ATTACHMENT 5
CAPITAL IMPROVEMENTS PLAN

CITY OF READING, PENNSYLVANIA
19th WARD PUMP STATION

CAPITAL IMPROVEMENTS PLAN

FINAL DRAFT

NOVEMBER 7, 2012

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CITY OF READING, PENNSYLVANIA
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EXECUTIVE SUMMARY

The 19th Ward Pump Station is located in the western extents of Reading, along the Tulpehocken Creek in Stonecliffe Park. The pump station collects flow from Bern Township, the northern end of Spring Township and a section of Reading that is situated on the western side of the Schuylkill River and conveys it into Reading's sewer interceptor system, a few miles upstream of the 6th & Canal Pump Station. The pump station was originally constructed in 1966 and upgraded in 1995. In 2011, the triplex pump station conveyed an average flow of approximately 0.66 MGD from the three municipalities. According to a 2006 hydraulic test conducted by another engineer (Douglas McGill, P.E.), the station has a capacity of 2.17 MGD with one pump operating, 3.0 MGD with two pumps operating and 3.3 MGD with all 3 pumps operating.

The scope of this project is intended to assess the existing condition of the pump station facility and to determine what improvements are necessary for its future performance. As presented within this study, although the pump station appears to be in fair condition, it is imperative that the station be upgraded in the near future to accommodate flows that will increase by 70 percent over the next 20 years and to replace outdated equipment that is approaching the end of its useful life. Below is a summary of our recommendations which must be undertaken by the City in next 5+ years:

- The major deficiency that impacts the overall performance of the pump station is the 10-inch diameter force main, which is adequate for one pump in operation (2.17 MGD), but undersized for existing/future pumping scenarios in excess of 2.8 MGD. The selection of a new force main size is ultimately dependent on the future pump size; however, a 16 or 18-inch diameter main will be able to adequately convey both existing and future flow rates and, at the same time, significantly lower pump horsepower requirements.
- As the upgraded force main is being brought on-line, three new pumps capable of conveying 2,000 – 2,500 GPM should be installed to replace the existing pumps. As discussed above, the pump horsepower requirements are likely to be much lower, depending upon the new force main diameter. When the City moves forward with the replacement of the pumping units, it should review and consider all available pump styles
- The holding volume of the 19th Ward Pump Station wet well is relatively modest for the existing flow rates and undersized for future flows. During a 2012 average day scenario (≈460 GPM), the City has only 10 minutes of storage capacity between the Low and High Water Flow Alarms. By 2035, there will be approximately 6 minutes of storage between the Low and High Water Flow Alarms during an average day and less than 3 minutes during a peak day. Therefore, the holding capacity

of the wet well is a significant issue that must be addressed going forward. There are two ways to resolve this issue: (1) Provide VFDs for the future pumps, which will allow for the station pumpage to keep pace with the influent flow rate; or, (2) Construct a second (or larger) wet well, most likely underneath the existing parking area on the south side of the building. Either option will require some disturbance to Stonecliffe Park, since the electrical/control room has limited space for the provision of VFDs (and HVAC to keep them cool).

- The larger pumps will necessitate the construction of new interior piping and appurtenances.
- No major electrical upgrades appear necessary. However, the electrical components, switches, fixtures, etc. should be considered for replacement due to their age and condition, particularly within the exposed wet well area.
- The City should investigate the feasibility of connecting the 19th Ward Pump Station into the City's SCADA system, most likely via a backhaul radio system.
- Since the grinder units were recently rehabilitated, they should last several additional years, but the City should keep a watchful eye on their condition. When an engineering firm is retained by the City to design improvements to the 19th Ward Pump Station, it is recommended that they review the existing condition of the units and evaluate the ability of the station's influent concrete channels to accommodate a larger grinder unit that is equivalent to the station's future flow rates.
- Due to age and/or condition, the access hatches, doors, and HVAC equipment should be replaced.
- Because of the closeness of the pump building to the public access road, safety measures should be put in place around the station, including upgraded exterior lighting and removable bollards to channel traffic away from the building.
- The new higher capacity pumps, larger diameter force main and expanded wet well/VFDs should eliminate the need for the sanitary sewer overflow.
- For planning-level purposes, the estimated construction cost for improvements to the 19th Ward Pump Station is approximately $2.81 million, which includes costs for both variable frequency drives on the new pumps and a second wet well.

As our evaluation did not uncover any major hydraulic, structural or electrical issues, and because the site sits within a public park, it is our recommendation to upgrade the station within the confines of the existing site footprint, where possible. However, as noted above, it will be necessary to disturb small portions of the park to provide room for VFDs and/or additional wet well storage.

1.0 INTRODUCTION

The 19th Ward Pump Station is located in the western extents of Reading, along the Tulpehocken Creek in Stonecliffe Park. The pump station collects flow from Bern Township, the northern end of Spring Township and a section of Reading that is situated on the western side of the Schuylkill River (see Figure 1-1) and conveys it into Reading's sewer interceptor system, a few miles upstream of the 6th & Canal Pump Station. The pump station was originally constructed in 1966 and upgraded in the 1990's to accommodate higher flows (particularly from neighboring Bern and Spring Townships). In 2011, the triplex pump station conveyed an average flow of approximately 0.66 MGD from the three municipalities. According to a 2006 hydraulic test, the station has a capacity of 2.17 MGD with one pump operating, 3.0 MGD with two pumps operating and 3.3 MGD with all 3 pumps operating[1]. The pump station has a 15-inch overflow connection to Tulpehocken Creek.

As discussed within this report, much of the equipment within the station appears to be reaching the end of it's useful life and/or operating below its intended capabilities. In order to ensure continued operation of the collection system and provide for future growth, it is imperative that the City continue to maintain the 19th Ward Pump Station and plan for future improvement projects at this time.

This study will focus in on the following objectives:

- Establish existing and projected flows for the pump station;
- Provide an evaluation of the existing pump station equipment;
- Analyze future alternatives; and,
- Identify capital improvement projects.

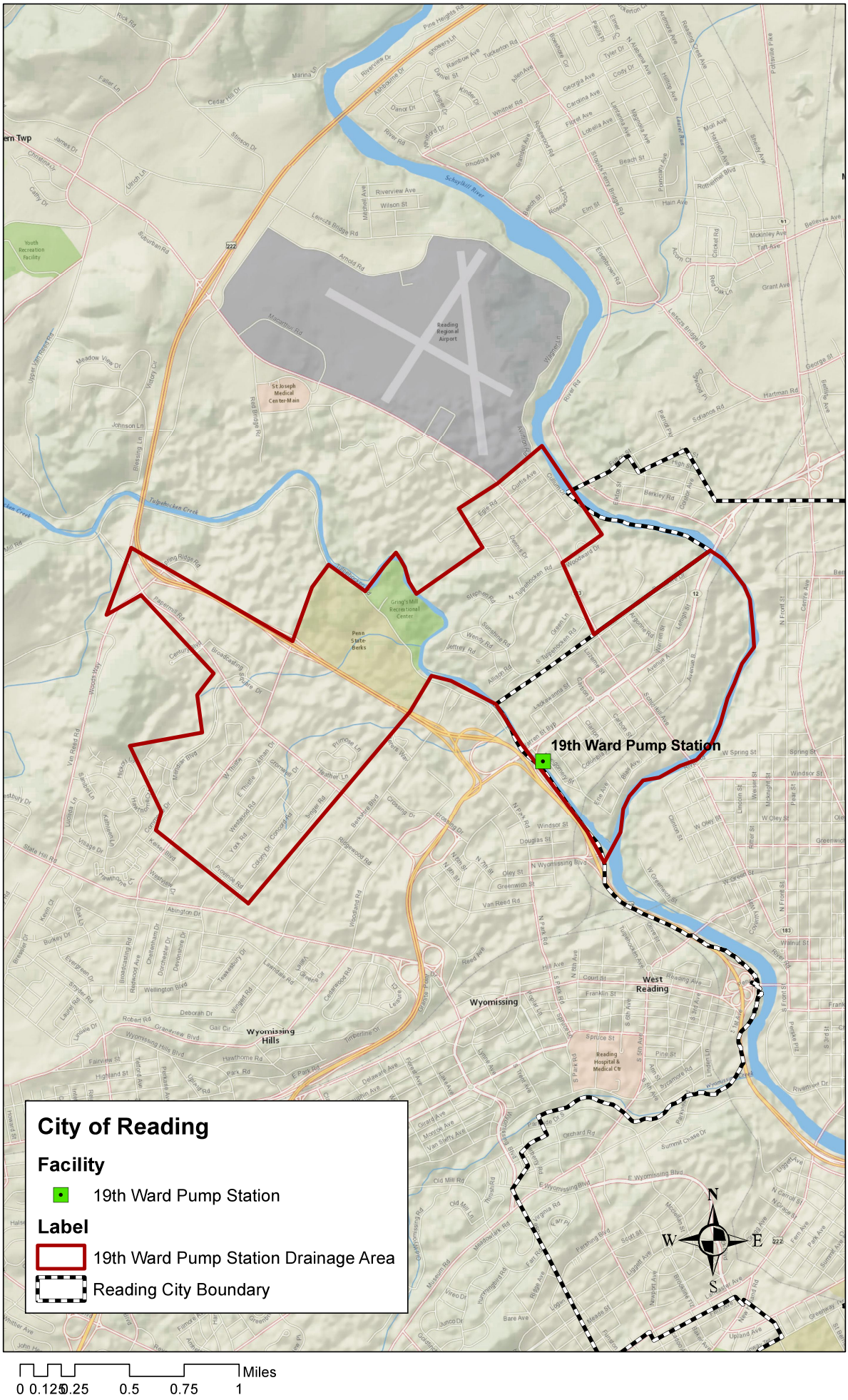
1.1 Reference Materials/Acknowledgements

