adequate access during all times of the year.

2. The Village should address security at the site. There is no fencing around the tank to restrict access.

We also reviewed the following routine operation and maintenance items for the distribution system. Distribution system operation and maintenance is covered by Subpart 5-1.71(b)

Cross Connection Control:

Mr. Pierce indicated he has records for cross connection control device testing. The Village has a program for obtaining test results and insuring protection of the public water system. In accordance with Subpart 5-1.31, the Village shall ensure that all devices are tested annually.

Meters & Leak Detection:

It is our understanding that the Village has a water service meter replacement program in place and that some of the meters are more than 20-years old. These meters should be calibrated or replaced as meters tend to lose up to 20% of their accuracy as they approach 30 years of age. The backwash meter in the plant must be calibrated or replaced. The Village should also track unmetered water for uses such as hydrant flushing and perform leak detection studies if its unaccounted-for-water is 15 percent or more. There are production costs associated with unmetered water that are not recovered.

Hydrants and Valves:

Hydrants and valves must be routinely (annually) exercised to ensure they will work when needed and are not a liability to the Village in case of an emergency. Guidance for proper operation and maintenance of a distribution system can be found in AWWA G-200.

Routine Maintenance:

Routine maintenance must continue to be performed. Replacement of screens on vents, mowing grass and trimming brush, drainage of pits and maintenance of meters must be routinely performed.

Distribution System Turbidity:

Distribution system turbidity analysis is required by Part 5-1.52 Table 10A. The

water treatment plant operators currently take distribution samples for turbidity using a bucket and pour them into an on-line analyzer in the plant. Due to chances for error or inaccurate readings using this method the Village shall purchase a bench/handheld turbidimeter for analyzing grab samples and for verification of the on-line analyzers.

WATER QUALITY

A review of the most recent water quality monitoring results indicates that there were two turbidity treatment technique violations in August 2018. More than 5% of the composite filter effluent turbidity readings were above the performance standard of 0.3 NTU in a single month and the composite filter effluent readings exceeded 1.0 NTU on August 16th and 17th. These violations were issued in separate correspondence and the appropriate public notification was completed on August 16, 2018 and November 2, 2018.

The Village and it's purchase water systems in the Towns of Reading and Dix must work to address disinfection by-products. Disinfection by-products form when chlorine combines with naturally occurring organic matter in the water. Two groups of compounds are regulated, total trihalomethanes (TTHMs) and haloacetic acids (HAAs). The Environmental Protection Agency has set Maximum Contaminant Levels (MCLs) for these groups of 80 and 60 micrograms per liter (ug/l), respectively, based on the locational running annual averages of quarterly sample results taken from the distribution system. Although the Village has not exceeded these standards, there are issues in the Towns that purchase water from the Village. As such, the Village should consider all options for the reduction of these contaminants within its distributions system.

Some options to evaluate to reduce disinfection by-products include changing chemicals at the raw water intake, extending the raw water intake, improving filtration by evaluating different coagulants, and providing mixing and aeration at water storage tanks. In addition, the Village should work with the Towns of Dix and Reading to develop and implement a robust flushing program.

The Village has performed raw water e. coli monitoring as required by the Long Term 2 Enhanced Surface Water Treatment Rule. Hornell District Office will review the data and inform the Village of any additional requirements.

CERTIFIED OPERATORS

The Village currently employs only two certified operators. Mr. Martin Pierce holds a IIA certification and Mr. Stanley Swarthout holds a D certification. The Village also contracts with Hunt Engineers (Mr. Harley Connelly – IIA, IIB, C, and D) for a back-up operator. Please provide a copy of this contract to the Hornell District Office as soon as possible. While this meets the certified operator requirements for the Village outlined in Subpart 5-4, you are strongly encouraged to pursue the hiring of additional certified operators. In addition, it is our understanding that the Village contracts with the Towns of Dix and Reading to operate their

systems. The Town of Reading Water Districts require an operator with a D certification. The Town of Dix Water District also requires an operator with a D Certification, as well as a C certification due to the addition of chlorine.

In general, the system appears to be in good physical and operating condition. Mr. Pierce and Mr. Kent were very knowledgeable of the systems' components and very courteous and helpful during the sanitary survey. Please provide a written response to all the items in this report, no later than **January 31, 2019**. If you have any questions, please do not hesitate to contact the Hornell District Office at (607) 324-8371.

Sincerely

Hyland Hartsough, PE
Western Region Water Supply.
(for April Kellerhouse, Gary
Garofalo, PE and Michael Bailey)

pc: Lloyd Wilson, PhD, NYSDOH BWSP

APPENDIX D

FIRE STORAGE CALCULATIONS AND HYDRANT TEST RESULTS

MRB|*group*

Project Title	Village of Watkins Glen Comprehensive Water Study
Project No.:	2300.19001
Date:	September 10, 2019
Engineer:	J. Lang-Bentley
Objective:	To calculate the required storage volume based on existing demand and required fire flow, and determine if additional storage is needed.

Demand	Average Daily Flow (Village) =	0.45	MGD	
	Average Daily Flow (Towns) =	0.05	MGD	
	Total Average Daily Flow =	0.50	MGD	
	Max Daily Flow =	0.67	MGD	
	Peak Hourly Flow =	1.49	MGD	PF = 2.5
Design	Design Average Daily Flow =	1.00	MGD	
	Design Max Daily Flow =	1.50	MGD	
	Design Peak Hourly Flow =	2.50	MGD	
Fire Flow	Maximum ISO Fire Flow =	3500	GPM	
	ISO Duration =	3	hr	
	Fire Flow Storage =	0.63	MG	
Compare	Max Daily Flow + Fire =	1.30	MG	
	Peak Hourly Flow =	**2.50**	**MG**	*Most conservative storage volume*
Nominal Storage	Steuben Tank =	0.50	MG	
	Padua Tank =	0.33	MG	
	Total Existing Nominal Storage =	**0.83**	**MG**	
Actual Storage	Steuben Tank =	0.49	MG	
	Padua Tank =	0.32	MG	
	Total Existing Actual Storage =	**0.81**	**MG**	
Available Storage + Fire	Steuben Tank =	0.75	MG	
	Padua Tank =	0.96	MG	
	Total Existing Available Storage =	**1.71**	**MG**	
Recommended Storage + Fire	Steuben Tank =	0.89	MG	
	Padua Tank =	0.81	MG	
	Total Existing Recommended Storage =	**1.70**	**MG**	
Check	**Average Daily Design Flow + Fire**	**1.63**	**MG**	
	Based on Ten States =	PASS		
	Based on Recommended Fire Flow =	PASS		

HYDRANT FLOW TEST

Village of Watkins Glen

WATER TREATMENT PLANT

HYD (Howard & Bath)

HYD (Steuben & So. Glen)

HYD (Madison & Partition)

HYD (Franklin & 14th)

HYD (Franklin & 6th)

HYD (Porter & 8th)

HYD (High School - Any)

HYD (10th & Magee)

HYD (WalMart - Any)

Watkins Glen

Schuyler

W 2nd

Orchard Ave

Summit Ave

Howard Ave

Lakeview Ave

S Glen Ave

Cedar St

Cemetery Rd

S Jackson St

S Monroe St

Pine St

S Madison Ave

Cross St

Division St

Seneca St

Reading Rd

S Rte 14

Smalley Ln

N Decatur St

Porter St

N Porter St

Clarence St

Perry St

Magee St

Shannon St

Limbeck Ln

Willow Dr

Old Corning Rd

S Rim Trail

Finger Lakes Trail

Gorge Trail

Indian Trail

South Ave

Grandview Ave

14th St

15th St

12th St

10th St

9th St

7th St

6th St

5th St

3rd St

E 2nd St

1st St

409

28

30

419

414

14

329

Legend

- ALTERNATE Hydrant Locations
- PRIMARY Hydrant Locations

N

1000 ft

MRB | *group*

Project Title: Village of Watkins Glen Comprehensive Water System Study
Project No.: 2330.19001
Date: September 26, 2019
Engineer: J. Lang-Bentley

Objective: Results of hydrant flow testing and calculated available fire flow.

Hydrant No.	Location	Time	Flow Hydrant			Residual Hydrant		Calc. Available Fire Flow at 20 psi (gpm)	Comments
			Static P (psi)	Pitot P (psi)	Q (gpm)	Static P (psi)	P (psi)		
1	Bath St. and Howard St.	9:06 AM	74	20	750	53	0	580	First location to lose pressure when tank lowers
2	Steuben St. and South Glen Ave.	9:13 AM	29	26	855				No hydrant to take static
3	N. Madison St. and Partition St.	9:40 AM	73	60	1298	57	51	3467	
4	8th St. and Porter St.	10:30 AM	77	65	1351	79	71	3975	
5	10th St. and Magee St. (new main)	11:00 AM	83	61	1309	82	71	3330	
6	Wal-Mart (SW)	11:20 AM	81	57	1265	84	65	2438	
7	Route 414 and Boat Launch Road	11:45 AM			960				
8	14th St. and S. Franklin St.	12:15 PM	74	59	1287	79	70	3554	
9	6th St. and N. Franklin St.	12:34 PM	77	65	1351	79	71	3975	

APPENDIX E

MIKE URBAN+ MODEL AND RESULTS

FILE PATH LOCATION N:\2330.19001.000\dwg\Model Network Map.mxd

Comprehensive Water System Study

Village of Watkins Glen

MIKE URBAN+ Water Model Network

5

Drawn By: JLB

Scale: 1" = 1,456

Date: October 2019

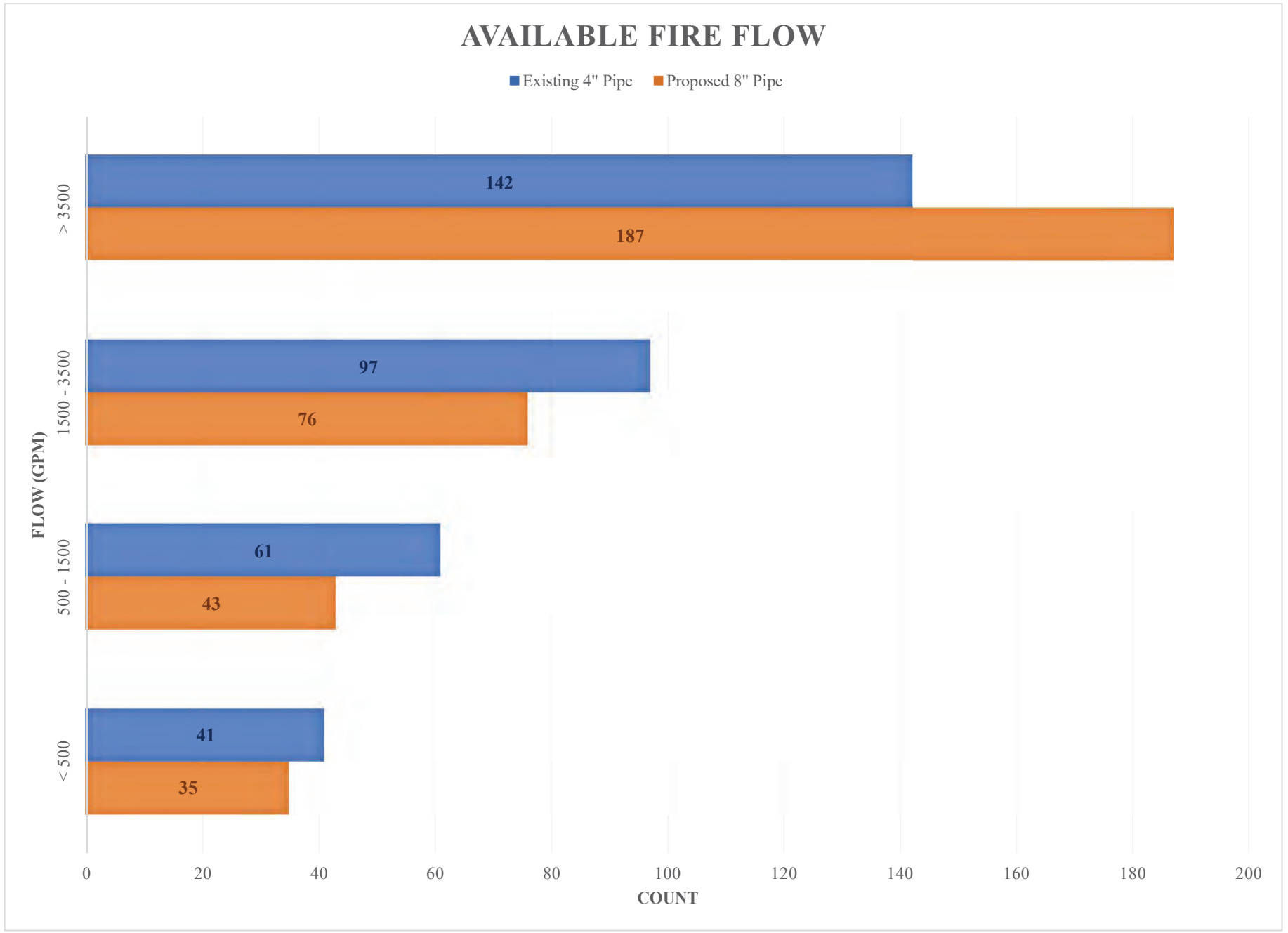
MRB | group
Engineering, Architecture, Surveying, D.P.C.
145 Culver Road, Suite 160, Rochester, New York 14620 585-381-9250 FAX 585-381-1008
www.mrbgroup.com

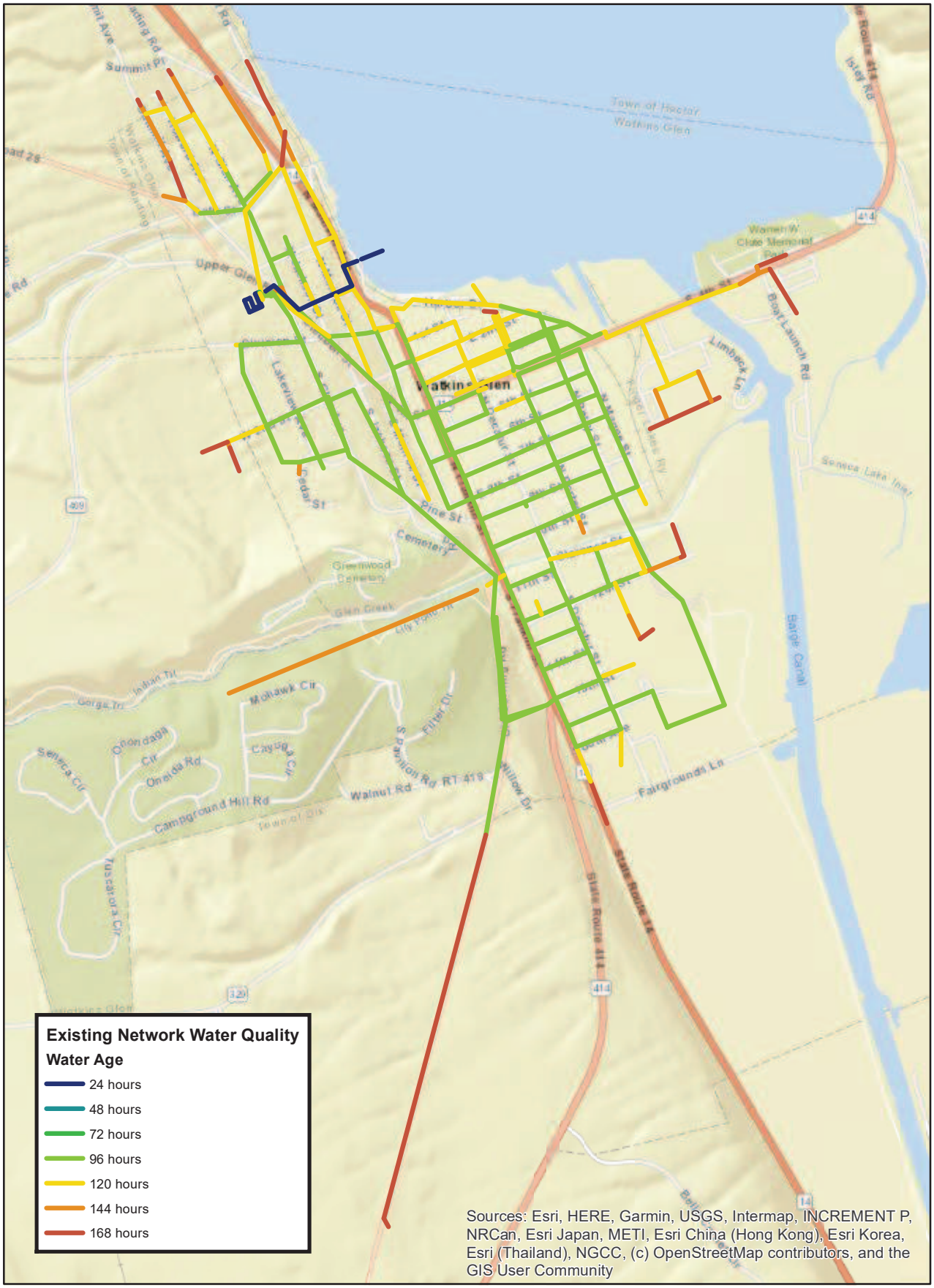
PROJECT NO.

2330.19001

SHEET NO.

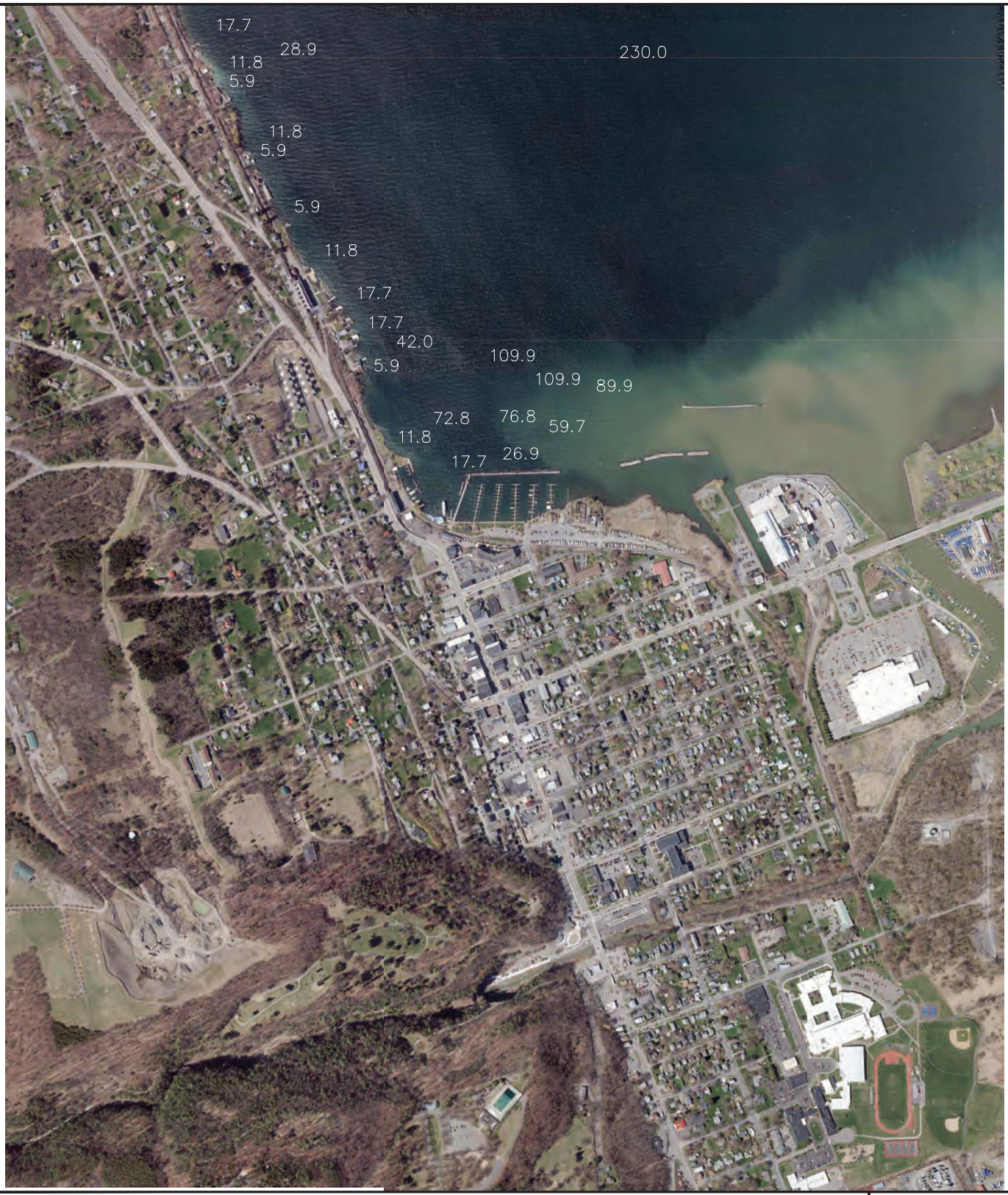
1 of 1


AVAILABLE FIRE FLOW
Existing 4" Pipe
Proposed 8" Pipe
FLOW (GPM)
> 3500
1500 - 3500
500 - 1500
< 500
142
187
97
76
61
43
41
35
0
20
40
60
80
100
120
140
160
180
200
COUNT


Existing Network Water Quality
Water Age
24 hours
48 hours
72 hours
96 hours
120 hours
144 hours
168 hours
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

APPENDIX F

SENECA LAKE BATHYMETRY



Project Name:

WATER SYSTEM STUDY
VILLAGE OF WATKINS GLEN
SCHUYLER COUNTY, NEW YORK

Project No.

2330.19001

MRB | group

Engineering, Architecture & Surveying, D.P.C.

The Culver Road Armory, 145 Culver Road, Suite 160, Rochester, New York 14620
Phone: 585-381-9250

www.mrbgroup.com

Drawn By: BT

Checked By: JBL

Scale: 1" = 1000'

Date: 7/17/2019

No.	Revisions	By	Date

Distribution:

Sheet No.

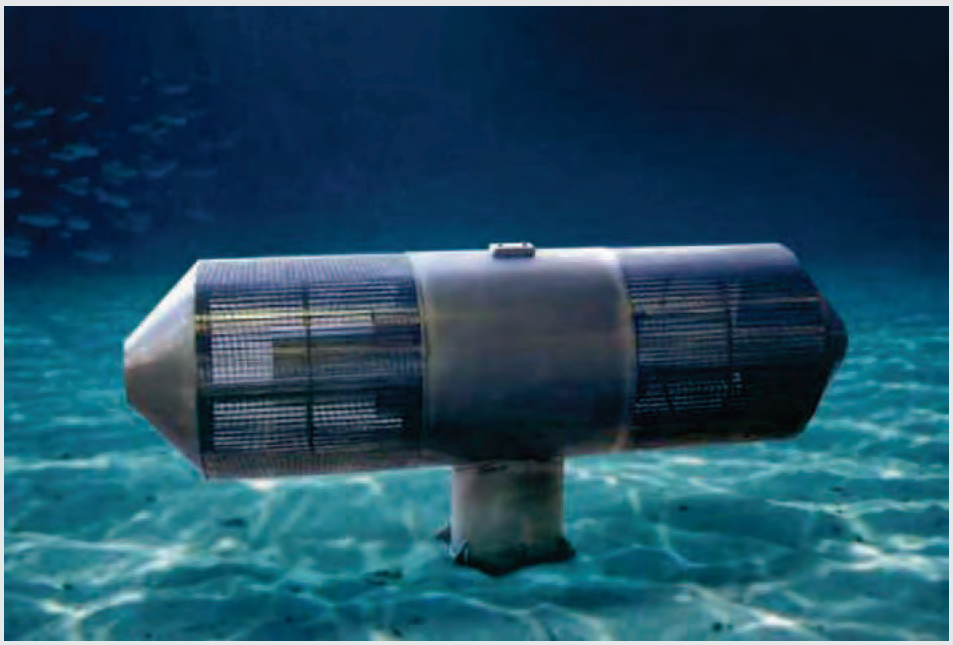
FIGURE 1

Drawing of Origin:

N:\2330.19001.000\dwg\Water Depth.dwg

APPENDIX G

JOHNSON SCREENS PRODUCT INFORMATION



AQSEPTENCE GROUP

JOHNSON SCREENS® PASSIVE INTAKE SYSTEMS

JOHNSON SCREENS® high capacity passive intake screens provide uninterrupted water withdrawal from lakes, rivers and oceans. With over 30 years of intake screen experience and thousands of installations covering a variety of conditions, application engineers from the Aqseptence Group can provide design and application assistance. From shallow rivers to deep oceans, the passive intake screen systems can meet site requirements anywhere in the world.

To provide maximum efficiency, the JOHNSON SCREENS® passive intake screens are custom designed and engineered to each unique environment, resulting in a system which costs less to install, operate and requires less maintenance.

The JOHNSON SCREENS® high capacity passive intake screens are constructed using non-plugging vee-Wire® with a patented internal dual flow modifier that creates a nearly uniform low flow velocity through the entire screen surface. This significantly reduces impingement and entrainment of debris while protecting aquatic life. Passive screens are designed to meet regulatory requirements for a maximum slot velocity for both entrainment and impingement. This velocity is typically 0.15 m/s which is the maximum velocity at which a juvenile fish can turn around, swim away and not be impinged onto a passive screen but the screens can be designed to the velocity requirements of the application. This, combined with a wide range of slot sizes (typically between 2 - 10 mm) determines our screen sizing. Furthermore, the large open area and low velocities result in a very low head loss in all applications, providing low overall operating costs.

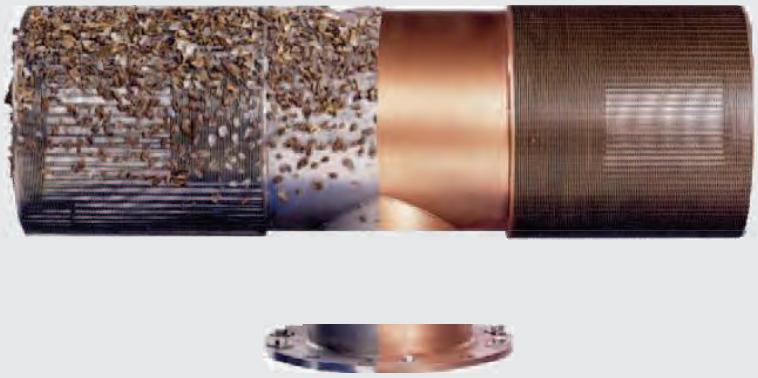
Key Features

- Low capital costs and no moving parts, no power consumption, and low maintenance needs.
- Environmentally-friendly – this approach meets the US EPA's 316b regulations for fish protection.
- No waste stream – there is no debris brought to the surface to be handled or disposed of.
- Easy cleaning – with a periodic blast of compressed air using our Hydroburst™ system.
- Three standard configurations – drum, tee and half screens.
- Selection of materials – 304 stainless steel for fresh water and Z-alloy (CuNi) for repelling zebra mussel attachment and anti-bio fouling in seawater.
- Seawater applications – higher corrosion-resistant materials such as 316L, along with cathodic corrosion protection and duplex steels.
- Dual-flow modifier – provides low and even slot velocity (CFD modelling is available on demand).
- Patented internal flow modifier.

ADVANTAGES

- Highly efficient
- Custom-designed and engineered
- Low operating costs
- Low capital costs
- Environmentally-friendly:
  EPA Rule 316b-compliant and also compliant with UK fish protection laws
- Low head loss
- Proven technology for shallow water resources
- No waste stream

JOHNSON SCREENS® Vee-Wire®



JOHNSON SCREENS® Passive Intake Screen Z-Alloy (CuNi) to avoid zebra mussel growth

Internal Dual Flow Modifier

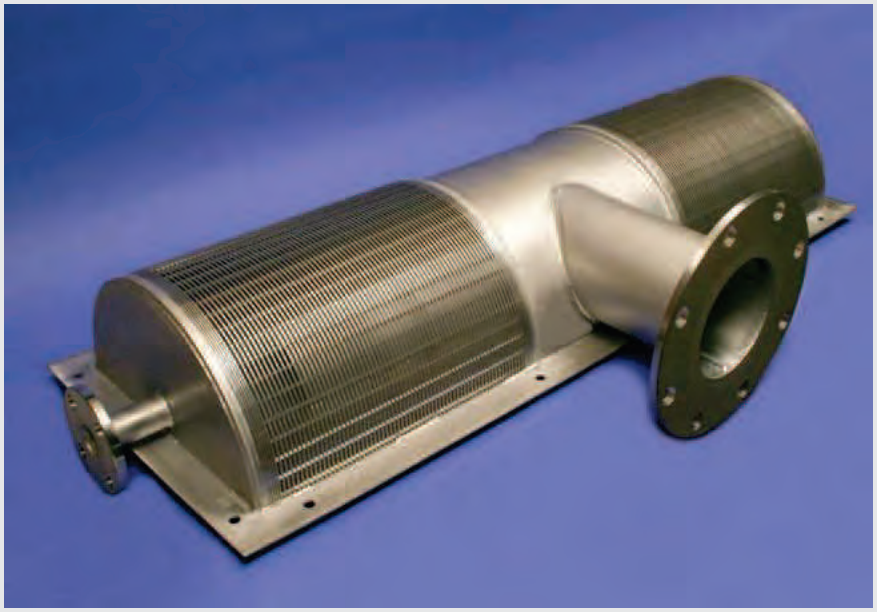
Early flow modifier designs, which included restrictive pipes using slots and holes, plugged easily and experienced a very high pressure drop across the screen surface area. The JOHNSON SCREENS® passive intake screen systems have an open pipe design that is much more effective, and is now the industry standard.
The key component of an intake screen system is the internal dual flow modifier. The even flow raises the overall efficiency of the screen to over 90 percent, which means more compact screen cylinders and Hydroburst™ components can be used.

The low pressure drop across the screen surface and through the screen body (lower head loss) reduces the amount of energy required to pull water through the screen, creating significant savings on operating costs.

Half Intake Screens: For Shallow Water

As water demands increase for cities, towns and industry, shallow water resources previously hard to withdraw from due to their lack of depth, have become a more viable option.

Our patented half screen has all the same attributes (low slot velocity, Hydroburst™ option, Vee Wire®, Dual flow modifier, etc.) as the standard passive intake screens but can operate in a much lower depth of water. Our standard passive screens require approximately half a diameter clearance around the screen. The half screen sits flat on the bottom and only needs the top clearance.



Hydroburst™ Air-Backwash System: Maximizes Intake System Efficiency

The Aqseptence Group developed the Hydroburst™ backwash system especially for conditions in which intake screens may need regular cleaning due to areas with high concentrations of debris or areas that are difficult to access.

Hydroburst™ with Surface Blast

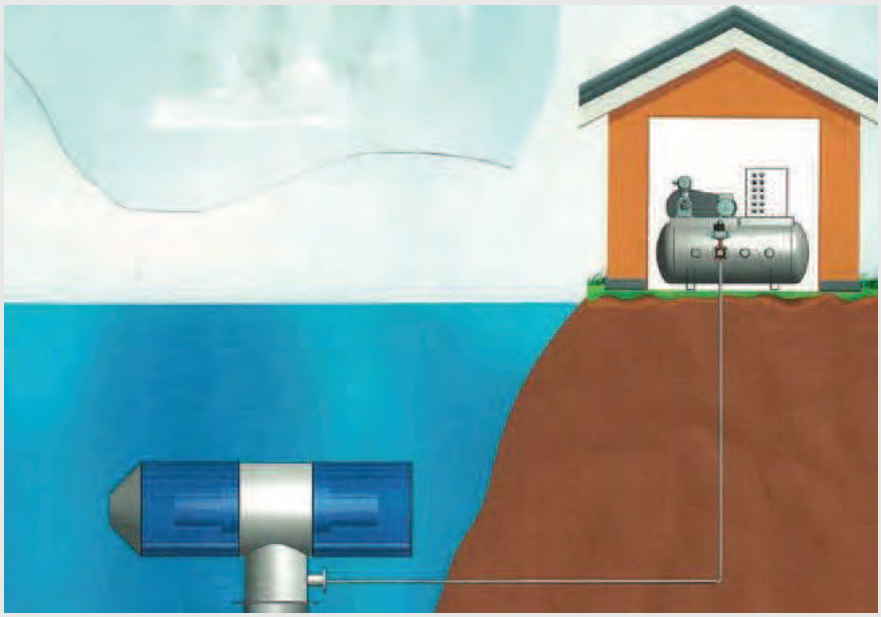
The process flushes the debris away from the screen surface by releasing a large volume of compressed air through the bottom of the screen within a few seconds. The typical backwash procedure cleans each water intake either sequentially or at regular intervals.

The Hydroburst™ basically consists of four main components typically pre-assembled on a skid:

1. A modern control panel, for manual or automatic operation.
2. A high-capacity receiver tank that stores the compressed air.
3. A high-capacity compressor, which supplies compressed air, needed to recharge the receiver tank.
4. Valves.
5. An optimized air distribution pipe assembly and nozzles inside the screen for even and efficient air distribution.

Hydroburst™ Air-Backwash System: Mode of Operation

With time, general debris will gather on the outer screen surface and will need periodic cleaning to keep the screen functioning continuously and properly. Our Hydroburst™ system offers an efficient method of regular cleaning without having to send divers in to clean the screens.



The Complete Hydroburst™ System

Our Hydroburst™ system is designed to deliver a sufficient volume of air in 3 – 5 seconds time – a real solid blast of air that has proven to work in all types of applications and conditions. This volume of air comes out from the bottom of the screen, and as it rises and expands, grabs and carries impinged debris away from the screen surface, returning the screen to a clean and efficient operating condition. Our application engineers evaluate screen size, depth and distance away in order to deliver the correct amount of air. Systems vary from operating a manual valve, to using a programmable timer system or automated PLC system that communicates to a central data control system / SCADA system for control.

AQSEPTENCE GROUP

Division Water Intake Systems

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Fax +56 02 9280705

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Fax +33 5 4902 1616

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www.water.bilfinger.com
www.aqseptence.com

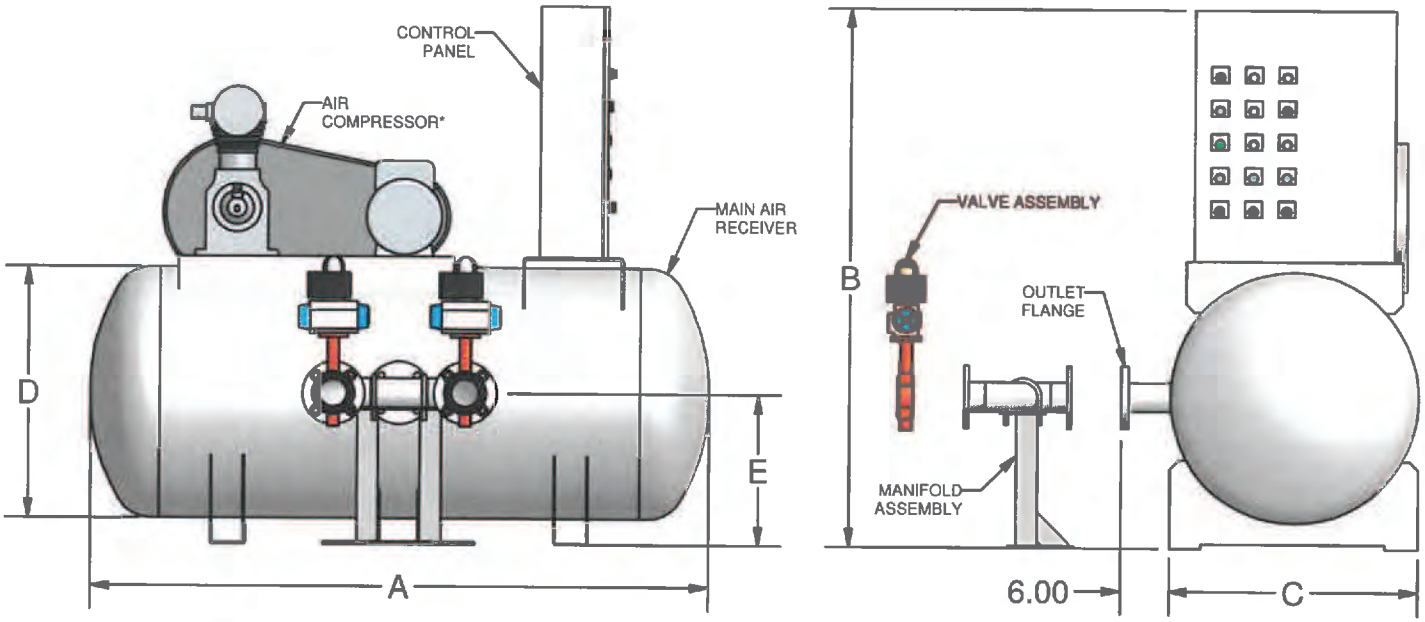
JOHNSON SCREENS® Passive Intake Installation: Drinking Water Plant in South Carolina, USA

JOHNSON SCREENS® Passive Screen Installation for WE Power at Lake Michigan

Transport of JOHNSON SCREENS® Passive Screens to the Santa Maria Power Plant at a Site in Chile

Hydroburst Selection Chart

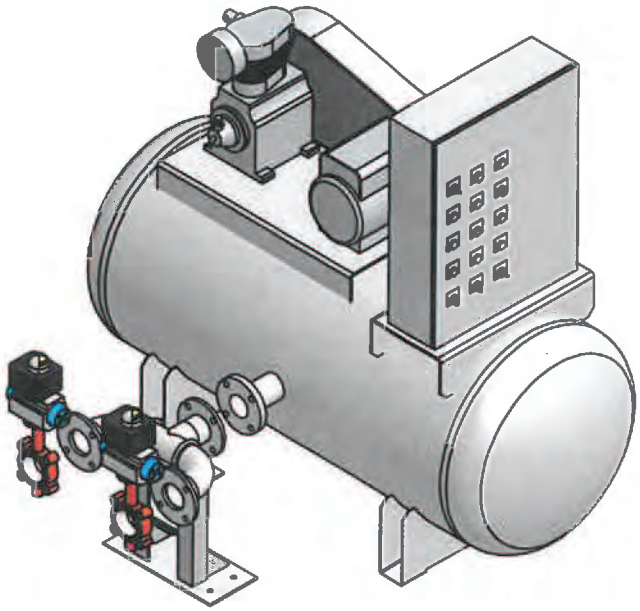
60 - 400 Gallon Horizontal Air Receiver



Model #	Outlet Flange Size	Dimension "A"	Dimension "B"	Dimension "C"	Dimension "D"	Dimension "E"	Estimated Weight**
60H*	2"	47.63"	56.50"	33.00"	20.00"	13.00"	850 LBS
80H	2"	62.63"	56.50"	20.00"	20.00"	13.00"	900 LBS
120H	3"	65.00"	60.50"	24.00"	24.00"	15.00"	1000 LBS
200H	3"	74.00"	66.50"	30.00"	30.00"	18.00"	1200 LBS
240H	3"	83.75"	66.50"	30.00"	30.00"	18.00"	1300 LBS
400H	4"	92.00"	72.50"	36.00"	36.00"	21.00"	1800 LBS

*Air Compressor Rotated 90 degrees for Model 60H
**Estimated Weight based on 1 Valve Hydroburst System - Add 50 lbs for each additional valve

Component	Description
Main Air Receiver	200 PSIG MWP
Air Compressor	5 HP (10 HP for Model 400H) Less Than 15 Minute Recharge
Control Panel	
Valve Assembly	Ball Valve - 1" & 1.5" Size Butterfly Valve - 2" to 4" Size
Manifold Assembly	1, 2, 3 or 4 Valve



F. Algae Growth

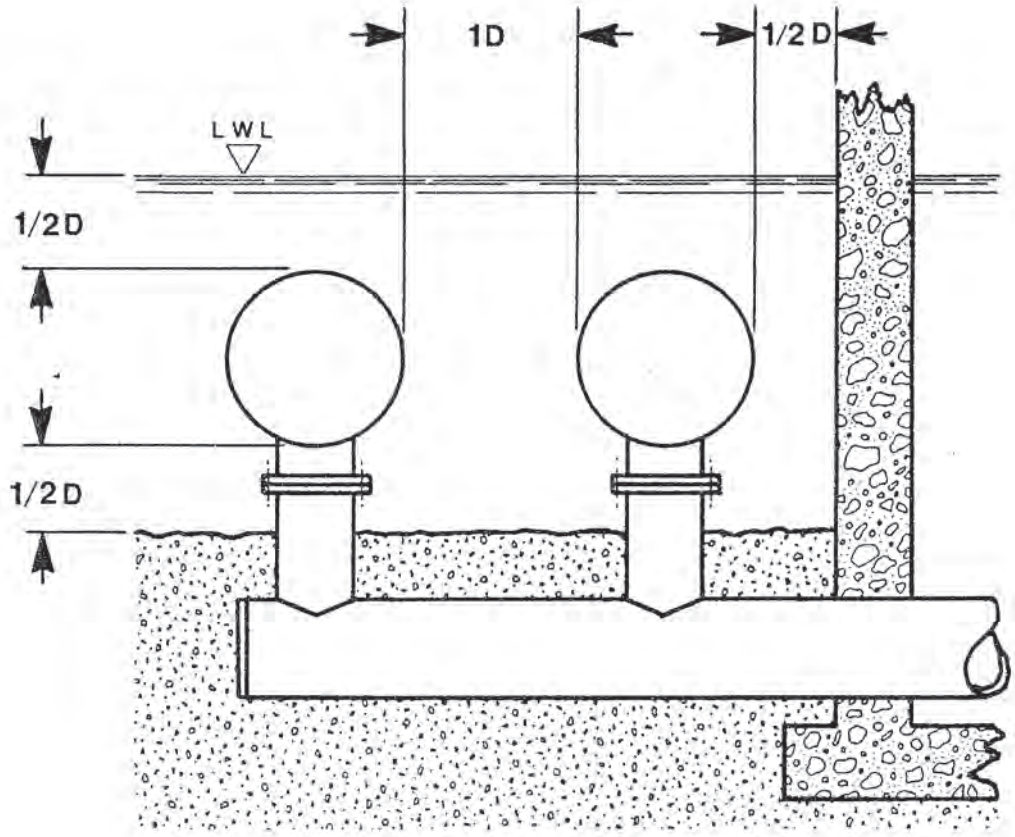
Algae growth occurs on screens in fresh water but is generally not harmful and does not affect performance. The rate of growth depends on the clarity of the water, temperature and sunlight penetration. Algae growth is seasonal in temperate climates and dies or lies dormant at low temperatures. On fine slot screens, 1.0MM or less, algae growth accelerates the buildup of fine sediment and such systems may require more frequent cleaning.

G. Boundary Clearances

1. The minimum distance between the screen and any boundary in a radial direction, including the water surface, should be one-half screen diameter.

