BOROUGH OF CHAMBERSBURG

WWTP UPGRADE PROJECT

DESIGN SUMMARY REPORT

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- Aerial Photo of Site with Proposed New Feature Locations
- Preliminary Opinion of Probable Construction Costs

Introduction

The Borough of Chambersburg ("Borough") owns and operates a wastewater treatment plant (WWTP) that serves the Borough, along with portions of Greene, Hamilton, and Guilford Townships, in Franklin County, Pennsylvania. A small portion of Letterkenny Township is also serviced through Hamilton Township.

The Chambersburg WWTP is located in the Potomac River Basin within the Chesapeake Bay Watershed, and will therefore be subject to Total Phosphorous (TP) and Total Nitrogen (TN) limits of the Commonwealth's recently adopted Chesapeake Bay Tributary Strategy.

The Borough and its partners have determined that an upgrade and expansion of the WWTP is required at this time in order to meet the anticipated growth within the service area and to meet the new total nitrogen (TN) and phosphorus (TP) discharge limits that have been established by the PA DEP.

As such, the Borough has contracted with AECOM, in partnership with ARRO Consulting, to provide engineering services for a WWTP Upgrade Project that will meet these objectives. This Design Summary Report ("Report") will provide a general summary of the project.

It is noted that compliance with the Chesapeake Bay Tributary Strategy discharge limits is required beginning in October, 2012. Since the upgraded WWTP will not be fully operational until the summer of 2014, it is anticipated that the Borough will need to acquire "nutrient credits" to meet these requirements in the interim period. The Borough is presently investigating the most cost effective way to acquire these credits.

General Project Overview

The existing treatment facilities at the Chambersburg WWTP are not able to meet the pending nutrient discharge limits. Therefore, an upgrade to the WWTP will be required to meet the TN and TP caps. In addition to meeting the TN and TP caps, an expansion from 6.8 MGD to 11.28 MGD is needed to accommodate the anticipated growth within the service area. A peak design flow of 28.2 MGD, based upon a 2.5 peaking factor, has also been established for the general plant design. As such, all treatment processes are designed to meet permit limits at these flows. However, from a hydraulic capacity standpoint, it has been decided by the Sewer Committee that the facilities must be able to convey a total influent peak flow of 33.5 mgd. This value was arrived at based upon analysis provided by the Borough's conveyance system engineer. This analysis indicated that 33.5 mgd represents the maximum flow that can presently be conveyed by the collection and conveyance system without widespread surcharges within the system. As such, the Sewer Committee selected this same value as the appropriate maximum hydraulic loading to the WWTP.

Based on these design criteria, the new headworks and influent pumping station facility must be sized for 33.5 mgd of influent flow, and all internal conveyance infrastructure must be capable of passing flows that are associated with a peak influent flow of 33.5 mgd. The PA DEP has also indicated that the UV disinfection system must be sized to treat the 33.5 mgd peak flow.

The Chambersburg WWTP upgrades will be broken out into 2 projects that will be bid and constructed separately as described below. Project 1A is nearing the completion of construction, and Project 1B is currently in the bidding process.

Project 1: Part A - Construction of a new Ultraviolet (UV) disinfection system in parallel with the existing system; Part B- Construction of the new forcemain for the new influent pumping station.

Project 2: The remainder of items included in the upgrade project, as described in this report, including construction of a new influent screening and influent pumping station structure to accommodate a peak flow of 33.5 mgd.

As a general summary, the upgrade will consist of the following primary components:

Liquid Processing System Upgrades

- Upgrade of the existing grit removal system by adding a second, parallel unit
- Upgrade and supplement of the existing Vertical Loop Reactor (VLR) treatment process to provide biological nutrient removal. As a general description, under this approach, the primary clarifier effluent will be directed to VLR tank 2, which will be utilized as a pre-anoxic reactor. Submerged mixers will be installed to provide solids suspension without introducing oxygen. Flow would then go into VLR tank 3, which will be operated under minimally oxygenated conditions, around 0.5 mg/l dissolved oxygen (DO) conditions. Then flow will be directed into VLR tank 4, which would be fully aerobic, operated at about 2 mg/l of D.O.

  A new effluent weir, spanning the entire width of VLR tank 4, will be installed to assist in keeping liquid levels in VLR tank 4 at a suitable level as the flows through the tank are significantly increased as a result of the treatment process modifications. Flow will then be directed into the VLR tank 4 effluent trough. Two new 42" pipes will be connected to the existing effluent trough's side wall and will run in parallel prior to tying into a common 60" pipe. Flow will then be conveyed through the 60" pipe to the west, travelling to the area to the south of the biosolids storage pad and the west of the existing final clarifiers where it would discharge into the new post aeration tanks. Effluent from the post aeration tanks would then flow into a deoxygenation tank. Flow will then be pumped back to the VLR tanks, travelling through a new flow splitting meter vault along the way. The meter vault will send a portion of the total flow as internal recycle to VLR Tank 2 (the pre-anoxic reactor). The remaining portion of the flow will discharge into VLR tank 1, which will be converted to a post-anoxic reactor (the aerators will be removed and turned over to the Borough for parts).

  Effluent from the post-anoxic reactor will be piped to a new reaeration tank. Effluent from the reaeration tank would then discharge to the existing secondary clarifier flow splitter box.

- Phosphorus removal will be enhanced by metal salt addition at both the primary and secondary clarifiers.
- Two new final clarifiers will be constructed along and associated return activated sludge (RAS) pumps will be installed.
- The UV System is currently being expanded to accommodate the projected 11.28 MGD average daily flow (ADF).

Solids Handling System Upgrades

The solids handling process will be upgraded so that there are no longer two separate solids products produced, but rather one Class B solids product. This will be attained by the following modifications:

- The waste activated sludge (WAS) will be withdrawn from the secondary clarifiers and pumped to the existing aerated waste sludge holding tank.
- This WAS will be thickened by the existing rotary drum thickeners.
- The thickened WAS will be combined with the gravity-thickened primary sludge in a newly constructed acid phase anaerobic digester.
- Flow from the acid phase digester will be directed into a gas phase digester, which will be provided by converting the existing primary digester to be used for this purpose. The digested sludge will be conveyed into the existing secondary digester (which has a gas-storing Dystor cover) and then into the existing digested sludge storage tank, as is the current practice.
- The digested solids will be pumped from the digested sludge storage tank to the existing belt filter presses to be dewatered and then taken off-site as a Class B biosolids product.

The electrical and SCADA systems will be upgraded as required to accommodate the plant upgrades. All of the upgrades will be designed for the projected ADF of 11.28 mgd with appropriate peaking factors.

Finally, as part of the upgrade project, the Borough plans to construct a new 6 bay municipal vehicle garage.

Following is a more focused discussion of the various aspects of the WWTP Upgrade project.

Mechanical and Process

Influent Wastewater Pump Station

The existing influent wastewater pump station consists of two (2) 16-in Fairbanks Morse vertical turbine solids handling pumps, “VTSH pumps”, (Model VTSH-UWF, 5250 gpm, 69 feet total dynamic head, “TDH”, 1185 rpm, 125 HP) and (5) existing Allis Chalmers centrifugal dry pit pumps (Model 400, 6 x 6 x 17, 1513 gpm, 82 feet TDH, 1175 rpm, 50 HP). The existing vertical turbine pumps are located outdoors and have a dedicated wet well, which is exposed to atmosphere and hydraulically connected to the dry pit pump wet well by a 36-in diameter pipe. The vertical turbine pumps discharge to a single 18-in force main. The existing dry pit pumps are located inside the pump station and discharge to two existing 16-in force mains. Flows from all three force mains combine when they discharge into a single 30-in pipe on the north end of the site, upstream of the grit chamber.

The existing influent pumping station has demonstrated the ability to pump the peak flows that have been experienced during the spring 2011 wet weather conditions, but this was only possible with all of the pumps operating at their full pumping capacity. As such, it is obvious that the existing system will not be capable of pumping the future peak design flow of 33.5 mgd.

Several scenarios for modifying the existing raw wastewater pump station to provide the required future flow were investigated. However, it was determined that the existing wet wells are not large enough to accommodate the pumping capacity required without violating the required net positive suction head requirements or risking cavitation conditions. As such, it was determined that a new influent pumping station would be constructed in conjunction with the new headworks structure.

AECOM and Borough staff have undergone extensive discussions regarding influent pump station design alternatives, have done a site visit and had a workshop session to evaluate alternatives. It has been concluded that the basis of design for the new influent pump station will be a self-cleaning wet well configuration, which employs an influent channel that slopes down to increase fluid velocity prior to discharging into a trench-type wet well in which the pumps are lined up in a single row. This type of self-cleaning trench wet wells can utilize either VTSH pumps or submersible pumps. The Borough staff has discussed this and has elected to use submersible pumps as the basis of design.