The reference information presented within this report was provided by the City of Reading - Wastewater Treatment staff. Hazen and Sawyer acknowledges that it has reviewed and relied upon the below noted information in the development of this report:

1. *"Upgrading of 19th Ward Pumping Station"* drawings, Mast Engineering Co. Inc., 1994.
2. *"Operation and Maintenance Manuals; 19th Ward Pump Station Upgrade; Mechanical Upgrade",* Eastern Construction Assoc. Inc., April 1995.
3. "*COR 19th Ward Pump Station*" memo, John R. Ackerman, P.E. (Entech Engineering), July 25, 1995.

1 - As reported by Douglas L. McGill, P.E. November 2006 letter to City of Reading

Figure 1-1
19th Ward Pump Station - Drainage Area



4. "*Throttling Valves for 19th Ward Pump Station*" memo, John R. Ackerman, P.E. (Entech Engineering), July 27, 1995.
5. "*Westinghouse Starter/Chatterbox Dialer Start-up Meeting Minutes"*, Entech Engineering, August 17, 1995 (for meeting on August 3, 1995).
6. "*19th Ward Pumping Station, Facilities Audit"*, Entech Engineering, July 1996.
7. *"Topo Survey for Metering Chambers"* drawing (Dwg No. 921011-006-E-001), Great Valley Consultants, April 27, 2002.
8. *"Elevations at Outfall and Vicinity"* drawing (Dwg No. 927087-002-D-001), Great Valley Consultants, June 23, 2006.
9. *"Profile from Pump Station to Tulpehocken Creek"* drawing (Dwg No. 927087-002-D-001), Great Valley Consultants, September 14, 2006.
10. *"Locate Sewer Line East and West of Pump Station"* drawings (Dwg Nos. 927087-002-E-001 and E-002), Great Valley Consultants, November 3, 2006.
11. *"Profile of Sanitary Sewer Lines to Pump Station"* drawings (Dwg Nos. 927087-002-D-002 and D-003), Great Valley Consultants, November 8, 2006.
12. *"Summary of Current Overflow Events to the Tulpehocken Creek"* letter, Douglas L. McGill P.E., November 2006.

In addition to the above, Hazen and Sawyer visited the 19th Ward Pump Station site several times and also met with the City's operations personnel to get their input on the existing condition of the pump station.

2.0 FLOW EVALUATION

This section summarizes the historical and projected flows for the 19th Ward Pump Station.

2.1 Historical Flows at Pump Station

Table 2-1 summarizes the 19th Ward Pump Station flow data provided by the City.

Table 2-1
2011 Flows and Peaking Factors[1,2]

Flow Criteria	Flow (MGD)	Peaking Factor
Minimum Day	0.339	0.51
Average	0.660	1.00
Maximum (Average) Month	0.778	1.18
Maximum 30-Day	0.780	1.18
Maximum 7-Day	1.030	1.56
Maximum Day	1.504	2.28
Peak Hour	3.00+[3]	4.5+[3]

(1) From WWTP flow data
(2) Pump station effluent flow meter was out of service between January 1 – February 10, 2011
(3) Spring Township metered flow only (on September 7, 2011) – does not include Bern Township or City of Reading flow

The pump station appears to have very "tight" daily flow data, varying between the 0.30 and 1.50 MGD (the firm capacity of the station is 3.0 MGD) in 2011. There were only eight days in 2011 where the effluent flow volume exceeded 1.0 MGD - six of those occurred in late August/early September when the City experienced over 13 inches of rain (primarily from Hurricane Irene and the remnants of Tropical Storm Lee).

2.2 Municipal Flows – Existing and Future

Future flow projections (through the year 2035) for municipalities contributing to the City's Fritz Island WWTP were developed by SSM Group Inc. as part of their study entitled *"Components of an Act 537 Special Study"*. The results of the SSM Group study were also included in the City's *"Final Act 537 Special Study"* which was issued to the U.S. Department of Justice, U.S. Environmental Protection Agency and Pennsylvania Department of Environmental Protection on August 24, 2012.

Existing flows conveyed by the three municipalities into the 19th Ward Pump Station can be derived from a combination of metering data, the Chapter 94 reports and/or the SSM Study.

2.2.1 Bern Township Flows Conveyed to 19th Ward Pump Station

Based upon equivalent dwelling units, the SSM study indicates that the 2010 flow from Bern Township into the 19th Ward Pump Station is 0.070 GPD, while the 2035 flow is projected to rise to 0.170 GPD. The Bern Township Chapter 94 Report for 2011 reported an average flow of 0.067 GPD based on metering data.

For the purposes of this report, we will assume that Bern Township's current flow is 0.067 MGD and their 2035 flow will be 0.170 MGD.

2.2.2 Spring Township Flows Conveyed to 19th Ward Pump Station

Similar to Bern Township, the SSM study utilized equivalent dwelling units to determine that the 2010 flow which is conveyed from Spring Township into the City's interceptor system is 1.07 MGD. However, only 25-30 percent of this flow is conveyed to the 19th Ward Pump Station (the majority of Spring Township's flow is routed to the 18th Ward Pump Station). The 2011 metering data provided by Spring Township reported an average discharge flow into the 19th Ward Pump Station of 0.266 MGD.

The SSM report estimates that the 19th Ward drainage area within Spring Township will grow by an additional 0.27 MGD by 2035. Utilizing the 2011 metering data in conjunction with the SSM's future growth projections, we estimate that Spring Township will convey 0.536 MGD to the 19th Ward Pump Station in 2035.

For the purposes of this report, we will assume that Spring Township's current flow is 0.266 MGD and their 2035 flow will be 0.536 MGD.

2.2.3 City of Reading Flows Conveyed to 19th Ward Pump Station

Establishing the City's existing flow contribution to the 19th Ward Pump Station can be accomplished by utilizing the station's effluent flow meter data and subtracting out the known flow from Bern and Spring Townships:

City Flow = 19th Ward P.S. ADF (0.660 MGD) – Bern Twp ADF (0.067) – Spring Twp ADF (0.266 MGD)

Therefore, the estimated City contribution to the 19th Ward Pump Station is 0.327 MGD. As established in the SSM Report, 0.327 MGD is approximately 4.2 percent of the City's ADF (7.767 MGD) which is conveyed to the Fritz Island WWTP.

There are no year 2035 projections for this section of Reading; however, we can establish an approximate flow by utilizing SSM's 2035 projected flow for the entire City (9.592 MGD) and multiplying it by 4.2 percent,

the current flow ratio for this portion of the Fritz Island WWTP drainage basin. This would equate to a projected 2035 flow of 0.403 MGD conveyed by the City to the 19th Ward Pump Station.

2.2.4 Total Existing and Future Flows into the 19th Ward Pump Station

Table 2-2 presents a summary of the existing and future projected flows to the 19th Ward Pump Station.

Table 2-2
Existing and Future Projected Flow Summary

	Existing Flow (MGD)	Year 2035 Flow (MGD)
Bern Township ADF	0.067[1]	0.170[2]
Spring Twp ADF	0.266[1]	0.536[3]
City of Reading ADF	0.327	0.403
19th Ward ADF	**0.660**	**1.109**
Peaking Factor (Peak Day:Average Annual)	2.28	2.28
19th Ward Max Day	**1.505**	**2.529**
Peaking Factor (Peak Hour:Average Annual)	4.5[4]	4.5[4]
19th Ward Peak Hour	**3.00+**[4]	**5.00+**

(1) Metering data from municipalities' Chapter 94 Report
(2) SSM Group, Inc., *"Components of an Act 537 Special Study"*
(3) Combination of metering data and SSM Group, Inc., *"Components of an Act 537 Special Study"*
(4) Spring Township metered flow only (on September 7, 2011) – does not include Bern Township or City of Reading flow

While the conveyed flow to the 19th Ward Pump Station will remain relatively modest in comparison to other drainage basins within the City, it is still expected to grow by almost 70 percent over the next 20+ years.