2. The minimum distance between adjacent screen surfaces should be one screen diameter.

3. Clearances should be increased if site conditions are subject to icing or sedementation.

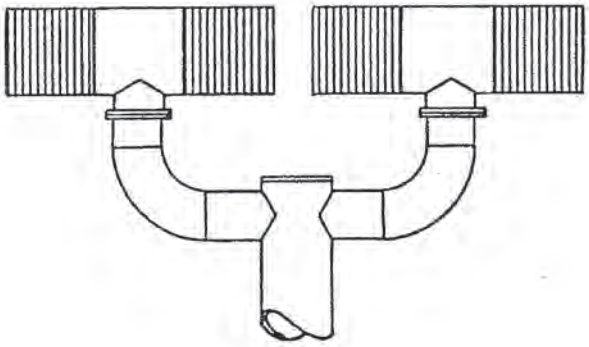


H. MANIFOLDING

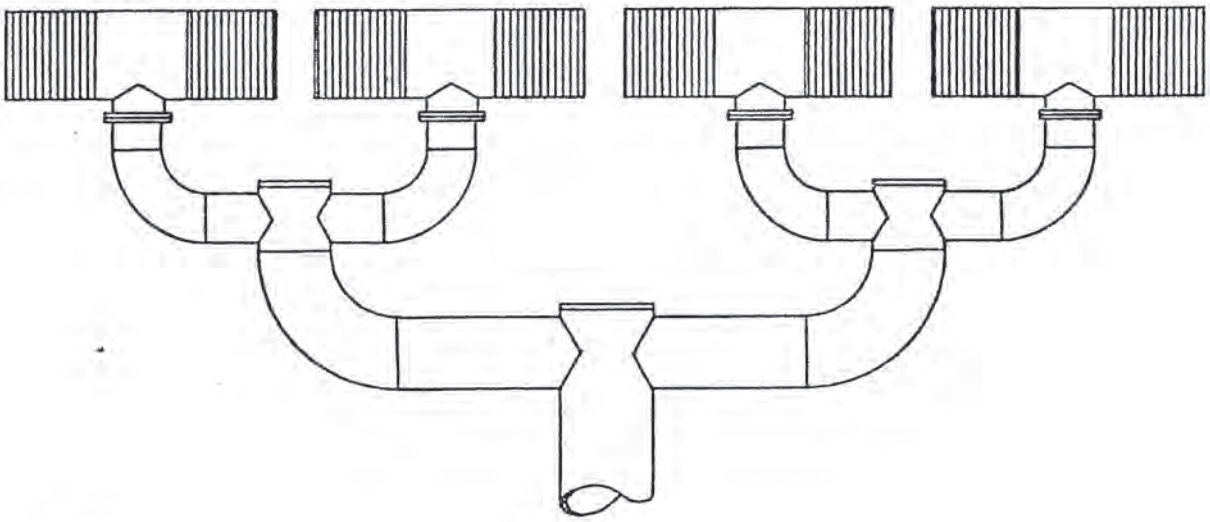
To establish equal flow and optimum performance from each screen in a multi-screen system, the intake manifold must be hydraulically balanced. This is accomplished when each path through the manifold results in the same head loss.

The simplest way of designing a balanced manifold is to use symmetry. In a manifold using symmetry the size, form and length of pipe traveled is the same for each path resulting in equivalent head loss and flow rate. The following are examples of manifolds which use symmetry.

Example 1.



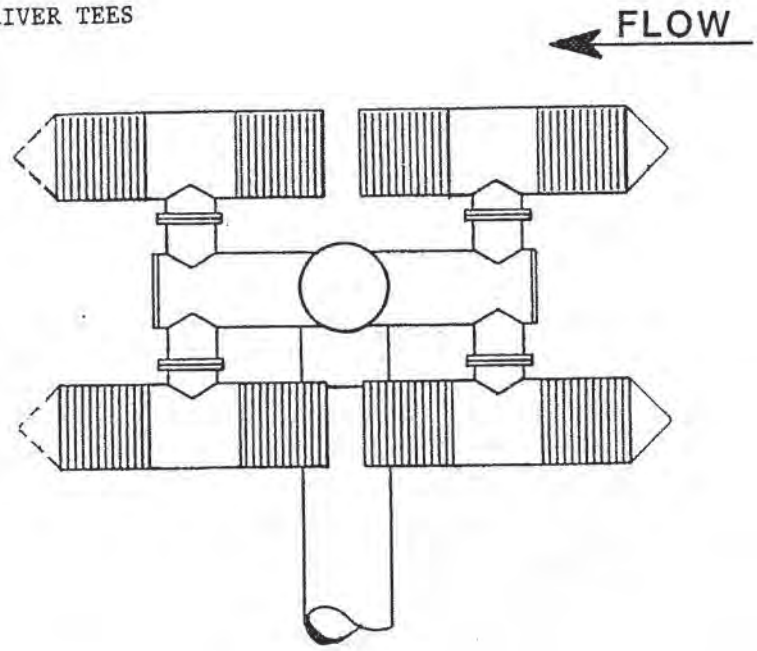
Example 2.



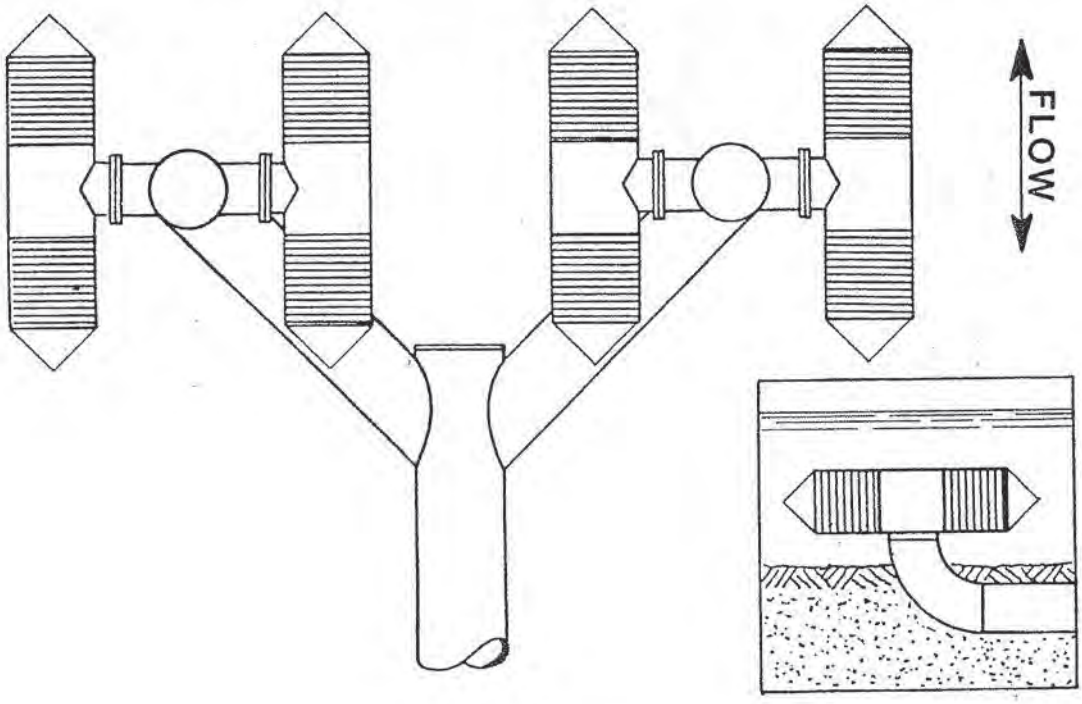
Note:

The optimum flow velocity through the intake pipe will vary, but 5 fps is typical.

Example 3. RIVER TEES

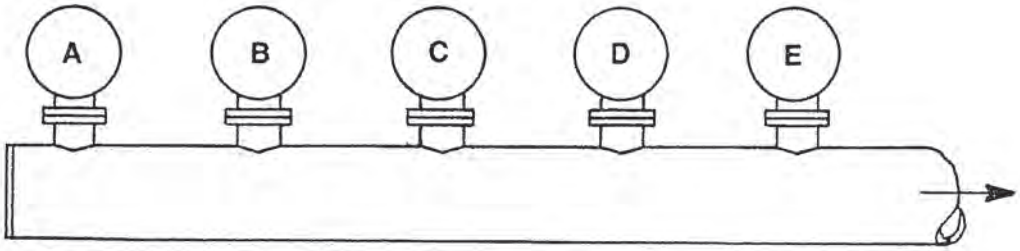


Example 4. TEE ARRAY FOR ALTERNATING TIDAL CURRENTS

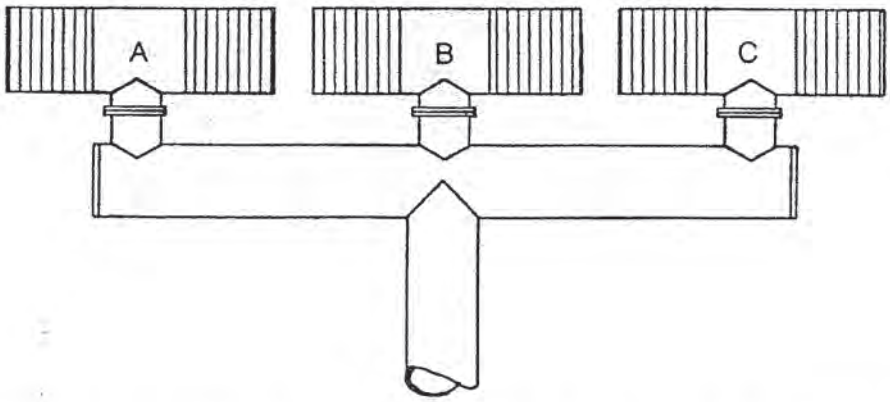


These manifolds are not symmetrical.

Example 1.

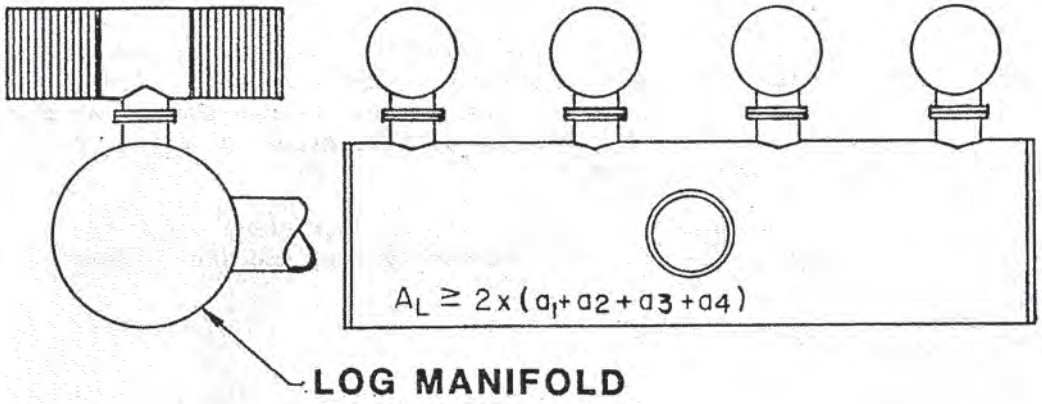


Example 2.



When symmetry is not possible the manifold may be balanced by the use of restrictive orifices. For the screens mounted on the header in example 1 above, acceptable balance may be obtained by orifices in screens "D" and "E". In example 2 balance can be improved by an orifice in the outlet of screen "B".

Another method of achieving system balance is by the use of a log manifold.



Imbalance can be reduced by making the diameter of the log chamber significantly larger than the riser pipes. A guideline for sizing the manifold is to make the cross sectional area of the log chamber, A_L, at least twice as large as the sum of the cross sectional areas of the individual risers, A_n.

Aqseptence Group, Inc.
1950 Old Hwy 8 NW
New Brighton, MN 55112
Tel no : 1-800-833-9473
Fax no : 651 - 638 - 3132

Aqseptence Group

Quotation

Number/Date 20072383 / 09/13/2019
Reference no./Date Watkins Glen, NY
Sold-To 10004012
Validity period 09/13/2019 to 09/13/2019
Sales person name Mark Watson
Entered by Billy Emmers

We deliver according to the following conditions:
Currency USD
Terms of payment: Within 30 days without deduction
Terms of delivery: CPT Watkins Glne, NY
Shipping conditions : US: Prepaid

BUDGET QUOTE

Contact: Johanna Lang-Bentley
Email: Johanna.Lang-Bentley@mrbgroup.com
Tel: (585) 381-9250

NOTE:
- Johnson Intake Screens are covered by one or more of the following patents - #6,05,131; #6,712,959; #8,297,448; other patents pending
- Price does not include taxes
- Johnson will warranty their goods for 1 year from start up or 18 months from delivery – whichever date occurs first
- Due to site specific conditions - bolting and anchoring hardware is outside of Johnson Scope and will be provided by others.
- Isolation kits may be required, with Z-Alloy, due to galvanic corrosion between dissimilar metals. Isolation kits provided by others.
- Johnson will take exception to all that is not explicitly stated in our offer.

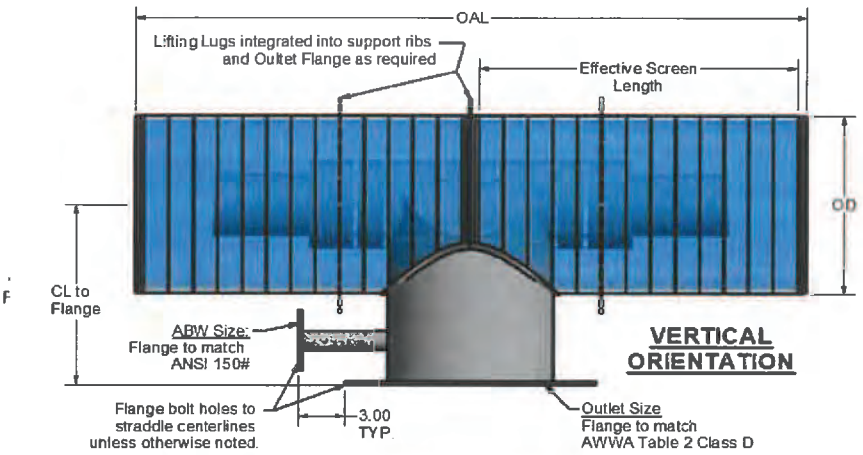
INTAKE MANUFACTURING LEAD TIME
4 weeks for drawing submittal
6-8 weeks after drawing approval, subject to manufacturing capacity and material availability at time of approval

HYDROBURST MANUFACTURING LEAD TIME
3-4 weeks for drawing submittals,
12-14 weeks after drawing approval, subject to manufacturing capacity and material availability at time of approval

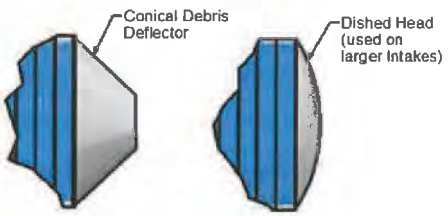
REV-A 9/13/2019

Item	Material Description	Qty	UoM	Price		Value
000010		1.000	EA	21,681.00	USD	21,681.00
	Johnson T-18MF Intake Screen					
	T18 Max Flow Intake Screen Wire: #69 Slot: 0.75 mm Material: Z-Alloy Air Backwash: 2" PS Flange Flow: 1,300 GPM / Screen has under 0.5 ft/sec max thru slot velocity Installation Depth: 60 ft Collapse Rating: 4.33 PSI Outlet: Flange pattern to match AWWA C-207 class D 12" PS with pipe connect End connection: Endplate x Endplate					
000020		1.000	EA	38,800.00	USD	38,800.00
	Johnson Hydroburst System					
	ADDER HYDROBURST Based on an airline distance of 450 feet and a screen depth of 60 feet you would need a 240 gallon air receiver tank with 2" air lines. Airlines provided by others. Price would include air receiver tank, reciprocating compressor/motor assembly, timer & relay logic based automatic controls with NEMA 12 enclosure, control air receiver and (1) valves for the above screen. System is tank mounted and designed for indoor installation only					
000030		1.000	EA	4,500.00	USD	4,500.00
	Johnson Field Service					
	Onsite Commissioning / Training One (1) Technician for One (1) Trip consisting of One and a half (1.5) days. Additional days billed at $1,500/day. 2-3 weeks advance notice for field service scheduling is required. Please make sure that the following items have been addressed prior to Johnson's technician arriving on site: - Permeant power is connected to the unit. We cannot perform start up with temporary power. - The hydroburst's airlines must be connected to the screens, so the air receiver to be pressurize and the system can cycle through all the screens, air bursting each individually. - Operators will be available for training during the scheduled visit Additional trips and costs may be required, if these items are not address prior to our tech arriving on site. Cancelation of scheduled start up will result in additional change fees					

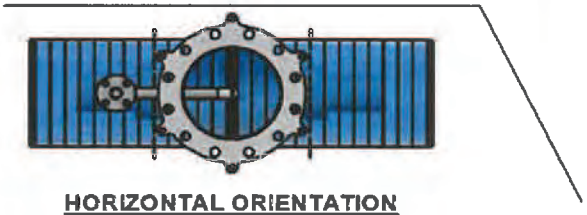
Items total			64,981.00
Tax Jur Code Level 1	0.000	64,981.00	0.00
Final amount			64,981.00



VERTICAL ORIENTATION



Optional End Closures



HORIZONTAL ORIENTATION

Dimension/Sizes	Value	Unit	Comments
Model	T18MFE		
OD	17.74	in	Nominal See note 1
OAL	72.00	in	Nominal See note 1
CL to Flange	20.00	in	Nominal See note 1
Outlet Connection Size	12PS		See note 2
ABW Connection Size	2PS		See note 2
Estimated Weight	410	lbs	
Left End Closure	Plate		
Right End Closure	Plate		
Intake Orientation	Horizontal		

Screen Specifications			
Slot Opening	0.750	mm	
Open Area Percentage	29.37%		
L/D Ratio	1.900		Effective Screen Length / OD
Effective Screen Length	33.75	in	
Wire Type	69		

Design:			
Depth	10	Ft	Hydrostatic Load
Collapse Rating	4.34	psi	
Material	ZALLOY		SS or Z-Alloy

Flow Capacities:			
Flow/Screen	1300	GPM	See note 3
Maximum Slot Velocity	0.47	fps	See note 3
Average Slot Velocity	0.40	fps	See note 3
Estimated DP/Screen	0.0015	psi	Thru clean screen surface only-See note 4
Estimated DP/Assy	0.2215	psi	Through entire clean assembly - See note 4

PATENT # #6,051,131

Notes:

1 Dimensions shown are nominal. All screens are made to order and can be adapted to a wide variety of installation requirements.

2 Outlet and ABW connections are based on the size of the connecting and abw pipe and may vary from the values listed in the technical brochure.

3 Flow capacities are based on use of the patented Johnson Screens flow modifier design.

4 Pressure drops below 0.1 psi should be considered an order of magnitude only, as testing data for these low values is not available.

Johnson Screens
1950 Old Hwy. 8, New Brighton, MN 55112
(651)-638-3151 (Phone), (218)-206-9004 (Fax)

Model T18MFE

Preliminary Intake Screen Specification
Watkins Glen, NY

Date:
9/13/2019

Aqseptence Group

SALES TERMS AND CONDITIONS

1. **ENTIRE AGREEMENT, MODIFICATIONS** – The terms, conditions and specifications contained in this agreement ("Terms") constitute the entire agreement between the parties for the provision of goods by Aqseptence Group, Inc. ("SELLER") at any time. No change in, addition to, or waiver of the Terms will be a binding obligation on SELLER unless approved in writing by its authorized representative. SELLER'S receipt, acknowledgement and/or acceptance of CUSTOMER'S purchase order form will not modify these Terms or become part of SELLER'S agreement to the extent it contradicts these Terms. SELLER is a material supplier and is not a party to CUSTOMER'S agreement with owner or others. CUSTOMER agrees to pay SELLER without reference to CUSTOMER'S contract with owner or others. It is understood the CUSTOMER has the ultimate obligation to pay SELLER on the terms and within the time period set forth herein, regardless of CUSTOMER'S payment status from the owner or others. If any provision of this agreement is held to be invalid or enforceable, the balance of this agreement will remain in force.

2. **TITLE AND RISK OF LOSS** – TITLE of the goods herein described shall pass to CUSTOMER upon full payment of said goods and any prior outstanding debt.

RISK OF LOSS passes to CUSTOMER upon delivery of said goods at SELLER'S plant. Such title to and risk of loss of said goods will not pass to CUSTOMER in any other way, notwithstanding any agreement to the contrary, including, but not limited to, any agreement to pay freight, express or other transportation or insurance charges. Unless otherwise specified, all sales are FCA SELLER'S Plant. In the event that SELLER pays for cost of transit or cost of transit and insurance, the Incoterm® 2010 is CPT BUYER'S Place or CIP BUYER'S Place, as applicable.

3. **PAYMENT AND PRICES** – SELLER may, at its option, require CUSTOMER to pay for all goods at the time the order is placed or require CUSTOMER to obtain an irrevocable letter of credit in favor of SELLER from an issuer acceptable to SELLER. In the event SELLER does not require advance payment or require such letter of credit, payment by CUSTOMER will become due thirty (30) days from the date of SELLER'S invoice covering a particular shipment. Time is of the essence with respect to CUSTOMER'S payment obligations. CUSTOMER may only rely on the accuracy of wiring instructions provided by the SELLER if they have been signed by SELLER'S CFO. No retainage or other deductions shall be made from such payments. Pro-rata payments shall become due with partial shipments. In the event of failure by CUSTOMER to make any payment when due, SELLER may decline to make further shipments until such default is cured. In the alternative, SELLER may elect to continue to make shipments despite the continuance of such default, but such election by SELLER will in no way constitute a waiver of such default nor affect SELLER'S legal remedies thereof. CUSTOMER assumes full responsibility, including reporting and payment, of all taxes, however designated, or other governmental charges arising out of, levied or based upon, or in connection with the sale of the goods herein described, including state and local privilege, sales and use, or excise taxes based on gross revenue or any taxes or amount in lieu hereof paid or payable by SELLER in respect of the foregoing, exclusive however, of taxes paid on net income. In no event will any charges for engineering services imply a conveyance of any design and/or manufacturing rights as to the goods, unless such conveyance is expressly set forth in a separate written agreement signed by authorized representatives of both parties. In the event that CUSTOMER falls behind in payment, SELLER, without prejudice to any other right or remedy available to SELLER, shall, at its sole discretion, be entitled to: (i) terminate the Contract and/or suspend any further deliveries to CUSTOMER and/or (ii) charge the CUSTOMER interest on any unpaid portion of the purchase price at twelve percent (12%) per annum. Furthermore, the defaulting CUSTOMER shall bear all costs arising in connection with the recovery of the invoiced sums outstanding, including costs of reminders and seeking information, collection expenses, and reasonable attorney's fees.

4. **SECURITY INTEREST** – CUSTOMER hereby grants to SELLER a purchase money security interest in all goods purchased by CUSTOMER from SELLER until CUSTOMER has paid for such goods in full. CUSTOMER hereby authorizes SELLER to file UCC-1 financing statements in accordance with applicable law to perfect its security interest granted herein.

5. **WARRANTIES** – (A) Provided that CUSTOMER subjects Equipment only to operating conditions specified by CUSTOMER when the order is placed, if any, and operates it in accordance with SELLER'S written operating instructions, if any, SELLER warrants Equipment sold pursuant hereto to be free of defects in material and workmanship for a period of 1 year after the date Equipment is delivered. The above warranty does not apply to: (i) used Equipment or Equipment that has been repaired or worked over; (ii) Equipment that has been modified or subjected to improper handling, storage, installation, operation or maintenance by CUSTOMER, including use of unauthorized replacement parts; (iii) component parts not manufactured by SELLER, whether purchased by SELLER or furnished by CUSTOMER, such parts being subject to any applicable manufacturer's warranty; (iv) parts requiring replacement because of normal wear and tear; (v) design on those jobs where SELLER prepared drawings, lists or bills of material from designs furnished by others; and (vi) models or samples furnished to CUSTOMER as illustrations only of general properties of equipment. This warranty will not apply if CUSTOMER, on request by SELLER, does not return the defective part to SELLER for inspection, freight prepaid. (B) SELLER'S liability for breach of this warranty is expressly limited to the repair or replacement, at its sole option, of any Equipment or parts of Equipment which prove to be defective during the warranty period. All parts repaired or replaced hereunder shall be repaired or replaced FCA SELLER'S Plant.

6. **LIMITATION OF LIABILITY** – SELLER and BUYER each agree to protect, defend, indemnify and hold harmless each other and each other's parents, subsidiaries, affiliates and their successors and assigns, and the officers, directors, employees of each, from and against all claims, demands and causes of action of every kind and character without limit and without regard to the cause or causes thereof or the negligence or fault, active or passive, of any party or parties including the sole, joint or concurrent negligence of the other party and any theory of strict liability arising in connection herewith in favor of the other party's employees, invitees or subcontractors or their employees on account of bodily injury, death or property damage. To the fullest extent permitted by law, SELLER shall indemnify and hold harmless CUSTOMER from and against claims, damages, losses and expenses arising out of, or resulting from, performance of Equipment under this agreement, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to, or destruction of, tangible property (other than the Equipment itself), but only to the extent caused by the negligent acts or omissions of SELLER. SELLER shall not have a duty to defend. SELLER agrees to defend CUSTOMER only to the extent the claims relate to bodily injury or property damage arising solely (principally) from SELLER'S Equipment. SELLER'S duty to indemnify CUSTOMER for expenses, including attorney's fees, is limited to that portion of any expenses attributable to the negligence or intentional acts of SELLER. SELLER WILL NOT BE LIABLE FOR PROSPECTIVE PROFITS OR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES INCLUDING WITHOUT LIMITATION, FACILITY DOWNTIME, LOSS OF PROFIT OR BUSINESS INTERRUPTION WHETHER ANY SUCH CLAIM OR LAWSUIT BE BASED ON TORT, CONTRACT OR OTHERWISE. IN NO EVENT WILL RECOVERY OF ANY KIND AGAINST SELLER BE GREATER THAN THE PURCHASE PRICE OF THE SPECIFIC GOODS SOLD WHICH CAUSED THE ALLEGED DAMAGE.

7. **CATASTROPHIC LOSSES –** Notwithstanding anything to the contrary contained herein, CUSTOMER hereby agrees to assume the liability for the following specified types of losses or events: (1) reservoir or underground damage, including loss of any mineral substance, or water or the wellbore itself; (2) control of a wild well, underground or above the surface; and (3) pollution, including clean-up and control of the pollutant or contamination.

8. **CLAIMS** – Within twenty (20) days after tender of delivery to or receipt by CUSTOMER of any shipment and before any part of such goods (except for reasonable test and inspection quantities) has been changed from its original condition, CUSTOMER will inform SELLER in writing if said goods are found defective in any respect. Failure to so inform SELLER or use of said goods (except for reasonable test and inspection quantities) will be conclusive that SELLER has satisfactorily performed.

9. **MODIFICATION AND CANCELLATION** – SELLER reserves the right to reject any order made by CUSTOMER, including changes. Changes to an order may be subject to price adjustments. Custom orders and orders designed specifically for CUSTOMER cannot be cancelled once the construction material has been ordered and/or production has begun. Cancelled orders will incur charges for materials ordered, design and manufacturing time to the point of cancellation.

10. **PATENT INFRINGEMENT –** If the goods herein described are to be manufactured by SELLER based on specifications or drawings furnished by CUSTOMER, CUSTOMER agrees to indemnify and hold harmless SELLER, its successors and assigns, against any and all loss, damage, or injury arising out of a claim or suit for alleged infringement of any letter patent granted by the United States or any foreign government relating to the goods herein described. CUSTOMER agrees that in such event it will assume the defense of any and all such suits and pay all expenses incidental thereto.

11. TERMINATION – This agreement may be terminated immediately by SELLER if CUSTOMER is unable to meet its financial obligations as they come due or in the case of proceeding under bankruptcy against the CUSTOMER, or if receivers for CUSTOMER are appointed or applied for or if any assignment for the benefit of creditors is made by CUSTOMER. This agreement will otherwise remain in full force and effect continuously until either party cancels with a minimum of thirty (30) days written notice to the other party.

12. FORCE MAJEURE – SELLER will not be liable for any loss or damage of any nature whatsoever incurred or suffered as a result of any failures or delays in performance due to any cause or circumstances beyond its control, including but not limited to any failures or delays in performance caused by any strikes, lockouts, or labor disputes, fires, acts of God or the public enemy, riots, incendiaries, interference by civil or military authorities, compliance with the laws of the United States of America or with the orders or policies of any governmental authority, delays in transit or delivery on the part of the transportation companies or communication facilities, or failures of sources of materials. In the event of a shortage of goods, SELLER reserves the right to allocate available goods among all of its customers in its own discretion.

13. EXPORT OR IMPORT LICENSE – CUSTOMER will procure at its expense any export or import licenses required for any of the material included in the Quotation. For any goods being exported from the United States, CUSTOMER agrees to comply fully with all applicable economic sanctions and export control laws and regulations. CUSTOMER shall not – directly or indirectly– sell, provide, export, re-export, transfer, divert, loan, lease, consign, or otherwise dispose of any equipment, product, services, software, source code, technical data, or technology received from SELLER to or via any person, entity, or destination, or for any activity or end-use restricted by laws or regulations of the United States or any other applicable jurisdiction (including nuclear, missile, chemical or biological weapons proliferation, military, or money laundering activities) without obtaining all required government authorizations. CUSTOMER recognizes and agrees to comply with SELLER's policy to not support the use of its products for any operations in any country so prohibited under the export laws and regulations of the United States. As may be requested by SELLER, CUSTOMER shall provide SELLER with the relevant end-use, end-user and country of end- use information with respect to the goods, software or technology to be supplied hereunder. Based on and in reliance on such information, SELLER will supply such goods, software or materials in compliance with applicable law including that of the United States of America (U.S.). SELLER cautions and CUSTOMER acknowledges that any change in end-use, end-user or country of end- use (including a shipment between countries other than the U.S.) may be restricted or prohibited by applicable law, whether it is of the U.S. or other country.

14. ANTI-CORRUPTION – CUSTOMER represents and warrants that it and all of its affiliates and agents shall act in accordance with the principles described in the Convention on Combating Bribery of Foreign Public Officials in International Business Transactions, signed in Paris on December 17, 1997, as amended ("the Convention"), and the Convention's Commentaries (collectively "the OECD Principles"), and shall comply with all applicable laws implementing the OECD Principles (including the U.S. Foreign Corrupt Practices Act of 1977, as amended), as well as any applicable local laws related to anti-corruption, anti-kickbacks, and anti-money laundering.

15. DEFINITIONS – "CUSTOMER" means the person or company to whom the quotation is submitted. The "Quotation" means techno-commercial offer to which these terms and conditions are attached. The "Contract" means the contract/order formed upon acceptance by the purchaser of the quotation and these terms and conditions.

16. QUOTATION – The Quotation is subject to withdrawal or variation by SELLER, at any time prior to acceptance in writing by CUSTOMER.

17. PRICES AND VARIATION – Unless otherwise stated in writing, the quoted prices are net, in U.S. Dollars based upon labor and material cost at the date of quotation. The quotation is for supply of goods to be provided by SELLER for the CUSTOMER or purchased from another manufacturer. The prices quoted are calculated on the basis of the prices charged by the SELLER, the rate of exchange, duty, freight, insurance, clearance, and other similar charges, as applicable, ruling at the date of quotation and any increase therein shall be to the account of the CUSTOMER. The prices quoted for the goods manufactured by SELLER are subject to rise and fall for variation in the cost of labor, material, or overhauls after the due date of quotation, unless otherwise specified in writing.

18. DISPUTE RESOLUTION – The laws of the state of Minnesota shall govern the validity, construction, interpretation, and effect of this agreement, without regard to its choice of law rules. The parties irrevocably consent to the personal jurisdiction of the state and federal courts of the state of Minnesota for any and all disputes arising out of or in connection with this agreement and expressly waive any defense of forum non conveniens.

19. ALTERATION – The above terms and conditions may be modified by the SELLER from time to time in writing and such variations shall be binding on the CUSTOMER for any subsequent orders.

APPENDIX H

INTAKE HEADLOSS CALCULATIONS

MRB|group

Project Title Village of Watkins Glen Comprehensive Water System Study
Project No.: 2330.19001
Date: October 25, 2019
Engineer: J. Lang-Bentley

Subject: Intake and clearwell headloss calculations accounting for pump operations and minor losses; pump submergence and approach velocity check.

INTAKE

Design Criteria

Design Lake Level =	444.19	ft MSL	per USGS records mean low lake level
Low Water Level =	440.20	ft MSL	Lowest water level in clearwell possible
Available Head Loss =	3.99	ft MSL	This controls design
C =	100		Very conservative, accounts for old pipe
Nominal Diameter =	12.0	in	
Outside Diameter =	12.8	in	
Length =	450	linear ft	

Equations

Minor Loss in Piping (HL) = K*v2/2g

		12" Pipe	K
No. of 90 deg. bends =	2	0.4	0.78
No. of 45 deg. bends =	6	0.2	1.26
No. of 22.5 deg. bends =	3	0.1	0.30
No. of Gate Valves =	1	0.1	0.10
No. of Pipe Exits =	1	1.0	1.00
Total ∑K =	3.44		3.44

Intake Headloss Calculations

Flow (MGD)	gpm	Velocity (fps)	Friction HL (ft)	Minor HL (ft)	Total HL (ft)	Clearwell Depth (ft)
0.4	278	0.79	0.17	0.03	0.21	7.96
0.7	486	1.38	0.49	0.10	0.59	7.58
0.9	625	1.77	0.78	0.17	0.95	7.22
1.1	764	2.17	1.13	0.25	1.39	6.78
1.3	903	2.56	1.55	0.35	1.90	6.27
1.5	1042	2.96	2.01	0.47	2.48	5.69
1.7	1181	3.35	2.54	0.60	3.14	5.03
1.9	1319	3.74	3.12	0.75	3.87	4.30

CLEARWELL

Design Criteria

Clearance Depth (CD) =	6.0	in	1994 Hunt record drawings
Diameter =	12.0	in	
Area =	0.8	ft2	

Equations

Submergence = CD + D + 0.574Q/D^1.5
Area = π*D^2/4

Clearwell Submergence Calculations

	Flow (MGD)	Flow (gpm)	Actual Clearwell Depth (in)	Min. Depth for Pump Submergence (in)	Current Approach Velocity (fps)	Approach Velocity with Johnson Screen (fps)	Comments
	0.4	278	95.55	19.92	0.39	0.47	
	0.7	486	90.92	21.36	0.69	0.47	
	0.9	625	86.63	22.32	0.89	0.47	
	1.1	764	81.42	23.27	1.08	0.47	
Design Flow	1.3	903	75.29	24.23	1.28	0.47	Max with (3) filters in use, (1) in backwash
	1.5	1042	68.28	25.19	1.48	0.47	
	1.7	1181	60.39	26.15	**1.68**	0.47	
Peak Design Flow	1.9	1319	51.64	27.11	**1.87**	0.47	Max with (4) filters in use

APPENDIX I

ZEQUANOX® PRODUCT BROCHURE

ZEQUANOX®
Invasive Mussel Control

In Open Water Systems: Bio-Based Invasive Mussel Control

The Need for a New Approach

The rapid spread of invasive zebra and quagga mussels in lakes and rivers is threatening ecosystems and quality of life for homeowners, recreationists and business owners. Some examples are as follows:

- Deposits of sharp, foul-smelling shells can litter beaches.
- Colonies can sink buoys, damage docks and boat lifts, and cause expensive repairs for boat owners by fouling hulls and clogging motors.
- Anglers will see desirable fish populations decline as a result of ecological changes over time.
- As filter feeders, mussels eliminate food sources and destroy native habitat critical to other aquatic organisms, particularly native freshwater mussels.

Where invasive mussels are present, the abundance of native organisms decreases dramatically while the growth of unwanted weeds and algae increases—negatively impacting fisheries, recreational life, and property values.

Preventing the spread of invasive mussels is no longer enough. Control methods that are effective and environmentally responsible are needed to mitigate the damage these mussels are causing and to limit even further expansion of their populations.

Zequanox® Molluscicide: Leveraging the Power of Nature

Zequanox molluscicide—a naturally derived aquatic biopesticide—has proven to be effective in selectively controlling invasive zebra and quagga mussels and offers an environmentally responsible solution to this daunting ecological challenge.

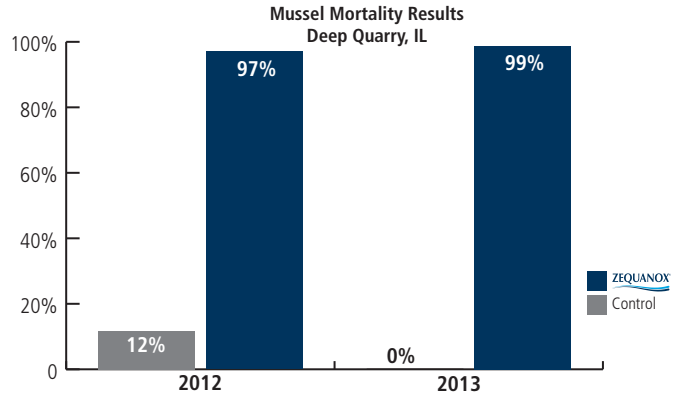
Key Characteristics of Zequanox Molluscicide

- Selectively targets zebra and quagga mussels in all life stages
- Safe for non-target organisms (e.g., humans, fish, native mussels, other aquatic species) when used according to label instructions
- No impact to biodiversity or natural ecosystems
- No bioaccumulation
- Biodegradable, doesn't persist in the environment
- EPA tolerance exempt — no concerns or restrictions for use in water that is used for recreation or for irrigating crops and turf
- Noncorrosive — poses no risk to boats or other recreational equipment

How Does Zequanox Molluscicide Work?

Zequanox molluscicide is composed of dead cells from a naturally occurring strain of the bacteria *Pseudomonas fluorescens*. Zebra and quagga mussels perceive Zequanox molluscicide as a nonthreatening food source and readily consume the product along with their normal diet. Once ingested, Zequanox molluscicide causes their digestive lining to deteriorate, resulting in death.

Mussel mortality begins within a couple of days of the treatment and continues for several weeks following exposure to Zequanox molluscicide. The rate of mortality varies with mussel metabolic (or biological) activity and water temperature. This mode of action prevents a quick mass kill, reducing the risk of causing anoxic conditions in the treated water body.



Open water trials conducted at Deep Quarry Lake in Illinois, summer of 2012 and 2013

Putting Zequanox Molluscicide to Work

Zequanox molluscicide, developed by Marrone Bio Innovations, Inc. (MBI), provides multiple solutions for lake restoration projects:

- Rapid response to prevent infestation after identification of newly formed colonies, or when prevention methods are unsuccessful.
- Rehabilitation of recreational areas, such as treating shoreline access points.
- Treatment of problematic mussel populations in marinas.
- Rehabilitation of critical habitat (e.g., fish and native mussel beds).

In addition, MBI offers a series of consultation services to aid in mussel prevention and management:

- Methods and techniques for monitoring mussel populations in infested and uninfected water bodies.
- Development of Rapid Response Plans.
- Design of a treatment program and product application and monitoring once mussels are detected in the water body.

Round Lake in Petosky, MI - Open Water Treatment

Zequanox molluscicide and Other Species

Zequanox molluscicide has been shown to be highly selective toward zebra and quagga mussels. Extensive studies have been completed on numerous species of fish, native mussels, plants, algae, crustaceans, and insects, as well as mallard ducks, with no indication of any harmful effects on any other species at treatment concentrations.[1]

Zequanox molluscicide and Recreational Water Bodies

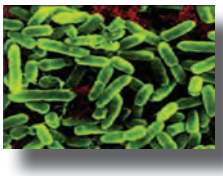
Zequanox molluscicide is composed of dead bacterial cells, so breakdown occurs very quickly. Water treated with Zequanox molluscicide can be used for recreation as well as irrigation of crops and turf. Because it has a zero-hour re-entry interval, water can be used continuously for recreational purposes. Zequanox molluscicide is also noncorrosive, so it poses no risk to boat surfaces or equipment. Finally, *Pseudomonas fluorescens* is already prevalent in food and in surface water, so eating fish from treated waters poses no risk to humans.

Cooperative Research and Development

MBI has cooperated with the United States Geological Survey (USGS) on Zequanox molluscicide open water research trials in the United States since 2013. The USGS continues to work with MBI to optimize application strategies and further product development for invasive mussel control in an open water environment.

The Discovery

Zequanox molluscicide was discovered by New York State Museum (NYSM) scientists in search of an environmentally responsible solution to the zebra and quagga mussel problem. After screening more than 700 strains of bacteria, the scientists discovered that a specific strain of *Pseudomonas fluorescens* (CL145A), found in a river soil sample in the northeastern United States, was lethal to zebra and quagga mussels. Marrone Bio Innovations, Inc. holds the commercial license for Zequanox molluscicide and was responsible for the commercial development of the product.



Pseudomonas fluorescens species have been used in many applications, including pharmaceutical production, snow making, frost protection for strawberries, and disease protection for apples. It has also been designated as "Biosafety Level 1" by the American Type Culture Collection and the American Biological Safety Association, defining *Pseudomonas fluorescens* as "having no known potential to cause disease in humans or animals." U.S. and international health and safety regulators consider *Pseudomonas fluorescens* species to be of the lowest possible risk to human health and the environment.

Christmas Lake in Shorewood, MN - Rapid Response Treatment

[1] When used as directed on the EPA-registered label.