In order to provide efficient pumping at the range of flows required that must be accommodated, (approximately 3 mgd during present day overnight conditions, and 33.5 mgd at peak future flow conditions) the pumps will be equipped with variable frequency drives.

Headworks

Flow enters the treatment plant by gravity flow through a 48” sewage interceptor main prior to discharging into the headworks. The existing headworks provides three parallel channels. The first channel has a manually cleaned bar screen, the second channel has a hydraulically operated

JWC grinder (Model 30003-0040-DI), and the third channel serves as a bypass. The channels are separated by removable sliding plates and flow into a single Parshall flume.

The existing influent channels have been evaluated to determine if their hydraulic capacity is adequate for future flow conditions. Analysis indicates that they cannot accommodate the future peak hydraulic design flow of 33.5 mgd that has been established for the project. In addition, storm events experienced during the spring of 2011 resulted in flows that approached the 25 mgd range. During these times, the capacity of the existing headworks was taxed. As a result, it has been concluded that a new headworks will be required as part of this upgrade project.

Upon review of treatment alternatives for the headworks, Borough staff has concluded that an automatically cleaned mechanical fine screen for removal of rags is preferred over continuing the practice of using a grinder to macerate the rags. Borough staff and AECOM visited a treatment facility that successfully utilizes a ¼-inch screen provided by Huber called the RakeMax, which is a single screening unit that could potentially serve the purpose of both coarse and fine screening and is designed to be utilized without an upstream bar screen or other protective device. Huber representatives indicate that the RakeMax screen with ¼" spacing is designed such that the frame itself is used as a course screen with up to 2" bar spacing, and that the bars are designed to be replaceable.

By installing a single screening unit that can serve the functions of both coarse and fine screening, the new headworks can be smaller and therefore more economical than a facility that must have a separate course and fine screen in series. There is another manufacturer (Headworks) that offers a unit model very similar to the Huber unit, so a competitive bidding environment can be provided.

A wash compactor and vertical conveyer will be required to move screenings outside of the new headworks structure into a bin. The Borough has indicated that the design of the new headworks should be performed with the goal of providing an effective system as economically as possible. As such, the basis of design is to have the headworks as an open-topped (not enclosed) structure, and portions of the screenings equipment would be heat traced and insulated to protect against freezing.

It is anticipated that the new headworks will contain a single primary channel, approximately 6 feet wide, which will be equipped with the previously described automatically cleaned screen, as well as a similarly sized bypass channel, equipped with a manually cleaned bar screen.

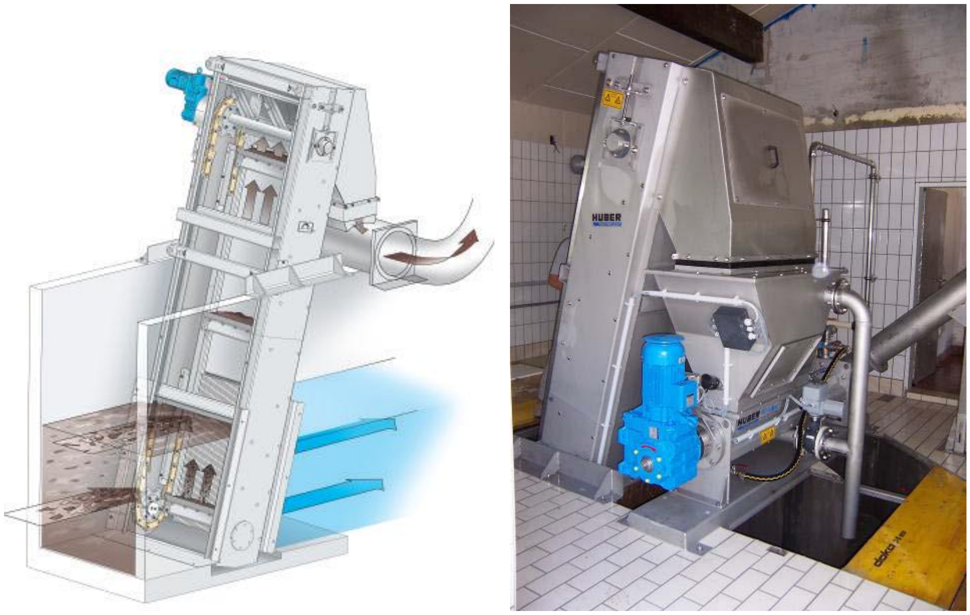
Another necessary component of the new headworks structure will be a reliable influent meter, capable of measuring flows at the peak design flow. AECOM will coordinate with the Borough, its municipal partners, PA DEP, and the Borough's collection/conveyance system engineer (CET) to select a suitable influent flow meter.

The new headworks will consist of a multi-rake mechanical bar screen, wash press, bypass channel with manual bar screen, followed by a self-cleaning trench wet well and (5) submersible solids handling pumps (4 operating and 1 standby). The headworks will be located below grade with an approximate footprint of 90 feet long, 40 feet wide, and 35 feet deep. The screenings area will be covered with a concrete slab to support the screen and wash press. The wet well will be exposed to the elements and not be covered per the Borough's request. A stair, railings, wash down hose reels with 50-ft of 1-in hose, railings, lighting, and ventilation will be provided. Submerged concrete surfaces will be coated with epoxy. Fabricated stainless steel slide gates will be provided to isolate the bypass and mechanical screen. Aluminum stop logs and storage racks will be provided for each slide gate. A motor operated cast iron gate will be installed upstream of the pumps for use during a cleaning cycle. An epoxy coated steel frame will be located over the pumps to support an electric wire rope hoist and monorail, to assist with pump and screenings removal when the manual bar rack is in service. Wet well baffles and flow splitter will be Type 316L stainless steel. Each pump discharge will consist of a magnetic flow meter, pressure instruments, air/vacuum valve, dismantling joint, rubber flapper check valve, and a plug valve. A flood alarm will be provided via float switch and an ultrasonic level sensor will be used to control pump speed. The raw waste water piping will be ductile iron with epoxy coating and ceramic epoxy lining. Exposed piping will be insulated and heat traced.

The mechanical bar screen is based on Huber's RakeMax model 7300/1852/6, ¼-in bar spacing, 75 degree incline, 7-ft channel width, 27-ft discharge height, and a 3 HP drive motor. The screen will be constructed from Type 304L stainless steel and heat tracing is required. A local control panel will be provided with HMI and PLC.

Screenings will be washed, pressed, and discharge into a covered storage bin at grade through a continuous bagger. The wash press is based on Huber's ROTAMAT model WAP 4 with maximum capacity of 140 cubic feet per hour. The wash press will be constructed from Type 304L stainless steel, have a 5 HP drive motor, and be heat traced. Plant water is required.

The rail mounted submersible solids handling raw wastewater influent pumps are based on ABS Model XFP 301M-CH2, with a primary rating of 5,815 gpm at 70 feet TDH driven by variable speed 140 HP 1200 RPM motors. The pumps will have a 12-in discharge, fabricated tail piece with suction bell, be coated with ceramic epoxy, and be capable of passing 5-in solids. Station capacity will be 4 mgd minimum (1 pump running), 11.3 mgd average (2 pumps running), and 33.5 mgd peak (4 pumps) running. The variable frequency drives will be located in the storage area of the existing administration building, located north of the UV reactors. Air conditioning will be provided to cool the VFD's. Pump control panels with HMI will be provided. The location has not yet been finally determined.



Huber RakeMAX Mechanical Bar Screen

Huber WAP wash press

ABS XFP pump

Influent Pump Station Effluent Force Main

At the peak influent design flow of 33.5 mgd, velocities in the existing forcemains that lead to the grit removal system will exceed 11 feet per second (fps). This is higher than is recommended for standard practice when selecting forcemain sizes. An additional consideration for Chambersburg's specific situation is that, since grit removal is not provided prior to pumping, the grit in the wastewater can cause accelerated wear on the forcemain pipe. This is of particular concern in the existing older cast iron 16" forcemains. A final consideration is that when such high liquid velocities exist, sudden stoppages in pumping as the result of pump failure can cause hydraulic surges (pressure spikes) that can potentially cause catastrophic failures.

AECOM's hydraulic modelers have done a preliminary evaluation of potential pressure surges and estimate that pressure surges of up to 138 psi are possible based upon their initial analysis. This is a concern as we are unsure of the original design pressure of the pipe and are also uncertain of the existing condition of these existing 16" cast iron forcemains as they have been exposed to continuous pumping of grit-containing wastewater for many years.

One option that AECOM's hydraulic modelers have proposed is that they could perform additional analysis and generate potential surge mitigation measures, such as special pressure sustaining valves or surge tanks, to buffer the potential effects of an immediate pumping stoppage. It is noted, however, that pressure sustaining valves, or similar valves, are generally designed with "clean water" in mind, so grit-containing wastewater may make maintenance of such valves somewhat labor intensive and make their proper operation suspect in the event that conditions warrant their functioning.