Prior to project design, the City's engineer should coordinate with Bern Township, Spring Township and the City of Reading to get a better understanding of the flows conveyed to the 19th Ward Pump Station, particularly during maximum day or peak hour flow periods. The above values occurred during a particularly wet time period – two tropical storms in less than 2 weeks –in a year where annual precipitation records were broken throughout the northeastern United States.

3.0 INFLUENT FLOW TO 19TH WARD PUMP STATION

Prior to entering the wet well, the influent wastewater is conveyed through a gravity sewer system that contains an overflow discharge to Tulpehocken Creek. The ensuing section provides a brief synopsis of the following:

- Upstream Sewer System
- Sanitary Sewer Overflow

3.1 Upstream Sewer System

The 19th Ward Pump Station is primarily fed by a 21-inch PVC interceptor that runs southeasterly along Montgomery Street, parallel to Tulpehocken Creek. This sewer main picks up flow from Spring Township (via an inverted siphon under Tulpehocken Creek) and Bern Township (via a 12-inch sewer main) in the general vicinity of the Montgomery Street & Lackawanna Street Right-of-Way intersection. The City of Reading's flow is conveyed into the 21-inch interceptor via two gravity mains (1) a 12-inch main located on the western side of the Route 12 bridge/overpass and (2) a 10-inch main that parallels the pump station access road, but is located in the wooded area to the west. Based upon the survey information provided to our office, the 21-inch interceptor is capable of conveying a peak flow of approximately 8 MGD.

While Section 2.0 studied existing and future flows that will be conveyed by the three municipalities, it is important to note the peak/instantaneous flow rate that could be discharged into the 19th Ward Pump Station through the 21-inch interceptor. Both Bern and Spring Townships have upstream pump stations that feed into this interceptor. The Spring Township pump station (Penn State-Berks) is a triplex pump station that has a firm capacity of 1.536 MGD, while the Bern Township (Greenfields) is a duplex station that has a firm capacity of 0.576 MGD. If both of these stations were to operate at their firm capacity and simultaneously pump for 5 minutes prior to shutting down, they would convey over 7,300 gallons to the 19th Ward Pump Station wet well (in addition to the gravity flow from the City and a portion of Bern Township), which could temporarily overwhelm the wet well's storage capabilities (see Section 4.2). As such, the City should monitor the operation of these upstream pump stations to determine if they have any impact on the 19th Ward Pump Station under existing and future flow scenarios. As discussed in Section 2.2.4, prior to project design for improvements to the 19th Ward Pump Station, the City's engineer should coordinate with Bern Township, Spring Township and the City of Reading to get a better understanding of the flows conveyed to the 19th Ward Pump Station, particularly during maximum day or peak hour flow periods.

3.2 Sanitary Sewer Overflow

The last manhole prior to the pump station wet well has an overflow connection - a 15-inch PVC pipe that allows the station to discharge sewage into Tulpehocken Creek during excessive flow periods. The headwall for the overflow piping is located less than 100-feet from the pump station and is visible from the Schuylkill Trail. The overflow piping is controlled by a duckbill valve, which is located within a manhole between the headwall and the pump station. The duckbill acts as a check valve, allowing sewage to discharge into the creek, but does not allow flow from the creek to enter into sewer system or pump station. According to previous topographical surveys, the overflow connection invert was constructed at an elevation of approximately 3.40-feet higher than the pipe flowing into the pump station.

Based upon information provided by the City and discussions with the operations staff, the last three overflows occurred in October 2005, June 2006 and September 2006. A previous engineering analysis conducted by Douglas McGill, P.E. indicated that over a two year period (August 2004 – September 2006), only one of the three pumps at the 19th Ward Pump Station was called into operation 99.9 percent of the time. Since an overflow should theoretically occur only during an excessively high flow period when two, or possibly all three, pumps are in operation, this engineering analysis indicates that overflows are very rare at this station.

With the construction of a larger diameter force main, higher capacity pumps and a second (or enlarged) wet well and/or pump VFDs, there should be no need for the overflow connection.

4.0 EVALUATION OF PUMPING SYSTEM

After entering the pump station building, the flow is split into two channels, conveyed through two wastewater grinder units and then discharged into a single wet well. This section will provide a review and analysis of the following elements related to the pumping system:

- Wastewater Grinders
- Wet Well
- Pumping Units
- Piping System

4.1 Wastewater Grinder Units

4.1.1 Existing Condition

After entering the wet well through a 20-inch DIP influent pipe, the flow is split into two parallel channels, each approximately 18-inches wide x 30-inches deep. The wastewater grinder units were installed within each channel in the 1995 upgrade project (previously there was a static bar rack) to breakdown large solids that could damage or clog the equipment. The grinder channel units are made by Muffin Monster, Model 30003-32, cast iron material, 3 horsepower, with 32-inch cutting chambers. According the manufacturer, the Model 30003-32 unit can accommodate 1,470 GPM (2.1 MGD). Therefore, each grinder unit is capable of handling the 2011 maximum day flow rate (1.505 MGD), but not the estimated 2011 peak hour or peak instantaneous flow rates.

According to the pump station O&M staff, the grinders are regularly maintained and were rehabilitated within the last year. In addition, there is a third grinder unit which is kept as a shelf spare and is rotated into operation on a regular basis. The units have operated without a major concern/breakdown in recent years.

4.1.2 Analysis

As discussed above, each grinder unit cannot individually accommodate the estimated 2011 peak hour and peak instantaneous flow rates. Ideally each unit should be designed to handle the station's peak instantaneous flow rate in case one of the two units is taken out of service during a high flow period. However, since the City retains an on-site spare, this issue is not as critical.

When the pumps, piping and appurtenances are upgraded to handle future flows, the grinder units would typically be upsized as well. However, the depth of the existing concrete channels within the station appears to be a limiting factor and may not accommodate a large grinder unit. If the influent concrete chan-

nels cannot be modified to handle a large grinder unit, in the future it will be necessary to operate both grinder units to handle maximum day, peak hour and peak instantaneous flow rates. Therefore, it will be critical to keep these units, and the spare, in proper working order at all times.

4.1.3 CIP Recommendation

Since the grinder units were recently rehabilitated, they should last several additional years, but the City should keep a watchful eye on their condition. When an engineering firm is retained by the City to design improvements to the 19th Ward Pump Station, it is recommended that they review the existing condition of the units and evaluate the ability of the influent concrete channels to accommodate a larger unit.

4.2 Wet Well

4.2.1 Existing Condition

The 19th Ward Pump Station has a single reinforced concrete wet well located on the western side of the building. The wet well is rectangular in shape with a sloped western side wall - approximate dimensions of the wet well are 8'-0" x 13'-8" x 10'-8" deep,. The usable portion of the wet well - the area between the bottom of wet well and the influent pipe invert - is capable of storing approximately 7,000 gallons. However, it is possible for the flow to overwhelm the station up to the underside of the finish floor slab (15+ feet). There was evidence of paper hung up on ladder rungs 5 to 10 feet above the influent pipe invert – the operations personnel indicated that the paper probably had been there for years. All three pumps withdraw flow from the wet well via separate 6-inch flared 90-degree elbows that are set six inches above the wet well floor.