ZEQUANOX®

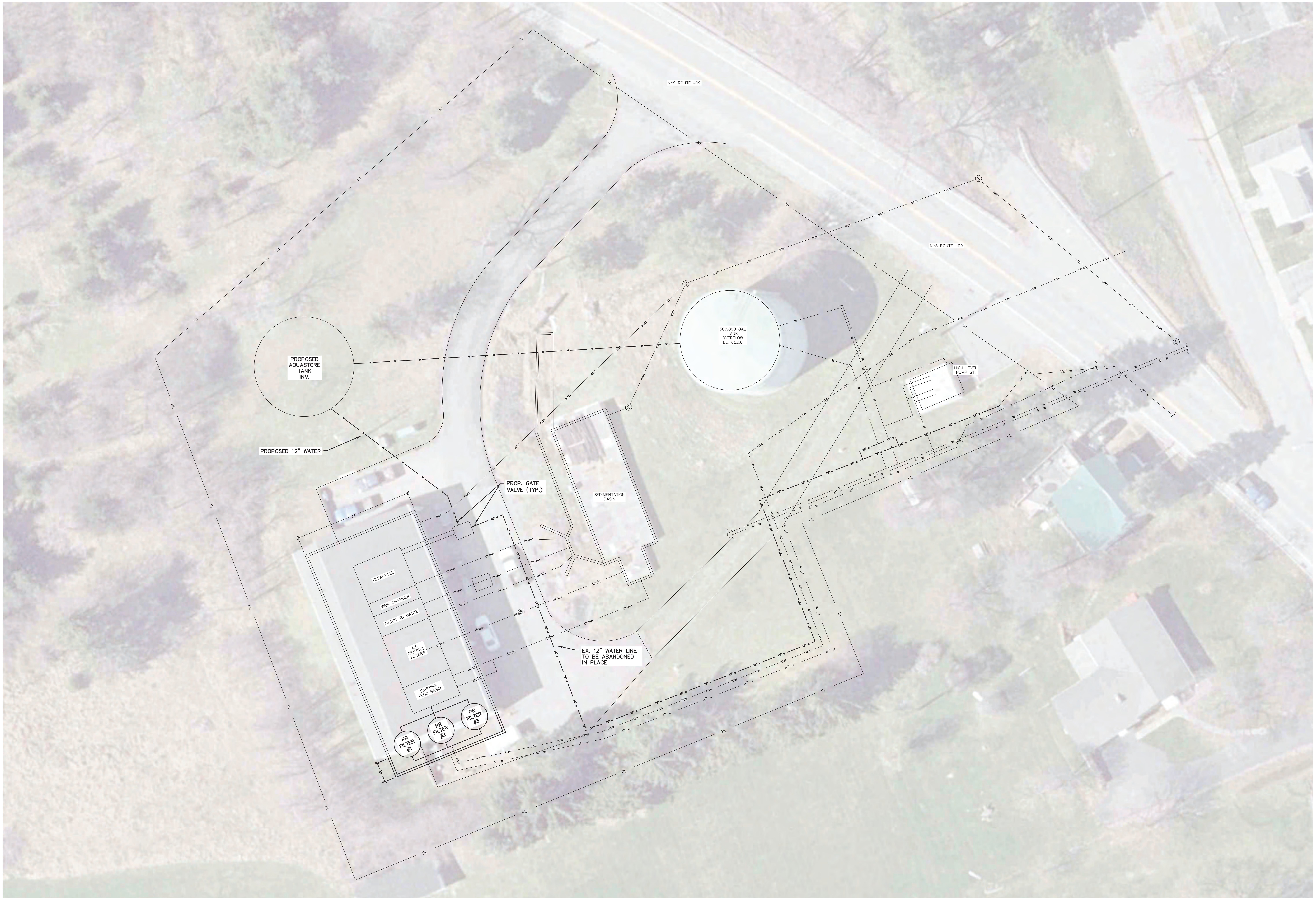
For More Information
Call 1-530-750-2800 • Email zequanox@marronebio.com • Visit www.zequanox.com

ZQ-OpenWater_2018-01-08

Marrone® Bio Innovations

APPENDIX J

WTP HYDRAULIC PROFILES



DRAWING ALTERATION THE FOLLOWING IS AN EXCERPT FROM THE NEW YORK EDUCATION LAW ARTICLE 145 SECTION 7209 AND APPLIES TO THIS DRAWING. "IT IS A VIOLATION OF THIS LAW FOR ANY PERSON UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER OR LAND SURVEYOR TO ALTER AN ITEM IN ANY WAY. IF AN ITEM BEARING THE SEAL OF AN ENGINEER OR LAND SURVEYOR IS ALTERED, THE ALTERING ENGINEER OR LAND SURVEYOR SHALL AFFIX TO THE ITEM HIS SEAL AND THE NOTATION "ALTERED BY" FOLLOWED BY HIS SIGNATURE AND THE DATE OF SUCH ALTERATION AND A SPECIFIC DESCRIPTION OF THE ALTERATION".

No.	Revisions and Descriptions	By	Date

Drawn By: ABT
Checked By: JLB
Scale: 1" = 20'
Date: 10/2019

Project Title:
COMP. WATER SYSTEM STUDY
VILLAGE OF WATKINS GLEN
SCHUYLER COUNTY, NEW YORK

Drawing Title:
SITE PLAN - PROPOSED

MRB group
Engineering, Architecture & Surveying, D.P.C.
The Culver Road Armory, 145 Culver Road, Suite 160, Rochester, New York 14620
Phone: 585-381-9250
www.mrbgroup.com

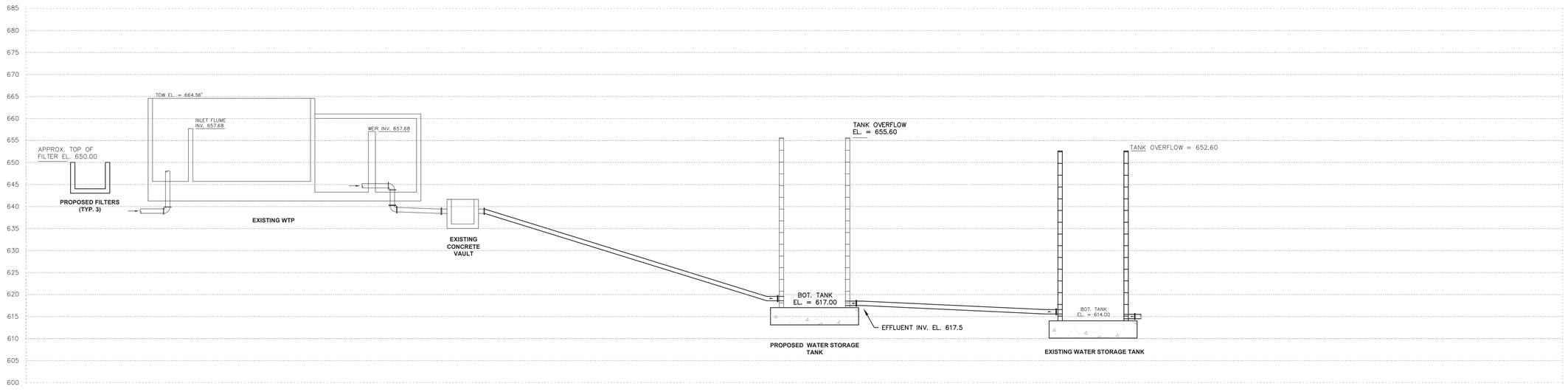
Sheet No. G-002
2 of TOT

Project No. 2330.19001

EXISTING HYDRAULIC PROFILE

VERTICAL SCALE: 1" = 1'-0" | REFERENCE: –

1



PROPOSED HYDRAULIC PROFILE

VERTICAL SCALE: 1" = 1'-0" | REFERENCE: –

2

Drawn By: ABT
Checked By: JLB
Scale: H: AS NOTED
Date: 10/2019

No.	Revisions and Descriptions	By	Date

Project Title:
COMP. WATER SYSTEM STUDY
VILLAGE OF WATKINS GLEN
SCHUYLER COUNTY, NEW YORK

Drawing Title:
HYDRAULIC PROFILES

MRB group
Engineering, Architecture & Surveying, D.P.C.
The Culver Road Armory, 145 Culver Road, Suite 160, Rochester, New York 14620
Phone: 585-381-9250
www.mrbgroup.com

Sheet No. **N-100**
3 of **TOT**

Project No. **2330.19001**

APPENDIX K

PRESSURE FILTER PRODUCT INFORMATION

Village of Watkins Glen WTP

New York

Engineer
MRB Group

Furnished by
Matt Williams
mwilliams@westech-inc.com

Represented by
Gregg Palmer
Koester Associates Inc
Canastota, New York
(315) 697-3800
greggp@koesterassociates.com

WesTech®

WesTech Opportunity Number: 1930513
Friday, October 25, 2019

Item A – Three (3) Train Multi-Tech™ System

Design Criteria	
Project Flow	900 gpm (1.3 MGD)
Peak Flow	1309 gpm (1.87 MGD)
Number of Filters	3
Number of Contact Clarifiers	3
Flow per Filter/Clarifier	450 gpm
Size of each Vessel	144 in diameter x 72 in side shell height
Vessel Loading Rate	3.86 gpm/ft^2
Filter Media Type	0.8-1.0 mm anthracite
Backwash Type	Waterwash
Backwash Rate*	12 gpm/ft^2 water and

*The design backwash rate listed is based on a temperature of 25 degrees Celsius. The actual backwash water rate must be adjusted 2% up or down for each degree Celsius difference above or below from design temperature

Technical Description

Vertical Pressure Filters are an effective, inexpensive, and low-maintenance method of reducing raw water constituents including, but not limited to, iron, manganese, turbidity, color, and arsenic. Water is introduced to the top side of the vessel where it passes through a bed of filter media to remove unwanted particulate. The water passes an underdrain plate with distribution nozzles for effluent discharge. Once the media fouls to a predetermined set-point, a backwash cycle is required to dislodge residual particulate for waste discharge.

Key Features and Benefits

- Economical multi-media filtration at low flows (under 1.0 MGD)
- Robust, high quality non-code or ASME code tanks
- Versatility across many applications (groundwater, surface water, process water)
- Customized to accommodate a specific application (MULTIWASH, air/water, water wash)
- Reduced operator attention with automatic actuated system valves
- Reduced scope requirements with backwash from in service filters. Eliminates backwash supply pumps, tanks, and valves.

The following budget pricing includes:

Scope includes (6) six ASME Code constructed pressure vessels capable of 100 psi working pressure. Tanks will be provided with the following: supporting legs; top side inlet connection with steel pipe overdrain; bottom center effluent connection; shop installed steel plate underdrain with ABS plastic nozzles; one 14 inch x 18 inch manhole in tank top head; one coat of interior and exterior primer; and two coats of interior finish paint (above the underdrain). Plus the following shipped loose for field assembly: automatic filter function valves (pneumatically actuated); air compressor; backwash control panel; air scour blower (clarifiers only); PVC air wash grid (clarifiers only); face piping (prime painted on exterior); automatic air release valves and piping; graded media support gravel; 30" 0.8-1.0 mm anthracite and 13" support gravel for filter media; 36" sand and 10 in support gravel for clarifier media; headloss and backwash rate of flow gauges; plus freight and 3 trips 6 days technical direction for start-up and training.

Note: Any Item Not Listed Above to Be Furnished by Others.

Items Not Furnished by WesTech

- Unloading of equipment from delivering carrier, protected storage of equipment, installation, supervision of installation
- All underground and interconnecting piping, piping and fittings (not specifically listed), pipe supports, wall inserts or sleeves, Dresser or flexible couplings, hangers, valves (not specifically listed), pneumatic tubing from air compressor to filter batteries, air release piping and valves, sampling lines and sinks, small pressure water supply piping, field work of piping (i.e., drilling and tapping for instrumentation) and flow meters
- Walkways, handrails, stairways and ladders
- Finish paint and intermediate field coats, cathodic protection systems
- All chemical feeders, feed lines, start-up chemicals, chemicals, labor and procedures for the disinfection of equipment, laboratory test equipment
- Structural design, supply and installation of concrete pads, foundations, rebar, anchors, concrete, grout, sealant and sumps
- Motor control center, motor starters, disconnects, electrical wiring and conduit, telemetering equipment, level controls, supports for controls, all instrumentation not specifically listed
- All pumps, operating and start-up lubricants
- Any equipment and service not listed in this proposal

This proposal has been reviewed and is approved for issue by Rene Carson on October 25, 2019.

Budget Pricing

Proposal Name: Village of Watkins Glen WTP
Proposal Number: 1930513
Friday, October 25, 2019

1. Bidder's Contact Information

Company Name	WesTech Engineering, Inc.
Contact Name	Matt Williams
Phone	801.265.1000
Email	mwilliams@westech-inc.com
Address: Number/Street	3665 S West Temple
Address: City, State, Zip	Salt Lake City, UT 84115

2. Pricing

Currency: US Dollars

Scope of Supply

A	(3) Train Multi-Tech™ System	$1,200,000
	Taxes (sales, use, VAT, IVA, IGV, duties, import fees, etc.)	Not Included

Prices are for a period not to exceed 30 days from date of proposal.

Field Service

Daily Rate	$1,200

Prices do not include field service unless noted, but it is available at the daily rate plus expenses. The customer will be charged for a minimum of three days for time at the jobsite. Travel will be billed at the daily rate. Any canceled charges due to the customer's request will be added to the invoice. The greater of visa procurement time or a two week notice is required prior to trip departure date.

3. Payment Terms

Submittals Approved	15%
Release for Fabrication	35%
Net 30 days from Shipment	50%

All payments are net 30 days. Partial shipments are allowed. Other terms per WesTech proforma invoice.

4. Schedule

Submittals, after PO receipt	6 to 8 Weeks
Customer Review Period	2 weeks
Ready to Ship, after Submittal Approval	18 to 20 weeks
Total Weeks from PO to Shipment	**26 to 30 weeks**

Terms & Conditions: This proposal, including all terms and conditions contained herein, shall become part of any resulting contract or purchase order. Changes to any terms and conditions, including but not limited to submittal and shipment days, payment terms, and escalation clause shall be negotiated at order placement, otherwise the proposal terms and conditions contained herein shall apply.

Freight: Prices quoted are **F.O.B. shipping point** with freight allowed to a readily accessible location nearest to jobsite. All claims for damage or loss in shipment shall be initiated by purchaser.

Paint: If your equipment has paint included in the price, please take note to the following. Primer paints are designed to provide only a minimal protection from the time of application (usually for a period not to exceed 30 days). Therefore, it is imperative that the finish coat be applied within 30 days of shipment on all shop primed surfaces. Without the protection of the final coatings, primer degradation may occur after this period, which in turn may require renewed surface preparation and coating. If it is impractical or impossible to coat primed surfaces within the suggested time frame, WesTech strongly recommends the supply of bare metal, with surface preparation and coating performed in the field. All field surface preparation, field paint, touch-up, and repair to shop painted surfaces are not by WesTech.

APPENDIX L

EXISTING FILTER UPGRADES PRODUCT INFORMATION

AWI US
471 West Universal Circle
Sandy, UT 84070

801.566.1700
www.awifilter.com

October 25, 2019

Johanna Lang-Bentley, P.E.
MRB Group
The Culver Road Armory
145 Culver Road
Suite 160
Rochester, NY 14620

Subject: Information Package Describing AWI Phoenix™ Lateral Underdrain Systems for the Village of Watkins Glen Water Treatment Plant

Dear Johanna:

We would like to thank you for this opportunity to provide you with information describing Phoenix Filter Underdrain Systems suitable for installation at the Village of Watkins Glen Water Treatment Plant. AWI has been a leader in filter optimization for over 25 years so we hope we have been able to use our combination of filtration technology, expertise, and lessons learned to create a filter underdrain solution that is right for your project.

With this package of information we hope to address two goals; 1) provide you with background information about AWI to help you to assess AWI as a provider of filter solutions and, 2) describe the solution we feel will best address the needs of this facility. AWI has a long history of successful installations demonstrating expertise, adroit problem solving under difficult conditions, reliability, and customer service. AWI customers both recent and from long ago feel comfortable giving us a call to talk about how their filters are performing and how they can perform better.

Each AWI Phoenix Filter Underdrain System is custom designed based upon a facility's water quality, method of operation, filter dimensions, hydraulic characteristics, and the quality of the water to be treated. Facilities with AWI Filter Underdrain Systems installed have confidence based upon the knowledge that their filter underdrain system will last 40 years and more. Anthratech U.S. Inc. (AWI) is pleased to offer for your consideration stainless steel Phoenix Underdrain Systems for the granular media filters on your project.

AWI is providing this information to you in support of our Representative in your area:

Pete Kundin

of

Upstate Valve and Control
46 Valewood Run
Penfield, NY 14526

Telephone: 585.410.4587
E-mail: pete.kundin@upstatevalveandcontrol.com

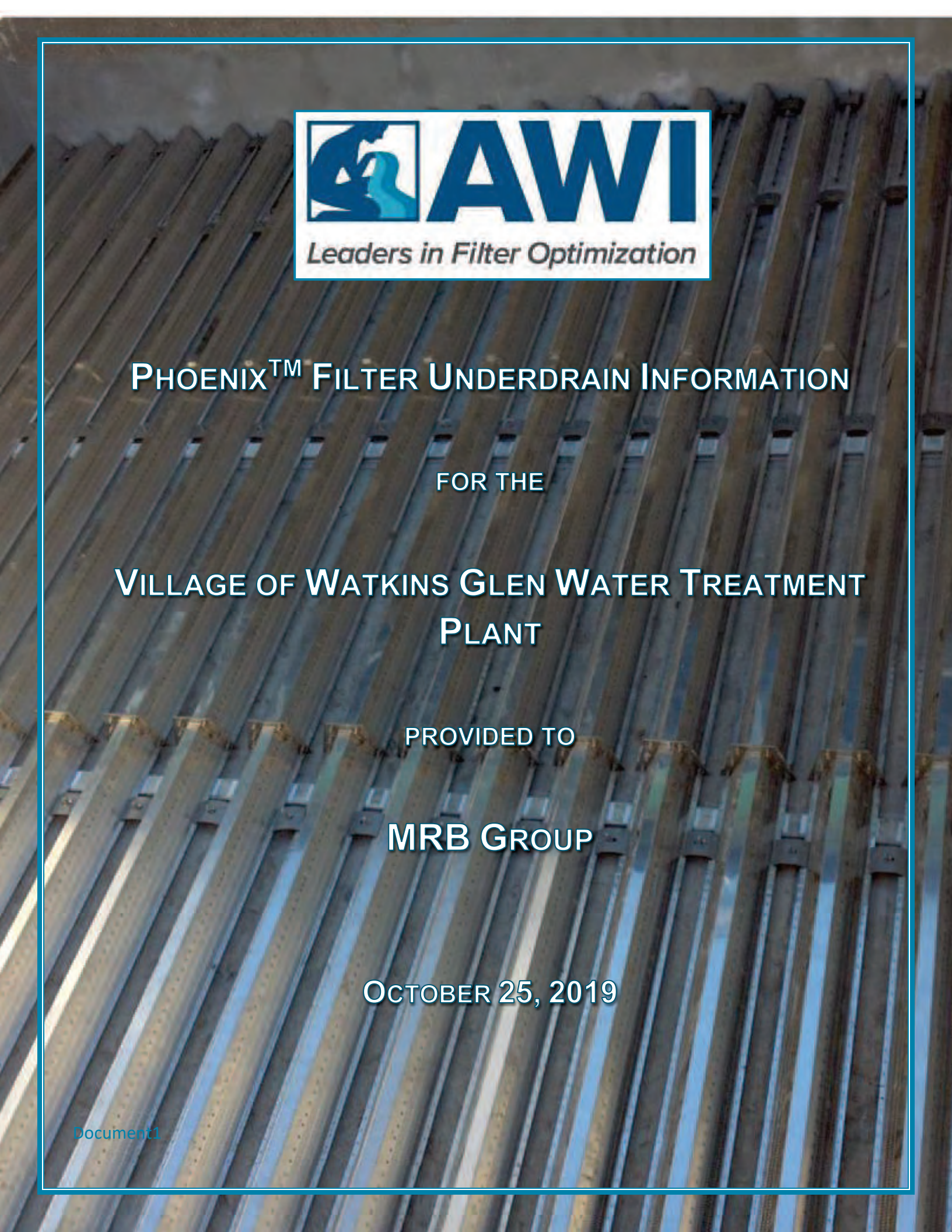
We look forward to following up with you to insure that we have properly understood the needs of your application and provided a suitable recommendation. Please note that all of the information provided by AWI is in Adobe .pdf format. We recognize the value in providing you with modifiable specification files in Microsoft Word format and modifiable drawing files in .dwg format. Once we are confident that we understand the needs of your project and feel that we have properly addressed those needs, AWI would welcome the opportunity to provide you with the requisite modifiable electronic files.

Should you have any questions or concerns regarding our offering, please contact us at your earliest convenience.

Regards,

Hollie Scott
AWI Director of Marketing

cc: Pete Kundin/Upstate Valve and Control
David Silverman/PSI



PHOENIX™ FILTER UNDERDRAIN INFORMATION

FOR THE

VILLAGE OF WATKINS GLEN WATER TREATMENT PLANT

PROVIDED TO

MRB GROUP

OCTOBER 25, 2019

Document1

AWI Information Package Contents[1]

[1] Note that all page numbers in this Table of Contents are hyperlinks in .pdf format. The reader can go to the desired location in this document by simply clicking on the page number. From most pages in the document, the reader can get back to the Table of Contents by clicking on the hyperlink entitled "Contents" at the top of the page.

AWI OFFERING

INTRODUCTION

Anthratech Western incorporated (AWI) was founded in 1977 in Calgary, Alberta by Barry Hambley as a supplier of media for granular media filters. Over the years, Mr. Hambley consulted frequently when the filters for which he supplied media under performed. He realized that many problems attributed to poor filter media performance really stemmed from an inability to properly clean the media. Mr. Hambley decided that he could design a far better filter underdrain system than the ones whose flaws he saw on a daily basis. As it turned out, he was right.

The predecessor to today's Phoenix Filter Underdrains was first sold in 1989. In the ensuing years, AWI has updated and refined the original design to ensure that the Phoenix Underdrain System remains the most effective means available to retain, clean, and maintain granular media.

AWI Offices in Calgary

Today, AWI has installed its Phoenix Filter Underdrains on over five hundred separate projects with thousands of individual filters totaling well over a million square feet of filter underdrain. We use the toughness, design flexibility, and durability of our Phoenix Filter Underdrains to solve a host of problems – the bulk of the work AWI does involves repairing existing filters by replacing filter underdrain products provided by others. We have replaced them all:

- Clay tile underdrains
- False floors with nozzles
- Plastic blocks
- Stainless steel underdrain systems supplied by others
- Wheeler bottoms
- …and more

The oldest filters retrofitted by AWI were originally constructed in the early 1900s.

AWI Filter Underdrains are performing successfully under the most challenging of circumstances including biologically active filters, industrial settings, situations with great potential for precipitation, and wastewater treatment.

What to Look for in Filter Underdrain Systems

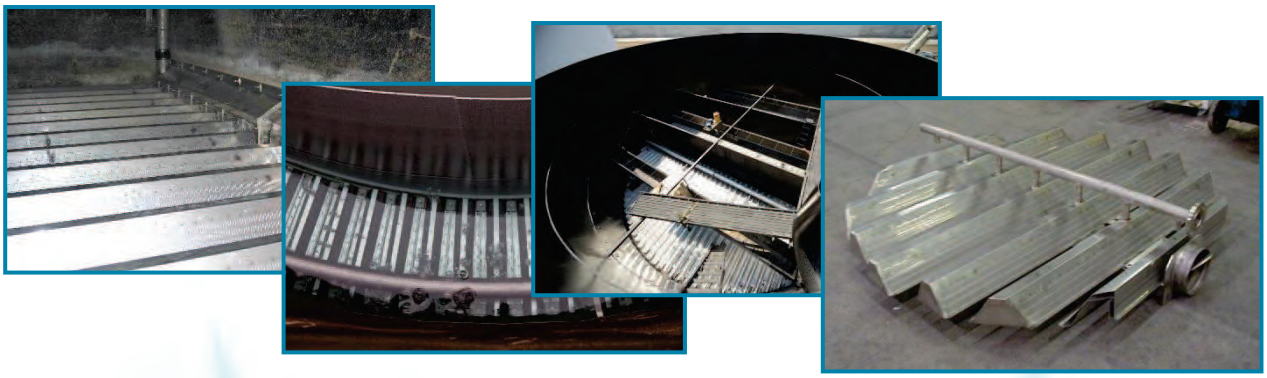
What should you look for in a filter underdrain system? AWI suggests that the list below might be a good start:

- Is easy to install – a normal construction crew can get the job done so that the filter underdrain system lasts and lasts – no special contractors or skills needed
- Supports the media so that it can do its job producing filtered water with low turbidities
- Distributes water and air for effective backwashing – producing a clean, level media bed with every backwash
- Has the strength necessary to survive the occasional mishap
- Is durable enough to provide 40 years and more of successful operation
- Has a proven track record of success in terms of both number of installations and length of service
- Provides ready access to the filter underdrains so they are repairable - if anything ever goes wrong the underdrain system can be removed, the problem remedied, and the filters placed back into service quickly and at modest cost
- Is supported with excellent technical knowledge and customer service, which brings us to….
- Has satisfied customers who are willing to tell you why they are satisfied

As you evaluate your granular media filtration needs, please note how AWI successfully addresses each of these points.

AWI Phoenix™ Lateral Underdrain Systems

Phoenix Lateral Underdrain Systems are designed to meet the needs of a specific application and fabricated from stainless steel. As a result, they can readily adapt to a host of filter layouts from the simplest rectangular design to numerous circular configurations.



The starting point for AWI is stainless steel as a material of construction. Stainless steel has long been recognized in the water treatment industry as a desirable material of construction due to its strength and durability. Combine that strength and durability with modern manufacturing techniques and you get some serious problem solving ability.

AWI Phoenix Underdrain Laterals

Concerned about high pressures in your filters? Phoenix Underdrain Systems can withstand far greater internal pressures than block systems. Concerned about deteriorating and/or failing grout, the most common reason for filter underdrain failure? Phoenix Underdrain Systems do not rely upon grout at all for their structural integrity. Concerned about excessive structural loads? These guys should put your mind at ease.

Impromptu Load Testing

That is a 25 foot long Phoenix Underdrain Lateral supported at each end with the guys in the shop balancing on it – the lateral held up just fine. The lateral was later shipped to the customer who asked about the structural capacity of our underdrain laterals along with this photograph.

Perhaps the biggest variable we deal with is the manner in which filtered water is withdrawn from the filter and backwash water is introduced into it. Backwashing really drives the design of the filter underdrain system because the flowrates are much higher than flowrates for collection of filtered water. We have adapted to filter flumes at one end or in the middle, ported walls, single point end feed, slotted walls, and more. We have gotten air for air scouring into these filters from above, from below, and from the side. No matter how odd a filter layout might be, in all likelihood, AWI has gotten maximum filter performance under the same or even more difficult circumstances.

No matter what the configuration of the filter might be, AWI uses sound engineering basics to insure that air and water are evenly distributed during backwashing – the key to maintaining filter media performance. The Darcy-Weisbach Equation has been used for over a hundred years as a basic element of fluid mechanics in predicting flows. AWI uses the variation of this equation shown at right to custom size the orifices in Phoenix Underdrain

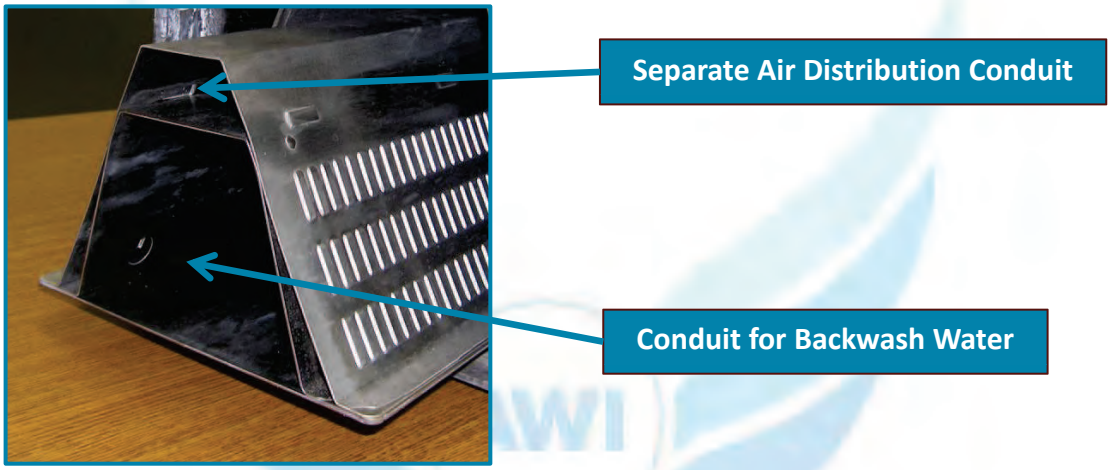
$$h = \left(k_1 \frac{v_m^2}{v_o^2} + k_2\right) \frac{v_o^2}{2g}$$

Variation of the Darcy-Weisbach Equation

Laterals so that backwash flows are evenly distributed.

This equation used to predict flow to each underdrain lateral and individually size the orifices down the length of each underdrain lateral is only valid if the conduit through which backwash water flows is full. AWI carefully separates air and water flows by using separate conduits. The backwash water conduit flows full to insure that we can accurately predict performance.

The result is AWI's ability both measure distribution of backwash water flow in operating filters and guarantee evenness of distribution that significantly exceeds industry standards.



Section of a Phoenix Underdrain Lateral

Many people don't realize that stainless steel filter underdrains have been offered for many years with a notable lack of success until AWI came along. For more than 30 years there have been numerous designs available in the marketplace. Why has AWI been so successful in building stainless steel filter underdrains when much larger companies have not? What everyone needs to understand about stainless steel filter underdrains is that even though the toughness and durability of stainless steel is a great starting point for a filter underdrain system the key to AWI success has been the way in which its filter underdrain systems are designed.

AWI Phoenix Underdrain Systems are always custom designed based upon the characteristics of the installation. Three key elements are part of every design:

- Air and water are distributed in separate conduits within the underdrain laterals eliminating destructive wave action within filters and uneven distribution of air and water during backwashing as pressures try to stabilize.

- Primary orifices control the rates of flow of air and water into each lateral during backwashing and each orifice is custom sized for a lateral's position in the filter.
- Custom sized secondary orifices that vary down the length of the lateral control the rates of flow of air and water from the lateral insuring even distribution during backwashing.

A stainless steel underdrain system lacking these characteristics is just one more name added to the list of products that over the years that have tried to take advantage of the strength of stainless steel but found limited success because of an inability to truly optimize filter performance.

Talking about even distribution of backwash flow is one thing, demonstrating it in unequivocal fashion is another. AWI maintains a shop testing facility designed to allow customers to view shop validation of the hydraulic designed developed specifically for their filters. We encourage customers to visit us and participate.

AWI Flow Distribution Test Stand

In addition to shop testing, AWI does field verification testing to directly measure backwash flows to various parts of installed filter underdrain systems. By directly measuring flows at multiple points within a filter, AWI can verify that it has designed a filter underdrain system capable of evenly distributing backwash flows within a tolerance of ±3% across the entire filter. Note that AWI verifies distribution of backwash flows by directly measuring them rather than measuring pressures and trying to infer flowrates, an approach that is at best problematical.

All of this is accomplished with an underdrain system that has the lowest overall height available. The low profile of the Phoenix Lateral Underdrain System coupled with its direct media retention eliminating the need for gravel to support the media bed means that there is more room in an existing filter for the media that actually does the work when it comes to

filtration. New filters can be constructed with lower wall heights using less concrete and there is no need for a filter flume that requires additional excavation as well as more concrete.

One last point concerning Phoenix Underdrain Systems – you can fix them. Unlike most filter underdrain systems, Phoenix Underdrain Systems bolt together. When the occasion demands, what has been bolted together can be unbolted with relative ease. We talk about how tough and durable Phoenix Underdrain Laterals are so why would you ever need to unbolt them? Here are a few reasons our customers have discovered why the ability to make repairs comes in handy:

- Construction debris in the backwash circuit piping
- Dropping a heavy object on the filter underdrain system from a crane
- Earthquake damage
- Filter media from older, unrepaired filters got into the clearwell and backwash circuit
- Having a filter sit empty and dried accumulated growth sloughs into the backwash circuit

That's why we say that the complete Phoenix Underdrain System Repair Kit consists of a shovel and some wrenches and it does not include a jackhammer. Repairs are never fun but the ability to make repairs is far better than firing up a jackhammer and starting all over.

PROJECT SCOPE OF WORK

Information provided by AWI for the Village of Watkins Glen Water Treatment Plant is broken down into characteristics of the filters and their operation and design information that is relevant for properly specifying other equipment needed to complete a filtration system.

Note that AWI is capable of providing filter underdrain system designs that can accommodate a wide range of granular media filtration scenarios. If any of these parameters does not accurately reflect the needs of this project or if further discussion is needed to arrive at the optimum design for the project, AWI would welcome the opportunity to assist.

Characteristics of the Filters and Their Operation

Filter Characteristics	
Item	**Value**
Filter Layout Information	
Total Number of Filters	One (1)
Number of Cells per Filter	Four (4)
Filter Cell Width	10 feet
Filter Cell Length	10 feet
Filter Media Selection[2]	
Sand Depth	12 inches
Granular Activated Carbon Depth[3]	32 inches
Filtration Rate	
Design Filtration Rate	4 gpm/ft^2

[2] Note that the depth of media measurement for the bottom layer of filter media starts at the top of the lateral and measures upwards.

[3] State regulatory agencies generally want to see provision made to allow for 30% expansion of the filter media bed in order to facilitate proper media cleaning. Given the elevation of the existing filter floor, the elevation of the top of the filter troughs an assumed trough depth of 18 inches, and use of Ultra-low Profile Underdrain Laterals, a media bed depth of up to approximately 44 inches can be accommodated with media bed expansion of 30%. Given the desire to include granular activated carbon (GAC) as part of the treatment design, the 44 inches of filter media can include any combination of filter sand, filter coal, and GAC deemed desirable.

Filter Characteristics	
Item	**Value**
Filter Cleaning Rates	
Design Backwash Water Flowrate	20 gpm/ft^2
Design Air Scour Air Flowrate	[4]4 scfm/ft^2
Underdrain System Information	
Backwash Water Feed Design	Flume
Air Scour Air Feed Design	Air Header Below Laterals
Type of Underdrain System Laterals	Ultra-low Profile
Lateral Slot Size	0.30 mm
Underdrain System Material of Construction	
Stainless Steel – Welded Steel/Fasteners	316L/316

Design Information

Design Information	
Item	**Value**
Backwash Information	
Backwash Conduit Maximum Velocity[5]	0.85 ft/sec
Filter Media Fluidization Headloss[6]	24.1 inches

[4] Insert an appropriate air scour range for this application. AWI typically recommends 4 scfm/ft^2 plus or minus 1 scfm/ft^2. Note that AWI Underdrain Systems are custom designed for a specific application and can accommodate a wide range of design values.

[5] In order to achieve even distribution of backwash flows, AWI prefers to limit the velocity in the backwash water conduit to 5 feet per second. Most underdrain systems are limited to around 2 feet per second because they lack the ability to custom size the primary orifices feeding the underdrain system laterals. In the event the velocity in the backwash water conduit exceeds 5 feet per second, some discussion is in order.

[6] In this case, the underdrain system headloss has been increased to insure that the underdrain system headloss exceeds the fluidization headloss of the filter media selection. Unless the underdrain system headloss is greater, the filter media will control distribution of the backwash water rather than the underdrain system resulting in undesirable movement of filter media within the filter.

Design Information	
Item	**Value**
Underdrain System Headloss[7]	30 inches
Air Scour Information	
Air Scour Piping Maximum Velocity[8]	67.4 ft/sec
Lateral Air Connection Maximum Velocity	65.4 ft/sec
Underdrain Air Scour Pressure Drop[9]	35 inches
Structural Design	
Underdrain Lateral Structural Design Capacity	10 psi

BIOLOGICALLY ACTIVE FILTERS

Filters that are biologically active present some of the greatest challenges for filter underdrain system designers because biological growth tends to plug filter underdrain systems either due to biological growth plugging filter underdrain system openings or biological material actually growing within the filter underdrain system.

AWI has a great deal of experience with biologically active filters as evidenced by the list of biologically active filter installations that follows. Note that our definition of "biologically active" requires some discussion. AWI confines its definition of biologically active to only filters in wastewater treatment plants and filters in plants that are using granular activated carbon as a filter medium. Many water treatment plants describe their filters as biologically active because they do not chlorinate their backwash water and allow biological growth to occur in their filters. We don't count these filters in our definition of biologically active filters simply because anecdotally we know that there are many AWI installations functioning in that mode out there but we don't have an accurate means of tracking them.

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[7] AWI custom designs the orifices for both air and water for each project. The headloss shown here is a reasonable but conservative value. If the headloss shown is potentially problematical, please contact AWI to review how concerns can be addressed.

[8] In order to prevent excessive noise and vibration, AWI prefers to limit the velocity in the air scour piping and the air connections to 100 feet per second. This is a soft limit and we will occasionally accept values that are just over 100 feet per second if necessary.

[9] AWI custom designs the orifices for both air and water for each project. The pressure drop shown here is a reasonable but conservative value. If the pressure drop shown is potentially problematical, please contact AWI to review how concerns can be addressed.

The reason that AWI underdrain systems perform so well in biologically active situations is that AWI uses punched slots specifically sized for the media being used to retain the media. The punched slots can be seen in the photo below.

AWI Punched Slots

Punched slots produce an opening between two relatively sharp edges. Biological material can potentially cover the opening but it cannot become lodged inside the slot. Because the material is not lodged, any biological material covering the slot will be carried away during the next backwash event clearing the filter underdrain system leaving it ready to perform as designed.

Contrast the AWI punched slot approach with use of “caps” or other means of media retention. Caps are notoriously problematical producing failure after failure around the U.S. both in water treatment plants and wastewater treatment plants that have biologically active filters.

FILTER MODIFICATIONS

The existing filters will require some modification so that maximum advantage can be taken of the available vertical space in the filter box.

Demolition

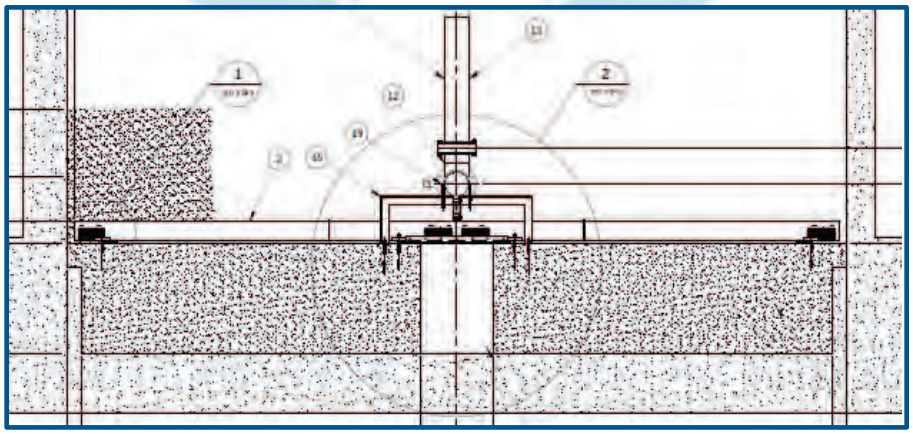
False floor underdrains were used in the original design of these filters so there is a plenum area beneath the false floor. Originally, backwash water was fed via a pipe into this plenum area and presumably even headloss across the false floor was used to achieve reasonably even distribution of the backwash water. The false floor is supported by a series of piers.

In order to free up as much space as possible in the filters, the false floor and supporting piers will need to be demolished.

Creating a Filter Flume

Backwash water is fed to the filter plenum and filtered water is collected from the plenum via a pipes embedded in the filter floor. The simplest means of getting backwater into the filters and collecting filtered water given the location of the existing piping is to create a filter flume by pouring concrete to a level even with the ledges around the periphery of the filter cells. The flume should be 48 inches wide to provide room for mounting an air header in the flume.

Note that the concrete fill being poured to from the flume should include reinforcing dowled into the existing concrete walls and floor due to the uplift forces imposed during backwashing. The drawing from a past project that follows illustrates the pouring of a flume in an existing filter.



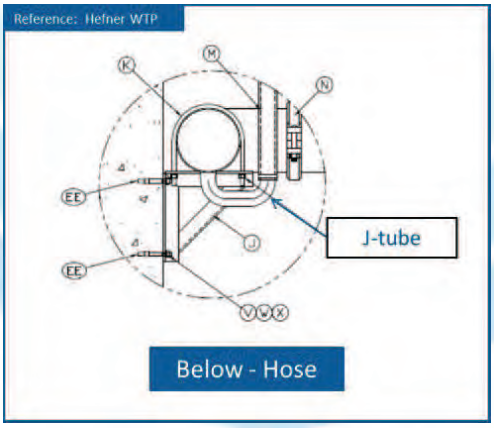
Concrete Poured to Create a Flume

This illustration shows air for air scouring being fed from an air scour header located above the filter underdrain laterals in the center of the filter. There are numerous alternatives to this air header location including feeding air from either end of the laterals or from a header located below the laterals in the flume.

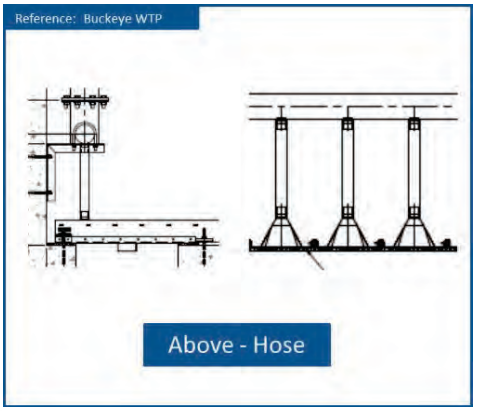
Air Scour Air Header Location

There are two potential locations for the air scour headers. The choice between the two locations will be dictated by constructability issues and Owner preference.

The cleanest potential location for the air scour headers from a filter layout perspective is to put them below the underdrain laterals in the filter flume as shown in the illustration that follows.



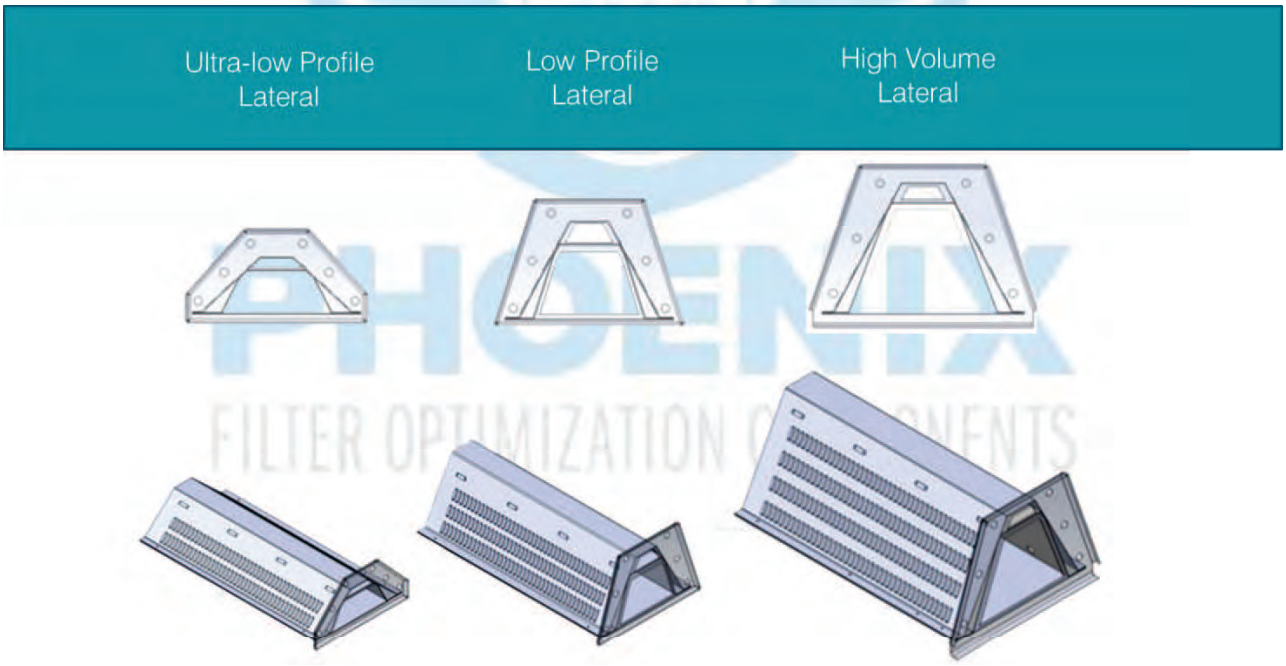
The second potential location is to put the air scour headers above the underdrain laterals. The underdrain laterals can be placed either in the filter media or above the filter media as shown in the illustration that follows.