The alternative to tying the discharge of the new influent pump station back into the existing forcemains would be to install a new forcemain from the new influent pump station to the grit removal units. This alternative has several benefits:

1) The new forcemain would be constructed of new ductile iron pipe with a high abrasion resistance coating or some other pipe material that would be more resistant to abrasion from grit containing wastewater than the existing cast iron piping. Additionally, the velocities would be lower in a properly sized new forcemain and the effects of abrasion would therefore be less pronounced. The risk of catastrophic pipe failure would be eliminated.

2) The pressure loss due to pipe friction would be less than through the three existing pipes, so the required pump and motor sizing for the new influent pumps would likely be a little smaller, saving some capital costs.

Due to the uncertainty surrounding the condition of the existing forcemains and with a view to long-term reliability and viability of the influent pumping system, AECOM recommended that the forcemain be replaced as part of the influent pump station replacement project. The Borough has authorized AECOM to proceed accordingly.

Grit Removal

The existing grit chamber is a John Meunier 16-ft diameter vortex type with a 2 HP paddle drive. There are (2) existing centrifugal self-priming grit pumps (Gorman-Rupp Model T4A3-B /F, 7.5 HP) located in the basement of the solids handling building, that feed the existing classifier.
To provide the additional treatment capacity required by this upgrade project, a new grit chamber will be installed. The new grit chamber would be identical to but installed as a mirror image of the existing one. This will promote even flow distribution across both units. Further investigation is required to determine if the two units will be capable of performing over the entire flow range, or if there will need to be a way to switch to operation of a single unit under low flow conditions.

The originally envisioned plan was to demolish the existing truck unloading station to provide the space required for the new grit chamber. Since the existing truck unloading station is currently not being used, it would not need to be replaced. During a walk-thru with plant staff, the concern was raised that this area is near what is believed to be the perimeter of the former garbage disposal site. It was, however, also noted that there had obviously been previous disturbance in this area, which may mitigate the concern of encountering garbage should excavation be performed in this area.

During the recent geotechnical investigations, a boring was taken in this area and no abnormal material was encountered. Construction in this area represents the most operator friendly and cost effective approach if there are not regulatory issues associated with it. As such, since, contingent upon the agreement of the Borough and its solicitor, AECOM would propose to further pursue locating the new grit removal system in this area in a manner that is flexible and responsive to the subsurface conditions that are encountered.

For the new grit removal system, a new sample pump and flow meter will be provided. The new grit chamber will have a dedicated 4-in glass lined ductile iron pipe, routed to grit pumps in the basement of the solids handling building. A 3rd grit pump will be provided so each grit chamber has a dedicated pump and the grit piping will be modified so (1) pump will serve as a common standby. Manual slide gates will be installed on the new grit unit similar to the existing one, to allow for isolation and maintenance. Some modifications to the existing 30-in inlet and 42-inch discharge piping will be required.

An additional hydrocyclone is required and can be mounted on the existing classifier. Plant staff has noted that the bearing on the drive end of the existing grit extraction screw is in need of replacement.

It has been assumed that the existing odor control system will be tied into the new grit chamber inlet channel. However, it must be confirmed that the existing odor control system has sufficient capacity available to accommodate this additional load.

The Existing Grit Chamber

The (2) Existing Grit Pumps

Biological Treatment Process Description

<u>Discussion on Treatment Approach</u>

In recent months, the project approach with regards to the Biological Treatment Process has been modified as the project objectives have been redefined. Originally, the objective of minimizing initial project costs by implementing a phased project directed the approach that was taken. As such, the initially proposed plan was to construct a biological treatment process that would treat approximately 9.0 mgd of average daily flow (ADF) under typical microbiological performance characteristics. The ultimate design ADF of 11.28 mgd was planned to be provided as a second phase project.

Concurrently, a side stream treatment process for the high nutrient-containing belt filter press filtrate was proposed. It is often found that microorganisms that are incubated in these types of side stream reactors develop a high efficiency in nutrient removal functions. As a result, it was proposed to introduce microorganisms incubated in the side stream process to the main biological process in an attempt to enhance the nutrient removal performance of the process. Under this plan, the side stream process would serve two primary functions: 1) it would remove the nitrogen from the filtrate so that it would not need to be treated in the main biological process; and 2) it would provide the potential for reducing the size of a future phase project to increase the biological treatment capacity to the ultimate design capacity of 11.28 mgd. As AECOM performed its initial evaluation of treatment alternatives, these two benefits seemed to warrant the additional capital expense and operating complication that would be associated with sidestream treatment.

However, as the objectives of the Borough and it partner municipalities have been discussed in recent months, the project objective has morphed from a phased approach to constructing all of the required facilities that would be required for complete 11.28 mgd build-out in an initial first stage. As AECOM took a fresh look at the project approach, it realized that one of the two benefits that motivated the original recommendation had now been eliminated – that of optimizing the efficiency of a second phase project. As such, as a step in determining whether it is still a good investment to implement sidestream treatment, we estimated the amount of total additional nitrogen loading that is represented by the belt filter press filtrate. Although the available data on existing filtrate is limited, and it is recognized that the biosolids characteristics will change as a result of the new solids digestion treatment process, it is roughly estimated that the nitrogen concentration in the waste stream would be increased by approximately 5 mg/l if sidestream treatment were not implemented.

Based upon that estimate, AECOM performed evaluations of the effects that eliminating sidestream treatment would impose on the new biological treatment process. AECOM had previously estimated that approximately 2.0 million gallons (MG) of additional aerobic treatment volume would be required at the 11.28 mgd ADF condition. Modeling indicates that this volume would still allow for the necessary detention time to fully nitrify the wastewater even if we did not treat the nitrogen load from the filtrate as a separate side stream process. The additional nitrogen removal capacity of the treatment process would be provided by raising the mixed liquor concentration.

Based upon this analysis, and in light of the change of objective from phasing to constructing for full build-out at this time, AECOM recommended that the Borough eliminate sidestream treatment of the filtrate from the design, which will result in lower overall project costs than if it were included. The Borough has authorized AECOM to proceed accordingly.

Description of Biological System Project Components

Modifications will be made to supplement the existing vertical loop reactor (VLR) treatment process to accommodate the increased flows and to provide for biological nutrient removal (BNR) treatment. Under the modified system, primary clarifier effluent will be directed to VLR tank 2, which would be utilized as a pre-anoxic reactor. The existing VLR aerators will be removed and turned over to the Borough for parts. The existing course bubble diffusers will be demolished. Submerged mixers will be installed to provide a motive force for the liquid and solids suspension without introducing oxygen. Flow would then go into VLR tank 3, which would be operated under minimally oxygenated conditions, around 0.5 mg/l dissolved oxygen (DO) conditions. Then flow would be directed into VLR tank 4, which would be fully aerobic, operated at about 2 mg/l of D.O. Air will be provided from the existing four VLR blowers (3 operating, 1 standby). All four will be piped to a single header at the VLR tanks and two flow control valves and thermal mass flow meters will be provided to distribute air to new course bubble diffusers in VLR tanks 3 and 4. DO probes will be installed to provide a set point for the flow control valves.

A new effluent weir, spanning the entire width of VLR tank 4, will be installed to assist in keeping liquid levels in VLR tank 4 at a suitable level as the flows through the tank are significantly increased as a result of the treatment process modifications. Flow will then be directed into the VLR tank 4 effluent trough. Two new 42” pipes will be connected to the existing effluent trough’s side wall and will run in parallel prior to tying into a common 60” pipe. Flow will then be conveyed through the 60” pipe to the west, travelling to the area to the south of the biosolids storage pad and the west of the existing final clarifiers where it would discharge into the new post aeration tanks. Effluent from the post aeration tanks would then flow into a deoxygenation tank. Flow will then be pumped back to the VLR tanks, travelling through a new flow splitting meter vault along the way. The meter vault will send a portion of the total flow as internal recycle to VLR Tank 2 (the pre-anoxic reactor). The remaining portion of the flow will discharge into VLR tank 1, which will be converted to a post-anoxic reactor (the aerators will be removed and turned over to the Borough for parts).

Effluent from the post-anoxic reactor would be piped to a new reaeration tank. Effluent from the reaeration tank would tie into the existing pipe that feeds the secondary clarifier flow splitter box.

Phosphorus removal will be enhanced by alum addition to both the primary and secondary clarifier feeds. Experience indicates that overall chemical consumption is lower when addition is made at both clarifier feed points. Following is further discussion of the proposed new tanks associated with the biological treatment process.