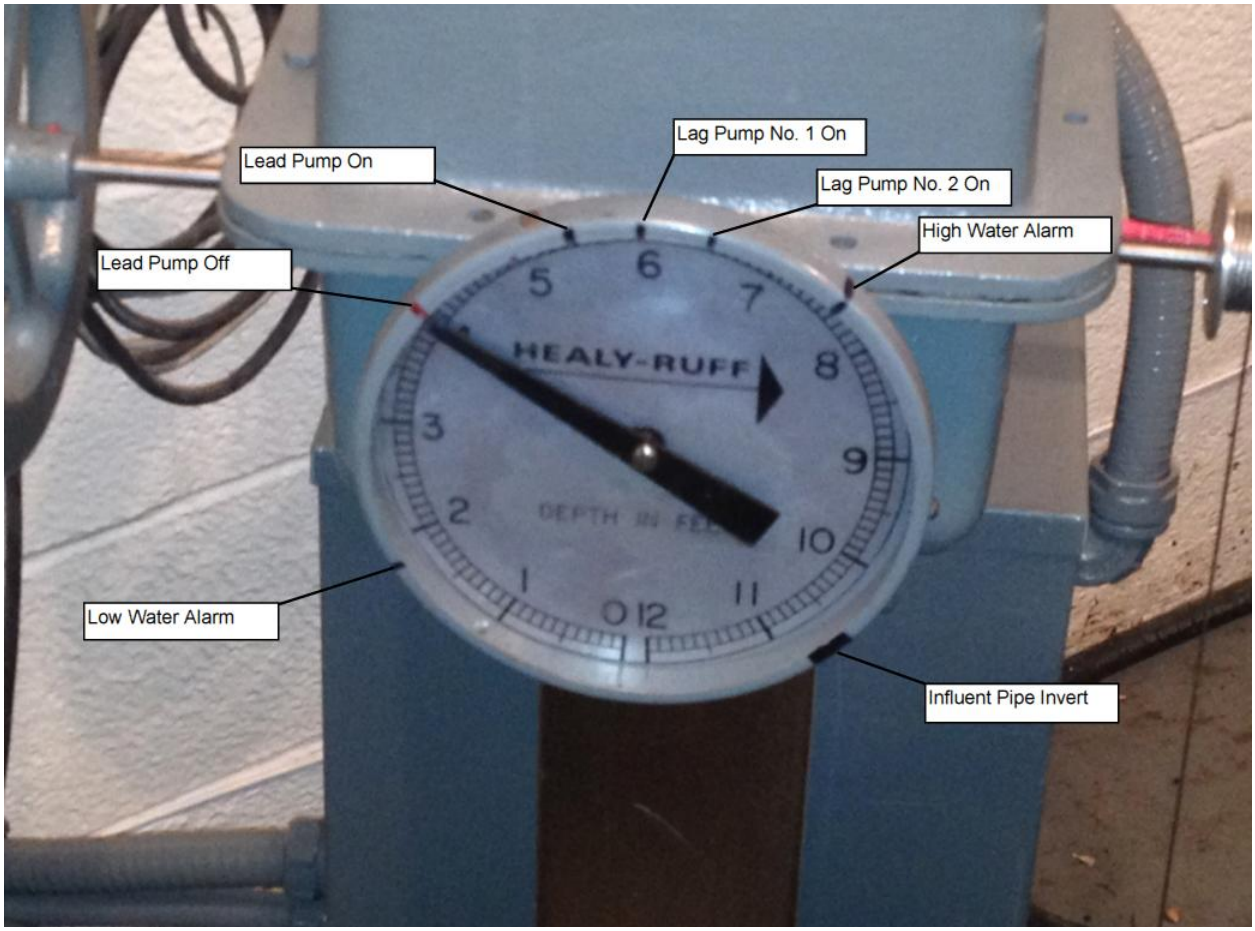
Table 4-1 lists the pump settings as denoted on the Healy Ruff mechanical float control system (also see Figure 4-1).

Table 4-1
Pump Settings

	Elevation #1	Elevation #2
Bottom of Wet Well	177.10'	
Bottom of Suction Elbow	177.60'	
Suction Pipe Centerline	178.60'	
Low Level Alarm	178.90'	
Lead Pump	Pump On - 182.60'	Pump Off – 181.10'
Lag Pump No. 1	Pump On - 183.10'	Pump Off – Not Provided
Lag Pump No. 2	Pump On - 183.60'	Pump Off – Not Provided
High Level Alarm	184.60'	
Influent Pipe Invert	187.80'	

Based upon the above pump settings, there is approximately 1,225 gallons of storage between Lead Pump On and Lead Pump Off and 4,660 gallons between the Low Level Alarm and the High Level Alarm settings.

Figure 4-1
Pump Settings (as Depicted on Healy-Ruff Unit)



Our office was able to gain access to the lower walkway area of the wet well, but was not able to inspect the area below the normal flow cycle elevations. In general, the wet well above the lower walkway area appears to be in fair to good shape considering it's age (46 years old). It is our understanding that the wet well is drained and inspected by the City every two years. The operations personnel indicated that their last inspection occurred earlier this year and that the wet well was in good condition, with no observed structural issues.

4.2.2 Analysis

The holding volume of the 19th Ward Pump Station wet well is relatively modest for the existing flow rates. PADEP allows for a maximum of 10 minutes of storage time between Lead Pump On and Lead Pump Off settings during the maximum month average flow periods. During a 2011 average day scenario (≈460 GPM), the City has 2.5 minutes of storage between the Lead Pump On and Lead Pump Off settings and only 10.2 minutes of storage capacity between the Low and High Water Flow Alarms – the full extent of the

station's operating range. By 2035, there will be approximately 6 minutes of storage between the Low and High Water Flow Alarms during an average day and less than 3 minutes during a peak day. Therefore, the holding capacity of the wet well is a significant issue that must be addressed going forward. There are two ways to resolve this issue: (1) Provide VFDs for the future pumps, which would allow for the station's pumpage to keep pace with the influent flow rate; and/or, (2) Construct a second wet well, most likely underneath the existing parking area on the south side of the building. If the City elects to move forward with a second wet well, the holding capacity should be sized based upon 2035 flow rates. The volume of the second wet well should also take into account the instantaneous flow rates conveyed by the upstream Spring and Bern Township pump stations.

4.2.3 CIP Recommendation

In the short term, the wet well should continue to be inspected and cleaned on a regular basis, making spot repairs and re-coating as necessary to properly maintain the structural integrity of the wet well. While our office was not able to inspect the full wet well, the City indicated that it remains in good condition and is properly maintained.

In the long term, the size of the wet well is dependent upon whether the new pumps are provided with VFDs. If VFDs are provided and the future pumping capacity meets or exceeds the influent flow rate, the wet well size should not be a major concern for the City. However, if VFDs are not provided, the wet well holding capacity must be significantly increased – at least double, if not triple, in volume. It appears that a second wet well could be constructed in an area that is already being used by the operations staff as a parking spot, resulting in little-to-no net loss to Stonecliffe Park.

4.3. Pumping Units

4.3.1 Existing Condition

The 19th Ward Pump Station consists of three vertical open shaft pumps, each rated for 1,530 GPM (2.20 MGD) at 126 feet total dynamic head (TDH). The pumps are manufactured by Chicago Pump Company, model 64154A, 75 HP, 1750 rpm and a 12-1/2 inch diameter impeller[2]. These pumps were installed 17 years ago, in the "Upgrading of 19th Ward Pumping Station" project by Mast Engineering. The operations staff indicated that the pumps were rebuilt approximately 3 years ago and have not had any significant problems since. A fourth pump is provided as a shelf spare – the pump is located in the electrical/control room, while the spare motor is located off-site. Each pump has a small domestic water system connection for sealing purposes.

The pumps are constant speed (i.e. without variable frequency drives) and cycle on and off according to the level in the wet well. Based upon the lead pump setting and the 2011 average influent flow rate (≈460 GPM), the lead pump is called on-line every 4 minutes or 15 times per hour during an average flow period. The pumps are regularly rotated via a defined pump sequence setting in the Healy Ruff mechanical float system. Therefore, each pump is called into operation approximately 5 times per hour. According to documents provided by the City[3], the factory recommendations allow for a maximum of 30+ starts per hour for the existing pumps.