Note that in States that subscribe to Ten States Standards placing the air scour headers above the filter media with air drop piping that runs through the filter media has implications that require further discussion.

ULTRA-LOW PROFILE LATERALS

AWI offers three different size filter underdrain laterals as shown in the illustration that follows.



In general, use of the lowest applicable lateral profile is desirable to create as much room as possible in the filter cell for filter media. Velocity of flow in the lateral's water conduit is the

limiting factor when it comes to lateral height – if the velocity becomes too great then the lateral headloss is excessive and we need to use a taller lateral with less headloss. The effective length of a lateral is the distance from the point at which backwash water is fed to the lateral to the end of the lateral (i.e., the effective length of a lateral in a 20 foot wide filter that is fed from a center flume is nominally 10 feet). In the absence of more detailed information, AWI typically limits effective lengths of its laterals as follows:

- Ultra-low Profile Laterals – 15 feet (approximately 3¼ inches high)
- Low Profile Laterals – 30 feet (approximately 5¼ inches high)
- High Volume Laterals – up to 60 feet (approximately 7 inches high)

In the case of this project, the effective length of the underdrain laterals is nominally _____ feet so Ultra-low Profile Laterals will fit the application.

UNDERDRAIN SYSTEM SLOT SIZES

Slots in AWI Phoenix Underdrain Systems are punched according to the size of the filter media being retained. Punching dies are built to AWI specifications and changed regularly to prevent the die from becoming dull such that quality control over the slot aperture diminishes. As a result, we have the ability to produce any slot size that is needed to meet the needs of a project or media configuration.

Here is a listing of the slot sizes used in recent times by AWI such that punching dies are on the shelf:

Slot Size (inches)	Slot Size (mm)
0.004	0.10
0.008	0.20
0.010	0.25
0.012	0.30
0.039	1.00

Small slot sizes are usually associated with garnet sand and large slot sizes are usually associated with granular activated carbon. AWI can provide a broad range of slot sizes in between.

All AWI Phoenix Underdrain Systems are designed for direct media retention. There is no need to include torpedo sand or garnet in a media selection to prevent media from penetrating into the underdrain system, the slots handle that task exceptionally well. We would have a small concern if torpedo sand or garnet were included in the media selection simply because the air scouring action is vigorous and there is a chance that torpedo sand

or garnet would be displaced up into the sand layer. This would not be a major problem in terms of filter performance but we would prefer to avoid the disruption.

UNDERDRAIN SYSTEM BUDGET PRICING

AWI welcomes the opportunity to provide budget pricing to assist customers in their evaluation of project costs. Budget pricing for the scope of work described in this information package is being provided in a separate budget pricing document to assist in the budgeting process.

PROJECT SPECIFICATIONS

Project specifications are intended to establish a design basis for process equipment, in this case filter underdrains, and set minimum standards which the designer feels must be met in order for the best interests of the facility owner to be served. The filter underdrain specifications offered by AWI are carefully crafted with those objectives in mind. A number of key points drawn from the AWI specifications serve to illustrate this point:

- Design Parameters – Design parameters are presented so that a bidder incurs the obligation to not only meet the product physical characteristics called out in the specifications but should also be sufficiently adept in the design of filter underdrain systems to understand the implications of these design parameters.
- Design Standards – Design standards developed by unbiased sources (American Welding Society, American Water Works Association, National Sanitation Foundation, etc.) are called out to establish that work is to be performed in a manner commensurate with industry standards.
- ISO Certification – Adherence to International Standards Organization (ISO) guidelines for manufacturing has become the industry standard. ISO certification establishes that an organization is capable of project execution in conformance with customer needs.
- Experience – Experience is indeed a great teacher. Few customers are willing to incur the cost premium to be paid in terms of both dollars and time to deal with a product provider who has yet to demonstrate project execution experience with the specified product.
- Manufacturers Named in the Specifications – As noted, specifications are intended to establish design parameters and set minimum standards. Having a manufacturer's name appear in the specification should never be construed as absolving the manufacturer of the need to meet the requirements of the specifications.

- Structural Design – Filter underdrain systems fail with alarming regularity and those failures are often structural failures. The structural minimum design standards presented minimize the potential for structural failure.
- Anchorage – Anchorage is a critical element of filter underdrain design. AWI has teamed with Hilti, the industry gold standard for anchorage systems, to design anchorage for its filter underdrain systems that is as durable as the underdrain laterals themselves.
- Installation Supervision and Commissioning – Too often installation supervision and commissioning is an afterthought offered as an "option" to bidding contractors. AWI feels that the quality of its field supervision staff is a significant strength and a key reason why we rarely have to deal with warranty related difficulties. We advocate calling out the requisite on-site attention in the specifications and insuring that the person on-site is indeed qualified. Ultimately, AWI has sufficient confidence in our field supervision staff that once that have approved installation of an AWI Phoenix Lateral Underdrain System, we will take warranty responsibility for not only the product but also the quality of its installation.
- Performance Demonstration Testing – "Talk is cheap" and "trust but verify", sayings that all boil down to the same thing – prove it. AWI advocates doing just that by directly measuring backwash performance. No use of pressure as a problematical surrogate to try to infer even distribution of backwash flow, just a visual observation of how fast different areas of the filter fill with backwash water timed with a stopwatch.
- The Warranty – Very simple – 5 years covering everything. Once an AWI Installation Supervisor signs off on an installation, if there is a problem it is our problem to resolve including not only the product but gaining access to the filter underdrains, making repairs, and putting the filters back in service.

Please note that though project specifications are presented in this document in .pdf format, AWI is glad to deliver specifications in Microsoft Word format after making any changes requested by the designer. Alternately, the designer can provide AWI with the desired specification format and AWI will deliver Microsoft Word specifications in the designer's preferred format.

Leaders in Filter Optimization

Phoenix™ Lateral Underdrain System Specifications

for the

Village of Watkins Glen Water Treatment Plant

SECTION 13220

FILTER UNDERDRAIN SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. There shall be furnished a filter underdrain system for a total of one (1) filter having four (4) cells. Filter underdrain systems shall be installed as shown on the Contract Drawings. The underdrain system shall include from a single source all items, materials, fasteners, and sealants within the filter cell to collect filtered water, uniformly distribute backwash air and water, retain the filter media, and to retain, support, and seal the filter underdrain system to make it complete and operable.

B. Each filter cell is 10 feet wide by 10 feet long with a 48 inch wide and flume as shown on the Contract Drawings.

C. The filter underdrain system shall include filter underdrain laterals designed to span the flume with separate conduits for distribution of backwash water and air scour air, hydrostatic testing of the underdrain, and testing of the entire system for air and water distribution.

D. The filter underdrain system shall be designed to avoid localized areas of excessive backwash flow that may cause mounding or other deleterious disturbance of the filter media.

E. The filter underdrain system will be designed to accommodate a maximum internal pressure of 10 psi and deliver the specified underdrain performance without leaking the specified filter media at any fabricated joint. The entire filter underdrain system shall be designed to withstand, with a prudent safety factor, intermittent operation, or continuous 24 hour per day operation.

F. The ability to efficiently repair the filter underdrain system if that becomes necessary is a key aspect of this project. Anchorage must be designed so that all elements of the filter underdrain system can be removed for repairs and/or cleaning and reinstalled without damaging any stainless steel filter underdrain system components, concrete, or grout.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. PIPING AND VALVES .....Division 2

B. CONCRETE .....Division 3

C. AIR SCOUR BLOWERS .....Division 11

D. FILTER BACKWASH TROUGHS .....Division 11

E. FILTER MEDIA .....Division 13

F. FILTER CONTROLS .....Division 13

1.03 PROCESS REQUIREMENTS

A. The filter underdrain system will support a dual media bed cleaned by water backwash, air scour, or a combination of the two. The intent of this specification is to obtain a filter underdrain capable of being an integral part of a complete filter system that will effectively remove turbidity, have long filter run times, and have low backwash water requirements.

B. Design parameters are as follows:

- Design filtration rate ..... 4 gpm/ft^2
- Design backwash rate ..... 20 gpm/ft^2
- Design air scour air pressure at the filter cell wall (excludes static head)..... 1.5 psig
- Design air scour rate ..... 4 scfm/ft^2
- Sand media depth above the top of the underdrain laterals ..... 12 inches
- Granular activated carbon media depth ..... 32 inches

1.04 REFERENCE STANDARDS

A. ASTM A312 - American Society for Testing and Materials - Pipe Specifications

B. ASTM A380 5.3 - American Society for Testing and Materials – Mechanical Descaling

C. ASTM A276 - American Society for Testing and Materials - Stainless Steel Material Specifications

D. AWS B2.1 - American Welding Society – Specification for Resistance Welding for Aerospace Applications

E. AWS D1.3 - American Welding Society - Structural Welding Code Sheet Steel

F. AWS D1.6 - American Welding Society – Structural Welding Code Stainless Steel

G. AWS D9.1 - American Welding Society – Sheet Metal Welding Code

H. AWS D17.2 - American Welding Society – Specification for Resistance Welding – Spot Welding by Machine

I. AWS G2.1 - American Welding Society – Guide for the Joining of Wrought Nickel-based Alloys

J. AWWA B100 - American Water Works Association - Standards for Filter Media

K. NSF/ANSI 61 - National Sanitation Foundation/American National Standards Institute - Drinking Water System Components – Health Effects

1.05 QUALITY ASSURANCE

A. The filter underdrain system shall be designed to ensure long-term functional stability in terms of its operating characteristics. Under customary filter operating and environmental conditions, the filter underdrain system shall be resistant to changes in head loss, flow uniformity, corrosion, and any other effects which would in time cause loss of efficiency or effectiveness of its operation.

B. All components that comprise the filter underdrain system shall be designed and furnished by a single manufacturer. The manufacturer shall be responsible for the compatibility of all underdrain components. In addition, the manufacturer must be regularly engaged in the manufacture of similar filtration equipment.

C. Lateral orifice sizing and spacing must be verified with sizing calculations done specifically for this project. If requested by the Owner or Engineer, a factory backwash distribution test must be performed to verify that the underdrain lateral orifice configuration used for this project is able distribute backwash flow within the specified variance of ±3%. The Owner and Engineer will be given two weeks' notice in advance of finalizing orifice sizing and they may elect to schedule witness factory backwash distribution testing at their discretion. A written report presenting factory backwash testing results will be forwarded to the Engineer.

D. The manufacturer of the filter underdrain system will modify its standard equipment to meet the minimum values specified for dimensions, design, and intent of this specification.

E. All welding shall be performed in accordance the previously listed codes and specifications. Welding shall be in accordance with qualified Welding Procedure Specifications (WPS) with Procedure Qualification Records (PQR) and Welder Performance Qualifications (WPQ) records maintained and available for review.

F. In order to ensure that a consistent level of quality is maintained with appropriate record keeping and corrective action procedures, all welding must be performed in a facility that is ISO 9001 certified.

G. The manufacturer must have regularly been involved in providing filter underdrain systems for a period of five (5) years with valid reference projects installed in at least ten (10) separate sites. Valid references for fulfilling this requirement must use a stainless steel product identical to the product being offered for this project and projects must be of a size and scope of work that allows performance to be reasonably compared to this project.

H. The filter underdrain system will be manufactured by AWI (ANTHRATECH) U.S. INC. of Salt Lake City, Utah.

I. Identifying a manufacturer by name in these specifications indicates that the manufacturer is regularly engaged in the manufacture of filter underdrain systems. The Engineer has not reviewed manufacturer product offerings in detail and makes no representation regarding the ability of manufacturers identified by name in these specifications to provide a product that meets these specifications. The appearance of a manufacturer's name in these specifications in no way relieves the manufacturer from the obligation to provide a product that meets the detailed requirements of these specifications.

1.06 CONTRACTOR'S SUBMITTALS

A. The Contractor shall submit complete shop drawings of all equipment furnished including cut sheets describing purchased sub-components with the specific sub-components used for this project properly highlighted. All submitted information must include a certification that the submittal describes exactly the equipment to be provided and substitutions subsequent to submittal approval will not be accepted.

B. The Contractor shall submit for approval a minimum of the following information:

C. Detailed general arrangement drawings showing the filter underdrain system configuration, and sufficient information describing the underdrain components to determine compliance with the specifications.

D. Structural calculations verifying the underdrain system anchorage.

E. Detailed installation instructions specific for this project.

F. Field testing procedures for this project.

G. Submittal information must be stamped by a Registered Professional Engineer regularly employed by the underdrain system manufacturer.

1.07 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals shall be provided by the equipment manufacturer at least two weeks prior to shipment of all major equipment components. Manuals shall be submitted electronically in bookmarked Adobe Acrobat format.

B. As a minimum the manual shall contain:

1. General arrangement drawings.

2. General arrangement detail drawings.

3. A complete bill of materials for the equipment.

4. Safety data sheets for all items of equipment purchased from other manufacturers.

5. Installation and maintenance instructions for the specific equipment including the assembly sequence, maintenance items, storage instructions, and trouble-shooting checkpoints.

1.08 PRODUCT HANDLING AND STORAGE

A. All components must be crated and adequately marked for ease of assembly.

B. The filter underdrain system shall be installed immediately upon receipt from the manufacturer or stored in strict conformance with storage recommendations provided by the manufacturer in the operations and maintenance manual.

PART 2 - PRODUCTS

2.01 GENERAL

A. The filter underdrain system shall include a series of laterals acting as pressure vessels and analyzable as such. The laterals shall span and receive flow from a concrete floor flume.

B. The laterals must compensate for water velocity and momentum changes during backwashing operations by varying the size of the orifices along the lateral length. The height of the laterals shall not exceed 3 and 1/2 inches.

C. The filter underdrain system shall be designed to sustain an operating differential pressure of 10 psi across the laterals and remain fully functional. Underdrain laterals shall have a minimum weight per lineal foot of 40 pounds per square foot

of lateral cross-sectional area to insure a minimum amount of structural integrity. Weights of lateral flanges, seal plates, and end caps are excluded from calculation of the weight per lineal foot.

D. The filter underdrain anchorage system shall be capable of sustaining a vertical downward load of 2,400 pounds per square foot and a vertical upward load commensurate with the design differential pressure across the laterals.

2.02 LATERALS

A. Laterals shall be one-piece cross-section containing two separate compartments and an integral stainless steel bottom to provide structural rigidity and preclude having to try to seal laterals to the filter floor. In order to minimize wave action during air scouring resulting in deleterious movement of filter media, laterals must be designed to preclude wave action by having completely separate dedicated conduits for air and water. The water conduit must make provisions to vent any air which might be trapped in the backwash piping to escape during backwashing operations.

B. Laterals must be evenly spaced across the filters on nominal 12 inch centers but in no case will the center-to-center spacing exceed 12 and 1/2 inches. The centerline of laterals adjacent to a wall may not be more than 6 and 1/2 inches from the wall. Laterals will extend to within a nominal distance of 3 inches from the filter wall to all points along the ends of the lateral to allow for unevenness of the filter walls and/or floor. If necessary, lateral ends will be mitered to maintain this nominal distance. All laterals will be fabricated to be flat to within 0.03 inches per lineal foot of underdrain lateral.

C. Separate orifices shall be provided down the length of the filter underdrain system laterals with one set of orifices controlling the distribution of air and another set of orifices controlling the distribution of water. Orifices controlling the flow of backwash water must be custom sized specifically for this project such that their diameter varies down the length of the underdrain lateral insuring even distribution of backwash flow. Orifice sizing and spacing must be designed such that the laterals can distribute backwash water with a maximum variance of ±3%.

D. Media retaining slots having a maximum gap of [1] 0.30 millimeters shall be integrally fabricated with the laterals to support filter media without the need for filter gravel while allowing passage of water for filtered water collection and backwashing. In order to ensure that filter media does not pass through an inadvertently flared slot, slots may not be burned/laser cut. Media retention slots that are manufactured separate from the laterals and then mechanically attached to

[1] The slot gap dimension can be varied within limits to accommodate various media selections and applications. For example, use of granular activated carbon with a larger effective size as a media selection in a biologically active environment can best be accommodated with a larger slot gap. Consult AWI to discuss filtration applications and available slot gaps.

the lateral will not be allowed because of their propensity to separate from the laterals during air scouring.

E. In order to maintain the structural integrity of the underdrain system and prevent misalignment of lateral segments during filter operations, all connections between lateral segments must but made with bolted and gasketed flanges. Lateral ends will be fully sealed with an end cap that is welded in place.

F. Laterals will be designed with sufficient structural integrity that no modulation of air scour airflow is required to protect them.

2.03 LATERAL FEED ORIFICES AND FLUME SEAL

A. Each lateral shall have at least one dedicated feed primary orifice in its seal plate designed to evenly collect filtered water from and distribute backwash water to the lateral by compensating for velocity and momentum changes during delivery of backwash water to the laterals. Orifice size and spacing will be calculated to meet the specific needs of this project. Primary orifices will be changeable in the field in the event adjustments must be made in response to field testing.

B. The laterals will seal to the floor on either side of the flume. Each lateral will bolt and seal directly to the adjacent laterals where the flume is spanned.

C. Each lateral will include an air connection specifically for the air conduit in that lateral. The air connection will include an orifice to ensure that the air is metered in proportion to the area of the filter that the lateral services.

2.04 AIR SCOUR HEADERS

A. A properly sized air scour header as shown on the Contract Drawings shall be supplied to provide air for scouring to each lateral.

B. All air feed piping, air conduits, and air connections must be sized such that air flow velocities are kept below 100 feet per second at the design maximum air scour rate.

C. Air shall exit the bottom of the header to prevent wave action in the header.

D. The air header shall be constructed of type 316L stainless steel and shall be schedule 10 minimum.

E. Connections between the air scour header and underdrain laterals will be made using reinforced hose held in place with type 316 stainless steel clamps.

2.05 ANCHORAGE AND STRUCTURAL REQUIREMENTS

A. Anchorage to the floor will be accomplished through the use of adhesive type anchor bolts with hold down clamps. Primary floor anchor bolts around the flume will not be less than $^1/_2$ inch in diameter. Secondary floor anchors for the laterals away from the flume will not be less than $^1/_2$ in diameter.

B. Adhesive anchor bolts must be set according to instructions provided by the manufacturer using adhesives supplied by HILTI.

C. The filter underdrain system and its anchorage must be capable of sustaining the structural imposed by a vertical upward load of 2,400 pounds per square foot applied at the filter flume. The underdrain system must also remain operational when exposed to a design difference in pressure of 10 psi between the pressure inside the underdrain system and the pressure outside of the underdrain system. This design pressure is based upon a 10 psi pressure differential applied to a fully plugged underdrain system.

D. Anchorage to walls will be accomplished through the use of wedge anchors. Wall anchors will not be less than ½ inch in diameter.

E. Grout may be used only for the purposes of leveling and/or providing a smooth sealing surface. Due to its inherent weaknesses and history of contributing to filter underdrain failures, grout placed in tension may not be relied upon in any way to contribute to structural integrity when developing structural calculations.

F. All anchors much be torqued according to the manufacturer's recommendations using a torque wrench.

2.06 MATERIALS

A. All fabricated items inside the filters will be constructed from 316L stainless steel material.

B. All fasteners inside the filters will be constructed from 316 stainless steel.

C. All attachments and connection points shall be properly sealed to prevent media leakage.

D. The manufacturer will supply all materials necessary for properly installing anchors according to HILTI instructions including:

- Anchor bolts
- Adhesive
- Adhesive applicators

- Hole brushes
- Hole brush handles

E. All sealed connections will be gasketed. Gaskets will be installed with a sealant provided by the manufacturer to insure a proper seal.

F. All materials in contact with water must be certified to NSF 61.

G. A reasonable amount of surplus hardware, sealant, and gasket materials are supplied to assure sufficient material to complete the assembly and installation.

- 2% more anchor bolts that the quantity shown on the manufacturer's drawings
- 2% more assembly bolts than the quantity shown on the manufacturer's drawings
- 2% more sealant than is needed for installation as shown on the manufacturer's drawings
- 2% more gasket material than is shown on the manufacturer's drawings

PART 3 - EXECUTION

3.01 INSTALLATION

A. The underdrains shall be installed in accordance with the manufacturer's recommendations as approved by the Engineer.

B. Prior to installation of the underdrain system, the Contractor shall vacuum clean all surfaces that might come in contact with the filtered water or backwash water. Backwashing will be performed until the backwash circuit is clean to a degree acceptable to the underdrain system manufacturer.

C. Following media placement, the media shall be thoroughly washed and cleaned in accordance with recommendations from the filter media supplier.

D. Prior to installation of filter media, a field service representative employed directly by the underdrain system manufacturer shall inspect the filter underdrain system, make necessary final adjustments, and certify the equipment ready for operation.

E. Field welding will not be allowed unless permission is granted by the Engineer for the express purpose of making repairs after the underdrain system components have arrived on site.

3.02 SERVICE

A. The equipment manufacturer shall supply a factory trained field service representative to inspect installation of the filter underdrains. In addition, the field service representative shall instruct the owner's personnel in the proper operation and maintenance of the filter underdrains. Installation supervision described in these specifications can be accomplished in 8 days of service delivered in 4 separate trips; therefore, the manufacturer must provide these service days and trips.

B. Qualified field service representatives must have a minimum of three (3) years of experience installing the specific filter underdrain product provided for this project.

C. At the start of the filter underdrain installation process, a field service representative employed by the filter underdrain manufacturer will inspect the first filter and filter underdrain components to be installed in it to verify that the filter has been properly cleaned and the filter underdrain components are prepared for installation instructing the installing contractor’s personnel in what to observe and document. The field service representative will train the personnel performing the installation of the filter underdrain system in the proper procedures for installation.

D. The Contractor shall take all necessary precautions recommended by the filter underdrain manufacturer to ensure that the backwash system and air piping are completely clean and free of any debris, dirt, or other foreign materials which could clog the underdrain system or interfere with flow. Backwash air and water piping shall be thoroughly flushed clean. Cleaning of the first filter to be installed shall take place in the presence of the manufacturer’s field service representative to establish the level of cleanliness required.

E. A qualified field service representative employed by the filter underdrain manufacturer will supervise installation of at least a portion the first filter underdrain system to ensure that proper installation procedures are being followed. Upon completion of installation of the filter underdrain systems, the field service representative will provide a full and complete test report for each test performed. Completion of the filter underdrain system installation process is signified by a signed certification indicating that the filter underdrain systems are properly installed, the filter underdrain warranty is in force, and the filter underdrain systems are ready to be put into service.

F. Service by a representative of the filter underdrain manufacturer who is not a direct, full time employee of the filter underdrain manufacturer is not acceptable.

3.03 FILTER UNDERDRAIN WARRANTY

A. The filter underdrain manufacturer’s warranty will extend for a period of five (5) years from the date that the document certifying that the filter underdrains are

properly installed is signed. The filter underdrain warranty will cover the cost of the following items:

- Repair or replacement at the sole discretion of the filter underdrain system manufacturer of any failed filter underdrains, fasteners, and appurtenances supplied by the filter underdrain manufacturer.
- Any movement or removal of filter media necessary to effect needed repairs.
- Removal of any filter underdrain components and appurtenances which have failed to provide proper service including any required demolition.
- Reinstallation of repaired or replaced filter underdrains.
- Reinstallation of any filter media removed for the purpose of the covered warranty work.

B. The filter underdrain manufacturer will guarantee the functional integrity of the filter underdrains and underdrain system when that system is subjected to operating differential pressures up to 10 psi as measured in the feed piping which supplies backwash water to the filter underdrains. (This statement should be interpreted to mean that with all of the media retention shots plugged a static head of 23 feet can be applied to the filter underdrain system without the filter underdrain system sustaining damage.) This guarantee does not apply to damage caused by water hammer events.

C. The filter underdrain manufacturer is not responsible for the concrete to which the filter underdrain system is attached under the terms of this warranty. The filter underdrain manufacturer will not be responsible if contaminated backwash water causes the underdrains to plug with the result that differential pressures are in excess of the specified design pressure. System operating pressures within the filter underdrains will be continuously monitored and recorded by the user.

D. The filter underdrain manufacturer will pay the cost of all warranty related repairs as defined by the filter underdrain system manufacturer and the Owner will not be required to pay for any of the warranty-related activities identified in this warranty statement. The Owner will be responsible for providing a nearby laydown area for the storage of filter media removed during any warranty related activities as well as any utilities required to perform the warranty work.

3.04 PERFORMANCE DEMONSTRATION TEST

A. After start-up and prior to final acceptance, the Contractor shall conduct an Engineer witnessed performance demonstration tests on the filter underdrains in one of the filters selected by the Engineer.

B. After even distribution of backwash flow has been established and visually confirmed and before the filter media is put into the filter, the filter underdrain system shall be tested for uniform air scour distribution and combined air scour water backwash distribution. For the air distribution test, the filter cell shall be flooded to a level approximately 6 to 9 inches above the top of the underdrain. The air flow rate shall be slowly increased to the specified air only rate, and sustained for approximately 2 minutes while visual observations are made. While continuing to air scour at the specified air scour rate, backwash water will be introduced into the filter at a backwash rate of 4 to 8 gpm/ft^2 in conjunction with the air while the level in the filters rises to the bottom of the filter troughs. Within seconds of the introduction of air for air scouring and throughout the test, the surface of the filter will appear stable with uniform agitation and no evidence of dead spots or surging. The test shall be witnessed and certified by a manufacturer's field service representative.

C. The testing protocol to be executed by the manufacturer will be submitted for approval to the Engineer. Test procedures shall be submitted to the Engineer for approval with submittal drawings. Tests will be scheduled with the Engineer at least two (2) weeks prior to the planned test date.

D. The field service representative shall submit to the Engineer a written report stating that the filter underdrain systems have been checked and are suitable for operation.

E. Inspection by a representative of the manufacturer who is not a direct, full time employee of the manufacturer is not acceptable.

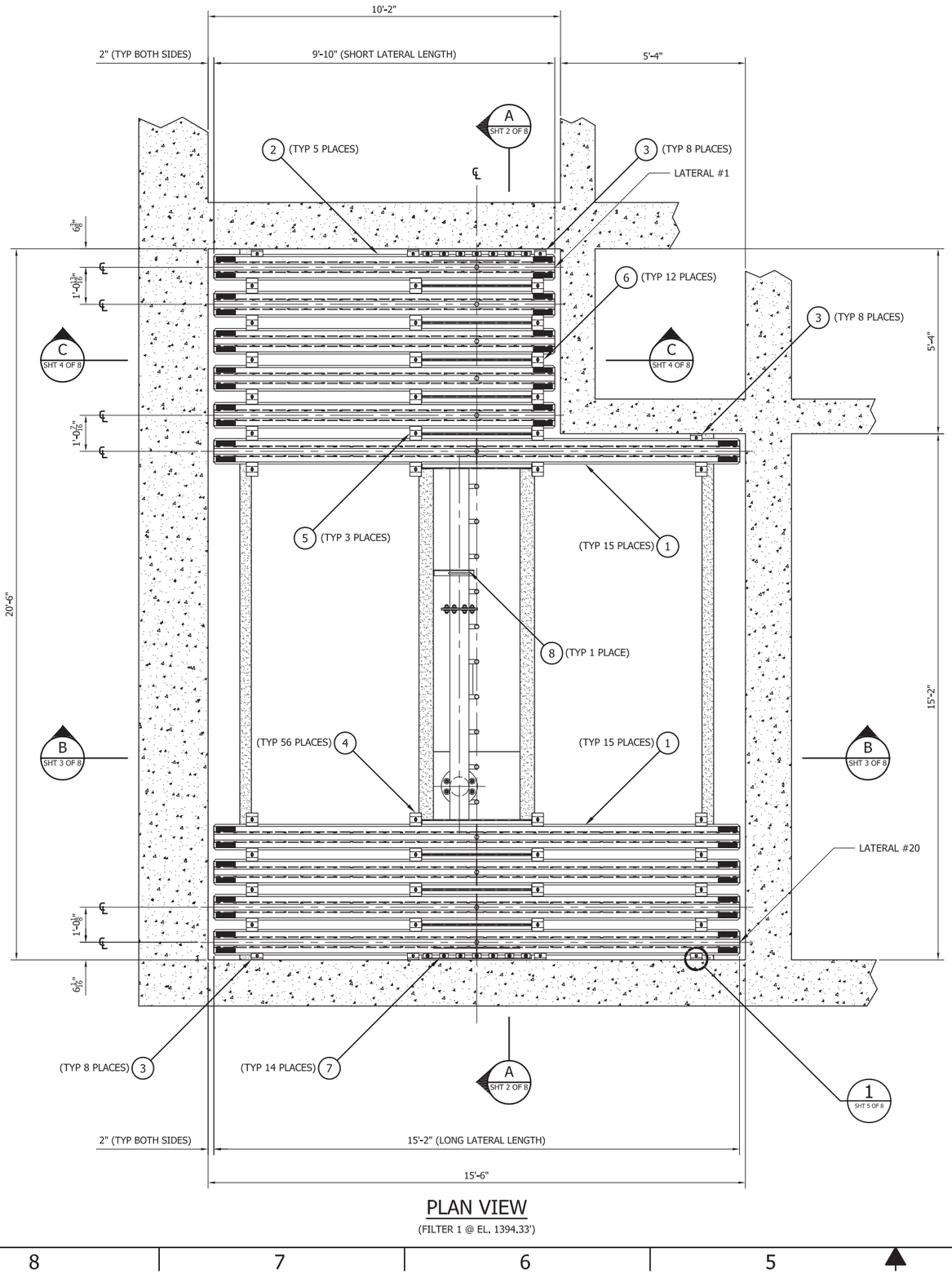
END OF SECTION 13220

DRAWINGS

Drawings provided with this information package are in .pdf format. Once a satisfactory filter configuration for this project has been established, AWI will be glad to provide drawings reflecting that configuration in .dwg format that can readily be manipulated for inclusion in contract documents.

Phoenix™ Lateral Underdrain System

Representative Project Drawings



PLAN VIEW

(FILTER 1 @ EL. 1394.33')

REVISION HISTORY							
REV	DESCRIPTION	DATE	BY	DATE	CHKD	DATE	APPROVED
A	INITIAL RELEASE						
B	ADDED END PLUG DIMENSION (SHEET 2)	07/26/17	KPS	07/26/17	DKT	07/26/17	TURNER
C	CHANGE LATERAL NUMBERING ON FILTERS 2 & 4 (SHEET 8)	08/16/17	KPS	08/17/17	DKT	08/17/17	TURNER
D	CHANGED AIR MANIFOLD FLANGES TO FULL FACE	02/22/18	KPS	02/27/18	DKT	02/27/18	TURNER

DESIGN PARAMETER DESCRIPTION	VALUE	UNITS
NUMBER OF FILTERS	FOUR (4)	-
NUMBER OF CELLS PER FILTER	ONE (1)	-
NORMAL FILTRATION RATE	2.4	GPM/FT^2
MAXIMUM BACKWASH WATER FLOW RATE	20.0	GPM/FT^2
MAXIMUM AIR SCOUR FLOW RATE	3.00	$SCFM/FT^2$

REVISED AS FINAL - 02/27/2018

GENERAL NOTES:

1. ALL DIMENSIONS SHOWN ARE TO BE VERIFIED BY THE CONTRACTOR.
2. ALL COMPONENTS SUPPLIED BY AWI TO BE 304L STAINLESS STEEL UNLESS OTHERWISE NOTED.
3. QUANTITIES SHOWN AND NOTED IN THE BILL OF MATERIALS REFLECT COMPONENTS FOR ONE (1) FILTER (AWI TO SUPPLY MATERIAL FOR FOUR (4) FILTERS).
4. MAXIMUM INTERNAL PRESSURE WITHIN THE UNDERDRAIN SYSTEM DURING BACKWASH IS NOT TO EXCEED 10 PSIG. OPERATION OF THE FILTERS ABOVE 10 PSIG VOIDS THE AWI WARRANTY.
5. BACKWASH TROUGHS NOT SHOWN FOR CLARITY.
6. FILTER MEDIA NOT SHOWN FOR CLARITY.

ITEM NO	QTY	PART NO	DESCRIPTION	MATERIAL	MATERIAL SPEC.
34	A/R	-	HILTI HIT HY-200 ADHESIVE	-	-
33	A/R	-	SIKA 1A SEALANT	-	-
32	70	-	SHIM, VARIOUS THICKNESSES (1/4")	HDPE	-
31	70	-	SHIM, VARIOUS THICKNESSES (1/8")	HDPE	-
30	70	-	SHIM, VARIOUS THICKNESSES (1/16")	HDPE	-
29	2	-	GASKET, GROUT STRIP, 3/8" THICK X 4" WIDE X 3'-2" LONG	NSR	-
28	2	-	GASKET, GROUT STRIP, 3/8" THICK X 4" WIDE X 20'-6" LONG	NSR	-
27	2	-	FLANGE GASKET RING, NEOPRENE RUBBER, 6" 150#	NEOPRENE	-
26	19	-	GASKET, SEAL PLATE FLANGE, 1/8" THICK X 1 1/2" WIDE X 3'-2" LONG	NSR	-
25	32	-	NUT, HEX, 3/4"-10UNC	304 SS	-
24	32	-	WASHER, FLAT, 3/4", TYPE A PLAIN, NORMAL	304 SS	-
23	16	-	STUD, FULL THREAD, 3/4"-10UNC X 4 3/4" LONG	304 SS	-
22	190	-	NUT, HEX, 3/8"-16UNC	304 SS	-
21	190	-	WASHER, LOCK, 3/8", REGULAR HELICAL SPRING	304 SS	-
20	380	-	WASHER, FLAT, 3/8", TYPE A PLAIN, NORMAL	304 SS	-
19	190	-	BOLT, HHCS, 3/8"-16UNC X 1 1/4" LONG	304 SS	-
18	99	-	NUT, HEX, 1/2"-13UNC	304 SS	-
17	105	-	WASHER, LOCK, 1/2", REGULAR HELICAL SPRING	304 SS	-
16	99	-	WASHER, FLAT, 1/2", TYPE A PLAIN, NORMAL	304 SS	-
15	6	-	ANCHOR BOLT, EXPANSION TYPE, 1/2"-13UNC X 5" LONG, W/ NUT & WASHER	304 SS	-
14	93	-	THREADED ROD, 1/2"-13UNC X 8 1/2" LONG	304 SS	-
13	3	-	U-BOLT, 6" PIPE SIZE, 1/2-13UNC THREADS	304 SS	-
12	40	-	HOSE CLAMPS	304 SS	-
11	20	-	HOSE, 1 1/2" I.D. X 1/4" WALL AIR HOSE	PVC	-
10	3	-	AIR SCOUR SUPPORT BRACKET, 2" X 2" X 1/4" ANGLE	304L SS	ASTM A276
9	1	-	AIR SCOUR MANIFOLD, END	304L SS	ASTM A312
8	1	-	AIR SCOUR MANIFOLD, INLET	304L SS	ASTM A312
7	14	-	CLAMP, HOLD DOWN, FLUME END	304L SS	ASTM A276
6	12	-	CLAMP, HOLD DOWN, STANDARD, SHORT LATERALS	304L SS	ASTM A276
5	3	-	CLAMP, HOLD DOWN, STANDARD, TRANSITION	304L SS	ASTM A276
4	56	-	CLAMP, HOLD DOWN, STANDARD, LONG LATERALS	304L SS	ASTM A276
3	8	-	CLAMP, HOLD DOWN, EDGE	304L SS	ASTM A276
2	5	-	PHOENIX UNDERDRAIN LATERAL, SHORT LATERALS	304L SS	ASTM A240
1	15	-	PHOENIX UNDERDRAIN LATERAL, LONG LATERALS	304L SS	ASTM A240

DIMENSIONS AND SYMBOLOGY PER ASME Y14.5M - 1994
UNLESS OTHERWISE SPECIFIED
SURFACE ROUGHNESS: 125
DIMENSIONS AND TOLERANCES ARE IN INCHES
TOLERANCES: .X = ± .1, .XX = ± .03, .XXX = ± .010, FRACTIONS: ± 1/16", ANGLES: +/- .50°
DO NOT SCALE DRAWING

THIRD ANGLE PROJECTION

TASK	INITIALS	DATE
MODELED	-	-
DRAWN	PCB	06/08/17
CHECKED	KPS	06/14/17
APPROVED	SELIN	06/16/17
QA/QC	-	-

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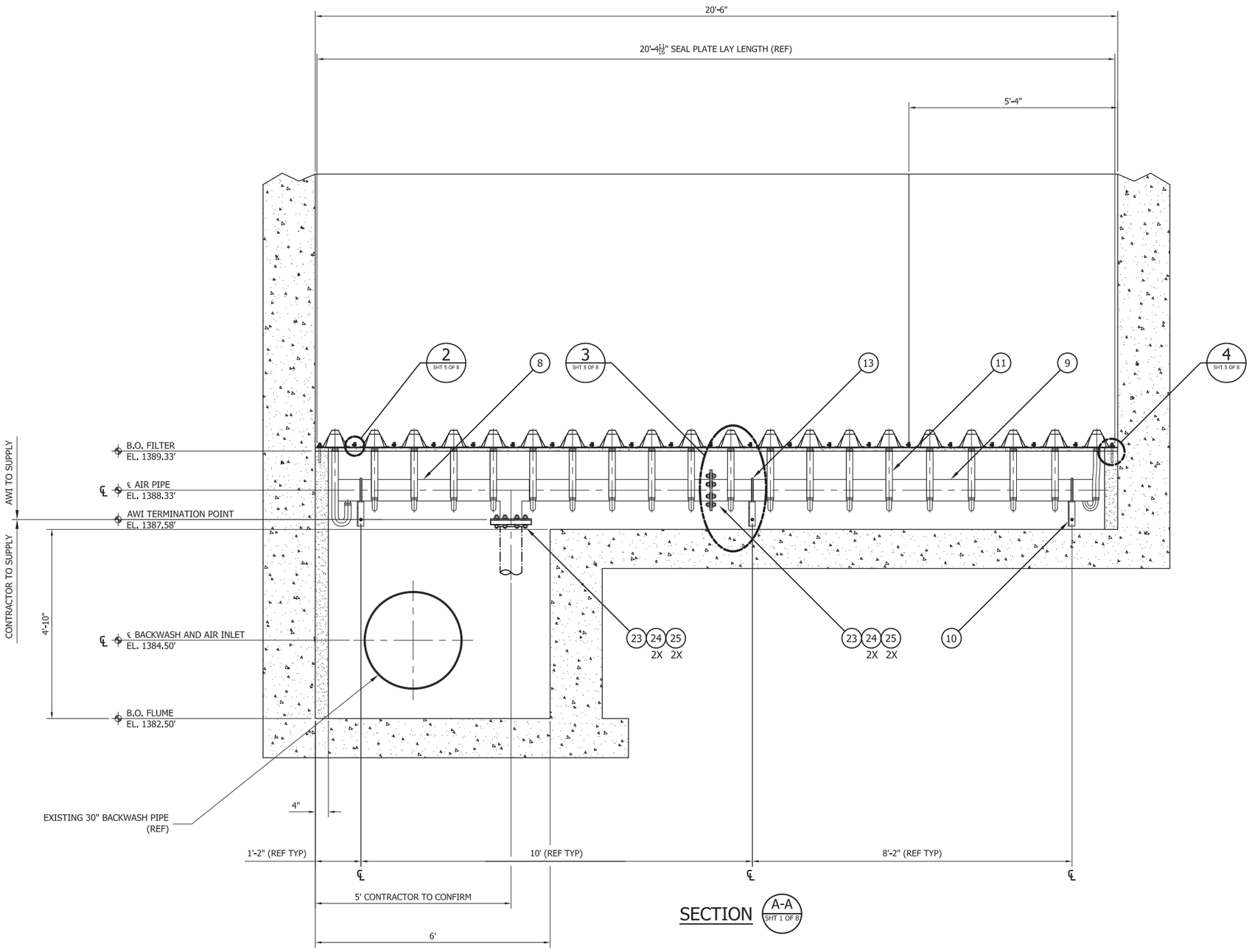
TITLE

GENERAL ARRANGEMENT

AWI PHOENIX UNDERDRAIN SYSTEM
CAMP CREEK WATER TREATMENT PLANT
CORNELIA, GEORGIA

SIZE	CAGE CODE	DWG NO	REV
D	N/A	2328-GA-001	D
SCALE	NTS	SHEET	1 OF 8



SECTION A-A SHT 1 OF 8

REVISED AS FINAL - 02/27/2018

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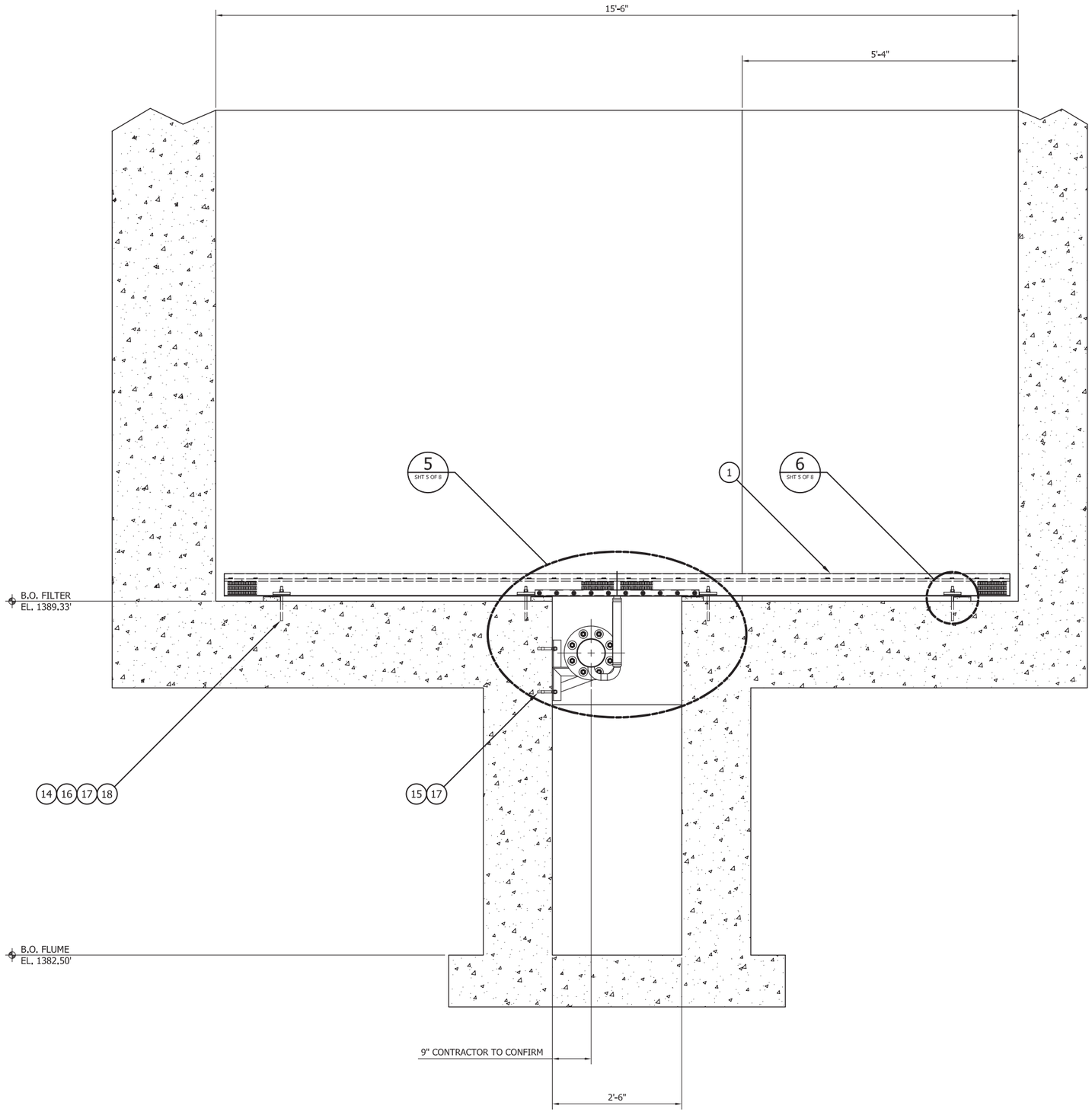