VLR Modifications and Biological System

Submerged mechanical mixers will be provided in the first and second tanks of the VLR system, which will be utilized as post and pre anoxic zones, respectively, so that recirculation and mixing can be accomplished without the introduction of performance-compromising oxygen into what will be operated as a pure anoxic zone. With the submerged mixers installed, the existing rotors can be removed and can be salvaged for replacement parts for the rotors that will remain in use in VLR tanks 3 and 4.

Surface wasting of foam and filamentous growth will be implemented in the biological treatment system. Control of filamentous (bulking) microorganisms will improve clarifier performance and ensure that the long Solids Retention Times (SRTs) required for nitrification will be maintained. Utility water sprays will be provided to retard filamentous growth.

Plant staff has discussed the potential need for upgrade of the existing VLR drives that will remain in VLR loops 3 and 4. This has been investigated to some extent but a final decision has not yet been made.

Post Aeration Tank

A new post aeration tank (Approximately 2.0 million gallon (MG) total capacity) will be constructed to the west of the existing secondary clarifiers. These aerobic reactors will serve to augment the aeration treatment that is provided in the back portion of the VLR so that complete nitrification is achieved.

The tank will consist of a post-aeration zones, deoxygenation zones, surface wasting pumps, and recycle pumps. The post aeration, deoxygenation, and surface wasting pump stations will be divided into 2 trains operated in parallel to allow for isolation of a single train to accommodate maintenance. Approximate dimensions of the tank will be 140 feet long and 75 feet wide (for both trains combined). The side water depth will be approximately 26 feet. Fine bubble aeration diffusers will be installed and new blowers will be required. At least (1) standby blower will be provided. The blowers will likely be positive displacement rotary lobe type, equipped with variable frequency drives, although the possibility of utilizing screw compressors is also being evaluated due to their high efficiency. The blowers will be located outdoors on a concrete pad with an integral sound-attenuating enclosure. New insulated stainless steel piping will be provided. DO probes and flow control valves will be used to distribute air flow to each diffuser grid. The tank drains will be tied into the existing plant drain system. Slide gates will be provided for isolation.

Deoxygenation Tanks

Deoxygenation zones, approximately 116,000 gallons in total volume, will be constructed immediately downstream of the new post aeration tanks. Similarly to the post aeration tanks, the deoxygenation tanks will be divided into two trains. The dimensions of both trains combined will be approximately 22 feet by 14 feet, with a side water depth of approximately 26 feet. The purpose of these zones is to reduce the dissolved oxygen concentration in the mixed liquor discharged from the post aeration tanks so that it does not introduce oxygen into the downstream anoxic treatment zones, which would inhibit denitrification activity.

Downstream of the deoxygenation zones, an internal recycle pump station will be constructed. This internal recycle pump station will facilitate the discharge a high percentage of the flow into the pre anoxic zone (converted VLR tank 2), while the balance of the forward flow will continue in the biological treatment process to the downstream post anoxic reactor (converted VLR tank 1). (4) vertical turbine solids handling pumps will be provided. Each pump will have a primary rating of 15,000 gpm and 18 feet TDH (3 operating at 65 mgd and 1 standby). Each pump will be driven by a variable speed, 100 HP, 600 rpm motor. Further investigation is required to determine if the Borough's mobile crane is capable of removing the pumps.

Re-aeration Tank

The forward flow from the post anoxic tank will discharge into a new 0.1 million gallon re-aeration tank, divided into two trains. The purpose of the re-aeration tank is to strip out the nitrogen gas that was produced during the denitrification process performed in the secondary anoxic tank and to raise the dissolved oxygen level in the wastewater so that proper settling can take place in the downstream clarifiers. As such, the depth will not exceed 15 feet to facilitate the stripping off of nitrogen gas so that degassing does not occur in the downstream secondary clarifiers.

Fine bubble diffusers and DO probes will be installed in both trains of the re-aeration tank. New insulated stainless steel piping will be provided. The tank drains will be tied into the existing plant drain system. Slide gates will be provided for isolation. The re-aeration tank effluent will flow directly to the final clarifier splitter box through the existing 36-inch pipe.

Final Clarifiers No. 4 & 5

There are (3) existing final clarifiers (Envirodyne Model HB37-TDS-1, 88-ft diameter by 16-ft total side wall). Based upon standard solids loading rate design recommendations, two new final clarifiers will be required to accommodate the additional flows associated with this project.
As part of this upgrade project, new weirs and manual stainless steel slide gates will be installed in the existing final clarifier splitter box to accommodate the new clarifiers. New 30-in cement-lined ductile iron pipe will connect the existing splitter box to the new clarifier inlets. New 24-in cement-lined ductile iron pipes will be tied into the existing 36-in pipe between the clarifiers and UV disinfection. A new 6-in glass-lined ductile iron pipe will be provided to bring scum to the existing final clarifier scum pump station.

New 12-in cement-lined ductile iron pipes will be routed from the new clarifiers to new return activated sludge (RAS) pumps. Plant staff has indicated there have been no significant problems with the existing clarifiers The new clarifiers will be similar to the existing units.

(1 of 3) Existing Final Clarifiers

RAS/WAS Pump Station
There are (4) existing RAS pumps (Allis-Chalmers Model 150, Type NSX, 6 x 6 x 14, 1575 gpm, 22 feet TDH, 705 rpm, 20 HP).

The possibility of extending the east end of the pump station to fit the additional pumps was considered. However, based upon recent discussions with plant staff, it was determined that a new brick and block building, constructed beside the new final clarifiers, is the preferred approach for housing the new RAS pumps.

The Basis of design for the new RAS pumps is horizontal solids handling, Fairbanks Morse 8" E5426 with a primary operating point of 1,575 gpm and 28 feet TDH, driven by a premium efficient variable speed 20 HP, 900 rpm motor. Each pump discharge will have a dismantling joint, rubber flapper check valve and magnetic flow meter, and plug valve.

The pump station will include an electric wire rope hoist and monorail, hose reel with 50-feet of 1-in hose, and flushing connections on the piping. An attached electrical room will be constructed to house the associated variable frequency drives and panel boards.

Ultraviolet Disinfection (UV)
There is an existing channel-type UV disinfection unit (Trojan Model UV4000) that disinfects the treated wastewater prior to discharge. This system consists of two banks, with each bank having 5 modules and each module containing 6 lamps. As such, both banks have 30 lamps each, and the entire existing system has 60 lamps. The existing system has a design capacity of 21 million gallons per day (mgd).

As part of Project 1A which is currently under construction, the Borough is installing a new Trojan UV4000 system that will be constructed in an adjacent channel to operate in parallel with the existing system. The new system will be installed similarly to the existing system, within an adjacent pass of a previously abandoned chlorine contact tank channel. The new system will also have a capacity of 21 mgd, and will have the following design characteristics:

1. Equipment shall disinfect an effluent with the following characteristics:
   a) Peak Flow: 21 MGD
   b) Total Suspended Solids: 30 mg/L, 30 day average of grab samples
   c) Effluent Temperature Range: 33 to 85 ^{o}F

d) Ultraviolet Transmittance @ 253.7 nm: 65 %, minimum
e) Maximum Mean Particle Size: 30 microns
f) Effluent standard to be achieved: 200 fecal coliform /100mL, based on a 30 day Geometric Mean of daily samples for the effluent standard as specified in a) through g). Effluent standard will be guaranteed regardless of influent count to the UV system.

2. The expansion UV system is to be installed in 1 open channel having the following dimensions:
   a) Length: 31.9 ft
   b) Width: 54 in
   c) Depth: 114 in
3. System expansion configuration:
   a) The upgraded UV system will consist of 1 complete UV reactor, 2 level controllers (one to replace existing weir plate and one weir for the new system) and a system control panel.

   b) The new UV system configuration shall be as follows:
      - Number of Banks per Reactor: 2
      - Number of UV Modules per Bank: 3
      - Number of Lamps per UV Module: 10

C. Performance Requirement:
   1. The ultraviolet disinfection system shall produce an effluent conforming to the following discharge permit: 200 fecal coliform /100mL, based on a 30 Geometric Mean fecal coliform. Grab samples shall be taken in accordance with the Microbiology Sampling Techniques found in *Standard Methods for the Examination of Water and Wastewater, 19th Ed.*

   2. The system shall be able to continue providing disinfection while replacing UV lamps, quartz sleeves and ballasts, and while cleaning the sleeves. Both mechanically and chemically.

In addition, as part of this project, the existing system is being modified to reflect improvements that have become available since the installation of the existing system The existing UV4000 Classic version system purchased in 1997 imposed higher head loss than the current version. For sites that had experienced head loss issues with the original system, Trojan developed a retrofit that shifted the UV modules out approximately 2.75”. The Classic 4000 had the vertical lamps in line, whereas the new “Twin” version, which is the version being installed as part of this project, has the lamps offset at 2.75”. This configuration imposes less head loss than the original version. The length of the UV lamps and quartz sleeves was also increased from 24” to 28” in the new version, so part of the retrofit will be to change the size of the lamps and quartz sleeves so that performance is improved and so that these components of both systems are interchangeable.