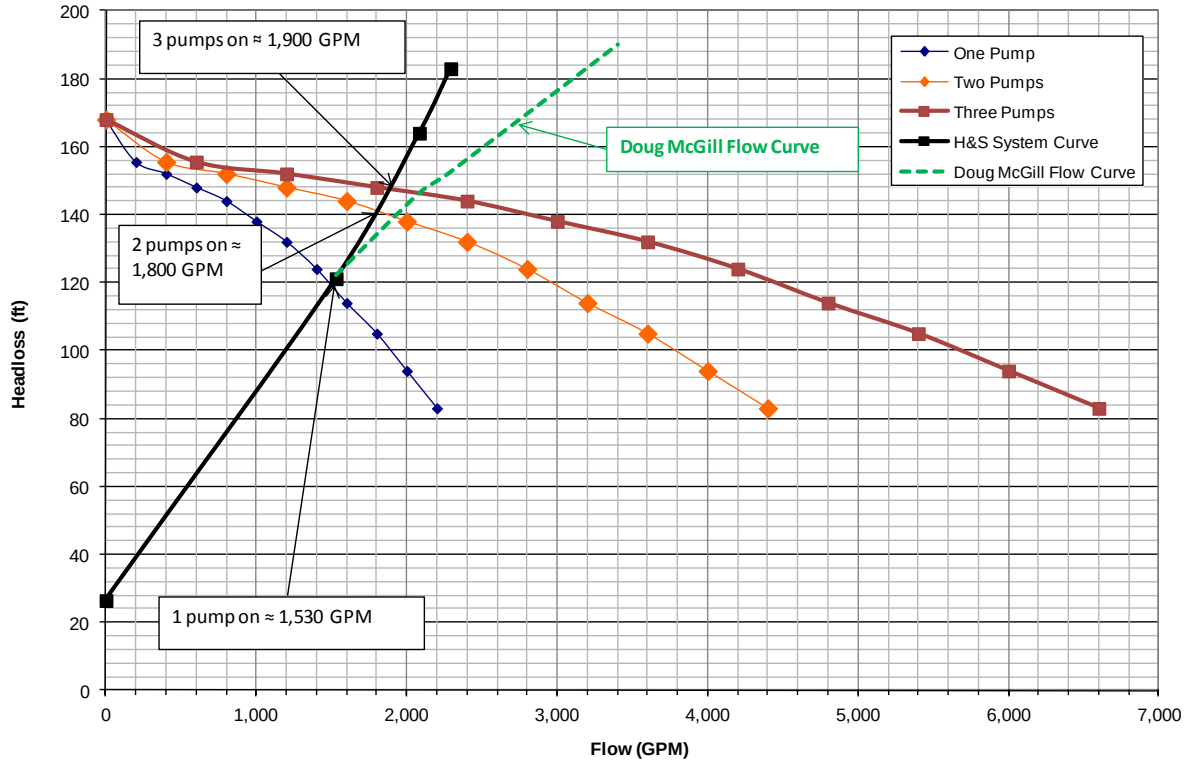
According to a Douglas McGill, P.E. letter from November 2006, discharge flow measurements indicate the pump station has a firm capacity of 3.0 MGD (2 pumps on) and a total capacity (3 pumps on) of 3.30 MGD. However, we were not able to replicate those values during the development of the preliminary pump curve (depicted in Figure 4-2), which estimates a firm capacity of 2.59 MGD (1,800 GPM) and a total capacity of 2.74 MGD (1,900 GPM).

With regards to Net Positive Suction Head (NPSH), the existing pumps have a required NPSH of 19.5-feet, while we calculated an available NPSH of 26.4-feet. Therefore, there are no NPSH concerns with the current pumps.

2 - "*19th Ward Pumping Station, Facilities Audit*", Entech Engineering, July 1996.
3 - "*Westinghouse Starter/Chatterbox Dialer Start-up Meeting Minutes*", Entech Engineering, August 17, 1995.

Figure 4-2

19th Ward Pump Station – System Curve



4.3.2 Analysis

As discussed in Section 3.2, in a previously referenced November 2006 letter, Mr. Douglas McGill, P.E. calculated that over a two year period only one pump was in operation for 99.9 percent of the time. These calculations, if accurate, indicate that the existing pumps were adequately sized for the present day flows, even during most extreme/wet weather events. With continued proper care and maintenance, the existing pumps may not need to be replaced for another 5+ years. However, with flow to this drainage basin expected to grow by 70 percent in the next 20 years, the pumps will soon be undersized. It is proposed that the City construct three new pumps, approximately 2,000 – 2,500 GPM in capacity, at the same time as the proposed discharge force main replacement project (see Section 4.5). It is our recommendation to provide the new pumps with variable frequency drives.

When the City moves forward with the replacement of the pumping units, it should review and consider different pump styles, including – (1) extended shaft (i.e. same style as the existing pumps); (2) dry pit submersible; and, (3) wet pit submersible (which would require some modifications to the existing building

& site). Each style of pump has several factors that should be carefully evaluated during the design process, including consideration of capital costs, maintenance costs, power requirements, equipment life, ability of staff to operate/maintain the pumps, operator preference, etc.

It should be noted that under each pump alternative, work would have to be done to the existing piping/appurtenances within the pumping station. Also, the size of the electrical feed/wiring and backup generator must be reviewed.

4.3.3 CIP Recommendation

In the short term, the City should continue to monitor and periodically inspect each of the existing pumps. In the long term, the City should replace the existing pumping units with three new 2,000 - 2,500 GPM pumps that are VFD controlled. The pumps should be constructed concurrently with an upsized force main. The firm capacity of the 19th Ward Pump Station should be able to convey the estimated 2035 peak day flow, while all three pumps operating should be able to convey the estimated 2035 peak hour flow. The style and manufacturer of the selected pump should be evaluated during the design process, with significant input from the City operations staff. The engineering consultant will have to conduct thorough background work/research to confirm the necessary TDH for the new pumps/new force main system to ensure the correct selection is made.

4.4 Interior Piping

The pumping units convey sewage flow through varying diameter of interior piping prior to discharge into the 10-inch force main. This section provides a summary of the interior piping system.

4.4.1 Existing Condition

In general, the suction side of each pumping system consists of approximately four feet of pipe and fittings, including a flared 90 degree intake, a gate valve and a 90 degree bend prior to the pump. On the discharge side of the pump, the piping configuration generally consists of approximately 20 feet of piping and fittings, including a 4-inch x 6-inch reducer, flexible coupling, Milliken swing check valve, long radius elbow, ITT diaphragm (throttling) valve and 90-degree elbow or wye prior to the piping header. While there are taps for pressure gauges, the gauges have been removed, most likely because of grease/maintenance issues. The three 6-inch piping runs join together at the header approximately 15-feet in the air. The piping header begins as an 8-inch pipe, prior to upsizing to 10-inch after the second pump connection.

On the exterior of the pump building, a bypass valve/pumping connection was constructed during the upgrade project in the mid 1990's. This configuration allows the City to bring in a rental/mobile pump unit (i.e. Godwin Pumps), and using the last manhole upstream of the station as a wet well, bypass pump around the 19th Ward Pump Station.

4.4.2 Analysis & CIP Recommendation

The Hydraulic Institute (HI) publishes a manual called the "*American National Standard for Pump Intake Design"* which is utilized by the engineering community as a standard/guide for pump station design. This manual recommends a pump suction inlet velocity between 2.0 and 9.0 feet per second (fps), with 5.5 fps being ideal. The 6-inch suction inlet bells at the 19th Ward Pump Station have an intake velocity of 17.3 fps, almost double the maximum velocity recommended by the HI. While not a critical flaw, the higher velocity at the intake contributes to increased head losses, less available NPSH and more turbulent flow that could result in excessive pump vibration and/or cavitation.

Based upon the correspondence provided by the City, it appears that the ITT diaphragm valves were added after the 1994 upgrade project because the new sewage pumps were pumping beyond their intended duty point (similar to the 6th and Canal Pump Station). It is our understanding that the diaphragm valves are now in the "full open" position. However, even in the 100 percent open scenario, these valves have high "k" values which add unnecessary head (and horsepower) to the system curve.

With the exception of the undersized suction inlet bells and the presence of the diaphragm valves, the existing piping configuration appears to be adequate for the current pumping units.

4.4.3 Analysis & CIP Recommendation

As stated above, while there are some minor points concerning the existing piping configuration, overall it appears to be adequate for the current pumping units. However, both the suction and discharge piping, including the bypass connection, must be upsized when the pumps and force main are replaced.

4.5 Discharge Force Main

The sewage flow is conveyed from 19th Ward Pump Station to the City's interceptor system through a 10-inch diameter force main. The ensuing section provides a summary of the force main system.

4.5.1 Existing Condition

The force main system consists of approximately 3,100 LF of 10-inch diameter cast iron piping between the 19th Ward Pump Station and the discharge manhole, which is located along the railroad tracks on the eastern side of the Schuylkill River (roughly in line with Douglass Street). After leaving the pump station, the force main takes the following route:

- Parallels a paved pedestrian trail along the Schuylkill River that is closed off to vehicular traffic. While following this path, the force main is located in the grass area, passing by restrooms, basketball courts, a skateboard park and parking lot, before reaching an athletic field.
- Approximately halfway through the athletic field the force main heads easterly, cutting diagonally through the field and crossing over to Montgomery Street.
- Within Montgomery Street, the force main passes under the railroad bridge, jumping in and out of the paved road, up to the terminus of Montgomery Street/top of river bank.
- After the Montgomery Street and Blair Avenue intersection, the force main goes down a steep bank and crosses under the Schuylkill River. As discussed above, the force main discharges into a manhole located on the eastern side of the Schuylkill River, in close proximity to the railroad tracks and adjacent to a vacant/cleared property that was once scheduled to house a water bottling factory.

It is believed that the force main was constructed in the mid-1960's. While we were not able to inspect the condition of the force main as part of this study, the City has indicated that there have been two breaks on the main over the years, one of which was related to the construction of the skate park in Stonecliffe Park. The City recently discovered an air release manhole on the force main piping along Montgomery Street, near the Eastern Rigging property. While doing work on the air release manhole, the O&M staff noticed that the valve was pulling a vacuum during pump shutdown.