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REVISED AS FINAL - 02/27/2018

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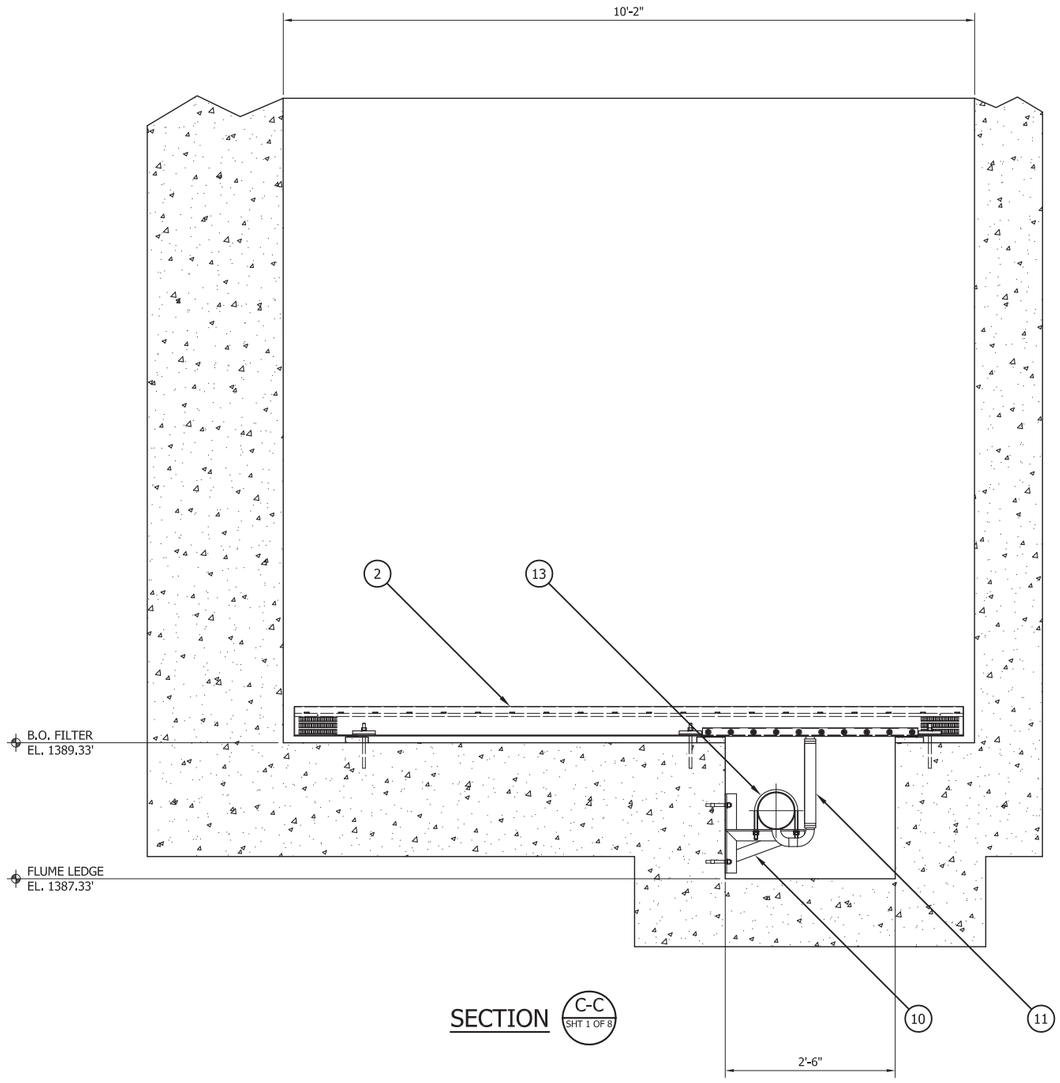

SECTION C-C SHT 1 OF 8

REVISED AS FINAL - 02/27/2018

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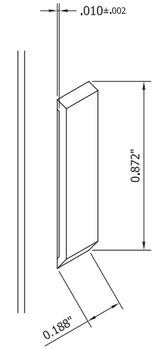

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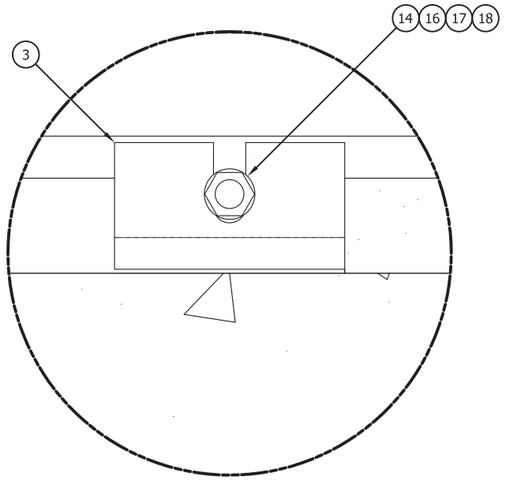
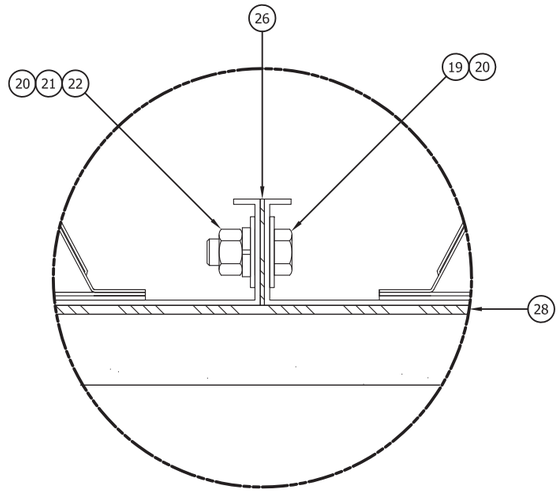


DETAIL 1 SHT 1 OF 8



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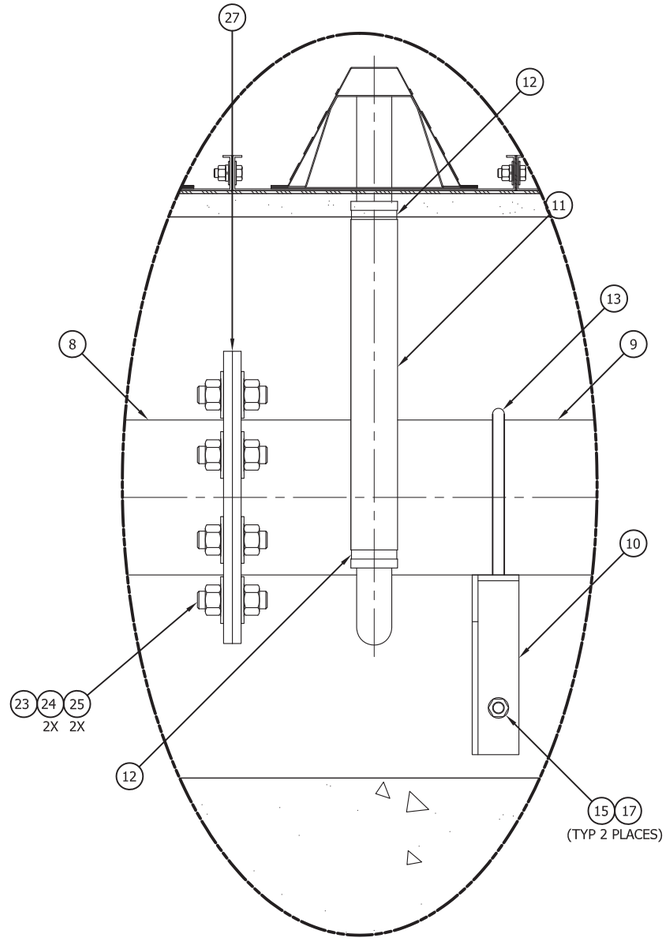

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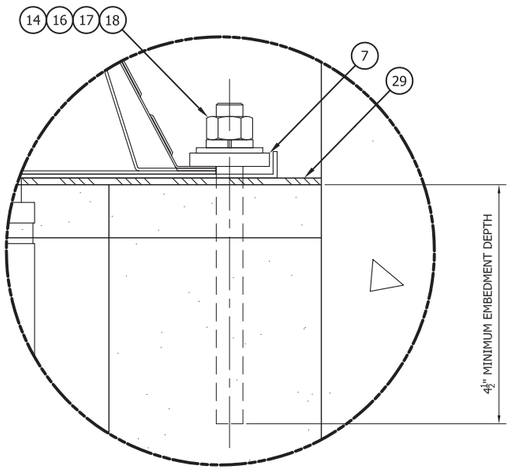

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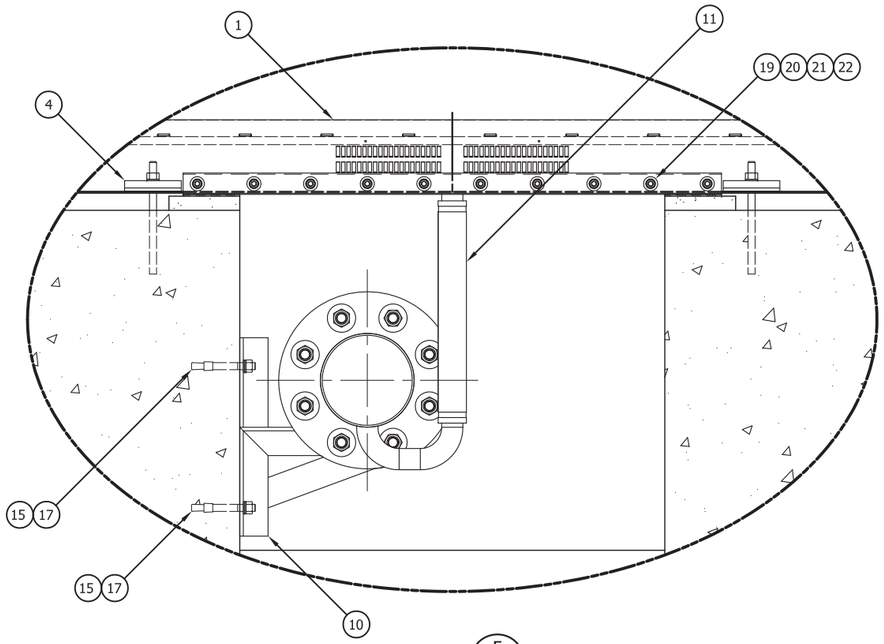

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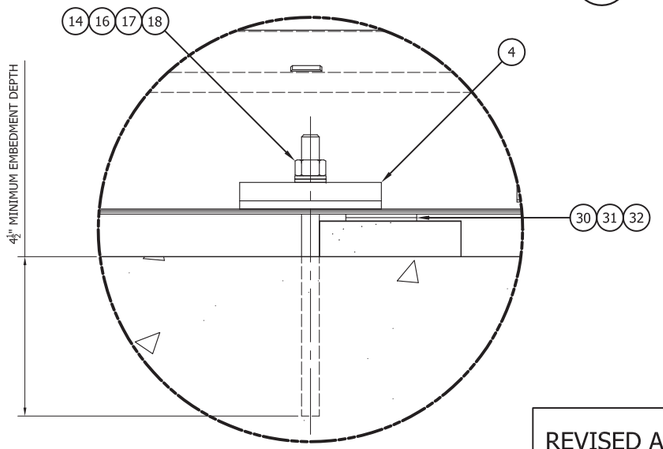

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REVISED AS FINAL - 02/27/2018

SIZE	CAGE CODE	DWG NO	REV
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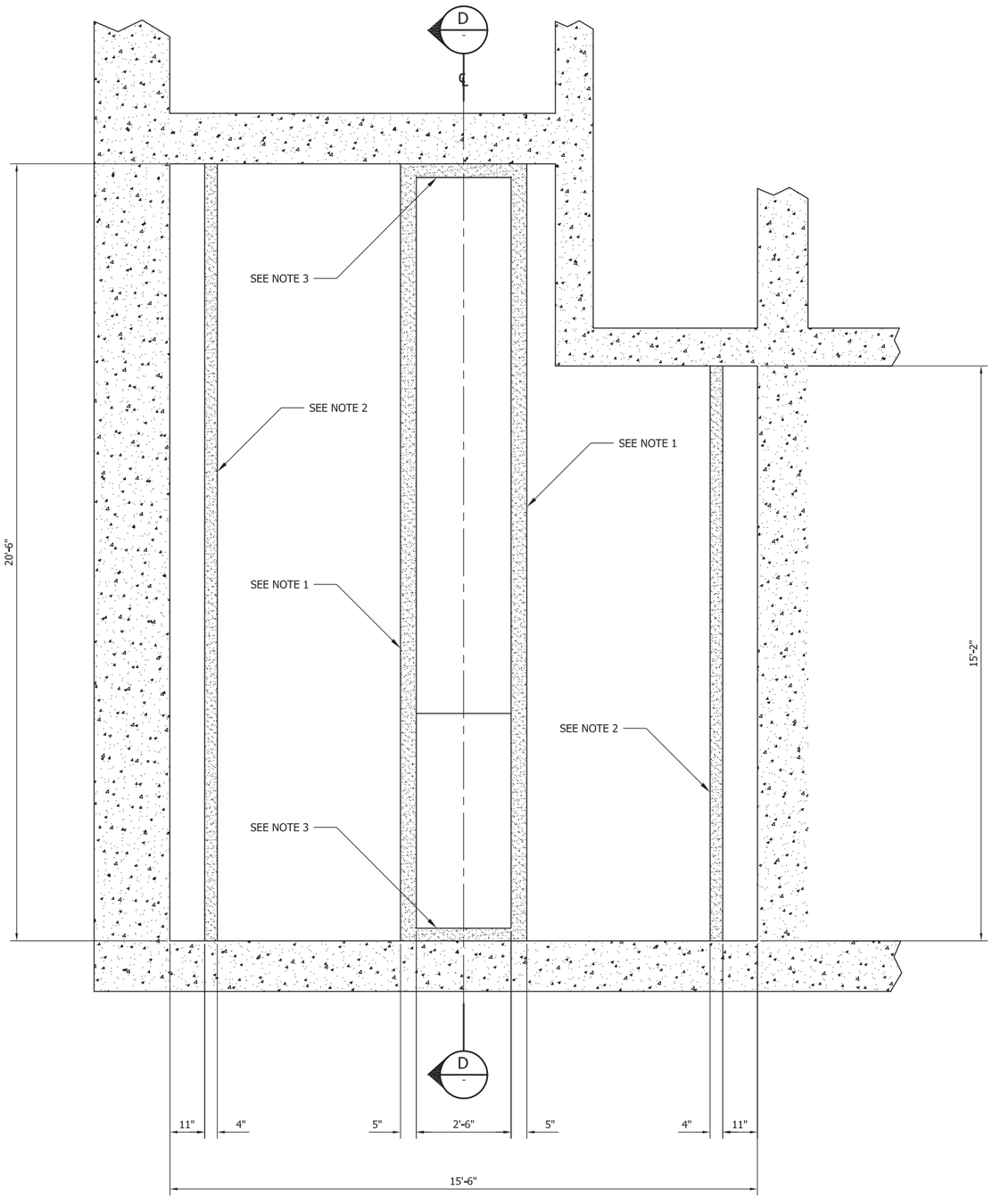
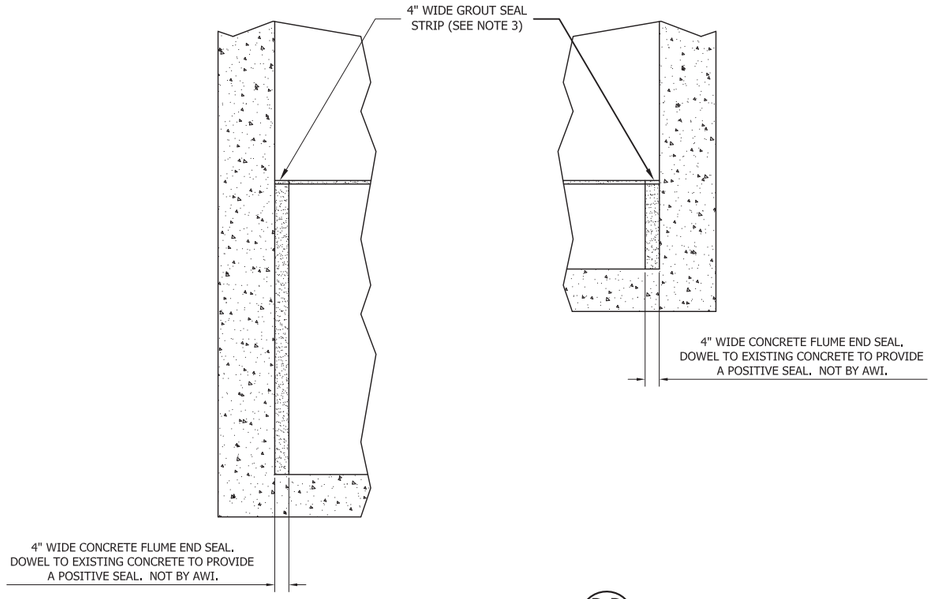
SCALE	NTS	SHEET	5 OF 8



PLAN VIEW - FILTER BASIN PREPARATION

(FILTER 1 @ EL. 1394.33')



SECTION D-D

NOTES:

1. 5" WIDE GROUT SEAL STRIP TO BE FORMED AND POURED THE ENTIRE LENGTH OF THE FLUME AS SHOWN. THE OVERALL GROUT STRIP THICKNESS TO BE DETERMINED BASED ON THE GROUT MANUFACTURER'S MINIMUM POUR REQUIREMENTS ABOVE THE HIGH POINT ELEVATION OF THE FILTER FLOOR. THE TOP SURFACE OF THE GROUT STRIP IS TO BE FINISHED TO A LEVEL WITHIN ± 1/8" END-TO-END AND ± 1/16" SIDE-TO-SIDE. GROUT STRIP NOT BY AWI.
2. 4" WIDE GROUT LEVELING STRIP TO BE FORMED AND POURED THE ENTIRE WIDTH OF THE BASIN AS SHOWN. THE OVERALL GROUT STRIP THICKNESS TO BE DETERMINED BASED ON THE GROUT MANUFACTURER'S MINIMUM POUR REQUIREMENTS ABOVE THE HIGH POINT ELEVATION OF THE FILTER FLOOR. THE TOP SURFACE OF THE GROUT STRIP IS TO BE FINISHED TO A LEVEL WITHIN ± 1/8" END-TO-END AND ± 1/16" SIDE-TO-SIDE. GROUT STRIP NOT BY AWI.
3. 4" WIDE GROUT SEAL STRIP TO BE FORMED AND POURED THE ENTIRE WIDTH OF THE FLUME AS SHOWN. THE OVERALL GROUT STRIP THICKNESS TO BE DETERMINED BASED ON THE GROUT MANUFACTURER'S MINIMUM POUR REQUIREMENTS ABOVE THE HIGH POINT ELEVATION OF THE FILTER FLOOR. THE TOP SURFACE OF THE GROUT STRIP IS TO BE FINISHED TO A LEVEL WITHIN ± 1/8" END-TO-END AND ± 1/16" SIDE-TO-SIDE. GROUT STRIP NOT BY AWI.
4. GROUT IS TO BE INSTALLED IN ACCORDANCE WITH MANUFACTURE'S SPECIFICATIONS.
5. GROUT IS TO BE FULLY BONDED TO EXISTING CONCRETE WITHOUT CRACKS OR DEFECTS.

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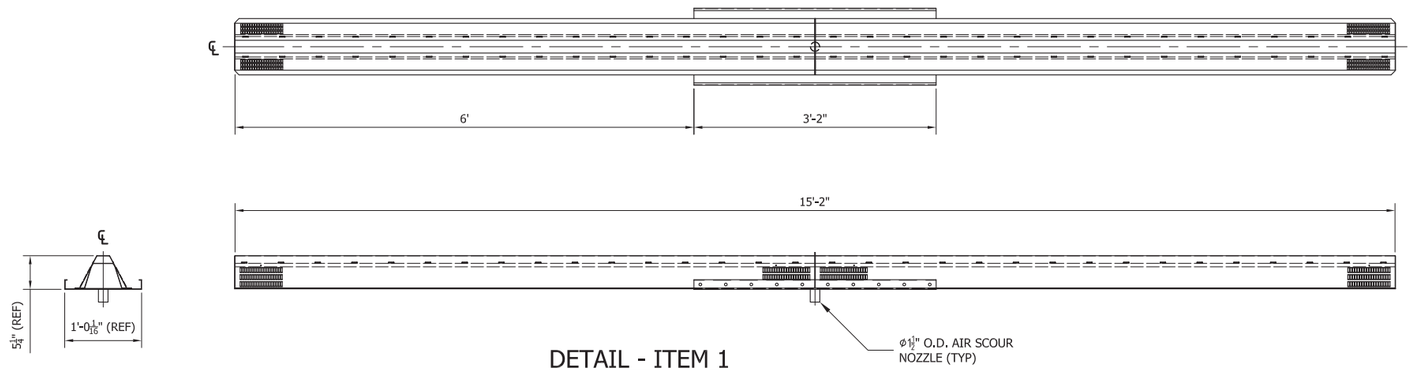
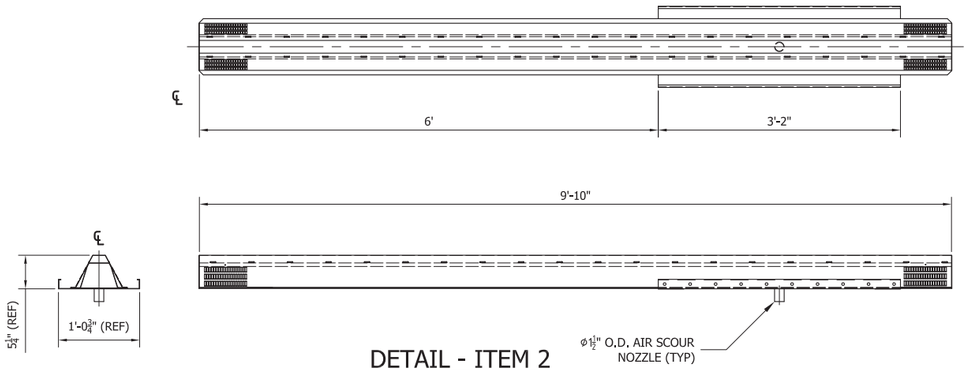
SIZE	CAGE CODE	DWG NO	REV
D	N/A	2328-GA-001	D
SCALE	NTS	SHEET	6 OF 8



DETAIL - ITEM 1



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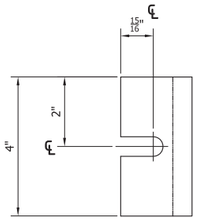

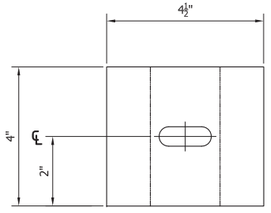

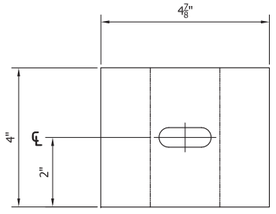

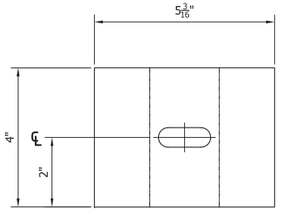

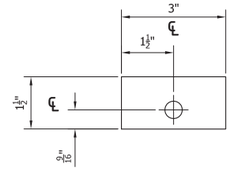

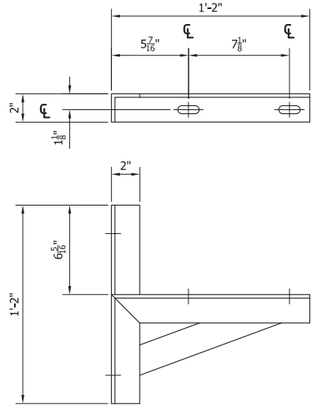

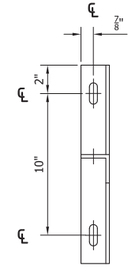

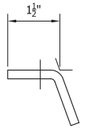

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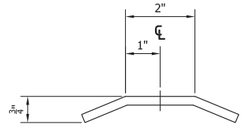

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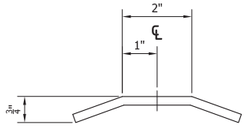

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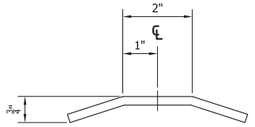
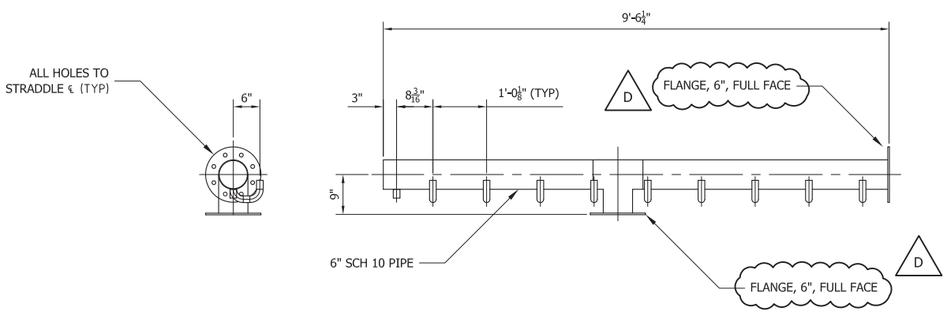


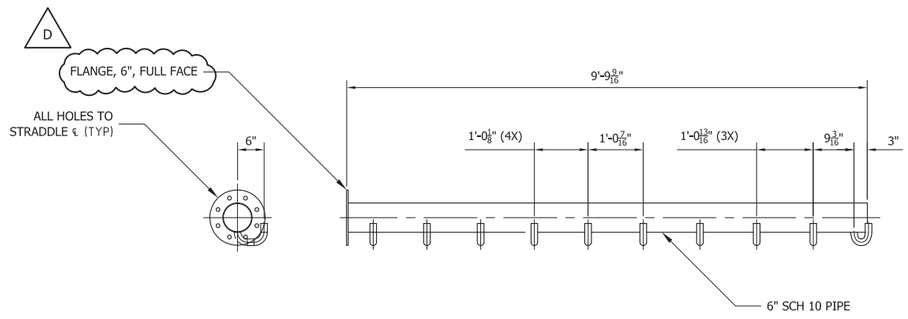
DETAIL - ITEM 6

DETAIL - ITEM 7

DETAIL - ITEM 10



DETAIL - ITEM 8



DETAIL - ITEM 9

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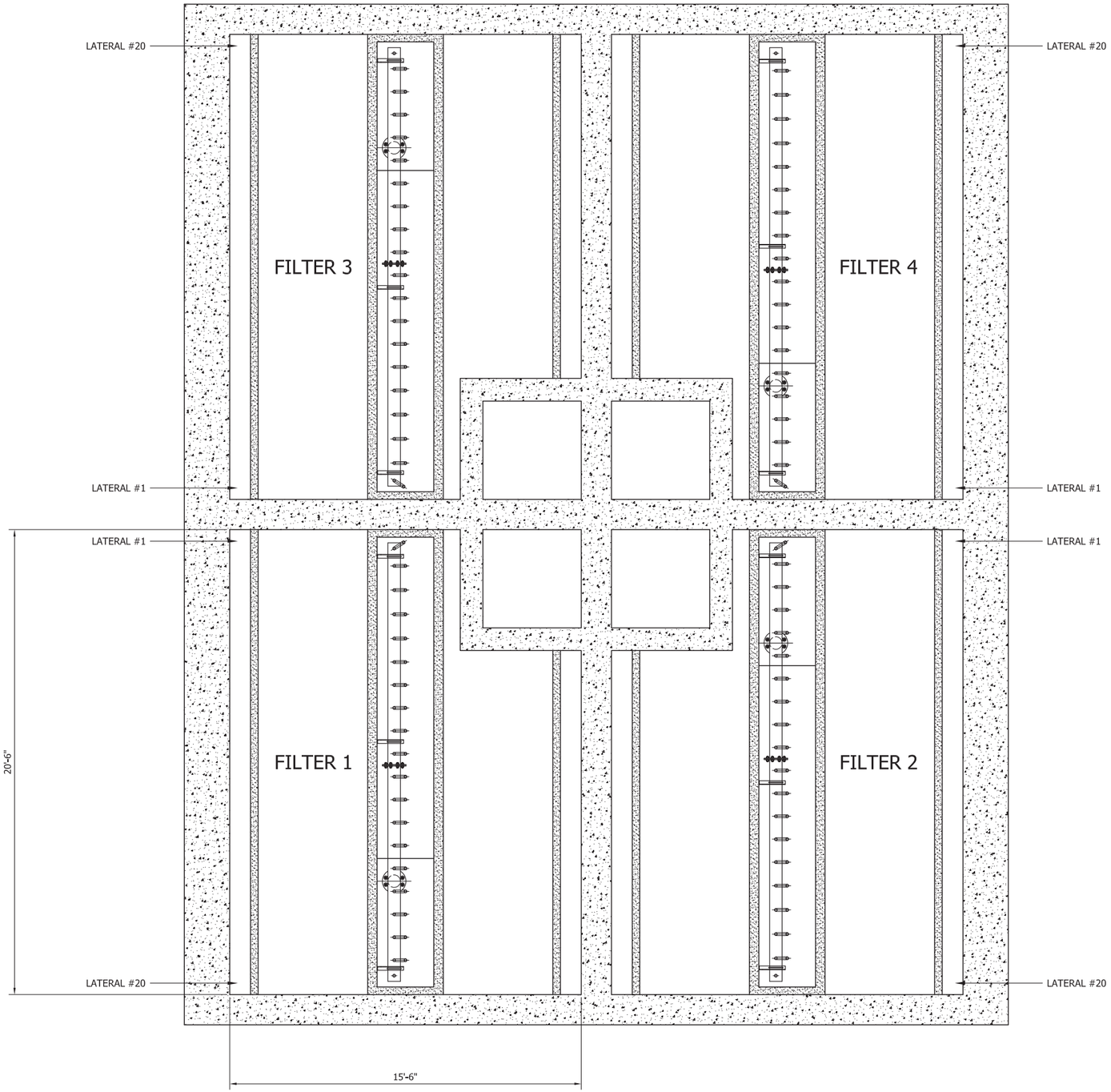
SIZE	CAGE CODE	DWG NO	REV
D	N/A	2328-GA-001	D
SCALE	NTS	SHEET	7 OF 8



FILTER LAYOUT

REVISED AS FINAL - 02/27/2018

SIZE	CAGE CODE	DWG NO	REV
D	N/A	2328-GA-001	D
SCALE	NTS	SHEET	8 OF 8

WARRANTY

The warranty offered by AWI for Phoenix Lateral Underdrain Systems is exceptional. In an industry where the typical warranty covers only the product and the cost associated with removing and reinstalling the product is left to the purchaser, AWI specifies a warranty that is far beyond what is typical. The AWI warranty includes:

- A term of 5 years
- AWI will remove and reinstall the media to gain access for repairs
- AWI will perform any needed demolition (with our attention to detail in design there is none)
- AWI will pay for any needed repairs or replacement of the filter underdrain laterals
- AWI will pay for any fasteners or appurtenances needed for reinstallation
- AWI will reinstall the underdrain laterals
- AWI will place the filter back in service

There is an interesting history behind this warranty and that history can be found in an AWI White Paper entitled “AWI Response at B.E. Payne WTP”.

Appendix A – The Phoenix Lateral Underdrain System Brochure

We Work With All FILTERS!

AWI

At AWI we focus on granular media water filtration. We have over thirty-five years of experience working with consulting engineers and water plant operators providing filter optimization solutions. We provide the technical expertise, products and services to improve water treatment processes for industrial, municipal water and waste-water treatment plants.

Potable Water Filters

Biologically Active Filters

Municipal / Industrial Wastewater Filters

Gravity Filters

Pressure Filters

Custom engineered to meet the design of the filter.

We modify **OUR** product to accommodate **YOUR** needs!

What Makes Our Products Different?

1. AWI's products are custom engineered
2. We have the lowest profile available
3. Product life cycle (40 Years and Counting)
4. Our products eliminate the need for gravel
5. The ability to run air scour and backwash simultaneously
6. Low installation cost
7. Our products hold a high residual value
8. Easy and low cost repairs

Product Chart

	New	Retro Fit	Municipal	Industrial
Phoenix™ Underdrain System - **Laterals**	✔	✔	✔	✔
Phoenix™ Underdrain System - **Panels**		✔	✔	✔
Phoenix™ Air Scour System		✔	✔	✔
Phoenix™ Backwash Troughs	✔	✔	✔	✔

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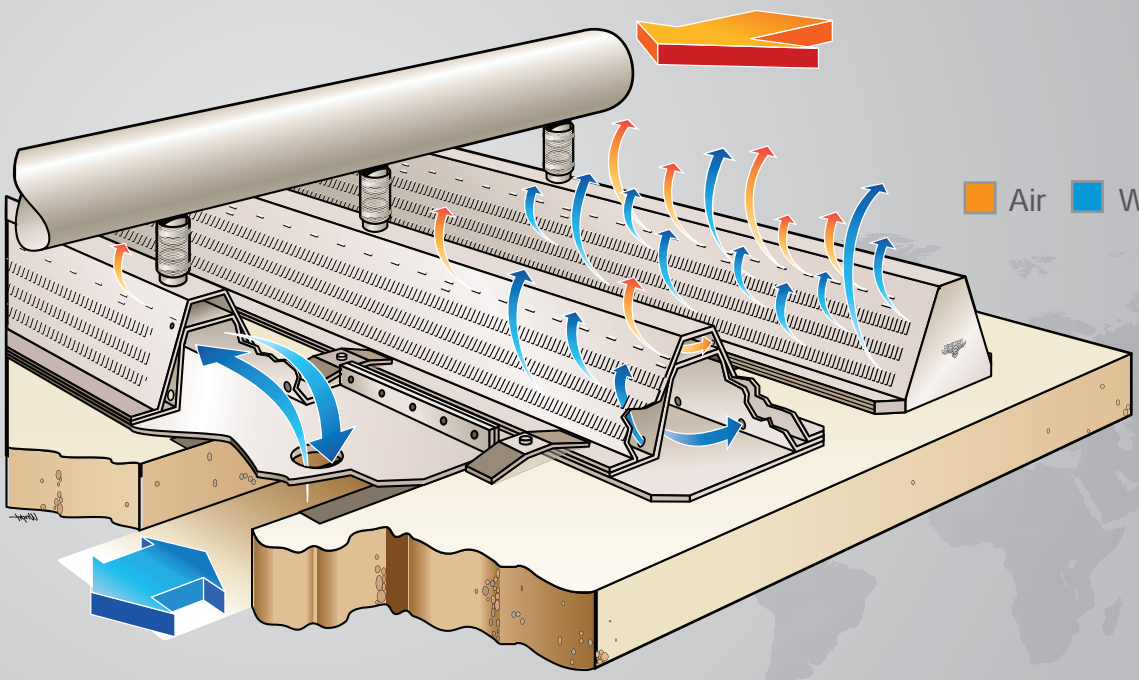
Sandy, UT 84070
Phone: 801-566-1700
Fax: 801-566-1722

Canada
4450 - 46 Avenue SE,
Calgary, Alberta T2B 3N7
Phone: 403.255.7377
Fax: 403-255-3129

Visit our website
www.awifilter.com

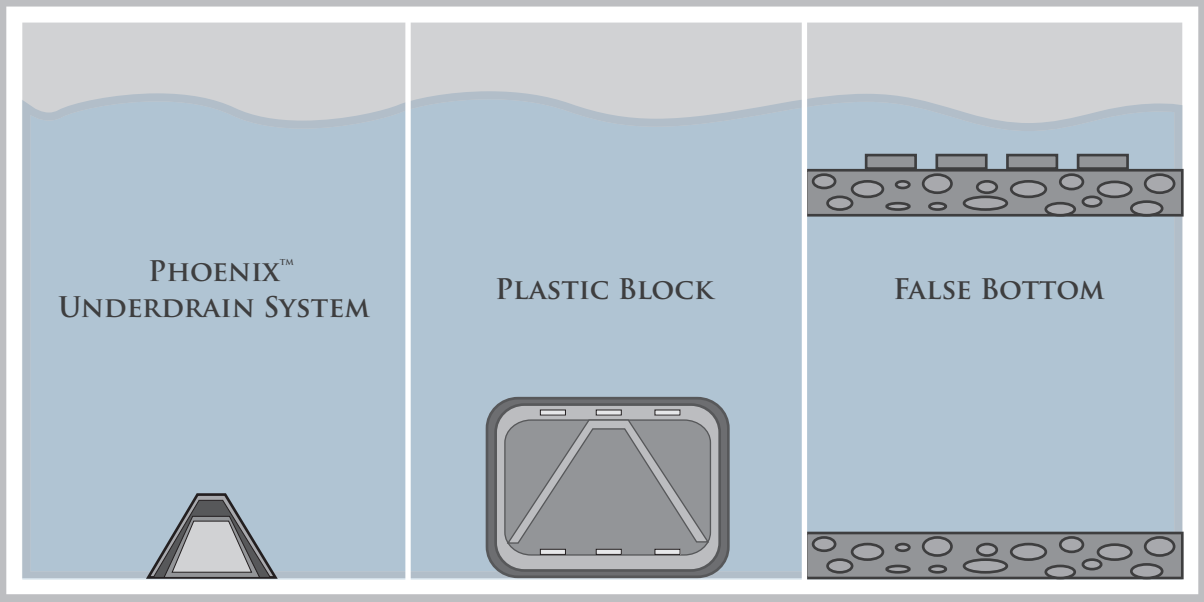
THE PHOENIX™ UNDERDRAIN SYSTEM
— LATERALS —



PHOENIX™ LATERALS

- Complete, custom designed underdrain system
- Guaranteed uniform distribution
- Rapid, low cost installation
- Integral air scour chamber
- Optimizes both gravity and pressure filter performance
- Durable stainless steel construction

— LOWEST PROFILE AVAILABLE —

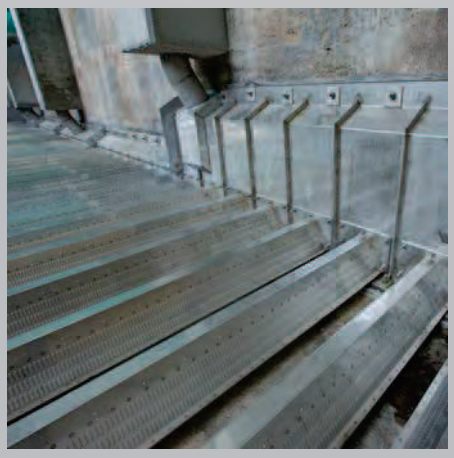


THE PHOENIX™ UNDERDRAIN SYSTEM

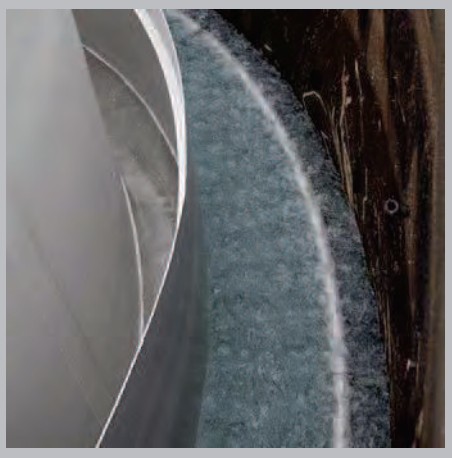
ONE SIZE DOES NOT FIT ALL!

To ensure uniform distribution, each Phoenix™ lateral component is tailored to existing filter conditions using AWI's proprietary hydraulic orifice sizing technique.

The Phoenix™ Underdrain is a complete system designed for all types of filters. Here is a typical gullet installation in a new filter with a 3 foot wide gullet. AWI is the only manufacturer that can accommodate a gullet width greater than 2 feet.



This filter retrofit feeds backwash water along the 50' wall. The custom designed feed box permitted the addition of more media than any other design, while distributing backwash water to the section of the feed wall that was not connected to the backwash supply.



This is a custom retrofit of an Aldrich unit. The retrofit increased the depth of the filter media and added air scour. The available filtration area was doubled.

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Appendix B – AWI Response at B.E. Payne WTP

AWI
RESPONSE AT THE B.E. PAYNE WTP

An AWI Filter Underdrain System at Louisville's B.E. Payne WTP composed of underdrain laterals fed from a feedbox installed at one end of each filter encountered a problem - filter media was discovered in the backwash circuit. The underdrain system had been in operation for roughly five years when a call was placed to AWI seeking help in figuring out why filter media was appearing where it should not be.

THE PROBLEM

AWI Senior Process Engineer, Tad Bassett, immediately flew to the site and began an evaluation. The conclusion from his evaluation was that during assembly when the underdrain laterals were bolted to the feedbox, the gasket between the laterals and the feedbox was displaced as the laterals were maneuvered into position for attachment. The gasket was displaced at the narrowest point of gasket contact and compression such that the edge of the gasket projected into the path of the backwash water as it flowed down the lateral. Over time more of the gasket was pulled into the path of flow and the gasket material eroded. The result was a space between the lateral and the mating surface on the feedbox through which media could pass compromising the underdrain system.

THE SOLUTION

Following examination of the underdrain laterals with eroded gaskets, AWI concluded that no one knew for certain that other laterals would not experience a similar problem at the lateral to feedbox connection. Because of that uncertainty, AWI replaced not just the problematical gaskets but all of the lateral to feedbox gaskets throughout the facility. Replacement of those gaskets was done by AWI without passing the cost along to the Owner despite the fact that the repairs were made years after the conclusion of the warranty for the underdrain system.

The lateral to feedbox connection which caused problems at B.E. Payne WTP had been made successfully for laterals at literally hundreds of filter underdrain installations prior to this installation. Rather than arguing the point, AWI took the approach of developing a connection between the lateral and feedbox making it easier for any installing contractor to install correctly.

Two changes were made to the lateral to feedbox connection to simplify the process of making the connection properly:

1. Rather than welding nuts to the back side of the feedbox into which connecting bolts had to be threaded during installation, threaded studs were welded onto the feedbox. This change meant that the gasket can be slid over the studs and properly positioned before the lateral connection is made.
2. Two quarter inch gaskets are used at each lateral to feedbox connection to provide a gasket thickness which insures proper compression when the connection is made. The narrow portion of the gaskets at the bottom of the lateral to feedbox connection is now held in place using a retainer clip to both add extra compression to the gaskets and provide a lip that precludes the gasket ever sliding into the path of the backwash flow.