Following is a description of what is included in the retrofit of the existing system:

- Replacement of the existing UV4000 Module Rack beams
- Installation of a Stainless Steel funnel on the upstream side of the reactor
- Replacing all the 24” long UV lamps with 28” long Lamps
- Replacing all the 24” long quartz sleeves with 28” long quartz sleeves
- Replacing all the Hydraulic cylinders for the quartz sleeve wipers with longer hydraulic cylinders.

With the existing UV system providing 21 mgd of disinfection capacity, and the new system providing an additional 21 mgd of disinfection capacity, the total capacity of the disinfection upgraded system will be 42 mgd. With regards to redundancy that is provided for the system, in the event of an equipment failure or maintenance, as mentioned previously, the existing system has a total of 10 modules with 6 lamps per module and the new system will have a total of 6 modules with 10 lamps per module.

All service work is expected to be done on an individual module basis, so the operators would not need to remove all of the modules in a bank at the same time for servicing. As such, the worst case scenario with regards to treatment capacity would be if an entire module from the new system was out of service, which would reduce the active lamps in that system from 50 to 60 lamps. In such a scenario, the capacity of the new system would be decreased from 21 mgd to 17.5 mgd, thereby decreasing the overall system disinfection capacity from 42 mgd to 38.5 mgd. This is greater than the 33.5 mgd future peak hydraulic capacity of the facility that will be the provided as a result of the future WWTP upgrade design project, so the proposed system will provide sufficient design capacity even with one of the system's largest modules inoperable.


Existing Ultraviolet Disinfection Unit

Acid Phase Digester

A new 90,000 gallon acid phase (pH of 5.5 to 6.0) digester will be constructed, east of the existing primary digester. The tank will be 22-ft diameter, 32-ft straight side, have an 11-ft high cone bottom, a skirt with access to the drain valves, an OSHA ladder and cage, railings on the top, and inspection/sampling ports. It will likely be welded steel with a suitable coating, fabricated in the field. The tank will have level instrumentation (either radar or pressure transmitters) located on the drain pipe. Temperature will be monitored to ensure process optimization. Dual pressure/vacuum relief valves with flame traps will mounted on the top.

A jet type mixing system will be provided with (2) horizontal chopper pumps (1 operating, 1 standby) and (3) discharge nozzles inside the tank. Each pump will be rated for 650 gpm and have a direct driven 10 HP, 1200 rpm motor. Piping and nozzles will be ductile iron and coated with epoxy.

Approximately 10% of the total gas in the digestion process will be produced during the acid phase. Based on data from similar process at a different plant, gas composition is expected to be

25% methane and 75% carbon dioxide. A new candlestick type waste gas burner with natural gas pilot will be provided to burn the acid phase waste gas. Since the gas will not burn at 25% methane, the waste gas will need to be blended with natural gas. The waste gas burner will be located adjacent to the existing burner and be provided with a pilot and control panel, back pressure regulator, flame trap, fire-safe isolation valves, flow meter, and monometer.

The digester will be designed for 200 Degrees F and but will normally operate around 140 Degrees F. The existing Bryan boiler will be demolished and replaced with a new dual fuel (natural and digester gas) boiler capable of producing steam. A tee will be installed on the discharge of the existing heat exchanger in the digester building and a new pipe will carry heated sludge to the acid phase digester. Approximately 1700 lb/hr of 75 psig steam will be mixed into the new heated sludge pipe through a control valve. A drain and overflow pipe will be provided. (3) outlet pipes will be mounted inside the tank at different elevations. Digested sludge will flow by gravity to the gas phase digester (the existing primary digester with floating cover). Flow control will be provided by motor-operated pinch valves that are controlled by a level monitoring system.

Gas Phase Digester

The Borough has an existing 60-ft diameter by 23-ft high primary digester with a USFilter/Envirex steel floating cover. This existing primary digester will be modified to operate as the gas phase digester. There are (2) existing mixing pumps mounted on the cover that do not provide the required mixing. A new jet type mixing system will be provided with (2) horizontal self-priming chopper pumps (1 operating, 1 standby) and (2) sets of mixing nozzles. Each pump will be rated for 1800 gpm, 37 feet TDH, with an output speed of 785 rpm. The pumps will be driven by belt and a 30 HP, 1800 rpm motor. A new linear motion mixer was also investigated for mixing but complications associated with modifications to the center dome, sludge piping, and gas piping that would be required to accommodate the new linear motion mixer made this option less attractive. The digested solids in the gas phase digester will be pumped to the existing secondary digester, then to the sludge holding tank, before flowing by gravity to the sludge pumping station to be pumped to the belt filter presses for dewatering.

Floating Cover on the Existing Primary Digester

(1 of the 2) Existing Mixing Pumps

Solids Handling Piping Changes
Currently the Gravity Thickener (GT) operates without elutriation water. This can lead to odor issues and rising solids which reduce the concentration fed to the digester. To address these concerns, WWTP staff has asked that this upgrade project make provision for plant water addition to provide elutriation (dilution) water for the primary solids feed to the GT. It has been proposed that this be accomplished by adding plant water to the discharge of the primary sludge transfer pumps at the Primary Sludge pump station. Further investigation is required to determine if the existing utility water pumps would need to be supplemented or replaced to provide the required flow and pressure for this purpose.

Currently there is no means for transferring primary sludge to the rotary drum thickening system. Adding a small amount of primary sludge to the RDT system will reduce polymer demand and improve percent solids performance. This capability will be provided by the addition of remotely actuated valves, located on the discharge of the primary clarifier sludge pumps that feed to the gravity thickener, to "jumper" primary solids to the new VLR surface wasting lines which will be used to introduce approximately a 10% mix of primary solids to the RDT WAS storage tank, which is the percent composition that experience indicates optimizes thickening performance.

Chemical Addition
Heated fiberglass sheds will be provided for new chemical feed equipment. Metal salt addition (alum is typically the preferred choice for wastewater facilities that utilize UV disinfection) will be utilized at the primary and secondary clarifiers for phosphorous removal. The biological modeling results indicate that sodium hydroxide will not be required in the biological treatment process for pH adjustment. However, in order to provide for flexibility in operations and to provide a contingency for unexpected circumstances, Borough staff has requested that provision of a future pH adjustment chemical feed system be provided. As such, the current project will be designed such that a future pH adjustment system will be possible if deemed necessary. The Borough has expressed a preference for magnesium hydroxide.

A supplemental carbon source will also be required at the secondary anoxic tank to accommodate the denitrification treatment process. Glycerol has been discussed as a possible supplemental carbon source alternative.

The use of these chemicals will necessitate some safety measures for compliance with regulations. A safety shower is required because of the use of sodium hydroxide and alum. Additionally, dependent upon the type of supplemental carbon source that is selected, a fire suppression system may be required.

<u>Electrical</u>

Emergency Generator and Electrical Service Upgrade

The plant is served from two separate underground primary service laterals and two separate pad-mounted transformers. The Borough has two existing 1980 vintage 500 kW generators cannot handle the entirety of the existing plant loads. It is reported that the Belt Filter Presses cannot be operated when the plant is on generator power.

The approach on "back-up" power supply, or duplicate electrical power supply to the WWTP, has been modified over the past year based upon discussions and additional information that has come to light regarding the existing system. Specifically, as discussed previously, it was originally planned to provide supplemental emergency on-site power generation in order to provide back-up power for the entire upgraded treatment system.

This initial approach has been revisited after it became known through the electrical department that there are two separate utility feeds to the facility. Because the treatment facility is equipped with two separate electrical feeds from the Borough, it was thought that DEP's view may be that this satisfies the Department's power redundancy requirement. We have corresponded with Mr. Jay Patel at PA DEP and he has concurred that the two electrical feeds from two separate substations would fulfill the duplicate power requirement. As such, not relying upon any other emergency power generation is an option for the Borough.

The Borough has evaluated the alternatives and elected to invest in having the security of uninterrupted power supply for critical facility equipment in the event that both of the utility services from the Borough were lost. Specifically, this equipment would include the new influent pumping station pumps, the new internal recycle pumps, and the UV disinfection system. Preliminary observations indicated that the existing power generation facilities may be able to provide the necessary power for these operations.

After preliminary sizing of the critical components (the new influent pumping station pumps, the new internal recycle pumps, and the UV disinfection system) was completed, calculations were run using four of the five influent pumps, three of the four internal recycle pumps, and the two UV system loads. This mode of operation would facilitate the full 33.5 mgd peak design flow of the upgraded facility. However, even when operating the two existing 500 kW generators in parallel, the load is too large and would require two 600 kW generators running in parallel.