4.5.2 Analysis

The 10-inch force main is adequate for existing average day flows when one pump is typically in operation (2.17 MGD), but is undersized for existing high flow periods (>2.8 MGD/2 or more pumps on) and future flow scenarios. As the flow conveyed to this pump station is expected to increase by almost 70 percent over the next 20 years, the force main must be upsized to keep pace. Table 4-2 depicts the high pumping heads that result from the existing 10-inch force main and how force main size will affect the future pump capacity & horsepower (i.e. the larger the force main size, the lower the pump horsepower).

Table 4-2

Existing & Future Pump Capacity and Force Main Scenarios

	Pump Capacity = 1500 GPM (2.16 MGD)			Pump Capacity = 2000 GPM (2.88 MGD)			Pump Capacity = 2500 GPM (3.60 MGD)			Pump Capacity = 3000 GPM (4.32 MGD)		
	Velocity (fps)	Estimated TDH (ft)	Pump HP[1]	Velocity (fps)	Estimated TDH	Pump HP[1]	Velocity (fps)	Estimated TDH	Pump HP[1]	Velocity (fps)	Estimated TDH	Pump HP[1]
10" (Ex.)[2]	6.13	126.0	75	8.17	157.7	2-75 HP pumps	10.21	Exceeds existing station capacity		12.26	Exceeds existing station capacity	
12" (New)	4.26	48.7	25	5.67	63.4	50	7.09	82.7	75	8.51	105.9	125
14" (New)	3.13	39.7	25	4.17	48.6	40	5.21	60.4	60	6.25	74.5	100
16" (New)	2.39	35.9	20	3.19	42.2	30	3.99	50.7	50	4.79	60.9	75
18" (New)	1.89	34.0	20	2.52	39.2	30	3.15	46.1	40	3.78	54.4	60

(1) - Rounded up to the next standard HP pump size, assumes standard pump efficiency of 75% for new pumps (ex. pump efficiency = 72% at design point)

(2) - Depicts existing conditions (i.e. current pump curve, existing pump horsepower/efficiency, 10" force main, etc.)

Note that PADEP requires that the future force main be sized such that the velocity is a minimum of 2.0 fps.

4.5.3 CIP Recommendation

In the short term, the City should replace the existing air release valve with a combination air release/air & vacuum valve. Even though we are recommending the construction of a new/larger diameter force main in the long term, this valve should be replaced immediately before damage (possible break or collapse) is incurred to the existing force main.

In order to accommodate the higher future flows, the City must move forward with the construction of a new force main, 16 to 18 inches in diameter. As shown in Table 4-2, a new 16 or 18-inch force main would convey flows from higher capacity pumps at a much lower horsepower. For example, if a new 16-inch force main were constructed, the pump horsepower requirement would be approximately 30 HP for a 2,000 GPM pump or 50 HP for a 2,500 GPM pump. As such, significant changes to the electrical feed and back-up generator infrastructure should not be required.

To keep the 19th Ward Pump Station in service, the new force main would most likely be constructed parallel to the existing force main. The City may also want to consider rehabilitating the existing 10-inch pipe under the Schuylkill River and using it as a secondary crossing, in the event it is needed in the future. The City's design engineer should be required to evaluate the force main size, route, different methods/materials of construction and the ability to rehabilitate/reuse the existing river crossing.

5.0 EVALUATION OF NON-PROCESS EQUIPMENT

In addition to the process equipment, there are several other important aspects of the 19th Ward Pump Station which were reviewed as part of this study. The resulting section provides an analysis of each of the following non-process elements of the 19th Ward Pump Station:

- Electrical
- HVAC
- Instrumentation
- Structural

5.1 Electrical

5.1.1 Existing Condition & Analysis

The pump station is fed via an underground 480V service to a main disconnect located outside the generator enclosure. The utility's CT and meter is located next to the main disconnect. From the disconnect, the service enters the generator enclosure and terminates in a motor control center. At this point the power is distributed to all the major loads and lighting panels. The generator enclosure houses the standby generator and automatic transfer switch.

The motor control center (MCC) is a 2100 series by Westinghouse. It is rated for 480V, 600A, 3 phase, 3 wire 60Hz with main lugs only. It contains three reduced voltage soft starters for the pump's motors, starters for the exhaust fans and grinders, feeder circuit breakers, step down transformer and lighting panel. An additional lighting panel is installed in the generator enclosure that provides power to the generator's auxiliary equipment including battery charger, jacket water heater, etc. The MCC appears to be in working order and maintained accordingly.

The standby generator is a 275KW, 480V, 3-phase diesel generator. The automatic transfer switch (ATS) is rated 480V, 3-wire with bypass. Per the maintenance personnel, the generator is checked weekly and exercised every two weeks with station load. The generator and ATS appear to be in good condition and working order.

The wet well has two elevations, the lower elevation contains two grinders, area lighting, level measuring probe, conduits and motor disconnects for the grinders. Corrosion is apparent on all lighting fixtures, disconnects, conduit and fittings on the lower level. The upper level of the wet well has lights, receptacles and switches - there is some corrosion on several of these devices.

The dry well has two elevations as well. All the control equipment, pump motors, disconnects and instrumentation is located on upper level, while the pumps are located on the lower level. All conduits are painted RGS. All lighting and electrical equipment is appropriately classified. All equipment in the dry well appears to be working and maintained accordingly.

5.1.2 CIP Recommendation

Based on the condition of the existing electrical and control equipment, the following electrical improvements are recommended for the 19th Ward Pump Station:

- The new pumps should be provided with VFDs. As previously noted, the inclusion of VFDS (and HVAC to keep them cool) on the proposed pumps would require an addition to the existing pump station building, since the electrical/control room has limited available space.
- Replace all electrical equipment in the wet well area including lighting, disconnects, conduit, fittings and wiring.

5.2 HVAC

5.2.1 Existing Condition

According to the "*Upgrading of 19th Ward Pumping Station*" design drawings by Mast Engineering Co., Inc., the following HVAC components were provided as part of the 1995 improvement project:

- Two roof ventilators - one over the wet well room, the other over the dry well/control room. The wet well roof ventilator is rated for 810 cubic feet per minute (cfm), 460 revolutions per minute (rpm) and 1/6 HP. The dry well/control room roof ventilator is rated for 3845 cfm, 780 rpm and 1/2 HP.
- A supply fan, with new 10" diameter aluminum ductwork that extends down into the wet well, was installed on the north wall of the wet well room. The fan is rated for 585 cfm, 860 cfm and 1/25 HP.
- A unit heater was to be provided in the wet well room. The unit heater is rated for 570 cfm, 5 kW, ¼ HP, 1725 HP.
- A 30-inch by 16-inch louver was constructed on the north wall of the dry well/control room. The louver was provided with 8-inch by 30-inch aluminum ductwork that extends to within 4-feet of the bottom of the dry well (pump room).
- A 30-inch by 16-inch louver was constructed on the north wall of the wet well room. The louver was provided with 8-inch by 30-inch aluminum ductwork that penetrates the top of the wet well.

5.2.2 Analysis

Since we did not have access to the roof, we were not able to verify the construction of the roof ventilators. The supply fan and two 30-inch by 16-inch louvers were constructed, although we were not able to confirm the size/capacity of each unit. The unit heater in the wet well room was either disconnected/removed or was moved over to the electrical/control room. Also, a small supply fan, with 8±" diameter ductwork and louver that connects into the upper dry well was constructed on the south wall of the electrical/controls room – this unit was not shown on the Mast design plans. Most of the HVAC equipment seems to be in fair, but aging, condition and should be replaced under a future contract.

5.2.3 CIP Recommendation

Although our office did not have access to much of the existing/as-built information on the HVAC units, it appears that the infrastructure has been adequately servicing the pump station building. However, most/all of these units are 17 years old and in need of replacement in the near future. It is recommended that each of these units be replaced when the pumps and force main are upgraded. Also, it should be noted that air conditioning units may be necessary if VFDs are provided with the new pumps.

5.3 Instrumentation

5.3.1 Existing Condition/Analysis

The station is remotely monitored via the Express II Monitoring System, which reports back to the WWTP via an autodialer/telephone line. The City has previously investigated the feasibility of tying this station into their SCADA system; however, it was not possible at the time due to low/no signal issues.

The station has two means of measuring the wet well level at the 19th Ward Pump Station:

1. The primary method of measurement is the mechanical float/level system by Healy Ruff which includes an alternator for pump control. The mechanical float is contained within piping that has been extended from the wet well over to the dry well area.
2. The secondary method of measurement is a liquid level probe sensor which is connected to the MT3PC pump controller by Multitrode. The level probe is hanging within the wet well.