Figure 1 provides perspective on how the lateral to feedbox connection is now made. In the years since this connection was changed, the gasket problem that surfaced at the B.E. Payne WTP has not reappeared.

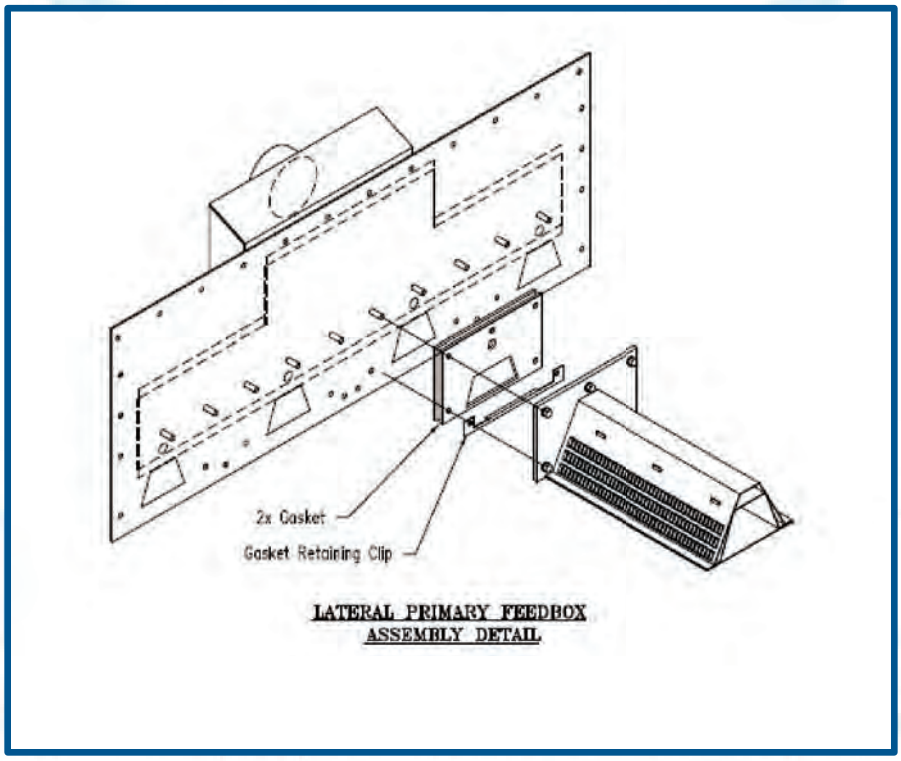

Figure 1 – Exploded view of the current AWI lateral to feedbox connection.

Figure 2 is a view of the gasket retaining clip and the photos in Figure 3 show a clip prior to installation.

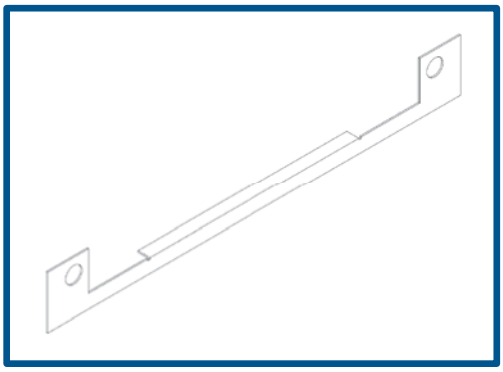

Figure 2 – Close-up drawing of the gasket retaining clip with lip.

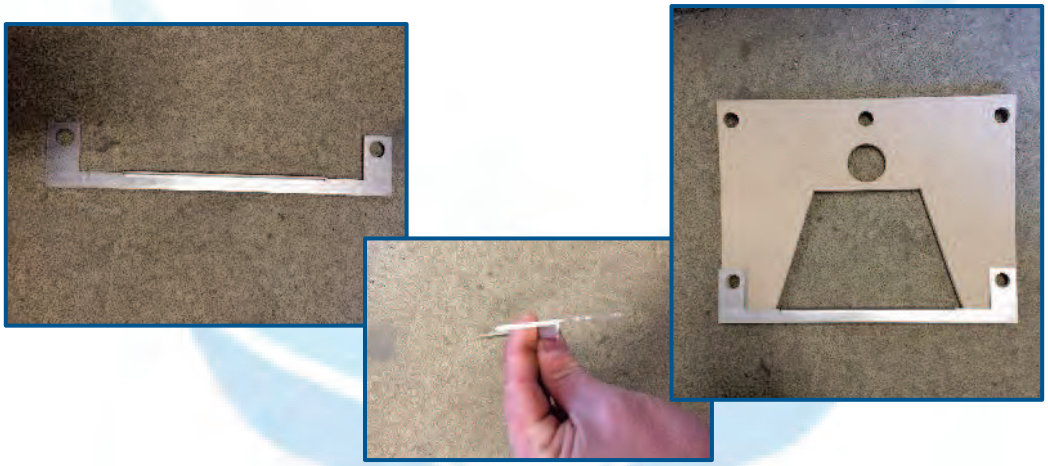

Figure 3 – Close-up view of a gasket retaining clip with lip prior to installation.

LESSON LEARNED

A substantial portion of the business done by AWI is replacement of problematical filter underdrains supplied by others. Filter underdrain failures are far from uncommon – just open an internet browser, bring up the Google Search Engine, and type in the words "Filter Underdrain Failure". The result will provide perspective regarding the reliability of some filter underdrain designs.

The AWI experience at B.E. Payne WTP was instructive in that AWI learned the value of a long term commitment to customers in today's business environment. Repairing the filter underdrains at B.E. Payne WTP without cost to the Owner despite the fact that the underdrains supplied by AWI were well out of warranty and the problem was with a connection that had been made successfully thousands of times in the past was a good business decision. The staff at B.E. Payne WTP and others involved have been very gracious in sharing the story of how AWI has stood behind its product.

A key element that led to a successful outcome at B.E. Payne WTP is an AWI Filter Underdrain design that can be repaired at a cost which is relatively modest when compared to grouted in place alternatives or, even worse, a legal challenge. Any problem with an AWI Filter Underdrain can be dealt with using a shovel, wrench, and torque wrench rather than having to jackhammer out the filter underdrains and start all over. This is significant because AWI has repeatedly helped to deal with problems that were clearly not the responsibility of AWI – things like peeling paint on a gullet wall that plugged the underdrain laterals or contaminated backwash water that caused similar problems. In each case, what could have been a disaster became a very manageable issue because the underdrain laterals could readily be removed, cleaned, and put back into service at modest cost.

THE AWI RESPONSE

Long term customer relationships have clearly benefitted AWI through positive word of mouth comments from existing customers and repeat business. Experience at B.E. Payne WTP helped to crystallize in everyone's mind at AWI the value of long term customer support. Our challenge is how to put this value into words.

B.E. Payne WTP taught us that problems don't always surface within the customary one year warranty period. We also learned that AWI benefits from supporting the customer well after a one year warranty has expired. AWI is going to support its customers even though a warranty has expired – it's good business. Perhaps just as important is a clear understanding of who is responsible. In the case of B.E. Payne WTP, installation of the gaskets was done improperly by the installing contractor but arguing that the contractor should bear the cost of repairs would have dramatically delayed addressing the customer's problem. The conclusion that AWI reached is that we must take great care in supervising the installation of our filter underdrains and be prepared to assume responsibility for their installation once we have signed off that the installation work was done properly. The result is a single source of responsibility for the customer and AWI is willing to assume that responsibility.

From the perspective of a customer, good intentions are fine but the ultimate question is what kind of binding commitment is a company willing to make to its customers? At AWI, we want to address that question in a very positive fashion. We now provide our customers with a written five year warranty covering both the filter underdrains as a product and the contractor's installation of those underdrains once we have signed off that the installation has been accomplished in accordance with our instructions. The result is the five year warranty language shown in the attachment that follows. We encourage customers to include this warranty their project specifications. If we are going to stand behind our product and support customers on a long term basis, we feel that customers should have that commitment in writing so they know they will be supported over the long haul. The AWI warranty is our strong statement that we will support our customers.

AWI WARRANTY

3.04 FILTER UNDERDRAIN WARRANTY

A. The filter underdrain manufacturer's warranty will extend for a period of five (5) years from the date that the document certifying that the filter underdrains are properly installed is signed. The filter underdrain warranty will cover the cost of the following items:

- Repair or replacement of any failed filter underdrains, fasteners, and appurtenances supplied by the filter underdrain manufacturer.
- Any movement or removal of filter media necessary to effect needed repairs.
- Removal of any filter underdrain components and appurtenances which have failed to provide proper service including any required demolition.
- Reinstallation of repaired or replaced filter underdrains.
- Reinstallation of any filter media removed for the purpose of the covered warranty work.

B. The filter underdrain manufacturer will guarantee the structural integrity of the filter underdrains and underdrain system when that system is subjected to operating differential pressures up to 10 psi as measured in the feed piping which supplies backwash water to the filter underdrains. (This statement means that with all of the media retention shots plugged a static head of 23 feet can be applied to the filter underdrain system without said system sustaining damage.) This guarantee does not apply to damage caused by water hammer events because water hammer is a function of system hydraulic characteristics which are beyond the control of AWI.

C. The filter underdrain manufacturer is not responsible for the concrete upon which the filter underdrains are installed under the terms of this warranty. The filter underdrain manufacturer will not be responsible if contaminated backwash water causes the underdrains to plug resulting in differential pressures exceeding 10 psi. System operating pressures within the filter underdrains will be continuously monitored and recorded by the user.

D. The filter underdrain manufacturer will pay the cost of all warranty related repairs and the Owner will not be required to pay for any of the warranty-related activities identified in this warranty statement. The Owner will be responsible for providing a nearby laydown area for the storage of filter media removed during any warranty related activities as well as any utilities required to perform the warranty work.

Appendix C – You Mean You Can Fix It?

YOU MEAN YOU CAN FIX IT?

Historically, problems with granular media filter underdrains meant incurring major costs and major disruptions in treatment plant operations. Whether underdrain failure is sudden and catastrophic or gradual, starting out with some filter media showing up in a clearwell, in most cases a simple repair is not an option. Because of the way in which most filter underdrain systems are designed and constructed, underdrain installation is most often monolithic and permanent. In that case "repair" means that the underdrain system must be jackhammered out of the filter and a new underdrain system must be constructed.

In contrast to underdrain systems constructed from poured-in-place concrete or grouted-in-place blocks, AWI Phoenix Underdrain Systems are bolted together. In fact, AWI Underdrain Systems are carefully designed so that what has been bolted together can be unbolted making fast and relatively easy repairs possible. Having built its business primarily upon replacing filter underdrain systems supplied by others that have met an untimely demise for one reason or another, AWI has understood since its founding that producing a filter underdrain system that is fixable is much preferred to reaching for a jackhammer.

Almost always, AWI Underdrain Systems get installed with ease - the filters are started up and placed into service without a hitch under the watchful eye of AWI Installation Supervisors. Over time, we almost become complacent but every once in a while a project makes us truly appreciate the advantage of having a filter underdrain system designed to be worked on rather one that has to be demolished so that you can have the pleasure of starting over. Birmingham Water Works' Western Filter Plant is a case in point.

WESTERN FILTER PLANT

Birmingham Water Works operates four water treatment facilities producing an average of 100 million gallons of treated potable water per day and the Western Filter Plant is one of them. Each of the water treatment facilities uses a traditional flowsheet for surface water treatment including:

- Raw Water Intake
- Chemical Addition
- Rapid Mixing
- Coagulation and Flocculation
- Sedimentation
- Granular Media Filtration
- Disinfection

The Western Filter Plant has three generations of filters including:

- Filters 1 through 4 – filters have two cells each – dimensions of each cell are 14 feet 8 inches x 30 feet
- Filters 5 through 8 – filters have a single cell – dimensions are 18 feet x 29 feet 6 inches
- Filters 9 through 16 – filters have a single cell – dimensions are 21' x 29' 6 inches

THE PROBLEM

The filters that proved to be problematical during construction were from the third generation – Filters 9 through 16 – they were Filters 11; 13; and 15. These filters are fed through a bullnose (end) gullet. The compromised filter underdrains that were jackhammered out of the filters during construction were clay tile blocks. Removal of the clay tile underdrains allowed air scour to be retrofitted into the existing filters by running an air header in the gullet.

The AWI Underdrain System was installed as designed by the consulting engineer and the installation went smoothly based upon solid work by the contractor coupled with close supervision by AWI.

Work on three filters was completed and everyone thought they were ready for testing prior to being placed into service. To the horror of the consulting engineer, contractor, and AWI Installation Supervisor, the paint system that was used to cover the concrete in the filters and in particular in the filter gullets then began to blister and peel just as the filters were declared ready for testing. Because installation of the filter underdrains was complete, there was no access to the filter gullets for removal of the defective paint system.

THE FIX

Everyone involved in the Western Filter Plant project understood the nature of the project and the remedial action that needed to be taken. The key to accomplishing that remedial action was quick

removal of the AWI Underdrain System by unbolting the underdrain laterals to allow access to the filter gullets. Once the filter gullets were accessible, the coating system was removed from the filter gullets and they were not recoated (based upon this experience and others, AWI now recommends that filter gullets not be coated). The AWI Underdrain System was then reinstalled and the only cost apart from labor was some gasket material and sealant that needed to be replaced during the reinstallation of the underdrain laterals.

Had a false floor or block underdrain system been installed at the Western Filter Plant, failure of the coating system in the gullet would have produced catastrophic results. Under these circumstances, any filter underdrain system that was monolithically poured or grouted in place would have needed to be completely demolished and then reinstalled with all new components. Luckily, that was not the case at the Western Filter Plant.

THE WARRANTY

Over the course of many years and many, many installations, AWI has seen numerous reasons for compromised underdrain systems including not only failed coating systems but also:

- Material in the clearwell from which backwash water is drawn
- Construction debris in backwash circuit piping
- Earthquakes
- Dropping a heavy object on the filter underdrain system from a crane
- A filter sitting empty and having accumulated growth in the backwash circuit slough

Having seen all of these modes of failure, AWI Installation Supervisors take great care to make sure that the source of backwash water is clean and the backwash circuit has been cleared of any debris when commissioning a filter. Nonetheless, failures can occur – just open Google as your browser and search on the words “filter underdrain failure” to see a litany of woe.

Having a problem with a filter underdrain system will always be painful; however, knowing that a problem can be dealt with by moving aside some media and unbolting laterals rather than reaching for a jackhammer is comforting. As we say during presentations for AWI Underdrain Systems:

YOU MEAN YOU CAN FIX IT?

In fact ease of repair when dealing with AWI Underdrain Systems coupled with demonstrated reliability that is unparalleled in the industry are the reasons why AWI can offer its unique 5 year comprehensive warranty. You may want to ask about that warranty!

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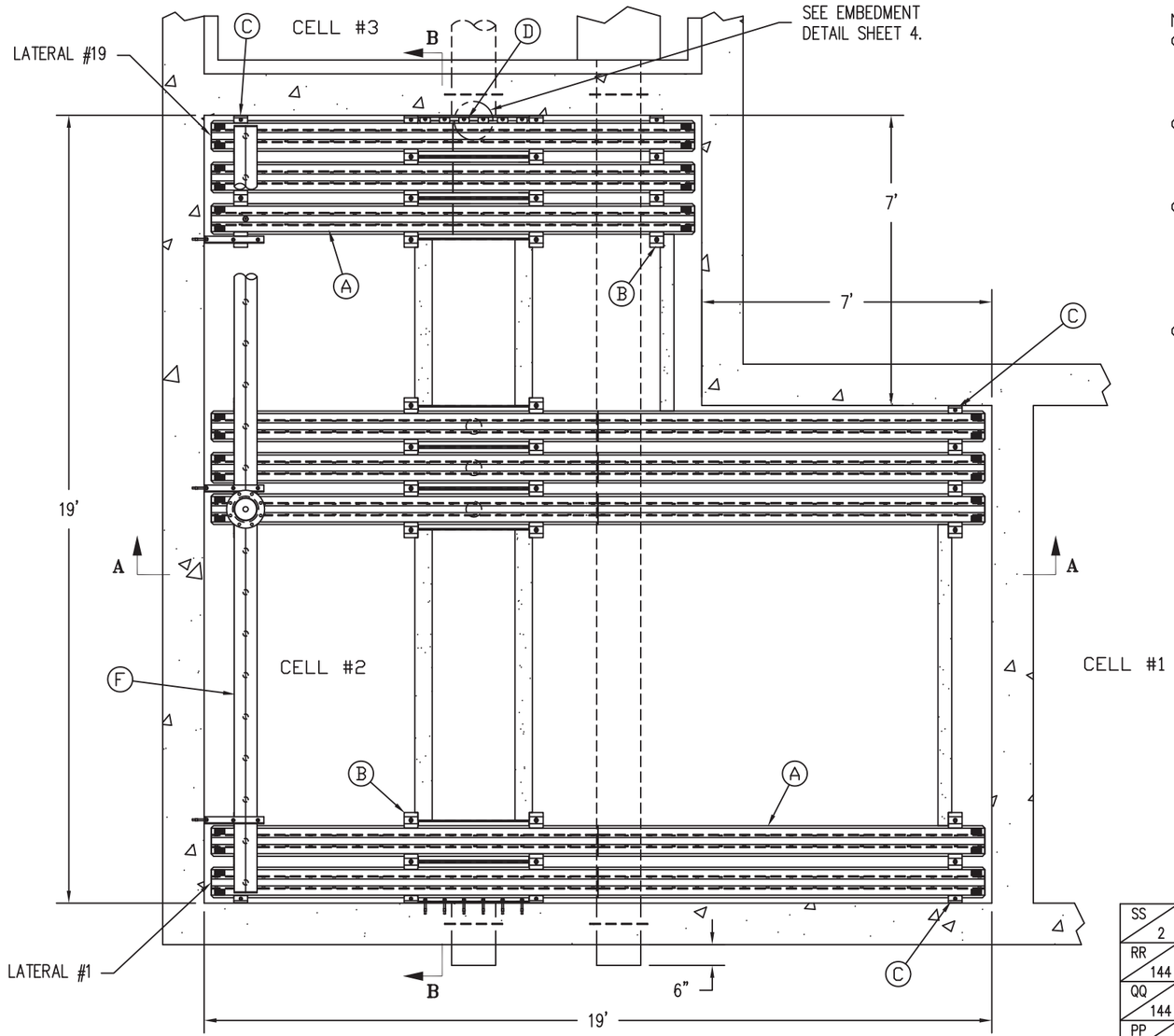


PLAN VIEW
TROUGHS NOT SHOWN

NOTES:
(1) ALL COMPONENTS SUPPLIED BY AWI TO BE 304L STAINLESS STEEL UNLESS OTHERWISE NOTED.

(2) QUANTITY ON BILL OF MATERIAL REFLECTS 1 FILTER CELL ONLY. AWI TO SUPPLY COMPONENTS FOR 6 FILTER CELLS.

(3) MAXIMUM INTERNAL PRESSURE WITHIN UNDERDRAIN SYSTEM DURING BACKWASH OF FILTER BASIN NOT TO EXCEED 10 PSIG. OPERATION OF FILTERS ABOVE 10 PSIG VOIDS AWI WARRANTY.

(4) INSTALLATION TO BE IN ACCORDANCE WITH AWI INSTALLATION, OPERATION AND MAINTENANCE MANUAL.

FINAL
4/21/15

REV	REVISION DESCRIPTION
DATE	
A	CORRECTED VIEWS, ADDED ITEM SS, CHANGED QTY. ITEM S
4/20/15	ADDED TROUGH ELEVATIONS

ITEM / REQ'D	MATERIAL DESCRIPTION	NOMINAL SIZE / DWG REF
DD / 108	HEX NUT, 1/4–20NC, STAINLESS STEEL 304	
CC / 108	1/4" HELICAL SPRING LOCK WASHER STAINLESS STEEL 304	
BB / 216	1/4" FLAT WASHER, STAINLESS STEEL 304	
AA / 108	BOLT, HEX HEAD, 1/4–20NC X 3/4" LONG STAINLESS STEEL 304	
Z / 145	HEX NUT, 1/2–13NC, STAINLESS STEEL 304	
Y / 189	1/2" HELICAL SPRING LOCK WASHERS STAINLESS STEEL 304	
X / 198	1/2" FLAT WASHERS, STAINLESS STEEL 304	
W / 53	BOLT, HEX HEAD, 1/2–13NC X 1 1/2" LONG STAINLESS STEEL 304L	
V / 86	THREADED ANCHOR RODS, 1/2–13 THREAD STAINLESS STEEL 304L	7 1/2" LONG
U / 4	WEIR PLATE, BACK WASH TROUGH SHORT 2 SHOWN AND 2 OPPOSITE	
T / 8	WEIR PLATE, BACK WASH TROUGH LONG 4 SHOWN AND 4 OPPOSITE	
S / 4	BACKWASH TROUGH WALL BRACKET	
R / 1	COLLECTION TROUGH WALL BRACKET, SIDE	
Q / 1	COLLECTION TROUGH WALL BRACKET, LOWER	
P / 2	TROUGH SUPPORT BEAM, WALL BRACKETS	
N / 1	BACKWASH TROUGH SUPPORT BEAM	
M / 1	BACKWASH TROUGH SHORT, 15" X 17" X 13'	
L / 2	BACKWASH TROUGH LONG, 15" X 17" X 18'	
K / 1	COLLECTION TROUGH, 18" X 23 3/8"" X 13'	
J / 19	HOSE, 1 1/2" I.D. X 1/4" WALL, NYLON REINFORCED PVC W/GEAR CLAMPS	10 1/4" LONG
H / 3	U–BOLT, 6" PIPE SIZE, 1/2–13 THREADS STAINLESS STEEL 304L	
G / 3	AIR SCOUR SUPPORT BRACKET 2" X 2" X 1/4" THK. ANGLE, STAINLESS STEEL 304L	
F / 1	AIR SCOUR MANIFOLD, 6" SCH 10 PIPE A312–304L STAINLESS STEEL	
E / 6	HOLD DOWN CLAMP WALL SEAL	
D / 6	HOLD DOWN CLAMP FLUME END	
C / 9	HOLD DOWN CLAMP FILTER EDGE	
B / 71	HOLD DOWN CLAMP STANDARD	
A / 19	PHOENIX LATERALS (VARIOUS LENGTHS)	
SS / 2	BACKWASH TROUGH WALL BRACKET, SHORT TROUGH	
RR / 144	HEX NUT, 3/8–16NX STAINLESS STEEL 304	
QQ / 144	3/8" HELICAL SPRING LOCK WASHER STAINLESS STEEL 304	
PP / 288	3/8" FLAT WASHER STAINLESS STEEL 304	
NN / 144	BOLT, HEX HEAD, 3/8–16 X 1 1/4" LONG STAINLESS STEEL 304	
MM / A/R	SIKA 1A SEALANT	
LL / A/R	HILTI HY–200 ANCHOR ADHESIVE	
KK / A/R	SHIMS, HPDE, VARIOUS THICKNESS	
JJ / 6	WEIR SPLICE PLATE	
HH / 2	GASKET, 1/8" THICK, OPEN CELL NATURAL RUBBER PRECUT, TROUGH BOLT FLANGE	
GG / 18	GASKET, 1/8" THICK, OPEN CELL NATURAL RUBBER PRECUT, LATERAL SEAL PLATE	
FF / A/R	GASKET, 3/8" THICK X 4" WIDE, OPEN CELL NATURAL RUBBER PROVIDED IN STRIPS	
EE / 44	1/2–13NC WEDGE ANCHOR, STAINLESS STEEL 304	4 1/2" LONG

DRAWN	COLE C.
DATE	2/25/15
SCALE	DO NOT SCALE
CHK'D	
APP'D	

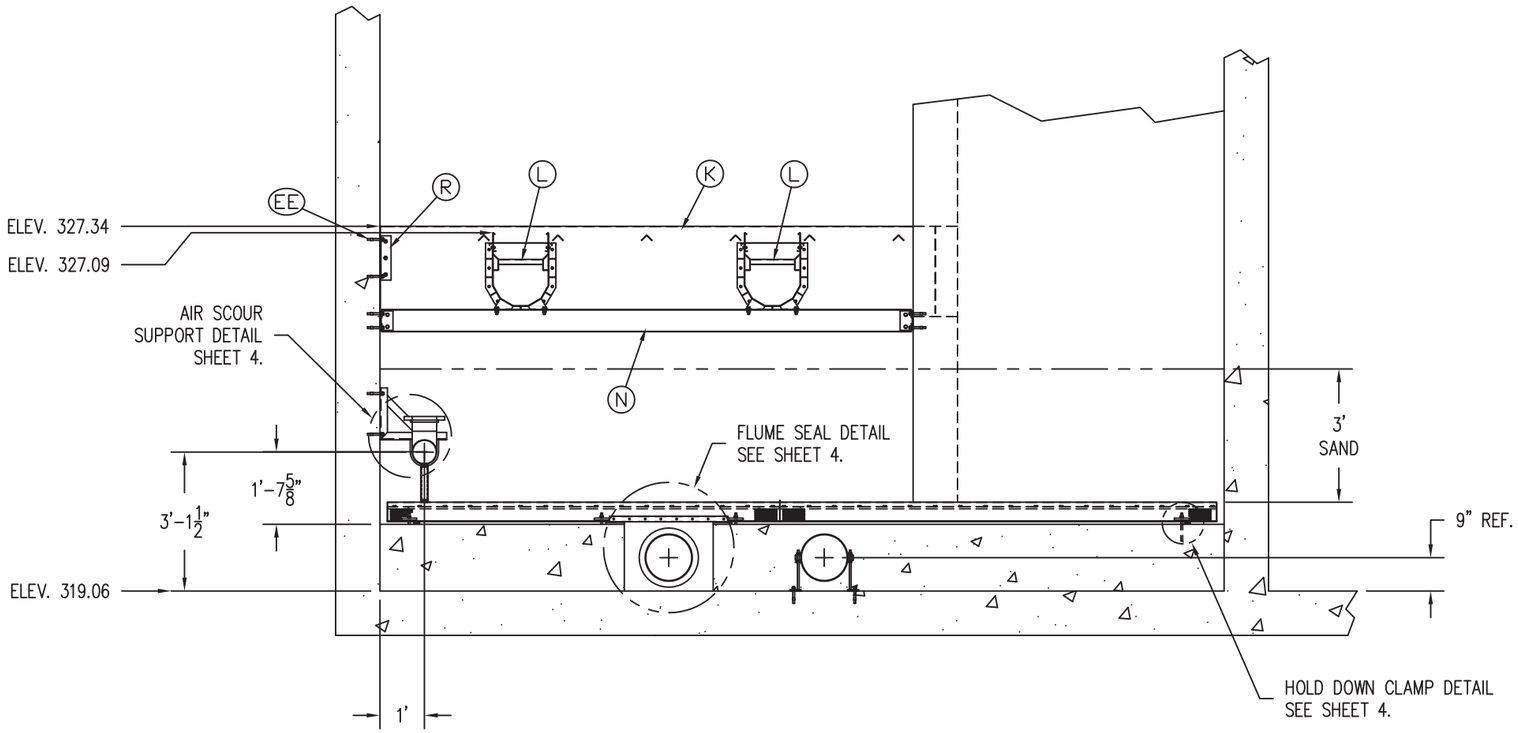
PHOENIX UNDERDRAIN GERNERAL ARRANGEMENT
FILTERS #1, #2, #6, #5, #10 AND #9
DOMTAR PAPER WTP

CUSTOMER: FLSMIDTH

SHOP ORDER:
REVISION: A

ANTHRATECH U.S. INC.
479 WEST UNIVERSAL CIRCLE
SANDY, UTAH
84070

DWG. 900437A
SHEET 1 OF 8



SECTION A-A

FINAL

4/21/15

DRAWN	COLE C.
DATE	3/12/15
SCALE	DO NOT SCALE
CHK'D	
APP'D	

SECTION A-A
FILTERS #1, #2, #6, #5, #10 AND #9
DOMTAR PAPER WTP

CUSTOMER: FLSMIDTH
SHOP ORDER:
REVISION: A

ANTHRATECH U.S. INC.
479 WEST UNIVERSAL CIRCLE
SANDY, UTAH
84070

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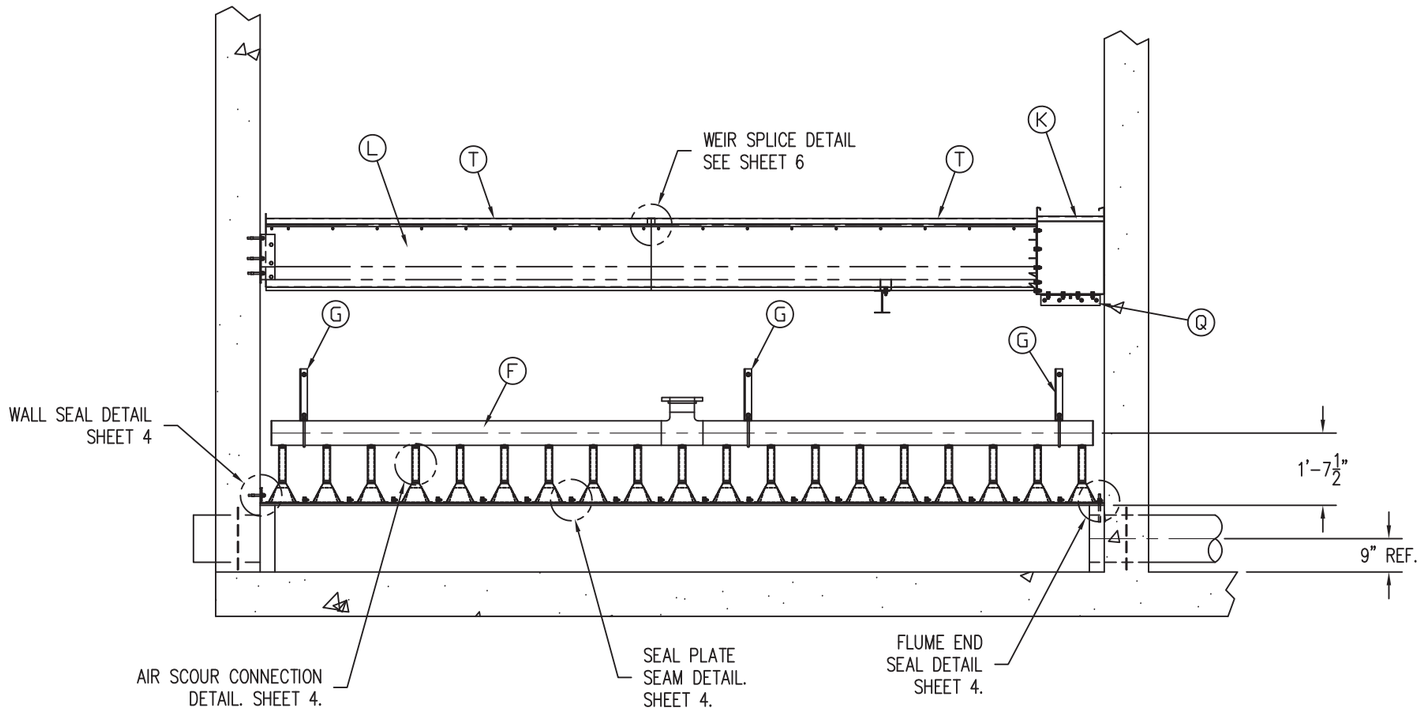
SHEET 2 OF 8



SECTION B-B

FINAL

4/21/15

DRAWN	COLE C.
DATE	3/12/15
SCALE	DO NOT SCALE
CHK'D	
APP'D	

SECTION B-B
FILTERS #1, #2, #6, #5, #10 AND #9
DOMTAR PAPER WTP

CUSTOMER: FLSMIDTH

SHOP ORDER:

REVISION: A

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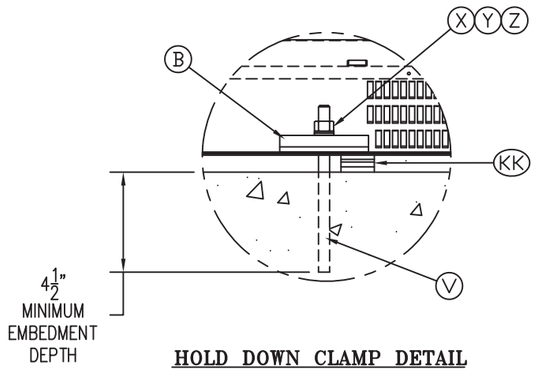
DWG. 900437A



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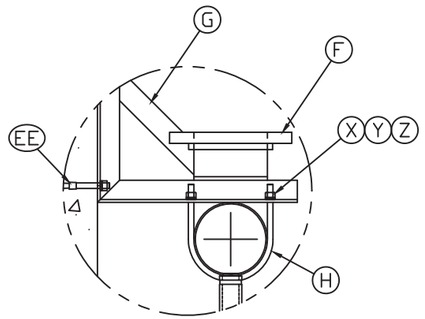

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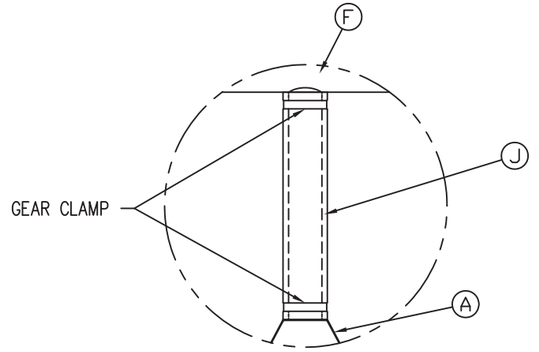
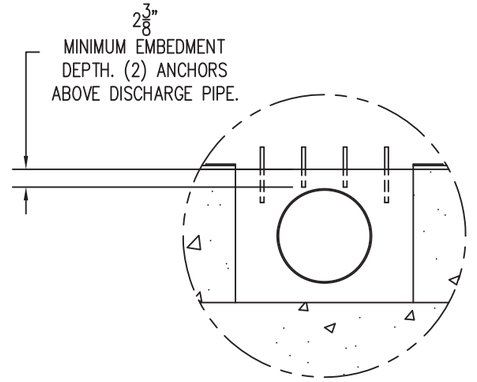


AIR SCOUR CONNECTION DETAIL



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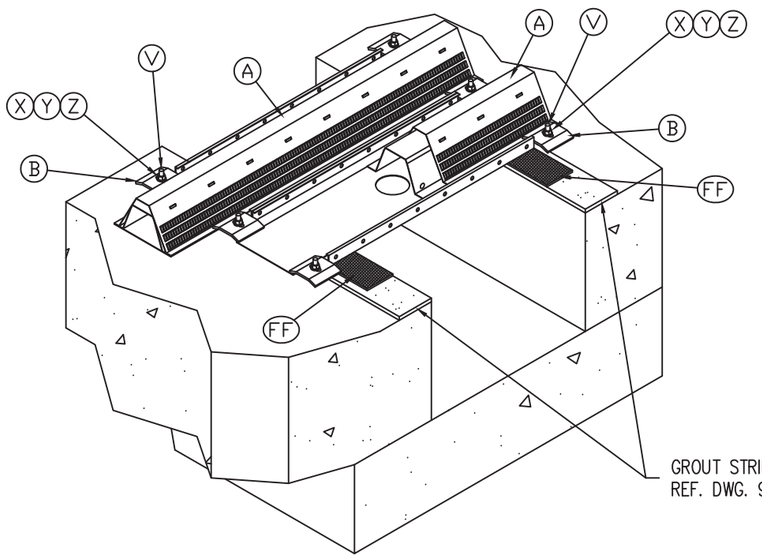

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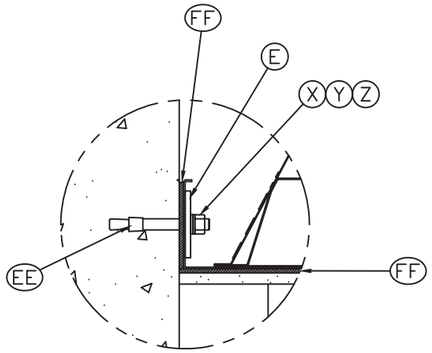

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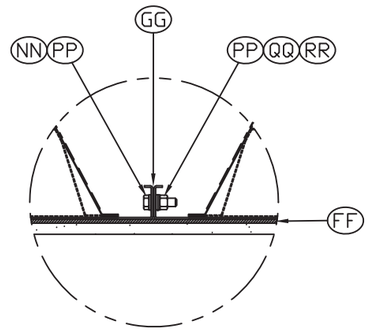

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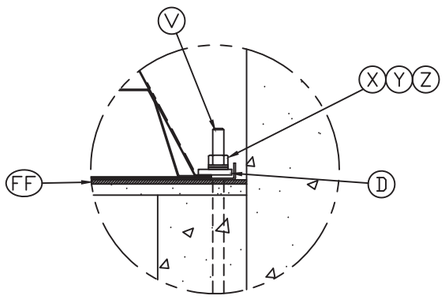

FLUME END SEAL DETAIL

FINAL

4/21/15

DRAWN	COLE C.
DATE	3/12/15
SCALE	DO NOT SCALE
CHK'D	
APP'D	

UNDERDRAIN DETAILS
FILTERS #1, #2, #6, #5, #10 AND #9
DOMTAR PAPER WTP

CUSTOMER: FLSMIDTH
SHOP ORDER:
REVISION: A

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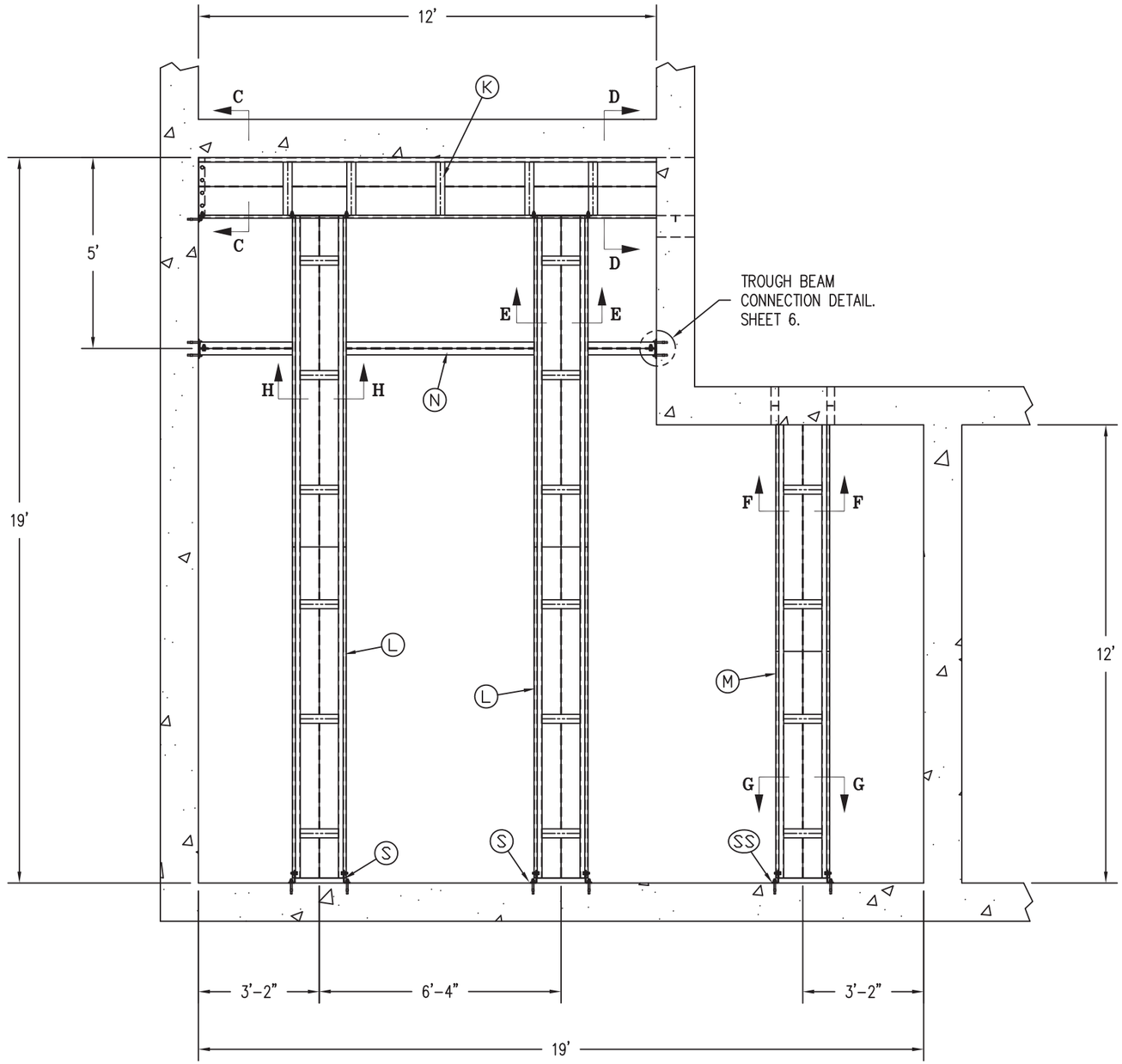
479 WEST UNIVERSAL CIRCLE
SANDY, UTAH
84070

DWG. 900437A
SHEET 4 OF 8



PLAN VIEW

FINAL
4/21/15

DRAWN	COLE C.
DATE	3/5/15
SCALE	DO NOT SCALE
CHK'D	
APP'D	

TROUGH LAYOUT
FILTERS #1, #2, #6, #5, #10 AND #9
DOMTAR PAPER WTP

CUSTOMER: FLSMIDTH

SHOP ORDER:

REVISION: A

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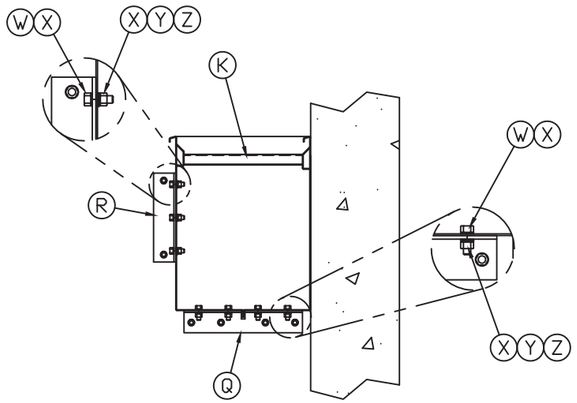
SANDY, UTAH
84070

DWG. 900437A
SHEET 5 OF 8



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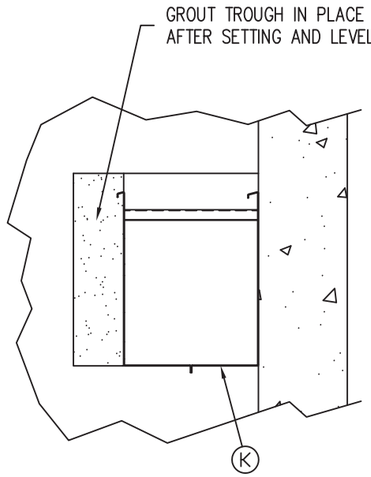