To keep the loading on the existing generators to within the capacity of those generators would require one additional recycle pump and one additional influent pump to be locked off during generator use. That would mean that only three of the five influent pumps and two of the four recycle pumps along with the two UV units can operate on the existing generators. Operationally, it would be possible to continue forward flow at 33.5 mgd influent flow with only two recycle pumps operating if the recycled flow to the pre-anoxic was eliminating during this time. However, the influent pumping capacity would be reduced below the 33.5 mgd design influent pump station capacity with only three of the five influent pumps operating. A decision will need to be made with regards to how to use the existing generators or how to address the critical path loads in an alternative option.

The Borough would also like to install new gear and wiring as part of this project to accommodate the potential future installation of a larger generator. Since the impetus for this provision is the benefit of the Borough's electrical department, the associated costs for this portion of the project would be the responsibility of that department. The design criteria of this portion of the project will need to be defined by the electrical department based upon their anticipated plans.

It has also been discussed at meetings with Borough staff that if the practice of on-site emergency power generation is continued, it would be beneficial for the existing generator transfer switch(es) to operate in a closed-transition configuration. During exercising of the generator, this allows the loads to be transferred to the generator(s) virtually unnoticed. Plant staff has mentioned that they currently need to bring in a portable heat bar unit to test the generators under load. This is inconvenient and requires additional cost. Furthermore, when switching to generator power, it is reported that lamps in the UV system are oftentimes damaged. These issues will be considered as a final decision on the approach to emergency power generation is finalized.

As mentioned previously, the plant is served from two separate underground primary service laterals and two separate pad-mounted transformers. The two transformers are rated at 1,500 and 2,500 kVA. Both transformer secondary feeders route from the transformers into the existing switchgear located in the Main Electric Building. Field investigations confirmed that the existing switchgear has a 3000-amp rating.

The existing plant main electrical equipment located in the existing electrical building is sized at 3000 amps. With the increase of process, the load will require 6000 amps at 480 volts. The included single line diagram shows an anticipated layout for plant power to the major components. Given that a new electrical building was proposed, it is expected that two new medium voltage services be brought to two new pad-mounted transformers located in the vicinity of the new building. The existing medium voltage services and transformers will be demolished.

Many of the loads on the existing switchboard will remain but others will be relocated to the new electrical building switchboard. The intent of relocating loads and the switchboard breakers is to keep the distance between the switchboard and the loads as short as possible to control voltage drop. The single line diagram shows those loads as they relate to the switchboards.

In the 30% design documents, a drawing was provided showing a critical path switchboard that includes the loads that relate to the requested generator backup power. The motor control centers and panel boards, which include these loads, are shown on the single line diagram. This is shown as though the critical path assumes that three of the five influent pumps and two of the four recycle pumps, along with the two UV systems is acceptable. This scenario will be adjusted accordingly as a determination is made on how to address the critical loads.

Existing Digester Building

There was a concern about how much change would have to be made to the electrical systems within the digester building when minor equipment changes are made. The concern was based on certain areas within the building being classified as hazardous and whether that would require more extensive upgrades to the existing systems. Mr. Joe Mellott of Commonwealth Code Inspection Service was asked to meet at the site so that he had first hand information on the situation and could offer an opinion on what had to be done to adhere to the National Electrical Code. According to Mr. Mellott, he felt that only those modifications necessary to address the minor equipment changes would need to be made. He did say that Mr. Bill Chittester, his supervisor, would be the person making the final decision; however, Mr. Mellott felt that given Mr. Chittester's fair handling of these situations, there should be no problems.

Electrical Components

a. Introduction

At this early stage of the project, it is premature to designate those electrical components that will remain or those that will be added based on the design. If there are manufacturers the Client prefers, they will be incorporated into the design specifications with equals or no equals depending on the Client's requirements.

There are areas where unclassified or hazardous conditions exist. These areas will be addressed both by ventilation means and equipment meant specifically for the areas. By ventilating in specific ways, there are some hazardous areas that can be degraded to lesser conditions and there are areas that can be downgraded to unclassified conditions.

b. Applicable Codes and Standards

All of the codes applicable to the project cannot be identified at this early stage of the project; however, there are some codes that are known to apply and, as such, will be followed. These include the following:

- National Electrical Manufacturers Association (NEMA).
- Occupational Safety and Health Administration (OSHA).
- American National Standards Institute (ANSI).
- National Fire Protection Association (NFPA).
  - NFPA 70; 2011 National Electrical Code, and current amendments.
  - NFPA 820 – Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
- Underwriters' Laboratories, Inc. (UL) Listings, Labels, and Approvals shall govern the quality and performance of certain specified Products.
- Institute of Electrical and Electronic Engineer (IEEE).
- Insulated Cable Engineers Association (ICEA).
- International Building Code as pertinent.

As the design progresses into the next stage, the AECOM Team will discuss with the Borough whether there are local electrical codes that should have bearing on the design.

c. Existing Electrical Distribution

It is apparent that the electrical distribution equipment will have to be evaluated based on the upgrade plant loading. There will be locations where the distribution system will remain undisturbed while areas with upgrades will command changes. Those areas where change is warranted, additional capacity will be built in to accommodate reasonable future loads.

d. Site Lighting

There will be areas of disturbance where existing site lighting might be interfered with due to the upgrades. In these instances, new site lighting will adhere to the existing lighting appearance, type of lamp, and distribution pattern as much as possible. Tank catwalks and building walls will receive lighting treatment to complement the site lighting. The control of site lighting will be a continuation of the existing methods of control. All lighting will be designed with energy efficiency in mind.

Instrumentation and Control

a. Introduction

The existing plant is operating through a redundant set of in-plant Supervisory Control and Data Acquisition (SCADA) systems using CitectSCADA by Schneider Electric. The design intent is to expand the system to incorporate the added facilities, but maintain the human-machine interface so as not to make the plant Operators learn an entirely different system.

b. Applicable Codes and Standards

Instrument Society of America (ISA)
National Electrical Manufacturers Association (NEMA)
Occupational Safety and Health Administration (OSHA)
American National Standards Institute (ANSI)
National Fire Protection Association (NFPA)
Scientific Apparatus Makers Association (SAMA)
Institute of Electrical and Electronic Engineer (IEEE)
Electronic Industries Association (EIA)
Insulated Cable Engineers Association (ICEA)
Local Power and Telephone Companies

c. Existing SCADA Systems

The existing plant wide system will remain in place. Buildings presently have remote terminal units for input/output functions as well as message display units. These I/O units are connected to the master via fiber optic cables.

d. Proposed SCADA Interface

The main program will be expanded to accommodate the plant upgrade. Remote I/O will be added to each new facility and existing remote I/O systems will be modified to follow changes to process within existing facilities. New I/O will be connected to the master via fiber optic cables.

e. Instrumentation

The equipment used for monitoring process conditions will be specified with consensus from the Borough in those areas for which there is a choice of equipment.

f. Installation and Testing

All hardware and system programs shall be completely factory tested under simulated operating conditions. In addition, the Owner and/or Engineer can be called on to witness a Factory Acceptance Test (FAT). This test is very costly since the Owner and/or Engineer could be at the plant for a week or so. In lieu of this, a Web-X virtual setup can be held over the Internet with none of the parties leaving home. At these sessions general conditons with similar functions are reviewed. The expected correct operations are then programmed at the site.

The FAT test procedures shall follow, insofar as they apply, to Section 8, Recommended Tests for Interacting Systems established by the Instrument Society of America under Standard RP 55.1 and the Factory Acceptance Plan detailed within these Specifications. The submittal shall contain a schedule identifying each testing activity. Upon satisfactory completion of each testing activity, the System Manufacturer shall provide the certification and documentation.

The availability of the entire distributed control system shall not be less than 99.97 percent with a mean time to repair (MTTR) of two (2.0) hours for any consecutive period of six months during the one (1) year guarantee period. Availability, MTTR and other supporting terminology shall be as defined in SAMA Standard PMC32.1-1976.

<u>Structural</u>

There will be several new concrete tank structures included in the project. The Borough has requested that the project bidding documents be structured such that prices are obtained for both cast-in-place and precast concrete structures.

Following are the criteria that will be used for design:

- Design shall conform to the current edition of the International Building Code.
- Loading criteria and loading combinations for buildings and structures shall conform to the American Society of Civil Engineers ***Minimum Design Loads for Buildings and Other Structures*** (ASCE/SEI-7) unless more severe loadings are required by the applicable building code.
- Design and placement of structural concrete shall conform to the American Concrete Institute ***Building Code Requirements for Reinforced Concrete*** (ACI 318).
- Design and placement of concrete for liquid containment structures shall follow the American Concrete Institute ***Code Requirements for Environmental Engineering Concrete Structures*** (ACI 350) in addition to the requirements of ACI 318.
- Design, fabrication, and erection of structural steel shall follow the American Institute of Steel Construction ***Specification for Structural Steel Buildings*** (June 1, 1989) and the 9th Edition (1989) of the AISC Manual of Steel Construction.
- Welding procedures and qualifications for welders shall follow the recommended practices of the American Welding Society D1.1 Structural Welding Code.
- Design and erection of masonry materials of brick, concrete block, or structural tile shall conform to the ***Building Code Requirements for Masonry Structures*** (ACI 530 / ASCE 5 / TMS 402) and the ***Specifications for Masonry Structures*** (ACI 530.1 / ASCE 6-99 / TMS 602) reported by the Masonry Standards Joint Committee.