Chart recorders document the wet well level and the pump flow. In addition, the station has an Endress + Hauser Memograph M RSG40 unit that records/manages data related to pump run-times, pump cycling, flow and generator run-time. The information from the RSG40 can be downloaded via a phone line or the unit's digital card can be removed and saved to a hard drive. The RSG40 software also permits the viewing of real time data through a phone connection.

The station has an MSA Toxgard oxygen monitoring system. According to the operations staff, this system has been inoperable for several years.

On the exterior of the building, the station has wall mounted lighting and a security system which consists of an outdoor camera for monitoring. The camera images are captured on a hard drive located in the electrical/control room – they cannot be monitored remotely.

5.3.2 CIP Recommendation

The following improvements are recommended for the 19th Ward Pump Station instrumentation:

- The City should investigate the feasibility of connecting the 19th Ward Pump Station into the City's SCADA system. A backhaul radio system – a method whereby remote data is linked to the main network by a wireless communication system – seems to be the most appropriate/feasible method and should be further investigated.
- Rewire/incorporate level measuring system for pump controls via the proposed VFDs.

5.4 Structural

5.4.1 Existing Condition/Analysis

The 19th Ward Pump Station was found to be in very good condition. No signs of significant deterioration or damage were noted during the site visit on August 10th. The concrete substructure (dry and wet wells) was in excellent condition with little cracking, and no spalling. In the wet well, it was noted that the surface of the concrete has started to deteriorate, most likely due to hydrogen sulfide attack. This is made evident by dusting of the concrete surface and the fact that the coarse aggregate is starting to be exposed on the concrete surface where the roof drain water washes down the wall. Although the attack is minor at this point, future rehabilitation is required. The concrete within the dry well exhibited no signs of significant attack or deterioration. The metal access doors, particularly on the wet well side, were found to be in deteriorating condition. Also, the grating at the lowest level of the wet well is installed in the wrong direction (90-degrees).

The masonry superstructure was found to be in very good condition as well. No sign of settlement cracking was observed, although one crack in the southeastern corner of the building was evident. Some loss of mortar was noted in the brick; therefore, we recommend that the mortar joint be repointed. It should be noted that during the site visit, access to the roof was not provided.

The pump station building is located directly adjacent to a (narrow) public access road, which was frequently travelled during our site visits. Other than some low/moderate lighting, there are no safety measures in place to protect and channel vehicular traffic away from the structure.

5.4.2 CIP Recommendation

We recommend the following structural improvements to the 19th Ward Pump Station:

1. Coat the wet well now to halt the deterioration of the concrete.
2. The crack in the lower southeastern corner of the building should be fixed.
3. The deteriorated access doors should be replaced.
4. The grating at the lowest level of the wet well should be refabricated, with the bearing bars spanning the short dimension of the inlet channels.
5. We recommend that the entire pump station structure be repointed to ensure the long term durability of the work, and to provide a uniform appearance of the mortar joints.
6. Although the wall capstones were not observed, it is recommended that the joints be recaulked.
7. Removable bollards or a curb, should be constructed around the building to channel traffic away from the structure. In addition, extra safety lighting should be provided.

6.0 CAPITAL IMPROVEMENTS PLAN SUMMARY

The 19th Ward Pump Station is a critical component of the City's wastewater operations, conveying flow from three upstream municipalities to the 6th and Canal Pump Station drainage area. As presented within this study, the pump station appears to be in fair condition, but must be upgraded in the near future to accommodate increasing flows and replace outdated equipment that is approaching the end of its useful life. As our evaluation did not uncover any major hydraulic, structural or electrical issues, and because the site sits within a public park, it is our recommendation to upgrade the station within the confines of the existing site footprint, where possible.

Presented below is a list of recommended capital improvement projects that are necessary for the future of the 19th Ward Pump Station. Each capital improvement project recommended within this report is summarized below:

6.1 Gravity Piping

Summary of Existing Condition: The 19th Ward Pump Station is primarily fed by a 21-inch PVC interceptor that runs southeasterly along Montgomery Street, parallel to Tulpehocken Creek. Both Bern and Spring Townships have upstream pump stations that feed into this interceptor - if both of these stations were to simultaneously pump for 5 minutes prior to shutting down, they would convey over 7,300 gallons to the 19th Ward Pump Station wet well (in addition to the gravity flow from the City and a portion of Bern Township), which could temporarily overwhelm the wet well's storage capabilities. Based upon survey information provided to our office, the 21-inch interceptor is capable of conveying a peak flow of approximately 8 MGD.

Proposed Capital Improvement Project: While we were not able to inspect the condition of the 21-inch interceptor, it appears to be adequately sized to handle both the existing and 2035 peak flow rates. Due to the importance of this main, it should be regularly televised and inspected for defects. In addition, the City should monitor the operation of the upstream Spring and Bern Township pump stations to determine if they have any negative impact on the operation of the 19th Ward Pump Station.

6.2 Overflow Connection

Summary of Existing Condition: The last manhole prior to the pump station wet well has a 15-inch PVC overflow pipe which allows the station to discharge sewage into Tulpehocken Creek during excessive flow periods. The headwall for the overflow piping is located less than 100-feet from the pump station and is visible from the Schuylkill Trail. Based upon information provided by the City and discussions with the sewer O&M staff, the last three overflows occurred in October 2005, June 2006 and September 2006.

Proposed Capital Improvement Project: Based upon the information provided by the City and a previous analysis conducted by another engineer (Douglas McGill, P.E.), overflows are very rare at this pump station. As such, with the construction of a larger diameter force main and new, higher capacity pumps that will be VFD driven and/or a second wet well, there should be no need for the overflow connection.

6.3 Wastewater Grinder Units

Summary of Existing Condition: There are three channel grinder units – two are installed within the wet well and a third unit is kept as a shelf spare which is rotated into operation on a regular basis. The units were recently rehabilitated.

Proposed Capital Improvement Project: Since the grinder units were recently rehabilitated, they should last several additional years, but the City should keep a watchful eye on their condition. When the pumps, piping and appurtenances are upgraded to handle future flows, the condition of the rehabilitated grinder units should be evaluated. Ideally new grinders, each capable of handling the future peak instantaneous flow rate, would be provided; however, the depth of the existing concrete channels within the station may not accommodate a large grinder unit. If the influent concrete channels cannot be modified to handle a large grinder unit, in the future it will be necessary to operate both grinder units to handle maximum day, peak hour and peak instantaneous flow rates.

6.4 Wet Well

Summary of Existing Condition: While our office was not able to inspect the full wet well, the City indicated that it remains in good condition and is properly maintained. The holding volume of the wet well is relatively modest for the existing flow rates. During a 2012 average day scenario (≈460 GPM), the City has only 10.2 minutes of storage capacity between the Low and High Water Flow Alarms – the full extent of the station's operating range. By 2035, there will be approximately 6 minutes of storage between the Low and High Water Flow Alarms during an average day and less than 3 minutes during a peak day.

Proposed Capital Improvement Project: In the short term, the City should continue to inspect and clean the wet well on a regular basis, making spot repairs as necessary to properly maintain it's structural integrity. In the long term, the holding capacity of the wet well is a significant issue that must be addressed. There are two ways to resolve this issue: (1) Provide VFDs for the future pumps which would allow for the station's pumpage to keep pace with the influent flow rate; and/or, (2) Construct a second wet well, most

likely underneath the existing parking area on the south side of the building. If the City elects to move forward with a second wet well, the holding capacity should be sized based upon 2035 flow rates.

6.5 Pumping Units

Summary of Existing Condition: The pump station consists of three vertical open shaft pumps, each rated for 1,530 GPM (2.20 MGD) at 126 feet total dynamic head (TDH). The pumps are manufactured by Chicago Pump Company, model 64154A, 75 HP, 1750 rpm. These pumps were installed 17 years ago, in the "Upgrading of 19th Ward Pumping Station" project by Mast Engineering. The operations staff indicated that the pumps were rebuilt approximately 3 years ago and have not had any significant problems since. A fourth pump is provided as a shelf spare.

Proposed Capital Improvement Project: In the short term, the City should continue to monitor and periodically inspect each of the existing pumps. In the long term, the City should replace the existing pumping units with three new 2,000 – 2.500 GPM pumps that are VFD controlled. The pumps should be constructed concurrently with an upsized force main. The firm capacity of the 19th Ward Pump Station should be able to convey the anticipated 2035 peak day flow rate, while all three pumps operating should be able to convey the anticipated 2035 peak hour flow rate. The style and manufacturer of the selected pump should be evaluated during the design process, with significant input from the City operations staff. The engineering consultant will have to conduct thorough background work/research to confirm the necessary TDH for the new pumps/new force main system to ensure the correct selection is made. Also, prior to project design for improvements to the 19th Ward Pump Station, the City's engineer should coordinate with Bern Township, Spring Township and the City of Reading to get a better understanding of the flows conveyed to the 19th Ward Pump Station, particularly during maximum day or peak hour flow periods.