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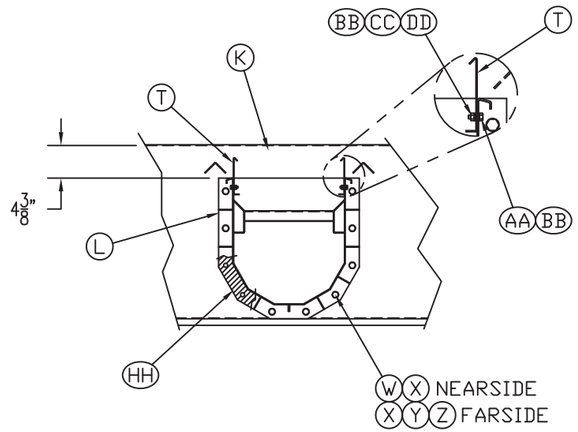

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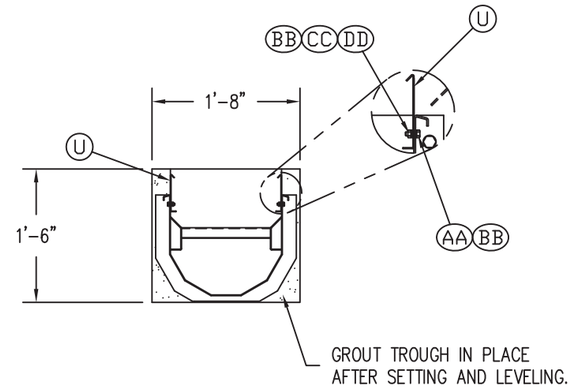

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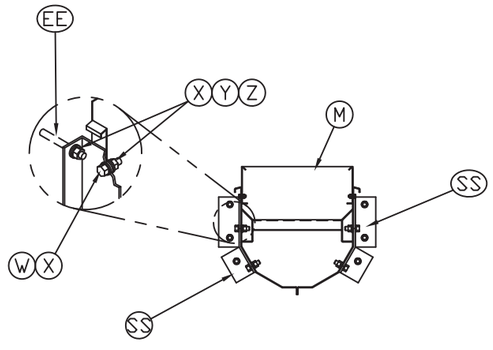

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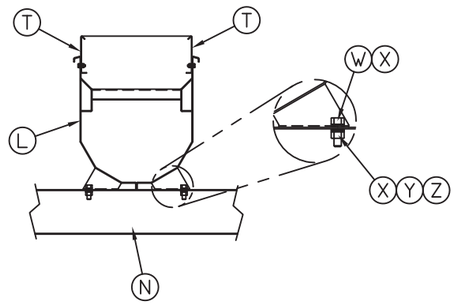

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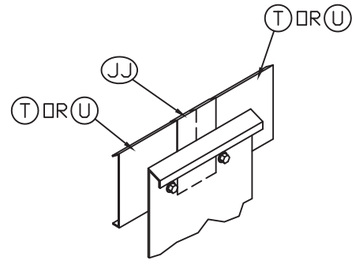
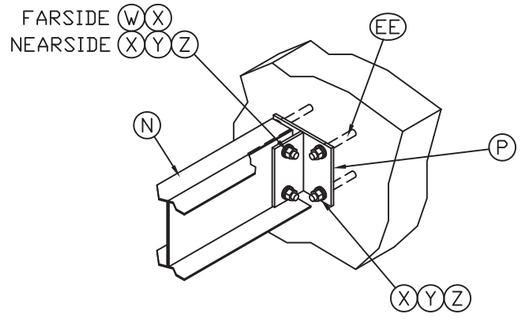


WEIR SPLICE DETAIL



TROUGH BEAM CONNECTION DETAIL

FINAL
4/21/15

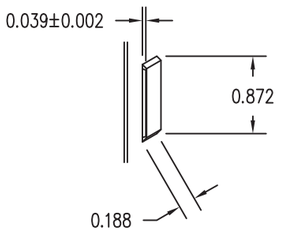
DRAWN	COLE C.
DATE	3/12/15
SCALE	DO NOT SCALE
CHK'D	
APP'D	

TROUGH DETAILS
FILTERS #1, #2, #6, #5, #10 AND #9
DOMTAR PAPER WTP

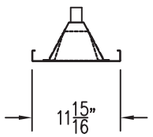
CUSTOMER: PRICE, UTAH
SHOP ORDER:
REVISION: A

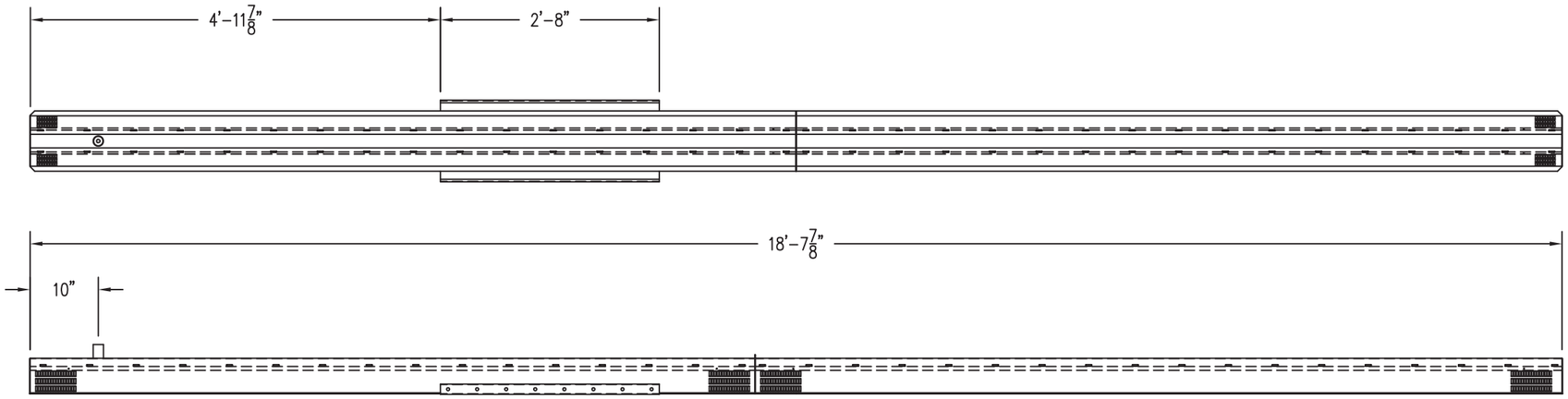
ANTHRATECH U.S. INC.
479 WEST UNIVERSAL CIRCLE
SANDY, UTAH
84070

DWG. 900437A
SHEET 6 OF 8

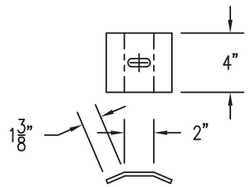


SLOT DETAIL

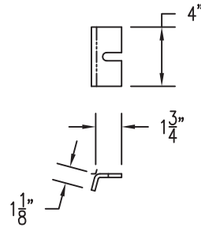




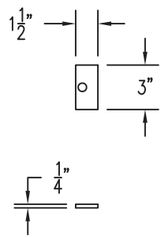
DETAIL ITEM A



DETAIL ITEM B



DETAIL ITEM C



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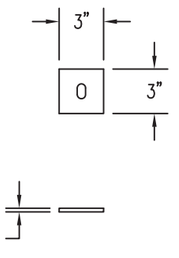

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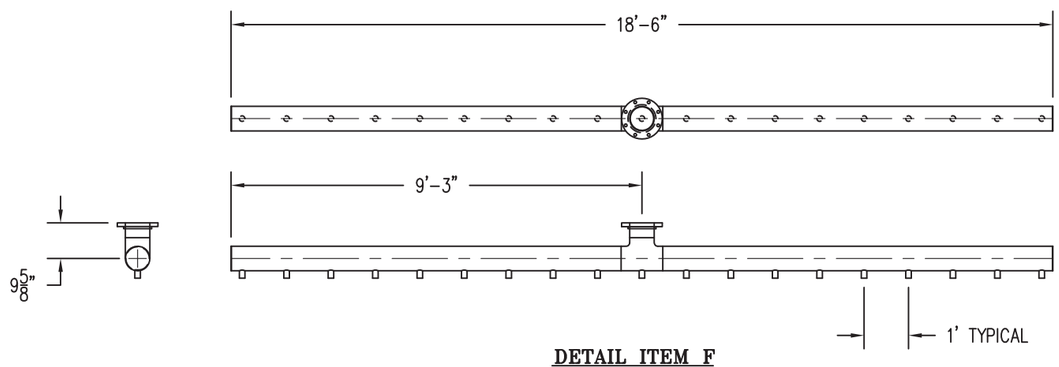

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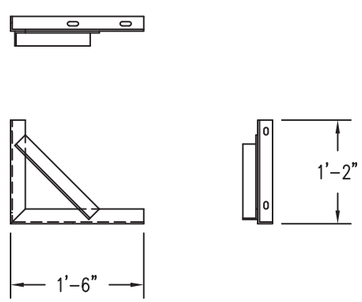


DETAIL ITEM G

FINAL

4/21/15

DRAWN	COLE C.
DATE	3/12/15
SCALE	DO NOT SCALE
CHK'D	
APP'D	

UNDERDRAIN COMPONENT DETAILS
FILTERS #1, #2, #6, #5, #10 AND #9
DOMTAR PAPER WTP

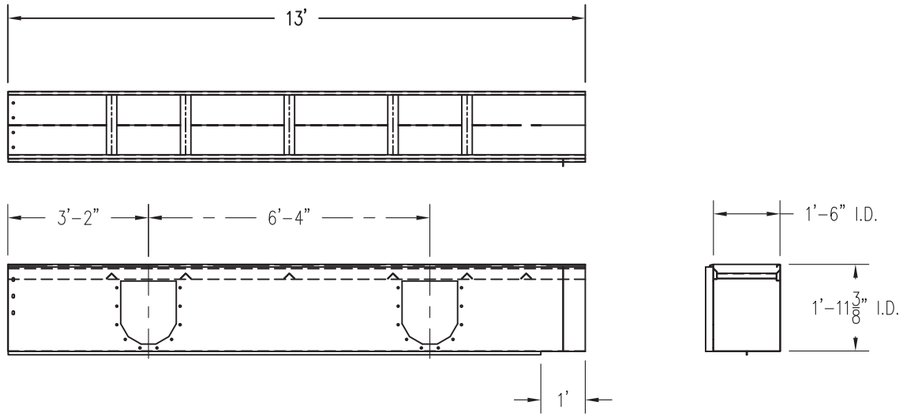
CUSTOMER: FLSMIDTH

SHOP ORDER:

REVISION: A

ANTHRATECH U.S. INC.
479 WEST UNIVERSAL CIRCLE
SANDY, UTAH
84070

DWG. 900437A



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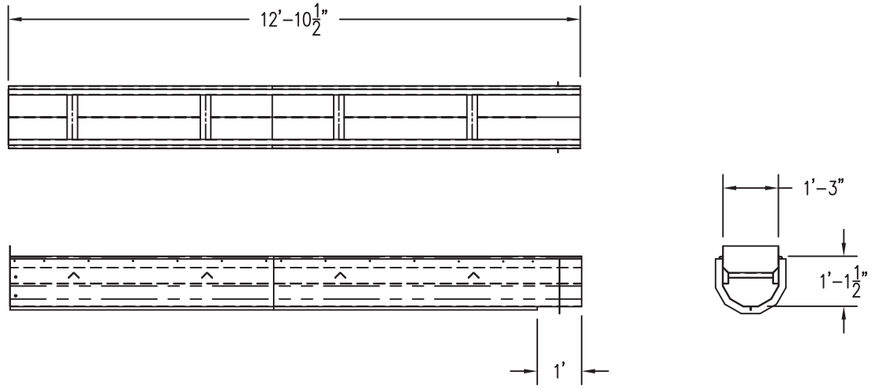

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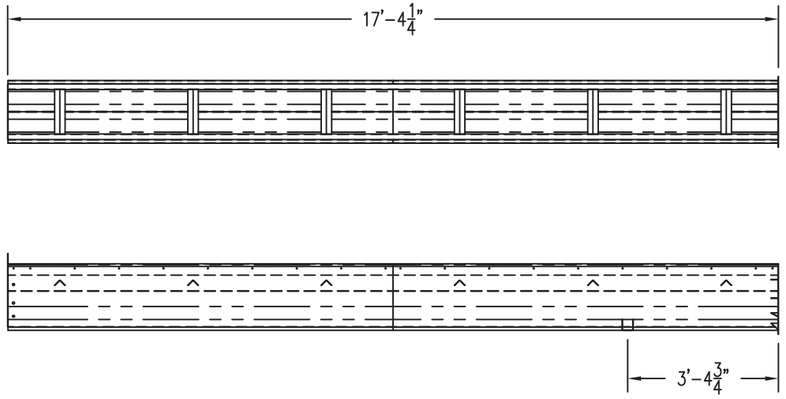

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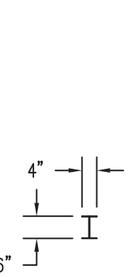

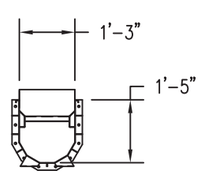

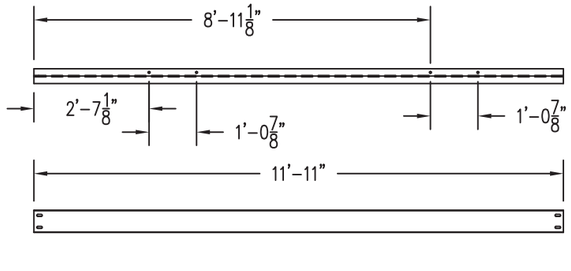

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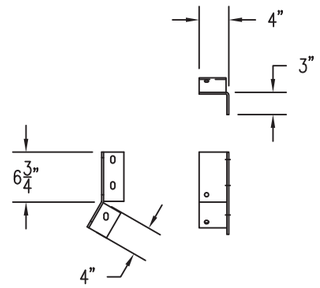

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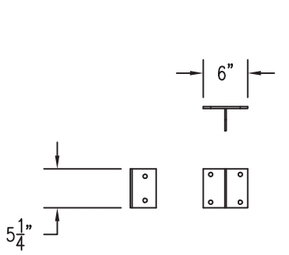

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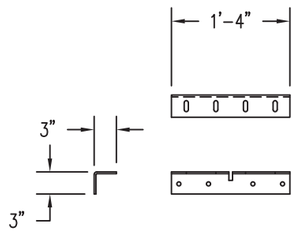

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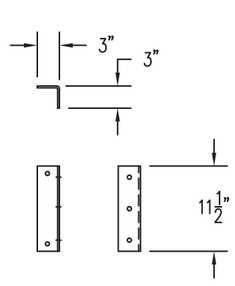

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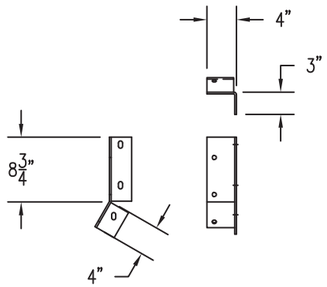

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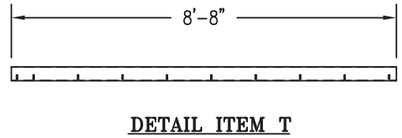

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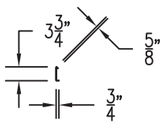

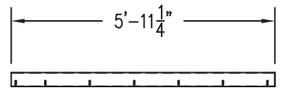

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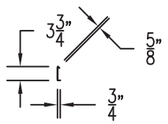
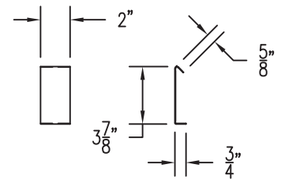




DETAIL ITEM JJ

FINAL
4/21/15

DRAWN	COLE C.
DATE	3/12/15
SCALE	DO NOT SCALE
CHK'D	
APP'D	

TROUGH COMPONENT DETAILS
FILTERS #1, #2, #6, #5, #10 AND #9
DOMTAR PAPER WTP

CUSTOMER: FLSMIDTH

SHOP ORDER:

REVISION: A

ANTHRATECH U.S. INC.
479 WEST UNIVERSAL CIRCLE
SANDY, UTAH
84070

DWG. 900437A
SHEET 8 OF 8

AWI Budgetary Pricing

Owner..... Village of Watkins Glen

Facility Name ..... Village of Watkins Glen Water Treatment Plant

Consulting Engineer..... MRB Group

Scope of Work

AWI Product.....Lateral Underdrain Systems

Material of Construction ..... 316L stainless steel (316 stainless steel fasteners)

Number of Filters..... One (1)

Number of Cells per Filter .....Four (4)

Filter Cell Width..... 10 feet

Filter Cell Length ..... 10 feet

Air Feed for Air Scour from.....Below

Includes:

- Phoenix Filter Lateral Underdrain Systems with Ultra-low Profile Laterals
- Air header with J-tubes and drop hoses
- All necessary fasteners
- Anchors with adhesive
- Gaskets and sealants
- Installation and maintenance manuals
- Freight FOB jobsite
- Customary field service

Budgetary Pricing

AWI Scope of Work..... $66,000

Date.....October 25, 2019

AWI Budgetary Pricing Philosophy

When preparing budgetary pricing for a project, the goal of AWI is to provide a price that conservatively reflects a reasonably accurate view of the scope of work for that project. By “conservative” we mean that in our view budgetary pricing should be higher by a small percentage than a bid day price at some reasonable point in the future allowing for minor changes in scope of supply.

AWI does not feel that comparison of budgetary pricing for capital equipment is a valid means to anticipate price competitiveness on bid day. When attempting to price-compete based upon budget pricing, the temptation is much too great to leave out or dramatically underestimate key components of a project such as freight and service. AWI includes full freight FOB jobsite and more than adequate field service by our exceptional Installation Supervisors in our budgetary pricing. In addition, comparison of budgetary pricing overlooks the substantial advantage AWI has when comparing the cost of equipment installation. We would welcome the opportunity to review installation of AWI Phoenix™ Underdrains Systems in greater detail.

In general, AWI welcomes the opportunity to provide budgetary pricing for our Products. We prefer to offer our underdrain systems on a standalone basis; however, when customer circumstances dictate, AWI does have the capability to furnish a broader package of filter equipment including such items as filter media, troughs, air scour blowers, etc.

In preparing budgetary pricing, the biggest variable that AWI confronts is the cost of stainless steel which has varied significantly over the years. AWI uses an index published by Global Stainless Steel, Inc. called “North American Surcharges” to monitor stainless steel costs. Fortunately, though the cost of stainless steel is a significant part of the overall cost of producing AWI Underdrain Systems, it is not the only cost. As a result, the cost of AWI Underdrain Systems is substantially less volatile than the cost of stainless steel.

APPENDIX M

CHLORINE CONTACT CT CALCULATIONS

MRB | *group*

Project Title: Village of Watkins Glen Comprehensive Water System Study
Project No.: 2330.19001
Date: October 24, 2019
Engineer: J. Lang-Bentley

Objective: Determine if Steuben Storage Tank meets 3-log inactivation for *G. Lamblia* for every month as required by the Department of Health.

References: Water and Wastewater Calculations Manual
EPA Guidance Manual, Disinfecting Profiling and Benchmarking

	Month												
	Jan	***Feb***	***Mar***	***Apr***	***May***	***Jun***	***Jul***	***Aug***	***Sep***	***Oct***	***Nov***	***Dec***	
PHF	0.85	0.71	0.63	0.58	0.69	0.78	0.79	0.74	0.64	0.57	0.51	0.53	MGD
Cl2 Residual	1.2	1.7	1.6	0.8	1.2	1.5	0.7	1.2	1.6	1.2	0.5	1.0	mg/L
Temperature	5	5	4	5	7	11	17	20	19	14	10	6	deg-C
pH	7.6	7.6	8.1	8.0	8.3	8.5	8.4	8.3	7.9	7.9	7.9	7.9	
HRT	838	1002	1137	1236	1037	911	904	956	1119	1255	1401	1336	min
ERT	84	100	114	124	104	91	90	96	112	126	140	134	min
CTcal	97	167	186	101	124	140	66	117	181	148	67	139	min
CT99.9	189	198	234	216	184	203	95	92	84	105	157	209	(mg/L) min
Inactivation Ratio	1.9	1.2	1.3	2.1	1.5	1.4	1.4	0.8	0.5	0.7	2.3	1.5	
Log Inactivation	5.8	3.5	3.8	6.4	4.4	4.3	4.3	2.4	1.4	2.1	7.0	4.5	
Log with Credit	7.8	5.5	5.8	8.4	6.4	6.3	6.3	4.4	3.4	4.1	9.0	6.5	
% Inactivation	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.6	95.9	99.3	100.0	100.0	
Results	PASS	PASS	PASS	PASS	PASS	PASS	PASS	FAIL	FAIL	FAIL	PASS	PASS	
Results with Credit	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	

MRB | *group*

Project Title: Village of Watkins Glen Comprehensive Water System Study
Project No.: 2330.19001
Date: October 24, 2019
Engineer: J. Lang-Bentley

Objective: Determine if Steuben Storgae Tank meets 3-log inactivation for *G. Lamblia.*

References: Water and Wastewater Calculations Manual
EPA Guidance Manual, Disinfecting Profiling and Benchmarking

Formulas:

CT = Concentration*Contact Time
T = HRT = V/Q
ERT = HRT*BF
CTcal = ERT*Cl2 Residual
Inactivation Ratio = CTcal/CTrequired
Log Inactivation = 3*Inactivation Ratio

Requirements: Inactivation *Giardia lamblia* = 3-log (99.9%)

Criteria:		**2018 PHF**	**Design Flow**	**Peak Design Flow**	**Peak Design Flow w/ 0.5 MG Extra Storage**	
Given:	Peak Hourly Flow (PHF) =	0.85	1.30	1.90	1.90	MGD
	Peak Hourly Flow (PHF) =	589	903	1319	1319	GPM
	Baffling factor (BF) =	0.1	0.1	0.1	0.1	Average
	Cl2 Residual =	1.7	1.7	1.7	1.7	mg/L
	Temperature =	4.0	4.0	4.0	4.0	deg-C
	pH =	8.5	8.5	8.5	8.5	
Dimensions:	Diameter =	47	47	47	94	ft
	Height / Length =	38	38	38	76	ft
	Volume =	65,928	65,928	65,928	131,856	ft3
		493,207	493,207	493,207	986,413	gal
Calculations:	HRT =	838	547	374	748	min
	ERT =	84	55	37	75	min
	CTcal =	140	91	62	125	min
	CTrequired =	278	278	278	278	(mg/L) min
	Inactivation Ratio =	0.5	0.3	0.2	0.4	
	Log Inactivation =	1.5	1.0	0.7	1.3	
	% Inactivation =	96.9	89.7	78.8	95.5	%
	Log Inactivation with DF Credit =	3.5	3.0	2.7	3.3	
	% Inactivation =	100.0	99.9	99.8	100.0	%
Results:		**PASS**	**FAIL**	**FAIL**	**PASS**	

MRB | *group*

Project Title: Village of Watkins Glen Comprehensive Water System Study
Project No.: 2330.19001
Date: October 24, 2019
Engineer: J. Lang-Bentley

Objective: Determine if Steuben Storage Tank meets 4-log inactivation for viruses.

References: Water and Wastewater Calculations Manual
EPA Guidance Manual, Disinfecting Profiling and Benchmarking

Formulas:	CT = Concentration*Contact Time
	T = HRT = V/Q
	ERT = HRT*BF
	CTcal = ERT*Cl2 Residual
	Inactivation Ratio = CTcal/CTrequired
	Log Inactivation = 4*Inactivation Ratio

Requirements: Inactivation *viruses* = 4-log (99.99%)

Criteria:		**2018 PHF**	**Design Flow**	**Peak Design Flow**	**Peak Design Flow w/ 0.5 MG Extra Storage**	
Given:	Peak Hourly Flow (PHF) =	0.85	1.30	1.90	1.90	MGD
	Peak Hourly Flow (PHF) =	589	903	1319	1319	GPM
	Baffling factor (BF) =	0.1	0.1	0.1	0.1	Poor
	Cl2 Residual =	1.7	1.7	1.7	1.7	mg/L
	Temperature =	4.0	4.0	4.0	4.0	deg-C
	pH =	8.5	8.5	8.5	8.5	
Dimensions:	Diameter =	47	47	47	94	ft
	Height =	38	38	38	76	ft
	Volume =	65,928	65,928	65,928	131,856	ft3
		493,207	493,207	493,207	986,413	gal
Calculations:	HRT =	838	547	374	748	min
	ERT =	84	55	37	75	min
	CTcal =	140	91	62	125	min
	CTrequired =	8	8	8	8	(mg/L) min
	Inactivation Ratio =	17.5	11.4	7.8	15.6	
	Log Inactivation =	70.0	45.7	31.2	62.5	
	% Inactivation =	100.0	100.0	100.0	100.0	%
	Log Inactivation with DF Credit =	71.0	46.7	32.2	63.5	
	% Inactivation =	100.0	100.0	100.0	100.0	%
Results:		**PASS**	**PASS**	**PASS**	**PASS**	

TABLE 5.11 *CT* Values [(mg/L)min] for Achieving 99.9% (3-log) Inactivation of *Giardia lamblia*

Disinfectant, mg/L	pH	Temperature, °C 0.5 or <1	5	10	15	20	25
Free chlorine							
≤0.4	6	137	97	73	49	36	24
	7	195	139	104	70	52	35
	8	277	198	149	99	74	50
	9	390	279	209	140	105	70
1.0	6	148	105	79	53	39	26
	7	210	149	112	75	56	37
	8	306	216	162	108	81	56
	9	437	312	236	156	117	78
1.6	6	157	109	83	56	42	28
	7	226	155	119	79	59	40
	8	321	227	170	116	87	58
	9	466	329	236	169	126	82
2.0	6	165	116	87	58	44	29
	7	236	165	126	83	62	41
	8	346	263	182	122	91	61
	9	500	353	265	177	132	88
3.0	6	181	126	95	63	47	32
	7	261	182	137	91	68	46
	8	382	268	201	136	101	67
	9	552	389	292	195	146	97
ClO_2	6–9	63	26	23	19	15	11
Ozone	6–9	2.9	1.9	1.43	0.95	0.72	0.48
Chloramine	6–9	3800	2200	1850	1500	1100	750

SOURCE: Abstracted from Tables E-1 to E-6, E-8, E-10, and E-12 of the US EPA Guidance Manual (US EPA, 1989a)

Example 1: What are the percentages of inactivation for 2- and 3.4-log removal of *Giardia lamblia*?

solution: Using Eq. (5.210)

$$y = 100 - 100/10^x$$

as $x = 2$

$$y = 100 - 100/10^2 = 100 - 1 = 99(\%)$$

as $x = 3.4$

$$y = 100 - 100/10^{3.4} = 100 - 0.04 = 99.96(\%)$$

Example 2: A water system of 100,000 gpd (0.0044 m^3/s) using a slow sand filtration system serves a small town of 1000 persons. The filter effluent turbidity values are 0.4 to 0.6 NTU and pH is about 7.5. Chlorine is dosed after filtration and prior to the clearwell. The 4-in (10 cm) transmission pipeline to the first customer is 1640 ft (500 m) in distance. The residual chlorine

TABLE 5.12 *CT* Values [(mg/L) min] for Achieving 90% (1-log) Inactivation of *Giardia lamblia*

Disinfectant, mg/L	pH	Temperature, °C 0.5 or <1	5	10	15	20	25
Free chlorine							
≤0.4	6	46	32	24	16	12	8
	7	65	46	35	23	17	12
	8	92	66	50	33	25	17
	9	130	93	70	47	35	23
1.0	6	49	35	26	18	13	9
	7	70	50	37	25	19	12
	8	101	72	54	36	27	18
	9	146	104	78	52	39	26
1.6	6	52	37	28	19	14	9
	7	75	52	40	26	20	13
	8	110	77	58	39	29	19
	9	159	112	84	56	42	28
2.0	6	55	39	29	19	15	10
	7	79	55	41	28	21	14
	8	115	81	61	41	30	20
	9	167	118	88	59	46	29
3.0	6	60	42	32	21	16	11
	7	87	61	46	30	23	15
	8	127	89	67	45	36	22
	9	184	130	97	65	49	32
Chlorine dioxide	6–9	21	8.7	7.7	6.3	5.0	3.7
Ozone	6–9	0.97	0.63	0.48	0.32	0.24	0.16
Chloramine	6–9	1270	735	615	500	370	250

SOURCE: Abstracted from Tables E-1 to E-6, E-8, E-10, and E-12 of the US EPA Guidance Manual (US EPA, 1989a)

TABLE 5.13 *CT* Values [(mg/L) min] for Achieving 99.99% (4-log) Inactivation of Viruses at pH 6 through 9

Disinfectant mg/L	Log inactivation	Temperature, °C ≤1	5	10	15	20	25
Free chlorine	2	6	4	3	2	1	1
	3	9	6	4	3	2	1
	4	12	8	6	4	3	2
Chlorine dioxide	2	8.4	5.6	4.2	2.8	2.1	1.4
	3	25.6	17.1	12.8	8.6	6.4	4.3
	4	50.1	33.4	25.1	16.7	12.5	8.4
Ozone	2	0.9	0.6	0.5	0.3	0.25	0.15
	3	1.4	0.9	0.8	0.5	0.4	0.25
	4	1.8	1.2	1.0	0.6	0.5	0.3
Chloramine	2	1243	857	643	428	321	214
	3	2063	1423	1067	712	534	365
	4	2883	1988	1491	994	746	497

SOURCE: Modified from Tables E-7, E-9, E-11, and E-13 of the US EPA Guidance Manual (US EPA, 1989a)

WASTEWATER

APPENDIX N

2019 STEUBEN STREET TANK INSPECTION REPORT

Watkins Glen, NY

Water Tank

500,000 Gallon Groundlevel Welded Steel

May 14, 2019

Prepared By: Tim L Smith

Atlantic Underwater Services Inc.
2538 State Route 8
Lake Pleasant, NY 12108
(518)548-3634

ROV And Drained AWWA Potable Water Storage Tank,
NFPA Fire Water Storage Tank, & Pipeline Inspections

Declaration

This report was composed from the visual observations made during an inspection of this water storage facility. Portions of this report may also contain material or other information obtained from conversations with the utility personnel, the tank information plate, drawings, reports, etc. The information contained herein is believed to be as true and accurate as could be obtained from these observations and the information and material supplied to us. No other assurance or warranty is expressed or implied. We assume no responsibility for any errors or omissions in this report.

The time frames stated in the recommendations are estimates based on our years of experience with other storage facilities and paint installations, and discussions with corrosion engineers, paint manufacturer's representatives, tank constructors, painting contractors, etc. Although these estimates can be considered to be fairly reliable, many different factors affect the condition of the water storage facility over time and we cannot be held responsible for the accuracy of these estimates. Since the condition of the storage facility will change over time, the accuracy of the condition of the storage facility described in this report will decrease according to the amount of time that has elapsed since the date of the inspection. Should three (3) or more years have elapsed since this inspection, this report should be considered to be null and void and the storage facility should be reinspected to determine the current condition.

By:

Timothy L Smith

Tank Information

The height to overflow is about:	**43**
The tank height is about:	**47**
The diameter of this tank is about:	**40**
This tank was constructed at the present location in:	**1989**
Tank has interior columns:	**NO**
Tank has a cathodic protection system installed:	**NO**
Latest interior recoat was done in:	**NONE ?**
Latest exterior recoat was done in:	**NONE ?**
This tank was previously inspected:	**NO**

AWWA D100 Standard

IMPORTANT NOTE ABOUT AWWA STANDARDS:

Except in the states that have adopted these Standards as law, there is no regulatory or enforceable requirement that any or all of the AWWA Standards be followed or adhered to. Therefore, these Standards are to be used as a guideline only and are not to be construed or interpreted as a requirement and abiding by any of the requirements of these Standards are voluntary and not mandatory.

Item	Description	Yes	No	N/A
1.	This tank has two shell manholes located in the first ring, one of which is at least 24” in diameter:	X		
2.	An additional upper access hatch or the center vent is installed near the center of the tank roof which has a at least a 4” high tank riser and a door plate with flanged edges so that a ventilation fan can be installed:	X		
3.	The existing upper access hatch has at least a 4” high tank riser and a door plate with edges that extends down over the riser at least 2” and is at least 24” in diameter:	X		

OSHA Regulations

Item	Description	Yes	No	N/A
1.	Interior ladder has safety equipment that meets current OSHA standards:			X
2.	Interior ladders (if existing) meet 16” width requirement:			X
3.	Exterior ladder has protective cage safety equipment that is longer than 20’ has balcony platforms with railings at maximum 20’ intervals or has other safety equipment installed that meets current OSHA standards:	X		
4.	Exterior ladder meets 16” width requirement:	X		
5.	Tank has a sloped/domed roof with an existing ladder, walkway, or stairs that extends from the sidewall/roof junction to near the center vent that has safety equipment that meets current OSHA standards:	X		
6.	Cable fall protection systems installed on all ladders have a large enough diameter to meet current standards and use currently available cable climb devices:			X
7.	The top edge height of all top rails, or equivalent guardrail system members, are 42 inches plus or minus 3 inches above the walking/working level, or when conditions warrant, the height of the top edge exceeds the 45-inch height, provided the guardrail system meets all other criteria of this paragraph as required by Section 1926.502(b)(1):	X		
8.	Utility owns and uses full body personal fall arrest systems and has eliminated the use of body belts after January 1, 1998 as per Section 1926.502(d):			X
9.	On tanks with sloped or domed roofs, the roof access hatch is installed in close proximity to the roof access ladder that this hatch can be safely accessed:	X		

OSHA Regulations (Cont.)

Item	Description	Yes	No	N/A
10.	Midrails, screens, mesh, intermediate vertical members, or equivalent intermediate structural members are installed between the top edge of the guardrail system and the walking/working surface when there is no wall or parapet wall at least 21 inches high. Midrails, if used, are installed at a height midway between the top edge of the guardrail system and the walking/working level. Screens and mesh, if used, extend from the top rail to the walking/working level and along the entire opening between top rail supports. Intermediate members such as balusters, additional midrails, or architectural panels, if used between posts, are installed such that there are no openings in the guardrail system that are more than 19 inches wide:	X		
11.	On tanks with a fall protection system installed, it is possible to remain connected, or to transfer between ladders or onto the roof with the use of a lanyard and safely access all parts of this tank:	X		
12.	On tanks with sloped or domed roofs which previously had a movable ladder which is supported by a bar or bracket that encircles the center vent and is not otherwise fastened to the roof by standoffs, which was unsafe and that this ladder could come loose and fall to the ground at any time, this ladder has been replaced or modified by being permanently fastened to the tank roof with standoffs:			X
13.	Saf-T-Climb bars initially installed on the ladders have been replaced with safety cables due to the multiple recalls of these climbing brackets and the hazards of using these devices:			X

Water Stratification

The display on the bottom left of the inspection video and interior photos displays the water temperature. Water stratification is the difference in water temperature throughout your tank and can affect the water quality.

Warmer water rises and colder water sinks. Therefore, in warmer weather if you input colder water from your pumps, this new water will stay on the bottom and be withdrawn when the pumps stop and not mix with the warmer water already in the tank. As the disinfectant level in the older water drops to nothing over time it is susceptible to bacteriological contamination. Also, as the water sits in your tank without being withdrawn, the existing disinfectant can form an amount of byproducts that exceed EPA standards, putting your system in violation.

Description	Yes	No
The temperature of the water throughout the tank was close to being the same temperature with a few degrees or less in difference:	X	

If this answer is "No", there is a problem with water stratification and water quality in your tank that should be addressed to prevent your system from having water contamination or being in violation of disinfectant byproduct levels.

Structural Condition

Component	Description	O.K.	Problem	N/A
Concrete Base	Concrete base or ring supporting sidewalls is not excessively deteriorated:	X		
Seal Between Concrete Base & Tank Bottom	Seal between base and tank bottom is adequate:		X	
Concrete Base	The concrete base or ring of groundlevel tank or standpipe extends at least 6" above the ground:	X		
Steel Ring	Steel ring to hold gravel base is not displaced:			X
Erosion/Settling	Ground at foundation or ring is not eroded or settled:	X		
Anchor Bolts	These bolts are not excessively corroded, all nuts are tight and not missing, and the structural integrity is not affected:			X
Exterior Ladders	Structurally sound, safe for use, not excessively bent, dented, twisted, damaged, or excessively corroded:	X		
Ladder Guards	The lowermost exterior ladder has a ladder guard installed to prevent access to the tank roof and tank interior:			X
Air Vent	Not excessively damaged, corroded, or deteriorated:	X		
Overflow Pipe	Structurally sound, not bent, twisted, deformed, otherwise damaged, excessively corroded:	X		
Leaks	No indications of leakage observed:	X		

Structural Condition (Cont.)

Component	Description	O.K.	Problem	N/A
Level Indicator	Functional, float not flooded, guide wires not broken, wire to flag not broken, bottom bracket not excessive corroded or loose, float and flag move freely and are not binding:			X
Handrails, Balconies	Balcony catwalk and all railings structurally sound and safe for use, not excessively corroded, level, smooth, not excessively bent, dented, twisted, or otherwise damaged:	X		
Interior Ladder	Not excessively bent, dented, twisted, damaged, corroded:			X
Cathodic Protection System	System components are in proper position and configuration and system is functional and adequately protecting the submerged metal from corrosion:			X
Interior Sidewall Welds	Interior welds not excessively corroded, deteriorated:	X		
Interior Sidewall Plate Surfaces	Interior plate surfaces not excessively corroded or deteriorated:	X		
Bottom Welds	Bottom welds not excessively corroded, deteriorated:	X		
Bottom Plate Surfaces	Bottom plate surfaces not excessively corroded or deteriorated:	X		
Bottom Plate Deflection	Bottom plates have not deflected or depressed 4” or more:	X		
Roof Interior Plates	Interior plate surfaces not excessively corroded or deteriorated:	X		
Roof Support Beams or Angles	Beams, angles, spider rods, not excessively bent or twisted not excessively corroded:	X		

Structural Condition (Cont.)

Component	Description	O.K.	Problem	N/A
Roof Support Beams or Angles	Beams have not been welded to roof plates and plates are free to move across beams:	X		
Roof Support Beams or Angles	Beams have not been caulked to roof plates and plates are free to move across beams:	X		
Exterior Sidewall Welds	Exterior welds not excessively corroded, deteriorated:		X	
Exterior Sidewall Plate Surfaces	Exterior plate surfaces not excessively corroded or deteriorated:		X	
Roof Exterior Plates	Exterior plate surfaces not excessively corroded or deteriorated:		X	
Interior Support Column	Surfaces not excessively corroded or deteriorated:	X		
Interior Support Column	Constructed out of pipe sections which have not been perorated by corrosion or damage and the pipe is not flooded:	X		
Interior Support Column	Not bent, deformed, or damaged.	X		
Interior Support Column	Bottom of column is not fastened to the floor and has angles or floor standoffs to prevent the bottom of the column from horizontal movement:	X		
Roof Railings	Railings are installed along the tank edge that extend at least 6’ in both directions from the top of the exterior ladder or stairs to prevent falls from the tank roof:	X		
Roof Railings	Railings are installed along the tank roof near or toward the edge that extend completely around the roof circumference to prevent falls from the tank roof:			X

Sanitary Condition

Component	Description	O.K.	Problem	N/A
Perimeter Fence	Has barbed wire on the top, fence and barbed wire are not damaged or deteriorated, has adequate number of "No Trespassing" signs:		X	
Gates	Are not damaged and can be opened:			X
Locks	Perimeter gate have locks:			X
Overflow screen, flap, size	Is adequately screened or flap opens and closes and pipe is large enough:	X		
Vent Screen Material	Screen is metal, not damaged, not excessively corroded, or missing:	X		
Access hatch	Has no excessive corrosion, is not deteriorated or bent, structurally sound:	X		
Access Hatch Lock	Upper access hatch adequately locked:	X		
Evidence of Foreign Matter	No debris laying on tank bottom:	X		
Vandalism	No graffiti, litter, trash, or damage:	X		
Silt Stop	Silt stop is not missing or displaced	X		
Water Visibility	Visibility in water is at least 10':	X		

Sediment:

Average Sediment Depth:	Less than ½"	Less than 1":	1" to 5"	5" to 10" or more
		X		

Recommendations

General Recommendations

Item	Description	Yes	No	N/A
1.	Reinspect tank interior in 5 years:	X		
2.	Recoat the tank interior:		X	
3.	Recoat the tank exterior:	X		
4.	Reseal the junction of the exterior tank bottom and concrete base:	X		
5.	Replace existing ladders:		X	
6.	Modify or add safety equipment to exterior ladder(s):		X	
7.	Modify or add safety equipment to interior ladder(s):			X
8.	Repair or replace roof vent:		X	
9.	Install, repair, or modify access control fence:		X	
10.	Modify drainage to expose 6” of base(s) and slope away from tank:		X	
11.	Modify or repair damaged or distorted balcony railing(s) or to meet current OSHA regulations:		X	

Note:	Due to the excessive cost of installation, and maintenance, and yearly inspection fees, of cathodic protection systems, and that these systems do not protect the unsubmerged portion of the tank interior which is the first area of protective coating to fail, and that they only protect up to 20% of protective coating failure when they are functioning at their peak performance, and the limited functionality of these systems, it is recommended that a cathodic system not be installed in this tank. If a cathodic system exists, it should not be reinstalled or replaced whenever this tank is recoated.

Recommendations (Cont.)

Recommendations Unique and Specific To This Tank

Item	Description
1.	Any items listed as NO in the AWWA Section, NO in the OSHA Section, PROBLEM in the STRUCTURAL and SANITARY Sections and listed as YES in the GENERAL RECOMMENDATIONS should be installed, modified, or repaired as indicated.
2.	To limit the liability of the utility, a 6' or higher, preferably 10', perimeter fence should be installed with barbed wire facing inward with "No Trespassing" signs installed at 30' intervals as soon as the funds can be made available.
3.	The exterior should be sprayed with a 50/50 mixture of bleach and water to kill and oxidize the mildew and then a day or 2 later, the tank should be pressure washed to remove the residue.
4.	As the tank is pressure washed, all loose material and moss, etc. should be removed from the junction of the tank bottom and concrete base, and then, a few days later, after this junction has dried, this junction should be sealed with CIM material. Data sheets included.
5.	Although there is some interior protective coating failures and corrosion, these failures are not nearly extensive for the interior to be recoated at this time and the inspection in 5 years will determine the timing of the next interior recoat.
6.	No other corrective actions are recommended at this time and the tank should be reinspected again in a period of time of 5 years.

Photo Identification

Note: **If you chose to include this option, you received a photo disc with digital copies of all the interior and exterior photos taken during the inspection, an electronic copy of this complete report including photos as an Adobe Portable Document File (.pdf) document, and the interior video as a Windows Media File (.wmv) that you can copy to and play on your computer. The photos printed in this report are a representative sample of all of the photos taken and you should review the entire collection on this disc. Please note that we may be unable to deliver additional copies of the inspection report or discs after the initial reports and discs are delivered to you so we recommend that you immediately copy this info to several of your computers and to make additional copies of this disc and the DVD and keep track of these discs. This is probably your only chance to be able to have additional copies at any time in the future.**

Pictures

Exterior Drone Ceiling Photo

Exterior Drone Ceiling Photos

Pictures (Cont.)