<u>Architectural</u>
Codes and Regulations

The following codes and regulations shall be used to perform the architectural work for the project:

- Building Code – 2009 International Building Code (IBC) with local amendments
- Fire/Life Safety Code – 2009 International Fire Code
- Accessibility Code – 2009 IBC Chapter 11 & 2003 ICC/ANSI A117.1 Accessible and Usable Buildings and Facilities
- The American Disabilities Act (ADA)
- Energy Code – 2009 International Energy Conservation Code (IECC)
- Occupational Safety and Health Act (OSHA) Regulations

Energy Code Requirements

The Borough of Chambersburg is located in Franklin County and is classified as Climate Zone 5A by the IECC. Minimum building envelope requirements for opaque assemblies in Zone 5A are as follows:

- Roofs with insulation entirely above deck – R-20ci
- Above grade mass walls – R-11.4ci

- Below grade walls – R-7.5ci
- Mass Floors – R-10ci
- Unheated slab-on-grade floors – No Requirement
- Swinging opaque doors – U-0.70
- Roll-up doors – U-0.50

Exterior Materials Overview

It is anticipated that a new electrical building will be required as part of the upgrade. The new building will be a single story masonry bearing wall structure with a flat roof and be similar in appearance to the existing Solids Handling and RAS buildings. The walls will be constructed of a CMU back-up wall with an air space/insulation cavity and concrete masonry veneer. The architectural aesthetic will complement the existing structures but will not be identical.

The roofing material will be a light colored multi-ply modified bitumen with a 25 year minimum service life. The light color will reflect the sun's energy, keeping the building cooler in the summer months while helping to reduce the heat island effect caused by dark colored surfaces. Doors and louvers will be constructed of anodized or Kynar finished aluminum for durability, corrosion resistance and minimal maintenance.

The addition to the RAS Building will receive a similar material palette and aesthetic as the original structure. Existing materials will be investigated and upgraded as required. The new addition will comply with the latest applicable codes.

Interior Materials and Finishes

Interior finishes will be selected for durability, ease of maintenance and appearance. The selection of finishes, furnishings, colors, and lighting will be analyzed in much greater depth during detailed design. Proposed preliminary finish choices are as follows.

Wall finishes and materials will be selected for maintainability, sound absorption and light reflectance. Paint colors will be chosen for visual balance and light reflectance of interior spaces. Interior doors will be painted hollow metal doors for durability. Process area finishes will be selected for minimal maintenance. Concrete floors will receive liquid hardener or dust proof sealer as appropriate. CMU walls will be painted for light reflectance and to provide an easily cleanable surface. Ceilings will be exposed steel framing or concrete with a paint finish. Metals such as guard railings shall be provided with a clear anodic finish and hatches will be corrosion resistant mill finished aluminum. Overhead structures such as monorails and specific floor areas will receive safety paint markings.

Safety

The facility will be designed to meet applicable code requirements for safety. Specific signs, equipment colors and other measures as required by code will be incorporated into this design to provide a safety conscious working environment. First aid kits and fire extinguishers will be provided.

Energy Conservation
The entire building envelope will contain sufficient insulation so as to satisfy, in conjunction with heating and ventilation equipment, the area temperature requirements that are determined in the HVAC design.

Sound Control
The acoustical design for the new structure that houses the new generator(s) will include the use of acoustical masonry walls and insulated metal doors.

<u>HVAC</u>
At this conceptual design phase of the project, the HVAC design has not yet been initiated since evaluation of HVAC requirements must follow the preliminary design of the other disciplines. The following codes and regulations shall be used to guide the HVAC for the project:

- Mechanical Code – 2009 International Mechanical Code (IMC)
- Energy Code – 2009 International Energy Conservation Code (IECC)
- American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc. (ASHRAE)
- National Fire Protection Association (NFPA)
- Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)

Design Conditions:

Outdoor Design Temperatures: (Reference: ASHRAE Fundamentals, 2009)
Summer: 89.6 deg F dry bulb, 72.5 deg F wet bulb
Winter: 8.7 deg F

Indoor Design Temperatures: Indoor spaces shall maintain 55 degrees F in process spaces in the winter and 104 degrees F in the summer. Electrical rooms shall be air conditioned to 85 degrees F to protect sensitive equipment.

<u>Plumbing and Fire Suppression</u>

Codes and Regulations
The following codes and regulations shall be used to guide the plumbing and automatic fire suppression for the project:

- Plumbing Code – 2009 International Plumbing Code
- Energy Code – 2009 International Energy Conservation Code
- Fire/Life Safety Code – 2009 International Fire Code
- National Fire Protection Association (NFPA) standards

Alum and supplemental carbon chemical storage tanks will be located outdoors. A combination emergency shower/eye wash unit will be provided in the vicinity of the storage tanks. The walking time from potential hazards to a shower/eye wash unit is recommended by ANSI Z358.1 not to exceed 10 seconds. Since the distance to existing buildings from the outdoor storage tanks will be in excess of this amount, a packaged emergency shower/eye wash building is proposed. The heated packaged building will house the shower/eye wash unit, tempered water heating equipment, and local and remote alarms. Connections to the municipal water supply, sanitary sewer, and electric utility will be provided.

The proposed RAS pump building will be equipped with a potable cold water wash-down station, floor drainage system discharging to the sanitary sewer, and a flat roof drainage system discharging to grade.

There is no other plumbing and automatic fire suppression work included in the current scope of the project.

<u>Permitting</u>

Based upon the project components that have been established at this point, it is anticipated that the following permits will be required.

- Water Quality Management Part II Permit, for each of the three projects, which will include:
    i. General Information Form (GIF)
    ii. PA Natural Diversity Inventory (PNDI). Scope of Work is based on no PNDI "hits" requiring additional permits, meetings, reports, site visits or other work.
    iii. PA Historic & Museum Commission (PHMC). Scope of Work is based on no PHMC "hits" requiring additional permits, meetings, reports, site visits or other work.
    iv. Engineer's Report
- Erosion & Sedimentation Control Permit for projects 1B and 2.
- Demonstration of Compliance with International Energy Code
- Air Quality Request for Determination (RFD). It is noted that, based upon preliminary investigations and discussion with the Borough, it does not appear that there is an existing air quality permit for the WWTP. Based on the scope of the project set forth in this BDR, which assumes no additional generators will be installed, it appears that air quality permit or request for determination will not be required.
- NPDES Permit for Stormwater Discharge for Projects 1B and 2.
- Wetlands walkover, assessment and delineate with flagging.
- Storage Tank Registration & Permitting for new tanks (>250 gals of regulated substance)
- Land Development Plan for Projects 1B and 2: Based on the site work involved with this project, it is anticipated that the sketch plan and preliminary plan submissions will be waived such that only a final land development plan will be submitted to the Borough's Zoning Hearing Board, Planning Commission and Council. Generally the approval process takes about four months. Due to the similar project timing for Projects 1B and 2, as well as the overlap of the areas affected by the two projects, the alternative of combining the Land Development Plans for both is being investigated.

Additionally, given that the plant is located beside a creek, typical stormwater practice is to have the peak stormwater discharge from this site enter the creek as soon as possible so that the site's stormwater does not contribute flow to the creek at the same time that the creek flow peaks due to upstream discharges. As a result, consistent with AECOM's design proposal, this BDR anticipates that the stormwater calculations, report and detention requirements will be waived following the Borough's "no harm" option. Stormwater best management practices will be incorporated into the civil design when feasible.

<u>Survey</u>

Survey of the site, by Dennis E. Black Engineering, including a site survey and elevation survey of points critical to the hydraulic profile evaluation has been completed.

<u>Geotechnical Investigations</u>

The geotechnical subconsultant, ECS, has completed its field investigations and provided a geotechnical report which is being used in the design of the new facilities.

<u>Additional Items</u>

This upgrade project included construction of a 6-bay municipal garage. The specific characteristics of the garage are still being decided. The garage bays will have overhead doors with a minimum height of 12 feet and a minimum width of 14 feet. To accommodate the vehicles that may be stored there, the building will be a minimum of 40 feet deep. It is preferred by plant staff that the building be heated as an open floor plan. If this is not the case, at least one bay must be heated for the vactor truck and one bay must be heated for working on equipment. Floor drains will be provided of suitable size to accommodate melting snow from trucks and equipment and to accommodate water from washing the floor. The Borough is evaluating whether a water fountain and a single occupancy bathroom and sink will be provided.