6.6 Interior Piping

Summary of Existing Condition: The existing interior piping and appurtenances meet the needs of the existing pumps. Two items of note: (1) the suction inlet bell appears to be undersized for the existing flow rate and may be creating additional turbulence; and, (2) the diaphragm valves, which are in the 100-percent open state, do not appear to be necessary and are adding extra head to the pump curve.

Proposed Capital Improvement Project: New interior suction/discharge piping and appurtenances should be constructed when the existing pumps and force main are upgraded.

6.7 Discharge Force Main

Summary of Existing Condition: The existing 10-inch force main is adequately sized for one pump in operation (2.17 MGD), but undersized for existing/future pumping scenarios in excess of 2.8 MGD. As the flow conveyed to this pump station is expected to increase in the near future, the force main must be upsized to keep pace.

Proposed Capital Improvement Project: In the short term, the City should replace a recently discovered air release valve with a combination air release/air & vacuum valve. This valve should be replaced immediately before damage (possible break or collapse) is incurred to the existing force main.

In the long term, in order to accommodate the higher future flows, the City should move forward with the construction of a new force main, 16 to 18-inches in diameter. The selection of a new force main size is ultimately dependent on the future pump size; however, a 16 or 18-inch diameter main will be able to adequately convey both existing and future flow rates and, at the same time, significantly lower pump horsepower requirements.

6.8 Electrical

Summary of Existing Condition: The pump station is fed via an underground 480V service to a main disconnect located outside the generator enclosure. The motor control center (MCC) is a 2100 series by Westinghouse – it's rated for 480V, 600A, 3 phase, 3 wire 60Hz with main lugs only. The standby generator is a 275KW, 480V, 3-phase diesel generator.

On the wet well side of the building, corrosion is apparent on all lighting fixtures, disconnects, conduit and fittings on the lower level. The upper level of the wet well has lights, receptacles and switches - there is some corrosion on several of these devices.

On the dry well side, all lighting and electrical equipment is appropriately classified. All equipment in the dry well appears to be working and maintained accordingly.

Proposed Capital Improvement Project: The City should replace all electrical equipment in the wet well area; including, lighting, disconnects, conduit, fittings and wiring. Also, the new pumps should be provided with VFDs and adequate cooling/ventilation. An addition will likely be required to the pump station building if VFDs are provided with the new pumps.

6.9 HVAC

Summary of Existing Condition: Although our office did not have access to much of the existing/as-built information on the HVAC units, it appears that the infrastructure has been adequately servicing the pump station building since it's initial construction. However, most/all of these units are 17 years old and in need of replacement.

Proposed Capital Improvement Project: It is recommended that each of these units be replaced when the pumps and force main are upgraded. Also, it should be noted that air conditioning units may be necessary if variable frequency drives are provided with the new pumps.

6.10 Instrumentation

Summary of Existing Condition: The station is remotely monitored via the Express II Monitoring System, which reports back to the WWTP via an autodialer/telephone line. The City has previously investigated the feasibility of tying this station into their SCADA system; however, it was not possible at the time due to low/no signal strength. The station has two means of measuring the wet well level – a Healy Ruff mechanical float/level system and a liquid level probe. Chart recorders document the wet well level and the pump flow, while an Endress + Hauser Memograph M RSG40 unit records/manages data related to pump run-times, pump cycling, flow and generator run-time. The City operation staff did not indicate that there were any specific problems with the existing control system.

Proposed Capital Improvement Project: The City should investigate the feasibility of connecting the 19th Ward Pump Station into the City's SCADA system, most likely via a backhaul radio system. If VFDs are provided with the new pumps, rewire/incorporate level measuring system for pump controls via the proposed VFDs.

6.11 Structural

Summary of Existing Condition: The 19th Ward Pump Station was found to be in very good structural condition. No signs of significant deterioration or damage were noted during the site visit. The concrete substructure (dry and wet wells) was in excellent condition with little cracking, and no spalling. In the wet well, it was noted that the surface of the concrete has started to deteriorate, most likely due to hydrogen sulfide attack. The concrete within the dry well exhibited no signs of significant attack or deterioration. The metal access doors, particularly on the wet well side, were found to be in deteriorating condition.

The masonry superstructure was found to be in very good condition as well. Some loss of mortar was noted in the brick. However, the pump station building is located directly adjacent to a (narrow) public access road, which was frequently travelled during our site visits. Other than some low/moderate lighting, there are no safety measures in place to protect and channel vehicular traffic away from the structure.

Proposed Capital Improvement Project: There are several recommended O&M measures, most/all of them are considered standard for 46 year old utility buildings. Among the proposed improvements are coating the wet well concrete, replacing deteriorated doors, repointing of the exterior masonry work and recaulking joints within wall capstones. One item of particular note was the proximity of the building to a public roadway – it is advisable that the City undertake some safety measures to channel traffic away from the structure and provide additional safety lighting.

6.12 Planning Level Costs

For the purposes of developing a future budget, we have prepared the below draft construction cost estimate. The estimate includes costs for both variable frequency drives on the pumps and a second wet well.

PLANNING LEVEL COST ESTIMATE

City of Reading - 19th Ward Pump Station

HAZEN AND SAWYER
ENVIRONMENTAL ENGINEERS AND SCIENTISTS

Description	Unit	Quantity	Cost/Unit	Total
Mechanical Equipment				
Pumps	UN	3	$100,000	$300,000
New Interior Piping, Valves & Appurtenances	LS	1	$50,000	$50,000
Force Main				
Force Main[1]	LF	2,750	$285	$783,750
River Crossing	LF	350	$350	$122,500
Bypass Pump Connection	LS	1	$25,000	$25,000
Electrical & HVAC				
HVAC	LS	1	$60,000	$60,000
Variable Frequence Drives	UN	3	$75,000	$225,000
New Electrical Switches, Lights, Etc.	LS	1	$50,000	$50,000
Connection to SCADA system	LS	1	$75,000	$75,000
Building Structure				
Structural Improvements to Building	LS	1	$40,000	$40,000
Addition for VFD Room[2]	SF	160	$350	$56,000
Second Wet Well[2]	LS	1	$375,000	$375,000
			Subtotal	$2,162,250
			+ 30% Contingencies	$648,675
			TOTAL=>	**$2,810,925**

(1) - Assumes no rock excavation for the construction of the force main
(2) - Assumes no costs for land acquisition related to building addition or second wet well

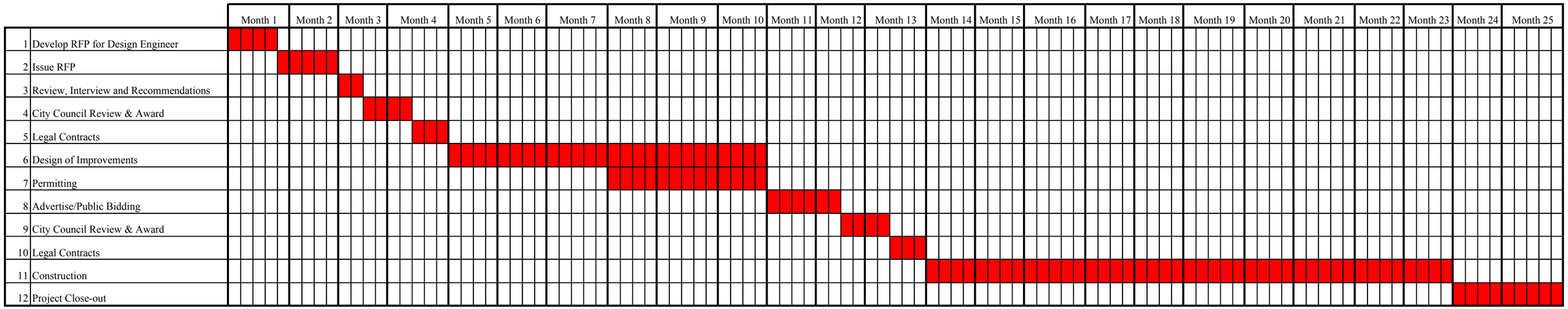
Note that this cost estimate should be considered for planning-level purposes only – a more formal estimate should be developed by the future design engineer.

6.13 Schedule

See attached Figure 6-1 for the draft project schedule. At this time, the estimated project length is expected to be approximately 25 months, with 12 months for construction activities.

Figure 6-1

Final Draft Schedule

11/07/12

City of Reading - 19th Ward Pump Station Improvements