Exterior Tank Drone Photos

Exterior Tank Drone Photos

Pictures (Cont.)

Exterior Overflow Screen

Exterior Overflow Screen

Pictures (Cont.)

Exterior Side Shell Access

Side Shell Access

Pictures (Cont.)

Exterior Tank Base

Exterior Tank Base

Pictures (Cont.)

Exterior Overflow

Exterior Overflow

Pictures (Cont.)

Exterior Ladder

Exterior Ladder

Pictures (Cont.)

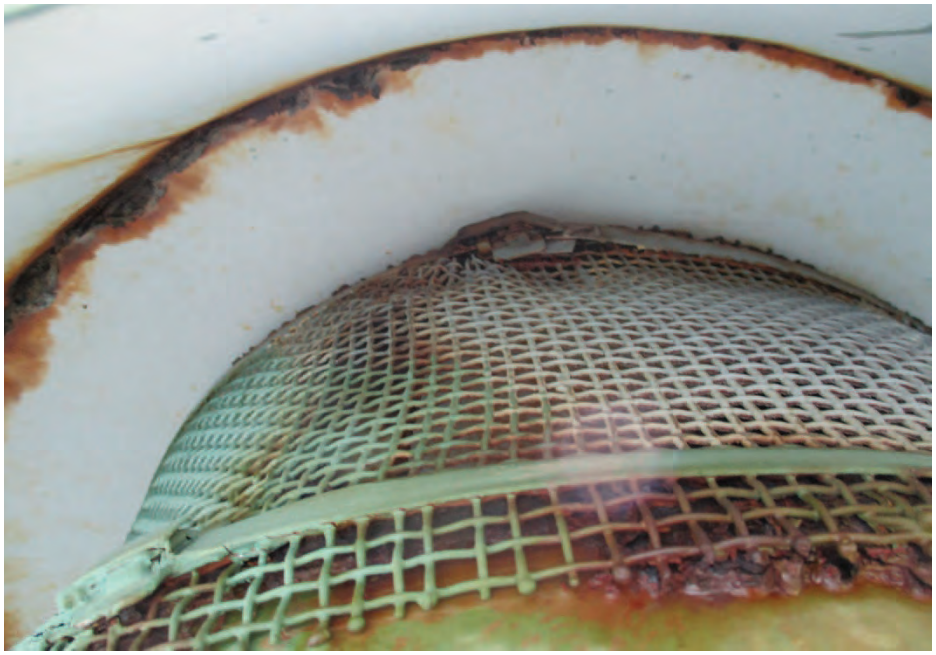
Top Access

Top Access

Pictures (Cont.)

Center Vent

Center Vent



Pictures (Cont.)

Inlet/Outlet Piping

Inlet/Outlet Piping

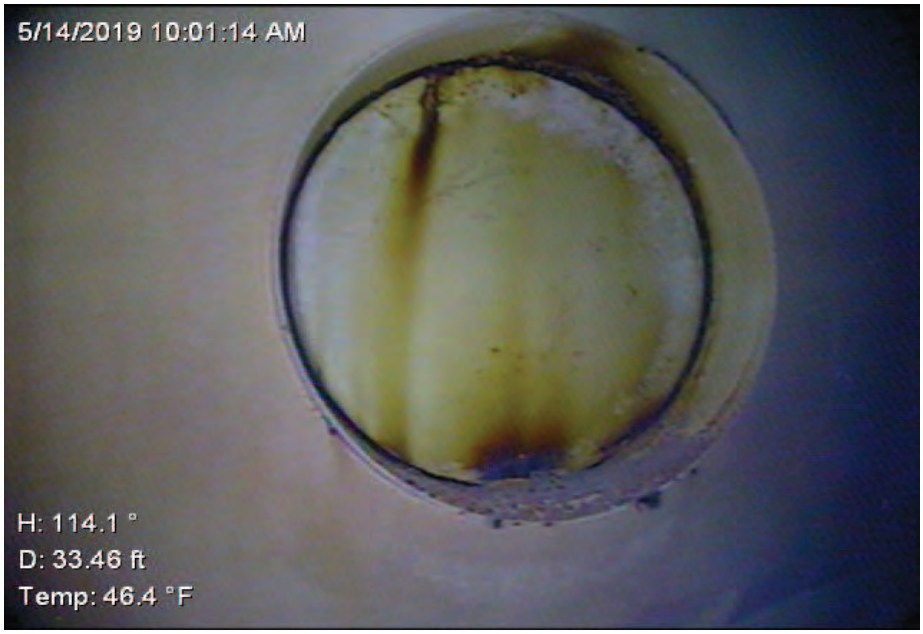
Pictures (Cont.)

Inlet/Outlet Piping

Inlet/Outlet Piping

Pictures (Cont.)

Interior Side Shell Access

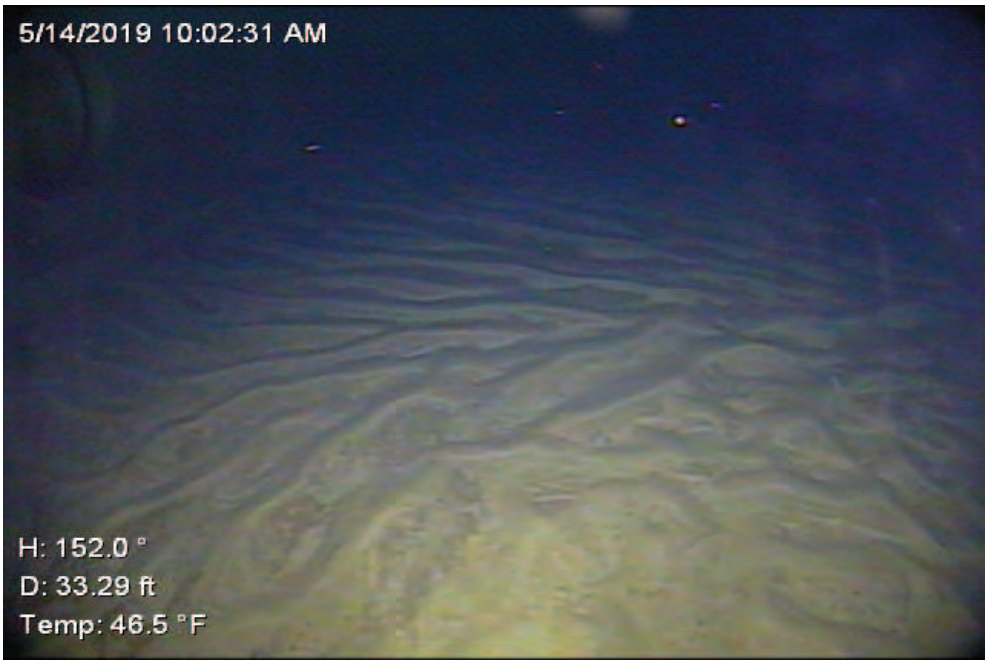


Interior Side Shell Access

Pictures (Cont.)

Interior Bottom

Interior Bottom



Pictures (Cont.)

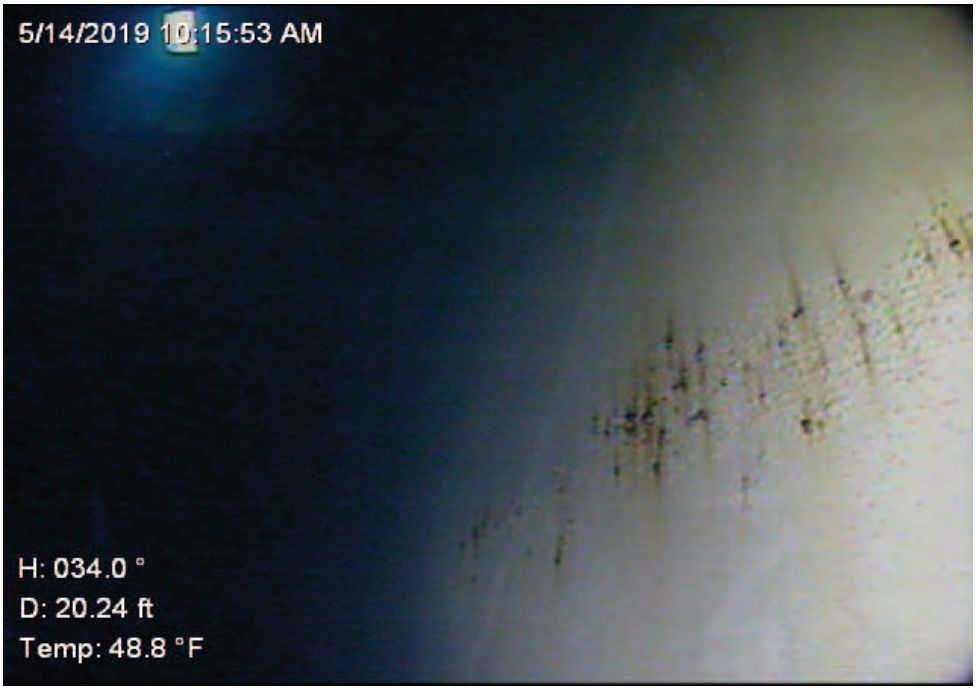
Interior Bottom

Interior Bottom

Pictures (Cont.)

Interior Side Walls

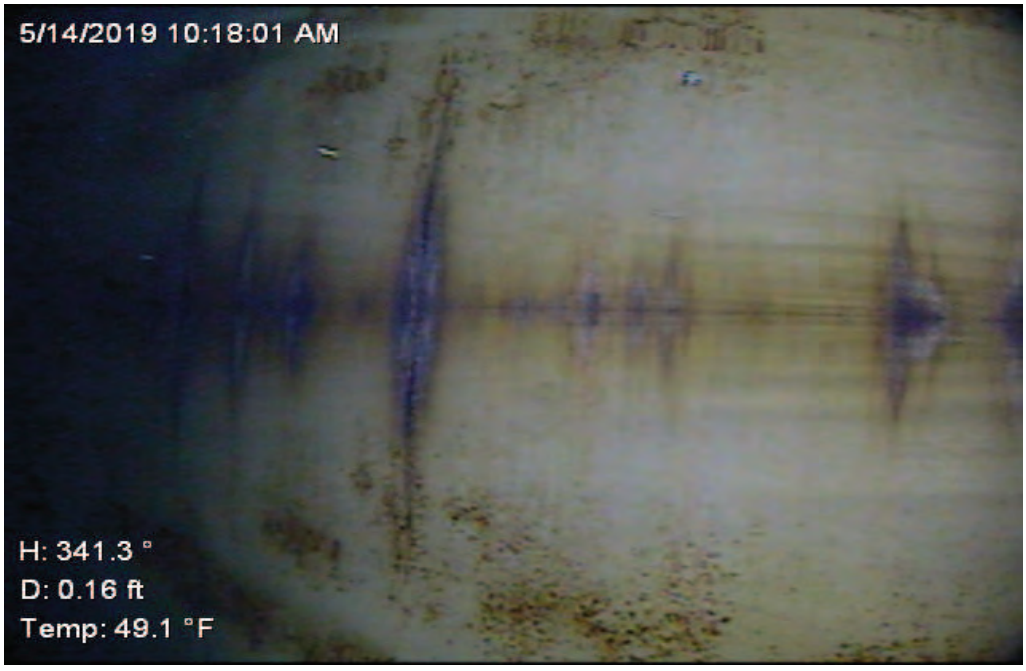
Interior Side Walls



Pictures (Cont.)

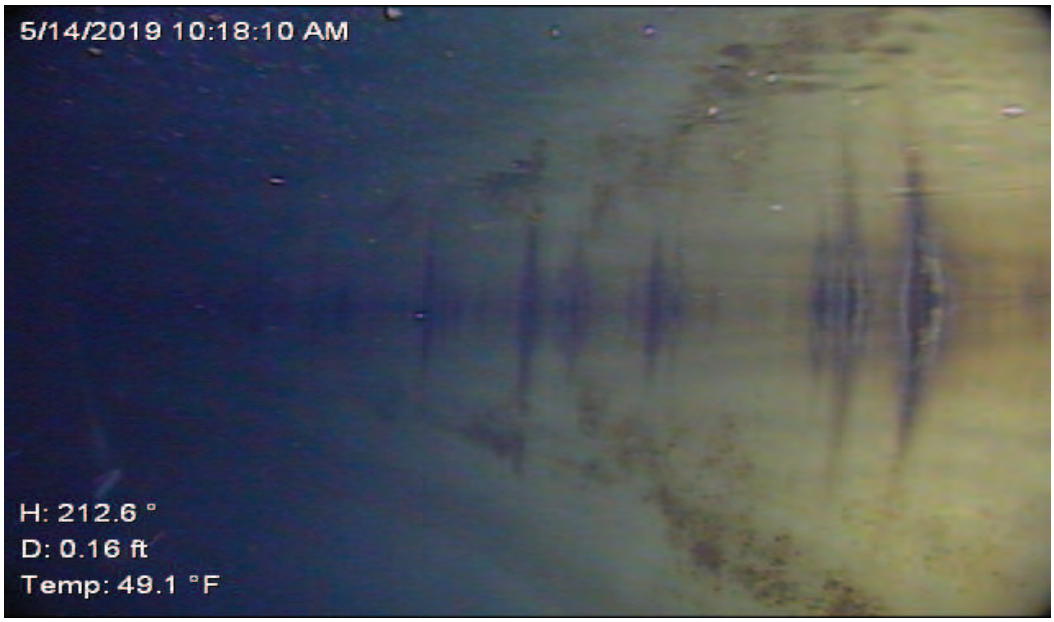
Interior Side Walls

Interior Side Walls



Pictures (Cont.)

Interior Side Walls

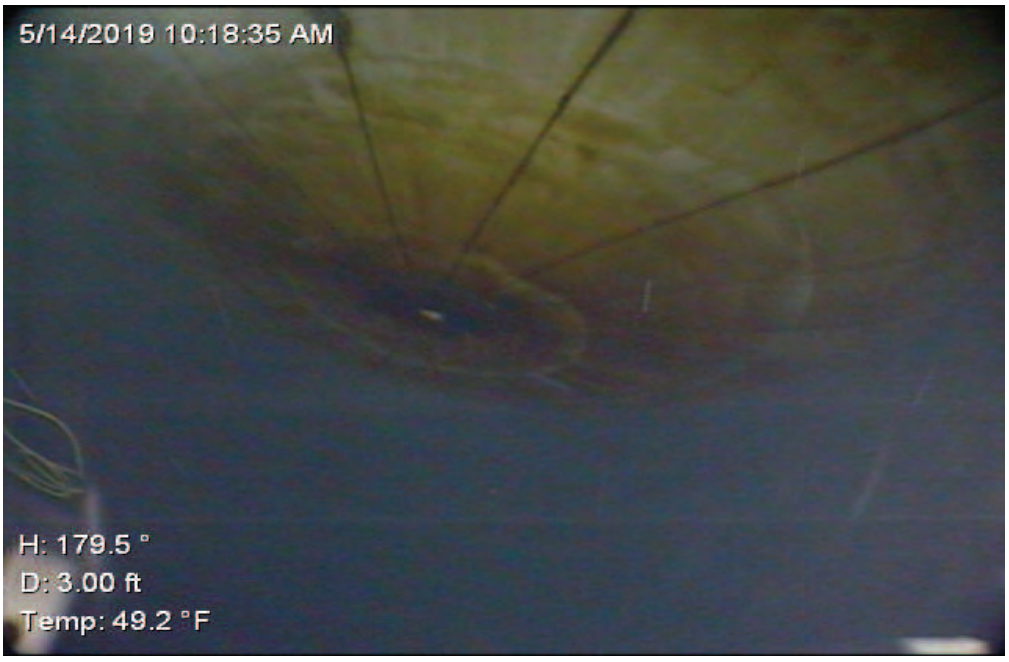


Interior Side Walls

Pictures (Cont.)

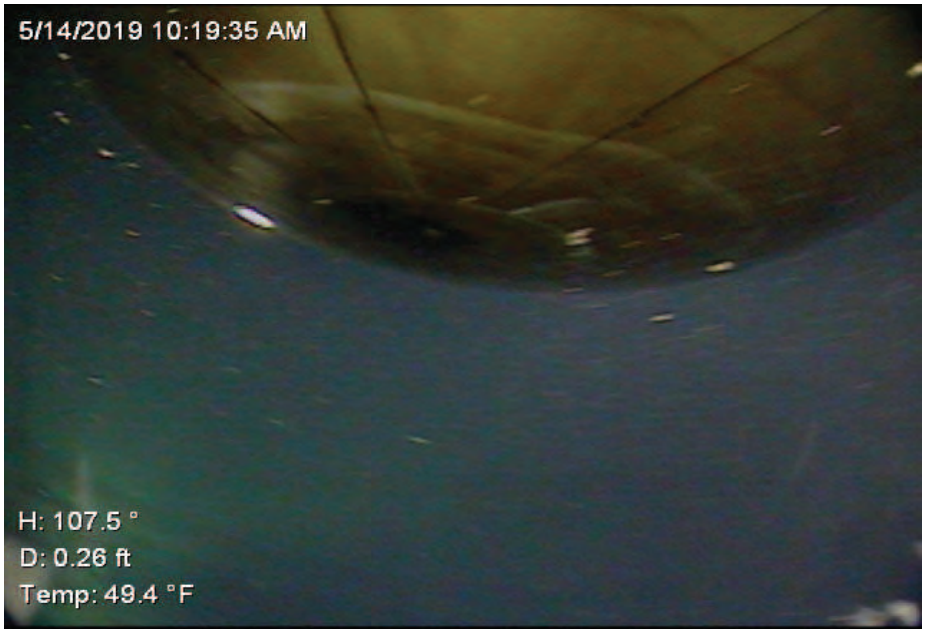
Interior Ceiling

Interior Ceiling



Pictures (Cont.)

Interior Ceiling



Interior Ceiling

APPENDIX O

EDU CALCULATIONS

MRB|group

Project Title Village of Watkins Glen Comprehensive Water Study
Project No.: 2330.19001
Date: November 19, 2019
Engineer: J. Lang-Bentley

Subject: EDU calculations based on quaterly water use for one year categorized by user.

		Residential			Commercial		Institutional		Industrial		
2018 Use	Total Use (1000 gal)	Residential Use (1000 gal)	Conn	Unit Flowrate (gpd/conn)	Commercial Use (1000 gal)	Conn	Institutional Use (1000 gal)	Conn	Industrial Use (1000 gal)	Conn	Total Connections
Village of Watkins Glen	157,622	82,862	879	262	57,010	47	17,000	13	750	3	942
Town of Dix	11,601	10,351	72		750	5	500	5	0	0	82
Town of Reading	1,544	1,544	38		0	0	0	0	0	0	38
EDU's	**1,782**		989		603		183		8		1,062

Average Total Use	467,854	gpd						
Unit Use	95,811	gpy/EDU	**ALL USERS**			**VILLAGE**		
Unit Use	262	gpd/EDU						
			water-00	22,511,250	CCF	Residential	879	connections
Actual Sewer Users	1,143		water-01	108,937	CCF	100 - 399	82,861,979	gal/year
Total Water Budget	$ 752,130.00		water-02	116	CCF			
Cost per user	$ 658.03			22,620,303	CCF	Commercial	47	connections
				169,222,487	gal/year	400 - 599	57,010,000	gal/year
Existing Cost per 1000 gal	$ 6.01							
Total Annual Use (Est.)	170,766,487	gal/year	**Village**	942	users	Institutional	13	connections
1000 gallons	170,766			21,069,640	CCF	600 - 699	17,000,000	gal/year
				157,621,979	gal/year	800 - 980		
Average Annual Revenue	$ 1,026,306.59							
			Dix	201	users	Industrial	3	connections
Estimated Project Cost	$ 16,000,000.00		(T-accounts)	1,550,663	CCF	700 - 799	750,000	gal/year
				11,600,508	gal/year			
Cost Increase per 1000 gal	$ 93.70	yr/conn				TOTAL	942	connections
	$ 7.81	mon/conn	**Reading**	86	users		157,621,979	gal/year
				206,390	CCF			
Proposed Annual Cost/year	$ 1,782,265.00			1,544,000	gal/year	*WGI is included in residential calculations		
Change in cost	$ 755,958.41							
Cost per connection/year	$ 802.50							
Rate increase/1000 gallons	13%							

APPENDIX P

OVERALL COST ESTIMATE AND FINANCING ANALYSIS

MRB|group

Project Title Village of Watkins Glen Comprehensive Water System Study
Project No.: 2330.19001
Date: January 2, 2020
Engineer: J. Lang-Bentley

Subject: Comprehensive cost estimate analysis for individual recommended water system improvement projects for CDBG grant funding.

Project A	*Item Description*	*Unit Price*	*Quantity*	*Units*	*Cost*
Raw Water Intake & Pump Station	Intake Screen	$ 66,000.00	1	LS	$ 66,000.00
	Raw Intake Line and Anchor	$ 850,000.00	1	LS	$ 850,000.00
	Existing Pump Station Demo & Decommissioning	$ 150,000.00	1	LS	$ 150,000.00
	CMU Building (approx. 30' x 35') & foundation	$ 280.00	1,100	SF	$ 308,000.00
	Roof and Siding	$ 300.00	1,100	SF	$ 330,000.00
	Intake Pumps (w/ VFDs and control panel)	$ 37,500.00	2	EA	$ 75,000.00
	Process Piping & Plumbing	$ 400,000.00	1	LS	$ 400,000.00
	Chemical Room (containment, coatings, etc)	$ 75,000.00	1	LS	$ 75,000.00
	Chemical Feed Equipment	$ 25,000.00	1	LS	$ 25,000.00
	Lab and Sink Area	$ 8,000.00	1	LS	$ 8,000.00
	Underwater Inspection and oversight	$ 100,000.00	1	LS	$ 100,000.00
	Concrete (retaining wall, wet well, gen. pad, slab, etc)	$ 1,000.00	110	CY	$ 110,000.00
	Erosion and Sediment Control	$ 30,000.00	1	LS	$ 30,000.00
	Manholes	$ 5,000.00	2	EA	$ 10,000.00
	Fencing	$ 25,000.00	1	LS	$ 25,000.00
	Sitework (excavation, tree removal, dewatering, final)	$ 100,000.00	1	LS	$ 100,000.00
	Subproject Construction Subtotal				$ 2,662,000.00
General Contractor Costs	Construction Cost Subtotal (GC)				$ 2,662,000.00
	Mobilization / Demobilization / Contract Costs / OHP				$ 106,480.00
	General Constructioan Subtotal				**$ 2,768,500.00**
Other Contract Costs	*Item Description*	*Unit Price*	*Quantity*	*Units*	*Cost*
	Electrical / Controls / Generator Replacement	$ 250,000.00	1	LS	$ 250,000.00
	HVAC	$ 150,000.00	1	LS	$ 150,000.00
	Other Contract Costs Subtotal				$ 400,000.00
	Total Construction Cost				**$ 3,168,500.00**
	Construction Contingency				$ 475,275.00
	Total Construction Cost w/ Contingency				**$ 3,643,800.00**
Associated Costs	Engineering, Bidding, & Construction Services				$ 728,760.00
	Administration, Financial, & Legal Services				$ 182,190.00
	Total Project Cost (calculated)				$ 4,554,750.00
	TOTAL PROJECT COST (rounded)				**$ 4,555,000.00**

Project B	*Item Description*	*Unit Price*	*Quantity*	*Units*	*Cost*
Water Treatment Plant	Vertical Pressure Filter System	$ 1,202,400.00	1	LS	$ 1,202,400.00
	Existing Filter Media Upgrades (GAC)	$ 55,000.00	1	LS	$ 55,000.00
	Existing Filter Underdrain Retrofit	$ 75,000.00	1	LS	$ 75,000.00
	Clearwell Tank (0.5 MG)	$ 450,000.00	1	LS	$ 450,000.00
	Miscellaneous Concrete	$ 1,000.00	30	CY	$ 30,000.00
	Equipment Installation and Process Piping	$ 250,000.00	1	LS	$ 250,000.00
	Site Piping	$ 125,000.00	1	LS	$ 125,000.00
	Building Extension Envelope (2 floors)	$ 300.00	550	SF	$ 165,000.00
	Building Extension Conc (2 floors)	$ 1,000.00	105	CY	$ 105,000.00
	Rough and Final Grading	$ 50,000.00	1	LS	$ 50,000.00
	Excavation	$ 150,000.00	1	LS	$ 150,000.00
	Subproject Construction Subtotal				$ 2,657,400.00
General Contractor Costs	Construction Cost Subtotal (GC)				$ 2,657,400.00
	Mobilization / Demobilization / Contract Costs / OHP				$ 106,296.00
	General Constructioan Subtotal				**$ 2,763,700.00**
Other Contract Costs	*Item Description*	*Unit Price*	*Quantity*	*Units*	*Cost*
	Electrical / Controls / Generator Replacement	$ 250,000.00	1	LS	$ 250,000.00
	HVAC	$ 150,000.00	1	LS	$ 150,000.00
	Other Contract Costs Subtotal				$ 400,000.00
	Total Construction Cost				**$ 3,163,700.00**
	Construction Contingency				$ 474,555.00
	Total Construction Cost w/ Contingency				**$ 3,638,300.00**
Associated Costs	Engineering, Bidding, & Construction Services				$ 727,660.00
	Administration, Financial, & Legal Services				$ 181,915.00
	Total Project Cost (calculated)				$ 4,547,875.00
	TOTAL PROJECT COST (rounded)				**$ 4,548,000.00**

MRB|group

Project Title Village of Watkins Glen Comprehensive Water System Study
Project No.: 2330.19001
Date: January 2, 2020
Engineer: J. Lang-Bentley

Subject: Comprehensive cost estimate analysis for individual recommended water system improvement projects for CDBG grant funding.

Project C	*Item Description*	*Unit Price*	*Quantity*	*Units*	*Cost*
Steuben Street Storage Tank	Exterior Tank Rehabilitation (Recoat & Sandblast)	$ 16.00	9,377	SF	$ 150,032.00
	Miscellaneous Repairs	$ 35,000.00	1	LS	$ 35,000.00
	Subproject Construction Subtotal				$ 185,032.00
General Contractor Costs	Construction Cost Subtotal (GC)				$ 185,032.00
	Mobilization / Demobilization / Contract Costs / OHP				$ 7,401.28
	General Constructioan Subtotal				**$ 192,450.00**
	Total Construction Cost				**$ 192,450.00**
	Construction Contingency				$ 28,867.50
	Total Construction Cost w/ Contingency				**$ 221,350.00**
Associated Costs	Engineering, Bidding, & Construction Services				$ 44,270.00
	Administration, Financial, & Legal Services				$ 11,067.50
	Total Project Cost (calculated)				$ 276,687.50
	TOTAL PROJECT COST (rounded)				**$ 277,000.00**

Project D	*Item Description*	*Unit Price*	*Quantity*	*Units*	*Cost*
Steuben Street Pump Station	Pump Replacement	$ 11,500.00	1	EA	$ 11,500.00
	Process Piping	$ 50,000.00	1	LF	$ 50,000.00
	Subproject Construction Subtotal				$ 61,500.00
General Contractor Costs	Construction Cost Subtotal (GC)				$ 61,500.00
	Mobilization / Demobilization / Contract Costs / OHP				$ 2,460.00
	General Constructioan Subtotal				**$ 64,000.00**
Other Contract Costs	*Item Description*	*Unit Price*	*Quantity*	*Units*	*Cost*
	Electrical / Controls	$ 100,000.00	1	LS	$ 100,000.00
	Other Contract Costs Subtotal				$ 100,000.00
	Total Construction Cost				**$ 164,000.00**
	Construction Contingency				$ 24,600.00
	Total Construction Cost w/ Contingency				**$ 188,600.00**
Associated Costs	Engineering, Bidding, & Construction Services				$ 37,720.00
	Administration, Financial, & Legal Services				$ 9,430.00
	Total Project Cost (calculated)				$ 235,750.00
	TOTAL PROJECT COST (rounded)				**$ 236,000.00**

Project E	*Item Description*	*Unit Price*	*Quantity*	*Units*	*Cost*
Distribution Network	8" Class 52 Ductile Iron Pipe Watermain	$ 90.00	17,500	LF	$ 1,575,000.00
	Polyethylene Encasement (Polywrap)	$ 1.00	17,500	LF	$ 17,500.00
	8" Gate Valve and Boxes	$ 1,900.00	56	EA	$ 106,400.00
	08" x 06" Tapping Sleeve and Valve	$ 7,000.00	17	EA	$ 119,000.00
	12" x 08" Tapping Sleeve and Valve	$ 8,500.00	6	EA	$ 51,000.00
	Hydrant Unit	$ 6,500.00	32	EA	$ 208,000.00
	Existing Hydrant Removal	$ 750.00	32	EA	$ 24,000.00
	2" Blowoff Assembly	$ 2,100.00	15	EA	$ 31,500.00
	1" Sample Tap	$ 700.00	15	EA	$ 10,500.00
	0.75" Short Side Copper Service	$ 1,400.00	116	EA	$ 162,400.00
	0.75" Long Side Copper Service	$ 2,500.00	116	EA	$ 290,000.00
	Connect New Watermain to Existing	$ 5,000.00	33	EA	$ 165,000.00
	Cut and Plug Existing Watermain	$ 1,750.00	53	EA	$ 92,750.00
	Erosion Control	$ 15,000.00	1	lLS	$ 15,000.00
	Road Pavement Replacement (10' wide)	$ 95.00	8,200	LF	$ 779,000.00
	State Roadway Reconstruction	$ 60.00	200	LF	$ 12,000.00
	Concrete Sidewalk (4' wide)	$ 40.00	960	LF	$ 38,400.00
	Driveway Pavement (Bituminous) Replacement	$ 9.00	39,930	SF	$ 359,370.00
	Lawn Restoration	$ 7.00	6,350	LF	$ 44,450.00
	Subproject Construction Subtotal				$ 4,101,270.00
General Contractor Costs	Construction Cost Subtotal (GC)				$ 4,101,270.00
	Mobilization / Demobilization / Contract Costs / OHP				$ 164,050.80
	General Constructioan Subtotal				**$ 4,265,350.00**
	Total Construction Cost				**$ 4,265,350.00**
	Construction Contingency				$ 639,802.50
	Total Construction Cost w/ Contingency				**$ 4,905,200.00**
Associated Costs	Engineering, Bidding, & Construction Services				$ 853,070.00
	Administration, Financial, & Legal Services				$ 213,267.50
	Total Project Cost (calculated)				$ 5,971,537.50
	TOTAL PROJECT COST (rounded)				**$ 5,972,000.00**

MRB|group

Project Title	Village of Watkins Glen Comprehensive Water System Study
Project No.:	2330.19001
Date:	December 17, 2019
Engineer:	J. Lang-Bentley
Subject:	Cost and finance projection based on various EFC rates and a 30-year loan with reserve funding.

PROJECT	DESCRIPTION
A	Raw Water Intake & Pump Station
B	Water Treatment Plant Upgrades
C	Steuben Street Tank Rehab
D	Steuben Street Pump Station
E	Distribution Network

Loan Rate Basis	Total Project Cost	Total EDUs	Interest Rate	Loan Period	Annual Capital Reserve Fund	Short Lived Assets	Total O&M Costs (Estimated)	New Debt Service (annual payment)	New Annual Operational Cost (with cap reserve)	New Total Annual Cost	New Total Annual Cost Per EDU	New Annual Debt Service Per EDU	New Annual Operating Cost Per EDU	Approx Existing Annual Cost (Total O&M Costs only)
Option 1 - Projects A, B, C, D, E														
EFC Hardship Rate (0%)	**$ 15,600,000**	**1782**	**0.00%**	**30**	**$50,000**	**$0**	**$750,000**	**$520,000**	**$800,000**	**$1,320,000**	**$741**	**$292**	**$449**	**$421**
EFC Subsidized Rate (2.5%)	$ 15,600,000	1782	2.50%	30	$50,000	$0	$750,000	$745,331	$800,000	$1,545,331	$867	$418	$449	$421
EFC Market Rate (4.5%)	$ 15,600,000	1782	4.50%	30	$50,000	$0	$750,000	$957,708	$800,000	$1,757,708	$986	$537	$449	$421
EFC Hardship Rate (0%) at 20 years	$ 15,600,000	1782	0.00%	20	$50,000	$0	$750,000	$780,000	$800,000	$1,580,000	$887	$438	$449	$421
EFC Subsidized at actual connections	$ 15,600,000	1143	0.00%	30	$50,000	$0	$750,000	$520,000	$800,000	$1,320,000	$1,155	$455	$700	$656
RD	$ 15,600,000	1782	2.38%	38	$50,000	$0	$750,000	$627,813	$800,000	$1,427,813	$801	$352	$449	$421
Option 2 - Projects A, B, C, D														
EFC Hardship Rate (0%)	**$ 9,620,000**	**1782**	**0.00%**	**30**	**$50,000**	**$0**	**$750,000**	**$320,667**	**$800,000**	**$1,120,667**	**$629**	**$180**	**$449**	**$421**
EFC Subsidized Rate (2.5%)	$ 9,620,000	1782	2.50%	30	$50,000	$0	$750,000	$459,621	$800,000	$1,259,621	$707	$258	$449	$421
EFC Market Rate (4.5%)	$ 9,620,000	1782	4.50%	30	$50,000	$0	$750,000	$590,587	$800,000	$1,390,587	$780	$331	$449	$421
EFC Hardship Rate (0%) at 20 years	$ 9,620,000	1782	0.00%	20	$50,000	$0	$750,000	$481,000	$800,000	$1,281,000	$719	$270	$449	$421
EFC Subsidized at actual connections	$ 9,620,000	1143	0.00%	30	$50,000	$0	$750,000	$320,667	$800,000	$1,120,667	$980	$281	$700	$656
RD	$ 9,620,000	1782	2.38%	38	$50,000	$0	$750,000	$387,151	$800,000	$1,187,151	$666	$217	$449	$421
Option 3 - Projects A, C, D														
EFC Hardship Rate (0%)	**$ 5,070,000**	**1782**	**0.00%**	**30**	**$50,000**	**$0**	**$750,000**	**$169,000**	**$800,000**	**$969,000**	**$544**	**$95**	**$449**	**$421**
EFC Subsidized Rate (2.5%)	$ 5,070,000	1782	2.50%	30	$50,000	$0	$750,000	$242,233	$800,000	$1,042,233	$585	$136	$449	$421
EFC Market Rate (4.5%)	$ 5,070,000	1782	4.50%	30	$50,000	$0	$750,000	$311,255	$800,000	$1,111,255	$624	$175	$449	$421
EFC Hardship Rate (0%) at 20 years	$ 5,070,000	1782	0.00%	20	$50,000	$0	$750,000	$253,500	$800,000	$1,053,500	$591	$142	$449	$421
EFC Subsidized at actual connections	$ 5,070,000	1143	0.00%	30	$50,000	$0	$750,000	$169,000	$800,000	$969,000	$848	$148	$700	$656
RD	$ 5,070,000	1782	2.38%	38	$50,000	$0	$750,000	$204,039	$800,000	$1,004,039	$563	$115	$449	$421
Option 4 - Projects B, C, D														
EFC Hardship Rate (0%)	**$ 5,065,000**	**1782**	**0.00%**	**30**	**$50,000**	**$0**	**$750,000**	**$168,833**	**$800,000**	**$968,833**	**$544**	**$95**	**$449**	**$421**
EFC Subsidized Rate (2.5%)	$ 5,065,000	1782	2.50%	30	$50,000	$0	$750,000	$241,994	$800,000	$1,041,994	$585	$136	$449	$421
EFC Market Rate (4.5%)	$ 5,065,000	1782	4.50%	30	$50,000	$0	$750,000	$310,948	$800,000	$1,110,948	$623	$174	$449	$421
EFC Hardship Rate (0%) at 20 years	$ 5,065,000	1782	0.00%	20	$50,000	$0	$750,000	$253,250	$800,000	$1,053,250	$591	$142	$449	$421
EFC Subsidized at actual connections	$ 5,065,000	1143	0.00%	30	$50,000	$0	$750,000	$168,833	$800,000	$968,833	$848	$148	$700	$656
RD	$ 5,065,000	1782	2.38%	38	$50,000	$0	$750,000	$203,838	$800,000	$1,003,838	$563	$114	$449	$421

NOTES:

Based on 30 year loan period

Existing annual capital reserve fund is approximatel $17,000, but Village would like to plan for minimum of $50,000 moving forward

Total Exising Annual Operating costs are based on current budget incl existing debt and capital reserve

APPENDIX Q

ENGINEERING REPORT CERTIFICATION

Appendix C: Engineering Report Certification

Engineering Report Certification
To Be Provided by the Professional Engineer Preparing the Report

During the preparation of this Engineering Report, I have studied and evaluated the cost and effectiveness of the processes, materials, techniques, and technologies for carrying out the proposed project or activity for which assistance is being sought from the New York State Clean Water State Revolving Fund. In my professional opinion, I have recommended for selection, to the maximum extent practicable, a project or activity that maximizes the potential for efficient water use, reuse, recapture, and conservation, and energy conservation, taking into account the cost of constructing the project or activity, the cost of operating and maintaining the project or activity over the life of the project or activity, and the cost of replacing the project and activity.

Title of Engineering Report: Engineering Report for the Village of Watkins Glen Comprehensive Water System Study

Date of Report: October 2019

Professional Engineer's Name: Johanna Lang-Bentley, P.E.

Signature: Johanna Lang-Bentley, P.E.

Date: October 2019

APPENDIX R

SMART GROWTH ASSESSMENT FORM

NEW YORK STATE OF OPPORTUNITY. | Department of Health | Environmental Facilities Corporation

Smart Growth Assessment Form

This form should be completed by the applicant's project engineer or other design professional.[1]

Applicant Information

Applicant: Village of Watkins Glen Project No.:

Project Name: Comprehensive Water System Study

Is project construction complete? ☐ Yes, date: ☑ No

Project Summary: (provide a short project summary in plain language including the location of the area the project serves)

In September 2018, representatives of the New York State Department of Health met with the Village of Watkins Glen to conduct a sanitary survey of the public water system. This survey was performed in response to previous surveys and events related to the boil water order issued in August 2018. In response to the recommended improvements outlined by the DOH, the following engineering study provides a comprehensive analysis of the existing Village of Watkins Glen water system. These improvements include water supply, treatment, storage, and distribution system to address water age, infrastructure condition, and water quality. A hydraulic model was used to evaluate system performance and identify problem areas in the network.

Section 1 – Screening Questions

1. Prior Approvals

1A. Has the project been previously approved for EFC financial assistance? ☐ Yes ☑ No

1B. If so, what was the project number(s) for the prior approval(s)? Project No.:

Is the scope of the project substantially the same as that which was approved? ☐ Yes ☐ No

IF THE PROJECT WAS PREVIOUSLY APPROVED BY EFC'S BOARD AND THE SCOPE OF THE PROJECT HAS NOT MATERIALLY CHANGED, THE PROJECT IS **NOT** SUBJECT TO SMART GROWTH REVIEW. SKIP TO SIGNATURE BLOCK.

2. New or Expanded Infrastructure

2A. Does the project add new wastewater collection/new water mains or a new wastewater treatment system/water treatment plant? ☐ Yes ☑ No

Note: A new infrastructure project adds wastewater collection/water mains or a wastewater treatment/water treatment plant where none existed previously

2B. Will the project result in either: ☐ Yes ☑ No

An increase of the State Pollutant Discharge Elimination System (SPDES) permitted flow capacity for an existing treatment system;

OR

An increase such that a NYSDEC water withdrawal permit will need to be obtained or modified, or result in the NYSDOH approving an increase in the capacity of the water treatment plant?

Note: An expanded infrastructure project results in an increase of the SPDES permitted flow capacity for the wastewater treatment system, or an increase of the permitted water withdrawal or the permitted flow capacity for the water treatment system.

[1] If project construction is complete and the project was not previously financed through EFC, an authorized municipal representative may complete and sign this assessment.

IF THE ANSWER IS "NO" TO BOTH "2A" and "2B" ON THE PREVIOUS PAGE, THE PROJECT IS NOT SUBJECT TO FURTHER SMART GROWTH REVIEW. SKIP TO SIGNATURE BLOCK.

3. Court or Administrative Consent Orders

3A. Is the project expressly required by a court or administrative consent order? ☐ Yes ☐ No

3B. If so, have you previously submitted the order to NYS EFC or DOH? If not, please attach. ☐ Yes ☐ No

Section 2 – Additional Information Needed for Relevant Smart Growth Criteria

EFC has determined that the following smart growth criteria are relevant for EFC-funded projects and that projects must meet each of these criteria to the extent practicable:

1. Uses or Improves Existing Infrastructure

1A. Does the project use or improve existing infrastructure? ☐ Yes ☐ No

Please describe:

2. Serves a Municipal Center

Projects must serve an area in either 2A, 2B or 2C to the extent practicable.

2A. Does the project serve an area **limited** to one or more of the following municipal centers?

i. A City or incorporated Village ☐Yes ☐No

ii. A central business district ☐Yes ☐No

iii. A main street ☐Yes ☐No

iv. A downtown area ☐Yes ☐No

v. A Brownfield Opportunity Area ☐Yes ☐No
(for more information, go to www.dos.ny.gov & search "Brownfield")

vi. A downtown area of a Local Waterfront Revitalization Program Area ☐Yes ☐No
(for more information, go to www.dos.ny.gov and search "Waterfront Revitalization")

vii. An area of transit-oriented development ☐Yes ☐No

viii. An Environmental Justice Area ☐Yes ☐No
(for more information, go to www.dec.ny.gov/public/899.html)

ix. A Hardship/Poverty Area ☐Yes ☐No
Note: Projects that primarily serve census tracts and block numbering areas with a poverty rate of at least twenty percent according to the latest census data

Please describe all selections:

2B. If the project serves an area located outside of a municipal center, does it serve an area located adjacent to a municipal center which has clearly defined borders, designated for concentrated development in a municipal or regional comprehensive plan and exhibit strong land use, transportation, infrastructure and economic connections to an existing municipal center? ☐Yes ☐No

Please describe:

2C. If the project is not located in a municipal center as defined above, is the area designated by a comprehensive plan and identified in zoning ordinance as a future municipal center? ☐Yes ☐No

Please describe and reference applicable plans:

3. Resiliency Criteria

3A. Was there consideration of future physical climate risk due to sea-level rise, storm surge, and/or flooding during the planning of this project? ☐Yes ☐No

Please describe:

Signature Block: By entering your name in the box below, you agree that you are authorized to act on behalf of the applicant and that the information contained in this Smart Growth Assessment is true, correct and complete to the best of your knowledge and belief.

Applicant: Village of Watkins Glen	Phone Number: 585-381-9250
Johanna Lang-Bentley, P.E.	MRB Group
(Name & Title of Project Engineer or Design Professional or Authorized Municipal Representative)	
Johanna Lang-Bentley PE	10/8/19
(Signature)	(Date)