A draft of the Combined Heat and Power (CHP) Study has been completed, which evaluated the options for utilizing the digester gas produced by the anaerobic digestion process. AECOM has reviewed this draft document with WWTP staff. The initial impressions are that implementation of CHP alternatives will not be recommended at this time based upon economic considerations.

Currently the design basis for the two phase anaerobic digestion process is to provide for a Class B biosolids product. It should be noted that at some point in the future, when future flows and loads to the WWTP increase, Class B will need to be met through fecal testing as opposed to a 15 day SRT per the EPA's 503 PSRP regulations. The low SRT operation has been employed successfully at other plants to meet Class B such as Back River, MD; Bergen County, NJ and East Bay Municipal Utility District in Oakland, CA.

Although the Borough has directed that the design basis for the two phase anaerobic digestion process is to provide for a Class B biosolids product, it has also requested that the design include provision for future adaptation of the process to produce a Class A biosolids product. This could be achieved by operating the acid phase and/or the methane phase reactor at thermophilic conditions.

Since the design includes only one methane phased digester, keeping the ability to bypass the digestion process and dewater unstabilized sludge is recommended as a backup disposal option. Landfill disposition of un-stabilized dewatered cake will provide a back up method for disposing residuals in case the gas phase digester has to be taken out of service for cleaning or maintenance. This method of disposal can also be employed as a contingency in the future in the unlikely event that sludge failed to meet Class A or Class B standards.

<u>Anticipated Project Schedule</u>

Following is the anticipated project schedule for Project 1:

Part A: UV System Upgrade

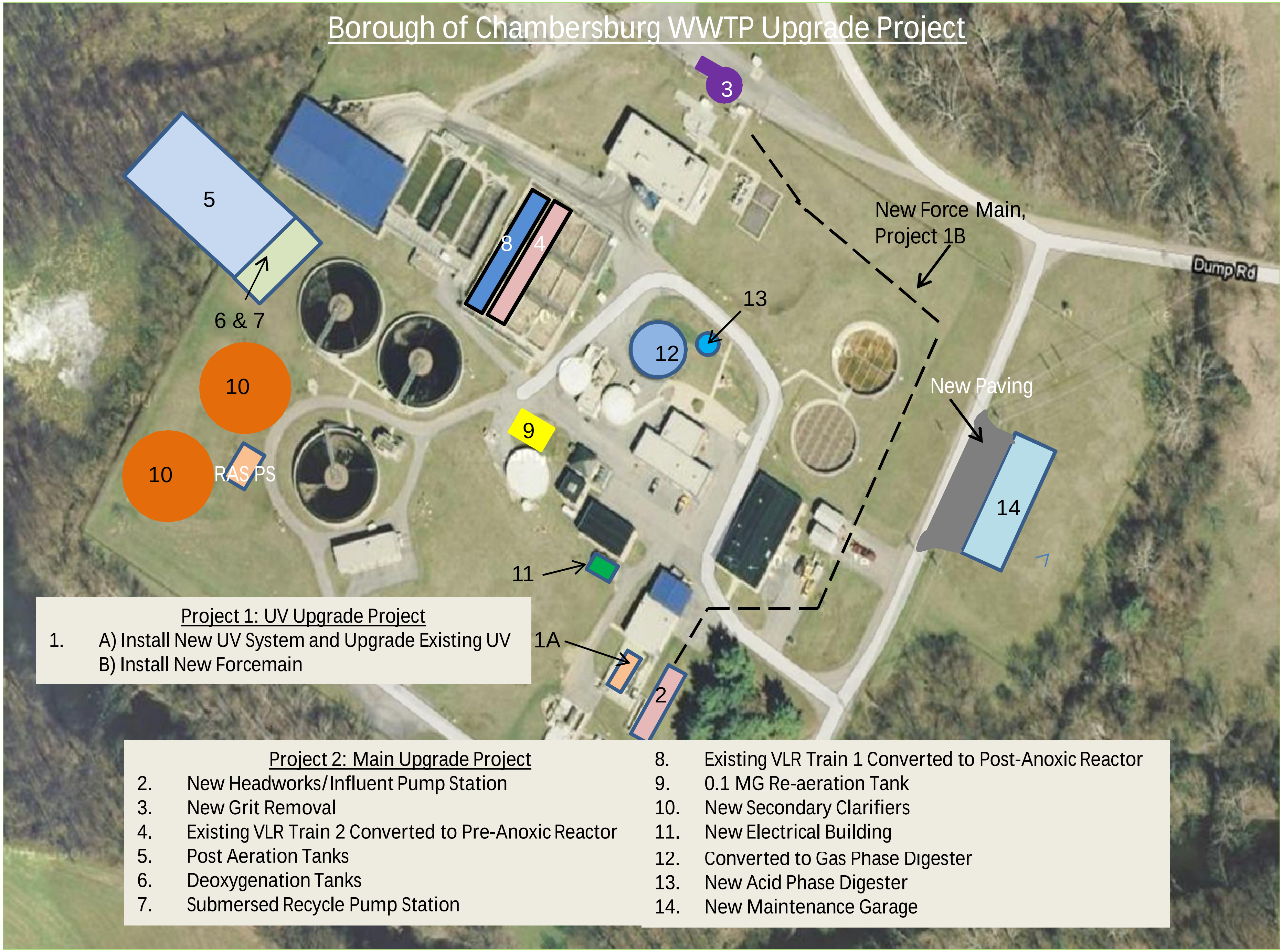
- March 2012: Construction Complete

Part B: New Forcemain

- Beginning of February 2012: Bids Opened
- Beginning of Summer 2012: Construction Started
- End of Summer 2012: Construction Completed

Following is the anticipated project schedule for Project 2:

- December 2011: 30% Design Submitted for Borough Review
- March 2012: 60% Design Submitted for Borough Review
- May 2012: Submit Water Quality Management (WQM) Part II Application to PA DEP for Review
- August 2012: Receive PA DEP WQM Part II Approval
- September 2012: Documents 100% Complete, Project Advertised for Bidding
- November 2012: Open Bids
- December 2012: Contract Awarded
- Summer 2014: Construction Complete, Start-up Performed


Borough of Chambersburg WWTP Upgrade Project
New Force Main,
Project 1B
Dump Rd
5
6 & 7
8
4
3
13
12
10
10
RAS PS
9
New Paving
14
11
1A
2
Project 1: UV Upgrade Project
1. A) Install New UV System and Upgrade Existing UV
B) Install New Forcemain
Project 2: Main Upgrade Project
2. New Headworks/Influent Pump Station
3. New Grit Removal
4. Existing VLR Train 2 Converted to Pre-Anoxic Reactor
5. Post Aeration Tanks
6. Deoxygenation Tanks
7. Submersed Recycle Pump Station
8. Existing VLR Train 1 Converted to Post-Anoxic Reactor
9. 0.1 MG Re-aeration Tank
10. New Secondary Clarifiers
11. New Electrical Building
12. Converted to Gas Phase Digester
13. New Acid Phase Digester
14. New Maintenance Garage

Borough of Chambersburg WWTP Upgrades
Preliminary Opinion of Probable Capital Costs February 2012

Project 1: UV Upgrade/New Forcemain & Yard Piping Installation

A) Low Bid received for UV Project	$988,800
B) Estimated cost for Forcemain Installation Project	$400,000
Project 1 Preliminary Opinion of Probable Construction Cost Estimate:	$1,388,800
20% (Before Grant Reduction) for Engineering, Legal, Admin. and Financial Services*:	$277,760
Associated H2O Grant Allocation:	($1,000,000)
Preliminary Opinion of Probable Capital Cost for Project 1:	$666,560

*10% of $1M grant for engineering and 3% of $1M grant for legal expenses ($130,000 total) are eligible for grant reimbursement.

Project 2: Main Upgrade Project

New Headworks/Influent Pump Station	$8,500,000
Grit Removal	$500,000
Existing VLR Tank Modifications	$700,000
New Process Tanks, Equipment, and Associated Piping	$7,000,000
New Secondary Clarifiers and Flow Splitter Box Modifications	$3,000,000
New RAS Pump Station	$800,000
Solids System Improvements	$2,700,000
Chemical Feed Systems and Associated Safety Provisions	$500,000
Electrical	$4,500,000
SCADA	$800,000
Main Upgrade Project Preliminary Opinion of Probable Construction Cost Estimate:	$29,000,000
20% for Engineering, Legal, Admin. and Financial Services:	$5,800,000
Associated H2O Grant Allocation:	($1,000,000)
Preliminary Opinion of Probable Capital Cost for Project 2:	$33,800,000
Total Preliminary Opinion of Probable Capital Costs for Projects 1 & 2 :	$34,466,560